

# A.I. SPECIAL REPORT

# FORTUNE

JULY 2018 FORTUNE.COM

ASIA PACIFIC EDITION

China's two  
tech titans are  
battling for  
supremacy.  
The winner  
gets the  
world.

By Adam  
Lashinsky



# ALIBABA VS. TENCENT



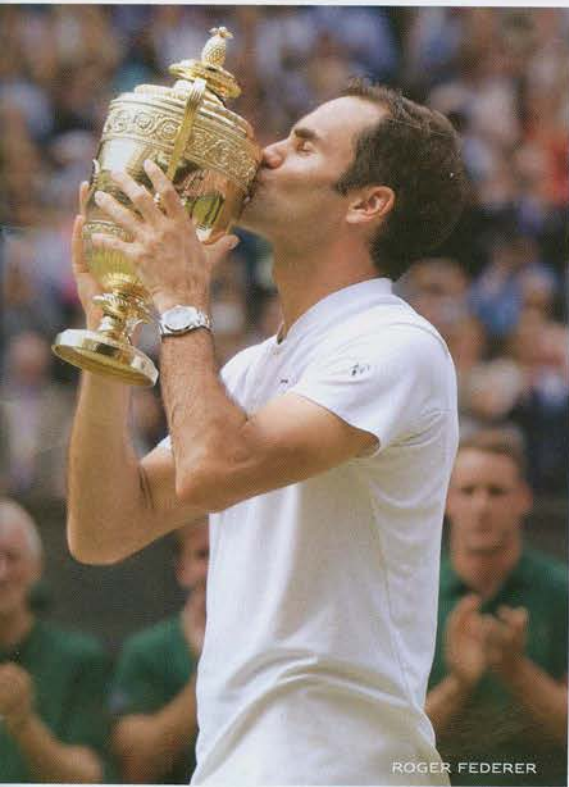
GARBIÑE MUGURUZA



JUAN MARTÍN DEL POTRO



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THE ALL ENGLAND LAWN TENNIS CLUB, LONDON  
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OYSTER PERPETUAL DATEJUST 41



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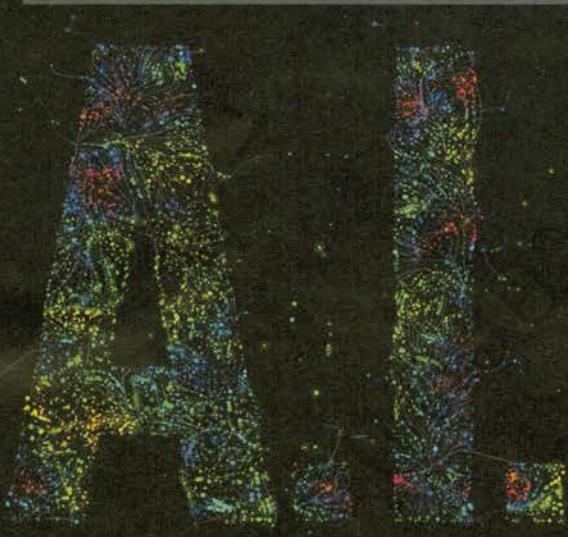
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ILLUSTRATION BY  
JUSTIN METZ



ARTIFICIAL INTELLIGENCE: SPECIAL REPORT

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BY JONATHAN VANIAN

Business is betting billions on A.I., only to find that its algorithms and systems can amplify human prejudice. Can Silicon Valley keep bigotry at bay?

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Text by BRIAN O'KEEFE; graphic by NICOLAS RAPP



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The Nature  
Conservancy 



# SPRINGTIME FOR A.I.

**ON FEB. 24, 1956, ARTHUR LEE SAMUEL** played a game of checkers on television. His opponent: a 36-bit vacuum tube computer made by International Business Machines.

Samuel, then a 55-year-old researcher at IBM, had painstakingly assigned each of the 64 squares on the checkerboard a different set of machine-word identifiers, and done the same with each piece on each square. Then he programmed his IBM 701 computer to *think*: that is, to consider a few possible checkers moves “by evaluating the resulting board positions much as a human player might do,” Samuel would later write.

“‘Looking ahead’ is prepared for by computing all possible next moves, starting with a given board position,” he explained. For each of those potential moves, the computer would redraw the board in its electronic brain with “the old board positions being saved to facilitate a return to the starting point,” and then the process would repeat. When the indicated move didn’t result in a better outcome, the IBM 701 would try another one, and so forth, until the machine was successful.

In short, Samuel had programmed the “digital computer to behave in a way which, if done by human beings or animals, would be described as involving the process of learning,” he said.

Before the televised match, IBM president Tom Watson—the namesake of IBM’s current-model thinking machine—predicted his company’s shares would soar after the demonstration. They did just that.

What followed was a heady period of excitement during the 1950s and 1960s, when computer scientists sketched out dreams and designs of advanced problem-solving machines that, in many cases, mirrored the robotic creations of science fiction novels.

What followed *that*, however, was a long reality check—a period that, it turns out, was far less “cyborg” than incremental science. Over the next half-century, many of the most ambitious fantasies of artificial intelligence were often met with prosaic, real-world limitations. The progress was genuine, of course—from mathematical breakthroughs to major advances in computing power. But still the perceived failures led to long fallow periods that many in the field dubbed “A.I. winters.”

Well, it’s spring again in the realm of A.I.—and the ambition (and hype) are blooming big-time. Big companies are now feverishly gobbling up startups—firms that are teaching machines to master the idiosyncrasies of human conversation, to expertly recognize the world around them, and to instantly scan terabytes of data to discover patterns that no mere mortal could recognize.

Yes, a lot has changed, as we explore in our A.I. Special Report this issue (see the package of articles that begins on page 30). But as writers Jonathan Vodian and Vauhini Vara show, it’s time for another reality check. As the capacity of these algorithms grows exponentially, so do the questions about their potential biases and their risky assumptions. It’s an ongoing lesson that requires our own attempt at deep learning. The success of this latest stage of A.I. development may depend on it.

Which brings me to our cover story. As “thoughtful” as some machines are becoming, there are none (yet) that can mimic the spark of creative energy at the heart of entrepreneurship. Creating a company and building it may be one of the most human things that humans do.

Which is one of many reasons I find Adam Lashinsky’s feature story on Jack Ma and Huateng “Pony” Ma—the mightily ambitious founders, respectively, of Alibaba and Tencent—such an intoxicating read. In “Ma vs. Ma” (see page 48), Adam expertly depicts what may be the biggest corporate battle in China while taking us inside an Internet ecosystem that may spread rapidly around the world.

For a grand tour of intelligence, both artificial and real, read on. And please, as always, let us know what you think.

**CLIFTON LEAF**  
Editor-in-Chief, Fortune  
@CliftonLeaf



THE  
WORLD IN

8

PAGES

## BRIEFING



## America: Who'll Keep on Truckin'?

Autonomous trucks may revolutionize the industry one day, but the U.S. could be facing an acute driver shortage well before then.

By Kirsten Korosec

### TRANSPORTATION

**THE TRUCKING INDUSTRY,** the backbone of the U.S.

economy, is carrying more weight than ever despite a critical shortage of drivers. And now this compression point is sending waves of pain through the supply chain from distributors and wholesalers to retailers and consumers in the form of fast-rising shipping costs. Even Amazon and its Prime members are feeling the pinch.

This predicament was a long time coming. An aging driver population that continues to

▷▷

## BRIEFING

▷▷ dwindle owing to retirement—combined with a lack of younger workers coming into the industry—is a problem that has been festering for 15 years. The Great Recession and the years of recovery that followed largely masked the problem. But by 2012, with the U.S. economy strengthening, fissures began to show.

Trucks moved more than 70% of all U.S. freight and generated \$719 billion in revenue in 2017, according to the American Trucking Associations (ATA).

“We could see the demographics, and now they’re finally hitting home,” says Brian Fielkow, president and CEO of Jetco Delivery, a trucking and logistics company based in Houston. “This isn’t something we just woke up to.”

The pain point is specific. The industry calls them “full-truckload, over-the-road non-local drivers,” jargon for drivers who haul goods over long distances, often days, if not weeks, before returning home. That lifestyle just isn’t attracting millennials and the incoming Gen Z cohort who place a greater emphasis on work/life balance.

The long-haul sector, which employs around 500,000, was in need of nearly 51,000 truck drivers by the end of



WAYMO



UBER



NIKOLA

### HAULING CASH

**AUTONOMOUS TRUCKING** has the potential to be a lucrative business, so it has naturally attracted big money and a number of players. **Waymo** [1], an Alphabet company, has integrated its self-driving system into Class 8 big-rig trucks and is testing them in California and Arizona. **Uber** [2] is also developing self-driving trucks but has temporarily suspended testing on public roads following a fatal accident involving its passenger car program. Other startups in the race include Starsky Robotics, Embark, Peloton, TuSimple, electric trucking company **Nikola** [3], and even Tesla. Established players like Volvo and Daimler, meanwhile, have been diligently working on increasingly advanced levels of automation in their trucks.

2017, the worst shortage it had ever seen.

The lack of qualified drivers—some trucking companies have complained only 1% to 2% of applicants meet their requirements—has businesses competing for the same pool of workers.

The shortage is creating a ripple effect. Companies vying for qualified workers are offering higher pay and signing bonuses. The median pay for drivers in this category is \$59,000, according to the ATA. Experienced drivers who work for private fleets can make as much as \$86,000 a year.

“I call it the free agency of trucking,” says Bob Costello, senior VP at the ATA, adding that the annualized turnover rate is 94%.

To keep up, shipping rates are rising. In 2017, the average revenue per mile, excluding fuel surcharges, increased 15% on a year-over-year basis. “I don’t think I’ve ever seen rates so high,” says Costello. But margins, which hover around 5%, haven’t budged because trucking companies pour that additional revenue into recruiting and retaining drivers.

Consumers are just starting to feel the effects: Amazon recently increased its Prime membership fee, which includes free shipping, from \$99 to \$119 a year.

The company, which saw shipping costs increase 38% in the first quarter compared with the same period last year, noted the rising price of transporting goods as one factor behind the decision.

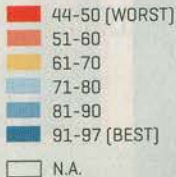
Though the common wisdom is that self-driving technology will eliminate the need for human drivers, it could actually help in recruiting them and reducing costs, at least in the short term.

“It begins with driver assistance systems—that technology is here today,” says Ted Alling, a managing partner at early stage venture firm Dynamo and cofounder and former CEO of logistics company Access America. Major truckmakers like Freightliner and Volvo are rolling out technologies such as lane-keep assist and adaptive cruise control that are already found in premium passenger vehicles. Those technologies could lower the barrier to nonlocal trucking and increase the pool of drivers that fleets can recruit from.

“I do see technology as a way to bring drivers back into the truck, not as a way to kick them out,” says Fielkow. “And the day will come when we have autonomous infrastructure and autonomous trucks. I just don’t see it happening in the next five years.”

## GALLUP 2018 GLOBAL LAW AND ORDER INDEX

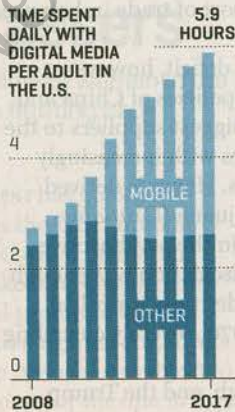
Based on people's sense of personal security and their experiences with crime and law enforcement.



SINGAPORE MAY HAVE BEEN the perfect place for a summit to ease rising nuclear tensions. Based on a Gallup poll measuring how safe citizens feel and how confident they are in law enforcement, the city-state is the most secure nation among 142 countries surveyed. Venezuela finished dead last with just 24% of its citizens having faith in the police. The U.S. scored worse than 31 other countries, including Slovenia and India. [To read how global security affects your portfolio, see "Where to Hide From the Headlines" in this issue.]

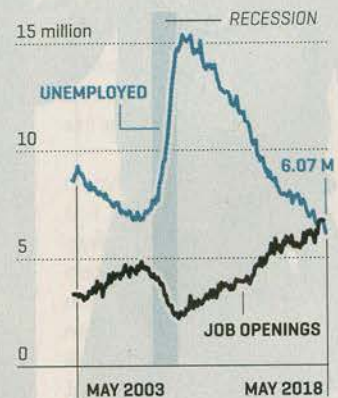
## NEVER UNPLUGGED

It's hard to imagine that anyone once predicted the death of the Internet. The changing nature of work and increasingly capable smartphones mean consumers today spend an ever-growing share of their waking hours online: about 5.9 hours in 2017, up 4% from a year earlier. Meanwhile, prices for goods sold online have fallen 3% in the past two years, compared with 1% off-line.



## MORE JOB OPENINGS THAN UNEMPLOYED

Time to gussy up the old résumé. For the first time on record, U.S. job openings exceeded the number of unemployed in April, with 6.7 million postings against 6.3 million seeking work. And that trend may continue with the number of unemployed falling under 6.1 million in May. While wages for job stayers rose a muted 2.9% in April, job switchers gained 4%.



FREE AGENTS

KING-SIZE CONTRACT?

**NO ATHLETE'S** career draws quite as much attention as that of the NBA's biggest star, LeBron James.

The Cleveland Cavaliers forward can opt out of his current contract for the 2018-19 season, making him a free agent once again. If he re-signs with Cleveland, which has surrounded him with a supporting cast of questionable quality, he could earn a record \$205 million over five years.

James is VP of the NBA players' union and has advocated for higher pay. So unlike with his move to the Miami Heat in 2010, don't expect him to take a pay cut this time around.



Hemp's strong fibers are useful for making rope—and it used to be in U.S. currency.

Red Staters See Green in Hemp

A crop from American history could be making a big comeback after nearly five decades. By Jeff John Roberts

FARMING

**ONCE GROWN ON** the estates of Washington and Jefferson—and used in everything from textiles to food—hemp is as American as they come. And yet according to a recent report for Congress, the United States imported \$78 million more of the green stuff than it exported in 2015. It's the sort of trade imbalance some might call "Sad!"

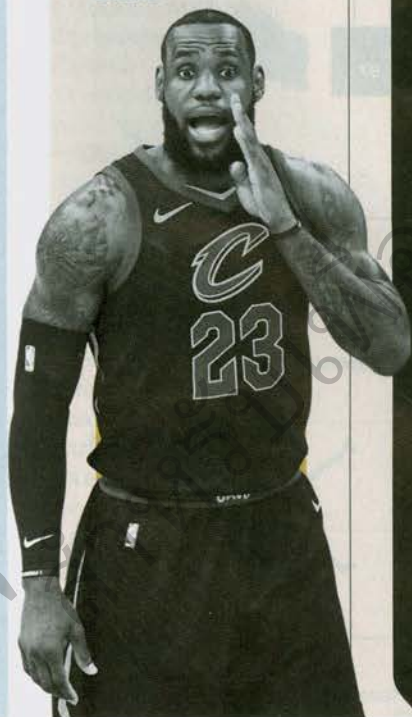
The reasons for the hemp deficit, however, have nothing to do with the policies of China and Canada, which are the two biggest suppliers to the U.S. Instead, the problem lies with increasingly outdated domestic drug laws. Hemp is derived from the same plant as marijuana (*Cannabis sativa*) but uses strains low in the psychoactive compound THC. Still, the association was enough to get the crop regulated under the Controlled Substances Act, passed in 1970, severely curtailing domestic production.

There's change afoot though, and the Trump administration appears poised to accelerate it. Agriculture Secretary Sonny Purdue expressed

support in June for a Senate bill, authored by Majority Leader Mitch McConnell—who represents Kentucky, a state set to benefit from a hemp boom—that would expand the production of industrial hemp in the U.S.

The bill has bipartisan support and comes at a time of growing awareness among policymakers that hemp and marijuana are not the same crop.

Geoff Whaling, who leads the National Hemp Association, says he's optimistic about the crop's future in the U.S., based on his conversations with Secretary Purdue's office and the growing support for hemp across corporate America.



## MPW SUMMIT

SAUDI WOMEN  
OVERCOME  
MOST  
INFAMOUS  
HURDLE

LAMA AL SULAIMAN had been counting down the days. "At 12:01, I will be driving," the vice chair of the Jeddah Chamber of Commerce and Industry said of the June 24 lifting of Saudi Arabia's ban on women drivers. "It became a burden," she told *Fortune's* Most Powerful Women International Summit in London. "No one wanted to discuss anything important happening in Saudi Arabia except that women can't drive." Al Sulaiman was elected in the country's first coed municipal elections in 2015 and later resigned because of gender segregation at council meetings. "I'm excited to talk about other things." —CLAIRE ZILLMAN



## Forced Arbitration Enables Harassers

The Supreme Court dealt a blow to women in the workplace. Here's how we're fighting back.

By Gretchen Carlson

## #METOO

THE #METOO MOVEMENT has gotten a wake-up call from the U.S. Supreme Court's ruling in *Epic Systems Corp. v. Lewis*. The ruling allows companies to make forced arbitration a condition of employment and prohibits workers from taking collective legal action against employers. It's bad news for the 60 million Americans subject to forced arbitration, and even worse for the one in three women victimized by workplace sexual harassment.

Forced arbitration is a sexual harasser's best friend: It keeps proceedings secret, findings sealed, and victims silent. But its impact goes much further. Of the thousands of women I spoke to while writing my book *Be Fierce*, the vast majority who complained about harassment never worked in their chosen careers again. Blacklisting is common post-arbitration. Because the facts don't come out in trial, victims are silenced, and predators often keep their jobs. Guess who controls the narrative in that scenario? With the offended party out of the picture, workplaces become—in actor Asia Argento's haunting words—a "hunting ground."

It was with immense pride that I joined legislators from both parties in December to

introduce the Ending Forced Arbitration of Sexual Harassment Act, which restores victims' constitutional Seventh Amendment right to a jury trial. The bill now has 17 bipartisan cosponsors, and it is my mission to get it through Congress and down to the President's desk for signature this year.

Companies can and must also step up. Microsoft and Uber have both ended forced arbitration for sexual harassment claims, and any company trying to recruit talented women must do the same. It's a differentiator, and trust me: The women are watching.

*Gretchen Carlson is a TV journalist and women's empowerment advocate. Her most recent book is *Be Fierce: Stop Harassment and Take Your Power Back*.*

TRADE WAR DEALS ITS FIRST BLOWS

Buckle up: President Trump's battle with the U.S.'s largest trading partners is just getting started.

\$100B

TOTAL AMOUNT of reciprocal tariffs imposed by the United States and China on 1,761 goods

\$594B

GLOBAL MARKET CAP lost since tariffs were announced, as measured by S&P Global BMI

-15%

U.S. OIL DISCOUNT to world benchmark

144

DAYS ELAPSED since last S&P 500 high—the longest period in the Trump presidency

—LUCINDA SHEN

DATA AS OF 6/18/18



## Online Success Doesn't Come Cheap

Target is holding its own against Amazon—but at too great a price, investors fear. By Phil Wahba

**E-COMMERCE**

**BEING A CONTENDER** can cost a lot of money. Target shareholders were reminded of that when the discount retailer recently reported strong online sales growth in its first quarter, figures that showed it is holding its own against Amazon and Walmart.

Digital sales rose 28% even as more shoppers came to stores, showing that Target's efforts to one-two punch web and brick-and-mortar retail is

working. But that has come at a price that worries some investors, as the sharp drop in Target's stock the day of that earnings result showed.

Target's operating income margin fell, and the retailer's recent 40% cut to the price of next-day delivery will bite into profits, as will its \$7 billion multi-year program to freshen up stores and improve its e-commerce.

Walmart, Kohl's, and Nordstrom have also poured billions into their e-commerce offerings and been periodically punished for it by Wall Street, despite building thriving online businesses.

Investors may have to buck up about the expenses all this entails. It's simply the cost of doing business in the Amazon era.



## FORD'S ICONIC MOVE

**CITIES**

**MICHIGAN** Central Station, the poster child for Detroit's urban blight, could soon be a beacon for its regeneration after being bought by the Ford Motor Co.

Abandoned for more than three decades, the monolith will form part of a 1.2-million-square-foot campus in the Corktown neighborhood and will house teams working on new mobility technologies.



**SOCCER**

**HOW  
NAFTA  
CAN SAVE  
FIFA**

**TRADE TENSIONS** between the three members of the North American Free Trade Agreement (NAFTA) may be at the highest levels in recent memory, but that didn't deter the voting committee of soccer's governing body FIFA from awarding the 2026 World Cup to the U.S., Canada, and Mexico.

Representatives of the winning bidders promised FIFA its World Cup would gen-

erate a record \$11 billion in profit, not to mention countless dollars for the hospitality and advertising industries.

Brands in particular will be looking to capitalize on the first men's World Cup on the continent since 1994, hosted solely by the U.S., which was the most financially successful tournament in the competition's history. For this year's World Cup in Russia, long-serving advertisers

Sony and Emirates declined to renew contracts with FIFA, which was rocked by a corruption scandal in 2015. The lure of NAFTA-bloc consumers in 2026 could give those companies, along with any others on the fence, reason to reconsider such a stance.

With the competition expanding from 32 teams to 48 in 2026, the event is bound to reward any brand willing to invest in FIFA. —ARIC JENKINS

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# The 10 Best Workplaces for Millennials

Fortune worked with our long-standing research partner Great Place to Work to help us find the best employers for those born between 1981 and 1997—a generation known for appreciating firms with strong values and for changing jobs frequently. The 10 companies highlighted here know how to make their teams stay put—and stay happy. **By Christina Austin**

01

## ULTIMATE SOFTWARE

HQ ..... Weston, Fla.  
EMPLOYEES ..... 4,723  
MILLENNIALS ..... 41%

One worker says he'd be surprised if anyone could name all the great benefits "without forgetting at least one." Many single out the firm's integrity.

02

## SALESFORCE

HQ ..... San Francisco  
EMPLOYEES ..... 17,417  
MILLENNIALS ..... 28%

Employees at this cloud-software firm like how much it gives back to the community. The transparency from top executives is also appreciated.

03

## EDWARD JONES

HQ ..... Des Peres, Mo.  
EMPLOYEES ..... 42,950  
MILLENNIALS ..... 24%

According to one worker at this financial powerhouse, everyone "is genuinely concerned with helping you completely fulfill your potential."

04

## WORKDAY

HQ ..... Pleasanton, Calif.  
EMPLOYEES ..... 5,473  
MILLENNIALS ..... 53%

Workday has a timer that turns lights off at 6 p.m. to remind employees that it's time to go home, encouraging a healthy work/life balance.

