

Intro to Generative AI

A Primer for Aspiring Entrepreneurs

Guest Lecture, ENFB 4200

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Jump Start

- What is Generative AI?
- How many of you have used Generative AI in the last 6-9 months?
- How many before that?
- How have you used them? Work / school / personal / other?
- What have you used them for? Help with _____
- Results? Utility?
- Embraced in your classes / workplace? Outlawed? Other?
- Ethics?
- Personal opinion?

What is Generative AI

- McKinsey: *algorithms that can be used to create new content, including audio, code, images, text, simulations, and videos*
- Examples
 - ChatGPT: text generation (txt2txt)
 - DALLE, MidJourney, StableDiffusion: image generation (txt2img)
 - Runway, Pika: image to movie
 - any “modality” to another: text, code, image, movie, 3d, audio, etc.

<https://www.mckinsey.com/featured-insights/mckinsey-explainers/what-is-generative-ai#/>

Examples





Today

- Trends
- How it Works (TLDR)
- Ethical Concerns
- Opportunities



more from photoai.com

How Big is This? Huge

How Fast is it Moving? Ludicrously

The screenshot shows the Hugging Face Model Hub interface. At the top, there's a search bar with the placeholder "Search models, datasets, users...". Below the search bar, a navigation bar includes links for "Models", "Datasets", "Spaces", "Posts", "Docs", "Solutions", "Pricing", "Log In", and "Sign Up". A "Tasks" tab is selected, showing various model categories: Multimodal (Image-Text-to-Text, Visual Question Answering, Document Question Answering, Video-Text-to-Text, Any-to-Any), Computer Vision (Depth Estimation, Image Classification, Object Detection, Image Segmentation, Text-to-Image, Image-to-Text, Image-to-Image, Image-to-Video, Unconditional Image Generation, Video Classification, Text-to-Video, Zero-Shot Image Classification, Mask Generation, Zero-Shot Object Detection, Text-to-3D, Image-to-3D, Image Feature Extraction, Keypoint Detection), Natural Language Processing (Text Classification, Token Classification, Table Question Answering, Question Answering, Zero-Shot Classification, Translation, Summarization, Feature Extraction, Text Generation, Text2Text Generation, Fill-Mask, Sentence Similarity), Audio (Text-to-Speech, Text-to-Audio, Automatic Speech Recognition, Audio-to-Audio, Audio Classification, Voice Activity Detection), Tabular (Tabular Classification, Tabular Regression), Time Series Forecasting, Reinforcement Learning (Reinforcement Learning, Robotics), and Other (Graph Machine Learning). A red box highlights the "Models" count of "1,052,503". On the right, a list of 20 model cards is displayed, each with the owner, name, type, last update, size, and metrics like stars and forks. The first card is "rain1011/pyramid-flow-sd3" (Text-to-Video, updated 4 days ago, 539 stars). The last card is "XLabs-AI/flux-RealismLora" (Text-to-Image, updated Aug 22, 253 stars).

Adoption

- ChatGPT crossed 1M+ users in 5 days
 - Compare: Netflix 41 months, FB 10 months, IG 2.5 months
- Gartner Predictions for 2022
 - By 2025, generative AI will be producing 10 percent of all data (now it's less than 1 percent) with 20 percent of all test data for consumer-facing use cases.
 - By 2025, generative AI will be used by 50 percent of drug discovery and development initiatives.
 - By 2027, 30 percent of manufacturers will use generative AI to enhance their product development effectiveness.
- Ironic. Most imagined AI would first excel at solving hard technical problems. In fact, its first breakout success is more creative in nature.

<https://www.gartner.com/en/articles/5-impactful-technologies-from-the-gartner-emerging-technologies-and-trends-impact-radar-for-2022>

Why Dedicate an Entire Lecture?

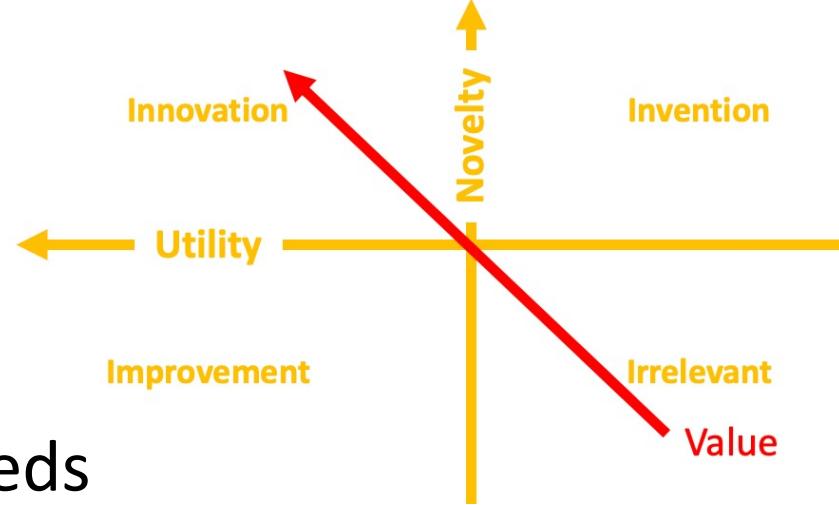
- *Software is eating the world.* – Marc Andreessen, 2011
- ...now AI (Software 2.0) is eating software. – Andrej Karpathy, 2017
- *The hottest new programming language is English.* – AK, 2023

