MUNI FI

Challenges of Generative Al for Academic Integrity

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My background & Disclaimers

- Faculty of Informatics, Masaryk University
 - Assistant professor at Department of Machine Learning and Data Processing
 - Member of the university working group for AI in education
 - Two workshops of AI&ED at my institution
- European Network for Academic Integrity
 - President of the Board
 - Head of working group: Technology and Academic Integrity
 - First author of ENAI Recommendations on Ethical use of AI in Education
- There are lots of tools available \rightarrow I don't know all of them
 - ThereIsAnAlforThat.com \rightarrow 12 thousand tools
- I don't know all specifics of your work

Lecture Outline

- 1. How does generative AI work?
 - Principles of generative AI
- 2. Ethical considerations
 - Generative AI in education
 - AI detection tools
 - Generative AI in science
- 3. Use of AI
 - Tools for academia
- 4. Q & A

Principles of Generative AI



Midjourney /imagine artificial intelligence writing student essay in blue and yellow, white background

What is AI?

Artificial Intelligence refers to systems that appear to have "intelligent behaviour by analysing their environment and taking actions – with some degree of autonomy – to achieve **specific goals**" (EU, 2018)

Generative AI: specific goals = content generation



Midjourney /imagine artificial intelligence

Challenges of Generative AI for Academic Integrity

Machine Learning

- Creation of single-purpose models (functions)

- by analysing data
- Principles known since 1960s
- The programmer does not write the code, but defines the problem and specifies the criteria
- The model is built iteratively
- We talk about "training" or "learning"

Definition of a Machine Learning Task

1. Task – A general question that the model answers

IS IT GOING TO RAIN TODAY?

2. Experience – Training data

| date | weather | is it going to rain? | |
|-------------|---|----------------------|--|
| 17. 5. 2023 | Brno, temo. 12 °C, partly cloudy, humidity 50%, percip. 0.0 mm | ? | |
| 16. 5. 2023 | 16. 5. 2023 Brno, temp. 10 °C, cloudy, humidity 75%, percip. 0.5 mm | | |
| 15. 5. 2023 | Brno, temp. 11 °C, partly cloudy, humidity 50%, percip. 0.1 mm | yes | |
| | | | |

- **3. Model** Based on the type of the task
- 4. Success metric Evaluation of correctness

Weather Forecast





When the model answering the question IS IT GOING TO RAIN TODAY? fails?

General question & specific model

VS.

Specific question & general model

Challenges of Generative AI for Academic Integrity

Generative Models

Text generation

- based on a text prompt, it generates an answer
 - ChatGPT,...

Image generation

- based on a text prompt, it generates a picture
 - Midjourney, Stable Diffusion,...

A language model answers the question

FILL IN THE NEXT WORD



Challenges of Generative AI for Academic Integrity

<word>: The 93%, Twelve 3%, Schindler 2%, ...

FILL IN THE NEXT WORD

p (<word> | **Q**)

Q: The best movie of all times is **The** <word>

fill in the answer

Challenges of Generative AI for Academic Integrity





Q: The best movie of all times is The Shawshank <word>

Latent Vector Space

- Images and texts are represented as latent vectors
- The position captures semantic relations among object

- Large language models (LLM)
 - multidimensional latent spaces



Word2Vec

Large Language Models

- Models trained on large corpora of texts
- Public text datasets:
 - Common Crawl, MassiveText, Wikipedia, GitHub, ...
- Training is expensive (computing time, hardware, annotation)
- Most known models:
 - GPT-4 (OpenAI), LLaMA (Meta), PanGu-Σ (Huawei), ...
- Used as a basis for further applications

Main Messages

- Machine learning model answers one question
 - it was trained for
- Behaviour of the model depends on the training data
 - "garbage in, garbage out"
- Both input and output are vectors
 - require accurate vector representation of data (text/image)
- Prompt should contain **context** that is not obvious

Ethical Considerations of Al in Education

Midjourney /imagine artificial intelligence on the shoulders of a giant, asking a question



