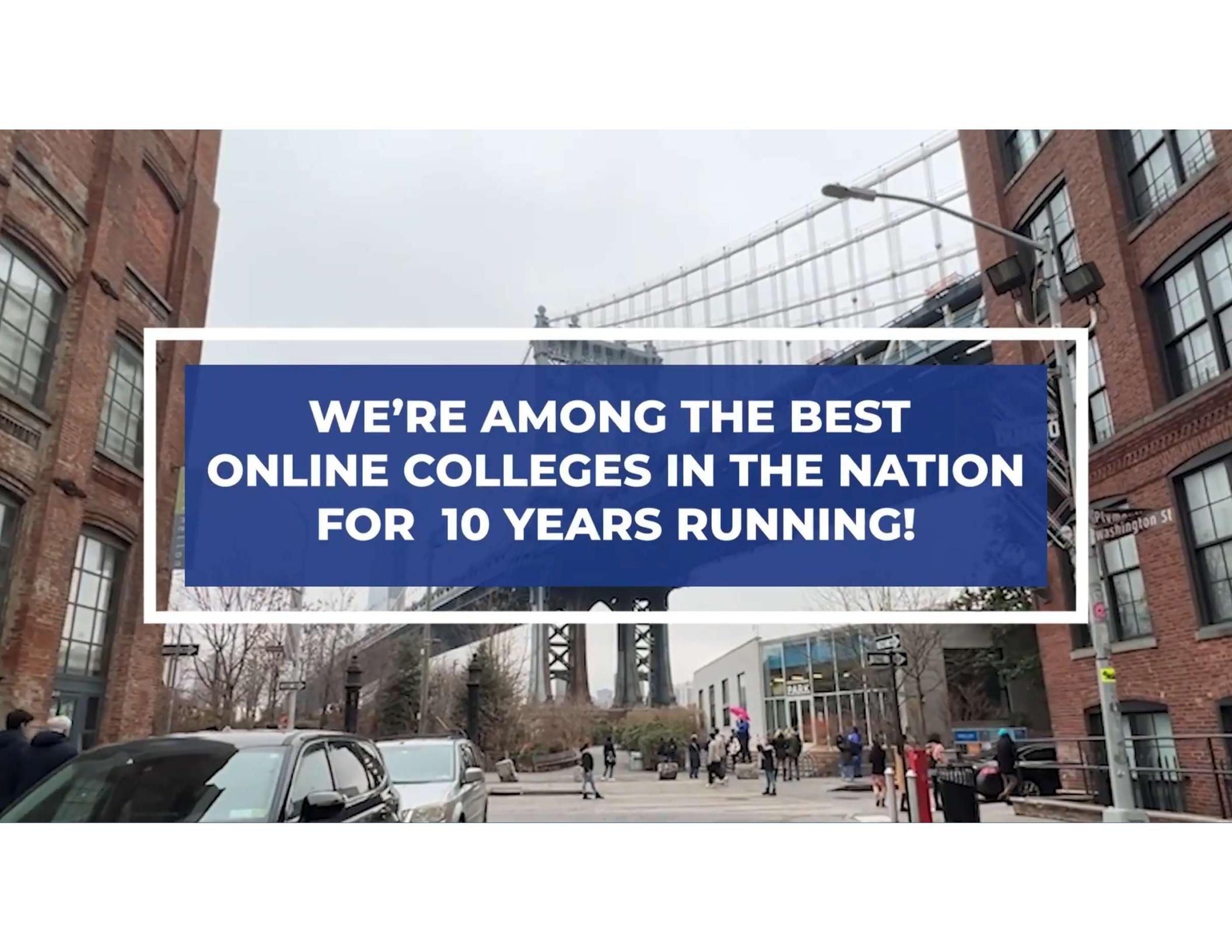


MASTER OF SCIENCE IN GENERATIVE AI

WEEK 1: INTRODUCTION



**HIGHEST RANKED
ONLINE COLLEGE IN
NEW YORK CITY!**

