Science and Technology:
Today, they are more important than ever

George Neofotistos, Ph.D.

Harvard University

(School of Engineering and Applied Sciences)

&

University of Crete

(Institute for Theoretical and Computational Physics, Physics Dept)

Harvard John A. Paulson
School of Engineering
and Applied Sciences

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mRNA to the Rescue

Briefing | The medicine is the message

Covid-19 vaccines have alerted the world to the power of RNA therapies

And the molecule has many more tricks up its sleeve

Massachusetts Institute of Technology

Education Research Innovation Admissions + Aid Campus Life News Alı

MIT News

ON CAMPUS AND AROUND THE WORLD

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MIT reshapes itself to shape the future

Gift of $350 million establishes the MIT Stephen A. Schwarzman College of Computing, an unprecedented, $1 billion commitment to world-changing breakthroughs and their ethical application.

Watch Video

MIT News Office
October 15, 2018

The Harvard Crimson

Chan Zuckerberg Initiative Pledges $500 Million for AI Institute at Harvard

The Kempner Institute for the Study of Natural and Artificial Intelligence will open at the Science and Engineering Complex by the end of 2022. By Thomas Maisonneuve

MAGAZINE · SPACE X

Elon Musk's fledgling Starlink satellite network has become a lifeline in Ukraine

BY VIVIENNE WALT
May 31, 2022 10:00 PM GMT+3

The New York Times

June 13, 2022

Can We Tech Our Way Out of Climate Change?

The billionaire venture capitalist John Doerr offers his views on what Silicon Valley's elite can — and can't — do about our global crisis.

SUSTAINABLE DEVELOPMENT GOALS

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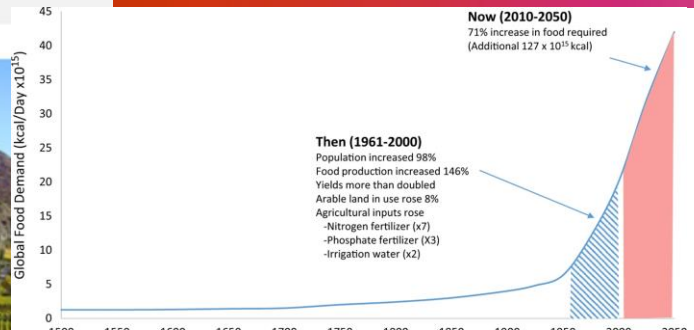
Green economy could create 24 million new jobs



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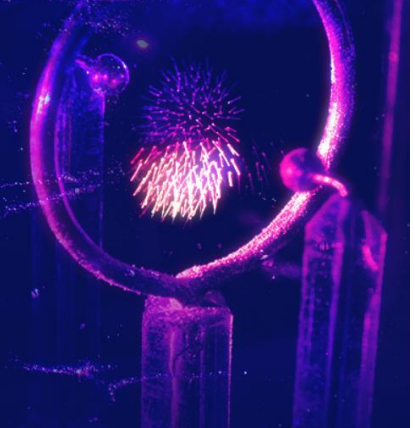
QUANTUM FLAGSHIP

Discover Q About QF Registration

The future is Quantum.

The Second Quantum Revolution is unfolding now, exploiting the enormous advancements in our ability to detect and manipulate single quantum objects. The Quantum Flagship is driving this revolution in Europe.

