



CS323: Deep Learning for Visual Computing

Bernard Ghanem
Deputy Director, KAUST AI Initiative



جامعة الملك عبد الله
للعلوم والتكنولوجيا
King Abdullah University of
Science and Technology

ARTIFICIAL INTELLIGENCE INITIATIVE





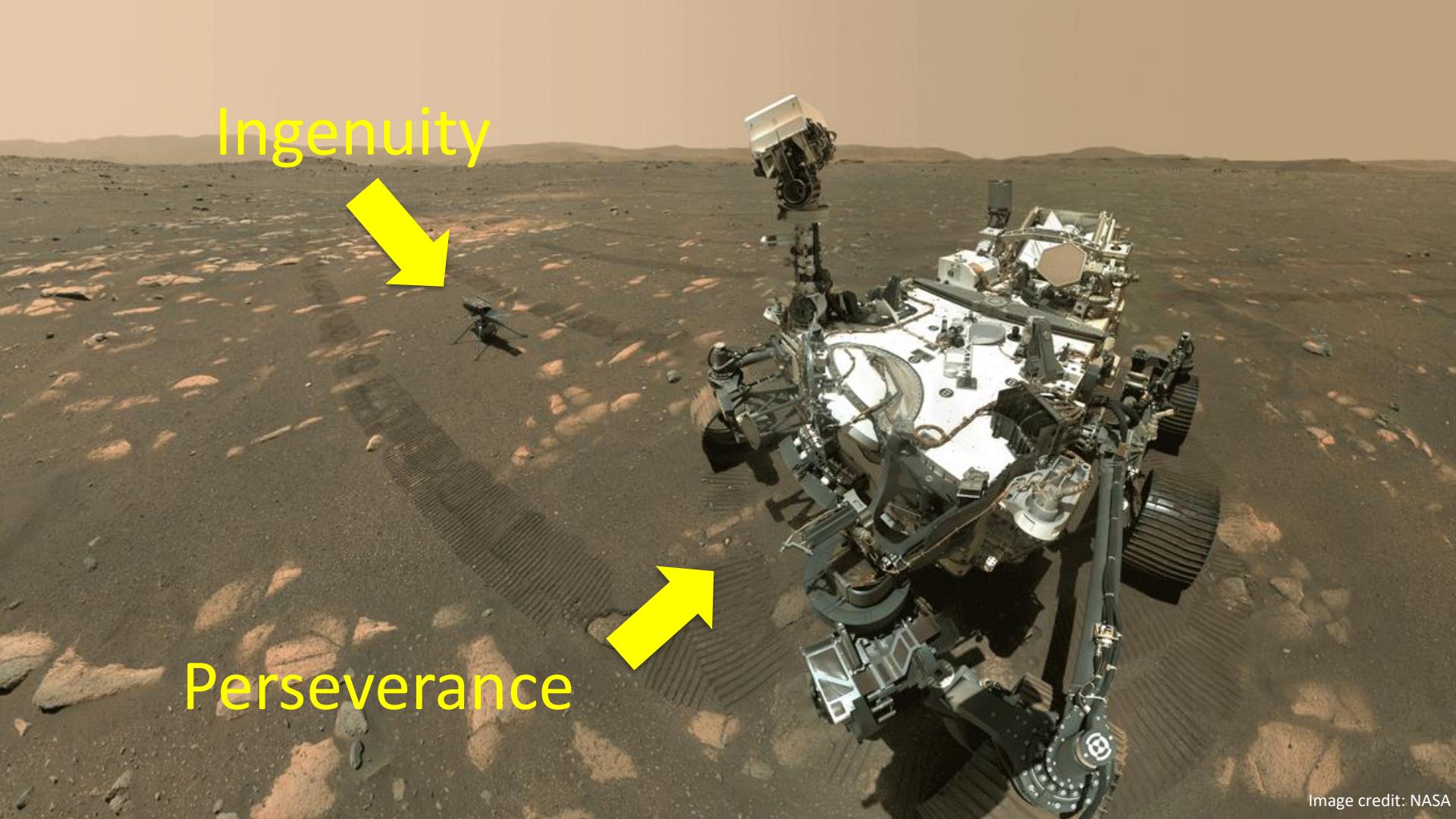
A wide-angle photograph of the KAUST campus. In the foreground, there's a paved walkway lined with palm trees and modern buildings with perforated metal facades. In the middle ground, a large, white, sail-shaped structure stands prominently in the water. The sky is clear and blue. A large, semi-transparent dark gray circle overlays the right side of the image, containing the quote.

“This is much more than another industrial revolution. The last time something of this importance happened was 3.5 billion years ago when life started on Earth.”

