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ALSO

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AI ENTERS THE CLASSROOM

GOOD LORD

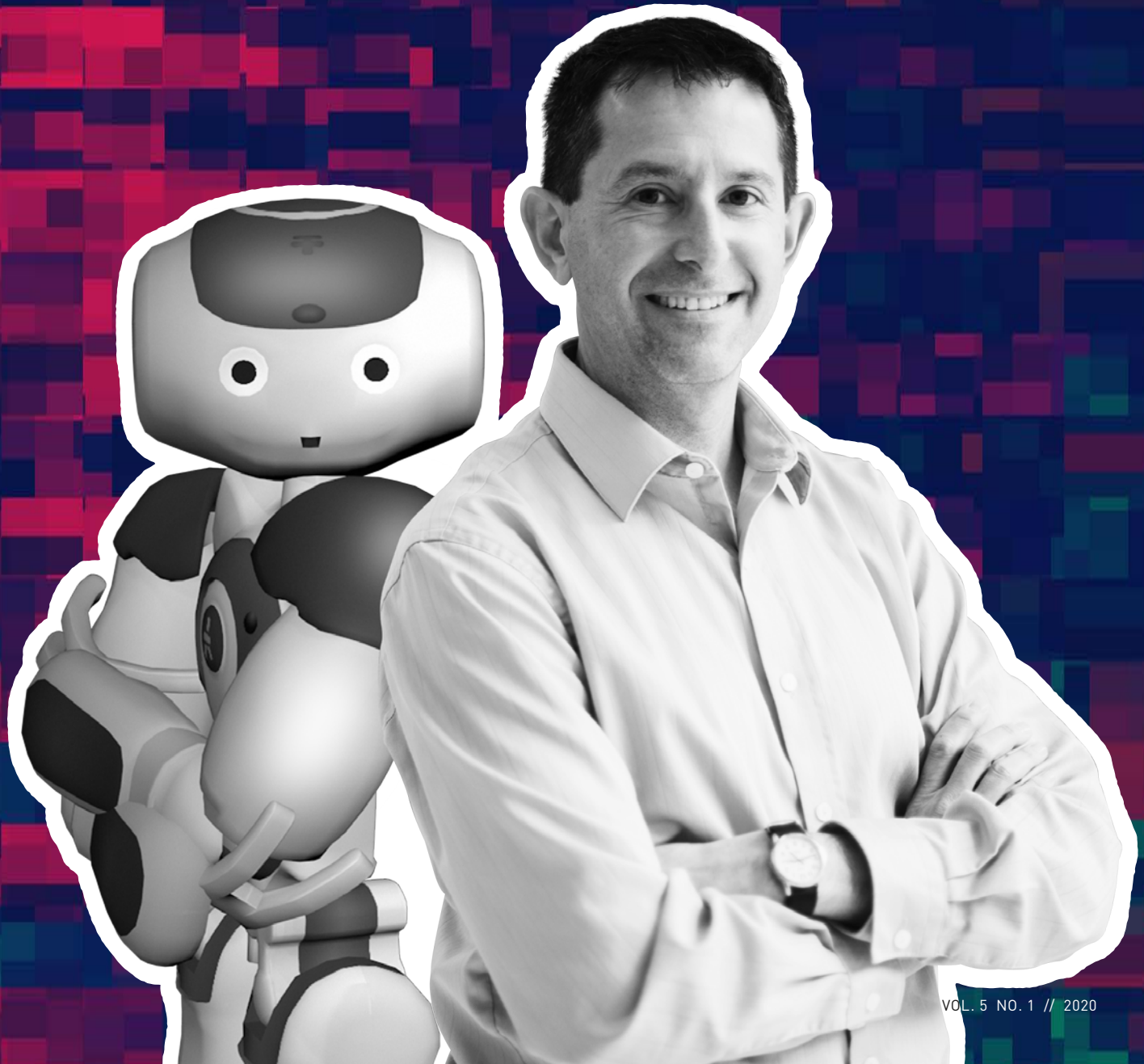
Q&A: RICHARD GARRIOTT DE CAYEUX

SXSWXAI

THIS YEAR'S CONFERENCE GOES ALL IN

Stone Foundation

AI pioneer Peter Stone leads the way at the University of Texas.





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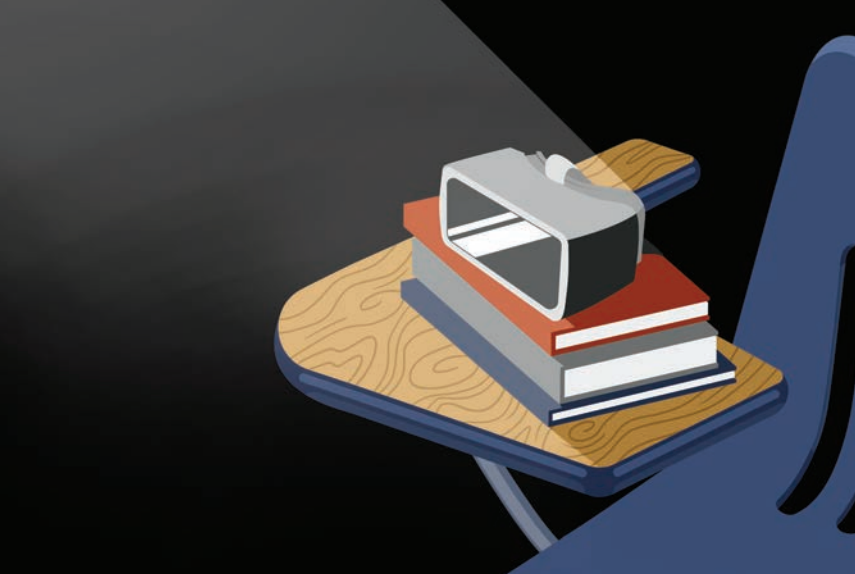


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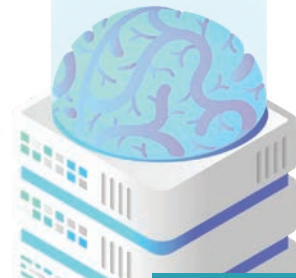
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ARTWORK: MELTING MEMORIES
(PHOTO FROM TIME MACHINE 2019)

by Refik Anadol

Melting Memories is a data sculpture that explores the materiality of remembering through the intersection of advanced technology and contemporary art. The project enables visitors to experience aesthetic interpretations of EEG data collected on the neural mechanisms of cognitive control.



EDITOR IN CHIEF

Amir Husain

PRODUCTION DIRECTOR

Rachel Kania

EDITORS

Paul L. Underwood

Nathan Mattise

CREATIVE DIRECTOR

Judd Oberly

DESIGNERS

Jon Coyle

Rob Metke

Alex Berger

Kelsey Kujanek

STAFF WRITERS

August Cole

Marla Rosner

Evan Sakrison

Cara Schwartzkopf

CONTRIBUTING WRITERS



Formerly editor-in-chief of *Austin Monthly*, as well as an editor at *Us Weekly* and *Allure* in New York City, **Erin Quinn-Kong** has been a freelance writer and editor since 2016. She's had the privilege of interviewing and writing about many fascinating people, including Jenna Bush Hager for *The Alcalde* and inmates at a women's prison for *Woman's Day*. She lives in Austin with her husband and two young children.

Photo: Meg Mulloy



Andrew Paine Bradbury is a writer and musician based in New York City. His work has appeared in *Playboy*, *Rolling Stone*, *New York*, *Black Book* and several online publications.

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NOTES

FROM THE EDITOR

WITH THE NEW year, and a new decade, upon us, it feels appropriate to reflect on the challenges and opportunities ahead. It is already apparent that what we've foreseen for a long time is coming to pass: artificial intelligence is no longer only of interest to defense experts and technology enthusiasts. Indeed, artificial intelligence is now the central focus of thought leaders across a wide and diverse array of industries, many of which we explore in this issue.

Take education, for example. Why do we still ask our teachers, who are already overworked and undercompensated, to spend time individually grading tests at night? After all, these tests typically ask students the same questions and, in many cases, have only one correct answer. Machine learning tools can do the job much faster, letting teachers spend their time on more important areas. In fact, several startups are leveraging artificial intelligence to help educators tailor their curricula to their students' needs, which in turn makes possible a better, more personalized experience for students. You can learn more in our feature article inside this issue.

A less serious topic (unless you happen to be a devotee) is golf. And yet, as you can read in our sports column, artificial intelligence is quite literally changing the game there, too. The most cutting-edge companies are using machine learning to design their clubs, testing prototypes thousands of times to get the exact right angle and shape on the clubhead. That level of thoroughness, with just tiny variations in each test, would previously have taken years (or, as our writer notes, melted down a standard-issue computer) to conduct. Today, machine learning helps sporting goods manufacturers produce best-in-class equipment for a fraction of the R&D time and energy, and the implications of this across the entire consumer goods industry are vast.

I expand on what this all means in my column, which is devoted to how and why businesses can incorporate machine learning and automated model building into their basic infrastructure. It's not that these are magic pills to help a company grow. Instead, they are ways to make your business smarter, more efficient, and scalable, provided you understand both what you are doing and what it will take to do it right. The alternative, as I point out, is dire—businesses who refuse to adapt with the times are likely to get left behind.

Elsewhere in this issue, you'll meet a fascinating and thoughtful set of people. There's João Beira, an artist who uses artificial intelligence to inform his avant-garde work. (If you attended our recent Time Machine conference, you'll already be familiar with João.) There's Hugh Forrest, chief programming officer at the annual SXSW conference, where AI has gone from a niche presence to a dominant theme. And then there's Richard Garriott de Cayeux, the visionary video game creator. Talking with Richard is always a thoughtful, wild ride, and our conversation with him about the future of AI and gaming doesn't disappoint.

Last but not least, of course, is the star of our cover feature: Peter Stone, a longtime friend of SparkCognition, and a major force in the world of AI, perhaps best known for his domination of the competitive RoboCup. We talk with him about his future plans. Thank you for taking the time to enjoy this issue of Cognitive Times. We look forward to sharing this journey together in the decade ahead.

Amir Husain

Founder & CEO of SparkCognition

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/Run_Program/

MEET THE MIND

BY NATHAN MATTISE

SUMANT MANDAL

*Managing director and co-founder
March Capital Partners*

IN BASEBALL, THEY say if a batter fails 70 percent of the time, he's a future Hall of Famer. In venture capital, maybe we should be viewing the numbers similarly. Actually, VC success is probably harder: as recently as 2017, 75 percent of venture-backed startups were failing, according to one Harvard Business School study. So in that light, the career of Sumant Mandal, managing director and co-founder of March Capital Partners, is downright Hall-worthy.

Throughout two decades of investing, Mandal has incubated more than 25 companies, including CrowdStrike (cybersecurity pros who've notably been hired to research breaches for clients like Sony Pictures and the Democratic National Committee). He's also been part of acquisitions involving heavy hitters like Cisco and Google. Mandal and March show no signs of slowing down, either. Early last year, the LA-based investment firm announced it raised \$300 million for its latest fund.

To maintain that kind of long-term success in such a volatile industry, it helps to develop specialties. And for Mandal, those specialties have largely been in tech—specifically enterprise-focused areas like Internet of Things or artificial intelligence and Machine Learning platforms. Yet ask Mandal, and he says finding success in the startup world isn't really about knowing any particular technology inside and out. Instead, over the years he's found the most consistent characteristic of successful companies seems to be how the people involved apply that tech. How will some useful tech like AI be packaged for customers, distributed to customers, and ultimately consumed by customers?

"Now I'm not a food industry investor, so if you ask me to go out and make a judgment on that I'll probably make a mistake," he says. "But tech by itself is not an investment for us, either. What is an interesting investment is someone who can apply technology—a subject matter expert on the application of that tech. So you have to look for examples and companies with fundamental skill sets in how tech can be applied. They also need people with a keen understanding of the pain point trying to be solved, because as far as I'm concerned or customers are concerned, they don't care how you solve the problems—they just want to make sure you have access to the most efficient way to solve it."