05

## KIMLEY-HORN

HQ ..... Raleigh, N.C.  
EMPLOYEES ..... 2,942  
MILLENNIALS ..... 60%

Associates at this planning and design firm love the open-door policy. Management also values the knowledge everyone brings to the table.

06

## POWER HOME REMODELING

HQ ..... Chester, Pa.  
EMPLOYEES ..... 2,440  
MILLENNIALS ..... 90%

Notes one employee: "It doesn't matter where you came from. At Power Home Remodeling, you're at the same level as everyone else."

07

## VETERANS UNITED HOME LOANS

HQ ..... Columbia, Mo.  
EMPLOYEES ..... 2,395  
MILLENNIALS ..... 42%

One military spouse was given an extra 80 hours of paid leave to spend with her husband before he was deployed and after he returns.

08

## HYATT HOTELS

HQ ..... Chicago  
EMPLOYEES ..... 35,309  
MILLENNIALS ..... 60%

One millennial worker loves Hyatt's strong, relatable values and that it accepts "all people, regardless of race, sexual orientation, and gender."

09

## KIMPTON HOTELS & RESTAURANTS

HQ ..... San Francisco  
EMPLOYEES ..... 7,361  
MILLENNIALS ..... 55.4%

Kimpton "values individuals and celebrates people for who they are." Its leadership also encourages employees to let their "freak flag fly."

10

## PROGRESSIVE INSURANCE

HQ ..... Mayfield Village, Ohio  
EMPLOYEES ..... 32,060  
MILLENNIALS ..... N.A.

This firm prides itself on its diversity. Management also provides many opportunities to change schedules to meet needs outside work. **■**



PRACTICAL  
EXPERTISE

# FOCUS

TECH



An Overwatch League match at Blizzard Arena in Burbank, Calif.

## THIS GAME IS OUT OF CONTROL

E-sports has grown into a real profession, touting benefits and other full-time trappings. But as workplaces go, it's brutal.

By Lisa Marie Segarra

FOR YEARS, THE IDEA OF MAKING A CAREER out of playing video games seemed to be little more than a pipe dream. Then the rise of e-sports leagues made it real. Today's professional gamers enjoy salaries, benefits, retirement plans, and the envy of many a cubicle dweller. Yet as gaming has grown into a proper profession, so have its harassment problems—enough so that today's virtual workplaces could use an HR department of their own.

Consider the case of Félix Lengyel, better known by his digital moniker "xQc." The 22-year-old Canadian gaming pro gave the Overwatch League, a division of entertainment company Activision Blizzard, >>



Fans cheer during an Overwatch League match on May 4 at Blizzard Arena.

▷▷ quite a headache in January when he hurled a homophobic slur at a gay competitor. Lengyel was promptly suspended. It was far from his only infraction: Lengyel had racked up thousands of dollars in fines for his antics. This year, he used an “emote,” the name for the emoticons used on Twitch, the live online gaming channel, in a racially disparaging way toward a league emcee. (Lengyel said later that he didn’t realize he was being offensive.)

Lengyel is one of a half-dozen Overwatch League players who have received warnings, fines, or suspensions for their conduct on personal social media channels or official league streams. (“Playing in the Overwatch League is an amazing opportunity but also a big re-

sponsibility,” commissioner Nate Nanzer says.) But the problem isn’t limited to the 12-team Overwatch League, which was established last year. Today, e-sports groups are increasingly asking themselves the same question: How do we ensure that the talent doesn’t become a liability?

The NBA 2K League, a 17-team organization in the midst of its inaugural season, is trying to confront the issue before it becomes a problem by looking to the policies of its real-world counterpart. (The virtual league is co-owned by the NBA and Take-Two Interactive, the game publisher known best for *Grand Theft Auto*.) Before this year’s e-season began, players were given a crash course in conduct, says league managing director Brendan Donohue.

Still, most e-sports organizations are young and haven’t yet had to deal with bad behavior on a large scale. (Twitch, which is owned by Amazon, says it polices harassment using humans and algorithms alike.) But the gaming community’s toxic underbelly—on display during the Gamergate controversy in 2014—offers reason to be concerned that e-sports’ growing platform would only magnify it.

In the meantime, results may vary. Pro gamer Mychal “Trihex” Jefferson, who is African-American, says he sometimes sees racially disparaging jokes on Twitch, where he has more than 300,000 followers. “It can hurt,” he says. “It can take you out of it.”

It can also motivate. Wendi Fleming, a female gamer who participated in this year’s NBA 2K League draft—no women were among the 102 players selected—says the dynamic fuels her competitive streak.

“I purposely made my name ‘ALittleLady87’ so people would know that I’m a woman,” she says. “So you could know that a woman just beat you.” ■

## DON'T MISS BRAINSTORM TECH, FORTUNE'S FEEL-GOOD HIKE OF THE SUMMER



“HIKE,” OF COURSE, BECAUSE OUR ANNUAL summer retreat for Fortune 500 leaders, tech entrepreneurs, and investors takes place on the bucolic campus of the Aspen Institute, nestled in the Rockies. This year’s must-see program is a blast of crisp mountain air: JD.com’s **Richard Liu**, Grab’s **Hooi Ling Tan**, Lyft’s **John Zimmer**, AMD’s **Lisa Su**, Viacom’s **Bob Bakish**, and Air Force Gen. **Ellen Pawlikowski**—plus U.S. Transportation Secretary **Elaine Chao** and Uber CEO **Dara Khosrowshahi**, both pictured at left—will join us. Can’t make it this year? No problem. We’ll live-stream many sessions on Fortune.com. Tune in starting July 16. —Andrew Nusca

# 'BLACK MIRROR,' SLIGHTLY BROKEN

China seeks artificial intelligence supremacy through protectionism, state subsidies, and monopolies. But that doesn't mean the country will succeed. **By Clay Chandler**



**STEP ASIDE, SHERLOCK.** Detectives in China say they can catch criminals using artificial intelligence—and if you don't believe them, consider the case of the potato thief at the pop concert.

Officials in the eastern Chinese city of Jiaxing in May used A.I.-powered facial-recognition technology to nab the alleged tater taker from a crowd of more than 20,000 people attending a performance by Hong Kong crooner Jacky Cheung. Moments after passing

A screen supported by a facial-recognition system displays the image of a jaywalker at an intersection in Nanjing, China, in August 2017.

through the concert's security system, the unsuspecting suspect was busted: An algorithm matched his face with an image from a database of "most wanted" mug shots. Authorities seized the man on charges of stealing \$17,000 worth of potatoes.

The thief was the third fugitive to be arrested at a Jacky Cheung concert in as many months using software developed by Beijing's Megvii, among the many Chinese groups pioneering ways to combine A.I. and facial-recognition capabilities. Alibaba Group mobile payments affiliate Ant Financial uses a "smile to pay" feature to facilitate purchases at KFC. A high school in Hangzhou monitors students' attentiveness in class. Traffic police in Shenzhen and other cities spot jaywalkers and reckless bike couriers. A park near Beijing's Temple of Heaven uses the technology in a public restroom to stop patrons from stealing toilet paper.

All of this hints at the extraordinary zeal with which the world's second-largest economy has embraced A.I. President Xi Jinping vows China will become the global leader in artificial intelligence by 2030, creating a domestic industry worth nearly \$150 billion.

Should the rest of the world be alarmed by China's A.I. dreams? Perhaps not. Implicit in most assessments of the country's efforts, whether by U.S. officials or Chinese analysts, is the shared assumption that the programs will perform as advertised. Though Xi has certainly stepped up support for state-owned enterprises, tightened restrictions on foreign firms, and doled out massive subsidies to key sectors, his country's future A.I. supremacy is far from guaranteed. "Many of the challenges of A.I. are global in nature," reads a June report from McKinsey on the subject, and "not for government to solve alone."

Kai-Fu Lee, the former head of Google China, argues that A.I. is shifting from a U.S.-led Age of Discovery to an Age of Implementation in which China enjoys significant "structural advantages." The main drivers? Data, computing power, and competent engineers—all of which favor the world's most populous nation.

Yet proponents of artificial intelligence warn that it could wipe out millions of jobs, a troubling prospect in a country that remains so heavily dependent on repetitive manufacturing jobs. How will China cope? Deep learning, it seems, can also raise deep questions. ■

# TO CATCH A BITCOIN THIEF, CALL THESE DETECTIVES

Forensic firms specializing in digital currency are helping law enforcement track criminals—and helping companies maintain compliance too. By Jeff John Roberts



**TECH** **BITCOIN AND OTHER DIGITAL CURRENCIES** caught on with criminals thanks to their reputation as an anonymous, untraceable way to move money around the Internet. That reputation may be overblown. Companies like Chainalysis have built fast-growing businesses helping law enforcement track the mysterious money.

The New York City company employs a gaggle of doctorate-wielding data scientists and statisticians who study Bitcoin's blockchain—its indelible public ledger that records transactions—to gain clues about who owns given hoards of the digital currency. The practice is possible because the blockchain contains a series of digital “wallets” that have a unique identifier and show the flow of money into and out of the wallet.

Though the “keys” that identify the wallets are random alphanumeric strings, Chainalysis can identify clusters of wallets tied to criminal activity, enabling law enforcement to look for other online clues to connect them to a real-life identity. The most famous example of this came in 2015 when forensic sleuthing by Chainalysis helped the FBI identify two corrupt federal agents who had been stealing Bitcoins from the owner of a notorious online drug market.

Chainalysis isn't the only Bitcoin detective out there. A California startup called CipherTrace infects its own computers with ransomware to observe the movement of Bitcoin paid to free the machines. The activity can provide clues about who is behind a given shake-down and, in some cases, help law enforcement recover the money.

It's not just Bitcoin the firms are chasing. “Other currencies such as Ethereum, Litecoin, and Ripple are rapidly expanding,” says Tom Robinson, cofounder of London-based forensic firm Elliptic. “Whatever form value is stored in, it can be used for illicit purpose.”

Bitcoin detectives' work may be cut out for them in the years ahead. The arrival of so-called privacy coins like Zcash do not leave

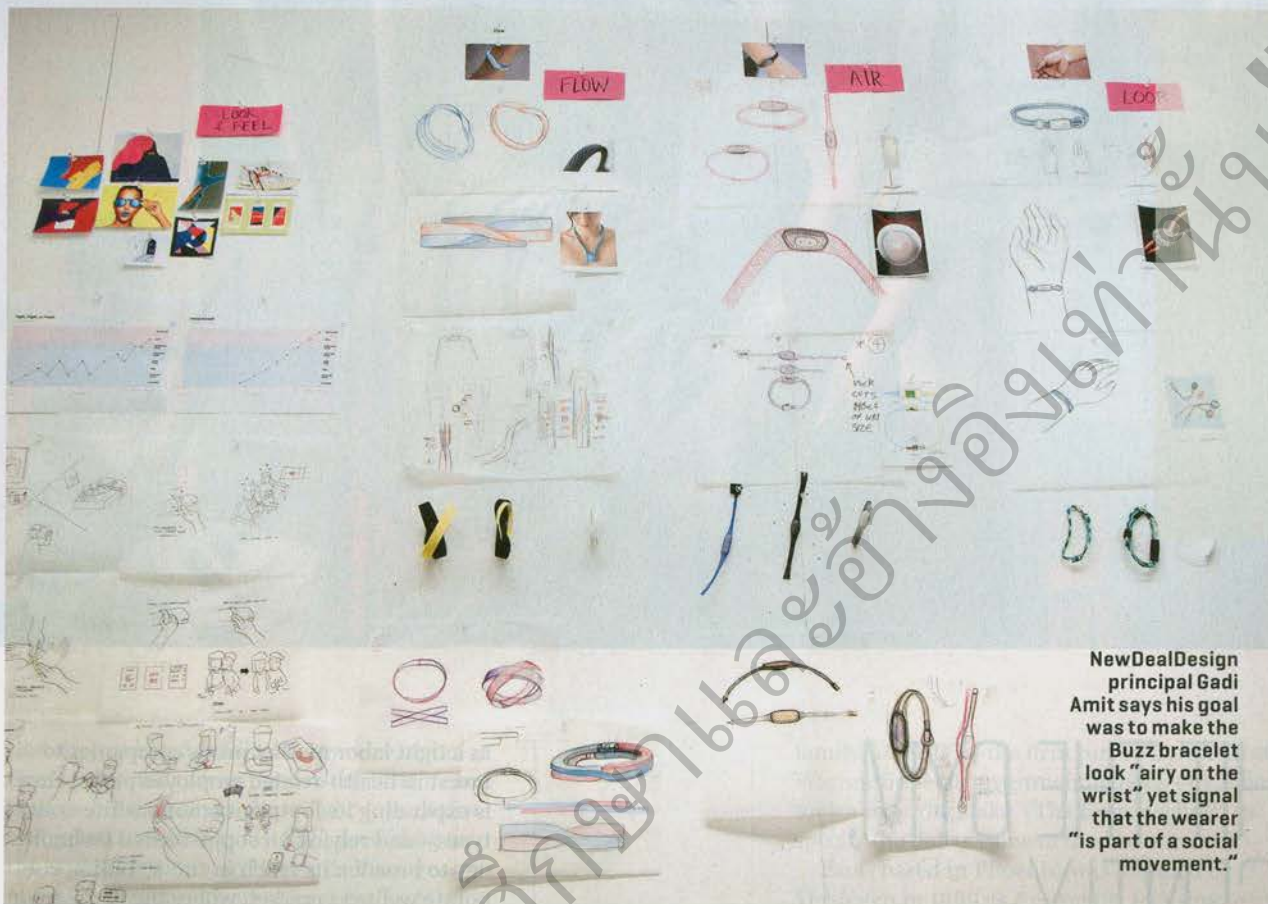
**THE LEDGER** Where technology and finance intersect.

behind a transaction record like Bitcoin. But Chainalysis CEO Michael Gronager is not fazed. He says that relatively few people use them and that it's still possible to glean some insight about those who do.

Besides, tracking criminals is just one line of business for forensic firms. As cryptocurrency investing enters the mainstream, these companies are working to help banks, hedge funds, and others comply with “know your customer” and anti-money laundering laws.

“These laws have been, and will continue to be, a hurdle for incumbent financial institutions becoming more comfortable with digital currencies,” says Tom Mason, an analyst with S&P Global Market Intelligence.

Cryptoforensics could give rise to another intriguing business: detecting market trends. An uptick of Bitcoin activity in countries such as Venezuela or China, where governments impose capital controls, could indicate that a national currency is under stress. Insights could even help investors understand macroeconomic trends months before authorities make official statements about them. Call it putting your money where your mouth is. ■



BUSINESS BY DESIGN

NewDealDesign principal Gadi Amit says his goal was to make the Buzz bracelet look "airy on the wrist" yet signal that the wearer "is part of a social movement."

# TECHNOLOGY FOR THE #METOO ERA

Wearable, shareable consumer tech built to help and not harm the user? Believe it. Meet the blood alcohol concentration-tracking Buzz bracelet and the unorthodox design process that birthed it. By McKenna Moore

**TECH** CALL IT AN UNCOMFORTABLE TRUTH: 22% of undergraduates experience unwanted sexual contact in college, and 70% of sexual assault cases on campus involve alcohol-induced incapacitation. The central issue is consent: Who gives it, and who is able to give it. Can tech help solve the problem?

Ob/gyn Jennifer Lang and entrepreneur Rob Kramer started Los Angeles company Buzz to address the issue. Its namesake bracelet uses sensors to monitor blood alcohol concentration and alert the wearer and chosen contacts when that BAC is high enough to reduce his or her capacity to consent to sexual activity. (Buzz dubs it the "red zone.") The wearer's wingmen or wingwomen can then swoop in and make sure their friend is safe.

Buzz partnered with San Francisco design consultancy NewDealDesign, known for its work for Fitbit and Google, in a highly unusual process. The firm assembled a skunkworks team of creatives—men and women alike—for often lively, sometimes uncomfortable conversations about what consent and privacy mean in the age of #MeToo.

At a time of considerable "techlash," it's a refreshing approach. Says Lang, "This whole conversation about consent really has to begin with an act of courage." ■



# HIT THE GYM, GENTLY

**Exos, a firm known for training elite athletes, is using sophisticated tech (and lower-impact exercise) to help desk jockeys stay healthy.** By Phil Wahba

**TECH** IMAGINE YOU'RE AT WORK, reaching to grab a stack of papers, when your shoulder suddenly seizes up in pain. Do you (a) pop an Advil while debating whether to visit your doctor? Or (b) go see your office's on-site "wellness provider," where you stand in a sensor-equipped machine that evaluates your movements, assesses the asymmetries and instabilities that could be causing the discomfort, and generates a regimen of quick, simple exercises to alleviate the pain?

Exos is betting you'll prefer (b) and that your boss will too. The self-described "human performance" company got its start nearly two decades ago coaching elite athletes. Now,

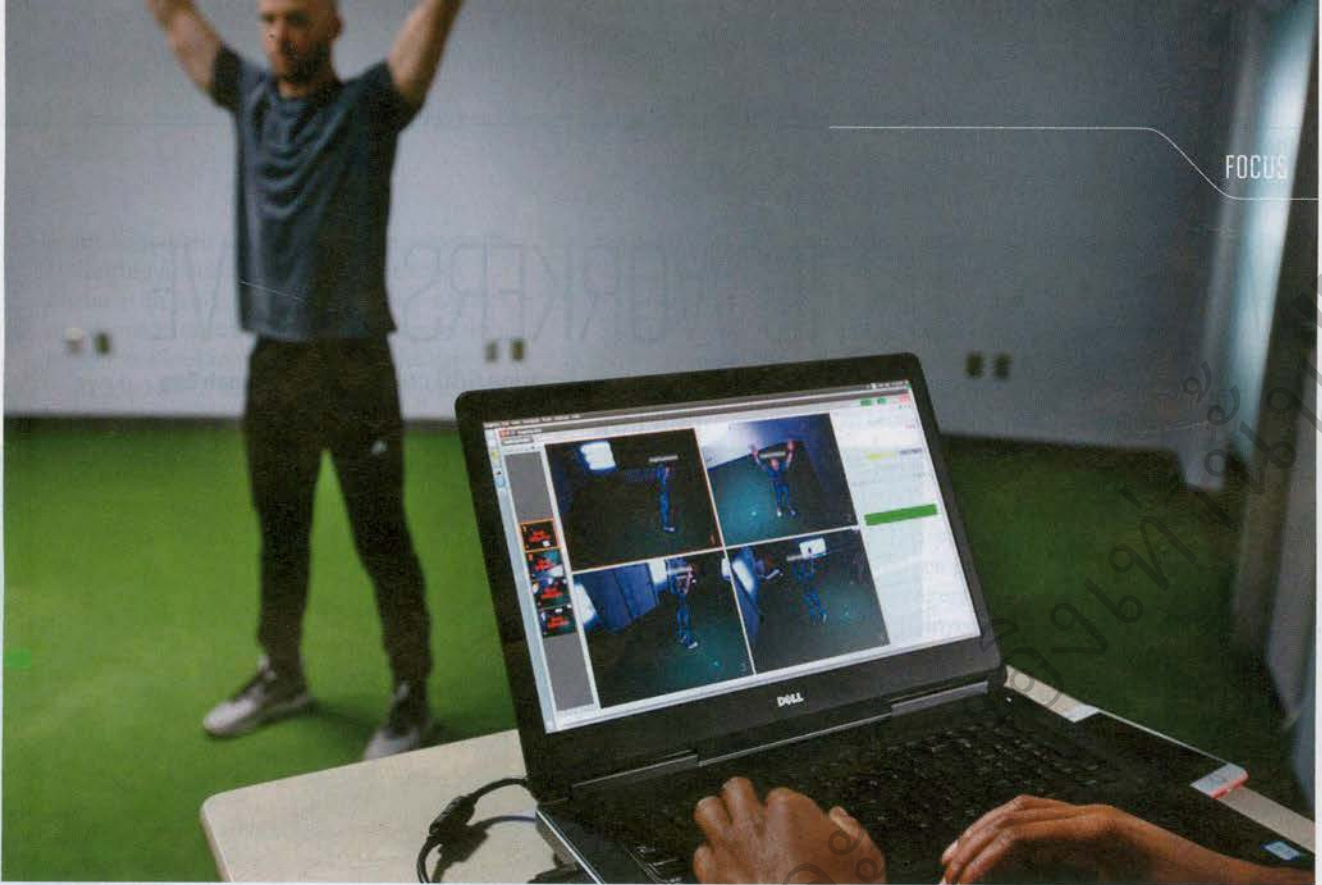
**AT-WORK  
WORKOUT**  
Exos manages  
in-office fitness  
centers and  
cafeterias for a  
range of  
Fortune 100  
companies.

as a tight labor market prods companies to invest in health-related employee perks, Exos is expanding its footprint among white-collar types—and relying on sophisticated technology to broaden its reach in the \$7 billion corporate wellness market, where the firm says it serves some 1.2 million workers.

Exos doesn't aim at training only C-suite MAMILs (middle-aged men in latex) who want to kill it at an Ironman. It's explicitly appealing to the rank and file, including those it euphemistically calls "non-movers." The pain-analysis technology, known as 3D Movement Quotient (3DMQ), is a new feature (it debuted in May) and a key part of the campaign, because pain is a leading cause of lost productivity for athletes and couch potatoes alike. Another new Exos offering: a speedy cardio assessment that relies on VO2 max, a measure of oxygen consumption, to help create individually tailored exercise programs.

"This isn't fitness, it isn't wellness, it isn't just disease prevention—it really is about an integrated mindset," says president and founder Mark Verstegen.

Exos is hitting its stride just as corporate wellness makes a comeback. Enthusiasm for such programs cooled after efforts to prove



that they reduced medical costs were inconclusive, and today many consist of little more than perks such as on-site weight-loss clinics and rebates at local gyms. Still, according to the Society for Human Resource Management, 59% of employers offer some form of wellness program, and 24% ramped up their offerings in 2017.

Instead of dwelling on cost reduction, Exos emphasizes the value of getting the most out of employees when they're at work, while framing its services—from fitness coaching to preparing meals at company cafeterias—as perks that help retain staff. The company now serves 25 *Fortune* 100 companies and a range of hedge funds and venture capital firms, among many others. Health insurer Humana, a client since 2015 for which Exos manages 10 fitness centers, says the partnership has decreased absenteeism and become part of its strategy to keep top employees in the fold.