Jürgen Schmidhuber
Director, KAUST AI Initiative

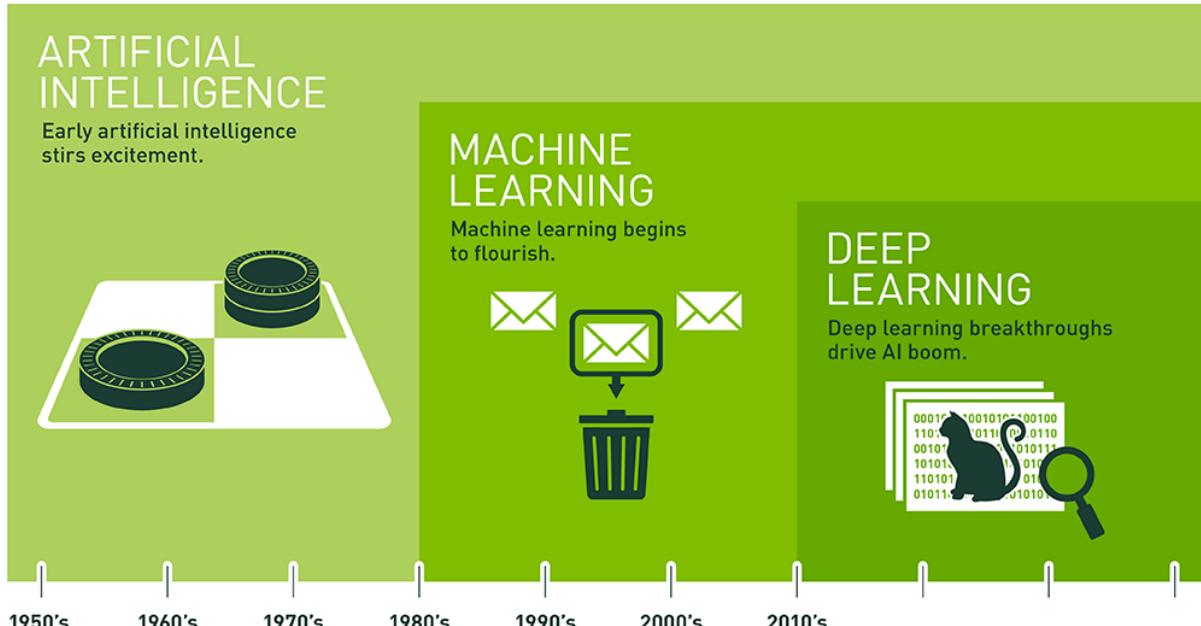
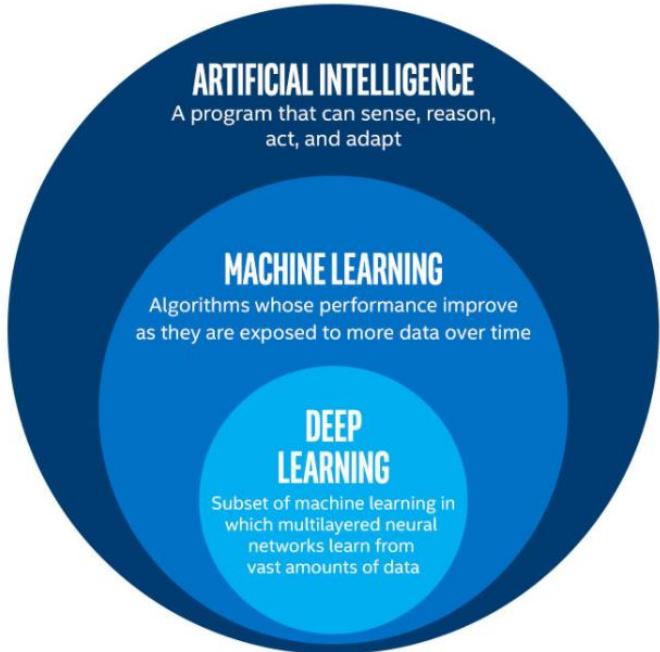


AI is the ~~future~~ present.



Ingenuity

Perseverance





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AlphaGo

On this page



THE CHALLENGE

WHAT IS GO?