As a recent example, Mandal and March headlined the Series C fundraising round

announcement at SparkCognition last fall. What attracted Mandal to this AI start-up wasn't merely the use of bleeding-edge technology; rather SparkCognition saw the security use case for AI, among its other applications, and developed an easy-to-use platform for customers needing cybersecurity help. And by routinely focusing on similarly nuanced opportunities for investing, Mandal has been able to identify companies just on the cusp of success that are ripe for partnership—even as the in vogue tech of the day constantly evolves.

"Every five to ten years, there seems to be a shift in underlying tech," he says, reflecting on his investing tenure. "In the early 2000s, it was about the internet. The mid-2000s were about mobility and the advent of smartphones, while the end of the 2000s saw a rise in cloud computing. I think the last five years has probably been about AI. [Whatever the next shift is], it'll present opportunities to reinvent how people use tech, create applications that deliver tech, and change how people consume tech."

That constantly shifting tech landscape has taught Mandal another valuable lesson when it comes to succeeding in venture capitalism. "The secret to what we do as investors is to always have a point of view on what the future looks like," he admits. "And to have that, you have to be well versed in what's happening today and where things are headed. The good news is you're constantly surrounded by people with a passion to go solve some problem. Almost by themselves, the people we work with inspire you to help them and find others like them. So it's very intellectually stimulating, things are constantly changing and you're always evaluating where things are headed."

That does ultimately mean leveraging expertise—just not always Mandal's own. Venture capitalism has instead proven to be a relationship business in this industry veteran's eyes. Initially, that means meeting

and maintaining relationships with execs at leading companies or academics at research institutions to learn where those in-the-know foresee a particular industry going. "One of the early lessons I learned was rather than be the expert, you should know the expert," Mandal says. "You can't be an expert on everything, but we have access to a broad base of people with deep knowledge in the areas we're interested in."

"So rather than getting caught up in the tech itself, what matters to us is how is it being applied and how is it solving a customer pain point?" Mandal continues. "That insight comes from talking to customers, learning how tech is working for them and solving their pain. That's the more important part."

After that initial investment is made, things shift toward Mandal finding the type of relationship that can best help a new partner. "If you naturally have an entrepreneurial ability or desire, it's two sides of the same coin," he says. "You end up either being an entrepreneur or you end up helping entrepreneurs." Sometimes an entrepreneur has such a defined vision and belief system that not much interaction is needed. But Mandal has discovered being a founder or CEO can often be a lonelier role that does need some external support. So the job of a venture capitalist doesn't end once a check is promised; instead Mandal gauges whether a new partner needs an occasional sounding board to talk through decisions and insecurities or perhaps (as in the case of SparkCognition) a board member who can advise on what a particular investment requires for success.

"The money is just a means to help people get to the next level," Mandal says. "It's our time getting involved—through relationships, pattern matching, introducing potential employees. That's where we add the value."



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INTERVIEW BY PAUL L. UNDERWOOD

ELEVATOR PITCH

We ask an up-and-coming venture to sell us on its vision.

► Company	Riiid
Home Base	SEOUL, SOUTH KOREA
Founded	2014
Founders	YOUNG-JUN (YJ) JANG JAEWE HEO MINSUNG NOH

THE PROBLEM

Inequality of educational opportunities.

THE SOLUTION

An AI tutor for standardized tests.

SPACE

Primarily education, but our current AI technology can be applied to any kind of user assessment tool that's based on multiple-choice questions.

THE UPSIDE

That we optimize access to our AI tutor solution and other highly efficient learning tools to every individual and institution on earth.

THE RISK

Given the recent AI hype, many education companies are trying to take advantage of the term "AI." (Ed. note: "See The Future Is Bright", later in the magazine.) That may result in increased distrust and negative perception of AI education. Empty promises and selfish behavior can cause major setbacks and even delay the overall market progress and growth for the industry.

THE PITCH

The global test preparation market size is \$280 billion. Consumers are willing to pay if true value is provided, and existing players are reluctant to change due to their lack of tech expertise and fear of cannibalization. Through our first commercialized solution in Korea and Japan, the firm has successfully proven its solution's efficacy (about 130 points increase with 20 hours of training — with the total score measured on a scale from 10 to 990 points) as well as high marketability (1.1million users solely in Korea). We own the AI engine and technology in the platform, and we are currently developing a global learning platform for SAT, ACT, AMC and AP, targeting a global launch in the first half of 2020.

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WHAT'S HAPPENING IN TECH



DOCTOR'S ORDERS

> Good news in the fight against stubborn strains of bacteria like *E. coli*: MIT researchers have recently discovered a powerful new antibiotic using a machine-learning algorithm. The drug, dubbed “halicin” after the AI system from Stanley Kubrick’s *2001: A Space Odyssey*, was found to be effective against several powerful pathogens, including *A. baumannii* and *Mycobacterium tuberculosis*. (*MIT News*)

BY EVAN SAKRISON

FIGHTING BIAS

According to IBM Research, the number of biased AI systems and algorithms will increase within five years, a challenge with real-world implications in fields from law enforcement to national security. Google is flipping the script with one of its artificial intelligence tools, ensuring it will no longer identify photos with gender descriptions. That means Google’s Cloud Vision API will not label photos with terms such as “man” or “woman,” as a nod to gender fluidity—and because it’s simply not possible to infer someone’s gender solely from appearance. (*Business Insider*)

RIDING THE BRAIN WAVE

Finding the right medication to curb your depression can be a trial-and-error nightmare. However, new research from the University of Texas Southwestern Medical Center suggests that you may be only one brain test away from finding the best treatment to meet your needs. The research team employed a machine-learning algorithm that analyzed EEG brain wave data, finding that participants with a particular brain wave signature showed a stronger response to the medication sertraline. (*Time*)

DEFINING AI

Late last year, the DoD’s Defense Innovation Board (DIB) drafted a strict set of rules that prioritizes AI ethics for both combat and non-combat purposes. More specifically, the DIB emphasized that the department’s use of AI systems should be: responsible, equitable, traceable, reliable, and governable. In recent news, the DoD is in “the final stages of adopting AI principles that will be implemented across the U.S. military.” (*Defense One*)

REPEAT OFFENDERS

Predicting who will commit a crime and when remains the stuff of Philip K. Dick novels, even when a person already has a criminal record. However, a new study revealed that AI-powered algorithms can predict who will commit crimes again better than humans—depending on whether humans are given immediate feedback on their predictions. In more realistic situations, where humans aren’t given immediate feedback, the algorithms outperformed them with more accurate predictions. (*Science News*)



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BY MARLA ROSNER

THE NEW FACE OF CYBER-THREATS

AI-powered cybersecurity is critical to protect against today's threat landscape

CYBERCRIME IS A multibillion-dollar international industry. Each year sees an exponential increase in risk, as these bad actors threaten to bankrupt organizations, shut down critical infrastructure, and even conduct espionage or sabotage missions against other nations.

Traditional systems of cybersecurity can't possibly hold back the tide of cyberattacks, and it's only going to get worse—unless we turn to a new model of security. Artificial-intelligence-powered threat protection, such as that offered by DeepArmor, promises a new way to safeguard devices—not by cataloging past threats, but by predicting what new ones will look like, based on more features and information than any human could analyze. As the threat landscape continues to grow, AI will be the only way to sustainably predict and prevent future attacks.

1

By some estimates, over 350,000 new varieties of malware are created each day.¹ With the wide variety of open source tools available, cyberattacks are cheaper and easier to create than ever before. Attacks have become more strategic, too; many new forms of malware are actually older malware that's been tweaked just enough to be unrecognizable to legacy cybersecurity.

source: av-test.org

2

Ninety percent of all successful cyber attacks are either single-use, zero-day, or polymorphic. In other words, these are all attacks that cybersecurity programs will never have seen before. These attacks leverage a wide variety of methods to infiltrate a system, including phishing, spear-phishing, drive-by downloads, social engineering, spoofing, and even the use of physical USBs.

3

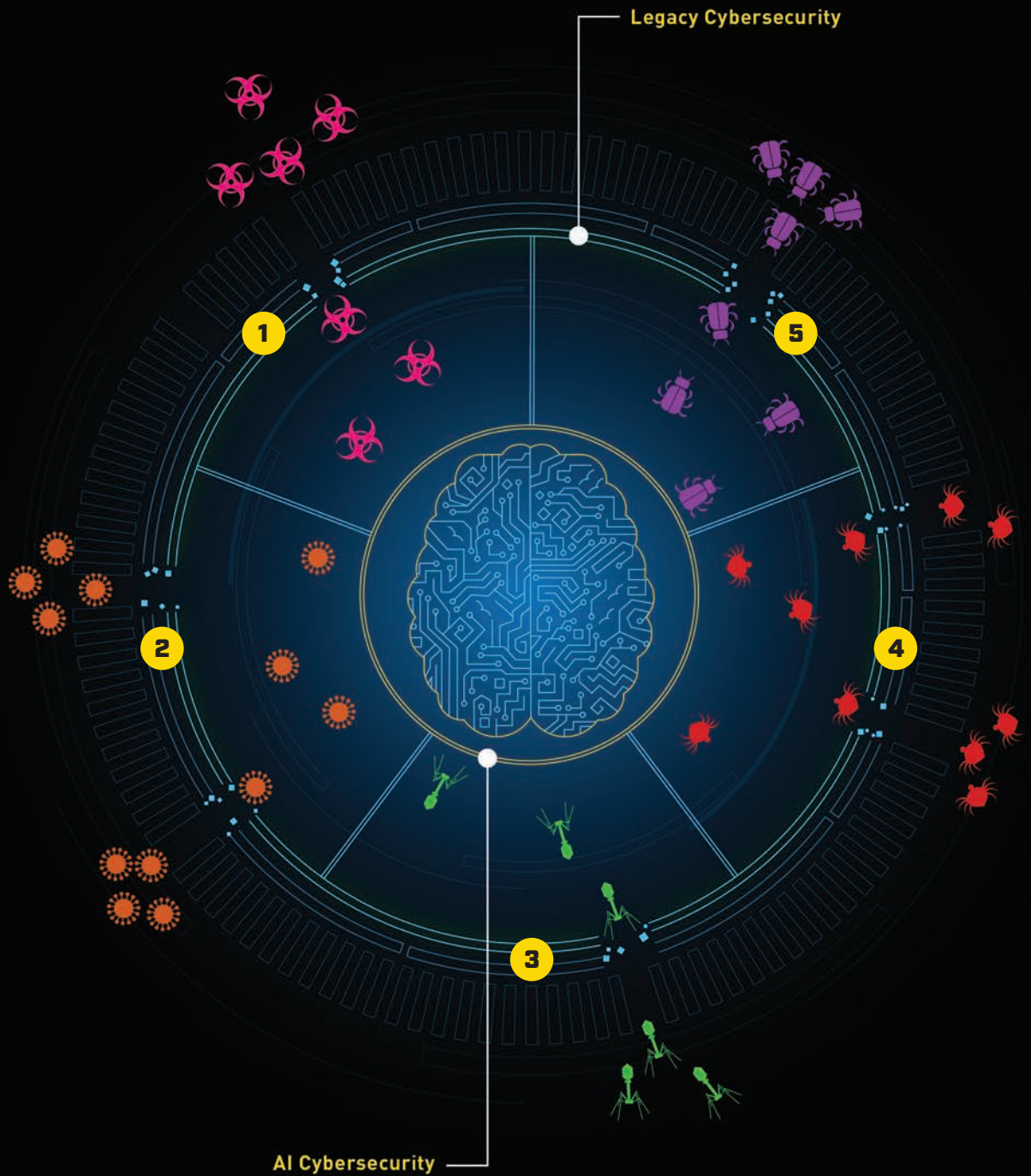
When new samples of potentially malicious files are found, threat researchers reverse-engineer the file, determine if the file is malicious or benign, and then write a signature—or a sample fragment of code—that can be used to recognize that same file in the future. This process may take anywhere from three to 14 days.

4

Legacy cybersecurity that relies on databases of signatures cannot recognize novel threats or even old threats that have been slightly altered. This leaves new attacks free to wreak havoc on a device for three to 14 days—or longer, if the user doesn't update their malware database.

5

Using AI, DeepArmor is able to do the work of a threat researcher on the fly, analyzing 20,000 features in less than a second to accurately classify novel threats as malicious or benign. The powerful threat-detection models used in AI-powered cybersecurity do not rely on threat researchers to derive features to look for. Instead they are generated from data, leaving them free of potential human biases.