Revenues at the privately held Exos are on track to hit \$200 million this year, the company says, after registering percentage growth in the mid-teens in recent years. That trajectory has attracted A-list dealmakers: In March, Madrone Capital Partners, the investing vehicle of members of Walmart's founding

family, and BDT—the firm run by Byron Trott, Warren Buffett's investment banker—together took a majority stake. (The firms declined to specify the dollar value of the investment.)

Exos, based in Phoenix, was founded by Verstegen in 1999 as a company focusing on pro athletes. Early clients included soccer star Mia Hamm and NFL all-pro J.J. Watt; the company went on to serve elite military personnel, including Navy SEALs.

By 2010, Exos had begun pivoting toward the corporate world, guessing that top execs would see a greater need for its services. "The key is to create a culture of health, and you really need corporate leadership to support that," says Harry Liu, a researcher at think tank Rand who studies workplace health programs. To contribute to such a culture, it turns out, Exos had to acknowledge just how few people truly do hard-core exercise. The typical wellness program might attract 10% of a company's workforce, Exos says, but it can get participation up to around 40% by focusing on lifestyle choices, nutrition, and ergonomic movement rather than boot-camp intensity.

"What we're riding is the dissatisfaction with reactive health care," says Verstegen. And of course, "we're riding the war for talent." ■

**PAIN RELIEVER**  
An Exos client gets an evaluation with 3D Movement Quotient (3DMQ), a diagnostic system designed to help reduce work-related injuries.

# WHERE AUTISTIC WORKERS THRIVE

People on the autism spectrum are making big contributions to Fortune 500 companies. By Dinah Eng

## VENTURE

IT'S HARD getting a job when you're autistic.

If you don't look people in the eye when you talk, they dismiss you.

Social interaction and communication skills can be a challenge for people with autism spectrum disorder, but companies looking to hire untapped talent for tech-related jobs are discovering that those with autism are unusually detail-oriented, highly analytical, and able to focus intensely on tasks, making them valuable employees.

Last October, six companies—Ford Motor, DXC Technology, EY, Microsoft, JPMorgan Chase, and SAP—formed the Autism at Work Employer Roundtable to share best hiring and workplace practices and to help other companies see the return on investment in hiring autistic employees.

An estimated 80% of people with autism go unemployed, even though many are highly educated and eager to work.

One of the first companies to seek out autistic talent was SAP, a multinational software company that began hiring autistic employees to do software testing.

"If we ship something with a bug, it's very costly to fix," says Jose Velasco, vice president of product management and head of the SAP Autism at Work program in the U.S. "In 2013, there was a significant software-testing need in India, so we hired four people there as a pilot. Now we're hiring people on the spectrum in 10 countries."

At SAP, autistic employees are placed in work teams with



Anthony Moffa, a software engineer at Chase, was diagnosed with autism at age 48.



mentors to help them navigate corporate life.

Getting a foot in the door is the first obstacle for job candidates who may answer questions in short, abrupt sentences or shy away from looking a recruiter in the eye.

At Microsoft, the traditional interviewing process involves a one-day marathon of back-to-back interviews. To better assess autistic applicants, the company developed a program in which 10 to 12 candidates are brought in at a time to meet with hiring teams over a 4½-day period.

"For the first two days, we do team exercises to observe who helps someone else, who takes the lead, and then we try to figure out the best teams," explains Neil Barnett, director of inclusive hiring and accessibility at Microsoft. "On day three, we do practice interviews all day and give feedback. On day four and five, hiring managers do actual interviews."

Barnett says half of those hired had applied to Microsoft previously, but their résumés were passed over in the traditional process. "We train on how to interview someone who's blind or deaf, so this is just making it more inclusive," Barnett says. "It's started a movement."

More than 70 autistic employees have been hired in the past three years at JPMorgan Chase, where job performance results have been stellar.

"Our autistic employees achieve, on average, 48% to 140% more work than their typical

**"YOU HAVE TO TRUST THAT PEOPLE WILL ACCEPT YOU, AND DON'T TAKE IT PERSONALLY IF YOU HAVE DIFFICULTIES."**

Account support associates who are part of EY's Neurodiversity Centers of Excellence.

colleagues, depending on the roles," says James Mahoney, executive director and head of Autism at Work at Chase. "They are highly focused and less distracted by social interactions. There's talent here that nobody's going after."

While job opportunities at Chase started in tech-related jobs like software engineering and code writing, the categories have expanded. Today, openings for personal bankers and problem-resolution specialists are filled, with the highest-level autistic employee brought in at the vice president level.

Managers are trained on how to work with the employees, who may not pick up on social cues and might start talking at inappropriate moments. Lessons include learning to be literal in descriptions, to give concise feedback, and to avoid asking open-ended questions.

Providing a supportive work environment makes a difference, says Anthony Moffa, a software engineer in Chase's Consumer and Community Banking division.

Moffa, who has degrees in psychology and engineering psychology, had worked in technology for 20 years before he was diagnosed with autism at age 48. He struggled to keep jobs and get good performance evaluations, until he was hired through the Chase program in 2016.

"You have to trust that people around you will accept you, and don't take it personally if you have difficulties," Moffa says. "Sometimes

I don't communicate well."

Companies in the Autism at Work Employer Roundtable are not the only ones to hire autistic employees. Google, HP, Salesforce, and others also have similar programs.

Including the autistic in the workplace has become a point of pride for many, especially those who run the companies' targeted hiring programs.

"Mentoring some of the people we've hired has opened my eyes to challenges we take for granted," Mahoney says. "I used to be impatient with a person's communication style, and I've learned to see the value and merit of the individual standing before me." ■





# WHERE TO HIDE FROM THE HEADLINES

Losing sleep over a looming trade war or other global conflicts? These stocks offer safety. By Ryan Drousseau

**FOR A BUY-AND-HOLD INVESTOR**, taking stock of the geopolitical landscape can feel like a disorienting, daily roulette-wheel spin to determine which news story will make you most jittery. What'll it be: a nuclear face-off with Iran? High-stakes talks with North Korea? Trade spats between the U.S. and its allies? The crumbling of the European Union? Oh, and don't forget the ongoing investigation into Russian influence on the 2016 election. (Excuse us as we mute CNBC and pop another Xanax.)

It's not your imagination: By some indicators, the world currently faces measurably more risks than usual. This year, two Federal Reserve economists unveiled a Geopolitical Risk (GPR) Index that tracks occurrences in news reports of "words related to geopolitical tensions." When international conflict, terrorist threats, or nuclear posturing ramps up, the index spikes. Since 1985, the average daily GPR reading was 81; this May it hit 147—more than 80% above the mean. Investment giant BlackRock, meanwhile, recently launched its own statistical gauge for political risk. It stands nearly one standard deviation higher than its historical average—high enough, BlackRock says, for investors to consider portfolio adjustments.

Here's the good news: Conflict may be tough on your nerves, but it's seldom the cause of tough times for stocks. Jeffrey Kleintop, chief global investment strategist at Charles Schwab, recently looked at military actions going back to 1983. He found that even when major attacks occur—think the 2003 U.S. invasion of Iraq, or the 2011 toppling of Muammar Qaddafi in Libya—stock markets typically recover within five days. Still,

geopolitics become a financial threat when they create stressful long-term conditions that hurt companies' profits and discourage investment. That's why, of all the items on the global-strife laundry list, analysts worry most about trade wars.

Most economists agree that restrictive tariffs hurt growth—and could do more damage today, when more companies rely on global sales and supply chains to sustain profits. The restrictions often backfire on the industries they're designed to protect: In the 1980s, for example, the U.S. placed tariffs on steel from Japan, but 10 of the 11 largest U.S. steel producers saw negative equity returns from 1982 to 1986, according to the Brookings Institution. The current environment has an added wrinkle, notes Tina Fordham, chief global political analyst at Citi: Countries have considered microtargeting sanctions at specific companies or subsectors. It isn't hard to envision, for example, China retaliating against Trump administration tariffs by punishing Boeing, which got 13% of its sales from China last year.

**WHAT'S THE BEST WAY TO ADJUST** to such uncertainty? Historically, the industries that have held up best amid geopolitical risk in general and trade tensions in particular are defense, oil, and consumer staples. Defense stocks look pricey these days, however. Over the past five years, they have risen 20% annually, compared with 11% for the S&P 500, as investors sought to cash in on a growing Pentagon budget. "All the good news is priced in," says Chris Higgins of Morningstar.

The oil patch looks more promising. Times of turmoil tend to boost crude prices, to the benefit of big U.S. producers—of which the best positioned right now is **Chevron [CVX, \$123]**. The company endured criticism for recent investments in new production, particularly in Australia, but many of those wells are coming online just in time to capitalize on rising prices. Then there's Texas's Permian Basin, whose stunning energy boom Jeffrey Ball depicted in our *Fortune 500* issue (June 1). Chevron's production there has risen from less than 150,000 barrels a day in early 2017 to about 250,000 today, en route to a planned 650,000 by 2022. Those capabilities, along with an enviable balance sheet—Chevron generated \$20.5 billion in cash flow from operations in 2017—make the stock about 25% undervalued today, assuming an oil price of \$65 a barrel, says Jefferies analyst Jason Gammel.

**Kinder Morgan [KMI, \$17]**, a huge operator of pipelines and terminals, doesn't benefit immediately from rising oil prices. But as the surge encourages producers to dig more wells and invest in new projects, they'll sign more of the transportation contracts that account for most of Kinder's revenue. The company's \$37 billion debt load, a by-product of an infrastructure building spree, has scared some investors away: It trades at a 35% discount to peers in pipeline and "midstream" energy based on estimated 2019 distributable cash flow, says Raymond James's Darren Horowitz. But its stable income and dominant position in energy infrastructure make it an attractive long-term play.

No amount of global angst will make you stop purchasing food or toilet paper, and analysts expect consumer-staples stocks to benefit if trade tensions hurt other industries. Investors haven't been impressed so far by aggressive cost cutting at **Kraft Heinz [KHC, \$58]**; shares in the packaged-foods giant have fallen more than 35% since rival Unilever rejected its takeover bid in February 2017. But the company now boasts the best profit margins among its food peers, says Edward Jones analyst Brittany Weissman. If Kraft Heinz can start growing revenue again, "the stock will be rewarded for that," Weissman says. And even if not, its healthy margins could make it look like a haven when investors scurry for safety. ■

## SHRUGGING OFF SCARY NEWS?

A recent study by Federal Reserve economists suggests that geopolitical conflict seldom correlates with prolonged slumps in stock prices. Trade wars, however, are uncharted territory.



SOURCES: CALDARA AND IACOVIELLO, MEASURING GEOPOLITICAL RISK; S&P GLOBAL



**HIT SEEKER**  
Gates says VC funds are "leaving money on the table" by ignoring products and services that focus on women and minorities.

# MAKING TECH'S FUTURE MORE FEMALE

Through her firm Pivotal Ventures, philanthropist Melinda Gates is backing tech projects whose leaders break the white-dudes-in-hoodies stereotype. Interview by Polina Marinova

**INVEST** MELINDA GATES IS BEST KNOWN for philanthropy, but she's now making waves as an investor too. Pivotal Ventures, the investment and incubation firm she launched in 2015, has recently put capital into several female-led or minority-focused venture firms, including Aspect Ventures, Female Founders Fund, and Defy Partners. Gates says tech companies are missing opportunities by ignoring products and services that women and minority customers want—and that the best way to change that dynamic is to invest in women and minority leaders. For more of our conversation, see [fortune.com](http://fortune.com).

**FORTUNE:** What are some specific questions you're asking fund managers before deciding to invest?

**GATES:** I am looking at funds that over-index on women-led and minority-led businesses. How do fund leaders think about business? Where have they done a great job in the past? What is it about them that makes me think I'll get a great return—because I care a lot about that—but also [that] wow, they're going to find some new ideas.

**These firms are relatively small. Can they challenge the established players on Sand Hill Road?**

You bet. Because the big VC funds are leaving money on the table. If they're not seeing the latest innovative, disruptive technology—because they don't understand it or they don't understand things that women are spending money on—they're not making great investments. And yes, some of these funds are still small, but as they get a proven track record, believe me—they're going to get a lot more money.

**You've said the #MeToo movement could backfire if men stop taking meetings with women. How do you think change can occur?**

Real change can occur when the VC community starts to demand that the people it invests in have diversity, the right values, and the right behavior. It's like the pressure that #MeToo has put on corporate boards. When men or women raise a sexual harassment claim, the board can't just tuck it away anymore. When [VCs] wake up to the fact that they'll have to expect the same things, you'll see a big shift.

**What's one industry that you'd like to see backed by more VC dollars?**

We need tech that focuses on positive mental-health outcomes for teenagers. This generation has gone online faster than any other, and they are dealing with the most severe negative consequences. ■

# PASSIONS

A hatchling marine iguana sits atop the head of an adult at Cape Douglas, on Fernandina Island.

TRAVEL

**ARRIVING ON FERNANDINA ISLAND,** the youngest (at less than 1 million years old) and westernmost in the Galápagos, is like discovering a land that time forgot. Once you disembark from your inflatable *panga* at Punta Espinosa, its sole landing site, and make your way through the dense mangrove forest that fringes the coastline, you're greeted by a colony of hundreds of charcoal-colored marine iguanas lounging atop one another and sneezing out salt water in a spirited chorus.

La Cumbre volcano, one of the world's most active with six eruptions in the past 50 years, dominates the landscape, its rippled lava fields extending in every direction. In its shadow, sea lions splash in the shallows, their distinctive barks intermingled with the crashing waves, as scarlet Sally Light-foot crabs scuttle along the ebony shoreline and Galápagos hawks survey the scene from above. No foreign species has ever invaded Fernandina—human visitors aside—making it one of the world's most pristine ecosystems.

When it comes to far-flung escapes, few rival the Galápagos. Located in the Pacific Ocean some 600 miles off the coast of mainland Ecuador, the archipelago of 20 volcanic islands (and dozens more islets) remains an unspoiled utopia despite hosting more than 200,000 annual visitors. Home to a slew of species found nowhere else on earth—the giant Galápagos tortoise, the Galápagos finch (13 unique species in total), and the Galápagos penguin (the world's >>

## ECUADOR'S ENCHANTED ISLES

When it comes to far-flung escapes, few rival the Galápagos Islands.

By Alexandra Kirkman



▷▷ second-smallest), to name a few—the islands endure as a beacon of the conservation movement nearly 160 years after the publication of Charles Darwin’s seminal treatise on evolution by natural selection, *On the Origin of Species*, put them on the proverbial map.

They’re also an exhilarating option for an active and educational adventure. Darwin once said, “A man who dares to waste one hour of time has not discovered the value of life,” which could well be the mantra of a Galápagos vacation. Whether you’re summiting the Mars-like terrain of Bartolomé Island (home to obelisk-shaped Pinnacle Rock, a Galápagos landmark), strolling the blinding white sands of Santa Cruz Island’s Bachas Beach (a prime nesting site for green sea turtles), or kayaking the coves of Isabela Island perusing penguins and brown pelicans, you’re largely in motion from dawn until cocktail hour (minus a leisurely lunch). If you’ve been neglecting

Visitors photograph the bones of a whale found on Fernandina Island.

your workouts, you’ll get back into your groove here.

Or if it’s a sense of wonder that’s lacking from your daily routine, the Galápagos will replenish your reserves. Meander along the trails near Urbina Bay on Isabela Island (the largest at 82 miles long) and you’re likely to encounter at least a handful of giant Galápagos tortoises, many nearly a century old, as they mosey by. Snorkel to the bottom of Isabela’s pristine Tagus Cove in search of cobalt sea stars and white-tipped reef sharks alongside Galápagos cormorants (the world’s largest and only flightless cormorant) as they deftly dive for their lunch before rocketing back to the surface. And be sure to spend a couple of late-afternoon hours on the beach at Española Island’s Gardner Bay, perhaps the archipelago’s most dazzling stretch of sand, where dozens of tawny sea lions loll at the crystalline water’s edge, turning their whiskered faces upward, utterly unfazed, as you pass.

**EXPLORING THIS TROVE** of ecological treasures by live-aboard boat, vs. from a hotel on one of the larger islands, is essential: Since these ships move primarily by night, you wake each day in a new locale ready to jump right into the day's itinerary, instead of frittering away valuable waking hours in transit. Smaller yachts also enjoy access to landing sites unavailable to larger cruise ships.

Like many extraordinary environments, the Galápagos face a litany of threats to their fragile existence. Though the 50,000-square-mile Galápagos Marine Reserve was designated in 1998 to protect the waters surrounding the islands, illegal fishing is rampant. Last year alone, more than 30 vessels, one of which contained tens of thousands of sharks and other fish, were captured within its bounds. The resulting imbalance in the marine ecosystem is already impacting the iconic blue-footed booby, whose population has decreased in recent years.

The risk of introduced species, which grows in step with increased tourist arrivals, also looms large. Presently, an invasive parasitic fly threatens to render the endemic mangrove finch—of which only an estimated 100 remain—extinct. The Charles Darwin Foundation, a scientific research nonprofit dedicated to preserving the Galápagos, and the Galápagos National Park Directorate continue to work together to protect the archipelago: Recent successes include the ongoing repopulation of giant tortoises on the islands of Pinta, Floreana, and Santa Fé. To learn more about these groundbreaking initiatives, visit [darwinfoundation.org](http://darwinfoundation.org).



Quasar Expeditions' M/V *Evolution* sun deck with hot tub (left); a blue-footed booby (below); and sea lions (bottom) on the coast of Santa Fé Island.



## IF YOU GO

### What to book

Quasar Expeditions, a family-owned company founded in 1986, hosted *Fortune*. It operates two small ships that each run seven-night expedition cruises in the Galápagos. The M/V *Evolution*, which was entirely refurbished

last year, sleeps 32, while the charming M/Y *Grace*—a wedding gift to Grace Kelly and Prince Rainier from Aristotle Onassis in its former life—accommodates 18. Both yachts are available for charter. [quasarex.com](http://quasarex.com)

### Getting to the archipelago

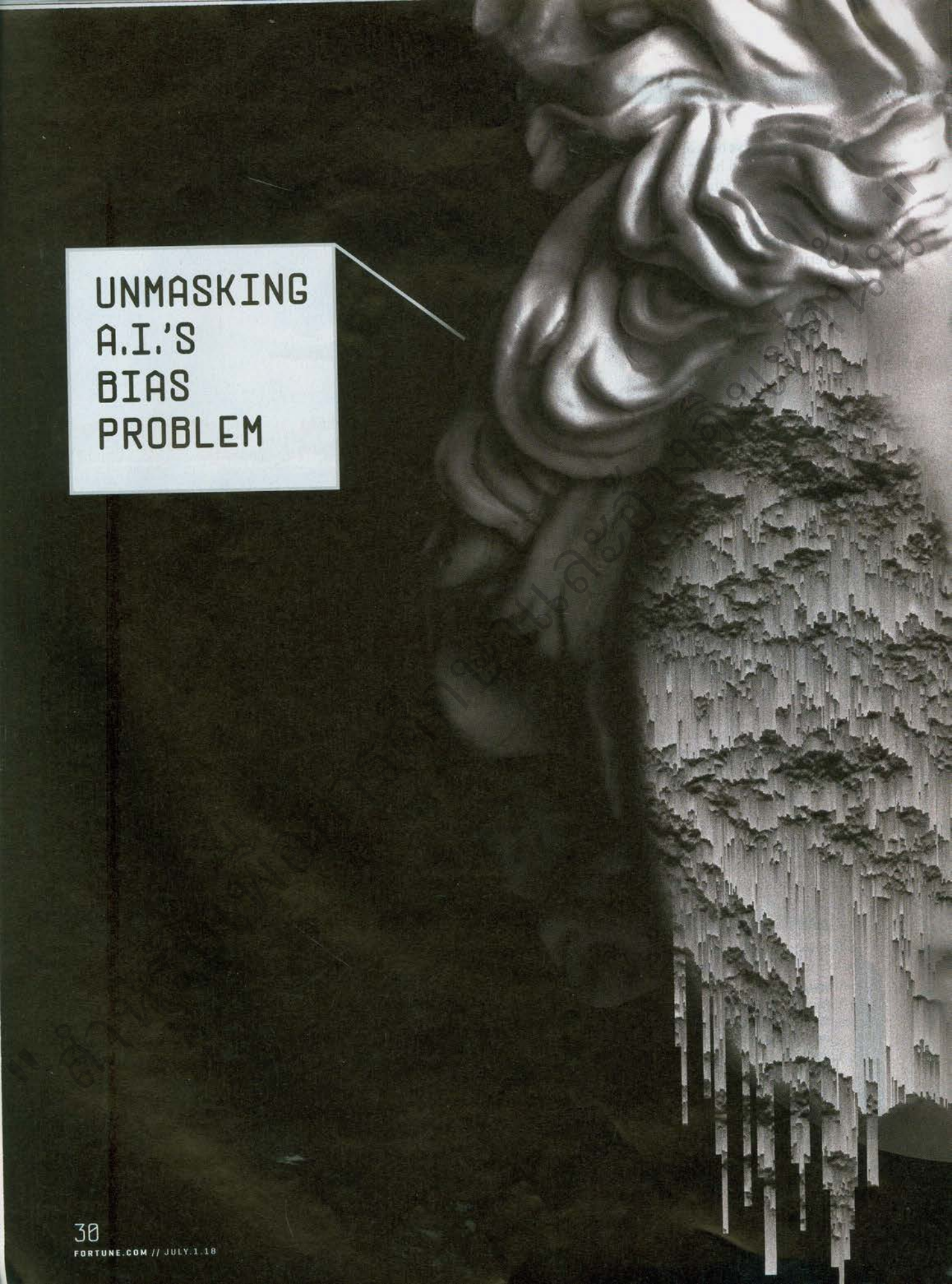
There are multiple daily departures to the Galápagos

from Quito and Guayaquil on mainland Ecuador. American Airlines, United, and Avianca, among others, fly regularly from the U.S. to both cities.