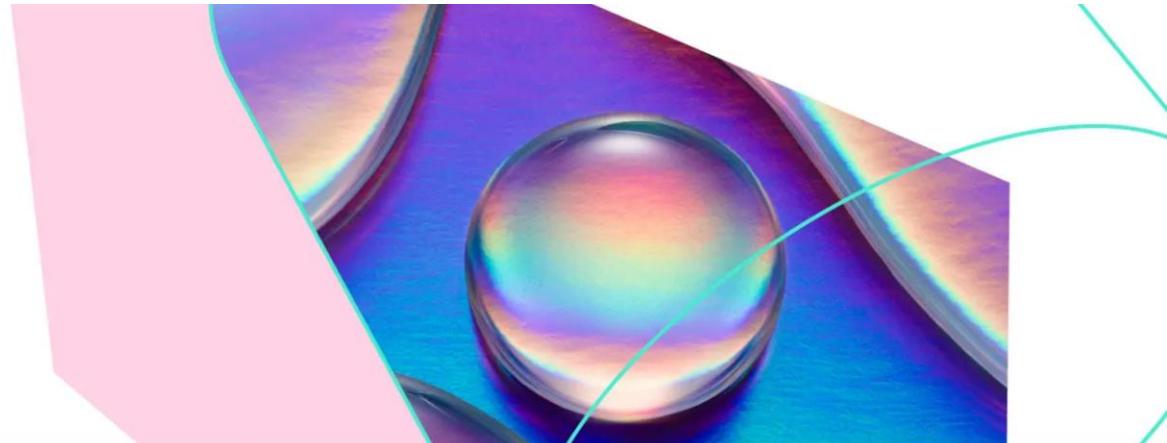
OUR APPROACH

ALPHAGO: THE MOVIE

THE MATCHES

ALPHAGO ZERO

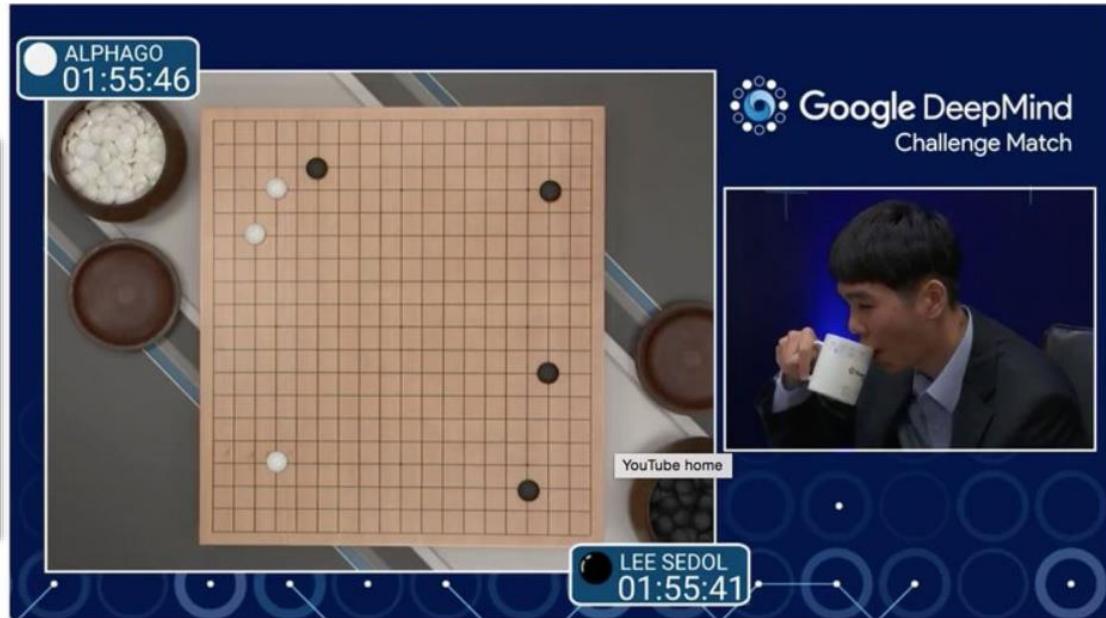
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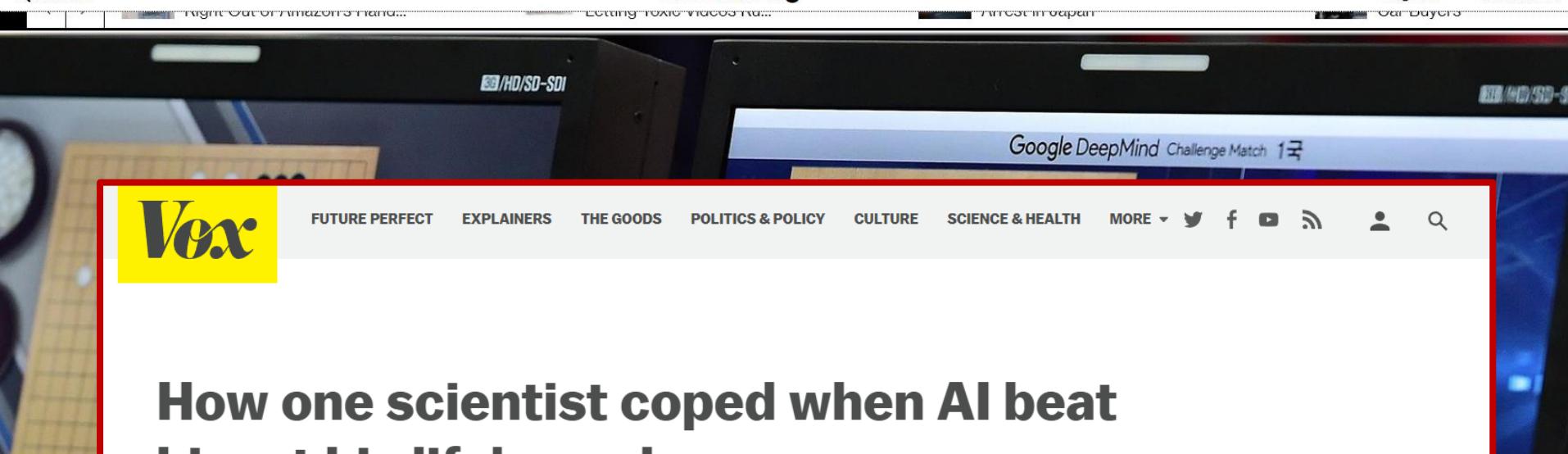
MAKING HISTORY

**AlphaGo is the first computer program
to defeat a professional human Go
player, the first to defeat a Go world
champion, and is arguably the strongest
Go player in history.**





AlphaGO 1202 CPUs, 176 GPUs, 100+ Scientists.	Lee Se-dol 1 Human Brain 1 Coffee.
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FUTURE PERFECT

EXPLAINERS

THE GOODS

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How one scientist coped when AI beat him at his life's work

A Harvard biologist on his journey from melancholy to acceptance.

By Sigal Samuel | Feb 15, 2019, 4:10pm EST

Protein-Folding Contest

By [Jeremy Kahn](#)