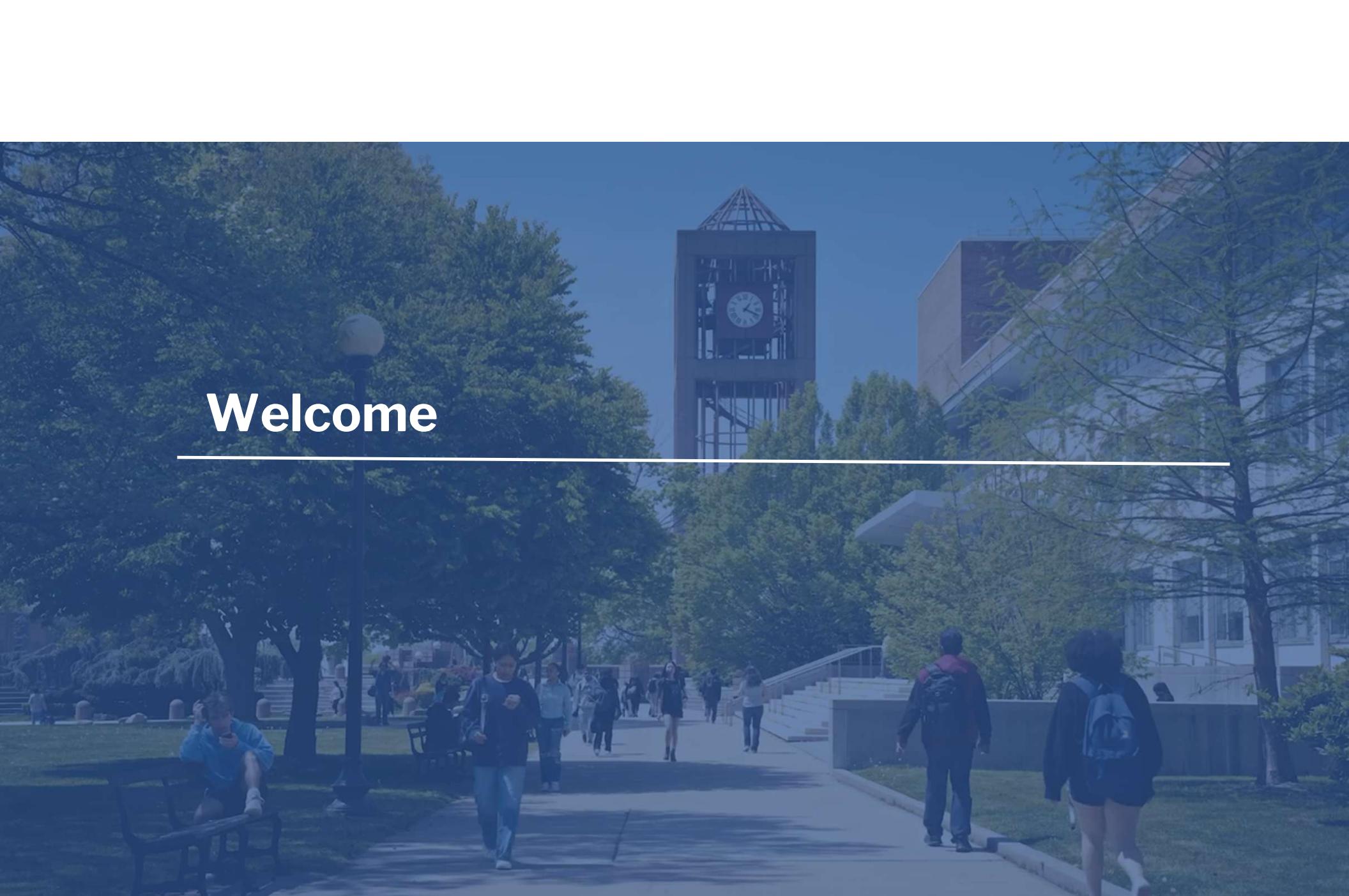


**WE'RE AMONG THE BEST
ONLINE COLLEGES IN THE NATION
FOR 10 YEARS RUNNING!**



Introduction to Generative AI (GAI602)