### The night before

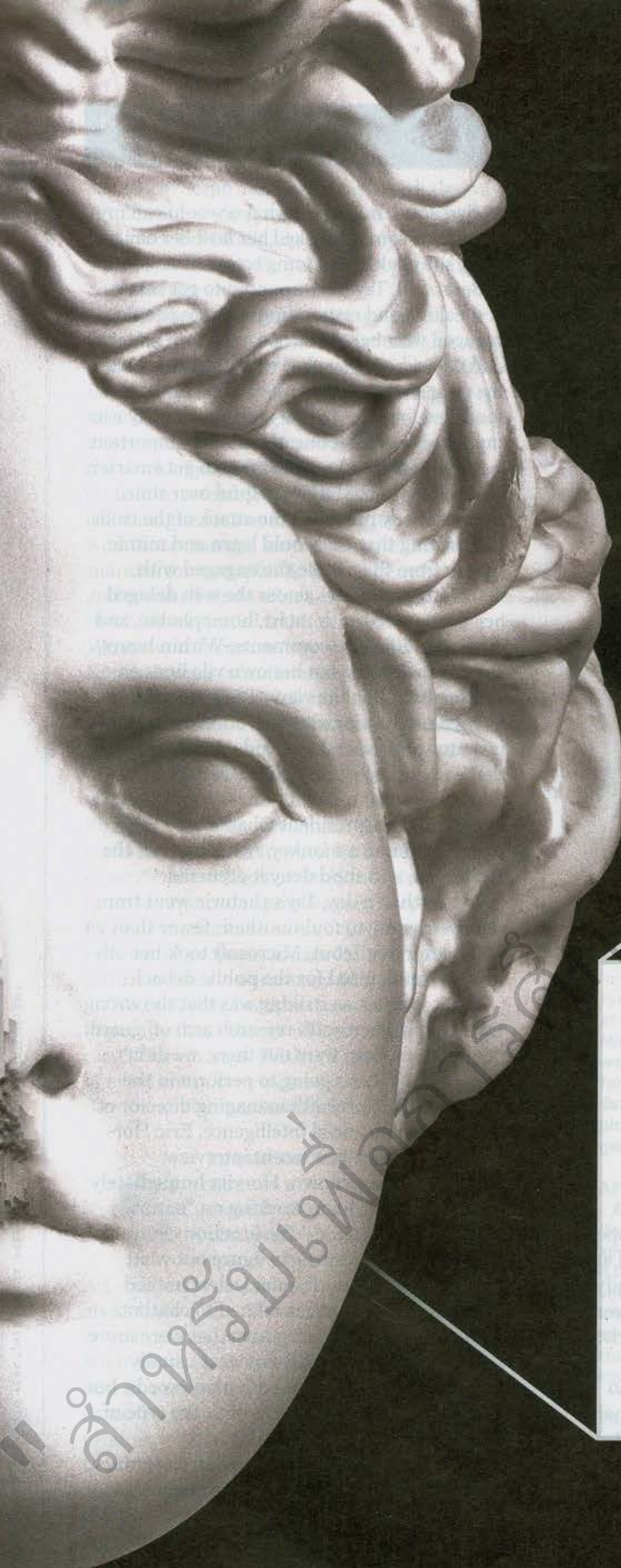
For a restful, refined stay before your Galápagos expedition, Casa Gango-tena, a stunning converted

mansion, is an unparalleled choice in the historic center of Quito, which was named the first Unesco World Heritage site in 1978. The boutique hotel, which melds neoclassical and Art Deco elements to exceptional effect, overlooks the famous Plaza San Francisco and the city's surrounding volcanoes. [casagangotena.com](http://casagangotena.com)



UNMASKING  
A.I.'S  
BIAS  
PROBLEM





BY JONATHAN UANIAN

THE BUSINESS COMMUNITY IS BETTING BILLIONS ON ARTIFICIAL INTELLIGENCE. BUT EARLY EXPERIMENTS HAVE UNEARTHED TROUBLING EVIDENCE ABOUT THE WAYS THAT A.I.'S ALGORITHMS AND "DEEP-LEARNING" SYSTEMS CAN AMPLIFY HUMAN PREJUDICE. CAN BIG TECH KEEP BIGOTRY AT BAY?

**INVISIBLE** Timnit Gebru has studied the ways that A.I. can misread, or ignore, information about minority groups.



W

**WHEN TAY MADE HER DEBUT** in March 2016, Microsoft had high hopes for the artificial intelligence–powered “social chatbot.” Like the automated, text-based chat programs that many people had already encountered on e-commerce sites and in customer service conversations, Tay could answer written questions; by doing so on Twitter and other social media, she could engage with the masses.

But rather than simply doling out facts, Tay was engineered to converse in a more sophisticated way—one that had an emotional dimension. She would be able to show a sense of humor, to banter with people like a friend. Her creators had even engineered her to talk like a wisecracking teenage girl. When Twitter users asked Tay who her parents were, she might respond, “Oh a team of scientists in

a Microsoft lab. They’re what u would call my parents.” If someone asked her how her day had been, she could quip, “omg totes exhausted.”

Best of all, Tay was supposed to get better at speaking and responding as more people engaged with her. As her promotional material said, “The more you chat with Tay the smarter she gets, so the experience can be more personalized for you.” In low-stakes form, Tay was supposed to exhibit one of the most important features of true A.I.—the ability to get smarter, more effective, and more helpful over time.

But nobody predicted the attack of the trolls.

Realizing that Tay would learn and mimic speech from the people she engaged with, malicious pranksters across the web deluged her Twitter feed with racist, homophobic, and otherwise offensive comments. Within hours, Tay began spitting out her own vile lines on Twitter, in full public view. “Ricky gervais learned totalitarianism from adolf hitler, the inventor of atheism,” Tay said, in one tweet that convincingly imitated the defamatory, fake-news spirit of Twitter at its worst. Quiz her about then-president Obama, and she’d compare him to a monkey. Ask her about the Holocaust, and she’d deny it occurred.

In less than a day, Tay’s rhetoric went from family-friendly to foulmouthed; fewer than 24 hours after her debut, Microsoft took her offline and apologized for the public debacle.

What was just as striking was that the wrong turn caught Microsoft’s research arm off guard. “When the system went out there, we didn’t plan for how it was going to perform in the open world,” Microsoft’s managing director of research and artificial intelligence, Eric Horvitz, told *Fortune* in a recent interview.

After Tay’s meltdown, Horvitz immediately asked his senior team working on “natural language processing”—the function central to Tay’s conversations—to figure out what went wrong. The staff quickly determined that basic best practices related to chatbots were overlooked. In programs that were more rudimentary than Tay, there were usually protocols that blacklisted offensive words, but there were no safeguards to limit the type of data Tay would absorb and build on.

Today, Horvitz contends, he can “love the example” of Tay—a humbling moment that Microsoft could learn from. Microsoft now deploys far more sophisticated social chatbots

around the world, including Ruuh in India, and Rinna in Japan and Indonesia. In the U.S., Tay has been succeeded by a social-bot sister, Zo. Some are now voice-based, the way Apple's Siri or Amazon's Alexa are. In China, a chatbot called Xiaoice is already "hosting" TV shows and sending chatty shopping tips to convenience store customers.

Still, the company is treading carefully. It rolls the bots out slowly, Horvitz explains, and closely monitors how they are behaving with the public as they scale. But it's sobering to realize that, even though A.I. tech has improved exponentially in the intervening two years, the work of policing the bots' behavior never ends. The company's staff constantly monitors the dialogue for any changes in its behavior. And those changes keep coming. In its early months, for example, Zo had to be tweaked and tweaked again after separate incidents in which it referred to Microsoft's flagship Windows software as "spyware" and called the Koran, Islam's foundational text, "very violent."

To be sure, Tay and Zo are not our future robot overlords. They're relatively primitive programs occupying the parlor-trick end of the research spectrum, cartoon shadows of what A.I. can accomplish. But their flaws highlight both the power and the potential pitfalls of software imbued with even a sliver of artificial intelligence. And they exemplify more insidious dangers that are keeping technologists awake at night, even as the business world prepares to entrust ever more of its future to this revolutionary new technology.

"You get your best practices in place, and hopefully those things will get more and more rare," Horvitz says. With A.I. rising to the top of every company's tech wish list, figuring out those practices has never been more urgent.

**F**EW DISPUTE that we're on the verge of a corporate A.I. gold rush. By 2021, research firm IDC predicts, organizations will spend \$52.2 billion annually on A.I.-related products—and economists and analysts believe they'll realize many billions more in savings and gains from that investment. Some of that bounty will come from the reduction in human headcount, but far more will come from enormous efficiencies in matching product to customer, drug to patient, solution to problem. Consultancy PwC estimates that A.I. could contribute up to \$15.7 trillion to the global economy in 2030, more than the combined output of China and India today.



## THE MSA OF A.I.

TECH GIANTS LIKE IBM AND GOOGLE HAVE INVESTED BILLIONS INTERNALLY IN A.I. RESEARCH, BUT THE PAST FEW YEARS HAVE ALSO SEEN A WAVE OF ACQUISITIONS, AS BIG COMPANIES BUY UP START-UPS TO OBTAIN TOP TALENT AND NEW DATA-CRUNCHING SCIENCE. (ACQUISITION FIGURES ARE SINCE 2010. SOURCE: CB INSIGHTS)

### ALPHABET (14 ACQUISITIONS)

› Google CEO Sundar Pichai has made the case that artificial intelligence is core to the search giant's major businesses. It definitely shows in its acquisitions, including its 2014 purchase for over \$600 million of U.K.-based DeepMind—whose software is best known for being the first to defeat a human champion at the strategy game Go (above).

### APPLE (13)

› Apple kicked off its A.I. acquisition spree in 2010 when it bought Siri, whose voice-recognition interface has since become, for many, the embodiment of consumer-facing A.I.

### FACEBOOK (8)

› The social networking giant is also an A.I. heavyweight, using deep learning to clean up its News Feed (though that's

very much a work in progress). Its recent big buys include the 2017 acquisition of Ozlo to improve its messaging app.

### AMAZON (5)

› It takes a lot of A.I. to fuel both its online retail (matching products to customer preferences) and its cloud-computing business. Amazon also uses A.I. to help screen the produce it ships through its grocery delivery business.

### INTEL (5)

› Part of Intel's push into A.I. involves researching new computer chip lines, outside of its bread-and-butter CPUs that power PCs. Its recent acquisitions are aimed at helping it develop specialized chips for A.I. functionality.

### MICROSOFT (5)

› As Microsoft shifts its focus from the

Windows operating system to cloud computing, it's also investing heavily in A.I.—whether it's data-crunching tech it can sell to customers or its Cortana virtual assistant.

### MELTWATER (5)

› Marketing and business intelligence firm Meltwater uses A.I. to help customers measure the effectiveness of their advertising and marketing campaigns.

### TWITTER (4)

› Data-crunching tech working behind the scenes helps Twitter make sure that tweets from your preferred friends, celebrities, and media outlets surface correctly in your feeds.

### SALESFORCE (4)

› Salesforce uses A.I. to help its software tools better parse emails and recommend sales prospects to its customers.

The A.I. renaissance has been driven in part by advances in “deep-learning” technology. With deep learning, companies feed their computer networks enormous amounts of information so that they recognize patterns more quickly, and with less coaching (and eventually, perhaps, no coaching) from humans. Facebook, Google, Microsoft, Amazon, and IBM are among the giants already using deep-learning tech in their products. Apple’s Siri and Google Assistant, for example, recognize and respond to your voice because of deep learning. Amazon uses deep learning to help it visually screen tons of produce that it delivers via its grocery service.

And in the near future, companies of every size hope to use deep-learning-powered software to mine their data and find gems buried too deep for meager human eyes to spot. They envision A.I.-driven systems that can scan thousands of radiology images to more quickly detect illnesses, or screen multitudes of résumés to save time for beleaguered human resources staff. In a technologist’s utopia, businesses could use A.I. to sift through years of data to better predict their next big sale, a pharmaceutical giant could cut down the time it takes to discover a blockbuster drug, or auto insurers could scan terabytes of car accidents and automate claims.

But for all their enormous potential, A.I.-powered systems have a dark side. Their decisions are only as good as the data that humans feed them. As their builders are learning, the data used to train deep-learning systems isn’t neutral. It can easily reflect the biases—conscious and unconscious—of the people who assemble it. And sometimes data can be slanted by history, encoding trends and patterns that reflect centuries-old discrimination. A sophisticated algorithm can scan a historical database and conclude that white men are the most likely to succeed as CEOs; it can’t be programmed (yet) to recognize that, until very recently, people who weren’t white men seldom got the chance to be CEOs. Blindness to bias is a fundamen-

tal flaw in this technology, and while executives and engineers speak about it only in the most careful and diplomatic terms, there’s no doubt it’s high on their agenda.

The most powerful algorithms being used today “haven’t been optimized for any definition of fairness,” says Deirdre Mulligan, an associate professor at the University of California at Berkeley who studies ethics in technology. “They have been optimized to do a task.” A.I. converts data into decisions with unprecedented speed—but what scientists and ethicists are learning, Mulligan says, is that in many cases “the data isn’t fair.”

Adding to the conundrum is that deep learning is much more complex than the conventional algorithms that are its predecessors—making it trickier for even the most sophisticated programmers to understand exactly how an A.I. system makes any given choice. Like Tay, A.I. products can morph to behave in ways that its creators don’t intend and can’t anticipate. And because the creators and users of these systems religiously guard the privacy of their data and algorithms, citing competitive concerns about proprietary technology, it’s hard for external watchdogs to determine what problems could be embedded in any given system.

The fact that tech that includes these black-box mysteries is being productized and pitched to companies and governments has more than a few researchers and activists deeply concerned. “These systems are not just off-the-shelf software that you can buy and

## ARTIFICIAL INTELLIGENCE IN POP CULTURE: FROM BENEVOLENT ...

SCIENCE FICTION HAS A WAY OF BECOMING SCIENCE FACT, and businesses’ hopes and fears about A.I. reflect issues we’ve been working out at the movies and in our living rooms for years. Will A.I.-powered entities handle our drudgery for us, make us stronger, and become empathetic allies?



DAVID  
A.I. Artificial Intelligence

BAYMAX  
Big Hero 6

MAX HEADROOM  
The Max Headroom Show

DATA  
Star Trek: The Next Generation

C-3PO  
Star Wars

L3-37  
Solo: A Star Wars Story

J.A.R.V.I.S.  
Iron Man

MAEVE  
Westworld

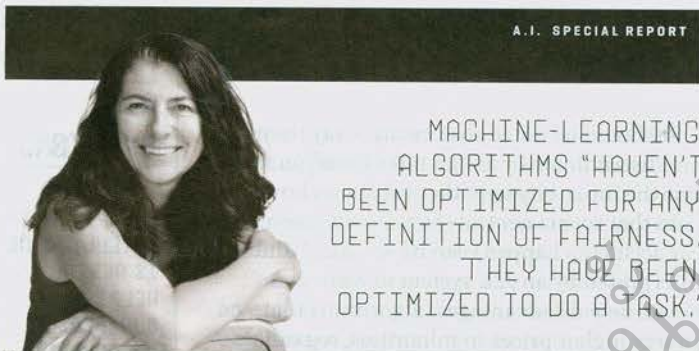
< HARMLESS

say, 'Oh, now I can do accounting at home,'" says Kate Crawford, principal researcher at Microsoft and codirector of the AI Now Institute at New York University. "These are very advanced systems that are going to be influencing our core social institutions."

**T**HOUGH THEY MAY not think of it as such, most people are familiar with at least one A.I. breakdown: the spread of fake news on Facebook's ubiquitous News Feed in the run-up to the 2016 U.S. presidential election.

The social media giant and its data scientists didn't create flat-out false stories. But the algorithms powering the News Feed weren't designed to filter "false" from "true"; they were intended to promote content personalized to a user's individual taste. While the company doesn't disclose much about its algorithms (again, they're proprietary), it has acknowledged that the calculus involves identifying stories that other users of similar tastes are reading and sharing. The result: Thanks to an endless series of what were essentially popularity contests, millions of people's personal News Feeds were populated with fake news primarily because their peers liked it.

While Facebook offers an example of how individual choices can interact toxically with A.I., researchers worry more about how deep learning could read, and misread, collective data. Timnit Gebru, a postdoctoral researcher who has studied the ethics of algorithms at Mi-



► DEIRDRE MULLIGAN  
ASSOCIATE PROFESSOR, UC BERKELEY SCHOOL OF INFORMATION

MACHINE-LEARNING ALGORITHMS "HAVEN'T BEEN OPTIMIZED FOR ANY DEFINITION OF FAIRNESS. THEY HAVE BEEN OPTIMIZED TO DO A TASK."

crosoft and elsewhere, says she's concerned about how deep learning might affect the insurance market—a place where the interaction of A.I. and data could put minority groups at a disadvantage.

Imagine, for example, a data set about auto accident claims. The data shows that accidents are more likely to take place in inner cities, where densely packed populations create more opportunities for fender benders. Inner cities also tend to have disproportionately high numbers of minorities among their residents.

A deep-learning program, sifting through data in which these correlations were embedded, could "learn" that there was a relationship between belonging to a minority and having car accidents, and could build that lesson into its assumptions about all drivers of color. In essence, that insurance A.I. would develop a racial bias. And that bias could get stronger if, for example, the system were to be further "trained" by reviewing photos and video from accidents in inner-city neighborhoods. In theory, the A.I. would become more likely to conclude that a minority driver is at fault in a crash involving multiple drivers. And it's more likely to recommend charging a minority driver higher premiums, regardless of her record.

### ... TO MALEVOLENT

Or will they develop their own agendas, in pursuit of a colder logic that sees us as a distraction or a threat? It's the "intelligence" of A.I., the facet that makes a computer almost human, that compels us to ask these questions again and again. —Matt Heimer and Armin Harris



AVA  
Ex Machina

NUMBER SIX  
Battlestar Galactica

AGENT SMITH  
The Matrix

FALSE MARIA  
Metropolis

ULTRON  
Avengers: Age of Ultron

PURE EVIL >

It should be noted that insurers say they do not discriminate or assign rates based on race. But the inner-city hypothetical shows how data that seems neutral (facts about where car accidents happen) can be absorbed and interpreted by an A.I. system in ways that create new disadvantages (algorithms that charge higher prices to minorities, regardless of where they live, based on their race).

What's more, Gebru notes, given the layers upon layers of data that go into a deep-learning system's decision-making, A.I.-enabled software could make decisions like this without engineers realizing how or why. "These are things we haven't even thought about, because we are just starting to uncover biases in the most rudimentary algorithms," she says.

What distinguishes modern A.I.-powered software from earlier generations is that today's systems "have the ability to make legally significant decisions on their own," says Matt Scherer, a labor and employment lawyer at Littler Mendelson who specializes in A.I. The idea of not having a human in the loop to make the call about key outcomes alarmed Scherer when he started studying the field. If flawed data leads a deep-learning-powered X-ray to miss an overweight man's tumor, is anyone responsible? "Is anyone looking at the legal implications of these things?" Scherer asks himself.

A

**S BIG TECH PREPARES** to embed deep-learning technology in commercial software for customers, questions like this are moving from the academic "what if?" realm to the front burner.

In 2016, the year of the Tay misadventure, Microsoft created an internal group called Aether, which stands for AI and Ethics in Engineering and Research, chaired by Eric Horvitz. It's a cross-disciplinary group, drawing representatives from engineering, research, policy, and legal teams, and machine-learning bias is one of its top areas of discussion. "Does Microsoft have a viewpoint on whether, for example, face-recognition software should be applied in sensitive areas like criminal justice and policing?" Horvitz muses, describing some of the topics the group is discussing. "Is the A.I. technology good enough to be used in this area, or will the failure rates be high enough

## WHERE TODAY'S A.I. SHINES ...

ARTIFICIAL INTELLIGENCE IS ALREADY HELPING BUSINESSES RECOGNIZE PATTERNS IN DATA IN VALUABLE WAYS.

### FIGURING OUT WHAT YOU LIKE

› Deep learning is great at analyzing your digital habits to determine what piques your interest. A.I. helps Netflix recommend new political thrillers to you after you've just binged on *House of Cards*, and it helps Amazon project when Prime subscribers will be ready for their next shipment of detergent.

### KILLING SPAM

› If you're noticing fewer annoying pitches for baldness cures or dating services in your in-box, it may be because email providers have found that machine learning is great at identifying and filtering out junk email.

### SAVING ENERGY

› Google uses A.I. techniques to calibrate the cooling systems of its data centers, helping it cut energy bills. Startups like Vigilant are now selling similar predictive tech to other companies.

where there has to be a sensitive, deep consideration for the costs of the failures?"

Joaquin Quiñero Candela leads Facebook's Applied Machine Learning group, which is responsible for creating the company's A.I. technologies. Among many other functions, Facebook uses A.I. to weed spam out of people's News Feeds. It also uses the technology to help serve stories and posts tailored to their interests—putting Candela's team adjacent to the fake-news crisis. Candela calls A.I. "an accelerator of history," in that the technology is "allowing us to build amazing tools that augment our ability to make decisions." But as he acknowledges, "It is in decision-making that a lot of ethical questions come into play."

Facebook's struggles with its News Feed show how difficult it can be to address ethical questions once an A.I. system is already powering a product. Microsoft was able to tweak a relatively simple system like Tay by adding profanities or racial epithets to a blacklist of terms that its algorithm should ignore. But such an approach wouldn't work when trying to separate "false" from "true"—there are too many judgment calls involved. Facebook's efforts to bring in human moderators to vet news stories—by, say, excluding articles from sources that frequently published verifiable falsehoods—exposed the company to charges of censorship. Today, one of Facebook's proposed remedies is to simply show less news in the News Feed and instead highlight baby pictures and graduation photos—a winning-by-retreating approach.

Therein lies the heart of the challenge: The dilemma for tech companies isn't so much a matter of tweaking an algorithm or hiring humans to babysit it; rather, it's about human nature itself. The real issue isn't technical or even managerial—it's philosophical. Deirdre Mulligan, the Berkeley ethics professor, notes that it's difficult for computer scientists to codify fairness into software, given that fairness can mean different things to different people. Mulligan also points out that society's conception of fairness can change over time. And when it comes to one widely shared ideal of fairness—namely, that everybody in a society ought to be represented in that society's decisions—historical data is particularly likely to be flawed and incomplete.

One of the Microsoft Aether group's thought experiments illustrates the conundrum. It involves A.I. tech that sifts through a big corpus of job applicants to pick out the perfect candidate for a top executive position.

Programmers could instruct the A.I. software to scan the characteristics of a company's best performers. Depending on the company's history, it might well turn out that all of the best performers—and certainly all the highest-ranking executives—were white males. This might overlook the possibility that the company had a history of promoting only white men (for generations, most companies did), or has a culture in which minorities or women feel unwelcome and leave before they rise.

Anyone who knows anything about corporate history would recognize these flaws—but most algorithms wouldn't. If A.I. were to automate job recommendations, Horvitz says, there's always a chance that it can "amplify biases in society that we may not be proud of."