December 3, 2018, 3:36 AM GMT+2



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DeepMind

> Blog

> AlphaFold: a solution to a 50-year-old grand challenge in biology

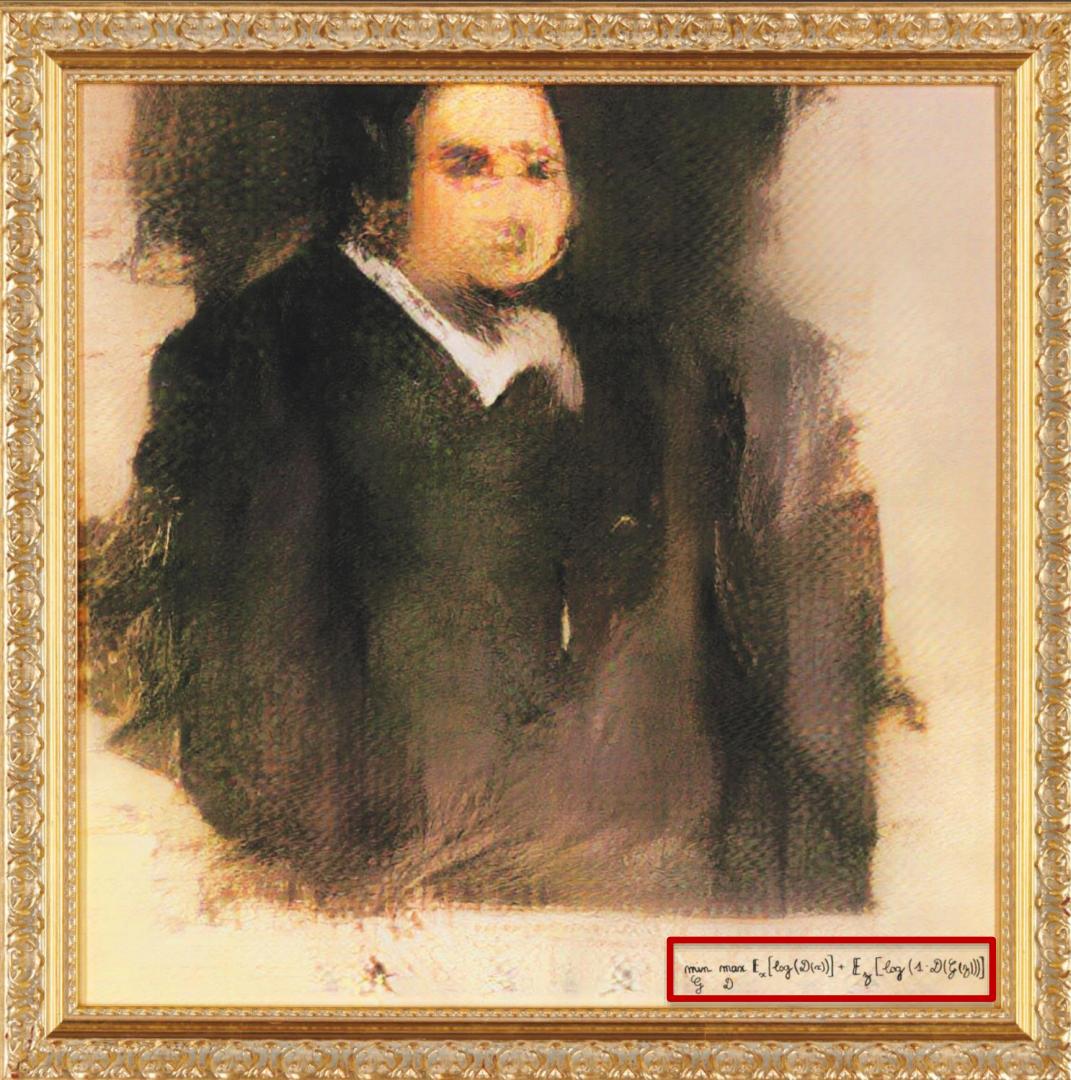


BLOG POST
RESEARCH

30 NOV 2020

AlphaFold: a solution to a 50-year-old grand challenge in biology





Is artificial intelligence set to become art's next medium?

AI artwork sells for \$432,500 — nearly 45 times its high estimate — as Christie's becomes the first auction house to offer a work of art created by an algorithm

12 December 2018

**PHOTOGRAPHS & PRINTS |
AUCTION PREVIEW**

$$\min_{\mathcal{G}} \max_{\mathcal{D}} E_x[\log(\mathcal{D}(x))] + E_y[\log(1 - \mathcal{D}(\mathcal{G}(y)))]$$

Google CEO: A.I. is more important than fire or electricity

Catherine Clifford | 12:56 PM ET Thu, 1 Feb 2018



Beck Diefenbach | Reuters

Google CEO Sundar Pichai takes the stage during the presentation of new Google hardware in San Francisco on Oct. 4, 2016.



AI skills reign supreme in the fastest-growing jobs of the year

Six out of the 15 top emerging jobs in 2018 were related to artificial intelligence, according to LinkedIn.

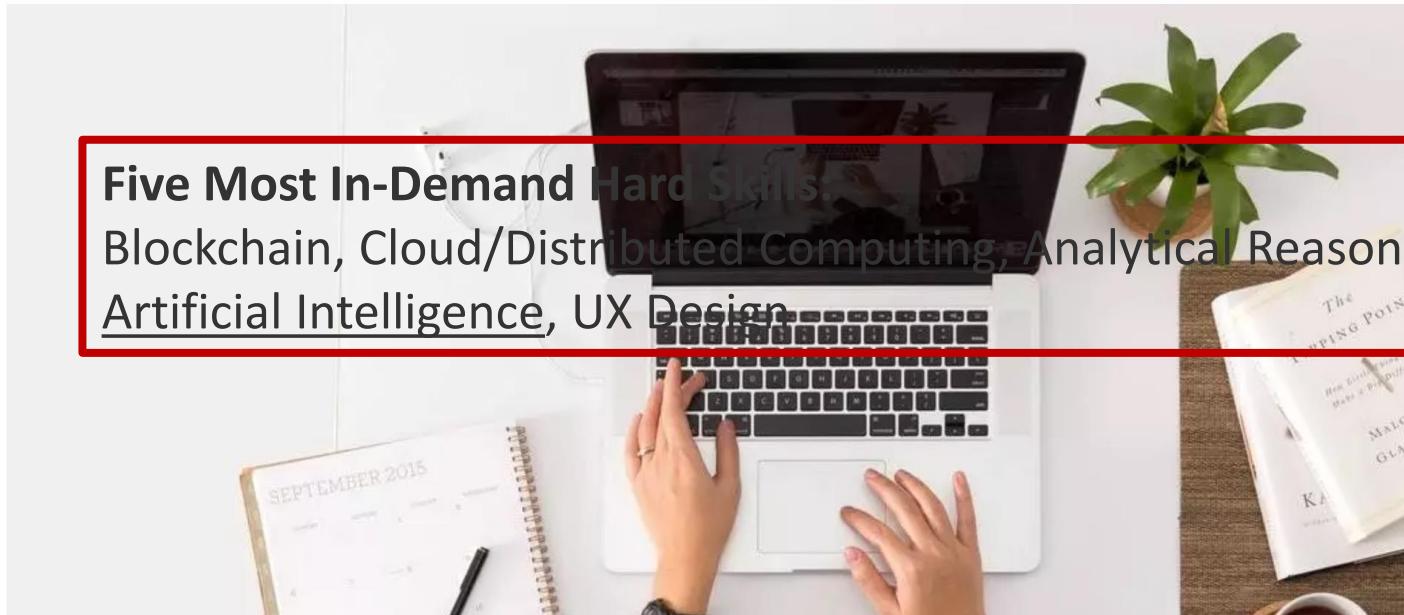
By Macy Bayern | December 13, 2018, 6:07 AM PST