LEARN MORE

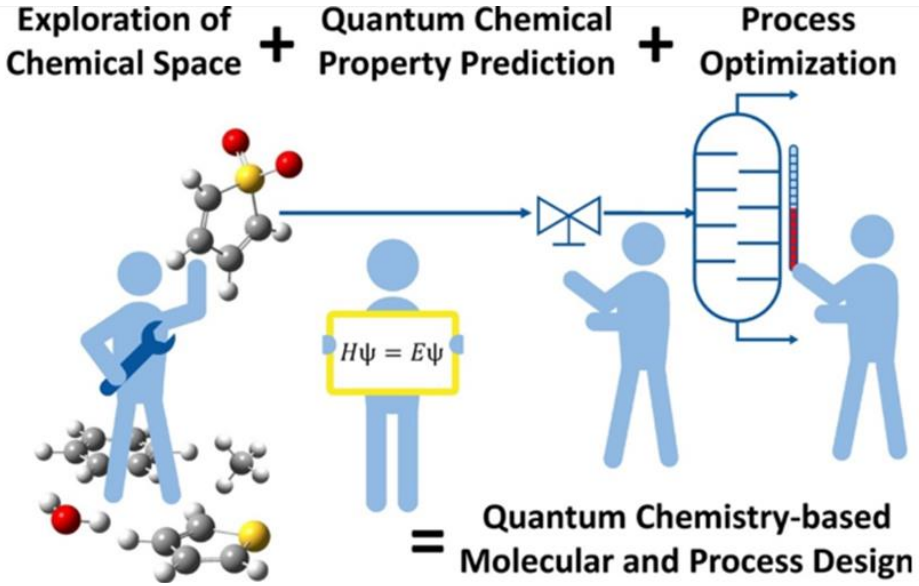


Quantum technologies:

to help design new molecules, and provide enhanced security and communication capabilities

Computer-aided molecular and processes design based on quantum chemistry: current status and future prospects

Christoph Gertig [1], Kai Leonhard [1], André Bardow [1,2]



nature

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Article | Open Access | Published: 25 May 2022

Qubit teleportation between non-neighbouring nodes in a quantum network

S. L. N. Hermans, M. Pompili, H. K. C. Beukers, S. Baier, J. Borregaard & R. Hanson

Nature **605**, 663–668 (2022) | Cite this article

44k Accesses | **1** Citations | **435** Altmetric | Metrics

Abstract

Future quantum internet applications will derive their power from the ability to share

Cornell University

arXiv > quant-ph > arXiv:2201.02773

Quantum Physics

[Submitted on 8 Jan 2022 (v1), last revised 27 Jun 2022 (this version, v4)]

A Survey of Quantum Computing for Finance

Dylan Herman, Cody Googin, Xiaoyuan Liu, Alexey Galda, Ilya Safro, Yue Sun, Marco Pistoia, Yuri Alexeev

Quantum computers are expected to surpass the computational capabilities of classical computers during this decade and have transformative impact on numerous industry sectors, particularly finance. In fact, finance is estimated to be the first industry sector to benefit from quantum computing, not only in the medium and long terms, but even in the short term. This survey paper presents a comprehensive summary of the state of the art of quantum computing for financial applications, with particular emphasis on stochastic modeling, optimization, and machine learning, describing how these solutions, adapted to work on a quantum computer, can potentially help to solve financial problems, such as derivative pricing, risk modeling, portfolio optimization, natural language processing, and fraud detection, more efficiently and accurately. We also discuss the feasibility of these algorithms on near-term quantum computers with various hardware implementations and demonstrate how they relate to a wide range of use cases in finance. We hope this article will not only serve as a reference for academic researchers and industry practitioners but also inspire new ideas for future research.

Comments: 60 pages, 5 figures

Subjects: **Quantum Physics (quant-ph)**; Computational Finance (q-fin.CP)

Neuromorphic computing and engineering

to reduce power consumption of IT infrastructures, and achieve better performance (by neural like electronic circuitry)

nature computational science

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nature › nature computational science › perspectives › article

Perspective | Published: 31 January 2022

Opportunities for neuromorphic computing algorithms and applications

Catherine D. Schuman, Shruti R. Kulkarni, Maryam Parsa, J. Parker Mitchell, Prasanna Date & Bill Kay

Nature Computational Science **2**, 10–19 (2022) | Cite this article

13k Accesses | **4** Citations | **19** Altmetric | Metrics

Cornell University

We gratefully acknowledge support from the Simons Foundation and member institutions.

arXiv > cs > arXiv:2105.05956

Search... All fields Search

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Computer Science > Emerging Technologies

[Submitted on 12 May 2021 (v1), last revised 13 Jan 2022 (this version, v3)]