"LLMs and Generative AI are not just tools; they represent a paradigm shift in how we approach problem-solving, creativity, and even human-machine interaction. By understanding them, we're not just keeping up with technology; we're shaping the future."

– ChatGPT (aka “Chet”), today

Why Software is Eating the World: <https://www.wsj.com/articles/SB100014240531190348090457651225091562946>
Software 2.0: <https://karpathy.medium.com/software-2-0-a64152b37c35>

What is Innovation?



- Change creates new Tech, unmet Needs
- Organizations seek Opportunities to meet Needs
- An Innovation is a novel and useful response to an Opportunity
innovation = invention (novelty) x value (utility) = new and useful
- The market, recognizing the Value of an innovation, adopts it

Change → Tech / Needs → Opps → Innovation → Value
“Making Valuable Things Happen” = Innovation

Creates new value, builds competitive advantage
Inherently Creative Problem-Solving Process

Benefits of Understanding

1. Transformation – likely powerful implications to life, work
2. Innovation – capabilities, competition
3. Collaboration – speak intelligently with other team members
4. Ethics – avoid bias and misinformation in systems
5. Learning – access to vast knowledge in conversational format
6. Disruption – drive or adapt to changes coming
7. Optimization – effectively leverage the tech in solutions
8. Opportunities – many to emerge from the changes and tech

Reminder...

Academic Honesty: All students are required to comply with the Auburn University Student Academic Honesty Code.

Violations include, but are not limited to:

Cheating on an examination/quiz/homework/project, such as copying from another's paper, using unauthorized notes, calculators, etc., or **giving or receiving unauthorized aid**, such as trading examinations (or taking online exams with or for others), whispering answers, passing notes, or using electronic devices to transmit or receive information (**such as copying the word, powerpoint, or excel spreadsheet assignment of another student**). Note: there are no scheduled exams or quizzes in this class. We will make it clear (e.g., Canvas discussion boards) what materials can be shared with your peers (i.e., the references you found valuable, but not your individual write-ups or assessments/work regarding those references).

Plagiarism. This is using someone else's work without giving credit. It is, for example, using ideas, phrases, papers, laboratory reports, computer programs, data - copied directly or paraphrased - that you did not arrive at on your own. Sources include published works such as book, movies, Websites, and unpublished works such as other students' papers or material from a research service. In brief, representing someone else's work as your own is academically dishonest. *The risk of plagiarism can be avoided in written work by clearly indicating, either in footnotes or in the paper itself, the source of any major or unique idea or wording that you did not arrive at on your own. Sources must be given regardless of whether the material is quoted directly or paraphrased.*

Unauthorized collaboration. This is working with or receiving help from others on graded assignments without the specific approval of the instructor. *If in doubt, seek permission from the instructor before working with others.* Students are encouraged to learn from one another: form study groups, discuss assignments, BUT each assignment must be individual work unless specifically stated and turned in as a group assignment.

- Copying another student's assignment and putting your name on it is plagiarism.
- You are encouraged to talk to one another about your assignments, however, all assignments must be done by the student whose name is on it unless you are specifically assigned to a "team" assignment.

Magic?!

