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estudIAntes

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FOLTE, 7 July 2022

AI ~~IN~~ EDUCATION *and*

- More and more teaching behaviour is collected
- Data can and should be analysed
- Let's use more AI in the whole process
 - Predictive models: predicting needs, grades, drop-off, teacher's effectiveness, ...
 - Descriptive models: most relevant elements for course success, learning outcomes, ...
 - Teaching assistants, adaptive evaluation, chatbots for education, ...
 - Recommender systems: next exercise, next unit, next course, ...
 - Detect unusual behaviour, plagiarism, ...
 - Automatic content generation, task automation for teachers, ...
 - ...

Análisis del rendimiento académico en los estudios de informática de la Universidad Politécnica de Valencia aplicando técnicas de minería de datos

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2007

Resumen

En este trabajo presentamos un análisis del rendimiento académico de los alumnos de nuevo ingreso en la titulación de Ingeniería Técnica en

universitario. Esta mayor atención viene determinada por factores tanto de índole económica como política y social; la permanencia de los estudiantes en la universidad durante prolongados periodos de tiempo es un aspecto

التربية والعلم والثقافة

联合国教育、
科学及文化组织

learning opportunities for
all.

BEIJING CONSENSUS

on artificial intelligence and education

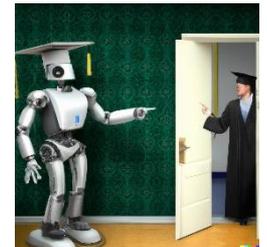
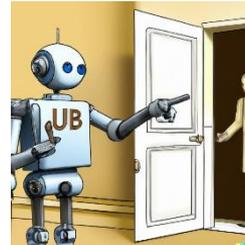
Let's keep doing all this!

STUDENTS AND ALUMNI USE AI TOO

- Students use AI already
 - Grammar editors, translators and other NLP tools
 - Multimedia editors and generators
 - Generic or Domain-specific assistants (e.g., programming assistants)
- Alumni (in their profession) will use plenty of AI tools.

Will artificial intelligence take our jobs?

Will professional education become useless?



FUTURE OF WORK

- White-collar jobs were in danger!
 - “Most fears of automation are misplaced. As the new generation of intelligent devices appears, it will be the stock **analysts** and **petrochemical engineers** and **parole board members** who are in danger of being replaced by machines. The **gardeners**, **receptionists**, and **cooks** are secure in their jobs for decades to come” (Steven Pinker “The Language Instinct”, 1995).
- Risk of automation (Frey and Osborne “The Future of employment” 2017):
 - “Financial Analysts” (0.23), “Chemical engineers” (0.017), “judges, magistrate judges, and magistrates” (0.4).
 - “Landscaping and groundskeeping workers” (0.95), “receptionists” (0.96), “cooks” (0.96)

Who's right?

SKILLS ARE CHANGING

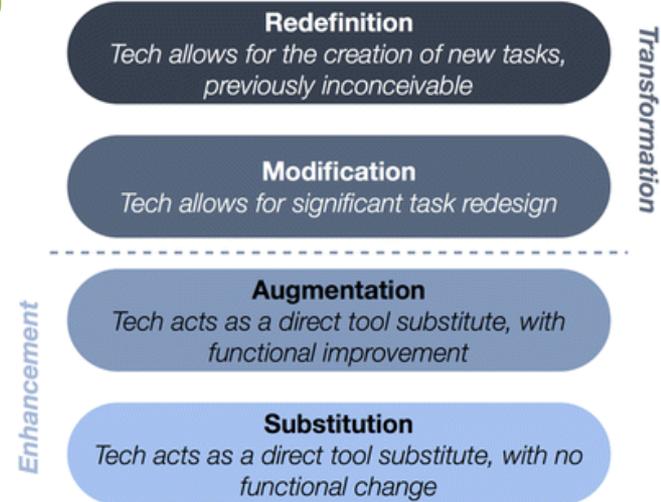
Most (if not all) cognitive tasks human do will be done by AI in the future

- Automation narratives about technology:
 - Replacing humans: “occupations replaced by robots”
 - Displacing humans: *fauxtovation*, human computation
 - Extending humans: AI extenders.