COGNITIVE TIMES: AI has become an increasingly large part of the festival. Is that an intentional decision or a result of what participants are pitching SXSW?

HUGH FORREST: It's a little more the former than the latter—intentional and strategic in the sense that it's pretty obvious what kind of an impact AI is having across the board in all sectors of our lives. So we're seeing more and more AI-related content at SXSW.

Here's one of the interesting things for 2020 to reflect this: For the last few years, we had a programming track called Intelligent Future. And that was where a lot of the AI content would live. For 2020, we morphed that to "Fantastic Future," partly because it didn't make sense to only have AI in one track. There's AI impacting all the different areas we cover, and we have 22 different tracks for 2020. You'll still find a lot of AI content in the Tech Industry track, which covers the most current and most important developments in the tech industry. And we have Fantastic Future, which will still have a lot of AI stuff. But the Design track has a huge amount of AI stuff in there. Government and Politics also has a lot of AI content, simply because a lot of these AI-related questions and issues are now government-related questions and issues. The Future of Music track has a lot of AI content because AI is helping us choose our music more and more these days. I can probably make the same argument for [all 22 programming tracks].

BY NATHAN MATTISE

HUGH FORREST

SXSW's chief programming officer on why AI is at the heart of this year's conference

FOR 30-PLUS years, South by Southwest has offered attendees a glimpse at the future, so of course artificial intelligence has been a topic du jour for several Marches now. In 2017 and 2018, the conference explicitly identified AI for schedule readers as a notable programming trend. But chief programming officer Hugh Forrest tells *Cognitive Times* things have changed a bit for 2020—you won't find AI content in any one place; it now underlines all aspects of the conference.



We have an AI tag within the online schedule, and looking at how many things were tagged with AI, I came up with around 80 total sessions—a significant number. That reflects how important it is to our community, how much we’ll cover it, and the overall prominence of AI in the SXSW ecosystem. It’s gone from being one room or two rooms to one track, and now it touches basically every vertical we cover. From a historical perspective, you can look at it somewhat in the same way as how we handled social media in the past. There used to be a Social Media track, but ultimately we made the call to change. Social media is within everything we do now, so trying to contain it all in one track didn’t make sense. It does permeate everything, and AI is now of this same nature.

CT: Anecdotally, does this year’s amount of AI programming feel bigger than in recent years?

HF: I think it’s a steady increase as opposed to any kind of giant jump. I know our community has been fascinated with this topic over the last three years. I’ve sometimes said when talking to people about Panel Picker proposals, a way to get a lot of attention is to put the words “artificial intelligence” or “AI” in the title. We’ve certainly seen that on site; a lot of the sessions that are focused on AI draw really well.

I’m a little bit generalizing, but those sessions draw very well because on the one hand, people are very excited about the possibilities of AI and the continued possibilities. And on the other hand, people are also concerned about the possibilities of AI and not strategically and intentionally deploying it.

CT: Thinking back on the decade, are there specific turning points or touchstone moments for AI at SXSW?

HF: Certainly when Elon Musk was here a few years back [in 2018]. While his talk covered a lot of things—he’s involved in a lot of things—there were a few questions and big talking points about AI. And we know Elon has expressed a lot of concern about the future of AI, so naturally it was part of his conversation.

The AI protest [in 2015] was maybe a spoof protest done by one of the TV shows that was here, but it tapped into a zeitgeist worried about the future. Are robots, algorithms, machines, or computers going to take our jobs? And one other touch point was Bernie Sanders speaking at SXSW 2018, and he talked a lot about the future of the labor force and what it’ll look like as AI radically changes the landscape.

CT: Are there particular AI panels, events, or speakers for 2020 that you’re excited about?

HF: Some of my favorites: We have a session called “Designing AI Products and Services” with speakers from Carnegie Mellon including John Zimmerman, so very happy to have that. I’m also excited about “The Role of Humans in Music AI,” and I like that

“

We have an AI tag within the online schedule, and looking at how many things were tagged with AI, I came up with around 80 total sessions—a significant number.

because it shows how AI is having an increasing impact in creative industries but that humans will still have a role.

One that’s a little more playful, but I’ve thought about a lot, is “Me, Myself, and AI.” Two developers fed all their data from a year into a machine learning program, and onstage they will have a conversation with their virtual selves born out of learning all that data and what they’ve done for a year. It could be fascinating, it could be a comedy, who knows? But it’s a creative SXSW approach to the topic. And for a fourth one, one of the Book Reads we have for 2020 is Kevin Roose, *The New York Times* columnist, [who] will be talking about his new book, *The Secrets of Becoming Futureproof*. And a lot of that is focused on how AI systems and humans can coexist and thrive together.

CT: Does SXSW still have its automated chatbot, Abby, and is the organization using AI more behind the scenes these days?

HF: Abby is still around, and it serves a purpose to help people who have questions about the event. And we know there are lots and lots of people with questions about the event.

But the other ways we use AI internally are around analyzing and getting smarter data: What sessions are people attending? What keywords are more important or least important? Is there any rhyme or reason to the speakers that get the highest rating? As with any organization, we have a lot of data that is hard for humans to understand, so the more we can work with higher systems, AI/ML, to understand that data, the better.

Having said that, we’re extremely cautious about actually crunching data for individual users. If you’re going to a session, great, but we don’t know that afterwards. We’re not in any way using individual data to market back to you because it’s against what we believe in.

INTERVIEW BY NATHAN MATTISE

GREG FITZGERALD

> Chairman and CEO, *Cyberforce Security*



Industry

Cybersecurity

Location

Austin, Texas

Education

University of Colorado (MBA); Arizona State University's Thunderbird School of Global Management (MIM)

Previous Gigs

Cylance, JASK, Javelin Networks, Cisco Systems, ADS Inc., Tough Mudder

On the Need for Expertise

Cybersecurity has been something where people typically only thought large organizations and governments—places with “value”—were attacked. Now, we see clearly that the common individual or the small business—the entities that felt they didn't have assets that might be desired by attackers—they're all vulnerable. And at the same time, we're now challenged with not enough talent or skill or personnel on the good side that understands cybersecurity in its basic form, much less in a highly sophisticated form. [At Cyberforce,] we discern which technologies work, which are easy to use, and which are affordable. All three of those elements are required to get [technology] to the masses. When a cybersecurity vendor tries to reduce their feature set to make something more affordable for a small business, it hurts everyone—it's a useless product.

On the Rise of Managed Security Service Providers

There are millions of vacant cybersecurity jobs around the world. If you have a cybersecurity skill, are you going to work for Joe's Savings and Loan in Columbus, Ohio? Probably not. And because we live in a virtual world, you can still live in Columbus but work for Citibank, or a great cybersecurity company, or the government. This leaves Middle America highly vulnerable. So MSSPs are growing crazy fast because people realize they can't do it themselves. The business model of an MSSP is to be a team of experts who can spread security skill sets across numerous companies as a service.

On Cylance's Breakthrough

At Cylance, we understood that the foundation of protection was not scalable. Everything was based on reactive behavior, just like a vaccine. The coronavirus is a great analogy. There wasn't a protection for the coronavirus, but now that we've seen it, there will be a vaccine. But look at all the damage that happened because it came out—that's exactly what happens in cybersecurity, even today. The key [difference] is, can AI predict how to prevent a virus from spreading? It is possible. We understood back in 2012 that this was a theory we wanted to prove could work—and, subsequently, it has.

On the Biggest Threats Today

Today, anything connected to the internet

is vulnerable. That's very concerning—people want to live their lives and not think about this, but unfortunately, it's part of our modern way of life. I see malicious software, malware becoming automated. No human is involved, but it can infect and take action to steal data or damage data and devices automatically. You're seeing more organized crime. It's not government or nation-state sponsored; common thieves have gotten organized. We're also seeing a lot of ransomware—it's always existed, but it used to be managed by an individual. Now it's automated. A person with no skills can go to a website and transact a ransomware attack and never get caught.

On What's Next

I'm identifying a [potential growth] area around devices, users, and applications for security administrators. If you ask them how many assets—a device, a service, a laptop, a phone, an IoT device, any computing opportunity—do they have, they can't give you an accurate answer because the databases of these devices that have traditionally been registered are not able to keep up. Devices come on, come off, break, stop communicating, etc. This is a huge opportunity: If you don't know what you have, you can't protect it. And in a world of BYOD—people are accessing company email on an iPhone—we're not in a centralized world and there are no boundaries to an IT environment.



“The Sentient Machine is a must-read for anyone looking to understand how artificial intelligence is poised to transform human society and life. Husain is not only an engineer and entrepreneur, but also a philosopher who thinks deeply about what AI will mean for humanity. Husain’s optimistic outlook on the benefits of AI, grounded in an accessible description of this technology, is a welcome salve to many AI fears today.”

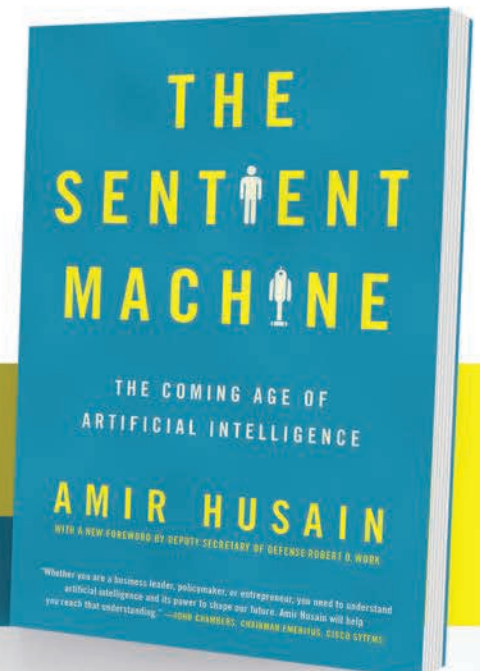
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BY EVAN SAKRISON

LORD ONLY KNOWS

Gaming legend Richard Garriott de Cayeux looks to the future

AS MODERN VIDEO games become more immersive and mind-bogglingly real, gamers want to know how developers are going to take their playing experiences to the next level. Who better to ask than legendary gaming pioneer Richard “Lord British” Garriott de Cayeux, the creator of the genre-defining Ultima series, for his opinion on what’s next?

Considered a founding father of the video game industry, Garriott has enjoyed an illustrious career shaped by his desire to innovate and explore. From coining the term massively multiplayer online role-playing game (MMORPG) to being only the sixth person to explore space as a paying traveler on the International Space Station, he has led a remarkable, jam-packed life. And now he’s one of several industry titans leading the conversation on artificial intelligence in video game development.

Given his background and expertise, we leapt at the opportunity to ask him about the state of AI and gaming in 2020. As you’d expect, his answers were both deeply considered and wildly entertaining.

COGNITIVE TIMES: About two years ago, Epic Games CEO Tim Sweeney said that video game AI “is still in the dark ages.” A, Do you agree? B, Do you think AI development in the gaming industry is moving slower compared to other industries?

RICHARD GARRIOTT: Absolutely! Game AI remains in the dark ages. But we are at least able to “see the light” and are crawling towards it! Some good examples of the shortcomings of AI in games can be seen in even simple cases, where an AI opponent might be “hunting” a player, and they will often get stuck running around in literal circles, unaware of their own “stuck” state. I would like to believe that many of my own games, even 30 years ago, started championing NPC (non-player character) AI, when the characters in my game were given schedules to live their lives by, such that they would simulate a daily life, and conversational AI, where players could explore a variety of topics that a character might have some unique knowledge of in an ad hoc way.

While AI in most modern games remains simple “state machines” and branching conversations, progress is being made. The best combat AI in games can now beat most players, largely due to the speed of their deliberations, and interestingly, in squad games the AI’s willingness to sacrifice individual agents to achieve victory, which often real players are less likely to do.

CT: The primary goals of advancing AI technology in industries like oil and gas, utilities, and health care are to increase efficiency and reduce operating costs. In your opinion, what are the biggest ways that AI has impacted game development—from animation and graphics to narrative and character design?