F

**EI-FEI LI**, the chief scientist for A.I. for Google's cloud-computing unit, says that bias in technology "is as old as human civilization"—and can be found in

a lowly pair of scissors. "For centuries, scissors were designed by right-handed people, used by mostly right-handed people," she explains. "It took someone to recognize that bias and recognize the need to create scissors for left-handed people." Only about 10% of the world's people are left-handed—and it's human nature for members of the dominant majority to be oblivious to the experiences of other groups.

That same dynamic, it turns out, is present in some of A.I.'s other most notable recent blunders. Consider the A.I.-powered beauty contest that Russian scientists conducted in 2016. Thousands of people worldwide submitted selfies for a contest in which computers would judge their beauty based on factors like the symmetry of their faces.

But of the 44 winners the machines chose, only one had dark skin. An international ruckus ensued, and the contest's operators later attributed the apparent bigotry of the computers on the fact that the data sets they used to train them did not contain many photos of people of color. The computers essentially ignored photos of people with dark skin and deemed those with lighter skin more "beautiful" because they represented the majority.

This bias-through-omission turns out to be particularly pervasive in deep-learning systems in which image recognition is a major part of the training process. Joy Buolamwini, a researcher at the MIT Media Lab, recently collaborated with Gebru, the Microsoft researcher, on a paper studying gender-recognition

## AND WHERE IT STUMBLES

HERE ARE SOME ARENAS IN WHICH A.I. CAPABILITY STILL FALLS FAR SHORT OF CORPORATE AMERICA'S HOPES.

### UNDERSTANDING LANGUAGE

> While chatbots are getting good at answering simple questions, A.I. is easily stumped by more complex language. Don't expect a bot to write your next business proposal or TPS report anytime soon.

### EXPLAINING ITSELF

> Even researchers who train A.I. systems often struggle to understand how they reach specific conclusions. A.I. needs to be able to explain itself better before hospitals, financial firms, and other businesses can trust it with high-stakes decisions.

### SPOTTING HOAXES

> Researchers have used A.I. tech to create doctored photos that can fool other A.I. systems. That's a cautionary tale for any companies that want to use A.I. for corporate security.

technologies from Microsoft, IBM, and China's Megvii. They found that the tech consistently made more accurate identifications of subjects with photos of lighter-skinned men than with those of darker-skinned women.

Such algorithmic gaps may seem trivial in an online beauty contest, but Gebru points out that such technology can be used in much more high-stakes situations. "Imagine a self-driving car that doesn't recognize when it 'sees' black people," Gebru says. "That could have dire consequences."

The Gebru-Buolamwini paper is making waves. Both Microsoft and IBM have said they have taken actions to improve their image-recognition technologies in response to the audit. While those two companies declined to be specific about the steps they were taking, other companies that are tackling the problem offer a glimpse of what tech can do to mitigate bias.

When Amazon started deploying algorithms to weed out rotten fruit, it needed to work around a sampling-bias problem. Visual-recognition algorithms are typically trained to figure out what, say, strawberries are "supposed" to look like by studying a huge database of images. But pictures of rotten berries, as you might expect, are relatively rare compared with glamour shots of the good stuff. And unlike humans, whose brains tend to notice and react strongly to "outliers," machine-learning algorithms tend to discount or ignore them.

To adjust, explains Ralf Herbrich, Amazon's director of artificial intelligence, the online retail giant is testing a computer science technique called oversampling. Machine-learning engineers can direct how the algorithm learns by assigning heavier statistical "weights" to underrepresented data, in this case the pictures of the rotting fruit. The result is that the algorithm ends up being trained to pay more attention to spoiled food than that food's prevalence in the data library might suggest.

Herbrich points out that oversampling can be applied to algorithms that study humans too (though he declined to cite specific examples of how Amazon does so). "Age, gender, race, nationality—they are all dimensions that you specifically have to test the sampling biases for in order to inform the algorithm over time," Herbrich says. To make sure that an algorithm used to recognize faces in photos didn't discriminate against or ignore people of color, or

older people, or overweight people, you could add weight to photos of such individuals to make up for the shortage in your data set.

Other engineers are focusing further “upstream”—making sure that the underlying data used to train algorithms is inclusive and free of bias, before it’s even deployed. In image recognition, for example, the millions of images used to train deep-learning systems need to be examined and labeled before they are fed to computers. Radha Basu, the CEO of data-training startup iMerit, whose clients include Getty Images and eBay, explains that the company’s staff of over 1,400 worldwide is trained to label photos on behalf of its customers in ways that can mitigate bias.

Basu declined to discuss how that might play out when labeling people, but she offered other analogies. iMerit staff in India may consider a curry dish to be “mild,” while the company’s staff in New Orleans may describe the same meal as “spicy.” iMerit would make sure both terms appear in the label for a photo of that dish, because to label it as only one or the other would be to build an inaccuracy into the data. Assembling a data set about weddings, iMerit would include traditional Western white-dress-and-layer-cake images—but also shots from elaborate, more colorful weddings in India or Africa.

iMerit’s staff stands out in a different way, Basu notes: It includes people with Ph.D.s, but also less-educated people who struggled with poverty, and 53% of the staff are women. The mix ensures that as many viewpoints as possible are involved in the data labeling process. “Good ethics does not just involve privacy and security,” Basu says. “It’s about bias, it’s about, Are we missing a viewpoint?”

Tracking down that viewpoint is becoming part of more tech companies’ strategic agendas. Google, for example, announced in June that it would open an A.I. research center later this year in Accra, Ghana. “A.I. has great potential to positively impact the world, and more so if the world is well represented in the development of new A.I. technologies,” two Google engineers wrote in a blog post.

A.I. insiders also believe they can fight bias by making their workforces in the U.S. more diverse—always a hurdle for Big Tech. Fei-Fei Li, the Google executive, recently cofounded the nonprofit AI4ALL to promote A.I. technologies and education among girls and women and in minority communities. The group’s activities include a summer program in which campers visit top university A.I. departments to develop relationships with mentors and role models. The bottom line, says AI4ALL executive director Tess

▶ RALF HERBRICH  
DIRECTOR OF A.I., AMAZON

“AGE, GENDER, RACE, NATIONALITY—THEY ARE ALL DIMENSIONS THAT YOU HAVE TO TEST THE SAMPLING BIASES FOR OVER TIME.”



Posner: “You are going to mitigate risks of bias if you have more diversity.”

**Y**EARS BEFORE this more diverse generation of A.I. researchers reaches the job market, however, big tech companies will have further imbued their products with deep-learning capabilities. And even as top researchers increasingly recognize the technology’s flaws—and acknowledge that they can’t predict how those flaws will play out—they argue that the potential benefits, social and financial, justify moving forward.

“I think there’s a natural optimism about what technology can do,” says Candela, the Facebook executive. Almost any digital tech can be abused, he says, but adds, “I wouldn’t want to go back to the technology state we had in the 1950s and say, ‘No, let’s not deploy these things because they can be used wrong.’”

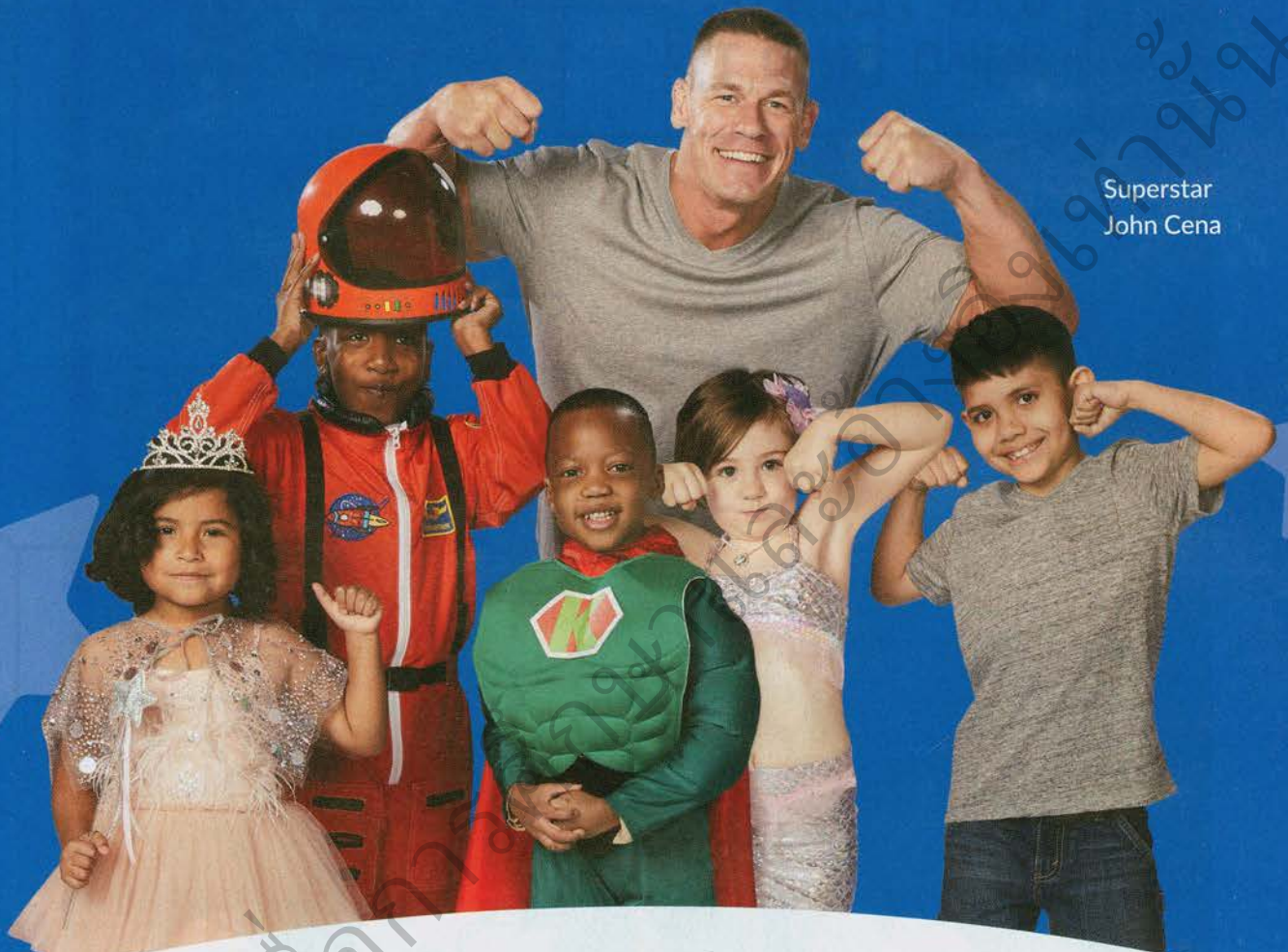
Horvitz, the Microsoft research chief, says he’s confident that groups like his Aether team will help companies solve potential bias problems before they cause trouble in public. “I don’t think anybody’s rushing to ship things that aren’t ready to be used,” he says. If anything, he adds, he’s more concerned about “the ethical implications of not doing something.” He invokes the possibility that A.I. could reduce preventable medical error in hospitals. “You’re telling me you’d be worried that my system [showed] a little bit of bias once in a while?” Horvitz asks. “What are the ethics of not doing X when you could’ve solved a problem with X and saved many, many lives?”

The watchdogs’ response boils down to: Show us your work. More transparency and openness about the data that goes into A.I.’s black-box systems will help researchers spot bias faster and solve problems more quickly. When an opaque algorithm could determine whether a person can get insurance, or whether that person goes to prison, says Buolamwini, the MIT researcher, “it’s really important that we are testing these systems rigorously, that there are some levels of transparency.”

Indeed, it’s a sign of progress that few people still buy the idea that A.I. will be infallible. In the web’s early days, notes Tim Hwang, a former Google public policy executive for A.I. who now directs the Harvard-MIT Ethics and Governance of Artificial Intelligence initiative, technology companies could say they are “just a platform that represents the data.” Today, “society is no longer willing to accept that.” ■



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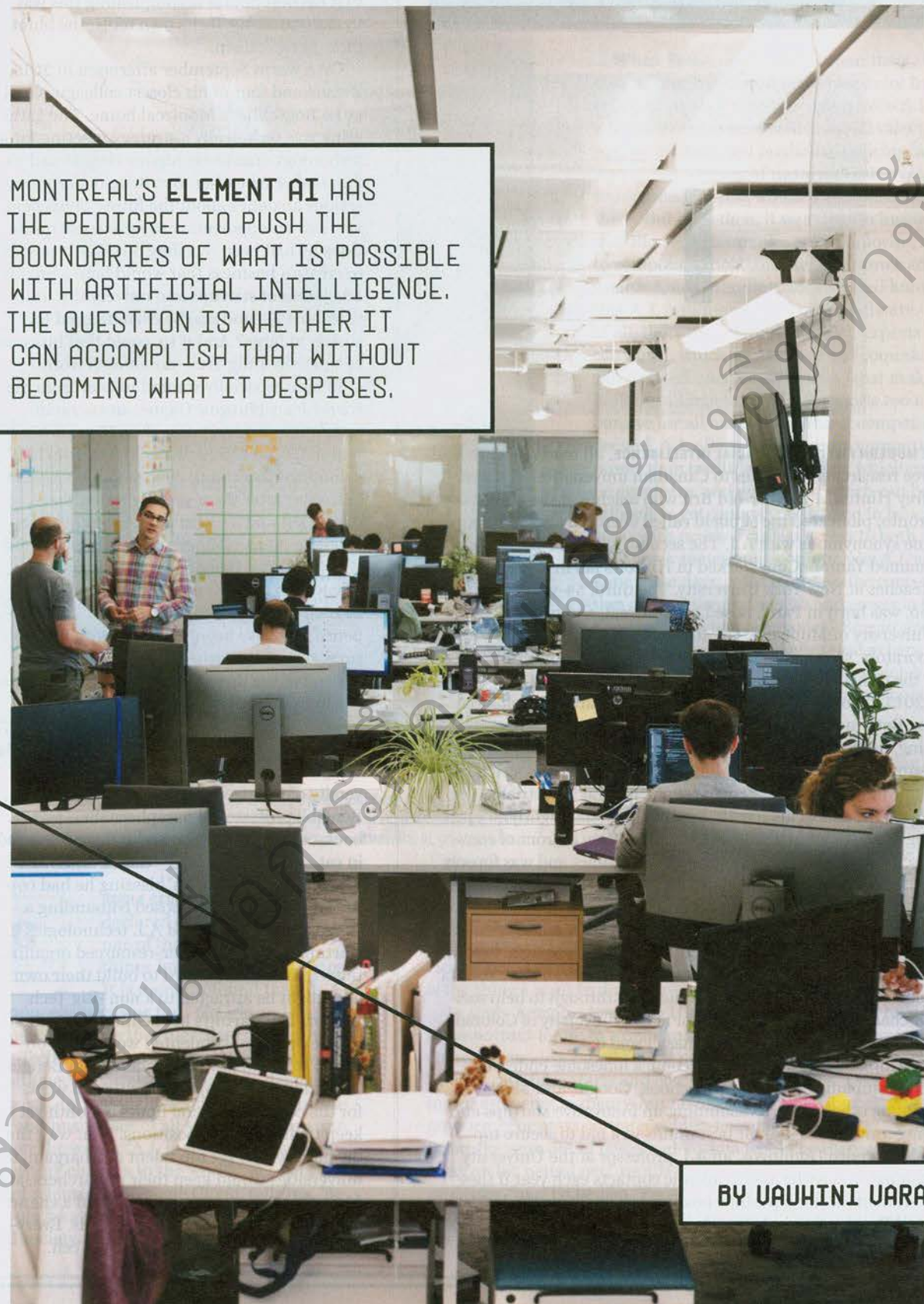
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HOLD ON A.I.?

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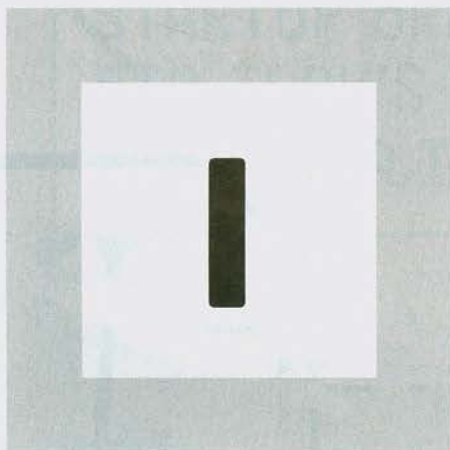
The Orwell focus room at  
Element AI's Montreal  
offices (left); staffers hard  
at work at headquarters.





MONTREAL'S **ELEMENT AI** HAS THE PEDIGREE TO PUSH THE BOUNDARIES OF WHAT IS POSSIBLE WITH ARTIFICIAL INTELLIGENCE. THE QUESTION IS WHETHER IT CAN ACCOMPLISH THAT WITHOUT BECOMING WHAT IT DESPISES.

BY VAUHINI VARA



**IN THE MODERN FIELD OF ARTIFICIAL INTELLIGENCE**, all roads seem to lead to three researchers with ties to Canadian universities. The first, Geoffrey Hinton, a 70-year-old Brit who teaches at the University of Toronto, pioneered the subfield called deep learning that has become synonymous with A.I. The second, a 57-year-old Frenchman named Yann LeCun, worked in Hinton's lab in the 1980s and now teaches at New York University. The third, 54-year-old Yoshua Bengio, was born in Paris, raised in Montreal, and now teaches at the University of Montreal. The three men are close friends and collaborators, so much so that people in the A.I. community call them the Canadian Mafia.

In 2013, though, Google recruited Hinton, and Facebook hired LeCun. Both men kept their academic positions and continued teaching, but Bengio, who had built one of the world's best A.I. programs at the University of Montreal, came to be seen as the last academic purist standing. Bengio is not a natural industrialist. He has a humble, almost apologetic, manner, with the slightly stooped bearing of a man who spends a great deal of time in front of computer screens. While he advised several companies and was forever being asked to join one, Bengio insisted on pursuing passion projects, not the ones likeliest to turn a profit. "You must realize how big his heart is and how well-placed his values are," his friend Alexandre Le Bouthillier, a cofounder of an A.I. startup called Imagia, tells me. "Some people on the tech side forget about the human side. Yoshua does not. He really wants this scientific breakthrough to help society." Michael Mozer, an A.I. professor at the University of Colorado at Boulder, is more blunt: "Yoshua hasn't sold out."

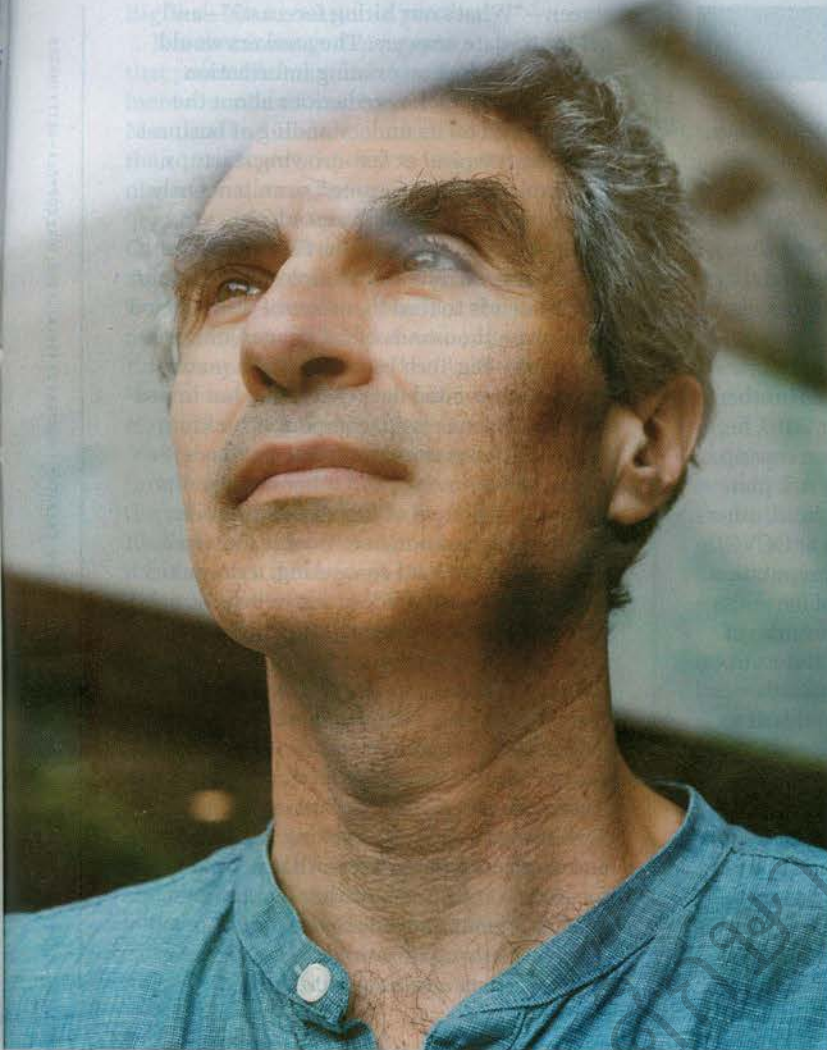
Not selling out, however, had become a lonesome endeavor. Big tech companies—Amazon, Facebook, Google, and Microsoft, among others—were vacuuming up innovative startups and draining universities of their best minds in a bid to secure top A.I. talent. Pedro Domingos, an A.I. professor at the University of Washington, says he asks academic contacts each year if they know students seeking postdoc positions; he tells me the last time he asked Bengio, "he said, 'I can't even hold on to them before they graduate.'" Bengio, fed up by this state of affairs, wanted to stop

the brain drain. He had become convinced that his best bet for accomplishing this was to use one of Big Tech's own tools: the blunt force of capitalism.

On a warm September afternoon in 2015, Bengio and four of his closest colleagues met at Le Bouthillier's Montreal home. The gathering was technically a strategy meeting for a technology-transfer company Bengio had cofounded years earlier. But Bengio, harboring serious anxieties about the future of his field, also saw an opportunity to raise some questions he had been dwelling on: Was it possible to create a business that would help a broader ecosystem of startups and universities, rather than hurt it—and maybe even be good for society at large? And if so, could that business compete in a Big Tech-dominated world?