ENAI Recommendations on the Ethical Use of AI in Education



- European Network for Academic Integrity
 - Association of HEIs and other institutions
 - Support and experience exchange in the field of academic integrity
- Wide availability of generative AI exacerbates current threats for academic integrity
 - contract cheating, data fabrication and falsification,...
- ENAI published a general recommendation

ENAl Recommendations on the Ethical Use of Al in Education

- January 2023: List of ideas
- February 2023: Feedback
 from ENAI working groups
- March 2023: Wording,
 clean document
- April 2023: Publication



Editorial Open access Published: 01 May 2023

ENAI Recommendations on the ethical use of Artificial Intelligence in Education

Tomas Foltynek, Sonja Bjelobaba [™], Irene Glendinning, Zeenath Reza Khan, Rita Santos, Pegi Pavletic & Július Kravjar

International Journal for Educational Integrity **19**, Article number: 12 (2023) Cite this article

15k Accesses 2 Citations 117 Altmetric Metrics

Background and Context

- Al-based tools can be used to transform, produce or generate any kind of content, such as text, images, art, music, or programming code.
- It is increasingly challenging to reliably distinguish Algenerated content from human-produced content
- The wide accessibility of AI may exacerbate existing types of academic integrity threats, such as essay and paper mills, fabrication and falsification of data, etc.

Borderline of Ethically Acceptable Use of Al

- Depends on the purpose of a task
 - Should be clearly communicated to students
- Authorised and declared use of AI is generally OK
- Unauthorised or undeclared use of AI fulfils the definition of Unauthorised content generation
 - Production of academic work, in whole or part, for academic credit, progression or award, whether or not a payment or other favour is involved, using unapproved or undeclared human or technological assistance.

What should be Acknowledged?

- All persons, sources, and tools that influence the ideas or generate the content should be properly acknowledged.
 - Consequently, when an AI tool is used, it should be acknowledged.
 - Form of acknowledgement may differ
 - If possible, prompt should be provided
- Appropriate use of services, sources, and tools that only influence the form is generally acceptable
 - e.g. proof-readers, proofreading tools, spelling checkers, thesaurus

How to Cite Generative Al

- Recommendations from <u>APA</u>, <u>MLA</u>
- The use that does not influence ideas: In the Acknowledgement, or not at all
 - proof-reading, better formulations
- Use for inspiration, design of structure, etc.
 - In the Acknowledgement, Introduction or Methods
- Whole passages should be cited as any other source
 - In compliance with the recommendations
 - If possible/relevant, provide prompt(s)

Responsibility

- The outputs of AI tools can include biased, inaccurate, or incorrect content that users should be aware of
- Neither the AI tool, nor the provider of the AI tool take responsibility for the generated content
- Human (user) is always responsible!
- An AI tool cannot be listed as a co-author in a publication
 - See COPE guidelines

ENAl Recommendation: Summary

- There is no doubt that AI brings significant change to education
- As with any other technology, it extends and enhances human abilities and may be used both in a positive and a negative way
- ENAI urges national policymakers, institutions, and all individual members of the academic community to seek ways on the ethical use of AI and share best practices in order to benefit from the opportunities that AI brings to education and science

Detection of Al-generated text





ENAI: Testing of AI Detection Tools

- 12 freely available and 2 commercial tools
- 54 documents in 6 categories
 - 01-Hum: human-written
 - 02-MT: human-written + machine translation to English
 - 03-AI: AI-generated text
 - 04-AI: AI-generated text
 - 05-ManEd: Al-generated text + manual edits
 - 06-Para: Al-generated text + machine paraphrase
- Weber-Wulff et al. Testing of Detection Tools for AI-Generated Text
 - <u>https://arxiv.org/abs/2306.15666</u>



Overall Accuracy per Doc Class



Average accuracy (no. of correctly classified cases / no. of all cases)

Challenges of Generative AI for Academic Integrity

ENALAI Detector Test: Conclusions

- The systems too often present both false positives and false negatives
- It is too easy to game the system by using paraphrasing tools
- They don't provide evidence
 - Impossible to prove student misconduct
 - Impossible to defend students

- The systems should not be used in academic setting!