- “Any sufficiently advanced technology is indistinguishable from magic.” Arthur C. Clarke
- Abstract the underlying patterns related to the input data so that the model can generate or output new content
- Best thought of as a kind of *Macroscope* capable of using an unimaginably large collection of learned patterns to construct new things
- Capable of transforming from/to text, images, video, audio, etc.; essentially any digital content

Sidebar: DS vs ML vs AI

- Data Science (DS) – statistical methods focused on insights from data
- Machine Learning (ML) – algorithms & models focused on prediction
- Artificial Intelligence (AI) – computational methods focused on simulating human-like intelligence and decision-making
- Lots of overlap between these
- I prefer to think of AI as a goal or desired outcome of applied methods related to DS/ML and other domains
- *AI is whatever machines haven't done yet.* – Larry Tesler
- Tesler's Theorem – moving goalposts, aka “AI Effect”

https://en.wikipedia.org/wiki/Larry_Tesler and D. Robinson (next pg)

How

- **NOT:** traditional search engine, database of content, mechanical turk, automated collage or cut and paste tool
- 100k foot view, two kinds of prediction:
 - Discriminative: Content → Label (e.g. is image “cat” or “not cat”)
 - Generative modeling: Content ← Label
- Process: training, fine-tuning for task/domain, inference (predictions)
 - GPT-3 trained on 570GB+ of text data, has 175B parameters

<https://www.altexsoft.com/blog/generative-ai/>

Parameters = weights and biases (w_n and b_n)

Equation of a line:

$$y = mx + b$$

Simple system of linear equations:

$$\begin{aligned}y_1 &= ax_1 + bx_2 + c \\y_2 &= dx_1 + ex_2 + f\end{aligned}$$

General form:

$$\begin{aligned}y_1 &= w_{11} \cdot x_1 + w_{12} \cdot x_2 + \dots + w_{1n} \cdot x_n + b_1 \\y_2 &= w_{21} \cdot x_1 + w_{22} \cdot x_2 + \dots + w_{2n} \cdot x_n + b_2 \\\vdots \\y_n &= w_{n1} \cdot x_1 + w_{n2} \cdot x_2 + \dots + w_{nn} \cdot x_n + b_n\end{aligned}$$

Matrix
Representation

$$\mathbf{Y} = \mathbf{W} \cdot \mathbf{X} + \mathbf{b}$$

Large Language Models

- Sometimes dismissed as “stochastic parrots” – in a sense they are designed to guess what you want to hear
- Gross oversimplification
- Modern SOTA techniques use a hierarchy of models
- Foundational models do next word prediction
- Additional functionality, e.g. tuning for chat interactions or following instructions are achieved with subsequent training steps

GPT Assistant training pipeline



State of GPT 2023: <https://youtube.com/watch?v=bZQun8Y4L2A>

Learning as Compression

- Data → Information → Knowledge → Wisdom (DIKW framework)
- “Synthesize” or “internalize” are common descriptions of learning outcomes and/or process
- Understanding involves a kind of compression
- e.g., Stable Diffusion text to image model
 - 2 billion images, 100 terabytes (100k gigabytes) → 2gb model data
 - 50,000x reduction: understanding not data
- Analogies to human learning process???
 - If so, why is it not ok for machines to “learn” in this fashion?

Why AI Matters... (E. Mostaque and P. Diamandis): https://youtube.com/watch?v=ciX_iFGySOM

Ethics / Concerns

- Intellectual property rights and compensation
- Attribution / Dishonest use / cheating
- Impact on human content creation – jobs and the content
- Transformation of knowledge work
- Accuracy of results: hallucinations, factual errors
- Misinformation / biased data / “Truth”
- Environmental impact
- Etc., etc., etc.

Some Predictions

- EVERYTHING WILL BE GENERATED
- Personalization at scale
- AI will be integrated into most (all?) tools, Human-AI collaboration the norm
- AI-based “multi-tools” will replace many separate apps
- Rise of bespoke apps – created as needed
- Acceleration of change
- Essential: curiosity, initiative, ability to convert problems into the right questions
- Democratization of expertise; empowerment
- Shifts in job markets – displacement, reskilling, transition
- Ethical & regulatory challenges – bias, IP rights / ownership, privacy, security
- Sustainability issues – power / resource utilization

A cartoon illustration of SpongeBob SquarePants. He is yellow with brown spots, has large white eyes with blue pupils, and a wide red smile showing two white squares. His arms are raised in excitement, and he is wearing his signature brown pants. The background features a vibrant rainbow with white stars against a blue sky.

OPPORTUNITY



What will YOU make of it?

Related Reading and Resources

- <https://www.thestreet.com/technology/google-brings-back-founders-page-brin-to-fend-off-chatgpt-threat> (Google sounds red alert)
- <https://oneusefulthing.substack.com/p/all-my-classes-suddenly-became-ai> (GenAI at Wharton biz school)
- <https://www.nytimes.com/2023/01/15/opinion/ai-chatgpt-lobbying-democracy.html> (NYT editorial on dangers)
- <https://www.wired.com/story/picture-limitless-creativity-ai-image-generators/> (by co-founder of Wired, originated 1000 true fans)
- <https://lexica.art/> (search engine for AI art and prompts)