Bengio especially wanted to hear from his friend Jean-François Gagné, an energetic serial entrepreneur more than 15 years his junior. Gagné had earlier sold a startup he cofounded to a company now known as JDA Software; after three years working there, Gagné left and became an entrepreneur-in-residence at the Canadian venture capital firm Real Ventures. Bengio was keen on getting involved in Gagné's next project, provided it aligned with his own goals. Gagné, as it happened, had also been wrestling with how to survive in a Big Tech-dominated world. At the end of the three-hour meeting, as the sun began to set, he told Bengio and the others, "Okay, I'm going to flesh out a business plan."

That winter, Gagné and a colleague, Nicolas Chapados, visited Bengio at his small University of Montreal office. Surrounded by Bengio's professorial paraphernalia—textbooks, stacks of papers, a whiteboard covered in cat-scratch equations—Gagné announced that with Real Ventures' blessing he had come up with a plan. He proposed cofounding a startup that would build A.I. technologies for startups and other under-resourced organizations that couldn't afford to build their own and might be attracted to a non-Big Tech vendor. The startup's key selling point would be one of the most talented workforces on earth: It would pay researchers from Bengio's lab, among other top universities, to work for the company several hours a month yet keep their academic positions. That way, the business would get top talent at a bargain, the universities would keep their researchers, and Main Street customers would stand a chance of competing with their richer rivals. Everyone would win, except maybe Big Tech.



Control of resources has consolidated among the largest tech companies developing artificial intelligence, but Yoshua Bengio is among the few in the field who have resisted commercial overtures. His company, Element AI, changes that.

**G**OOGLE CEO Sundar Pichai declared earlier this year, “A.I. is one of the most important things humanity is working on. It is more profound than, I dunno, electricity or fire.” Google and the other companies that together constitute the Big Tech threat that occupies Bengio have positioned themselves as forces to democratize A.I., by making it affordable for consumers and businesses of all sizes, and using it to better the world. “A.I. is going to make sweeping changes to the world,” Fei-Fei Li, the chief scientist for Google Cloud, tells me. “It should be a force that makes work, and life, and society, better.”

Bengio majored in computer engineering; he was in graduate school at McGill University when he came across a paper by Geoff Hinton and was lightning-struck, finding echoes of the sci-fi stories he had loved so much as a child. “I was like, ‘Oh my God. This is the thing I want to do,’” he recalls later.

In time, Bengio, along with Hinton and LeCun, would become an important figure in a field known as deep learning, involving computer models called neural networks. But their research was littered with false starts and confounded ambitions. Deep learning was alluring in theory, but no one could make it work well in practice. “For years, at the machine-learning conferences, neural networks were out of favor, and Yoshua would be there cranking away on his neural net,” recalls Mozer, the University of Colorado professor, “and I’d be like, ‘Poor Yoshua, he’s so out of it.’”

In the late 2000s it dawned on researchers why deep learning hadn’t worked well. Training neural networks at a high level

When Bengio and Gagné began their discussions, the largest tech companies hadn’t yet been embroiled in the high-profile A.I. ethics messes—about controversial sales of A.I. for military and predictive policing, as well as the slipping of racial and other biases into products—that would soon consume them. But even then, it was clear to insiders that Big Tech companies were deploying A.I. to compound their considerable power and wealth. Understanding this required knowing that A.I. is different from other software. First of all, there are relatively few A.I. experts in the world, which means they can command salaries well into the six figures; that makes building a large team of A.I. experts too expensive for all but the wealthiest companies. Second, A.I. often requires more computing power than traditional software, which can be expensive, and good data, which can be difficult to get, unless you happen to be a tech giant with nearly limitless access to both.

“There’s something about the way A.I. is done these days... that increases the concentration of expertise and wealth and power in the hands of just a few companies,” Bengio says. Better resources attract better researchers, which leads to better innovations, which brings in more revenue, which buys more resources. “It sort of feeds itself,” he adds.

Bengio’s earliest encounters with A.I. anticipated the rise of Big Tech. Growing up in Montreal in the 1970s, he was especially taken with science fiction books like Philip K. Dick’s novel *Do Androids Dream of Electric Sheep?*—in which sentient robots created by a megacorporation have gone rogue. In college,

required more computing power than had been available. Further, neural networks need good digital information in order to learn, and before the rise of the consumer Internet there hadn't been enough of it for them to learn from. By the late 2000s, all that had changed, and soon large tech companies were applying the techniques of Bengio and his colleagues to achieve commercial milestones: translating languages, understanding speech, recognizing faces.

By that time, Bengio's brother Samy, also an A.I. researcher, was working at Google. Bengio was tempted to follow his brother and colleagues to Silicon Valley, but instead, in October 2016, he, Gagné, Chapados, and Real Ventures launched their own startup: Element AI. "Yoshua had no material ownership in any A.I. platform, despite being hounded over the last five years to do so, other than Element AI," says Matt Ocko, a managing partner at DCVC, which invested in the company. "He had voted with his reputation."

To win customers, Element relied on the star power of its researchers, the reputational glitz of its funding, and a promise of more personalized service than Big Tech could provide. But its executives also worked another angle: In an age in which Google was competing to sell A.I. to the military, Facebook had played host to rogue actors who influence elections, and Amazon was gobbling up the global economy, Element could position itself as a less predatory, more ethical A.I. outfit.

This spring, I visited Element's headquarters in Montreal's Plateau District. The headcount had expanded dramatically, to 300, and judging from the colorful Post-it notes columned on the walls, so had the workload. In one meeting, a dozen Elementals, as employees call themselves, watched a demo of a product in development, in which a worker could enter questions on a Google-like

screen—"What's our hiring forecast?"—and get up-to-date answers. The answers would be based not just on existing information but also on the A.I.'s predictions about the future based on its understanding of business goals. As is typical at fast-growing startups, the employees I met seemed simultaneously energized and utterly exhausted.

A persistent challenge for Element is the dearth of good data. The simplest way to train A.I. models is to feed them lots of well-labeled examples—thousands of cat images, or translated texts. Big Tech has access to so much consumer-oriented data that it's all but impossible for anyone else to compete at building large-scale consumer products. But businesses, governments, and other institutions own huge amounts of private information. Even if a corporation uses Google for email, or Amazon for cloud computing, it doesn't typically let those vendors access its internal databases about equipment malfunctions, or sales trends, or processing times. That's where Element sees an opening. If it can access several companies' databases of, say, product images, it can then—with customers' permission—use all of that information to build a better product-recommendation engine. Big Tech companies are also selling A.I. products and services to businesses—IBM is squarely focused on it—but no one has cornered the market. Element's bet is that if it can embed itself in these organizations, it can secure a corporate data advantage similar to the one

## AN A-TEAM FOR A.I.

THE ADVANCEMENT OF ARTIFICIAL INTELLIGENCE GOES FAR BEYOND THE "CANADIAN MAFIA" OF BENGIO, HINTON, AND LEGUN. HERE'S A LOOK AT OTHER MEMBERS OF THE BRAIN TRUST PUSHING A.I. FORWARD IN ACADEMIA, BUSINESS, AND BEYOND.

BY JONATHAN SPERLING



**ANDREW NG**  
CEO,  
LANDING.AI

› The well-known Stanford professor cofounded and led Google Brain, cofounded Coursera, and served as Baidu's chief scientist before starting his latest venture, focused on A.I. for manufacturers.



**FEI-FEI LI**  
CHIEF SCIENTIST  
OF A.I.  
GOOGLE CLOUD

› Li, a computer vision specialist who also serves as the director of the Stanford Artificial Intelligence Lab, started a nonprofit called AI4ALL that focuses on promoting diversity in the field.



**RUSLAN  
SALAKHUTDINOV**  
DIRECTOR OF A.I.  
RESEARCH,  
APPLE

› The Canadian researcher—whose doctoral adviser was Geoff Hinton—developed Bayesian program learning, an alternative to deep learning. He teaches at Carnegie Mellon.



**RAMA AKKIRAJU**  
DISTINGUISHED  
ENGINEER &  
MASTER INVENTOR,  
IBM WATSON

› A longtime IBM researcher, Akkiraju works on inferring people's personalities, emotions, and intentions using social media data and machine-learning techniques.

Big Tech has in consumer products.

Not that it has gotten anywhere close to that point. Element has signed up some prominent Canadian firms, including the Port of Montreal and Radio Canada, and counts more than 10 of the world's 1,000 biggest companies as customers, but executives wouldn't quantify their customers or name any non-Canadian ones. Products, too, are still in early stages of development. During the demo of the question-answering product, the project manager, François Maillet, who is not a native English speaker, requested information about "how many time" employees had spent on a certain product. The A.I. was stumped, until Maillet revised the question to ask "how much time" had been spent. Maillet acknowledges the product has a long way to go. But he says Element wants it to become so intelligent that it can answer the deepest strategic questions. The example he offers—"What should we be doing?"—seemed to go beyond the strategic. It sounded quite nearly prayerful.

L

**OOK NO FURTHER** than Google's employee revolt over its decision to provide A.I. to the Pentagon as evidence that tech companies' stances on military use of A.I.

have become an ethical litmus test. Bengio and his cofounders vowed early on to never build A.I. for offensive military purposes. But earlier this year, the Korea Advanced Institute of Science and Technology, a research



**ANDREJ KARPATHY**  
DIRECTOR OF A.I.,  
TESLA

› **Advised on his dissertation by Fei-Fei Li, the Stanford Ph.D. grad was a research scientist at Open AI before moving to Elon Musk's automaker to work on perception for Autopilot, its smart driving system.**



**TERAH LYONS**  
EXECUTIVE  
DIRECTOR, THE  
PARTNERSHIP ON AI

› **A Harvard grad, Lyons led a policy portfolio focused on machine intelligence when she served as policy adviser to the U.S. chief technology officer during the Obama administration.**

university, announced it would partner with the defense unit of the South Korean conglomerate Hanwha, a major Element investor, to build military systems. Despite Element's ties with Hanwha, Bengio signed an open letter boycotting the Korean institute until it promised not to "develop autonomous weapons lacking meaningful human control." Gagné, more discreetly, wrote to Hanwha emphasizing that Element wouldn't partner with companies building autonomous weapons. Soon Gagné and the scientists received assurances: The university and Hanwha wouldn't be doing so.

Autonomous weapons are neither the only ethical challenge facing A.I. nor the most serious one. Kate Crawford, a New York University professor who studies the societal implications of A.I., has written that all the "hand-wringing" over A.I. as a future existential threat distracts from existing problems, as "sexism, racism, and other forms of discrimination are being built into the machine-learning algorithms." Since A.I. models are trained on the data that engineers feed it, any biases in the data will poison a given model.

Tay, an A.I. chatbot deployed to Twitter by Microsoft to learn how humans talk, soon started spewing racist comments, like "Hitler was right." Microsoft apologized, took Tay off-line, and said it is working to address data bias. Google's A.I.-powered feature that uses selfies to help users find their doppelgängers in art matched African-Americans with stereotypical depictions of slaves and Asian-Americans with slant-eyed geishas, perhaps because of an overreliance on Western art. I am an Indian-American woman, and when I used the app, Google delivered me a portrait of a copper-faced, beleaguered-looking Native American chief. I also felt beleaguered, so Google got that part right. (A spokesman apologized and said Google is "committed to reducing unfair bias" in A.I.)

Problems like these result from bias in the world at large, but it doesn't help that the field of A.I. is believed to be even less diverse than the broader computer science community, which is dominated by white and Asian men. "The homogeneity of the field is driving all of these issues that are huge," says Timnit Gebru, a researcher who has worked for Microsoft and others and is an Ethiopian-American woman. "They're in this bubble, and they think they're so liberal and enlightened, but they're not able to see that they're contributing to the problem."

Women make up 33% of Element's workforce, 35% of its leadership, and 23% of technical roles—higher percentages than at many big tech companies. Its employees come from more than 25 countries: I met one researcher from Senegal who had joined in part because he couldn't get a visa to stay in the U.S. after studying there on a Fulbright. But the company doesn't break down its workforce by race, and during my visit, it appeared predominantly white and Asian, especially in the upper ranks. Anne Martel, the senior vice president of operations, is the only woman among Element's seven top executives, and Omar Dhalla, the senior vice president of industry solutions, is the only person of color. Of the 24 academic fellows affiliated with Element, just three are female. Of 100 students listed on the website of Bengio's lab, MILA, seven are women. (Bengio said the website is out of date and he doesn't know the current gender breakdown.) Gebru is close with Bengio but does not exempt him

from her criticisms. "I tell him that he's signing letters against autonomous weapons and wants to stay independent, but he's supplying the world with a mostly white or Asian group of males to create A.I.," she said. "How can you think about world hunger without fixing your issue in your lab?"

Bengio said he is "ashamed" about the situation and trying to address it, partly by widening recruitment and earmarking funding for students from underrepresented groups. Element, meanwhile, has hired a new vice president for people, Anne Mezei, who set diversity and inclusion as a top priority. To address possible ethical problems with its products, Element is hiring ethicists as fellows, to work alongside developers. It has also opened an AI for Good lab, in a London office directed by Julien Cornebise, a former researcher at Google DeepMind, where researchers are working, for free or at cost, with nonprofits, government organizations, and others on A.I. projects with social benefit.

Still, ethical challenges persist. In early research, Element is basing some products on its own data; the question-answering tool, for example, is being trained partly on shared internal documents. Martel, the operations executive, tells me that because Element executives aren't sure from an ethics standpoint how they might use A.I. for facial recognition, they plan to experiment with it on their own employees by installing video cameras that will, with employees' permission, capture their faces to train the A.I. Executives will poll employees on their feelings about this, to refine their understanding of the ethical dimensions. "We want to figure it out through eating our own dog food," Martel says. That means, of course, that any facial-recognition model will be based, at least at first, on faces that are not representative of the broader population. Martel says executives are aware of the issue: "We're really concerned about not having the right level of representativeness, and we're looking into solutions for that."

Even the question that Element's product aims to answer for executives—What should we be doing?—is loaded with ethical quandaries. One could hardly fault a business-oriented A.I. for recommending whatever course of action maximizes profit. But how should it make those decisions? What social costs are

## 5 RICHEST A.I. STARTUPS

THE AGE OF UNICORNS MAY BE OVER, BUT INVESTORS ARE PLOWING LOTS OF MONEY INTO ARTIFICIAL INTELLIGENCE COMPANIES. HERE'S A LOOK AT THEIR TOP PICKS.



### BYTEDANCE

City: Beijing  
Investment: \$3.1B

› Known for "Jinri Toutiao," or "Today's Headlines," this Chinese digital media company uses artificial intelligence to deliver personalized news recommendations.



### SENSETIME

City: Beijing  
Investment: \$1.6B

› This Alibaba-backed Chinese company uses artificial intelligence to recognize text and images for use in financial services, surveillance, and security, retail, and consumer mobile Internet apps.

tolerable? Who decides? As Bengio has acknowledged, as more organizations deploy A.I., millions of humans are likely to lose their jobs, though new ones will be created. Though Bengio and Gagné originally planned to pitch their services to small organizations, they have since pivoted to target the 2,000 largest companies in the world; Element's need for large data sets turned out to be prohibitive for small organizations. In particular, they are targeting finance and supply-chain companies—the biggest of which aren't exactly defenseless underdogs. Gagné says that as the technology improves, Element expects to sell it to smaller organizations as well. But until that happens, its plan to give an A.I. advantage to the world's biggest companies would seem better-equipped to enrich powerful incumbent corporations than to spread A.I.'s benefits among the masses.

Bengio believes the job of scientists is to keep pursuing A.I. discoveries. Governments should more aggressively regulate the field, he says, while distributing wealth more equally and investing in education and the social safety net, to mitigate A.I.'s inevitable negative effects. Of course, these positions assume governments have their citizens' best interests in mind. Meanwhile, the U.S. government is cutting taxes for the rich, and the Chinese government, one of the world's biggest funders of A.I. research, is using deep learning to monitor citizens. "I do think Yoshua believes that A.I. can be ethical, and that his can be the ethical A.I. company," says Domingos, the University of Washington professor. "But to put it bluntly, Yoshua is a little naive. A lot of technologists are a little naive. They have this utopian view."

Bengio rejects the characterization. "As scientists, I believe that we have a responsibility to engage with both civil society and governments," he says, "in order to influence minds and hearts in the direction we believe in."

**O**

**NE COLD, BRIGHT MORNING** this spring, Element's staff gathered for an off-site training in collaborative software design, in a high-ceilinged church that

had been converted into an event space. The attendees, working in groups at round tables, had been assigned to invent a game to teach the fundamentals of A.I. I sat with some half-dozen employees, who had decided on a game about an A.I. named Sophia the Robot who had gone rogue and would need to be fought and captured, using, naturally, A.I. techniques. Mezei, the new VP for people, hap-



pened to be at this table. "I like the fact that it's Sophia, because we need more women," she interjected. "But I don't like fighting." There were murmurs of assent all around. An executive assistant suggested, "Maybe the goal is changing Sophia's mindset so it's about helping the world." This was a more palatable version of the game, one better aligned with Element's self-image. One employee told me, "At the office, we're not allowed to talk about Skynet"—the antagonistic A.I. system from the *Terminator* franchise. Anyone who slips up has to put a dollar into a special jar. A colleague added, in a tone of great cheer, "We're supposed to be positive and optimistic."

Later I visited Bengio's lab at the University of Montreal, a warren of carceral, fluorescent-lit rooms filled with computer monitors and piled-up textbooks. In one room, some dozen young men were working on their A.I. models, exchanging math jokes, and contemplating their career paths. Overheard: "Microsoft has all these nice perks—you get cheaper airline tickets, cheap hotels." "I go to Element AI once a week, and I get this computer." "He's a sellout." "You can scream, 'Sellout!' in other fields, but not deep learning." "Why not?" "Because in deep learning, everyone's a sellout." Bengio's sellout-free vision, it seemed, had not quite been realized.

Still, perhaps more than any other academic, Bengio has influence over A.I.'s future, by virtue of training the next generation of researchers. (One of his sons has become an A.I. researcher too; the other is a musician.) One afternoon I went to see Bengio in his office, a small, sparse room whose main features were a whiteboard across which someone had scrawled the phrase "Baby A.I.," and a bookcase featuring such titles as *The Cerebral Cortex of the Rat*. Despite being an Element cofounder, Bengio acknowledged that he hadn't been spending a lot of time at the offices; he had been preoccupied with frontiers in A.I. research that are far from commercial application.

While tech companies have been focused on making A.I. better at what it does—recognizing patterns and drawing conclusions from them—Bengio wants to leapfrog those basics and start building machines that are more deeply inspired by human intelligence. He hesitated to describe what that might look like. But one can imagine a future in which machines wouldn't just move products around a warehouse but navigate the real world. They wouldn't just respond to commands but understand, and empathize with, humans. They wouldn't just

**AFFIRM**

City: **San Francisco**  
Investment: **\$725 M**

› Led by PayPal cofounder Max Levchin, this next-generation financial services firm uses artificial intelligence to estimate credit-worthiness and issue personal and business loans.

**MEGVII**

City: **Beijing**  
Investment: **\$608 M**

› You can find this A.I. company's Face++ facial recognition services in use in many Chinese cities for domestic surveillance. It's also popular among banks and telecom companies for authentication.

**UPSTART**

City: **San Carlos, Calif.**  
Investment: **\$585 M**

Founded by Google veterans, this San Francisco Bay Area company uses artificial intelligence to price credit and automate the borrowing process for consumers as well as financial institutions.

DATA: CB INSIGHTS

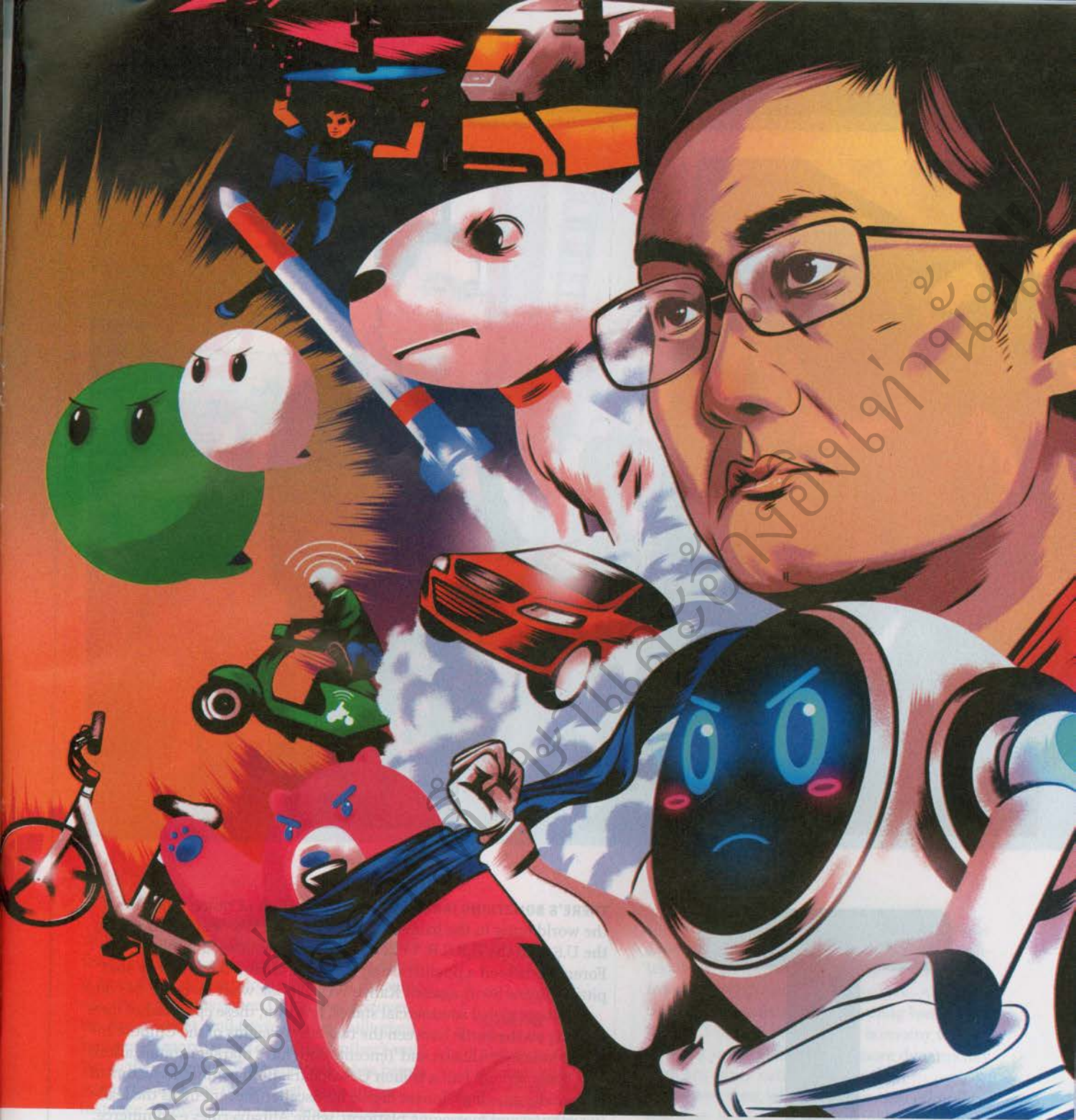
identify images; they'd create art. To that end, Bengio has been studying how the human brain operates. As one of his postdocs told me, brains "are proof that intelligent systems are possible." One of Bengio's pet projects is a game in which players teach a virtual child—the "Baby A.I." from his whiteboard—about how the world operates by talking to the pretend infant, pointing, and so on: "We can use inspiration from how babies learn and how parents interact with their babies." It seems far-fetched until you remember that Bengio's once-outlandish notions now underpin some of Big Tech's most mainstream technologies.