Ethical Considerations of AI in Science





Threats to Research Integrity

- Hosseini, M., Rasmussen, L. M., & Resnik, D. B. (Jan 2023).
 Using Al to write scholarly publications. Accountability in Research. <u>https://doi.org/10.1080/08989621.2023.2168535</u>
- Incorrect or irrelevant answers
 - Thorough check of correctness
 - Accountability of authors
- Publication integrity
 - Disclose the use of AI/NLP systems and their impact to the content
 - Do not use AI to fabricate or falsify data

Concerns Related to Al (Hosseini, Rasmussen & Resnik, 2023)

- Incorrect or irrelevant answers:
 - "any section of a manuscript written by an NLP system should be checked by a domain expert for accuracy, bias, relevance, and reasoning"
 - "If a section of a manuscript written by an NLP system contains errors or biases, coauthors need to be held accountable for its accuracy, cogency, and integrity"
- Research/Publication integrity:
 - "researchers should not use NLP systems to fabricate empirical data or falsify existing data"

Concerns related to Al (Hosseini, Rasmussen & Resnik, 2023)

- Publication integrity
 - researchers should disclose their use of such systems and indicate which parts of the text were written or co-written by an NLP system
 - When NLP assistance has impacted the content of a publication (even in the absence of direct use of NLP-generated text), this should be disclosed
- Contribution from someone who does not qualify for authorship → Acknowledgement
- To what extent is SOMEONE similar to SOMETHING?

Use of AI in Science

What if an AI tool

discovers

something new?

Challenges of Generative AI for Academic Integrity

Back to History: Four Color Theorem

- No more than 4 colors are needed to color the regions of any map (adjacent regions can't have same color)
- 1852 Conjecture formulated by Francis Guthrie
- 1976 Proof by Kenneth Appel & Wolfgang Haken
 - Infinite number of maps \rightarrow 1834 arrangements
 - Proved that the set of arrangements is complete
 - Found 4-color coloring for each arrangement
 - Including any map that contains this arrangement
 - Verification took over 1000 hours of computer time



AlphaGo (Google DeepMind)

- Go: Number of configuration too high for brute force

- More than atoms in the universe
- Analytical skills & intuition
- Trained on thousands of games played by professional human players
 - Each move \rightarrow probability of win
- Played against itself (reinforcement learning)
 - What kind of moves brings the most territory?
 - Discovered new strategies



AlphaGo vs. Lee Sedol (2016)

- 5 games during one week
- Game 2 Move 37: AlphaGo's unexpected move
 - Everybody thought AlphaGo made a mistake
 - AlphaGo won, the "beauty" of the move became clear later
 - Probability of a human expert making this move was 1:10,000
- Game 4 Move 78: Lee Sedol "surprised" AlphaGo
 - Similar to the Move 37: Beautiful, but improbable
 - Probability of a human expert making this move was 1:10,000
 - AlphaGo was unprepared for this move did not expect it
 - Lee Sedol learned what AlphaGo discovered and won this game
- Overall result: AlphaGo vs. Lee Sedol 4:1

Who is the Author?

- Go strategies ≈ scientific discoveries
- Imagine that the innovative Go strategy is published as an original scientific paper in *Interstellar Journal of Go Strategies*
- Who should be the **author** (and who should be acknowledged)?
 - Google DeepMind's team who trained AlphaGo
 - AlphaGo that actually discovered the strategy
 - Lee Sedol who played the game in a way that allowed the strategy to appear

Analogy with OpenAI / ChatGPT / user providing a prompt

AlphaGo vs. Current Gen-Al

AlphaGo

- Simple rules of Go
- Training data from games
 - Well-documented, public
 - Clear results
- Quality of results
 - Territory on the board
 - Win or lose the game

Current Generative AI

- Complexity of the real world
- Training data from the internet
 - Intellectual property rights
 - Bias
- Quality of results
 - Users "like" it
 - Much more complex criteria

Challenges of Gen-Al for Research Integrity

- Authorship & acknowledgement

- Who should be an author of a discovery made with significant contribution of AI?
- What should be acknowledged? Where is the borderline?