Joe Sabelja

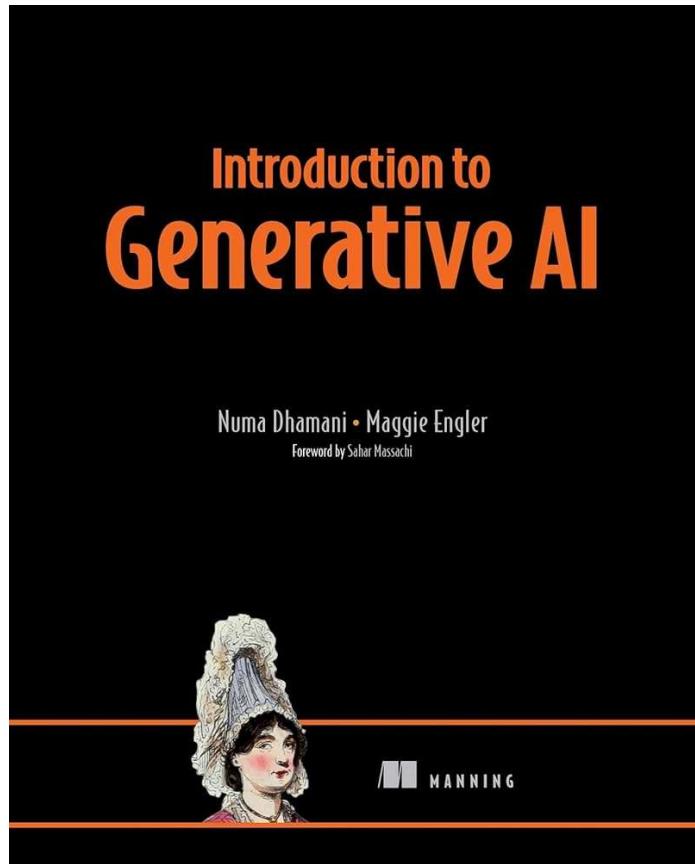


Welcome

Syllabus

1. Overview of the LLM Ecosystem
2. Tokenization
3. Sequence-to-Sequence Approaches
4. Transformers
5. Attention Mechanisms
6. Training Large Language Models (LLMs)
7. Prompt Engineering
8. Semantic Search and Embeddings
9. Fine-Tuning & Retrieval-Augmented Generation (RAG)
10. Agents and Plugins
11. Inference & Quantization
12. LLM MLOps (LMOps)
13. Ethics and Responsible AI
14. Scaling Laws and Model Evaluation

Textbook



Introduction to Generative AI

by Numa Dhamani (co-authored with Maggie Engler)

February 2024

ISBN-10: 1633437191

ISBN-13: 978-1633437197

Schedule

January							
MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY	
29	30	31	01	02	03	04	
05	06	07	08	09	10	11	
12	13	14	15	16	17	18	
19	20	21	22	23	24	25	
26	27	28	29	30	31	01	
First Day of Class Week 1		Class 7PM					

February							
MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY	
02	03	04	05	06	07	08	
Week 2		Class 7PM					
09	10	11	12	13	14	15	
Week 3		Class 7PM (Optional)					
16	17	18	19	20	21	22	
Presidents' Day - no classes scheduled*		Class 7PM					
23	24	25	26	27	28	01	
Week 4		Class 7PM					
02	03	Notes:					

March							
MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY	
02	03	04	05	06	07	08	
Week 6		Class 7PM					
09	10	11	12	13	14	15	
Week 7		Class 7PM					
16	17	18	19	20	21	22	
Week 8		Class 7PM					
23	24	25	26	27	28	29	
Week 9		Class 7PM					
30	31	Notes:					

April							
MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY	
30	31	01	02	03	04	05	
Spring Break							
06	07	08	09	10	11	12	
Spring Break							
13	14	15	16	17	18	19	
Week 10		Class 7PM					
20	21	22	23	24	25	26	
Week 11		Class 7PM					
27	28	29	30	Assignment 3			
Week 12		Class 7PM					

May							
MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY	
				01	02	03	
						Quiz 5	
04	05	06	07	08	09	10	
Week 13		Class 7PM					
11	12	13	14	15	16	17	
Week 14		Class 7PM					
18	19	20	21	22	23	24	
Final Examinations							
25	26	27	28	29	30	31	
Memorial Day - CUNY SPS is closed		Spring Term Ends					
Online Final Exam							