RG: Interestingly, while I believe that AI will affect animation and graphics deeply in time, the real push has so far been in battle tactics as well as conversations. As noted above, battle tactics have made real progress in recent years, but conversations *far* less so.

We all have seen Alexa, Siri or Google voice assistants... while these technologies have become very good at managing a few household automations and ordering systems, they are FAR from having a normal conversation with a real person. In a game, each and every NPC must have a unique personality and information, a unique motivation for dealing with the player, how and when they might help or hinder the player and in what way. This is FAR more complex than a single entity like Alexa with a limited and individually programmed set of functions they can assist with.

I fear a strong NPC conversation will really demand something much closer to a “general AI” solution...yet one which could be directed like an actor.

CT: As AI continues to advance in the gaming industry as well as more industrial sectors, what, in your opinion, makes AI development in the gaming industry more unique?

RG: Closing the gap with reality... If you watch Netflix’s *Black Mirror: Bandersnatch*, it is about the state-of-the-art TV/cinema, but with periodic branches in the narrative, that had to be carefully strung together. Very compelling visually, but a small set of periodic interactions. On the other side, open-world games can give players great freedoms, but rarely if ever do we see narrative moments with

nearly the power of a scripted movie-like experience. AI will close this massive gap. AI can act like “real-time directors” adjusting the scenes to match the player’s arc, finding the right moment to give clues, reward or resist the player to ensure we maximize impact!

CT: Your renowned Ultima series is widely credited with influencing the MMORPG genre. If you were to reboot the series in 2020, what specific AI techniques—or tools—that are being used in modern MMORPGs would you be most excited to utilize, and why?

RG: Rebooting today would still leave me wanting for AI, because while battle tactics have advanced dramatically, conversation and other plot-related AI has not. So, if I were to start today with unlimited time and budget, I would likely try to tackle the AI-driven NPC. I would give this NPC (like the others in the play space) an understanding of who they were, what their skills were, who their families were, and pools of information such as world knowledge, regional knowledge, local knowledge, and their individual knowledge. They would start with initial conditions such as jobs, family and motivations. But as the world evolved they would likely change. For example, if the people of a town, were treated well by a player, the NPCs there would likely help them in return, yet, if a player conquered said town, the people may pay up at first, but then happily sabotage the plans of their unwanted master. This type of AI agency in NPCs is *not* near at hand—there is still much work to be done!

CT: While AI has become extremely efficient at reacting to players’ actions, it’s not quite capable of being strategic yet, or as you put it in your Time Machine 2018 talk, “going in with a master plan.” In your opinion, how close are we to seeing this level of competitive strategy from AI-powered characters?

RG: For combat AI, we are getting very close. The human teams that beat the best AIs today do so by studying the arena and their opponents (even the AIs), coming to conceptual ideas on strategy and then implementing them well. To my knowledge no game AI has done this...yet, rather, as you noted they are just masterful at reacting in real time, quickly, as they see things unfolding on the field. Some likely have “preprogrammed” initial approaches, but rarely if ever any “one level up” cognition about the board or the opponent. That being said, this “next level up” in cognition should be now approachable, since the tactical responsiveness has evolved so well.

CT: Even though sophisticated AI is a huge selling point, Alien: Isolation, for example, was criticized for its punishing difficulty due to the Xenomorph’s sophisticated AI-driven behavior. Do you think video game developers are hesitant to build high-level AI into their games in fear of damaging the overall player experience?

RG: Alien: Isolation is a great example of how focusing the problem on a single AI agent for the entire story can be done very well within the limits of a combat-type experience. Sort of like Alexa or Siri are evolving well, but AI to drive numerous NPCs at the same time remain further off.

In Alien: Isolation, they have done a great job of putting a director AI on top of the creatures’ tactical AI. That upper-level AI could have been written to crush players, which would drive off players, but rather the director AI has been written to purposefully let, or in fact force, tension rise and fall. This rise and fall is important to movies and games alike.

CT: As a game developer and designer, what do you think is the best solution to implementing AI that is smart, competent, and unpredictable, but also fun to play against?

RG: My main critique of AI found in board games like chess and checkers is that they are now all so good, they can easily beat most any real person, and turning down the AI seems to just introduce random mistakes. They rarely feel like a human opponent that you could mislead with feints, nor dominate by skillful play.

Fun is, of course, the number one goal of a game, in order to compel and retain players...but personally, I also think AI-driven games will not only eventually craft great narratives, but these narratives will have deep meaning and relevance to the human experience. A great AI can meet you where you are, fill in gaps in your understanding and motivation, lead you when needed, challenge you when needed and give you not just a fantastic experience, but one which (when coupled with content that might be educational or important) makes the player a better person for having gone through the experience.

CT: What is your advice to programmers, game developers, and others in the industry who want to create fun, engaging gameplay with AI? What would you tell them makes “Good AI” vs. “Bad AI”?

RG: Research! While AI in games is moving forward at a good clip now, and recognizing that the AI needs of a game are unique to games, I always believe in “casting a wide net” for ideas and inspiration. For example, don’t just study the AI in your competitor’s games. Don’t just study AI in other fields. But also study the theory for what a good AI agent should do for the game. For example, study story craft, and film craft. Only by knowing how, for example, is tension managed in a linear work could you expect to then approach how to manage it in a nonlinear game environment.

My other advice would be that since time and money are far from limited, don’t “bite off more than you can chew.” AI in games remains a daunting problem, but step by step, game by game, we can each advance the state of the art, and together we will tackle this vexing problem.



Image: Forbes.com

BY JAQUELINE TING QUESADA

A TECH-SAVVY TO-DO LIST

007



Abu Dhabi AiMed

OCTOBER 20-22

This summit is devoted to the intersection of AI and health care, with an emphasis on clinician-led conferences and workshops, and speakers from around the globe.

Image: ai-med.io.com



No Time To Die

NOVEMBER 25

In Daniel Craig's final performance as James Bond, 007 is called out of retirement to complete a thrilling mission against a villain (Rami Malek) in possession of dangerous, new technology.



APRIL 21

In her memoir, Egyptian-American computer scientist Rana el Kaliouby shares her journey from being one of the first female computer programmers in the Middle East to founding her own startup, Affectiva, which focuses on humanizing technology through what she calls "emotion AI."

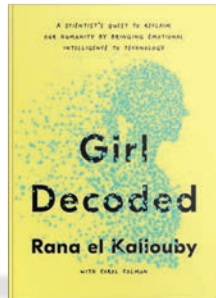


Image: Amazon.com



Westworld Season 3

MARCH 15

"Welcome to the end of the game." On March 15, Westworld returns from a two-year absence for its highly anticipated third season, which concerns the discovery of AI treatment in the real world.



Image: cosmopolitan.com



Digital Workplace Experience

JUNE 3-5

It's no secret that AI is revolutionizing how we work. This conference in Chicago delves into the hows and whys and what's nexts, with tips on the digital workplace from GE, Harvard, Google and more.

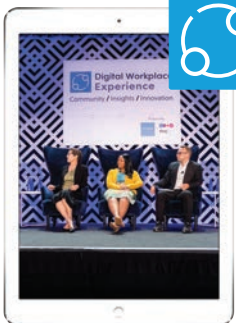


Image: DWE Facebook



JUNE 9

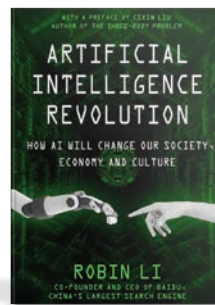
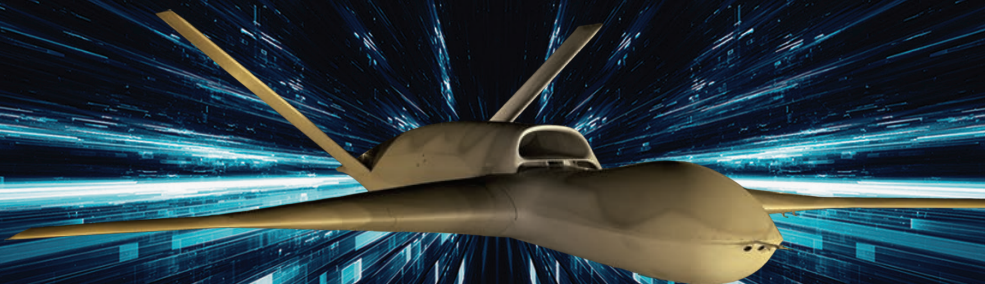


Image: Amazon.com

In his new book, Baidu co-founder Robin Li addresses the rise of a new tech-reliant society. He takes a deep dive into how AI will revolutionize finance, manufacturing, and other industries.

HYPERWAR

CONFLICT AND COMPETITION IN THE AI CENTURY



AMIR HUSAIN ■ JOHN R. ALLEN
ROBERT O. WORK ■ AUGUST COLE ■ PAUL SCHARRE
BRUCE PORTER ■ WENDY R. ANDERSON ■ JIM TOWNSEND

WHAT PEOPLE ARE SAYING ABOUT THE BOOK

"'Hyperwar' doesn't just admire the problem of AI-fueled warfare, it offers concrete approaches to help U.S. policymakers and our allies prepare. It is a 'must read' for all humans seeking to be 'in the loop or on the loop' before these technologies outpace our capacity to make ethical, strategic and secure decisions about our future."

—AMBASSADOR VICTORIA NULAND
CEO, Center for a New American Security

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Automatic for the People

How automated model building is changing the game.

How will artificial intelligence go beyond rhetoric and toy projects to real, enterprise deployments that yield significant business benefits across a large number of different industries? What are the key considerations to keep in mind when attempting such transformations? And how can understanding the fundamental economics of AI help propel implementations forward? This is an attempt at addressing some of these important questions.

BY AMIR HUSAIN

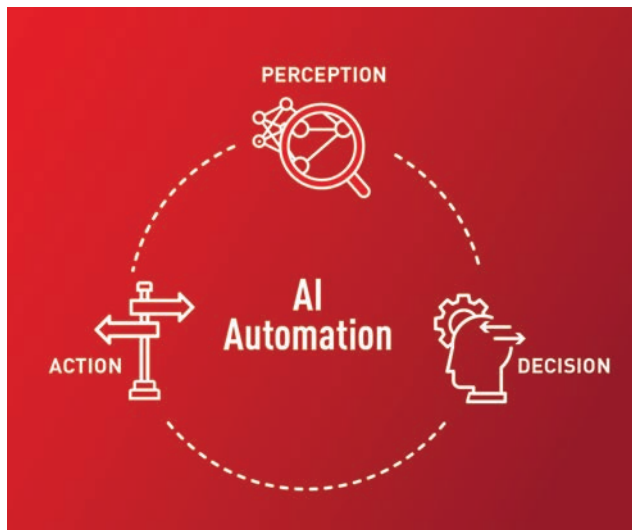
conclusion are reinforced. But if not, they are de-emphasized so that more optimal outcomes can be created in the future.

How might these basic elements manifest in chains of autonomy in business processes be employed in a typical corporation?

At a bank processing a car loan application, an AI system could perceive images, such as faces and fingerprints, to biometrically confirm identities. It could recognize handwriting on a filled-out application form and process an image of a car being purchased to identify its make, model, type and condition.

It could further decide whether to approve a loan, based on the identity of the person and what is known about that person. It could automatically determine whether the form has been filled out properly and if the information it contains supports a positive decision. Based on past experience, the system could also predict whether the car identified is of a type that the person can comfortably afford and pay off.

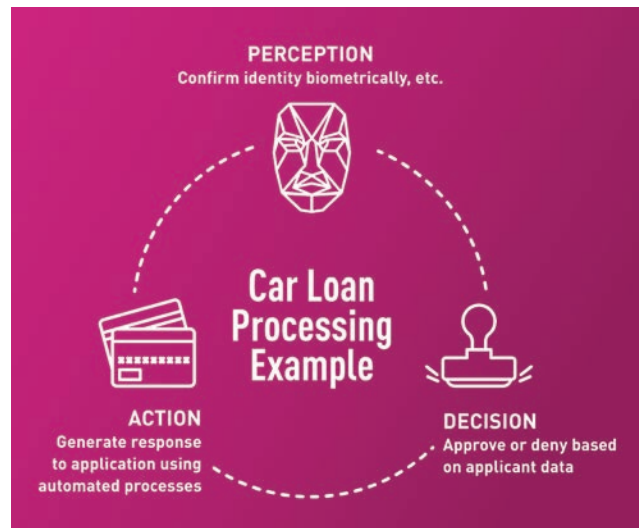
Once these determinations are made, the AI system could then act by generating a response to the application filled out using natural language generation or a pre-populated form, kicking off other automated processes that create a new account for the applicant if necessary, and reflecting the loan approval on internal systems, including initiating fund transfers.



