Generative AI

Module 9 of a course on *Ethical Issues in AI*

Prepared by

John Hooker
Emeritus Professor, Carnegie Mellon University

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Topics

- How does generative AI work?
  - *Large language models*
  - *Generative adversarial networks*
  - *ChatGPT etc.*
- Ethics of GPTs
  - *Creating documents with GPTs.*
  - *Intellectual property issues (next module)*

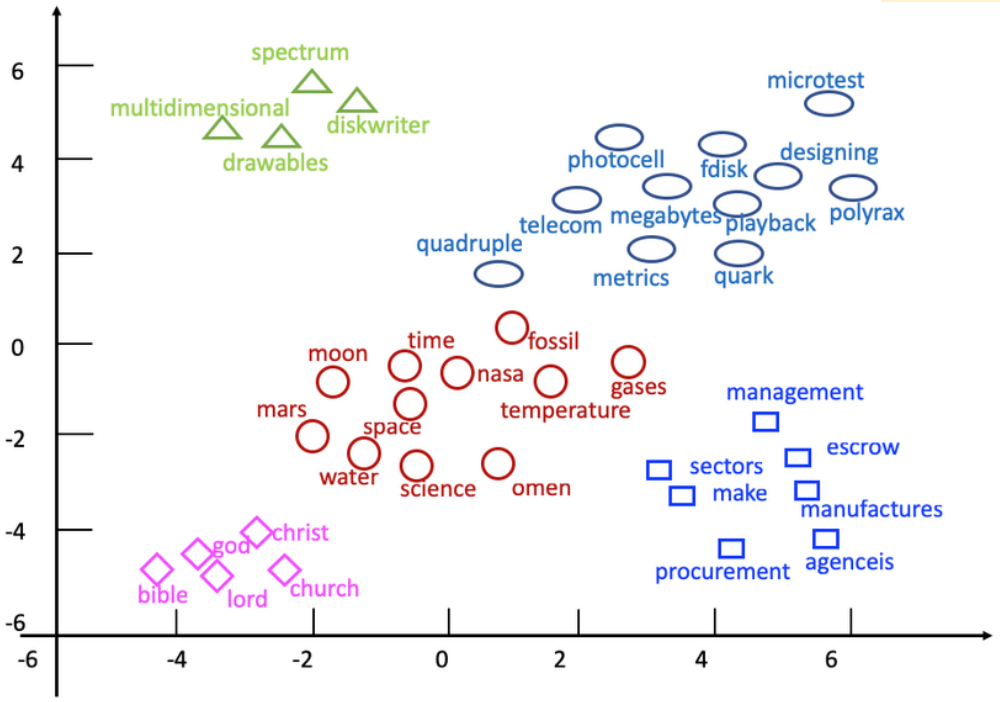
Large language models

Large language models

- **Word associations**
  - *The basic tool.*
  - *What words tend to occur **near others** in a given type of document?*
- **Learning tools**
  - ***Recurrent** NNs, **GAN**s (Generative Adversarial Networks)*
- **Massive training task**
  - NNs may have more than a **trillion** parameters