Class Policies

1. Please leave your camera on

- See: https://www.cuny.edu/wp-content/uploads/sites/4/page-assets/academics/faculty-affairs/Camera-Use-Guidance-for-Online-and-Hybrid-Courses_FINAL-JUNE-20-2024.pdf

2. Review the Course Policies on Brightspace

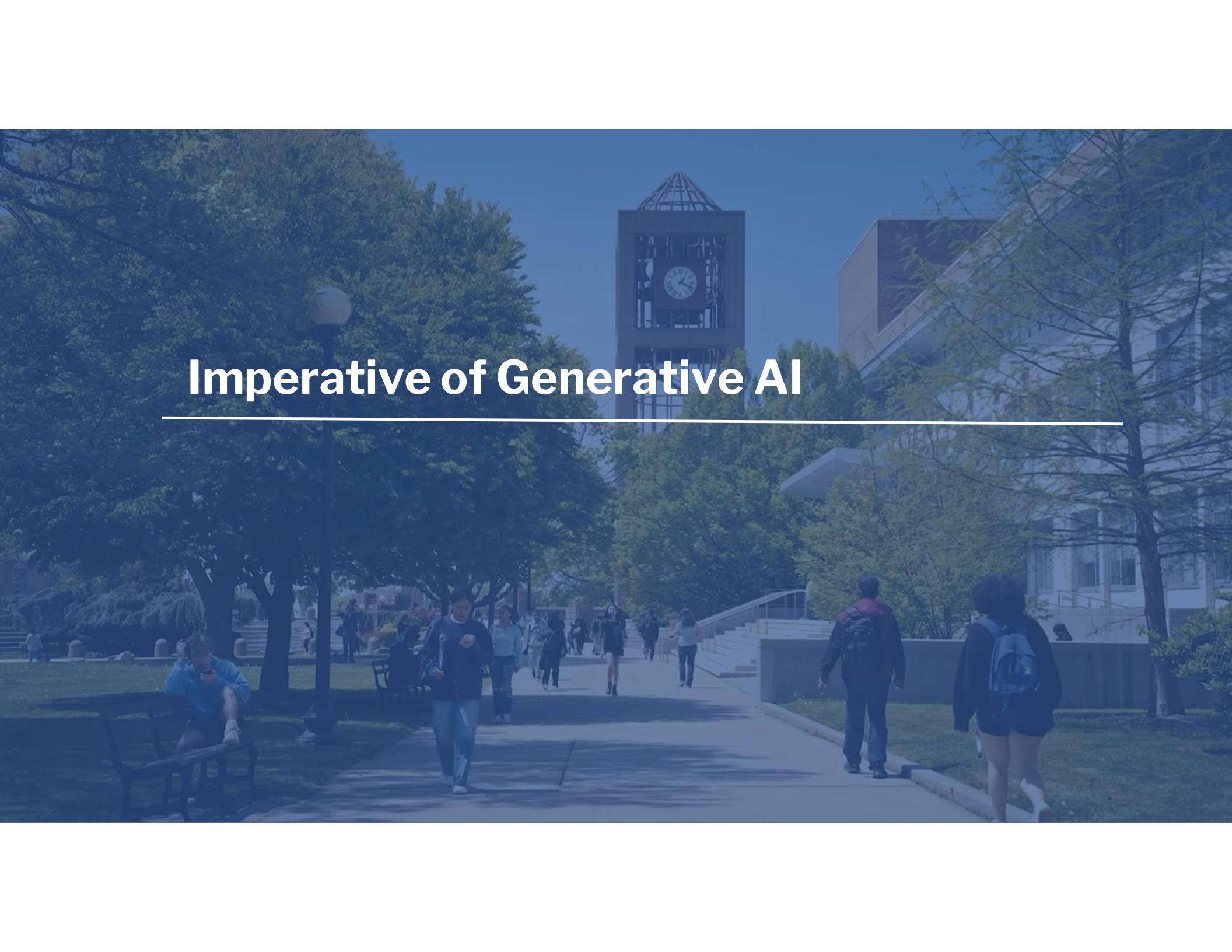
- Respect, Online Etiquette and Anti-Harassment
- Lateness Policy

3. Read the guidelines on Generative AI & Academic Integrity on Brightspace

- Provide Snapshots with answers
- Do not use Generative AI for quizzes and exams
- You (the human) manage AI, not the other way around
- Don't cheat yourself