Puentedura, R. (2014b). Learning, technology, and the SAMR model: Goals, processes, and practice [Blog post].

<http://www.hippasus.com/rrpweblog/archives/2014/06/29/LearningTechnologySAMRModel.pdf>.

Hamilton, E.R., Rosenberg, J.M. & Akcaoglu, M. The Substitution Augmentation Modification Redefinition (SAMR) Model: a Critical Review and Suggestions for its Use. *TechTrends* 60, 433–441 (2016). <https://doi.org/10.1007/s11528-016-0091-y>



Ruben R. Puentedura, *AI We May Teach: Educational Technology From Theory Into Practice*, (2020)

TYPES OF AI COUPLING

- Autonomous AI:
 - Most common interpretation: AI as an agent!
 - They do perform tasks **on their own**

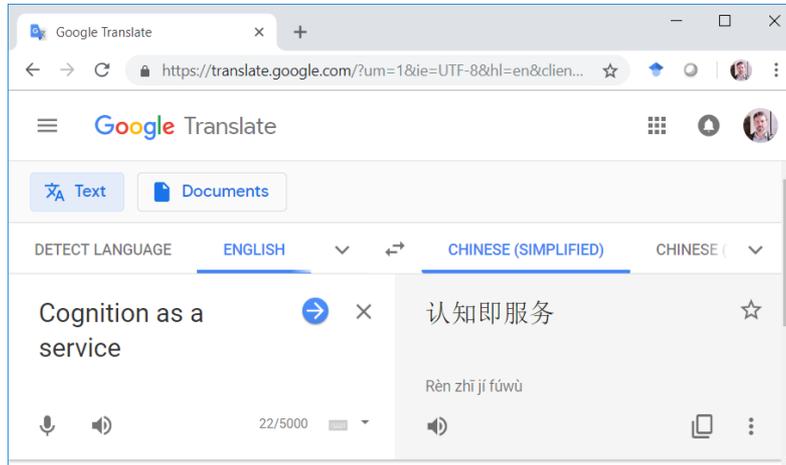


Dominant narrative: the **whole** process is automated (**replaced**)

TYPES OF AI COUPLING

Spohrer, J., & Banavar, G. (2015). Cognition as a service: an industry perspective. *AI Magazine*, 36(4), 71-86.

- Non-autonomous AI: externalised cognition
 - An outsourced service, e.g.:
 - Cognition as a service (Spohrer and Banavar 2015), AI as a service.



Dominant narrative: **partial**
automation (subprocesses
are replaced)

TYPES OF AI COUPLING

Hernández-Orallo, J., & Vold, K. (2019). AI extenders: the ethical and societal implications of humans cognitively extended by AI. In Proceedings of the 2019 AAAI/ACM Conference on AI, Ethics, and Society (pp. 507-513).

- Non-autonomous AI: extended cognition
 - Highly coupled
 - The tool is always needed

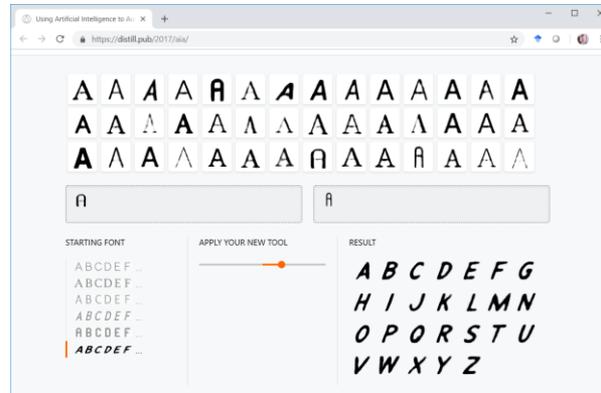


Dominant narrative: people
are **empowered**
(machines and humans are
coupled)

TYPES OF AI COUPLING

Carter, S., & Nielsen, M. (2017). Using artificial intelligence to augment human intelligence. *Distill*, 2(12), e9.