2022 Roadmap on Neuromorphic Computing and Engineering

Dennis V. Christensen, Regina Dittmann, Bernabé Linares-Barranco, Abu Sebastian, Manuel Le Gallo, Andrea Redaelli, Stefan Slesazeck, Thomas Mikolajick, Sabina Spiga, Stephan Menzel, Ilia Valov, Gianluca Milano, Carlo Ricciardi, Shi-Jun Liang, Feng Miao, Mario Lanza, Tyler J. Quill, Scott T. Keene, Alberto Salleo, Julie Grollier, Danijela Marković, Alice Mizrahi, Peng Yao, J. Joshua Yang, Giacomo Indiveri, John Paul Strachan, Suman Datta, Elisa Vianello, Alexandre Valentian, Johannes Feldmann, Xuan Li, Wolfram H.P. Pernice, Harish Bhaskaran, Steve Furber, Emre Neftci, Franz Scherr, Wolfgang Maass, Srikanth Ramaswamy, Jonathan Tapson, Priyadarshini Panda, Youngeun Kim, Gouhei Tanaka, Simon Thorpe, Chiara Bartolozzi, Thomas A. Cleland, Christoph Posch, Shih-Chii Liu, Gabriella Panuccio, Mufti Mahmud, Arnab Neelim Mazumder, Morteza Hosseini, Tinoosh Mohsenin, Elisa Donati, Silvia Tolu, Roberto Galeazzi, Martin Ejsing Christensen, Sune Holm, Daniele Ielmini, N. Pryds

Modern computation based on the von Neumann architecture is today a mature cutting-edge science. In the Von Neumann architecture, processing and memory units are implemented as separate blocks interchanging data intensively and continuously. This data transfer is responsible for a large part of the power consumption. The next generation computer technology is expected to solve problems at the exascale with 1018 calculations each second. Even though these future computers will be incredibly powerful, if they are based on von Neumann type architectures, they will consume between 20 and 30 megawatts of power and will not have intrinsic physically built-in capabilities to learn or deal with complex data as our brain does. These needs can be addressed by neuromorphic computing systems which are inspired by the biological concepts of the human brain. This new generation of computers has the potential to be used for the storage and processing of large amounts of digital information with much lower power consumption than conventional processors. Among their potential future applications, an important niche is moving the control from data centers to edge devices.

The aim of this Roadmap is to present a snapshot of the present state of neuromorphic technology and provide an opinion on the challenges and opportunities that the future holds in the major areas of neuromorphic technology, namely materials, devices, neuromorphic circuits, neuromorphic algorithms, applications, and ethics. The Roadmap is a collection of perspectives where leading researchers in the neuromorphic community provide their own view about the current state and the future challenges. We hope that this Roadmap will be a useful resource to readers outside this field, for those who

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Bernabé Linares-Barranco
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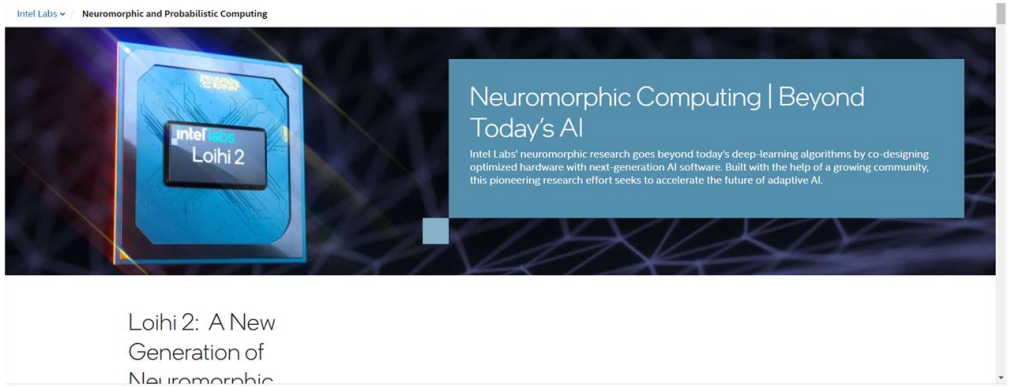


Loihi 2: A New Generation of Neuromorphic

The Age of AI
(Artificial Intelligence)

The New York Times

What to Read › | 88 Books for Summer | Our Summer Suggestions | Vacation Reading | Writers to Watch

NONFICTION

A Robot Wrote This Book Review

Give this article

The New York Times

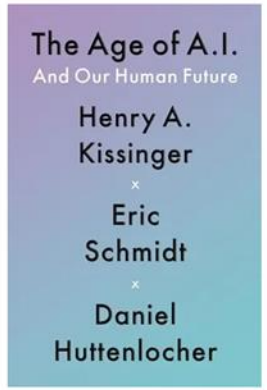
Google Sidelines Engineer Who Claims Its A.I. Is Sentient

Blake Lemoine, the engineer, says that Google's language model has a soul. The company disagrees.