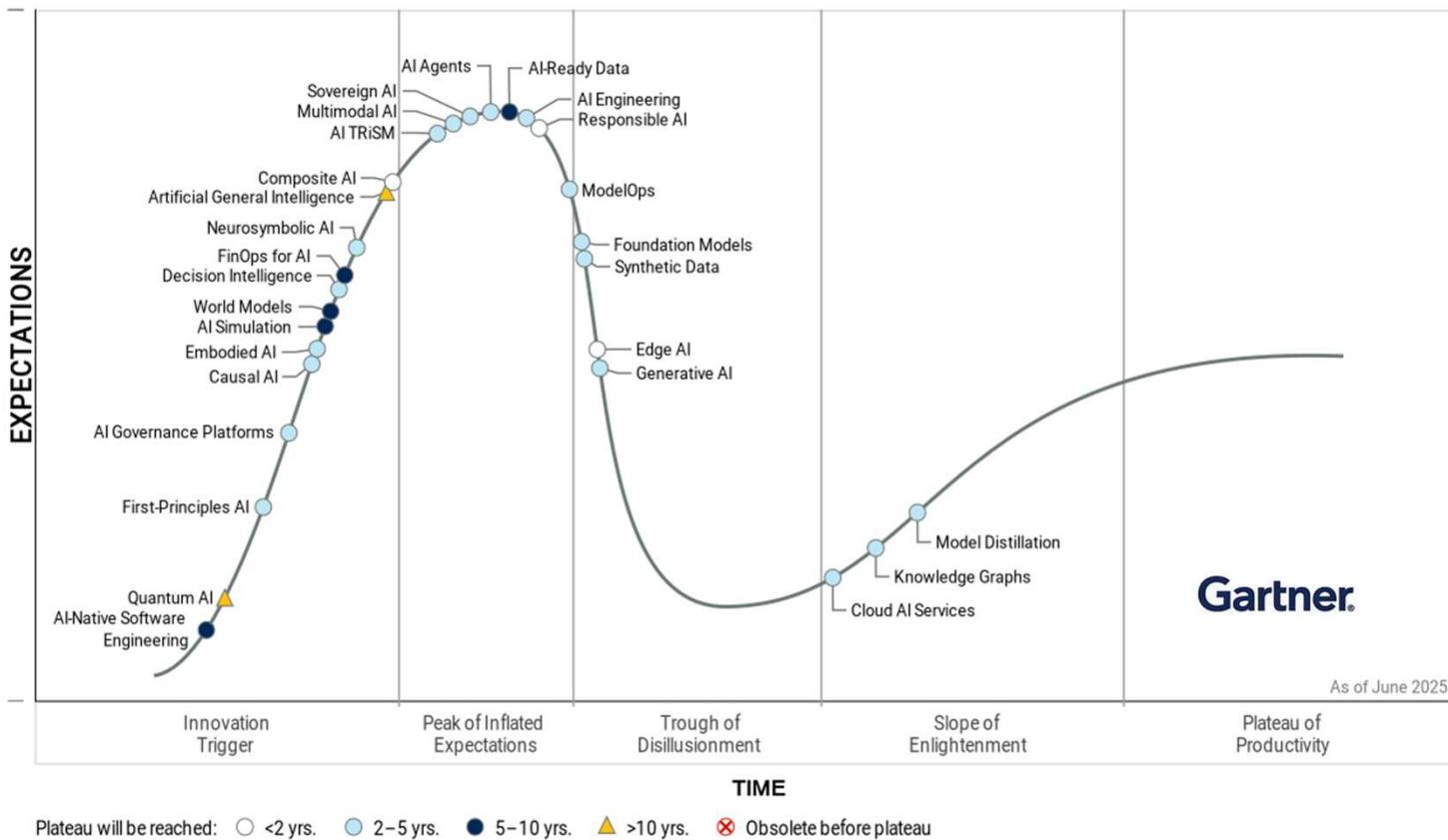
Grading

Component	Number	Total Value
Quizzes	5	20%
Assignments	4	20%
Exam: Mid-term	1	30%
Exam: End of semester	1	30%
		100%

A blue-tinted photograph of a university campus. In the background, a tall clock tower with a glass facade and a pyramid-shaped roof stands prominently. To the right, a modern building with large windows and a staircase is visible. In the foreground, several students are walking on a paved path. One student in a blue hoodie is sitting on a bench on the left. The scene is set against a backdrop of green trees and a clear sky.