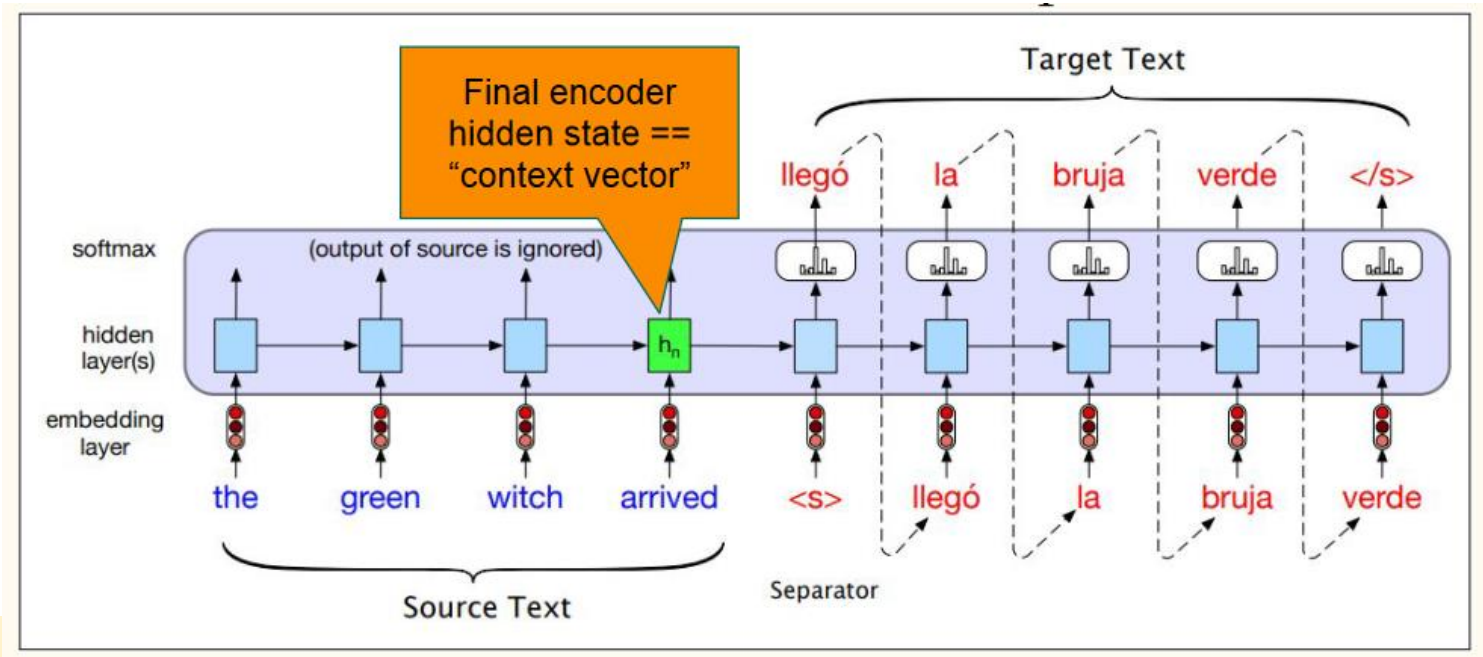
Language models

- **Spatial word embedding**
  - *Word = point in higher-dimensional space.*
    - Each coordinate is # of occurrences in a particular document.
    - "Nearby" words tend to occur together.
  - *Dimension of space reduced from millions to hundreds.*
    - Using technique similar to singular value decomposition.