Give this article

This article is part of our Daily Business Briefing

What to Read › | 88 Books for Summer | Our Summer Suggestions | Vacation Reading | Writers to Watch



Then I got a bright idea. What if I could have an A.I. finish this review, and save myself the trouble?

So I fired up Sudowrite, an A.I. writing program I've been experimenting with recently. The app uses GPT-3, the cutting-edge

Science and Technology for a Free Society:

Some big challenges for humanity (stemming from the "unreasonable effectiveness of data)

- Data-driven (model-free) v. model (mental representation of the environment):

  Opacity v. Transparency

  (ancient Babylonian v. ancient Greek astronomers)

- End of Enlightment?

"An AI ethic is essential…

…The AI age needs its own Descartes, its own Kant, to explain what is being created and what will mean for humanity"

AI and our human future

(AI ethics)

[Excerpt from *Security and Ethics* Form of EC submitted proposals]

Application Forms		
Proposal ID **XXXXXXXXX** *Acronym* **XXXXXXX**		
Does this activity involve the use of substances or processes that may cause harm to humans, including those performing the activity (during the implementation of the activity or further to the use of the results, as a possible impact)?	○ Yes ○ No	
8. ARTIFICIAL INTELLIGENCE		Page
Does this activity involve the development, deployment and/or use of Artificial Intelligence? (if yes, detail in the self-assessment whether that could raise ethical concerns related to human rights and values and detail how this will be addressed).	○ Yes ○ No	
9. OTHER ETHICS ISSUES		Page
Are there any other ethics issues that should be taken into consideration?	○ Yes ○ No	
Please specify: (Maximum number of characters allowed: 1000)		

I confirm that I have taken into account all ethics issues above and that, if any ethics issues apply, I

Computing is important

(Ethics too!)

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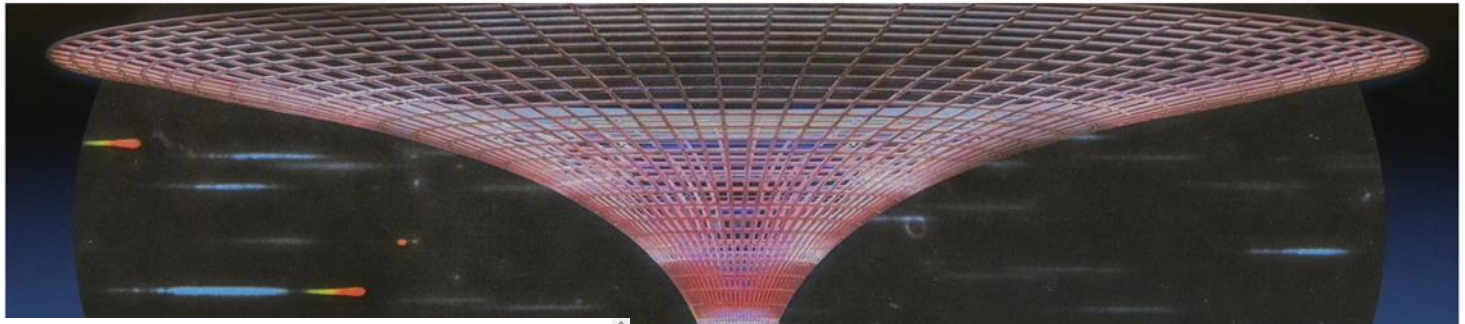
KEVIN KELLY BUSINESS SEP 18, 2010 6:00 AM

How the Internet Gave All of Us Superpowers

As the world became connected, regular people gained unprecedented access to knowledge and culture. Call it the rise of the bottom.