Imperative of Generative AI

Generative AI is an overnight sensation



Source: Gartner

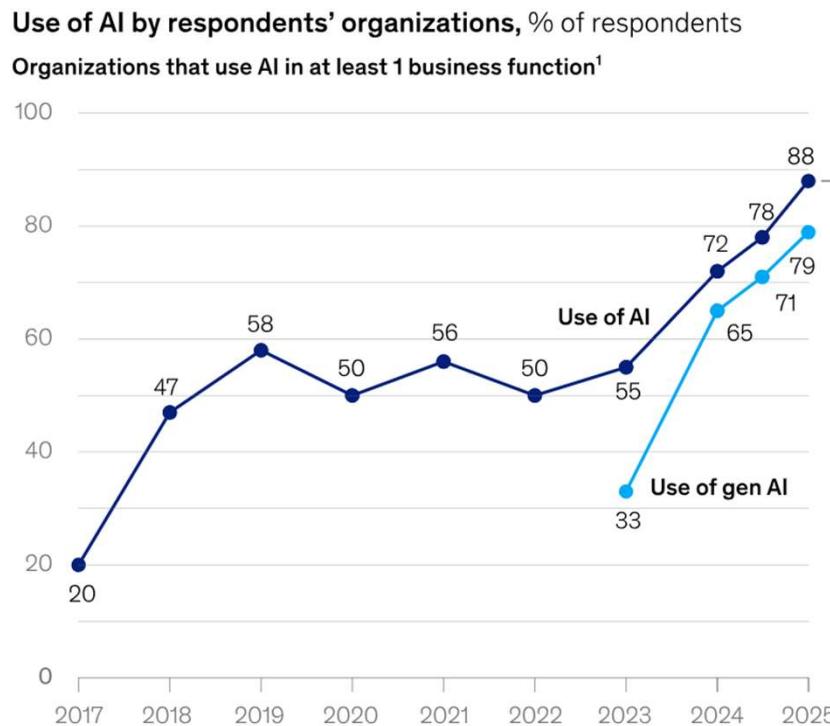
Sample use-cases

Research and development	Manufacturing	Sales and marketing	Supply chain management	Retailer and distribution	Enabling areas	Finance	Sales and marketing	Customer service	Operations
Autonomous product innovation	Autonomous quality control	Multi-channel campaign orchestrator	Demand forecasting agent	Shelf stocking assistant	Autonomous finance analyst	Under-writing recommendation agent	Cross-sell recommendation agent	Autonomous case resolution agent	Loan processing agent
Smart experimentation	Predictive maintenance agent	Dynamic pricing agent	Inventory balancer	Planogram compliance checker	HR talent scout	Risk reasoning assistant	Autonomous promotions campaigns	KYC/Onboarding compliance agent	Claims adjudication agent
Patent landscape navigator	Production scheduling optimiser	Sentiment-driven brand manager	Logistics route optimiser	Retail forecast collaboration agent	Compliance and risk monitoring agent [No Title]	Dispute resolution agent	AI sales advisor agent	Voice of customer agent	Fraud detection agent
Consumer sentiment synthesiser	Energy efficiency advisor	Autonomous content creator	Supplier risk monitor	Autonomous retail order management	Cybersecurity sentinel	Expense anomaly agent	Dynamic pricing agent	Grievance escalation agent	Payment reconciliation agent
Sustainability optimiser	Waste reduction agent	Retailer-specific offer optimiser	Autonomous procurement agent	Autonomous sales beat planning	ESG reporting agent	Regulatory reporting agent	Competitor intelligence agent	Proactive service agent	Branch/Channel performance agent
AI-driven competitive analysis	AI-driven process optimisation	Autonomous customer segmentation	Disruption detection and mitigation agent	Geo-targeted promotion agent					