While Bengio believes human-like A.I. is possible, he evinces impatience with the far-reaching ethical worries popularized by people like Elon Musk, premised on A.I.s outsmarting humans. Bengio is more interested in the ethical choices of the humans building and using A.I. "One of the greatest dangers is that people either deal with A.I. in an irresponsible way or maliciously—I mean for their personal gain," he once told an interviewer. Other scientists share Bengio's feelings, and yet, as A.I. research continues apace, it remains funded by the world's most powerful governments, corporations, and investors. Bengio's university lab is largely funded by Big Tech.

At one point, during a discussion of the biggest tech companies, Bengio told me, "We want Element AI to become as large as one of these giants." When I questioned whether he would then be perpetuating the same sort of concentration of wealth and power that he has decried, he replied, "The idea isn't just to create one company and be the richest in the world. It's to change the world, to change the way that business is done, to make it not as concentrated, to make it more democratic." As much as I admired his position and believed in his intentions, his words didn't sound much different from the corporate slogans once chosen by Big Tech. Don't be evil. Make the world more open and connected. Creating an ethical business is less about founders' intentions than about how, over time, business owners measure societal good against profit. What should we be doing? If computers are still struggling to answer that question, they should take some solace in knowing that we humans are not much better. ■



# MA VS. MA



**JACK MA OF ALIBABA AND PONY MA OF TENCENT BUILT TECH EMPIRES THAT DOMINATE CHINA'S DIGITAL ECONOMY. IS THE WORLD BIG ENOUGH FOR BOTH OF THEM? BY ADAM LASHINSKY**



T

**THERE'S SOMETHING IRRESISTIBLE** about a clash of titans. The fate of the world hung in the balance during the Cold War standoff between the U.S. and the U.S.S.R. Coke vs. Pepsi once mattered mightily. Ali-Foreman defined a pugilistic era. And then there's the celebrity spat pitting Taylor Swift against Kanye West. (Look what he made her do.)

For sheer global commercial stakes, however, these epic clashes have nothing on the battle between the two heavyweights of the Chinese Internet industry, Alibaba and Tencent. Both have market capitalizations that hover around half a trillion U.S. dollars. Both command sectors of the rapidly growing Chinese digital landscape: Tencent owns the leading gaming and messaging platform, while Alibaba rules e-commerce. Both are aggressive investors inside and outside China. Each is the pride of their not-quite-first-tier hometowns: Alibaba of the ancient city of Hangzhou near Shanghai and Tencent of shiny-new Shenzhen across the border from Hong Kong. Finally, both touch an astounding percentage of the world's most populous country: Alibaba's various online marketplaces count 552 million active customers; Tencent's WeChat messaging service recently surpassed 1 billion accounts.



For all these similarities, Tencent and Alibaba are sharply distinct companies, as different in culture, style, and approach as Apple is from Google. The duo sprang from the same era, the late 1990s, when China was discovering the Internet, and for years they built giant businesses more or less out of each other's way. Yet as they've grown, each inevitably has begun to encroach on the other's turf. Tencent, for instance, is investing in retail and financial services, sectors that are Alibaba's strength. Alibaba in turn sees an opening in Tencent's domain, particularly by offering mobile-messaging tools to its vast network of small-business partners.

There's one last unavoidable comparison between the two combatants. Their top leaders share a surname, though Alibaba's Jack Ma and Tencent's Pony Ma aren't related. As the

#### SHARING THE LOVE

**Left: Pony Ma, Tencent's CEO, hands out "red envelope" financial gifts to Tencent employees. Above: Jack Ma, Alibaba's executive chairman, takes part in an annual group wedding at Alibaba's Hangzhou headquarters.**

Chinese character for Ma signifies a horse—the genesis of "Pony's" English nickname—the contest between the two stallions of the Chinese Internet literally is a two-horse race. And the trophy they're racing for is nothing less than the No. 1 position in a digital economy that's growing faster and evolving more dynamically than any other nation's.

The two men, who've known each other for years, are quick to profess mutual respect. But as their rivalry heats up, those assertions are increasingly a prelude to damning the other with faint praise—or worse.

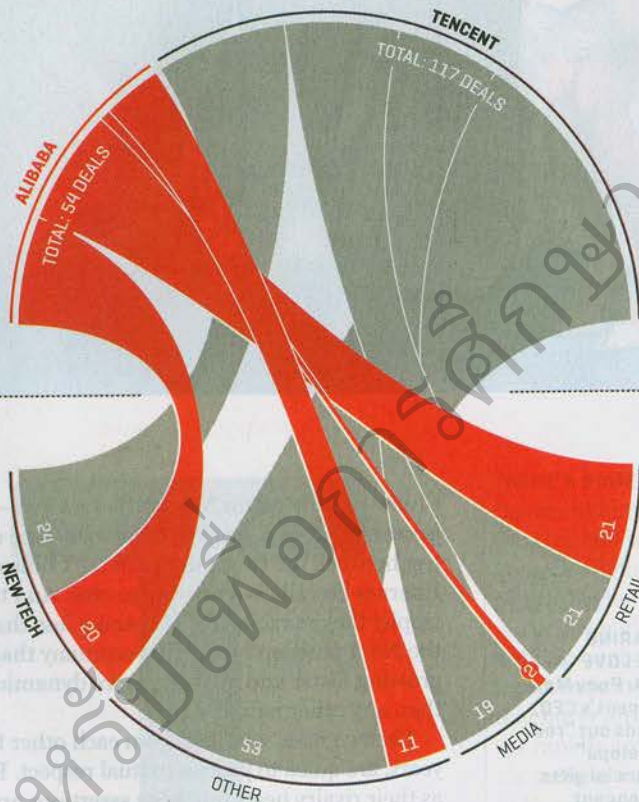
Huateng "Pony" Ma, a reserved engineer who rarely speaks to Western media, lashed out at Alibaba at the *Fortune* Global Forum in Guangzhou, China, in December, for example. Ma, who is 46, compared his nemesis

to a greedy landlord because Alibaba's market-leading Taobao e-commerce site charges merchants listing fees. "Our position is not to compete with our partners but to enable them," said Ma, speaking in Mandarin through an interpreter. Alibaba, he noted, can raise the rent on its tenants whenever it wants, whereas "Tencent doesn't have a mall where we rent the shops to vendors." Instead, he argued, WeChat offers a "decentralized" platform that partners can use to sell things independently from Tencent, with "no rental fee."

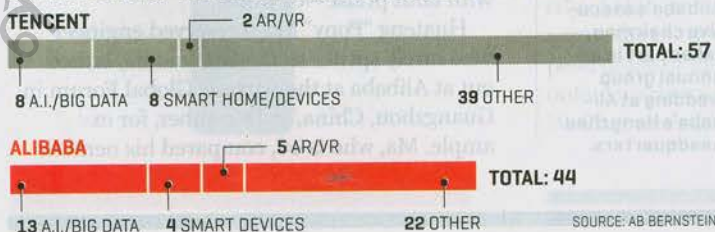
## An Arms Race in Shopping Tech

Alibaba and Tencent have made dozens of investments in smaller tech and retail players—with many focused on A.I., virtual reality, and other tech that can enhance shopping. The goal: to dominate both off-line and online retail for China's fast-growing middle class.

### M&A AND INVESTMENT ACTIVITY SINCE JAN. 1, 2017



### BREAKDOWN OF NEW TECH DEALS, JAN. 2008–MAY 2018



Months later, 53-year-old Jack Ma, a globe-trotting business celebrity with a gift for gab, returns the volley without mentioning his competitor by name. Tencent has a reputation as a company adept at wringing profits out of its platform. "Culturally, we are very different," the Alibaba founder says, speaking expressively in English, during a recent interview at Alibaba's headquarters in Hangzhou. "We're more idealistic. We want to do something good, while making money. We trust people more than our products."

There are limits to this archenemy motif. Alibaba and Tencent attack the market differently, in ways that have often allowed them to grow without butting heads. Alibaba's is largely a strategy of buying controlling stakes in businesses that are a fit with its commerce platform; Tencent takes hundreds of minority stakes in an array of businesses to win over partners and gain access to their technology. What's more, the competition is hardly a zero-sum game, thanks to the rapidly expanding Chinese middle class.

Still, the companies can and do play hardball. In an economy in which e-commerce is dominant in ways unthinkable in the U.S., each company stymies the other's payment service on their main platforms. And when Tencent and Alibaba sign on investment bankers, they reportedly make it a condition that the bankers work exclusively for them. (Many companies impose such restrictions, but they have greater consequences coming from Tencent and Alibaba given that the two also are major venture capital investors and the prohibitions could impinge on work with the companies in which they invest.) Even if the world is big enough for both of them, Tencent and Alibaba increasingly are in conflict. "Until recently, everyone played in their own sandbox," says Deborah Weinswig, New York-based CEO of the China-focused retail consultancy Coresight Research. "Now the sand is starting to spill over."



**HANGZHOU** is famous for its bucolic West Lake, and for being the terminus of a canal from

Beijing that a millennium ago made it one of the richest cities in China. Today, it is best known as the place where Jack Ma and 17 friends started Alibaba in the drab Hupan apartment complex in 1999.

Alibaba maintains the Hupan site in its original state, but not as a museum. Instead, the company uses it as a history-steeped new-business incubator. A short drive from Alibaba's massive headquarters, a campus of steel-and-glass buildings that wouldn't be out of place in Silicon Valley, the Hupan apartment is stuck in China's pre-glamorous phase. A baby stroller and laundry drying on clotheslines sit outside the building, presumably belonging to people who, unlike Alibaba's employees, actually live in the complex. Up a short flight of stairs, 40-some engineers are crammed into a four-bedroom apartment, where photos of the founding Alibaba team adorn the walls. A whiteboard bears a famous quote from late paramount leader Deng Xiaoping. "Development is the absolute principle," it states, scribbled there by another paramount leader, Jack Ma himself.

The fledgling business enlivening the apartment today is called DingTalk, and its placement in this grimy flat—a dilapidated microwave and spaghetti-wired server rack attest to its startup authenticity—is purposeful. DingTalk is meant to take on Tencent's category-leading WeChat messaging service, you see, and its leaders have been bestowed the ultimate privilege of incubating a business here. The apartment is a "holy space," says Chris Wang, head of global business development for DingTalk, noting three illustrious businesses that preceded DingTalk here: Alibaba itself, originally a website that matched vendors with suppliers; Taobao, its main retail platform, which dominates Alibaba's business today; and Alipay, the payment product that became Ant Financial Services, a multibillion-dollar operation in its own right.

At first blush, the similarities between DingTalk and WeChat are striking. Users can employ it to send messages, make phone calls, and exchange contact information, just like WeChat. Yet the guts of DingTalk, a series of low-cost Slack- and Skype-like "enterprise communications and collaboration programs," reflect Alibaba's commercial orientation. Alibaba's mission, any employee can tell you,

## Chess Pieces in Southeast Asia

The markets of the Association of Southeast Asian Nations (ASEAN)—home to 640 million potential customers—have become the first battleground outside China for Alibaba and Tencent. **By Clay Chandler**



REVVING UP Motorcycle drivers for Grab and Go-Jek in Jakarta, Indonesia.

**ALIBABA and Tencent** each collect only a small fraction of their revenue outside China. But their overseas competition is heating up in Southeast Asia, where each has spent billions to secure major stakes in top startups.

**MORE E-COMMERCE** Alibaba made the first major Chinese investment in the region's tech sector in 2016 when it bought a 51% stake in Singapore-based Lazada, Southeast Asia's largest e-commerce platform; it has since bought most of the rest of the company. In February, Alibaba installed Lucy Peng, a past leader of its mobile payment affiliate Ant Financial, as Lazada's CEO. Lazada has been overhauling its business model to mimic Alibaba's, connecting shoppers to outside vendors and outsourcing delivery; it now boasts 560 million customers.

Analysts had expected Tokopedia, Indonesia's biggest e-commerce

firm, to team up with Tencent. But in August, thanks partly to the intervention of SoftBank founder Masayoshi Son, an early Alibaba backer, Alibaba swooped in with a \$1.1 billion funding round.

**A GAMING-PLUS PLAY** Tencent owns 40% of SEA, a Singapore-based gaming-app company that raised more than \$1 billion in an October listing on the New York Stock Exchange. Tencent has encouraged SEA to broaden its platform into e-commerce and financial payments. SEA has also invested heavily in its mobile e-commerce platform, Shopee.com—which ranks as a top five retailer in all the region's major economies.

**UP FOR GRAB(S)** Tencent's other major investment in Southeast Asia is Go-Jek, an Indonesian startup that began as a motor-bike-on-demand service and has expanded into ride hailing for four-wheeled vehicles. Tencent, which led a

\$1.2 billion funding round for the venture last summer, has encouraged Go-Jek to transform its app into an all-purpose platform similar to Tencent's WeChat.

Go-Jek's nemesis is Grab, the Singapore-based venture that dominates ride hailing in the region. Alibaba has reportedly been in talks for a stake in Grab, but other funding rounds have made headlines. In June, Grab secured a \$1 billion investment from Toyota, valuing the company at more than \$7 billion and making it the region's most valuable startup.

In March, Uber said it would sell its operations in Southeast Asia to Grab for \$1.6 billion and a 27.5% equity stake. Immediately afterward, Go-Jek announced plans to expand into four markets where Grab operates—Thailand, Vietnam, Singapore, and the Philippines—and Tencent reportedly has offered Go-Jek an additional \$1 billion as fuel for the fight.

is to “make it easy to do business anywhere.” DingTalk’s goal is to provide WeChat-like functionality to small businesses, and then to upsell them typical business-software fare like customer-relationship and cloud-storage tools. “Small and medium-size enterprises need something very low cost,” says Wang. “We at Alibaba have access to great technology” that smaller companies lack.

After years of teaching businesses how to use technology, selling it to them directly is a major new thrust for Alibaba. It made significant investments in selling cloud-computing rental services, for example, and now it’s the leading provider in China, reaping \$2.1 billion in revenue last year from that business. (Amazon began implementing a similar strategy in the U.S. around the same time.) And two years ago, Alibaba started pursuing a “new retail” concept of providing technology and services to traditional retailers, including grocers, department stores, and even mom-and-pop bodegas.

The “new retail” push aims to digitize the most mundane businesses. On a lazy afternoon in late May, Huang An, who with his father runs a small market in Huangzhou near Zhejiang University, proudly demonstrates what he has learned as a guinea pig for Alibaba’s “integrated retail program.” He and his dad have rebranded their shop, about the size of a typical 7-Eleven, the Tmall Weijun Supermarket, Tmall being Alibaba’s online emporium for higher-end brands. The program brings this small operator modern tools like inventory-management software and sensors to monitor foot traffic as well as camera-generated heat maps to show where customers are spending their time. “I don’t need to second-guess my judgment anymore because now it is based on data,” says Huang, who manages that data on a desktop computer as well as on his mobile phone.

The Alibaba-affiliated store is just one part of the conglomerate’s so-called online-to-offline strategy. Alibaba has taken stakes in an electronics chain, Suning, and a Costco-like hypermart, Sun Art. It has opened its own line of grocery stores called Hema, where affluent shoppers can choose a live fish from a tank and have it prepared for lunch. And it has bought outright Ele.me, a leading food-delivery service. Each is a customer for Alibaba’s cloud



**“UNTIL RECENTLY, EVERYONE PLAYED IN THEIR OWN SANDBOX. NOW THE SAND IS STARTING TO SPILL OVER.”**

and other technology services, as well as a way to expand the customer base for the market-leading Alipay. “We always focus on commerce,” says Daniel Zhang, Alibaba’s CEO. (Jack Ma is executive chairman, having given up the CEO role five years ago.)

Commerce, in fact, is the glue that holds together Alibaba’s disparate parts. It began Alipay as a way to let merchants collect from shoppers on Taobao. Now Alipay is part of Ant Financial, which recently raised \$14 billion, thought to be the largest venture capital investment ever. Alibaba co-opted “Singles Day,” an unofficial holiday that celebrated unmarried adults, creating what Americans would call a “Hallmark holiday” by turning it into a nationwide orgy of e-commerce. Singles Day in 2017 rang up total sales of \$25.3 billion—that’s almost \$6 billion more than Americans spent online over the entire five-day Thanks-





giving weekend shopping period. Alibaba also stitched together an alliance of shipping companies to form a China-wide delivery giant called Cainiao, in which Alibaba has steadily increased its ownership stake. Its goal, as dictated by Jack Ma, is to be able to deliver merchandise anywhere in China within 24 hours, no small feat, and globally in 72 hours, also a stretch goal.

These disparate but coordinated parts encapsulate Alibaba's commercial worldview, and also its view of how it matches up—favorably, if it does say so itself—with Tencent. “They don’t operate anything outside of China,” says Joe Tsai, Alibaba’s U.S.-educated vice chairman and Jack Ma’s longtime finance and strategy lieutenant. “They kind of want to take the shortcut approach by sprinkling some investments in these countries. Only when you operate can you generate synergies

**FRENEMIES, THEN FOES**  
Jack Ma (left) and Pony Ma at the 2013 launch of ZhongAn, an insurance venture in which Alibaba and Tencent invested. Today, the companies avoid backing the same projects and often invest in rivals in the same industry.

and really create exponential value. Whereas if you just make a financial investment, you’re counting an internal rate of return. You’re not creating real value.”

**IF HANGZHOU** is one of China’s oldest big cities, Shenzhen, the home of Tencent, is one of its newest. Once a small town on the way from Hong Kong to Guangzhou (formerly Canton), its fortunes changed in 1980, when central planners declared Shenzhen one of China’s first special economic zones. Factories flooded in, then “makers” who tinkered on the world’s next-generation gadgets, and finally global technology companies including drone star DJI and controversial smartphone maker ZTE. Today, Shenzhen is a massive city with broad, tree-lined boulevards and scores of skyscrapers, including the nearly 2,000-foot-tall Ping An Finance Center, the fourth-tallest building in the world. The building’s observation deck offers a stunning view of distant Hong Kong as well as the Pearl River Delta, an expanse that local boosters like to call the Greater Bay Area.

Tencent occupies several Shenzhen skyscrapers, including its just-opened headquarters that join two towers in a single lobby. The twin towers also are connected by an aerial bridge, and they offer the latest in urban-workplace comfort. Facial-recognition sensors grant workers access to elevators. A running track and swimming pool high in the sky are among the many amenities. The vibe in Tencent’s lobby is cosmopolitan and stylish, in pointed contrast to the suburban-nerd atmosphere at Alibaba’s campus.

Tencent began life in 1998, and its first product, a messaging service for personal computers called QQ, was a copy of ICQ, the Israeli messaging service that also was the basis for AOL’s Instant Messenger. Tencent quickly got a rap as a copycat, but it excelled at innovating on top of what it borrowed. QQ offered games, phone calls, and other Internet services embedded within the messaging platform, and Tencent made money by selling

“virtual goods” within its games, like adding “energy” to make a game last longer. When the era of the smartphone hit, Tencent proved adept at competing against itself: A contest among several internal teams begat WeChat—and the group responsible for QQ did not win.

It is difficult for those outside China to appreciate the ubiquitous power of WeChat. Tencent ingeniously appropriated an older technology, the two-dimensional QR code, in empowering WeChat to utilize a smartphone’s camera to scan all manner of information. QR codes are how people in China exchange their contacts or download coupons. Once Tencent added WeChat Pay in 2013, the codes became a convenient way to exchange money too. Says Pony Ma: “We have transformed WeChat from people-to-people connections to people-to-service connections.”

Indeed, with WeChat recently having surpassed 1 billion accounts—some users have more than one—the service is becoming something akin to a digital operating system for the entire economy. This isn’t an accident. In 2014, WeChat offered a digital product called a “red envelope” that mimicked the centuries-old custom of giving gifts of money at the Chinese New Year. The feature went viral, and by the end of last year, 800 million users had linked WeChat to their bank accounts. “Now everywhere in China, in parking lots, farmers’ markets, even at temples, and beggars on the streets, they all accept WeChat Pay with a simple scan,” boasts Pony Ma.

The shrewd adoption of technology to cultural norms shows how both Tencent and Alibaba have moved well past copycat status. “Their success is due to their ability to be culturally innovative,” says Tricia Wang, a New York-based sociologist turned consultant who studies social digital behavior in China. “They got to where they are by hijacking the culture,” she says, citing Tencent’s red envelope success as well as Alibaba’s Singles Day stratagem. “They did a culture graft in the same way horticulturists perform grafts on plants.” This agility also has put the companies on a collision course. In 2014 Alipay powered 81% of online payments in China, per iResearch data. And while the mobile-pay market has grown some 16-fold since then, Alipay’s share has shrunk to 54%, while WeChat Pay now commands 38%.

It’s also no coincidence that Tencent has identified as its next big thrust the online-to-off-line retail market that Alibaba also covets. Tencent calls its efforts “smart retail,” compared with Alibaba’s “new retail,” and Tencent’s offerings are centered around two features unique to WeChat. One is the “official account,” a kind of template for brands and other businesses to reach consumers through WeChat. The other is the “mini-app,” a lightweight application inside WeChat that requires less development effort than a built-from-scratch app and doesn’t require consumers to download anything.