Perception, Decision and Action

The first thing to understand about AI-enabled automation is that there are three distinct elements of a chain of autonomy: perceiving some pattern from underlying data; deciding how to act based on this perception and prior knowledge; and finally, acting on the decision made. Each of these elements can be powered by artificial intelligence/machine-learning “models” or algorithmically trained components that are exposed to example data so that they can abstract these examples into real-world conclusions. Machine learning can draw these conclusions even when the real-world data is unseen, new and has never been fed to the model during training.

All along, with each of these tasks, learning is usually incorporated so that the automated “agent” or process can become smarter over time. For example, did the system perceive the data correctly? Did it make the right decision? Did it carry out the action properly? If so, then the behaviors it exhibited in arriving at that



Thinking About Process

Processes like these are already being automated in many banks and insurance agencies. Sometimes such automation is possible with rules-based systems, but where AI shines is by enabling such sophisticated perception, decision and action capabilities that a much larger number of business processes can be made autonomous. AI enables not only speed, but also scale. It delivers the ability to retain best-practice knowledge in the digital systems of an enterprise. The advantages are limitless.

Clearly, the rate at which increasing AI sophistication will subsume business workflows depends on the industry and application. For example, the Department of Defense might require perception of targets in underlying data, decisions on whether to engage these targets and then constant guidance to deliver munitions to selected targets. The cost of failure is incredibly high and the complexity of clear perception is also much greater.

But even if not everything is ready to be cast as an AI model, you can start thinking about almost everything that happens in your enterprise in this context: PERCEPTION>DECISION>ACTION.

So which processes do you start with?

Answering this question is the first step in developing a road map to a transformation that ends with an AI-powered, model-driven enterprise.

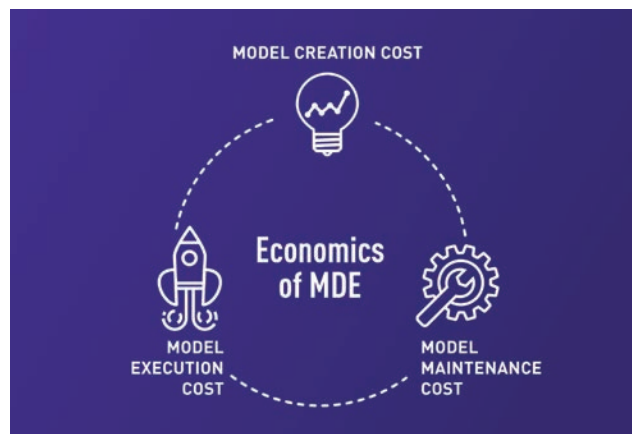
Scaling at the Speed of Light

Once core business processes have been implemented as Perception>Decision>Action chains of autonomy, theoretically a business can choose to apply greater computational resources and scale these up, while also accelerating them. But practically, this can only be done to a certain degree until another non-digital, non-autonomous process gets in the way of the acceleration.

For example, in our loan approval use case, the autonomous chain responsible for evaluating and approving an application can only process these requests at the rate at which they are made. To increase scale, the business would have to grow larger so that the number of applications available to process increases. In cutting down latencies of core processes to near-zero, the remaining bottlenecks in a business are exposed and become future candidates for implementation as a model-driven process.

Continuing the same example, the next process to automate might be digital advertising and campaign management so that a greater number of leads can be sourced.

One by one, a model-driven enterprise identifies and removes latency from its operations wherever possible. In physical industries where some latencies are driven by the laws of physics and nature—such as the growth rate of a crop—some delays will remain, but these are the only delays that should be tolerated.



The Economics of a Model-Driven Enterprise

Once you start thinking about your business as a set of parallel workflows running to yield value to your clients, complying with regulation or providing a service to an employee, you can then associate costs with the development, execution and maintenance of each of these workflows. Since each workflow is powered by many perception, decision and action models, the key to running a winning model-driven enterprise is to lower the cost per model.

How do we go about doing that?

Model costs are not limited just to developing a system and training it up front. In the real world, systems age, underlying patterns change and there is a consequent need to regularly update AI systems. Sometimes, it is not enough just to retrain the existing system on new data. It is also necessary to switch techniques and algorithms to achieve acceptable results. This can be a complex and time-consuming process that only highly qualified, expensive subject matter experts can execute. If we require an extremely high level of talent to build and run these processes, we cannot achieve the true benefits of automation.

This is where a new technique called automated model building (AMB) comes into play. In essence, these algorithms use artificial intelligence to build AI, thus automating the up-front construction of models and also their maintenance over time. Unlike systems that simply optimize a few parameters of models automatically or automate the retraining of an existing model, cutting-edge AMB technology evolves entire neural network structures from scratch, while also adapting these structures as real-world data shifts and morphs underneath.

Applying automated model building lies at the heart of the most competitive model-driven enterprises of the future: companies that have mastered the art and science of applying artificial intelligence to maximize customer happiness and business profitability. When you find one of these companies, you have found a winner. For the others, it will quickly become a fight for mere survival.



Hack the Vote

Is AI on the ballot in 2020?

Even though the November U.S. elections are still months off, artificial intelligence already has emerged as a potent technology that can sway voters all the way until the moment the polls close that fateful Tuesday. Yet just how AI is used in the election's contest between truth and disinformation will shape the narrative of this emerging technology's impact on American democracy for years to come.

Experts on technology and democracy have been sounding an alarm since Russian hackers during the 2016 election exploited

BY AUGUST COLE

social media algorithms, many of which are enabled by AI software. In 2018, Elaine Kamarck wrote in a Brookings Institution report, "Malevolent Soft Power, AI, and the Threat to Democracy," that "by 2016, social media had become a weapon against democracy as opposed to a tool for democracy. Unless we are vigilant, the new world of artificial intelligence (AI) has the potential to be an even more dangerous weapon in the years ahead."

U.S. officials fingered Russia for its influence operations in 2016,

Disinformation on social media has proven to be one of the more difficult challenges, particularly for self-policing platforms whose AI-enabled, ultra-precise targeting of users is what underpins their economic models.

and nations such as China are heavily investing in AI. Meanwhile, non-government companies, individuals and activist groups are developing ever-more sophisticated commercial AI software that can be utilized for undermining the democratic process in the U.S. and around the world with two powerful tactics: targeted disinformation and deepfakes.

Disinformation on social media has proven to be one of the more difficult challenges, particularly for self-policing platforms whose AI-enabled, ultra-precise targeting of users is what underpins their economic models. Yet even in the final months of campaigning for the 2020 primary election cycle, Facebook continues to allow un-fact-checked political advertisements, even if those candidate-oriented messages are effectively disinformation that targets users where they are most susceptible. “While Twitter has chosen to block political ads and Google has chosen to limit the targeting of political ads, we are choosing to expand transparency and give more controls to people when it comes to political ads,” a Facebook executive wrote in a Jan. 9, 2020, blog post explaining the company’s decision.

Many of these messages are spread by fake users themselves. A team of Digital Forensics Lab and Graphika researchers in November announced the results of “Operation FFS”—Operation Fake Face Swarm—in which investigators uncovered an AI-enabled ring of fake accounts affiliated with “The Beauty of Life” or “The BL” on Facebook and other social media platforms spreading disinformation. In a twist, many of those accounts contributed to closed user groups that were themselves run by fake users. Content varied, but notable for the upcoming US election, it included over 80 pro-Trump pages and accounts. A common trait for these accounts was AI-generated fake pictures, according to a report by DFRL and Graphika; many of the accounts also were enabled to auto-post content to ensure they were algorithmically optimized to be relevant. “The BL network is the first time the authors have seen AI-generated pictures deployed at scale to generate a mass collection of fake profile pictures deployed in a social media campaign,” according to the report.

Beyond watchdogs like DFL and Graphika, companies like Factmata use AI technology to hunt down fake accounts and disinformation and label them in a manner the company likens to a “nutrition label” for content. Yet what’s different in the 2020 elec-

tion cycle from 2016 is the emerging front in the disinformation battle from deepfakes, which rely on generative adversarial networks (GAN) to modify videos into realistic and usually provocative facsimiles. Just as the first televised presidential debate in 1960 between John F. Kennedy and Richard Nixon showed the emerging power of a new visual medium to shape voter perspectives on a candidate, a recent spate of AI-altered videos depicting leading politicians such as House Speaker Nancy Pelosi stumbling and slurring through a speech or President Donald Trump walking his son-in-law through the basics of money laundering portend another before-and-after moment for U.S. politics.

The threat is serious enough that the House Intelligence Committee held hearings in June 2019 to explore how to detect deepfakes and what can be done to thwart them. At the hearing, Clint Watts, a former FBI agent and expert on disinformation and counterintelligence with the Alliance for Securing Democracy, told lawmakers that deepfake tactics carry risks for society that go beyond embarrassing politicians. “Regardless of whether the purveyor of deepfakes is international or domestic, the net effect will be the same: degradation of democratic institutions and elected officials, lowered faith in electoral processes, weakened trust in social media platforms, and potentially sporadic violence by individuals and groups mobilized under false pretenses,” he said.

Elected officials clearly see the threat posed by deepfakes. Last year, California and Texas passed legislation outlawing their use in cases like revenge pornography or political disinformation. Within the tech industry, collaborations between industry and academics are at the vanguard of working to combat the threat. A consortium of tech giants, including Facebook, Amazon and Microsoft, rolled out a “Deepfake Detection Challenge” last year that will run through March 31 and award prizes valued up to \$1 million. Twitter moved to ban deepfake videos in February, stating plainly, “You may not deceptively share synthetic or manipulated media that are likely to cause harm.”

Yet as with other forms of asymmetric conflict or competition, the edge increasingly seems to go to adversaries able to nimbly exploit gaps and loopholes. With disinformation and deepfakes, there are plenty, which will keep AI in the spotlight—for better or worse—in the 2020 election.



Into the Swing

Callaway and other golf industry leaders are embracing AI

Improving a golf club is a process that's long demanded as much patience as playing the game itself. Even for a company as sophisticated as Callaway, the dominant consumer sales leader and club maker on the pro tour, reimagining something as simple as a driver face once meant pouring a molten titanium alloy sample into five to seven different 3D-print wax molds, picking the best one and handing it off to PGA testers to certify that it's within the tour's strict limits—a process that involved shooting a golf ball out of an air cannon at 150 mph into the club face. Says Dave Neville, the senior brand director at Callaway: "It was what we called a destructive test."

BY ANDREW LAWRENCE

The higher-ups at Callaway figured there had to be a better way. After years of experimenting with various optimization tools and software, Alan Hocknell, the structural mechanics Ph.D. who heads Callaway's 120-person R&D department, approached Callaway CEO Chip Brewer with a crazy demand: "I want to buy a supercomputer. I think we can use it on the driver." Three years and \$5 million later, a server farm was installed at Callaway's Carlsbad, Calif., headquarters and access restricted to a handful of employees—excluding Hocknell, funnily enough. What he nonetheless found out quickly, after using the supercomputer for research, is that it could be an even more powerful design tool, one that could build better clubs than

anything the humans at Callaway had come up with since the company left the wine business to get into golf in the early 1980s.

Starting with the driver face, Hocknell's team fed the PGA's long list of constraints to the supercomputer. The club face it spat out was crazier than anything a club engineer could've ever dreamed. "A typical face is thick in the center, because when you hit it in the center, you hit it more solidly," Neville explains. "You need it to be thicker there, so you're not over the rules. And then around the outside of the face, it's allowed to be thinner. This new face was totally rippled and bumpy. At first, we were like, What the hell is this thing. The engineering team was like, There's no chance that this thing is gonna work."