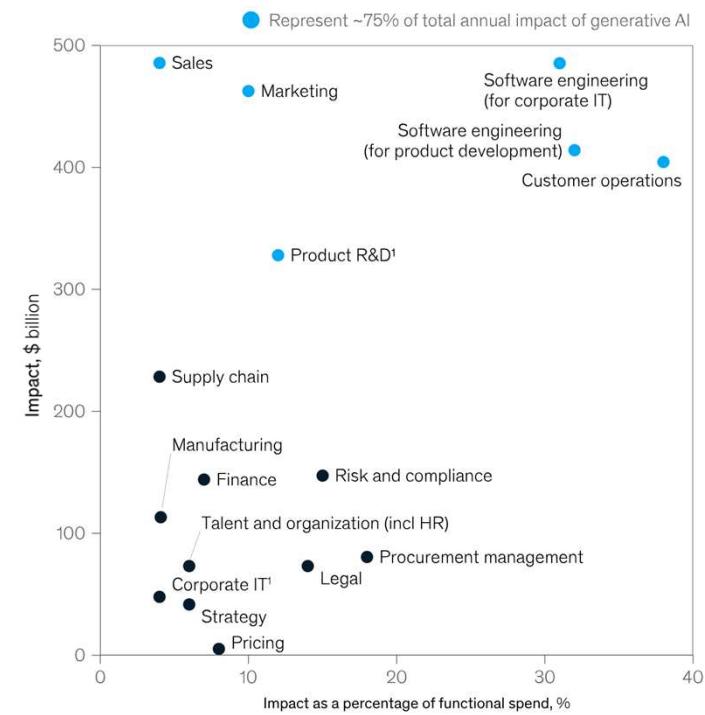
Source: Deloitte Insights, 2025

AI has become a critical need for firms

Reported use of AI in at least one business function continues to increase.

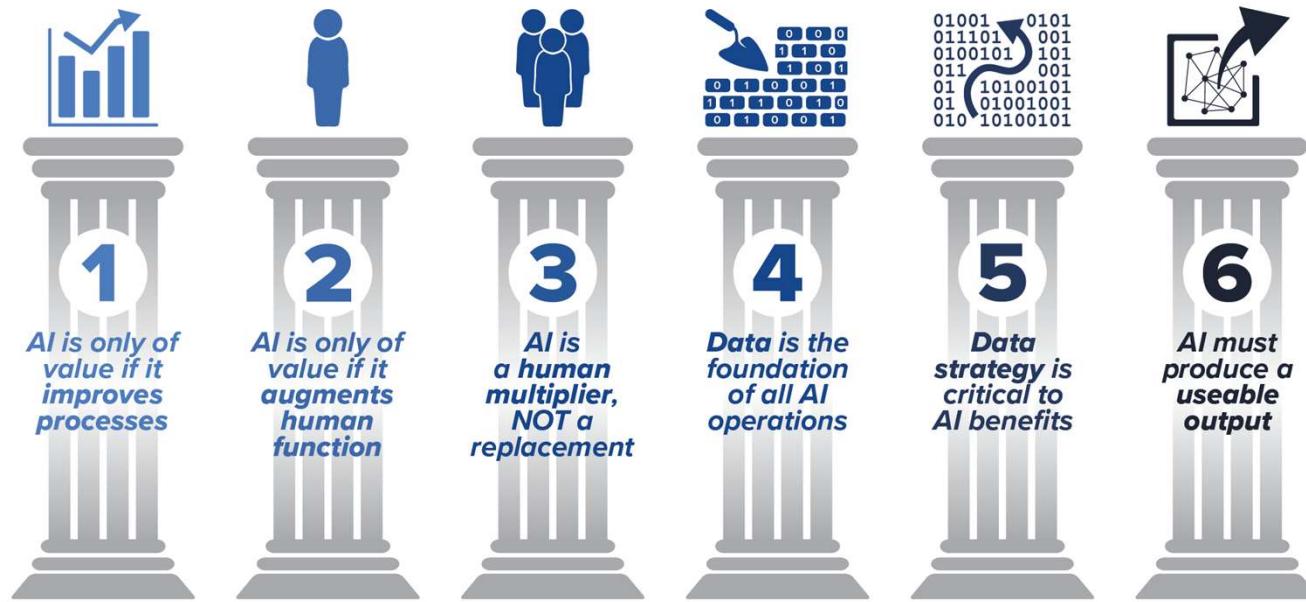


Using generative AI in just a few functions could drive most of the technology's impact across potential corporate use cases.