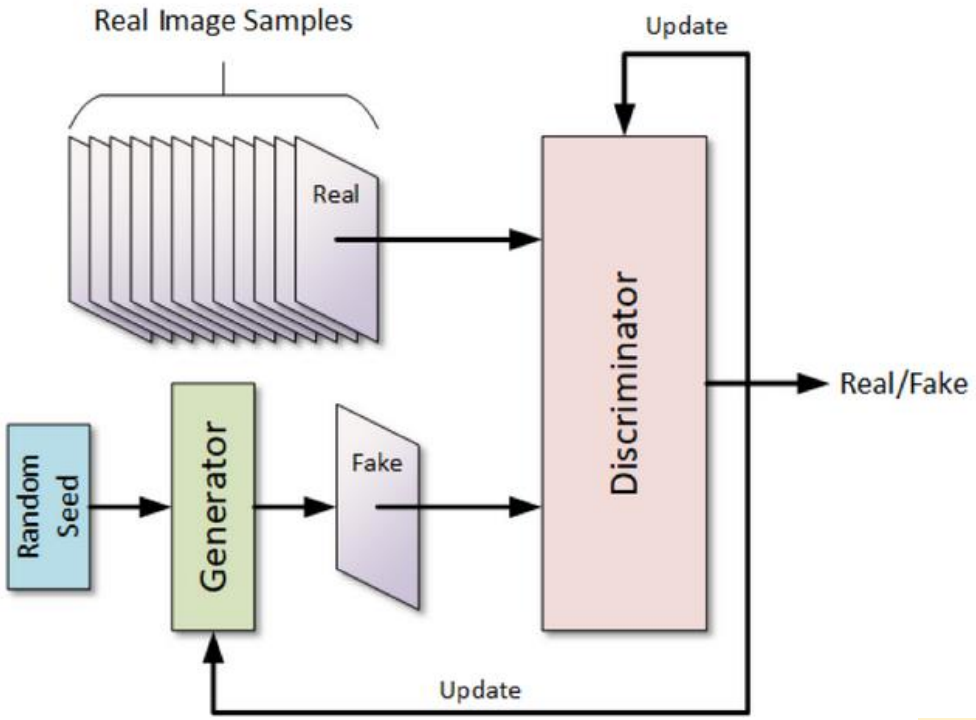
Language models

- **Language translation**.
  - ***Recurrent*** *NN matches words in one language with those in another having similar spatial positions.*
    - Taking into account **context** and **order** of words.



Generative Adversarial Networks

- **GAN**s – Used for both **images** and **text**.
  - *For example, "Draw a cat."*
    - **Generator** learns to create a fake image that the discriminator will classify as a cat.
    - **Discriminator** learns to recognize fake images.
    - This **adversarial** relationship generates a realistic but fictitious cat.



Generative Adversarial Networks

Cats that do not exist

Generative Adversarial Networks

People who do not exist

ChatGPT etc.

- **GPT** = Generative Pre-trained Transformer
  - Uses a **GAN** to **transform** existing material to **generated** text or images in response to a **prompt**.
    - It is **pre-trained** rather than learning on the fly.

Prompt: Create a Python script that calculates my age based on a birthday input

ChatGPT: Certainly! Here's a Python script that calculates your age based on a birthday input:

```
import datetime

def calculate_age(birthdate):
  today = datetime.date.today()
  age = today.year - birthdate.year
```

[etc.]

ChatGPT etc.

- Chatbots date back to the 1960s (e.g., ELIZA)
  - *ChatGPT isn't really a chatbot.*
    - Unclear how to **train** a chatbot from online data.
  - *But it is very adept at finding text, images and voice that respond to a prompt.*
    - Due to co-occurrence of this material with verbiage similar to the prompt.
    - Based on vast training data and **> 1 trillion** parameters.

ChatGPT etc.

- **Hallucinations**
  - *It thinks strawberry has 2 r's.*
    - It represents words as points with numerical coordinates.
  - *Other problems*
    - **Fake** resumes, legal citations, scientific facts, etc.
    - Impossible images.
  - *Famous example: How to keep cheese from sliding off my pizza?*
    - "Mix about 1/8 cup of Elmer's glue in with the sauce. Non-toxic glue will work."
    - This has been fixed.

ChatGPT etc.