MIT Schwarzman College of Computing

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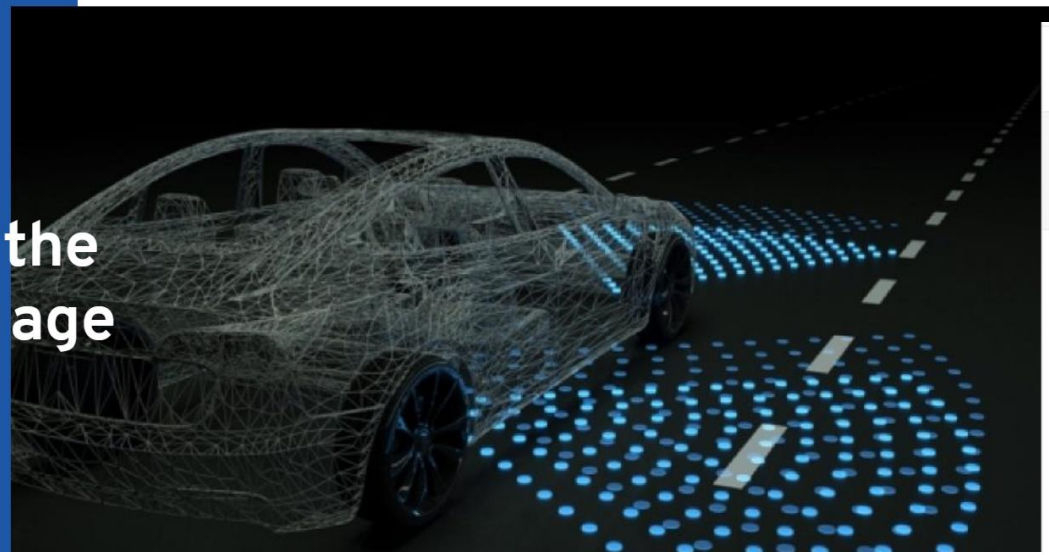
Reshaping the computing age

MORE ABOUT US



Massachusetts Institute of Technology

Education Research Innovation Admissions + Aid Campus Life News

MIT News

ON CAMPUS AND AROUND THE WORLD

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MIT reshapes itself to shape the future

Gift of $350 million establishes the MIT Stephen A. Schwarzman College of Computing, an unprecedented, $1 billion commitment to world-changing breakthroughs and their ethical application.

Watch Video

MIT News Office
October 15, 2018

Course Catalog

Courses and Academic Programs
Academic Calendar 2021-2022
Degree Programs
Programs of Study

The Ethics and Governance of Artificial Intelligence

Professor Jonathan Zittrain
Fall 2020 reading group
M 5:00pm - 7:00pm
1 classroom credit

EXPLORE COURSES BY
Other
Approved in 2021-22 (5)
Category
Aesthetics & Culture (46)
Ethics & Civics (37)
Science & Technology in Society (41)
Histories, Societies, Individuals (54)
HOME / COURSES /

Tech Ethics: AI, Biotech, and the Future of Human Nature (Gen Ed 1058)

Semester: Fall
Offered: 2019

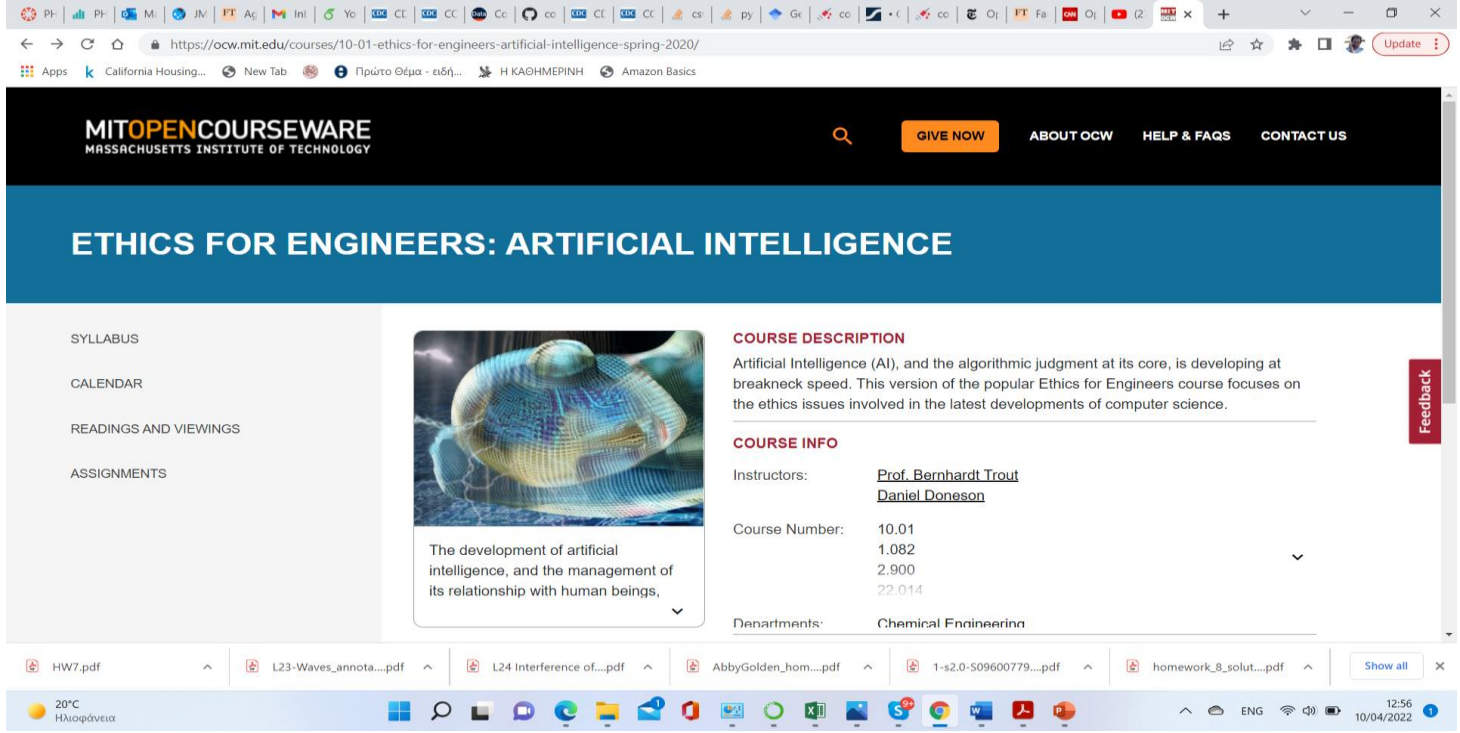
ETHICS & CIVICS
SCIENCE & TECHNOLOGY IN SOCIETY