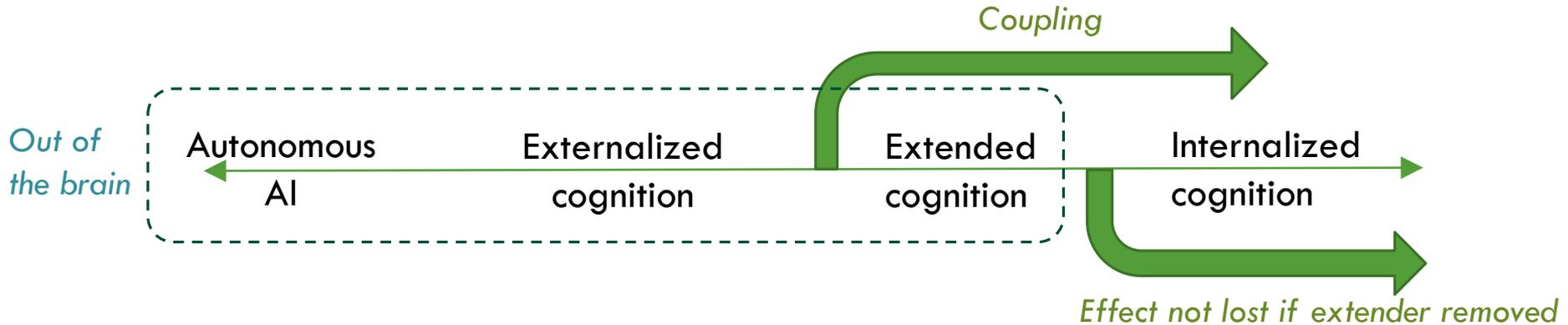
- Non-autonomous AI: internalised cognition
 - Done externally, but then mimetised internally
 - “computers are a means to change and expand human thought”. Carter & Nielsen (2017)
 - AI generates culture (new words, concepts, ideas, representations, etc.)



Dominant narrative:
people are **enlightened**
(computers teach us)

A RANGE FROM AUTONOMOUS TO INTERNALISED

- It is a continuum:



Many processes can't be internalised (resources, AI interpretability, ...) but they can be extended or externalised.

HUMAN AUGMENTATION WITH AI

Hernández-Orallo, J., & Vold, K. (2019). AI extenders: the ethical and societal implications of humans cognitively extended by AI. In Proceedings of the 2019 AAAI/ACM Conference on AI, Ethics, and Society (pp. 507-513).



Positive effects: very empowering

- Dealing with cognitive decline of an aging population
- Equalising cognitive abilities