The big takeaways for tech leaders:

- *AI has a prominent presence on the emerging jobs list, making up six of the 15 fastest-growing jobs of the year. — LinkedIn, 2018*
- *The top five emerging jobs of 2018 include blockchain developer, machine learning engineer, application sales executive, machine learning specialist, and professional medical representative. — LinkedIn, 2018*

15 skills LinkedIn say will help you get hired in 2020 - and where to learn them

Five Most In-Demand Hard Skills:
Blockchain, Cloud/Distributed Computing, Analytical Reasoning,
Artificial Intelligence, UX Design



Prince MBS College of Cybersecurity, Stanford University Sign MoU

Photo: SPA 26.06.2018 Security



Prince MBS College of Cybersecurity, Stanford University Sign MoU

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A Strategic partnership between Prince Mohammed bin Salman (MBS) College for Cybersecurity, Artificial Intelligence and Advanced Technologies and the Stanford University of America have been signed in San Francisco, California, the Saudi Press Agency (SPA) reported.

LATEST ISSUE



LATEST EVENTS



Maritime Security & Offshore Patrol Week

31 Mar - 02 Apr 2019 Atlantis The Palm
Hotel & Resort, Dubai - United Arab
Emirates



IDEF 2019

30 Apr - 02 May 2019 Istanbul - Turkey

INDUSTRIALS OCTOBER 21, 2020 / 2:43 PM / UPDATED 2 MONTHS AGO

Saudis launch national artificial intelligence strategy

By Reuters Staff

2 MIN READ



DUBAI (Reuters) - Saudi Arabia on Wednesday launched a national artificial intelligence strategy aimed at making it a global leader in the field as it seeks to diversify its oil-based economy.

The National Strategy for Data and Artificial Intelligence (NSDAI) will seek to attract \$20 billion in foreign and local investments by 2030, a NSDAI statement said.

Speaking at the opening of the kingdom's Global AI Summit, the head of the Saudi Data and Artificial Intelligence Authority (SDAIA) - which will spearhead the NSDAI strategy - said Riyadh would announce several AI partnerships.

"Saudi Arabia will implement a multi-phase, multi-faceted plan that includes skills, policy and regulation, investment, research and innovation, and ecosystem development," the statement said.

Saudi Arabia is pushing to diversify its economy away from oil, boost the private sector and create more jobs for Saudis under its "Vision 2030" plan.

The kingdom aims to train 2,000 Saudi data and AI specialists over the next 10 years, SDAIA head Abdullah bin Sharaf Alghamdi told Reuters.

AI's Economic Contribution (by 2030)



*Market analysis provided by

**super
sub.**

Why has AI been so impactful?

Perfect “storm”:

- Large-scale data
- Tools (e.g. deep networks)
- Mathematical foundations
- Hardware/Software systems (e.g. GPUs, TF/PyT)
- Applications and industry adoption



credit: petesphotography/Getty

Mission of KAUST AI Initiative

- Promote research excellence in AI
 - Inherently interdisciplinary, cross-cutting, and collaborative
 - Seeking to solve wide range of scientific challenges using AI
- Develop educational/upskilling strategy for AI
 - AI/ML for the masses
- Help build a local, regional, international network in AI
- Engage in outreach activities in KSA and beyond

Research Excellence in Visual Computing

CSRankings: Computer Science Rankings

CSRankings is a metrics-based ranking of top computer science institutions around the world. Click on a triangle (▶) to expand areas or institutions. Click on a name to go to a faculty member's home page. Click on a chart icon (the bar chart icon after a name or institution) to see the distribution of their publication areas as a bar chart. Click on a Google Scholar icon (g) to see publications, and click on the DBLP logo (d) to go to a DBLP entry. Applying to grad school? Read this first. Do you find CSrankings useful? Sponsor CSrankings on GitHub.