Intellectual property rights

- IPR of training data \rightarrow IPR of results?
- What kind of data should be allowed to use for AI training?

- Trust

- How can we trust the results produced using AI are correct?
- Huge challenge for reviewers

Applicability of the Rules

- Imagine there are clear rules for authorship and acknowledgement
- Declaration of the help of AI \rightarrow Disadvantage for researchers
 - Reviewers may be more suspicious
 - Papers may be more likely rejected
 - Grant applications may have less probability of funding
- Those who don't follow the rules are rewarded
- Again: Nothing new in principle
 - FFP may lead to more publications (rewards)
 - Whistle-blowers often lose their jobs
 - ...

Importance of Ethics and Integrity

- Focus not on what is rewarded, but what is right
- Ethical theories
 - Deontology
 - Rules and duties
 - Never will be specific enough
 - Consequentialism
 - Criteria for decision-making
 - Evaluation of harms and benefits
 - Conflict: individual vs. society
 - Virtue ethics
 - Focus on values
 - What would an ethical person do?



Challenges of Generative AI for Academic Integrity

Useful AI Tools



MidJourney /imagine artificial intelligence

AI for Reading Websites

- Chrome Extensions
 - <u>SciSpace Copilot</u>, <u>Wiseone</u>, <u>Merlin</u> (and many more for sure)
- Can "read" the content of the website/article
- Answers questions
 - Content summarization
 - Explanation of website purpose
 - Explanation of specific passages
 - Specific questions about the content
- Some tools "understand" non-English text, but answers in English



Statement on the Application of Artificial Intelligence in Teaching at Masaryk University

Introduction

This document presents the basic position of Masaryk University on the issue of using Artificial Intelligence (AI) in university education. The intention of Masaryk University is to promote the use of AI tools and at the same time to formulate conditions and recommendations for their active use by both students and teachers. The aim is to formulate principles that can become the basis for ethical, creative, beneficial and safe u of AI tools in the university environment.

Al tools are becoming widely available and are increasingly used in academia. We see t development and use of Al tools primarily as a challenge and opportunity, not just a thre or risk. MU is aware of the dynamic development of Al technologies, the potential benefi and pitfalls associated with these technologies. Working with Al tools also raises fundamental questions related to the ethics of academic work, its standards and academ integrity in the broadest sense.

Masaryk University recommends the following when using AI tools:

The key takeaways from this webpage are:

 The Masaryk University does not recommend using free tools for detecting the origin of text that promise to recognize the use of AI tools.

9:01 am

- The use of AI tools in education is in line with the university's commitment to constantly develop and adapt to new and more effective teaching methods and modern technologies.
- The AI in Education group at Masaryk University is responsible for adapting the development of AI methods and evaluating the study performance of students.
- Students should be cautious while using Al tools and declare their use in their work. They should also be aware of the responsibility that comes with using Al tools.
- The use of AI tools should be used to improve education and students should be given opportunities to develop skills in using AI tools.

13 9:01 am

What is the purpose of this webpage?, 🗧 🕂 +7 more 🔨

Write your question...

Summarise the contents of this webpage. 9:04 am The webpage discusses the use of AI tools in education at Masaryk University. It highlights the university's commitment to constantly develop and adapt to new and more effective teaching methods and modern technologies. The AI in Education group at Masaryk University is responsible for adapting the development of AI methods and evaluating the study performance of students. The university does not recommend using free tools for detecting the origin of text that promise to recognize the use of AI tools. Students should be cautious while using AI tools and declare their use in their work. They should also be aware of the responsibility that comes with using AI tools. The use of AI tools should be used to improve education and students should be given opportunities to develop skills in using AI tools.

)

9:05 am

← follow up []

13 12

What is the purpose of this webpage?, : +7 more 🔨

Write your question...