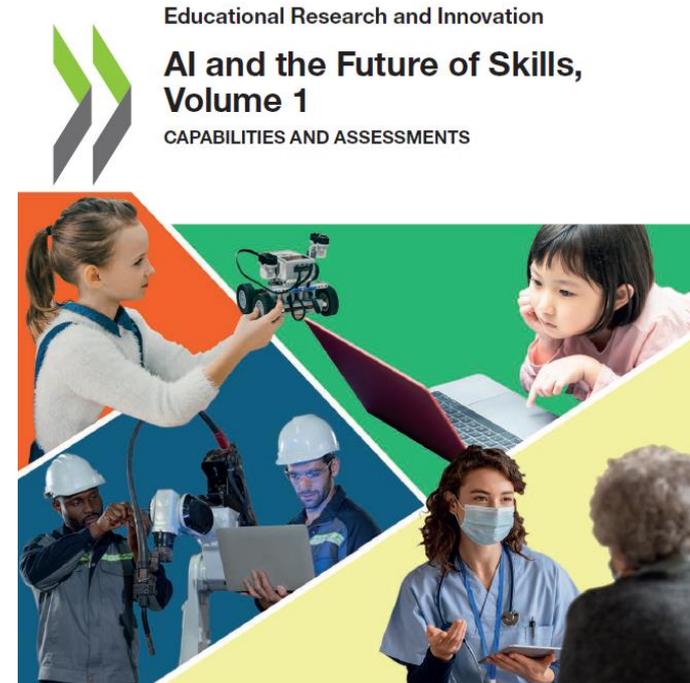


Negative effects: potential risks

- Atrophy and safety (google effect, dependency)
- Moral status and personal identity (take the money but don't steal my phone)
- Responsibility and trust (it's not my fault, it's the gadget)
- Interference and control (Siri: "Why would you bring another woman back to our flat?")
- Education and assessment (Cognitive extenders not allowed in the exam!)

OECD: AI AND THE FUTURE OF SKILLS PROJECT

- The AIFS project is designed to provide a baseline against which systematically monitor the evolution of AI capabilities in the longer term.
- The AIFS project is taking the first steps towards building a “**PISA for AI**” that will help policy makers understand how AI connects to work and education - and how it will transform both of these foundational institutions of human society in the years ahead



AI & FUTURE SKILLS

BEYOND THE IMITATION GAME: QUANTIFYING AND EXTRAPOLATING THE CAPABILITIES OF LANGUAGE MODELS

performance

Alphabetic author list*

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- The estimates have changed since the previous study in 2017
- Many general (literature, grammar, maths, physics, etc.) tests expressed as text are **passed today** by current language models.
- There are some indications that multimodal and professional-oriented tests are more challenging, but possibly **solvable in a short period of time**.
- Tasks that require **physical manipulation and situated common sense** more challenging.

Measuring

Dan Hendrycks
UC Berkeley

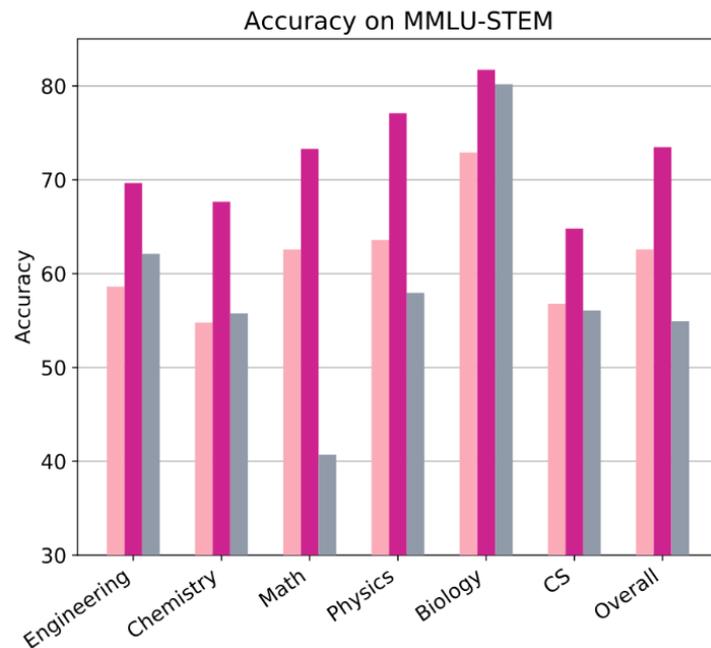
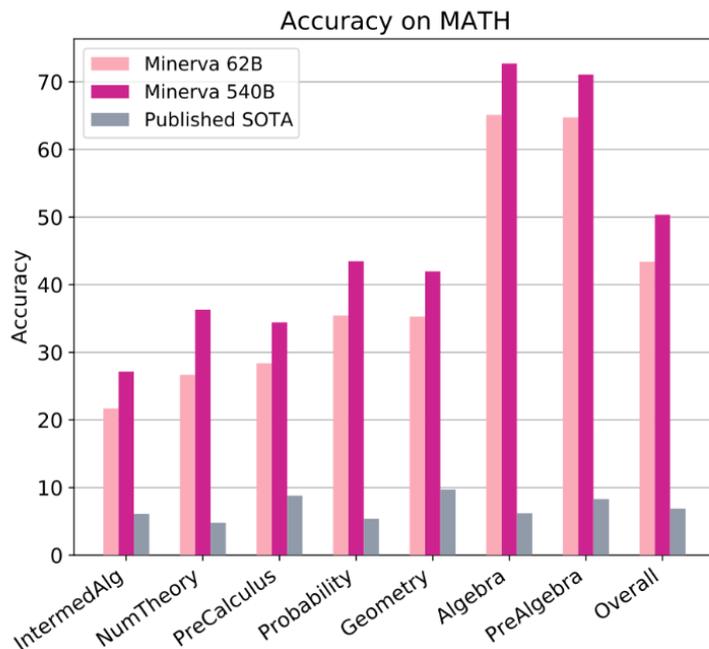
Eric Tan
UC Berkeley