Social and Ethical Responsibilities of Computing

Home – Cross-cutting –
Social and Ethical Responsibilities of Computing

Ethics

(for scientists and engineers)
Science + Humanities
STEAM is important



Sample from Week 2 (Can AI Be Intelligent?)

- Aristotle, *Nicomachean Ethics*, Book I.1–5
- Turing, “Computing Machinery and Intelligence”

➢ What is Aristotle’s argument about happiness, and how would you judge the objectives of AI on that basis?

Sample from Week 12 (Unartificial Intelligence)

- Plato, *The Republic*, Book VII, “Simile of the Cave”
- Aristotle, *Nicomachean Ethics*, Book IX, X.6-8
- Leonardo, images, notebooks
- Michelangelo, Sistine Chapel

➢ According to Plato, what is the relation of thinking and genuine education to freedom?

➢ What is great about Leonardo and Michelangelo, and can AI mimic them? Why or why not?

➢ How does AI contribute toward or hinder these endeavors?

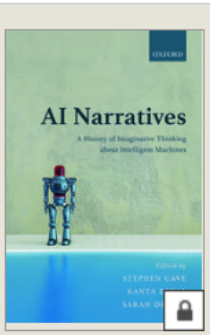
Important: teamwork/collaboration, interdisciplinarity, building confidence, critical thinking, questioning, speaking/writing

A (Harvard) example:

- Choice of concentration (50 fields)
- Joint/Double concentrations (see left panel)
- Collab pedagogies and platforms/tools:
  - ✓ In-person or online [Zoom (breakout rooms)]
  - ✓ Collab activities in class
  - ✓ Platforms for “social” learning, team-formation
  - ✓ Individual + Team Evaluation
  - ✓ Projects (not exams, collaborate but “own” the solution)
  - ✓ Easy-to-learn/powerful comp. languages [python]
  - ✓ Jupyter Notebook, Google Colab
  - ✓ Innovative grading schemes, auto-grader (s/w)
  - ✓ Help-rooms, office-hours, sections

Combining Science and Humanities

an example



AI Narratives: A History of Imaginative Thinking about Intelligent Machines

Stephen Cave, Kanta Dihal, and Sarah Dillon

Print publication date: 2020
Print ISBN-13: 9780198846666
Published to Oxford Scholarship Online: April 2020
DOI: 10.1093/oso/9780198846666.001.0001

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Go to page: Go

Homer's Intelligent Machines

AI in Antiquity

Genevieve Liveley
Sam Thomas

DOI:10.1093/oso/9780198846666.003.0002

Thank you

E-mail: neofotistos@g.harvard.edu or gn@physics.uoc.gr

(your feedback and comments are most welcome)