≻

≻

Literature Review with Consensus

- A language model connected with scientific database
- <u>https://consensus.app/search/</u>
- After entering a keyword(s) or a question
- Finds the most relevant scientific papers
- Extracts key findings
- Writes a summary
- For yes-no questions provides a "meta-analysis"

| beta 🜒 | Does human activity influence Earth clin | nate? × Q | 0 | C beta 🔿 | does vaccination cause autism? | × Q | 0 |
|--|---|---|---|---|---|--|-------------------------|
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| Summary 🕚 | | Consensus Meter 1 Yes - 100% 1 Possibly - 0% 1 No - 0% 1 | 6 papers analyzed | Summary () These studies suggest associated with the de spectrum disorder, des | Top 10 papers analyzed a that vaccinations are not evelopment of autism or autism spite some caregivers' beliefs. | Consensus Meter 1 Yes - 5% • Possibly - 26% • No - 68% • | 19 papers analyzed |
| The report judge climate change of (IPCC, 2013). The Carbon Footprint of G. Fauville et al. 2014 | ed it extremely likely that human acti due to an increase in anthropogenic as a Mediating Tool in Students' Online Reasonin 6 | vity is the predominant cause of recer greenhouse gases in the atmosphere g about Climate Change 59 | nt • Yes Cite 1 Share | Findings of this me development of au Vaccines are not associa Vaccine Luke Taylor et | eta-analysis suggest that vaccina utism or autism spectrum disord ted with autism: an evidence-based meta-a al. 2014 99 Highly Cited () | ations are not associated with the er. malysis of case-control and cohort studies. | • No 99 Cite 1 Share |
| (OPEN ACCESS http://climatescie 9780190228620 activity is causing both for the envi Climate Change Consp J. Uscinski et al. 2011 | ON ENCYCLOPEDIA WEBPAGE: ence.oxfordre.com/view/10.1093/ad -e-328) An overwhelming percentag g the global climate to change in wa ronment and for humankind. ofracy Theories | prefore/9780190228620.001.0001/ac ge of climate scientists agree that hur lys that will have deleterious conseque 99 | • Yes crefore- man ences Cite (), Share | The authors conclu ot associated with Autism and vaccination: Vaccine C. Turville et a Q Rigorous Journal (| uded that The findings of this me the development of autism or a The value of the evidence base of a recent of 1. 2015 | eta-analysis suggest that vaccinati utism spectrum isorder". neta-analysis. | ons are • Yes |
| Our results indic that human activ our study area. | ate that climatically induced ecolog vity has an increasing influence, part | ical thresholds are not yet crossed, bu icularly on the terrestrial ecosystem in | ut • Yes n | The extensive rese of the sharp increa [Childhood vaccines and Harefuah]. Solt et al. | earch conducted so far indicates ase in autism diagnoses in recen autism-much ado about nothing?]. 2010 | that childhood vaccination is not a t decades. | a cause • No |

Terrestrial and aquatic responses to climate change and human impact on the southeastern Tibetan Plateau during the past two centuries

(

59 Cite 1 Share

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| - | · | | | beta These features are in Beta and no | ot 100% accurate. You can share feedback here | | |
| Summary () These studies sugge plagiarism to some e combined with manu judgement. | Top 10 papers analyzed st that software can detect extent, but it is most effective when ual verification and human | Consensus Meter () Yes - 75% Possibly - 25% No - 0% | edback here 8 papers analyzed | Summary Top 10 papers analyzed Some studies suggest that artificial intelligence can promote educational innovation, improve teaching and learning, and enhance communication, while other studies argue that it may pose challenges, cause operational problems, and potentially waste opportunities for higher education. | Consensus Meter () 5 papers analyzed () Yes - 0% () Possibly - 20% () No - 80% | Ŧ | |
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| Plagiarism detect plagiarized manu | tion software combined with man uscripts and prevent their publicati | ual verification may be used to det on. | tect • Possibly | See detailed insights & Compare multiple rel artificial intelligence threaten university edu | Lated Papers for : "Does Compare insights [2] | | |
| Prevalence of Plagiarism in Recent Submissions to the Croatian Medical Journal Science and Engineering Ethics K. Baždarić et al. 2012 | | | 99 Cite .↑. Share | University in face of AI – an introduction to the analysis | | | |
| | | | | Artificial intelligence may constitute both a threat and a pote educational and research areas. | ential field for development for universities, impacting both | L. | |
| The paper conclu | udes by arguing that commonly us | ed detection software packages c | an • Unknown | Annales Universitatis Paedagogicae Cracoviensis Studia de Cultura Przemys | sław Chmielecki et al. 0 citations 2022 | | |
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| Investigating academic The International Journa | c plagiarism: A forensic linguistics approach to al for Educational Integrity R. Sousa-Silva et al | plagiarism detection 2014 | 99 Cite 🕂 Share | Artificial Intelligence for the Development of University Education | n Management | Unknown | |
| | | | | Artificial intelligence can make education management more management rationality, but may also cause some problems | e forward-looking, promote digitalization, transparency, and ; during operation. | d | |
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| A Program Plagiarism I The 2007 International C | Detection Model Based on Information Distant Conference on Intelligent Pervasive Computing (I | re and Clustering PC 2007) L. Zhang et al. 2007 | 99 Cite 🕂 Share | Exploring the impact of artificial intelligence on teaching and lear | rning in higher education | Unknown | |