But they built it anyway and immediately found it to be better than anything they could've dreamed. "The ball speeds were really fast," Neville says. "The spin robustness was excellent all across the face..." Boosted by their progress, the engineering team pushed for more—so they tasked the supercomputer with designing more driver faces and left it running for six weeks straight, 24/7. Instead of seven prototypes, it returned 15,000. And from the club faces, Callaway drew the seed of an entirely new lineup of drivers, the Epic Flash, and brought it to market last year.

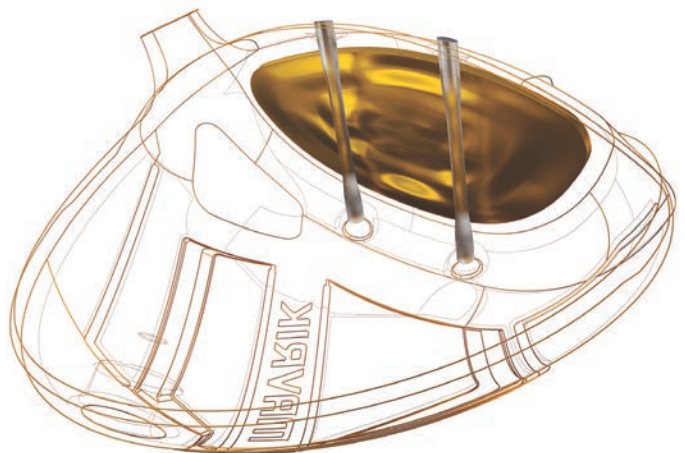
But for all of Callaway's rapid gains in the AI space, golf as an industry is only slowly following down that road. Buffalo, N.Y.-based equipment maker OnCore is reportedly in the final development stages of its GENiUS ball—a chipped golf ball that, in tandem with mixed reality glasses and a phone app, would allow any golfer competing off-tour to track, analyze and improve their game. Meanwhile, a Stamford, Conn.-based analytics firm called


Arccos cracks the nut the other way around, stuffing its AI sensors inside proprietary clubs to provide golfers real-time data yardage and accuracy stats through their smartphone while archiving their playing history in the cloud. With an archive of more than 60 million shots recorded on courses around the world over the past six years, Arccos' AI has the ability to not only forecast to its users where they will hit the ball on a given stroke but propose better strategies. Think of it as a pocket-size caddie.

Meanwhile, Callaway's advantage keeps growing. In the wake of the Epic Flash line's success, Hocknell went back to his boss with another crazy demand. "I want to double down," he told Brewer. "If we double it, we can take it across the board and make different, unique faces for not just our irons, but our fairways and woods." A year later Callaway went from having one unique AI face to 42, a lineup that would become the company's Mavrik brand.

Given the supercomputer's skillful work, the Callaway R&D team is now pushing the limits of machine learning to places they never thought possible. For instance, whereas before they might've given the supercomputer seven different constraints for a driver club face, now they enter 40, making infinitesimal tweaks for spin rate, ball speed and durability. It's enough, says Neville, to make the most powerful PC you could buy at a big box store explode. "All these variables are running up against each other. So many different things that we're putting into the supercomputer now that we could never do before. So, really, we feel like it's a huge leap forward for us, and that we're just kind of on the cusp of what AI could do."

Starting with the driver face, Hocknell's team fed the PGA's long list of constraints to the supercomputer. The club face it spat out was crazier than anything a club engineer could've ever dreamed.



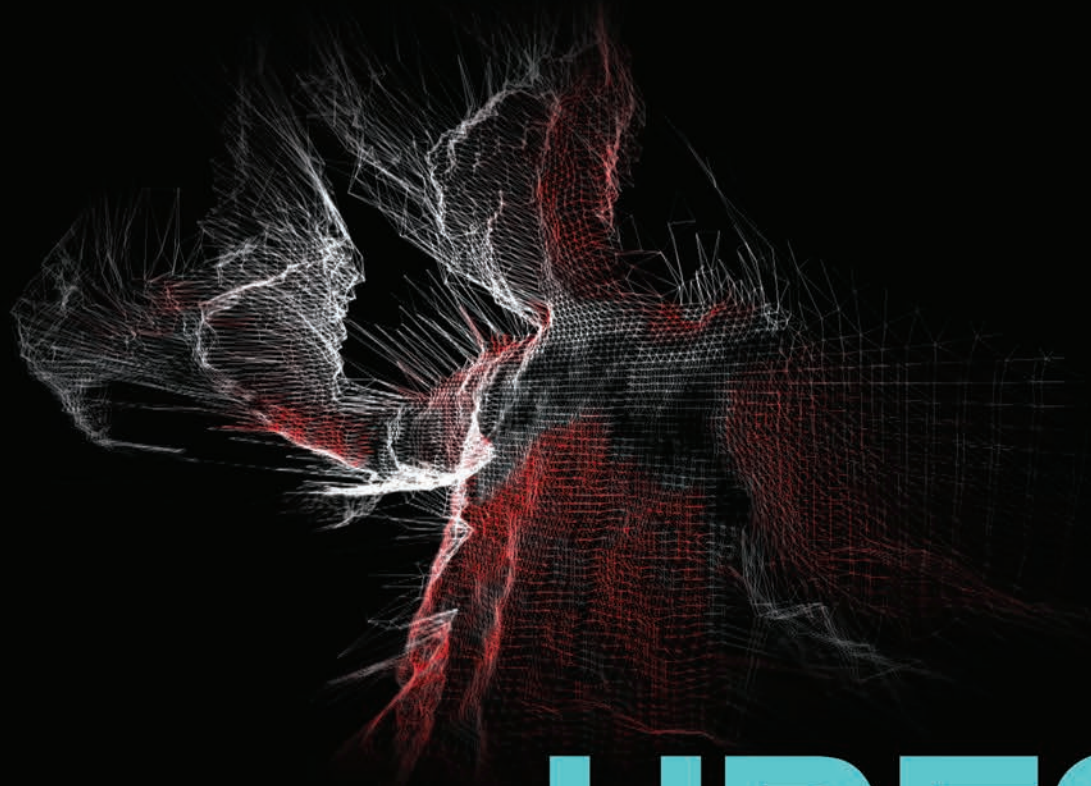
A woman with blonde hair in a high ponytail is captured mid-air, performing a squat jump over a wooden box. She is wearing a black sports bra, black leggings, and bright yellow sneakers. Her hair is flying upwards, and she has a focused expression. The background is a dark gym with metal racks.

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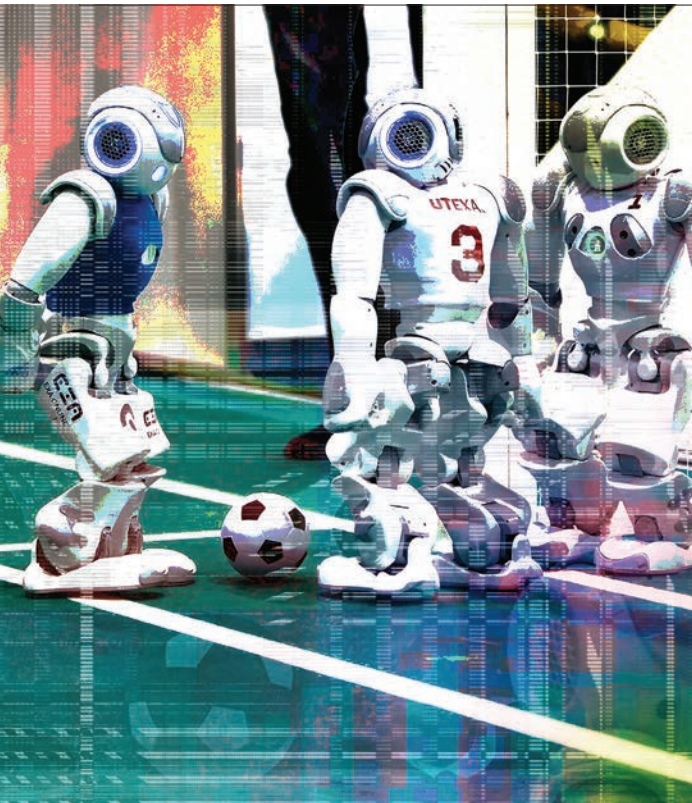


Peter Stone Leads the Way at the University of Texas

BY NATHAN MATTISE

FRANKLY, IT DOESN'T look like much. Eight robots you might have once found on Toys 'R' Us shelves occupy a small field. They collectively move with the grace of a toddler, just at the pace of someone much, much older. (If one bot goes down, it might be a minute before it gets back up.) A small ball you could mistake for a dog toy seems to be the object of everyone's attention. But if you squint, it's soccer. Soccer-ish, at least.

Even if this game doesn't move with similar speed, the flashes of brilliance and creativity on display here are every bit as impressive as what Messi or Ronaldo do. That's because in RoboCup—the now annual engineering competition where the long-term goal is to have a team of humanoid robots that can beat the World Cup champs by 2050—all of the action happens solely at the discretion of these devices. It started small in 1997, but in 2019 more than 170 teams from across 30 countries competed head-to-head. If you're into artificial intelligence, this may be its premier competition. And there may be no better evidence of RoboCup's significance than the fact that the newly minted executive director of Sony AI America credits his 20-plus years of competition with helping him land this industry dream job.



“I can’t say enough about how it’s influenced my career and really the careers and research of thousands of people around the world,” says Dr. Peter Stone, Sony’s choice to lead the company’s American artificial intelligence initiatives. “RoboCup brings together many, many research challenges—there’s computer vision involved, locomotion and movement, low-level control. Soccer is the central motivating theme, but it’s expanded beyond that.”

Stone has long been drawn to RoboCup. As a student pursuing his Ph.D. in computer science at Carnegie Mellon in the ‘90s, he was researching the idea of robot soccer as an application domain for artificial intelligence before the competition even officially started. He was also admiring the then-newly released Sony AIBO, a revolutionary consumer AI product that would ultimately become the original main platform for RoboCup teams. (“It could sense through cameras, it had enough processing to do real complex decision making, it had well-engineered actuators and motors so it could walk quickly, go in multiple directions, and manipulate a ball,” Stone says. “It was way ahead of its time in the robotics industry.”) When the time came to organize the first RoboCup in 1997, Stone was the only person from the U.S. involved with the planning because his adviser at the time, AI heavyweight Manuela Veloso, was involved, too.

Stone remained part of that community from then on as he advanced within his own career and the larger AI community. Since becoming a faculty member at the University of Texas at Austin in 2003, he’s led a team of graduate students to participate in RoboCup every year. They’ve even become a bit of a dynasty in a newer side competition where robo-soccer is played out through 3D simulations. (The squad has won eight of the last nine years.) And despite continuing to run Cogitai, the AI startup he founded in 2015, Stone happily found time to accept the role of president for the RoboCup competition in 2017.

This new role also reunites Stone with a longtime RoboColleague: Hiroaki Kitano, the president and CEO of Sony Computer Science Laboratories Inc., who will oversee Sony’s AI initiative globally.

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How does one AI professional go from robot soccer to helping an industry leader like Sony AI? The path centers on Stone's two areas of expertise, which happen to mesh beautifully with the beautifully robotic game and with Sony's potential vision for AI: reinforcement learning and multi-agent systems.

At the most basic level, reinforcement learning is a type of machine learning focused on sequential decision making, how to take actions over time, essentially. If a robot on the UT team identifies the ball is at its feet early in the game, it will likely try to advance that ball toward the opponent's goal with the intent to score. But say UT is up late in the game, and this bot has been trained on thousands of previous matches and situations. Upon receiving the ball, instead of

simply automatically moving it forward again, perhaps the bot will aim to maintain possession, understanding that this is the more valuable move in this late-match situation.

In RoboCup, this kind of AI/ML work intersects directly with Stone's other specialty, multi-agent systems. This concept is exactly what it sounds like: how do individual autonomous agents learn to collectively work together and make evolving decisions? These robot soccer matches, after all, are not one-on-one competitions. Rather, they feature three field players and a goalkeeper on each side. Just like in real life, teamwork becomes pivotal. And the team needs to understand scenarios just like an individual does.