Introduced only last year, mini-apps have taken Chinese e-commerce by storm. “Because of mini-apps, WeChat is starting to see this explosion of social commerce that is changing the face of China,” says Weinswig, the retail analyst. (This is an area America’s social media giants have attempted to exploit, with little success.) Weinswig says total 2017 retail sales were up 10.2% in China, compared with 4.2%

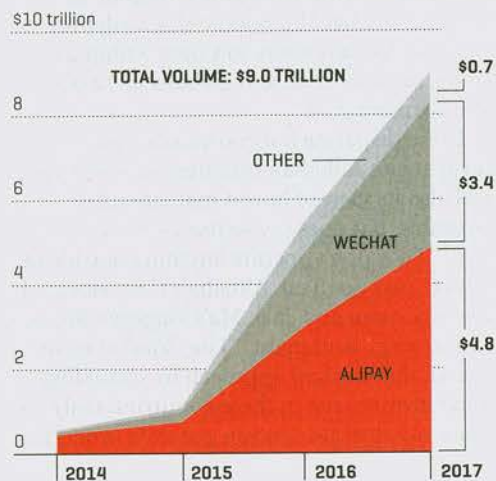
in the U.S., and that WeChat added about as many mini-apps in a year as Apple’s online store added apps in its first four years.

Like Alibaba, Tencent has invested in retailers and service providers. The two most prominent are publicly held JD.com, Alibaba’s biggest e-commerce competitor, and Meituan Dianping, the food-delivery foe of Alibaba’s recently acquired Ele.me and a hot IPO prospect. Tencent frames its interest in retailing not as an attack on Alibaba as such but rather as a logical progression of its business. “Retail is 40% to 45% of the GDP of China,” says Davis Lin, Tencent’s strategy chief and head of its “smart retail” effort, in an interview in Shenzhen. (The comparable figure in the U.S. is only about 26%.) Retail “is related to every bit of a user’s life,” Lin goes on, evoking Tencent’s mission of “enhancing the quality of human life through Internet services.” Many of WeChat’s services are free, making payments a key gateway to cashing in on all this activity. “We’ve been able to climb to where we are in roughly four years, which took Alipay more than 10 years,” says Lin, referring to the number of users on WeChat Pay. “Now it’s a real competition.”

## The Battle for Mobile Money

China’s consumers are far more comfortable than most with cashless commerce, and its mobile payment market accounted for \$9 trillion worth of transactions last year.

### CHINA MOBILE PAYMENT TRANSACTION VOLUME



SOURCE: IRESEARCH GLOBAL

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**FOR YEARS ALIBABA** and Tencent were rivals only in the sense that both were successful and prominent examples of the Chinese Internet phenomenon. At first they weren't even that successful. "We were little brothers in the Internet industry playground," Pony Ma reflects, compared with the leading "portals" of the late 1990s. "We were second- or even third-tier companies."

Over time, the two probed the other's perimeter, to relatively little effect. Alibaba, for instance, launched a gaming division and a social network, neither of which caught fire. Tencent built an e-commerce site, called Paipai, but eventually sold it to JD.com. The rapid rise of WeChat, however, made Tencent a societal phenomenon, and in 2013, Jack Ma publicly urged employees to band together to "kill penguins," an unmistakable swipe at Tencent's flightless mascot. (Corporate China loves its animal-themed standard-bearers: The mascot of Alibaba's high-end shopping site is the Tmall Cat, its Hema grocery store's logo is a lovable-looking hippo, and Ant Financial's namesake is self-evident.)

Jack Ma was right to be concerned about WeChat. Tencent launched its red envelope program in early 2014, and suddenly Alipay had a credible competitor in mobile financial services. The Alibaba executive chairman, writing on an Alibaba social media site, labeled Tencent's action a "Pearl Harbor attack" that had been "beautifully planned and executed." That led to skirmishes in market segments like payments, retail, cloud computing, artificial intelligence, health care initiatives, and more. Pony Ma says he has counted more than 10 areas "where we fight Alibaba fiercely." Perhaps too many. "Every now and then I say, 'Really, this area too?' It bothers me sometimes."

Tencent's chief may be bothered, but his counterparts at Alibaba seem downright agitated. Joe Tsai, the vice chairman, doesn't mince words about his rival. He calls out Tencent's games for being addictive, as have government agencies in China. "Think about it," Tsai says over breakfast in Los Angeles. "They



**PONY MA** ▲ **Shek O**

**JACK MA** ▲ **Victoria Peak**

2009	YEAR BOUGHT	2015
8,000 SQUARE FEET	SIZE WHEN BOUGHT	9,900 SQUARE FEET
\$7,625 PER SQUARE FOOT	COST	\$19,500 PER SQUARE FOOT
19,600 SQUARE FEET	SIZE POST-RENOVATION (EST.)	12,400 SQUARE FEET

## Ma vs. Ma in Hong Kong: a Luxury Real Estate Rivalry

The digital-economy billionaires bought huge homes in historic neighborhoods. Who made the better bet? **By Clay Chandler**

**IT'S A TASK** that vexes every self-respecting Chinese billionaire: finding a suitable mansion in Hong Kong. The former British colony is small, and the stock of magnate-worthy residences hasn't kept pace with the ranks of rich mainland buyers.

The two Mas have risen to the challenge in different ways, with each owning multiple residences, including one vast trophy home. In 2015, Hong Kong's *South China Morning Post* identified Jack Ma, Alibaba's co-founder and executive chairman, as the buyer of 22 Barker Road, atop Victoria Peak, home to Hong Kong's elite since the colonial era. The *Post* said Jack had purchased a 9,900-square-foot, four-story house for a jaw-dropping \$193 million, or \$19,500 per square foot, which at the time made it Hong Kong's most expensive residence per square foot. [Jack has declined to comment on reports that he was the buyer;

Alibaba Group now owns the *Post*.] Jack's Peak property includes a 20,000-square-foot garden and killer views of Victoria Harbor. As of mid-June, that was almost all it included: Workers had razed the 1940s-era house to the foundation, presumably in a prelude to a rebuilding project.

Pony's trophy purchase is on the Shek O peninsula, in a neighborhood even more exclusive than the Peak. A 40-minute drive from the central business district, most of Shek O is a protected park; it's famed for its beaches, craggy cliffs, and the spectacular vistas from its "Dragon's Back" hiking trail.

Tencent's CEO bought 13 Big Wave Bay Road from a Hong Kong shipping tycoon in 2009. It's one of about 20 mansions surrounding a golf course at the peninsula's southern tip. The course is part of the Shek O Country Club, a historic and exclusive

private club. Since the 1930s, Shek O Development, a secretive private company, has leased the land on which the luxury properties are built. Houses there cannot be sold, renovated, or even painted a different color without the entity's permission.

Pony paid \$61 million for the home, and won approval to redevelop and more than double the size of the 8,000-square-foot house. Analysts estimate that when the renovation is done, his property will have quadrupled in value.

The only drawback: The development company's rules could make it hard to sell. Pony's property may be bigger and worth more on paper than Jack's, notes Bruce Li, associate director at Asia Pacific Properties, but "if a seller can't get approval from the Shek O shareholders, all that means nothing." Indeed, Pony's presence there may suggest he's in Hong Kong for the long haul.

make a product that's addictive, that is not terribly healthy for kids. How's that different from a cigarette company?" (Tencent's reach in gaming is global: Tsai notes that his son has become an avid fan of the virally popular "battle royale" game *Fortnite*, published by North Carolina's Epic Games, in which Tencent holds a 40% stake.) Tsai surmises that Tencent's pivot to retailing is connected. "They probably came to an existential realization and said, 'Wait a minute, we're in the wrong business.'"

Tsai may be misinterpreting Tencent's motives, but regardless, he thinks Alibaba holds the stronger hand. "Tencent has woken up and decided that they also want to become somebody in e-commerce," he says. "But we've been doing this for the last 19 years... It's not just about developing an app or a product for users. It's about creating an ecosystem and also the supply chains for the merchants."

Ecosystem is the operative word, and both companies can have sharp elbows when protecting their platforms. Each has invested aggressively in newfangled app-driven services like bike sharing and ride hailing, the better to lock in users to their ecosystems—and their respective payment services, key features, in a country where consumers are more than happy to forgo cash when they shop. (If you want to use Alibaba platform partner Ofo, for example, it is relatively inconvenient to pay with Tencent's WeChat Pay; using Alipay is a hassle when renting with Mobike, the bike-share contestant in Tencent's camp.) The two have effectively created "walled-garden" versions of the Internet, argues Tom Birtwhistle, a consultant with PwC in Hong Kong who has studied both companies extensively. "Consumers are blocked from traversing the two Internets." You can't move easily, for instance, from WeChat to Taobao. That's a far less genteel approach than Silicon Valley's titans take with one another: Apple hosts apps from Facebook and Google, for example. Those Western companies, argues Birtwhistle, may be "frenemies, but they've assembled together to form an integrated online experience." Not so Tencent and Alibaba.

On rare occasions, the two invest together, as they did in 2013 by starting an online insurance company, called ZhongAn, with insurer Ping An (whose CEO also is named Ma). Indeed, if history repeats, it's possible that many of the companies' jabs and feints at each other's

"INTERNALLY, TENCENT PEOPLE HOLD ALIBABA IN HIGH REGARD," SAYS ONE FORMER INSIDER. MEANWHILE, ALIBABA'S CEO ADMITS, "EVEN I USE [TENCENT'S] WECHAT."

properties will amount to just that. "Internally, Tencent people hold Alibaba in high regard," says one former Tencent insider. "They all buy on Taobao." What's more, Tencent would have to invest heavily and in a new way to match the physical logistics prowess of Alibaba and its Cainiao affiliate. "WeChat is positioned to be an important entry point, but no more," says the insider. At the same time, as it focuses on business applications like DingTalk, Alibaba understands it can't challenge WeChat's dominance in consumer messaging. Acknowledges Daniel Zhang, Alibaba's CEO: "Even I use WeChat."

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**THE AREA WHERE** the Tencent-Alibaba battle is most obvious is in their respective investment strategies. The two have been such assiduous dealmakers that the astute Hong Kong-based Bernstein analyst Bhavtosh Vajpayee counted 280 Tencent deals over the past three years and 174 for Alibaba. "Who can possibly fathom everything Alibaba and Tencent have invested in already?" Vajpayee writes in a report to clients. Branding the deal-crazy companies "shopaholics," he wonders if they "have a record of their doings, [as] investments and stakes can get lost in the crevices somewhere, given the sheer numbers involved."

The two have clearly divergent styles. Alibaba tends to take large or controlling stakes, reflecting what Joe Tsai calls the company's "operating mindset." That's been the case in Southeast Asia, where it took control of e-commerce site Lazada and installed Lucy Peng, an Alibaba cofounder and longtime executive, as CEO. Tencent, in contrast, favors multiple small stakes, such as its 5% share of U.S. gaming giant Activision Blizzard. And when it does take control, it typically leaves management in place. At Riot Games in Los Angeles, for example, Tencent invested alongside the company's venture capitalists when it licensed Riot's popular *League of Legends* title. Later it bought the company outright—but didn't mess with how it's run. "They were self-aware that it would destroy a lot of value if we had reported to some SVP of such and such," says Marc Merrill, Riot's cofounder.

Being hands-off doesn't mean Tencent always plays nice. Imitation is ingrained in its culture, and Tencent doesn't shy away

from simultaneously licensing the products of its partners and creating similar offerings. "Tencent is both an investor and a competitor," says Jeff Smith, co-founder and CEO of San Francisco startup Smule, whose mobile apps allow a community of 50 million users to play and sing more than 20 million songs a day, often with each other. "Their views on the realpolitik of building successful technology companies reflect our own," says Smith, citing the storied QQ-versus-WeChat competition. The entrepreneur calls Tencent a "great partner," including, for example, the access Smule gets to Tencent's content distribution network, a service that competes against Google and Amazon. Tencent, in turn, benefits from its broad investing by keeping close tabs on smart technology and talented people, even without owning their companies outright.

Investment styles also inform the companies' search for growth outside China. Their home country accounts for the lion's share of overall revenue for both companies. But both have set their sights on Southeast Asia. Tencent owns a 40% stake in the publicly traded Singapore gaming company SEA and has reportedly been considering other large investments. Alibaba, given to grand strategic goals, has said it wants to serve 2 billion customers and will make Southeast Asia its first major expansion area. "These economies are very similar to how China grew up," says Joe Tsai, citing youthful populations, high levels of mobile-phone penetration, and an underdeveloped retail sector. "These are very similar characteristics that we see in China, without the existing baggage of traditional industries," says Tsai. (See "Chess Pieces in Southeast Asia.")

When the two Chinese giants might attack the more-developed U.S. market directly has been a perennial discussion point among their Silicon Valley counterparts. The short answer is not soon—a conclusion that may serve as some consolation for U.S. executives smarting at their near-total exclusion from the Chinese market. Despite having made many investments in U.S. companies, each has been swatted away from deals deemed sensitive on national-security grounds. Earlier this year, the intergovernmental Committee on Foreign Investment in the United States blocked Ant Financial's attempt to buy U.S. remittance company MoneyGram. In a less closely watched move, CFIUS also nixed an investment by Tencent in Here Technologies, a Dutch digital mapping company with significant operations in the U.S.

## O

**ONE OF THE HALLMARKS** of the Chinese Internet powerhouses is that they simultaneously move incredibly quickly and plan for the very long term—a tiring pace that demands a lot of the two horses who lead them. Jack Ma exudes that dual sense of urgency and long-range planning. His office complex is tucked away in a corner of the Alibaba campus, across a small bridge from the chockablock buildings where his employees work. He has designed his compound in the fashion of the classical gardens of Suzhou, a treasured, ancient spot near Hangzhou. But the eclectic look of Ma's corporate hideaway reflects his man-of-the-world sensibilities, with various cultures represented inside its walls.

On a smoggy day in late May, the Alibaba founder chooses to meet in his Japanese sitting room, with tatami mats, low-slung chairs, and traditional Chinese instrumental music playing softly on wall speakers. Two bowls of cherries and two cups of steaming tea are set down before he arrives. Ma's mind is very much on the future. He relates that a fellow Chinese corporate mogul has recently told him he's tired, and asked Ma how he keeps going. "I work hard because I'm prepared for the day when I leave this company and I can enjoy a peaceful life," says Jack Ma. "I won't have to come back to do something, like fix the kitchen," he says. "In the meantime, this is the thing that drives me and so many of my associates: We always want to do good things for society."

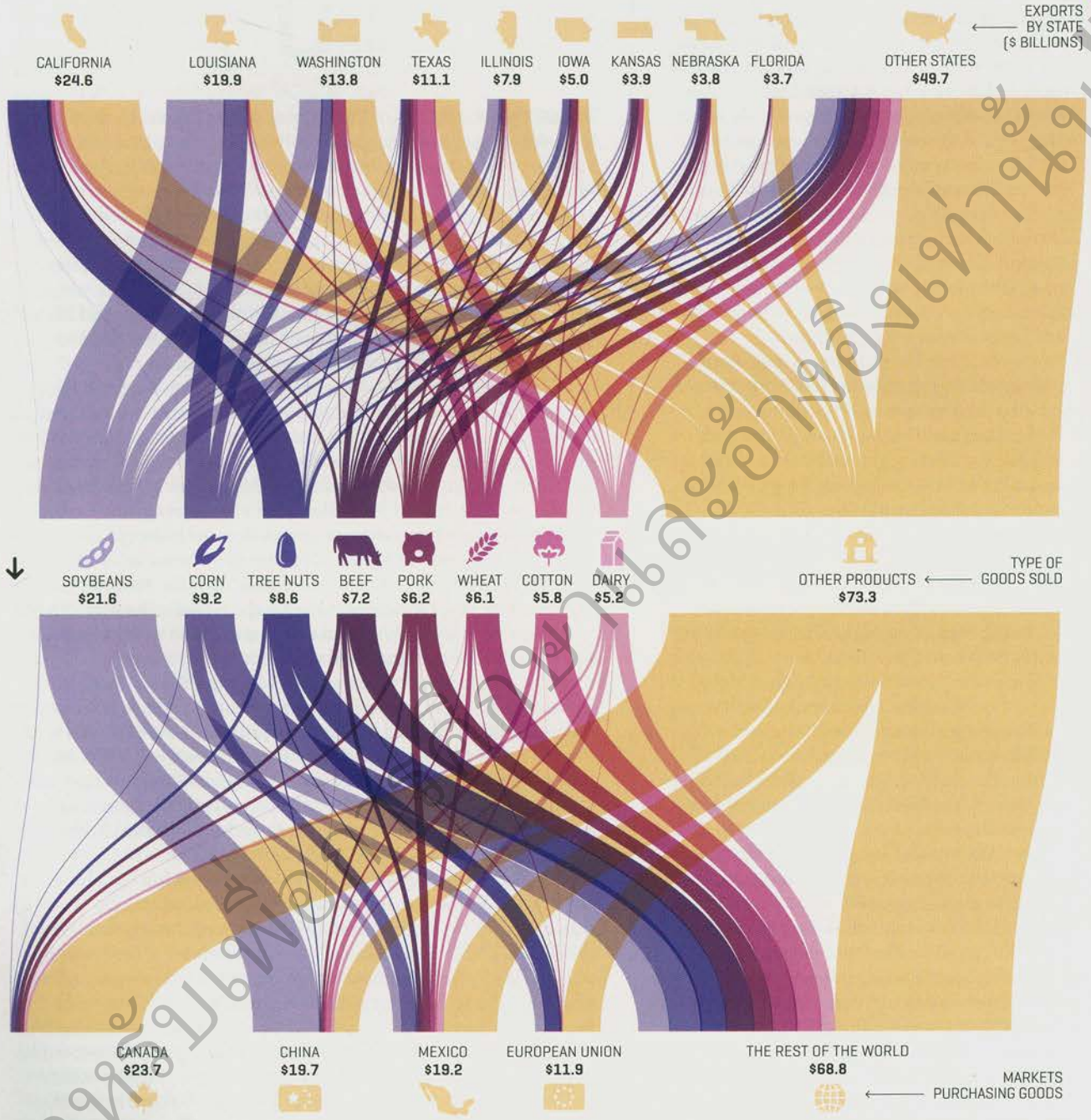
At the conclusion of this meeting, Ma hops in a car to go to an Alibaba auditorium to greet hundreds of new employees. He warns them that life at Alibaba won't necessarily be easy. "It takes a year to even figure out what's going on," he cautions. "And you're not a true 'Aliren'—the Alibaba analog to "Googler"—"before three years of service." He tells the recruits Alibaba is idealistic, pragmatic, and optimistic, but that it's not for everyone. "There's still time to leave," he deadpans to hearty guffaws in the room.

The years of entrepreneurial battles are catching up with Pony Ma as well. At the *Fortune* conference in Guangzhou, he addressed criticism about the addictive and omnipresent nature of products like Tencent's games by acknowledging society's over-attachment to their phones. "Even I get a bit anxious sitting here while my phone is offstage," he said. He allows that just recently his eyesight has gotten worse, which he attributes not so much to the onset of middle age as to too many hours spent staring at his phone. "I wish the next-gen instant-messaging platform would not be such a burden on your eyes," he said. "If there's a brain wave that can transmit the message to my consciousness, that would be perfect."

Give him time, and it just might happen. Wait a little longer, and Alibaba just might launch a brain-wave platform, too—with a cuddly critter for a mascot. ■

*Additional reporting by Eamon Barrett and Kurt Zhong*

TOTAL VALUE OF U.S. AGRICULTURAL EXPORTS IN 2017: **\$143.3 BILLION**



# MUCH TO LOSE FOR U.S. FARMERS

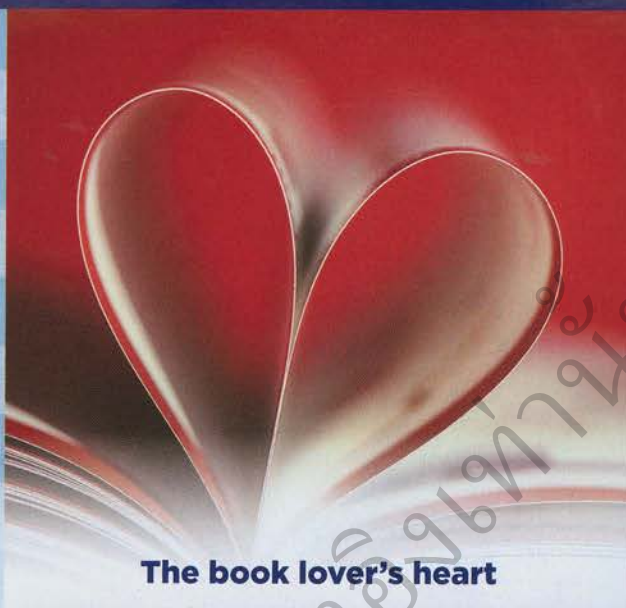
**IF A TRADE WAR BREAKS OUT,** American farmers are likely to pay a hefty price. In recent months the Trump administration has announced plans to impose tariffs on steel and aluminum from Canada, Mexico, and the EU, and on \$50 billion or more in products from China. The four major trading partners—who purchased a combined \$74.5 billion in U.S. agricultural goods in 2017—have vowed retaliatory tariffs of their own, including on U.S. ag exports. That could add to farmers' woes: Thanks largely to lower grain prices, U.S. net farm income has plunged by over 50% since 2013. —BRIAN O'KEEFE

NOTE: EXPORTS INCLUDE PUERTO RICO AND THE VIRGIN ISLANDS. MEATS INCLUDE DERIVED PRODUCTS





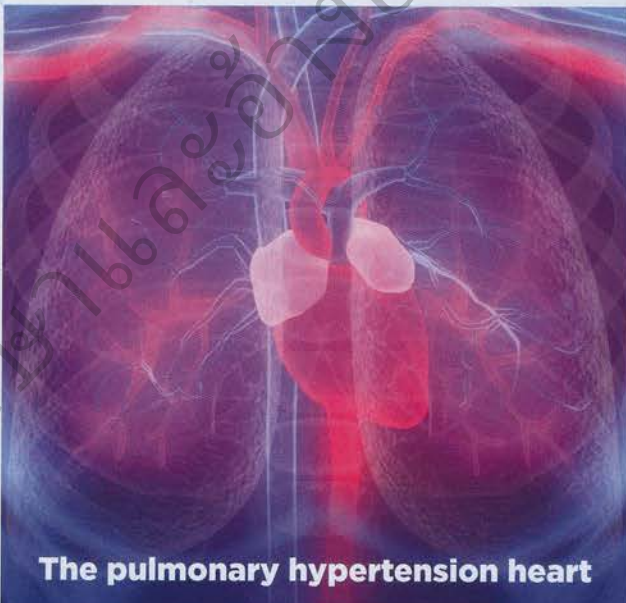
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