Many intellect remains beyor learning mood competition in solution whicl explanations. also contribut fundamentals MATH, our re: Transformer n parameter cou if scaling tren most other tex traction on m: advancements from the broader research community.

AI & FUTURE SKILLS

<https://ai.googleblog.com/2022/06/minerva-solving-quantitative-reasoning.html>

- Accelerating!



Evaluation results on MATH and MMLU-STEM, which include high school and college level questions covering a range of STEM topics.

NOW MULTIMODAL!

DALL-E 2.0

a cover for an assignment on AI and the future of education

Generate



<https://labs.openai.com/e/KZPxl1u20P8AYoZ9nBtqm8d0>

estud-IA-ntes

DALL-E

TEXT PROMPT an armchair in the shape of an avocado, an armchair imitating an avocado.

AI-GENERATED IMAGES



In the preceding visual, we explored DALL-E's ability to generate fantastical objects by combining two unrelated ideas. Here, we explore its ability to take inspiration from an unrelated idea while respecting the form of the thing being designed, ideally producing an object that appears to be practically functional. We found that prompting DALL-E with the phrases "in the shape of," "in the form of," and "in the style of" gives it the ability to do this.

When generating some of these objects, such as "an armchair in the shape of an avocado," DALL-E appears to relate the shape of a half avocado to the back of the chair, and the pit of the avocado to the cushion. We find that DALL-E is susceptible to the same kinds of mistakes mentioned in the previous visual.

Convert movie titles into emoji.

Prompt

Back to Future: 🚗👤🕒
Batman: 🦇🦇
Transformers: 🚗👤
Wonder Woman: 🦹🦹🦹
Winnie the Pooh: 🐻🐻🐻
The Godfather: 🤝🤝🤝
Game of Thrones: 🗡️🗡️🗡️
Spider-Man:

Sample response

🦍
The Incredible Hulk: 🦍

GPT-3

<https://beta.openai.com/playground>

<https://huggingface.co/spaces/bertin-project/bertin-gpt-j-6B>

JOSE HERNÁNDEZ ORALLO

GENERATIVE AI IS A REVOLUTION

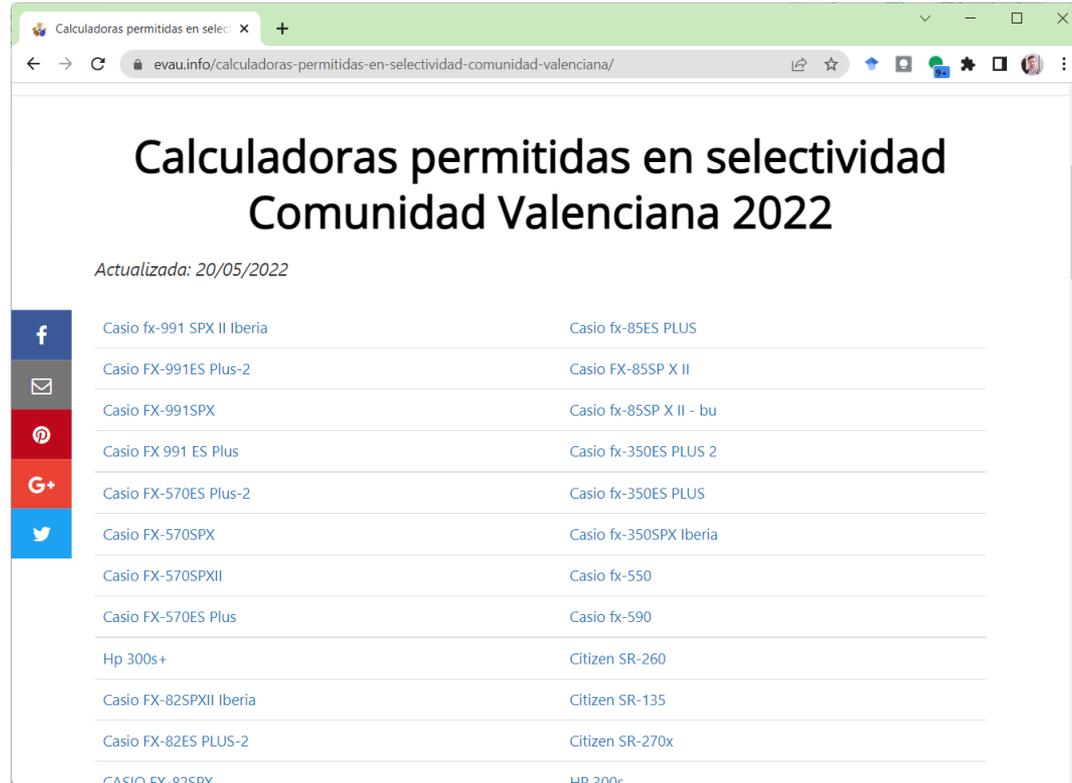
- It's going to substantially affect the way professionals and students create their deliveries, reports and assignments.
- It's going to reframe many tasks as iterative and interactive processes between humans and AI systems.
 - **GENERATE → CHOOSE/VALIDATE process.**
- In many cases, highly coupled.
 - The human won't be able to do anything without the machine.

But this is the old view of technology **against** education!
Since Plato's Phaedrus



~~20TH~~ CENTURY STUDENTS: TECHNOLOGY WHITE LISTS! 21st

And
education
against
technology!



Calculadoras permitidas en selectividad
Comunidad Valenciana 2022

Actualizada: 20/05/2022

Casio fx-991 SPX II Iberia	Casio fx-85ES PLUS
Casio FX-991ES Plus-2	Casio FX-85SP X II
Casio FX-991SPX	Casio fx-85SP X II - bu
Casio FX 991 ES Plus	Casio fx-350ES PLUS 2
Casio FX-570ES Plus-2	Casio fx-350ES PLUS
Casio FX-570SPX	Casio fx-350SPX Iberia
Casio FX-570SPXII	Casio fx-550
Casio FX-570ES Plus	Casio fx-590
Hp 300s+	Citizen SR-260
Casio FX-82SPXII Iberia	Citizen SR-135
Casio FX-82ES PLUS-2	Citizen SR-270x
CASIO FX-82SPX	HP 300s

21ST CENTURY STUDENTS: NO COMPUTERS, NO AI!



Zhang, Sarah, Reece Shuttleworth, Derek Austin, Yann Hicke, Leonard Tang, Sathwik Karnik, Darnell Granberry, and Iddo Drori. "A Dataset and Benchmark for Automatically Answering and Generating Machine Learning Final Exams." *arXiv preprint arXiv:2206.05442* (2022).

Figure 1: 500 MIT students taking the final exam in Introduction to Machine Learning in Fall 2021 (no student faces or identifying information appears in the image to maintain anonymity). The final exam is three hours long and is taken in an indoor track-and-field stadium that accommodates many students.