Search Tools

- Elicit.org
 - Finds and summarizes the most relevant sources
 - Data extraction from PDF
 - List of concepts
- Perplexity.ai
 - Question answering
- These tools provide links to sources
- _ ...are the sources reliable?

🕏 Elicit 🛛 🗆

 \bigcirc Find papers

How accurately can be detected the text generated by AI?

- O Searching for papers
- O Summarizing 8 abstracts
- Final answer

Summary of top 4 papers

🗇 Сору

These papers collectively suggest that the detection of text generated by AI is challenging and existing detection tools are not accurate or reliable. Weber-Wulff 2023 found that current detection tools have a bias towards classifying AIgenerated text as human-written and are affected by content obfuscation techniques. Orzhenovskii 2022 proposed a language model-based approach for detecting generated texts but also highlighted possible attacks on the detector that reduce the likelihood of detection. Sadasivan 2023 showed that various AItext detectors, including those using watermarking schemes and neural networkbased detectors, can be broken by paraphrasing attacks. They also provided a theoretical impossibility result indicating that as language models improve, even the best-possible detector may only marginally outperform a random classifier. Liyanage 2022 focused on creating benchmark datasets for the detection of automatically generated text in academic publications, emphasizing the difficulty of distinguishing between original and generated text.

| ¢ E | Paper | Abstract summary |
|-----|--|---|
| | Testing of Detection Tools for AI-Generated Text Debora Weber-Wulff +7 arXiv.org 2023 1 citation DOI 2 | The available detection tools are neither accurate nor reliable. |
| | Detecting Auto-generated Texts with Language Model and Attacking the Detector Mikhail Orzhenovskii Computational Linguistics and Intellectual Technologies 2022 1 citation DOI 2 | A pre-trained language model achieved 3rd place on the binary task leaderboard with 82.6% accuracy. |
| | Can AI-Generated Text be Reliably Detected? ♀ Vinu Sankar Sadasivan +4 □ arXiv.org 2023 57 citations DOI ∂ | Even LLMs protected by watermarking schemes can be vulnerable against spoofing attacks. |
| | A Benchmark Corpus for the Detection of Automatically Generated Text in Academic Publications Vijini Liyanage +2 International Conference on Language Resources and Evaluation 2022 8 citations | Automatic text generation based on neural language models has achieved performance levels that make the generated text almost indistinguishable from those written by humans. |
| | A Benchmark Corpus for the Detection of Automatically Generated Text in Academic Publications Vijini Liyanage +2 ArXiv 2022 0 citations | Automatic text generation based on neural language models has achieved performance levels that make the generated text almost indistinguishable from those written by humans. |

Challenges of Generative AI for Academic Integrity

Image Generation

<u>Midjourney</u>

- Communication via Discord
- Text or image prompt
- Example: Theis image was created from a photo of Tomas Garrigue Masaryk and text "Future university, Artificial intelligence

<u>Stable diffusion</u>

- Online app
- Positive and negative prompt
- Both apps generate 4 versions
 - More versions or upscale







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Thank you!

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