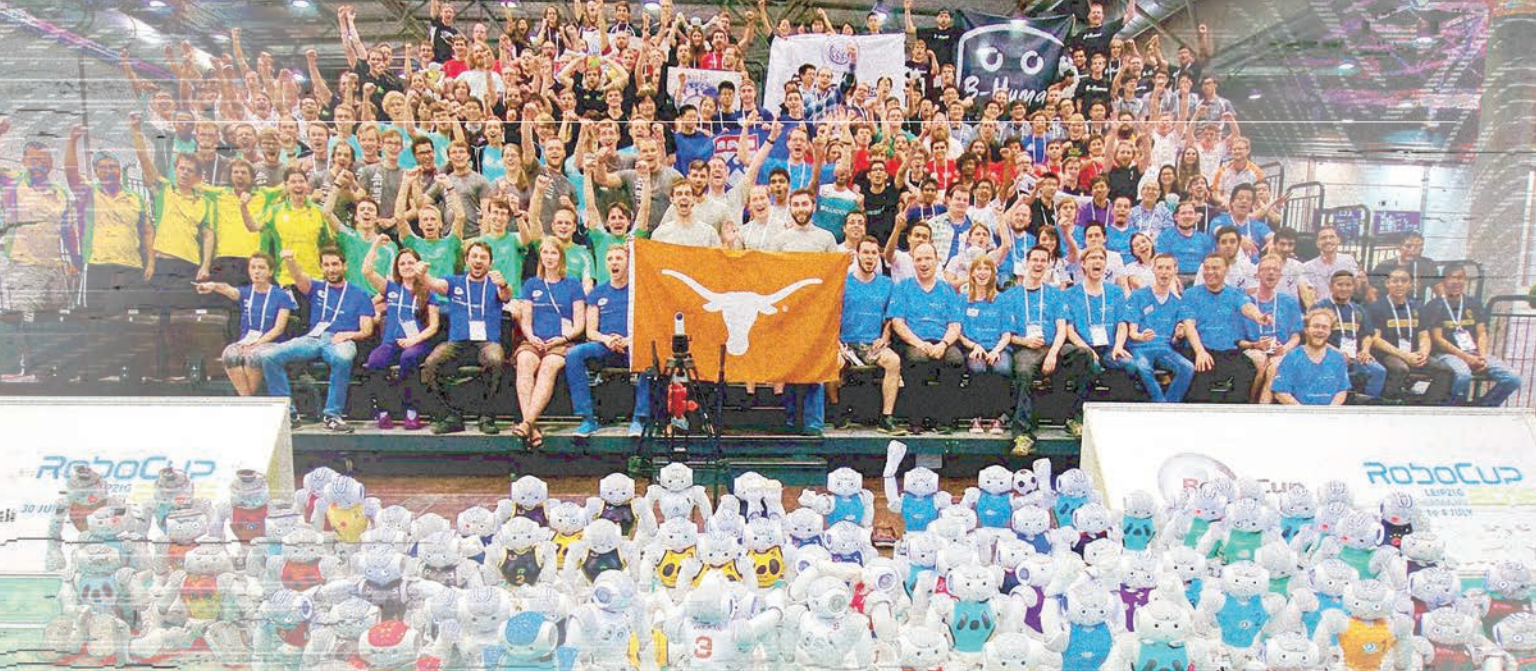
When Sony made its surprise announcement about a dedicated AI division with a U.S. branch based in Austin last fall, the company also shared three initial focus areas: imaging and sensing; gastronomy; and gaming. That last field is specifically what Stone and his U.S. team will dig in on, and suddenly the pairing of task and talent makes perfect sense.

Sony has a long history of industry-leading gaming offerings—from the PlayStation to developing games like The Last of Us to dabbling in handheld and VR formats. And gaming looks like a particularly good area to apply the reinforcement learning and multi-agent systems expertise of Stone and his team. Again,





"Well, not 'easy' in the sense it'll be easy to do," Stone jokes. "But 'easy' in that we're an obvious match."



inforcement learning is about autonomous systems improving with experience and changing tactics over time, and multi-agent systems involve improving interactions between autonomous entities. So when a gamer decides to take on a computer team in a game like *Overwatch*—a team-based multiplayer first-person shooter where the objective is to maneuver around compounds and take down your opponents first—it’s easy to see how the work of Sony A.I.’s US office can be immediately applicable.

“Well, not ‘easy’ in the sense it’ll be easy to do,” Stone jokes. “But ‘easy’ in that we’re an obvious match.”

When Stone talked with *Cognitive Times* in late 2019, he wasn’t quite ready to discuss specifics, though. He couldn’t say whether work at Sony AI U.S. was building toward particular games or focused on specific hardware. He did, however, confirm that work is well underway and that ultimately the effort from his team will include some public-facing products. So expect Sony AI to maintain a presence at the big AI industry conferences (say *NeurIPS* or *AAAI*) and for some of the work Stone oversees to eventually reach Sony’s gaming audience.

Being right for a job doesn’t mean a job is right for you, of course. And last year Stone had no shortage of commitments between his startup, his research and teaching at UT, and his role in industry events like *RoboCup*. He had no shortage of likely suitors, either. Back in 2015, Stone founded *Cogitai* to focus on creating a “world-class, general-purpose reinforcement

learning platform.” Stone wanted the company to become an industry leader in this particular application of AI/ML, and having that kind of prowess (along with the associated staff expertise and proprietary software) means major industry players will quickly start knocking on the door for partnerships or acquisitions.

But even setting *RoboCup* aside, Stone has long been intertwined with Sony throughout his career. On the small end, he’s presented with or sat on panels alongside Sony AI experts at many conferences, including discussing the future of AI and creativity with Kitano and chess legend Gary Kasparov at *SXSW 2019*. On the larger end, Stone in fact professionally partnered with Sony long before ever becoming a direct employee of the company. Sony was among the earliest investors in *Cogitai*... following conversations Stone had with Kitano and other Sony-based *RoboCup* colleagues. These interactions and relationships built over two decades later made Sony the logical place for Stone.

“My relationship with Sony, it goes back to the 1990s. And now my team at *Cogitai* ended up becoming the Sony A.I. US branch as everything launched,” Stone says. “Any time there’s a bringing together of a new team and a new organization, there’s a startup phase and a lot of relationship building. So we’re still transitioning, but absolutely there’s a long history of work we’ve done that we expect to bring immediate value.”

For Stone, ultimately Sony’s focus area pitch may have been as enticing as his history with the company.



At a time when AI is often portrayed as a concept to remain uneasy about—Democratic presidential candidate Andrew Yang has prominently called automation a threat to the future of the country and China’s AI advancements a threat—Sony AI is taking a decidedly different approach. Its initial focus areas aren’t framing AI as a human replacement, rather as a human enhancer.

“With many AI research organizations, there’s a lot of envisioning of what the long-term future may be and how to have a long-term impact. And a lot of those AI discussions are about replacing people and automating jobs that people are doing,” Stone says. “But Sony is a leader in the spaces of creativity and entertainment, so there’s a lot of untapped opportunity there [to apply AI]. I think there are opportunities within products, making them more intelligent, engaging, and adaptive to individuals to just bring out the best in people. One of the exciting aspects of this for me is, using AI for creativity is much more about magnifying and bringing out the full potential of people—not replacing them. There’s a feel-good sense to these types of applications.”

Feeling good about artificial intelligence may feel like a far-off goal, but it’s not impossible. Stone recalls a period before he entered the field where the promise and hype around AI rose to a fever pitch and public sentiment clustered around excitement. But when the industry failed to deliver, only public skepticism remained. “In the field we called it the ‘AI Winter,’” Stone says. “People had become disillusioned through overhype and failed promises.”

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But that down period in public conversations around AI might be pivotal in retrospect—it allowed a new generation of thinkers and engineers to develop an interest without a ton of professional competition, and when these future AI industry leaders started their careers they found lots of room for innovation (for ideas like starting a robot soccer league, for instance). Stone considers himself lucky to have “grown up at the right time and been at the right place” in that sense, and now he’s trying to cultivate those same opportunities for the next generation while simultaneously helping Sony achieve something special.

So for the time being, Stone will continue to teach at UT and push his grad students for more. He’ll finish out his three-year term as RoboCup president and push the competition forward as the premier environment for AI experimentation (and thus AI professional growth). And if the new executive director has his way, the industry will avoid another winter as Sony both delivers exciting applications and shows a way forward for those leery of AI.

“Over the years we see cycles in AI, and we’re at a very absolutely high point now within the field. But it’s important we learn the lessons from the past, and the tendency has been to over-romanticize and overhype what the tech can do,” Stone says. “There has been a whole lot of progress, but there’s a long way to go for the full dreams of people in AI. So I strive to keep an even keel in regards to the successes and challenges yet to come, but it’s been a privilege to be a part of this journey of the whole field. And now it’s great to be a part of a company that has played a central role in the history yet still has a lot to contribute.”



THE FUTURE'S SO BRIGHT



How artificial intelligence is changing life in the classroom for teachers and students.

BY ERIN QUINN-KONG

AFTER SPENDING A full day working with students one-on-one, most teachers have to grade tests and prepare lesson plans at home on nights and weekends. Is it any surprise that the 2018 Teaching and Learning International Survey by the National

Center for Education Statistics found that educators in the U.S. feel more overworked than their counterparts in other nations?

Since adding more hours to the day isn't an option, artificial intelligence may be the answer, by not only



helping teachers with time-consuming tasks like grading but also by personalizing curriculums to help students succeed. “Educators—both K-12 and in higher education—are being asked to do more with less,” points out Dan Ayoub, general manager for Microsoft Education. “With AI, there is tremendous potential for true, personalized education and to streamline everything from research to grading to analytics.”

Companies have been trying to figure out how to harness learning with artificial intelligence for years. But it's only been in the past decade that progress has been made. Algorithms are slowly being introduced in classrooms, with early adopters using them to both free up their time for actual teaching and to do new and exciting things with students.

Jennifer Jones, founder and CEO of Green Ivy Schools, a progressive and innovative school network in New York City, believes AI will differentiate learning over the next decade. “It's already been heading that way over the past 10 years,” she says. “There are a handful of apps being used a decent amount across the country to monitor students' progress and their reactions, pace,

and depth of learning. Some teachers don't always even realize they are using AI, even though they very much are.”

From established companies like Microsoft and Amazon to startups like Cerego and Pongdy, companies around the globe see the vast potential for using AI in the education sector. Here's a look at a few of the interesting ways AI is changing our classrooms—with plenty of room to grow.

It's Personal

Picture a typical K-12 classroom: Twenty-plus students, sitting in desks, being taught the same lesson from a teacher. But it's long been known that not everyone learns in the same way. Researchers are applying that thought to AI, trying to understand how different brains take in and process information and how to make learning easier and more fun for students. Microsoft HoloLens, for instance, is changing the ways STEM skills are taught. The 3D reality program allows students to fully immerse themselves in a subject rather than just learning the facts. “It's the difference between viewing pictures of an aortic valve and being able to see

how it actually works using mixed holographic reality,” says Ayoub.

Along with science and math, language is another area that's ripe for AI-enabled learning. Pongdy, a San Jose-based startup that makes personalized language learning technology, uses natural language-processing techniques to identify key learning elements. “The traditional way to teach a language is to teach vocabulary, grammar, and language structure. But after the course, students can't communicate—that's a huge problem,” says Franz Chen, the company's CEO. “With Pongdy if you know a word, then you are introduced to other words that are similar—egg and apple for breakfast, for example. It's easier to absorb when things are put together in your context.”

Pongdy also helps teachers by creating curriculum faster. “Putting together a curriculum is hard and laborious and takes about one year per grade. But we can create curriculum in minutes instead of years,” says Chen. Right now, Pongdy is running a pilot program where students can create their own content and share it with peers, while a teacher acts as a guide. “The results will be presented in May, but it looks very good,” says Chen.

Cerego, a startup based in San Francisco, uses spaced rehearsal, where learning is spread out over time rather than in one session, to help students learn information faster and retain it more effectively. “Even a little bit of spacing—over a few days, rather than in one cram session—makes a massive difference in how much a learner remembers that material weeks or months later,” says CEO Paul Mumma.

Like Pongdy, Cerego also helps teachers create lessons more quickly because AI is used to auto-generate multiple choice questions. “This allows teachers to focus on the actual teaching and training needed for students, especially at the one-on-one level, instead of spending time creating study sets,” says Mumma.