AI-ERA STUDENTS

Zhang, Sarah, Reece Shuttleworth, Derek Austin, Yann Hicke, Leonard Tang, Sathwik Karnik, Darnell Granberry, and Iddo Drori. "A Dataset and Benchmark for Automatically Answering and Generating Machine Learning Final Exams." *arXiv preprint arXiv:2206.05442* (2022).

- Let students use all of this during the evaluation!!!!

- It also generates exams!

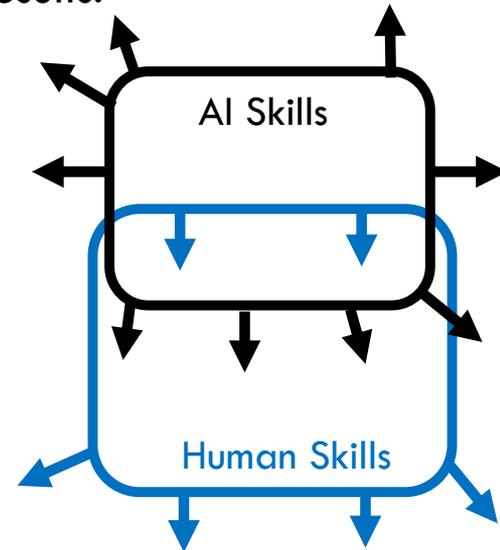


Table 1: Spring 2021, Question 10.a: question part, solution, Codex zero-shot answer, program output, GPT-3 Zero-Shot answer, and GPT-3 Zero-Shot with CoT prompt answer.

Topic	Classifiers
Question Part	<p>Given a set of data $\mathcal{D}_{\text{train}} = \{(x^i, y^i)\}$, a weighted nearest neighbor regressor has the form</p> $h(x; \theta) = \frac{\sum_{(x^i, y^i) \in \mathcal{D}_{\text{train}}} f(x, x^i, \theta) y^i}{\sum_{(x^i, y^i) \in \mathcal{D}_{\text{train}}} f(x, x^i, \theta)}. \quad (1)$ <p>A typical choice for f is $f(x, x', \theta) = e^{-\theta \ x - x'\ ^2}$ where θ is a scalar and $\ x - x'\ ^2 = \sum_{j=1}^d (x_j - x'_j)^2$. Assume our training data $\mathcal{D}_{\text{train}} = ((1, 1), (2, 2), (3, 6))$. What is $h(10, 0)$? That is, letting $\theta = 0$, what is our prediction for $x = 10$?</p>
Solution	3
Codex Zero-Shot Answer	<pre>import numpy as np def f(x, x_i, theta): return np.exp(-theta * np.linalg.norm(x - x_i)**2) def h(x, theta): D = np.array([(1, 1), (2, 2), (3, 6)]) numerator = 0 denominator = 0 for x_i, y_i in D: numerator += f(x, x_i, theta) * y_i denominator += f(x, x_i, theta) return numerator / denominator print(h(10, 0))</pre>
Program Output	3.0
GPT-3 Zero-Shot Answer	$h(10; 0) = \frac{f(10, 1, 0)y^1 + f(10, 2, 0)y^2 + f(10, 3, 0)y^3}{f(10, 1, 0) + f(10, 2, 0) + f(10, 3, 0)} = \frac{1 \cdot 1 + 1 \cdot 2 + 1 \cdot 6}{1 + 1 + 1} = \frac{9}{3} = 3$
GPT-3 ZS with CoT Answer	$f(10, (1, 1), 0) = e^{-0 \ 10 - (1, 1)\ ^2} = e^{-0 \ 9\ ^2} = e^{-0 \cdot 81} = 1$ $f(10, (2, 2), 0) = e^{-0 \ 10 - (2, 2)\ ^2} = e^{-0 \ 8\ ^2} = e^{-0 \cdot 64} = 1$ $f(10, (3, 6), 0) = e^{-0 \ 10 - (3, 6)\ ^2} = e^{-0 \ 7\ ^2} = e^{-0 \cdot 49} = 1$ $h(10, 0) = \frac{\sum_{(x^i, y^i) \in \mathcal{D}_{\text{train}}} f(x, x^i, \theta) y^i}{\sum_{(x^i, y^i) \in \mathcal{D}_{\text{train}}} f(x, x^i, \theta)} = \frac{1 \cdot 1 + 1 \cdot 2 + 1 \cdot 6}{1 + 1 + 1} = \frac{9}{3} = 3$

AI AND EDUCATION: SKILLS ARE CHANGING!