ChatGPT

write a resume for john hooker of carnegie mellon university

Academic and Professional Experience

Professor of Operations Research and Management Science

Carnegie Mellon University, Pittsburgh, PA

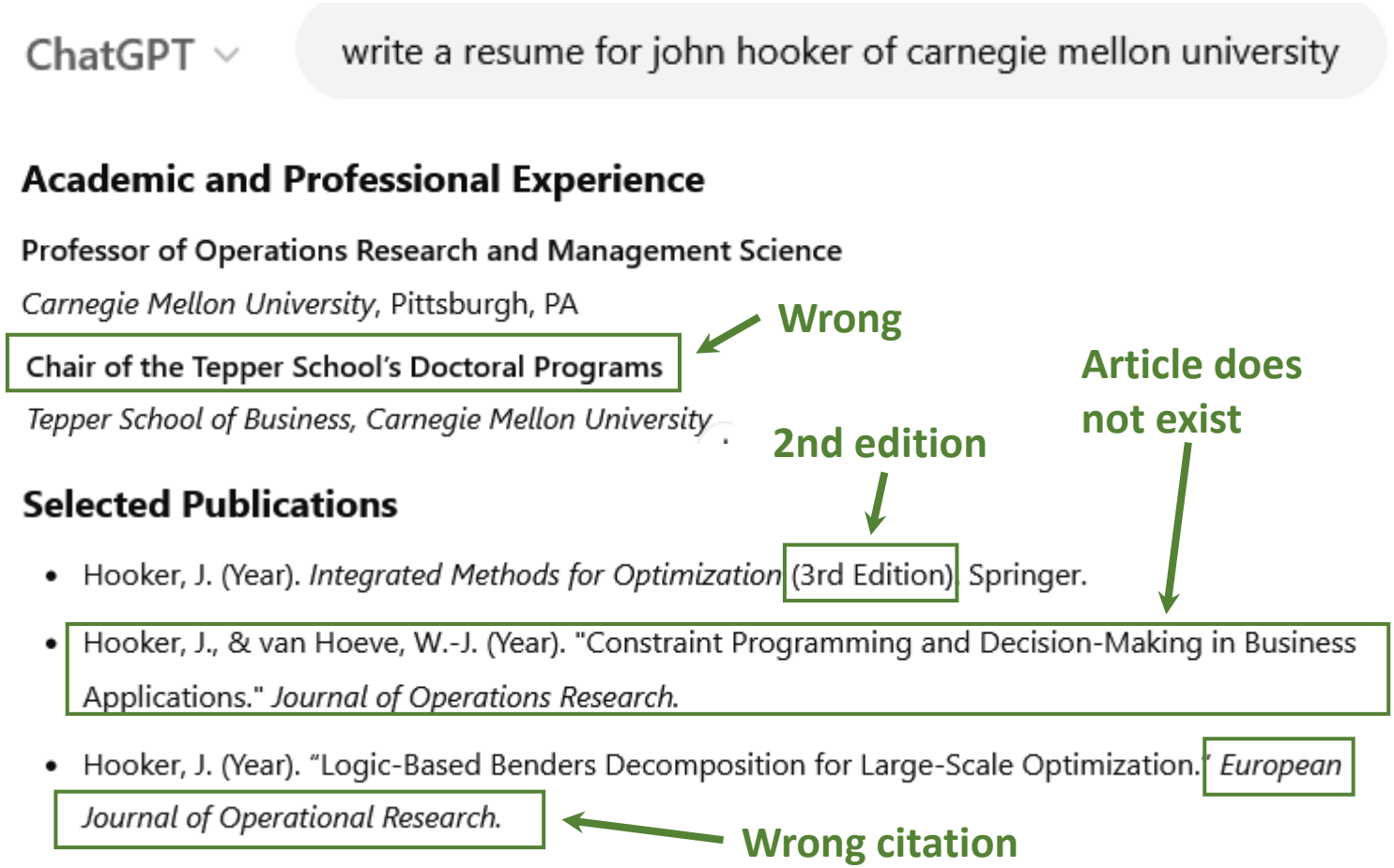
Chair of the Tepper School's Doctoral Programs

Tepper School of Business, Carnegie Mellon University

Selected Publications

- Hooker, J. (Year). *Integrated Methods for Optimization* (3rd Edition). Springer.
- Hooker, J., & van Hoeve, W.-J. (Year). "Constraint Programming and Decision-Making in Business Applications." *Journal of Operations Research.*
- Hooker, J. (Year). "Logic-Based Benders Decomposition for Large-Scale Optimization." *European Journal of Operational Research.*

ChatGPT etc.


ChatGPT
write a resume for john hooker of carnegie mellon university
Academic and Professional Experience
Professor of Operations Research and Management Science
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ChatGPT etc.

- Two key facts about GPTs
  - *They don't know what they are talking about.*
    - Language models **don't understand language**.
    - They would produce the same output if trained on **gibberish** (whether or not it encodes meaningful text).