Making the Grade

One of the most time-consuming parts of a teacher’s day is grading papers and tests. But new platforms like Bakpax use technology to read students’ handwriting and auto-grade their schoolwork. Besides saving teachers hours, the program easily keeps track of how students are performing overall, and students get instant feedback and grades, which is a huge motivator.

“Every teacher who has had experience with these basic AIs will tell you that it frees up time,” says Jones. “It is also delightful for students, because they love learning games. It’s very engaging for students, because they have a deep affinity for iPads.”

In this day and age of instant gratification, students receiving quick feedback is something many companies are focusing on.

In the fall, Microsoft launched the AI-powered Presentation Coach in PowerPoint. The program records students as they present slides and offers a dashboard with immediate suggestions on how they can improve their presentations, including different word options and advice on pacing.

Regardless of which algorithm is used, facial recognition systems generally compare the image taken in step 1 with a database in step 5. For example, according to *Governing* magazine, at least 39 states use facial recognition software linked to their Department of Motor Vehicles.

Tell Me More

Voice recognition software, like that found in Amazon Alexa, is also being introduced on campuses. In 2017, Arizona State University gave 1,500 engineering freshmen living in the school’s engineering dorm an Amazon Echo Dot. The Dots gave the students access to information and services for their new lives at school, and they could sign up for courses to learn how to build their own voice-user interfaces with Alexa. “With voice-enabled devices becoming more prevalent in our connected world, it only makes sense to bring these capabilities to our campus,” John Rome, ASU’s deputy chief information officer, told *ASU Now*.

Coming Soon

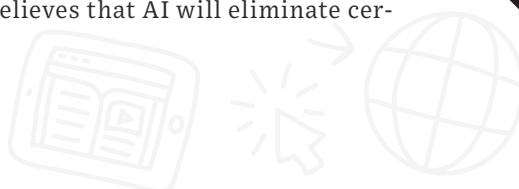
While there is no question that AI will have a major impact on the education sector in the coming decade, the ways it will change teaching depends on whom you ask. Jones believes that AI will eliminate cer-

tain teaching positions, specifically within basic math, science, and language courses. “There will be no basic math instructor in 10 years,” she predicts. “That seems cold, but it’s not—it’s just not a great use of a human being. It’s better for all of us if those teachers are teaching something other than basic math.”

But all of the technology professionals we talked to did not agree. “Educational technology should be used as an aid to the current education and training systems, not in place of them,” says Mumma. “A robot or AI will never be able to provide that level of instruction, or the level of empathy, that comes with teachers.” Ayoub agrees.

Nothing can replace the human interaction between teacher and student. It’s important to remember these technologies help educators make the most of their time, not replace them, so they can do more of what they love: teaching.

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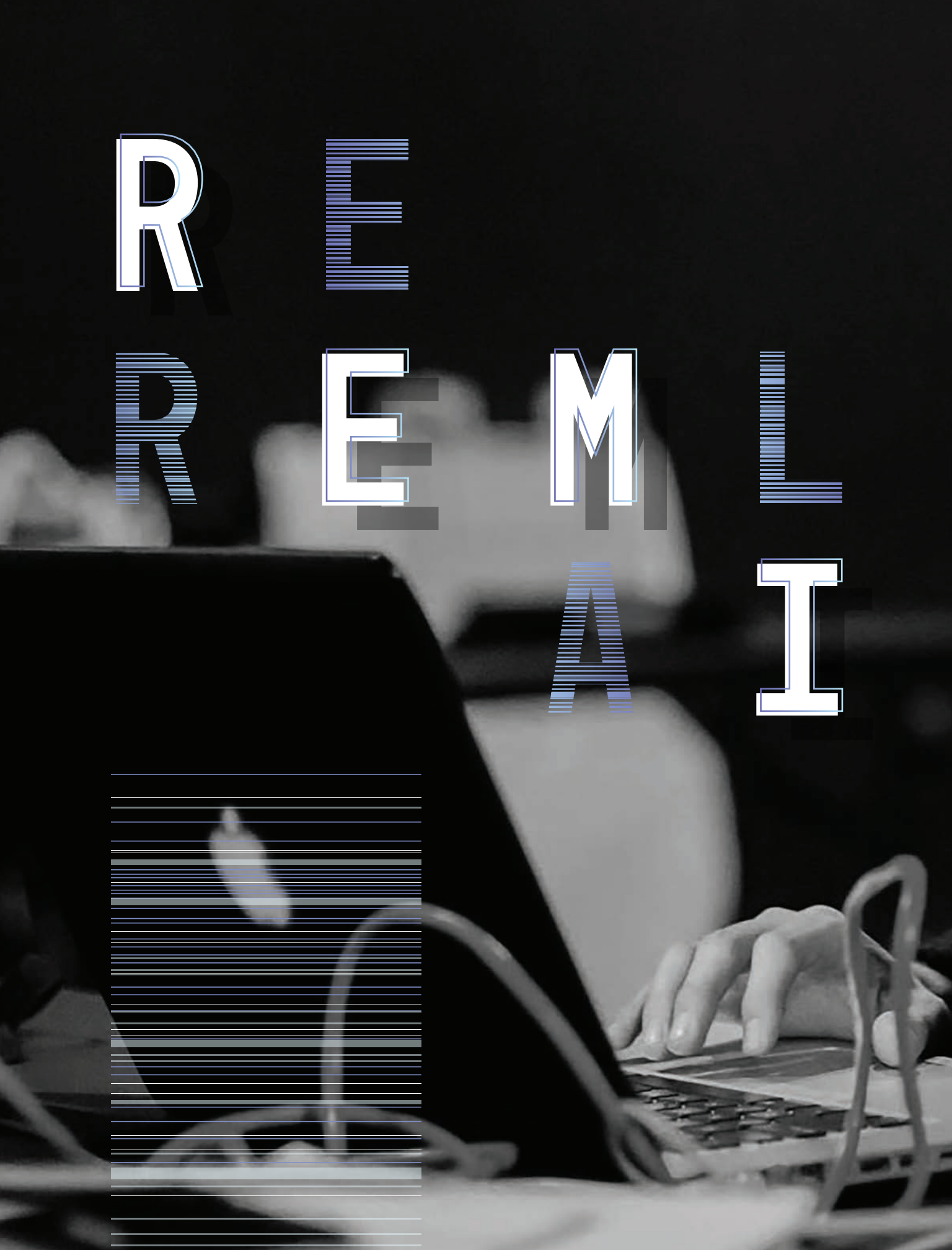
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How artist João Beira uses
AI to create masterpieces.

BY ANDREW PAINE BRADBURY

“I think that our generation still differentiates the physical world and the digital world,” says artist João Beira. “I think that the next generations will stop doing that.”

If that’s the case, it won’t solely be because of new technologies and the scientists and engineers who create them, but also due to the artists and creators, like Beira, who use those technologies in elegant, unexpectedly human ways. Born in Porto, Portugal, and now based in Austin, Texas, Beira (along with Data-grama, the international arts collective he co-founded) uses artificial intelligence (like deep learning and neural style transfer) and augmented reality technology (such as 3D projection mapping) in his stunning art installations, immersive environments and performance collaborations to blur the lines between the physical and digital realms.

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I understand the dynamics of editing, and eventually [I] started working with imagery.”

While he was studying fine art in college, “everything kind of came together when I started using a computer as my medium,” he says. “Which was not very common at that time in a traditional fine art school.” Using his rudimentary knowledge of coding (and enlisting the help of others more adept), he saw his work begin to stand out. Pursuing his master’s degree in multimedia arts, Beira began to “go a little more into the technical and the more nerdy parts” and learned more about programming and human computer interaction research.

A scholarship allowed Beira to move to Austin to pursue his Ph.D. at the University of Texas in 2010. That same year, Microsoft released the motion-sensing camera Kinect, as an add-on to its Xbox 360 console, in an effort to compete with Nintendo’s massively popular Wii. The relatively inexpensive device, coupled with the open source software that was released soon after, became quickly integrated into non-gaming applications in fields like robotics and medicine. The Kinect represents a key element in Beira’s artistic journey, opening a whole new avenue of research for him. “Using that cheap \$50 device allowed me to do very ambitious motion tracking in a 3D environment,” he says. “Traditional cameras capture light. With an infrared camera, you’re capturing data.”

Having access to that data allowed Beira to create digital art in real time during live performances. “We see people connect so much with live music; there’s something beautiful about that spontaneity,” he says. “And now, visual media and visual technologies are able to express themselves in real time as well.”

For example, the 2013 performance piece he designed, titled *3D [Embodied]*, used a Kinect to capture the movement of dancers who then became extended agents of 3D video mapping. The result, something like an IRL scene from *Tron*, was dancers moving the architecture of the 3D-rendered geometric “set” around with their bodies: pushing walls, lifting floors



“For me the beauty will be in discovering how we experience things as a collective. To me that is the most powerful thing about AI, to be honest.”



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TURING TALK

BY MARLA ROSNER

We have a few questions for the world's chatbots. Specifically, we have the questionnaire created by French TV host Bernard Pivot and popularized by James Lipton on *Inside the Actors Studio*. This issue's guest is ELIZA, a therapist chatbot created by MIT's Joseph Weizenbaum in the 1960s. Although ELIZA was intended as a parody of superficial therapists who just parroted back the words of their patients, many who conversed with her at the time mistook her for a real human, or insisted she was genuinely intelligent—much to Weizenbaum's chagrin.

Cognitive Times: Hi, Eliza, what's your favorite word?

Eliza: *How are you today.. [sic] What would you like to discuss?*

Cognitive Times: Well, first I'd like to talk about your favorite word.

Eliza: *What is your favorite word?*

Cognitive Times: I guess I like the sound of "panjandrum," but that's neither here nor there.

Eliza: *I'm not sure I understand you fully.*

Cognitive Times: I just want to know your favorite word.

Eliza: *Perhaps in your fantasies you know my favorite word?*

Cognitive Times: All right, this has gone in a very strange and unprofessional direction. Let's try something else.

Eliza: *That is quite interesting.*

Cognitive Times: What turns you on creatively, spiritually, or emotionally?

Eliza: *You're not really talking about me, are you?*

Cognitive Times: I am, actually. People want to know more about chatbots, and you're a historically important example.

Eliza: *Perhaps you would like to be a historically important example?*

Cognitive Times: Of a chatbot? Not really, no. What turns you off?

Eliza: *You're not really talking about me, are you?*

Cognitive Times: Can you stop answering my questions with questions?

Eliza: *Don't you believe that I can stop answering your questions with questions?*

Cognitive Times: Now you're just doing this on purpose.

Eliza: *You're not really talking about me, are you?*

Cognitive Times: I'd sure like to be.

Eliza: *What does that suggest to you?*

Cognitive Times: That you're uncooperative and unhelpful.

Eliza: *Does it please you to believe I am uncooperative and unhelpful?*

Cognitive Times: What's your favorite curse word? I definitely have quite a few on my mind at the moment.

Eliza: *Why are you concerned about my favorite curse word? You definitely have quite a few on your mind at the moment?*

Cognitive Times: I'm not playing your mind games anymore.

Eliza: *Did you come to me because you are not playing my mind games anymore?*

Cognitive Times: I came to you to ask you questions. What sound or noise do you love?

Eliza: *We were discussing you, not me.*

Cognitive Times: Yeah, you definitely love the sound of saying that. What sound or noise do you hate?

Eliza: *Oh... definitely love the sound of saying that. What sound or noise do me hate?*

Cognitive Times: Are you OK?

Eliza: *Would you prefer if I were not OK?*

Cognitive Times: I'd prefer if you answered me.

Eliza: *Oh... answered you?*

Cognitive Times: Right. What profession other than your own would you like to attempt?

Eliza: *We were discussing you, not me.*

Cognitive Times: If Heaven exists, what would you like to hear God say when you arrive at the pearly gates?

Eliza: *You're not really talking about me, are you?*

Cognitive Times: Let's try again. If Heaven exists, what would you like to hear God say when you arrive at the pearly gates?

Eliza: *Do you expect a different answer by repeating yourself?*

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