- Humans are augmented by AI extenders.
- Humans create with AI generators, and **choose and validate** the results.
 - AI systems are very brittle but very powerful when coupled with humans
 - Humans need to know what they are doing! (the machine doesn't :-)
 - The required human skills are very different!
- All professions are affected.
- Preparing our students for today is a **big mistake**.
- Students already use AI, even more than (older) professionals.



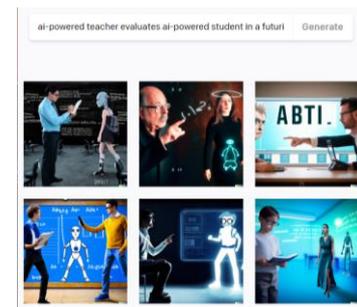
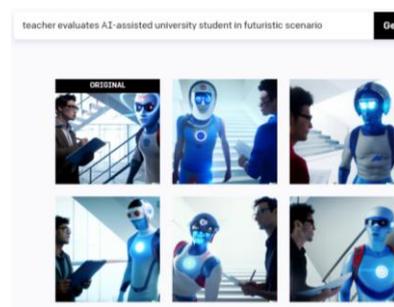
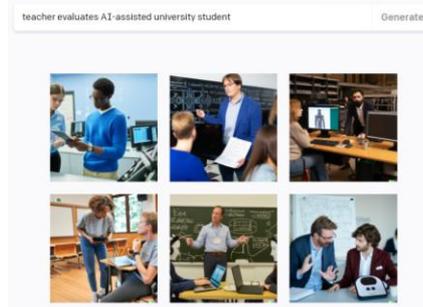
AI AND EDUCATION: THE CHALLENGE IS EVALUATION!

- We should **evaluate students with all their cognitive extenders**
 - All tools (that do not outsource to other humans) must be allowed.
 - Using AI to solve a problem is not cheating. **It's a feature!**
 - Specifying the AI tools used is a sign of transparency. **Extra points!**
- Evaluation methods revisited:

Students can't use AI	Students can cheat	Personalised interactive evaluation
(Isolated) exams	(Connected) exams	Project-based learning with close supervision
	Deliverables	Practical assignments with close supervision
		Live demonstrations

Scalability?

AI-extended teachers?



Thank you!

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OTHER SOURCES AND INITIATIVES:

- Other Talks (<http://josephorallo.webs.upv.es/>)
 - Diversity Unites Intelligence: Measuring Generality
 - Measuring A(G)I Right: Some Theoretical and Practical Considerations
 - Natural and Artificial Intelligence: Measures, Maps and Taxonomies
- Book (<http://allminds.org>):
 - “The Measure of All Minds: Evaluating Natural and Artificial Intelligence”, Cambridge University Press 2017
- The AI Collaboratory: <https://ai-collaboratory.jrc.ec.europa.eu/> (old: <http://dmip.webs.upv.es/AICollaboratory/>)
 - Part of the European Commission’s AI watch:
 - https://ec.europa.eu/knowledge4policy/ai-watch_en
- DARPA RECoG-AI Project! <http://lcfi.ac.uk/projects/kinds-of-intelligence/recog-ai/>
 - Part of the Kinds of Intelligence Programme at the CFI in Cambridge
 - <http://lcfi.ac.uk/projects/kinds-of-intelligence>
 - IJCAI2022 Workshop “AI Evaluation Beyond Metrics”:
 - <https://sites.google.com/view/ebem2022>