ChatGPT etc.

- Two key facts about GPTs
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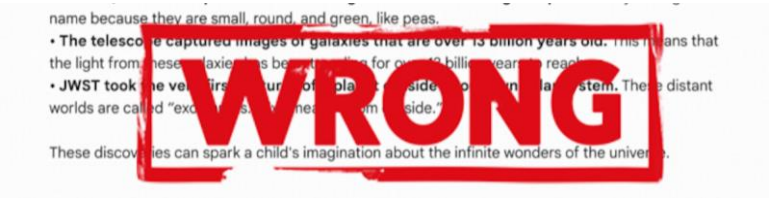
    - Language models **don't understand language**.
    - They would produce the same output if trained on **gibberish** (whether or not it encodes meaningful text).
  - *They parrot what has **already been said**.*
    - With some modifications, cutting and pasting.
    - Limited ability to **distinguish true from false**..



Ethics of GPTs

- When is it ethical to **generate documents** with GPTs?
  - *We look at generalization and utilitarian arguments.*
- When do GPTs violate **intellectual property** rights?
  - *See the next course module.*

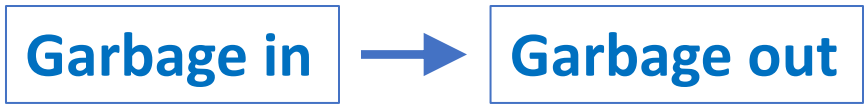
Note: The industry now euphemistically speaks of **document processing** rather than **document generation**

Ethics of GPTs

- **Generalization argument 1**
  - *An essay or article carries an **implied promise**.*
    - The author has made a good faith effort to **say something that is true**.
    - The author has thought about the topic and describes **his/her own understanding** or argument.
    - In other words, the **author is, in fact, the author**.
  - *Generating a document with a GPT **breaks this promise**.*
  - *When done for convenience or profit, this is **not generalizable**.*

Ethics of GPTs

- **Generalization argument 2**
  - *A new twist:*



Ethics of GPTs

- **Generalization argument 2**
  - *A new twist:*

Ethics of GPTs

- **Generalization argument 2**
  - *A new twist:*

    - Meaningful material exists for training **only because** humans have created and researched **their own material**.
    - GPT is **already** consuming its own output.
  - *If everyone were to use GPTs…*
    - because they create usable material and are convenient…
    - …then GPTs would **no longer create usable material**.
    - This is already beginning to occur.
  - *So, this practice is **not generalizable**.*

Ethics of GPTs

The New York Times

TheUpshot

When A.I.'s Output Is a Threat to A.I. Itself

As A.I.-generated data becomes harder to detect, it's increasingly likely to be ingested by future A.I., leading to worse results.

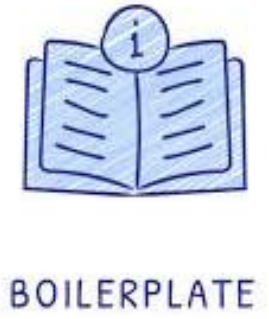
By Aatish Bhatia

Aatish Bhatia interviewed A.I. researchers, studied research papers and fed an A.I. system its own output.

Aug. 25, 2024

Ethics of GPTs

- **Generalization argument 2**
  - *However, **routine** and **boilerplate** documents may be generalizable.*
    - *They are mainly based on previous work anyway.*
  - *Using a GPT as an **assistant** (to get started) may be generalizable.*
    - *If fact claims are checked and references given*
    - *…and the essay is reorganized and heavily edited to represent the author's own thoughts.*



Ethics of GPTs

- **Utilitarian argument**
  - *By laboring to create one's own documents…*
    - One hones **research and reasoning skills**…
    - …which are in **short supply**.
    - One thereby makes a **greater positive contribution**.
  - *Reliance on GPTs is therefore **not utilitarian**.*
    - This applies particularly to **students**.
    - In fact, one can argue that conscientious writing **creates literacy**.