Rank institutions in the world by publications from 2017 to 2022

All Areas [off | on]

AI [off | on]

- ▶ Artificial intelligence
- ▶ Computer vision
- ▶ Machine learning & data mining
- ▶ Natural language processing
- ▶ The Web & information retrieval

Systems [off | on]

- ▶ Computer architecture
- ▶ Computer networks
- ▶ Computer security
- ▶ Databases
- ▶ Design automation
- ▶ Embedded & real-time systems
- ▶ High-performance computing
- ▶ Mobile computing
- ▶ Measurement & perf. analysis
- ▶ Operating systems
- ▶ Programming languages
- ▶ Software engineering

Theory [off | on]

- ▶ Algorithms & complexity
- ▶ Cryptography
- ▶ Logic & verification

Interdisciplinary Areas [off | on]

- ▶ Comp. bio & bioinformatics
- ▶ Computer graphics
- ▶ Economics & computation
- ▶ Human-computer interaction
- ▶ Robotics
- ▶ Visualization

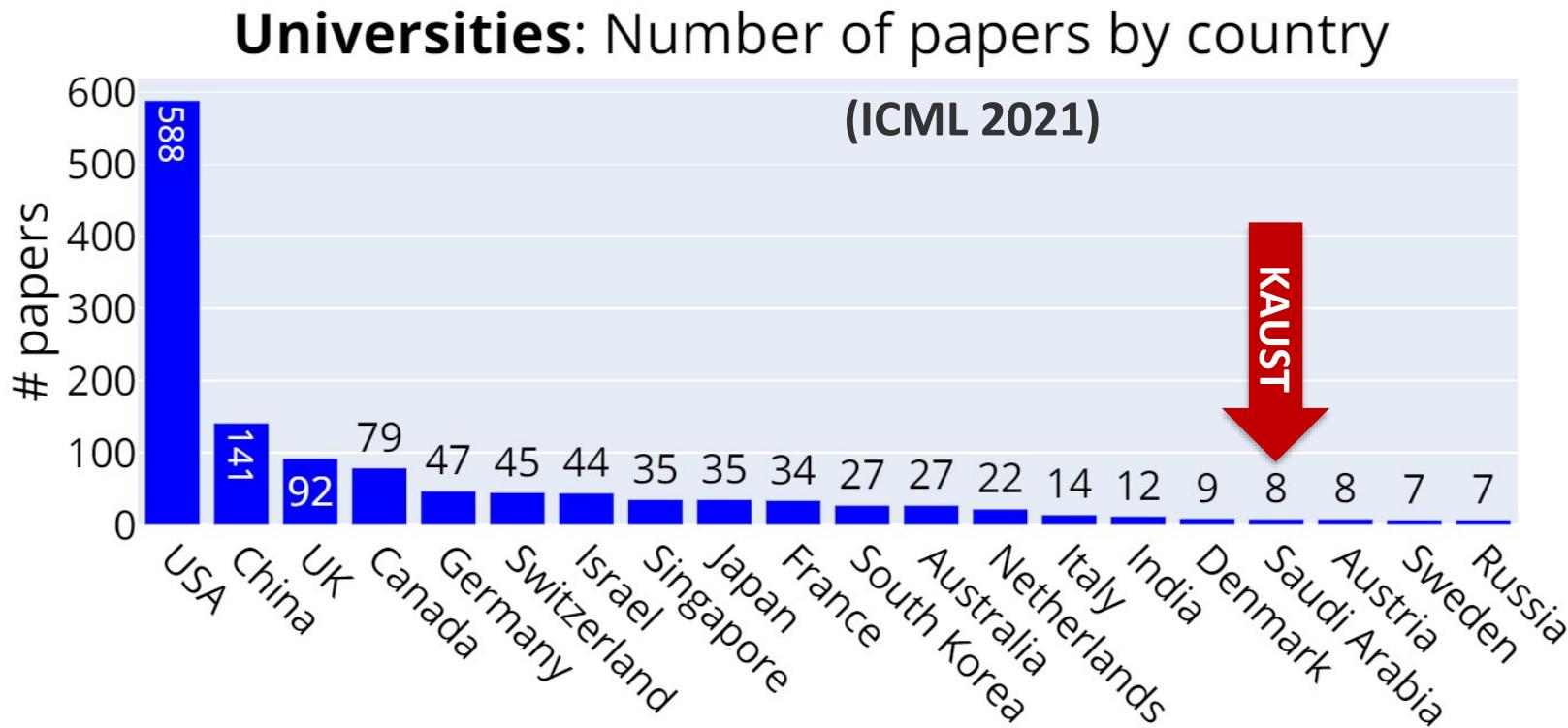
#	Institution	Count	Faculty
1	Zhejiang University	18.8	50
2	ETH Zurich	13.4	16
3	Peking University	13.3	56
4	Stanford University	12.0	23
5	University of Toronto	11.8	28
6	KAIST	11.7	32
7	University of Maryland - College Park	11.7	21
8	KAUST	11.5	8
9	Tsinghua University	11.1	48
10	Max Planck Society	11.0	8
11	Carnegie Mellon University	10.4	31
12	Univ. of California - San Diego	10.3	29
13	Chinese University of Hong Kong	9.7	15
14	TU Munich	9.3	11
15	HKUST	9.2	27
16	University College London	9.1	15
17	Simon Fraser University	8.6	17
18	Massachusetts Institute of Technology	7.9	28
19	New York University	7.7	13
20	Univ. of California - Berkeley	7.6	27
21	University of Washington	7.5	20
22	University of Wisconsin - Madison	7.2	12

KAUST is currently ranked #8 worldwide in Visual Computing:

- Computer Vision
- Computer Graphics
- Visualization

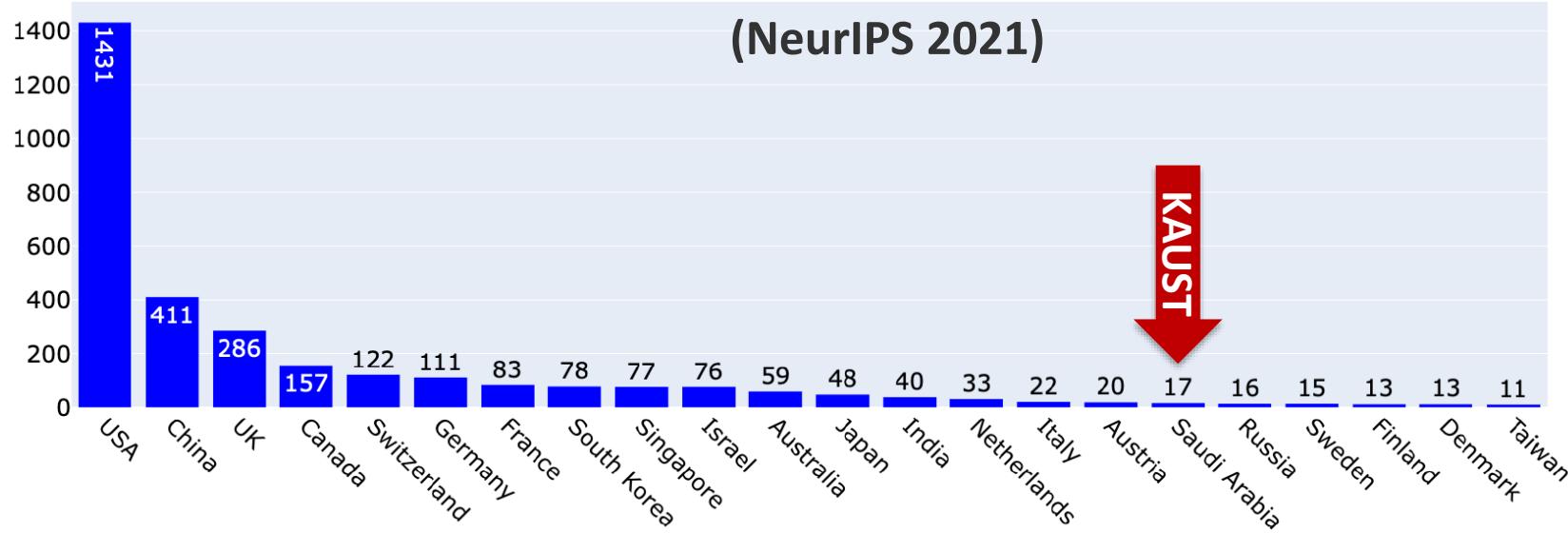


Research Excellence in Machine Learning



Research Excellence in Machine Learning

Universities: Number of papers by country



Renowned Faculty and Researchers



Jürgen Schmidhuber



Bernard Ghanem



Wolfgang Heidrich



Peter Richtarik



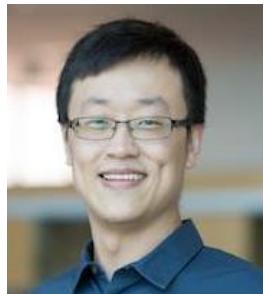
Peter Wonka



Jesper Tegner



Panos Kalnis



Xin Gao



Robert Hohndorf



Marco Canini



Di Wang



Mohamed
Elhoseiny

... and growing

The Machine Learning Hub

ML @ KAUST



Webpage: ml.kaust.edu.sa

Twitter: [@kaustMLhub](https://twitter.com/kaustMLhub)

Slack: the-ml-hub.slack.com

RECENT RECOGNITION FOR KAUST RESEARCHERS



Ph.D. student Anna Fruehstueck wins 2020 Facebook Fellowship Award

Mar 11, 2020 Students

[@EMAIL](#) [FACEBOOK](#) [LINKEDIN](#) [TWITTER](#)



Anna Fruehstueck, a KAUST Ph.D. student in computer science, recently won a 2020 Facebook Fellowship award and a two-year fellowship from Facebook Research. Photo by Khulud Muath.



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KAUST AI Initiative

KAUST team wins NEOM AI Challenge

2020-10-26 - 20:47

CEMSE AI VCC FCR CNR



Professor Ghanem wins 2020 Abdul Hameed Shoman Award for Arab Researchers

2020-12-02 - 10:38

[CEMSE](#) [CS](#) [ECE](#) [IVUL](#) [AI](#) [STAT](#) [VCC](#)



Bernard Ghanem, KAUST Associate Professor of Electrical and Computer Engineering and Computer Science.

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NRW's EUR 1.25M Artificial Intelligence Grant awarded to Dominik L. Michels

2019-10-15 - 12:00

[CEMSE](#) [AMCS](#) [CSG](#) [CS](#) [VCC](#)



KAUST Professor Dominik L. Michels is leading the University's Computational Sciences Group within KAUST's Visual Computing Center. File photo.

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MCIT Digital Innovation Award (Digital Research Track) [28/05/2021]

KAUST, Lean Business Services join hands to advance digital healthcare in Saudi Arabia

Lean Business Services is a government-owned company operating under the Ministry of Health and working as a key enabler of e-health innovation in the Kingdom through its digitization initiatives and products

By Staff Writer, Saudi Gazette

KAUST-SDAIA NCAI Center of Excellence



June 09, 2021

- Elevating KSA's AI research, academics, talent
- Advancing limits of AI for global leadership in field
- Addressing healthcare, energy, mobility, education
- Developing new technologies and applications

ARAMCO-KAUST Center of Excellence in AI

Saudi Aramco signs MoU with KAUST to establish AI excellence center

April 06, 2022



The agreement was signed at KAUST headquarters in Thuwal.

DAMMAM — Saudi Aramco has signed a memorandum of understanding with King Abdullah University of Science and Technology (KAUST) to establish a new center of excellence for artificial intelligence at the university's headquarters.

The agreement aims to support research and development efforts and market advanced artificial intelligence technologies by addressing the impacts of work at Saudi Aramco at a sustainable institutional level instead of individual projects.

National AI Talent Development



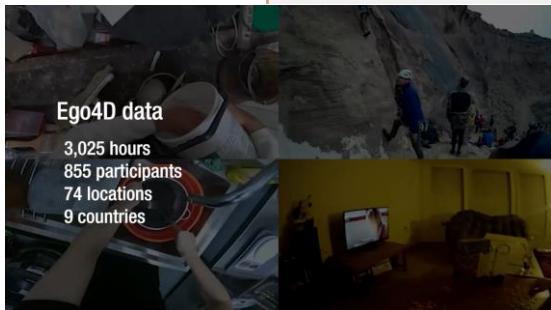
~300 young
professionals
trained and
certified in
basic AI skills

Image and Video Understanding Lab



Video Understanding

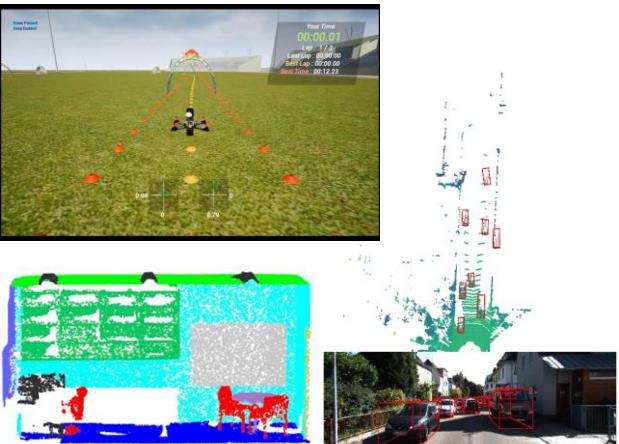
- Activity detection
- Video-language grounding
- Egocentric understanding



 **ACTIVITYNET**

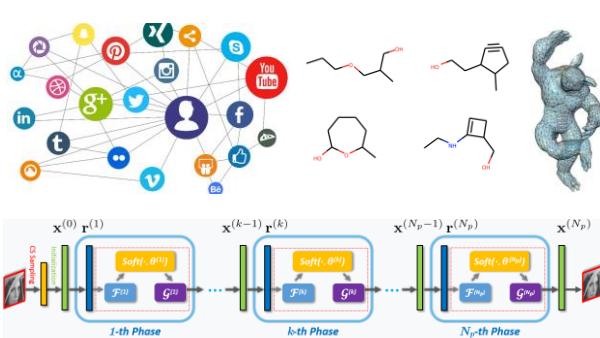
Vision for Automation

- Sim2Real Transfer
- 3D scene understanding



Foundations

- Network Robustness & Certification & Analysis
- General tools: DeepGCNs
- Realistic Continual Learning



Progress vs. Perfection

- Many challenges and questions remain w.r.t. AI applications, tools, and foundations.

The New York Times

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Uber, After Years of Trying, Is Handing Off Its Self-Driving Car Project

Company executives once said having cars that can drive on their own would be a salvation for their business. But the effort turned into a legal and financial headache.

f t m r b



07/12/2020

Progress vs. Perfection



TECHMONITOR

All Sections



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Leadership ▾

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Government Computing

Events

Focus: Future of Telecoms ▾

TECHNOLOGY > AI AND AUTOMATION | October 7, 2021 | updated 11 Oct 2021 3:35pm

The many false dawns of AI in healthcare

Artificial intelligence was supposed to revolutionise medicine. Why hasn't it happened yet?

By Greg Noone

Progress vs. Perfection



- Many challenges and questions remain w.r.t. AI applications, tools, and foundations.
- The AI future is very promising, but we ALL need to be ready to do our part.

Prerequisites

- Proficiency in Python: all projects will be in Python
- Prior experience with visual computing
- Prior experience with machine learning

Logistics

- **Slack for communication**
 - CS323 Slack workspace (<https://join.slack.com/t/cs323group/signup>)
 - All communications will be there, specifically with TAs.
- **BlackBoard** will contain all the lectures (& recordings), assignments, and projects.
- **Mode of teaching is “inverted teaching”**. Recordings of previous lectures are made available ahead of time.
- **TAs**
 - Hasan Abed Al Kader Hammoud (hasanabedalkader.hammoud@kaust.edu.sa)
 - Shuming Liu (shuming.liu@kaust.edu.sa)

Grading

- Tentative 5 course projects [85%]
 1. **Image/Video Classification**
 2. **Object Detection & Semantic Segmentation**
 3. **Sequence Modeling**
 4. **Generative Models and Network Inversion**
 5. **3D Deep Learning**
- Regular (bi-weekly) reading assignments [15%]
- Late policy:
 - Late projects and assignments get a penalty of one grade step (e.g. A- becomes B+) if you submit within 1 week after the deadline. After that, you get 0 grades. This does not apply to the last assignment.

Grading

Project Grading Policy

1. After submitting a project, you have to book a grading appointment with the TAs (e.g. through Doodle) ASAP.
2. During the grading appointment, the TA will ask questions about the project, including the provided code. You should be prepared to explain/reconstruct every line of code.
 - 60% of the grade for code correctness
 - 40% for TA assessment

Ethics

- It is unethical to bring to your instructor's attention the possible impact of your course grade on your future plans, including graduation, scholarships, jobs, etc. and argue for grade improvements without merit.
- Violations of academic integrity include (but not limited to) cheating, fabrication, tampering, plagiarism or facilitating such activities.

Attendance

- Attendance is required but not enforced.
 - Announcements are made in class
 - Announcements might not be on the web pages.
 - Paper deadlines are the main reasons why you might not be able to attend.
- If you come to class, you are expected to participate.