Source: McKinsey

Choosing the right use-cases

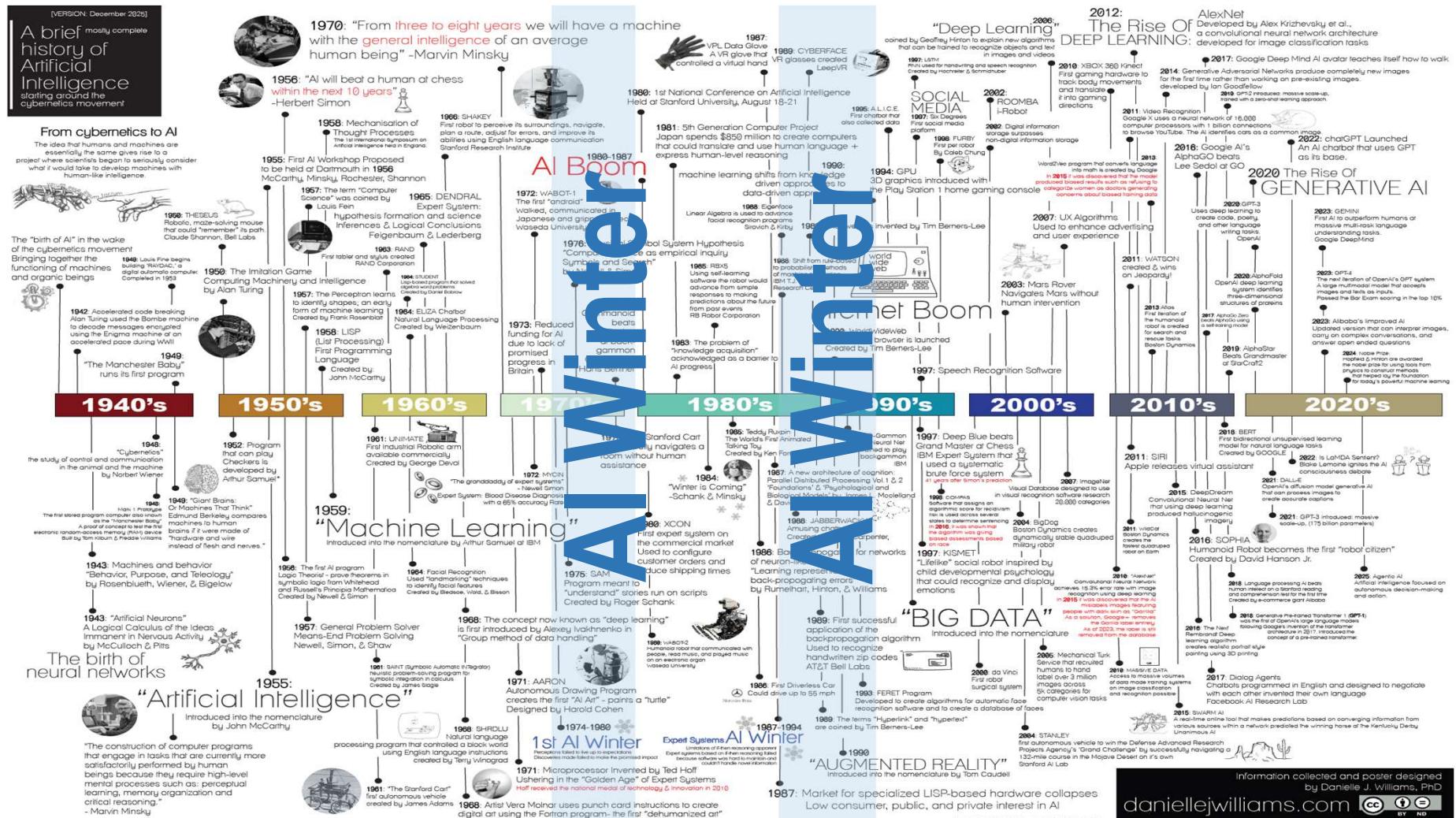


Source: Synergetics

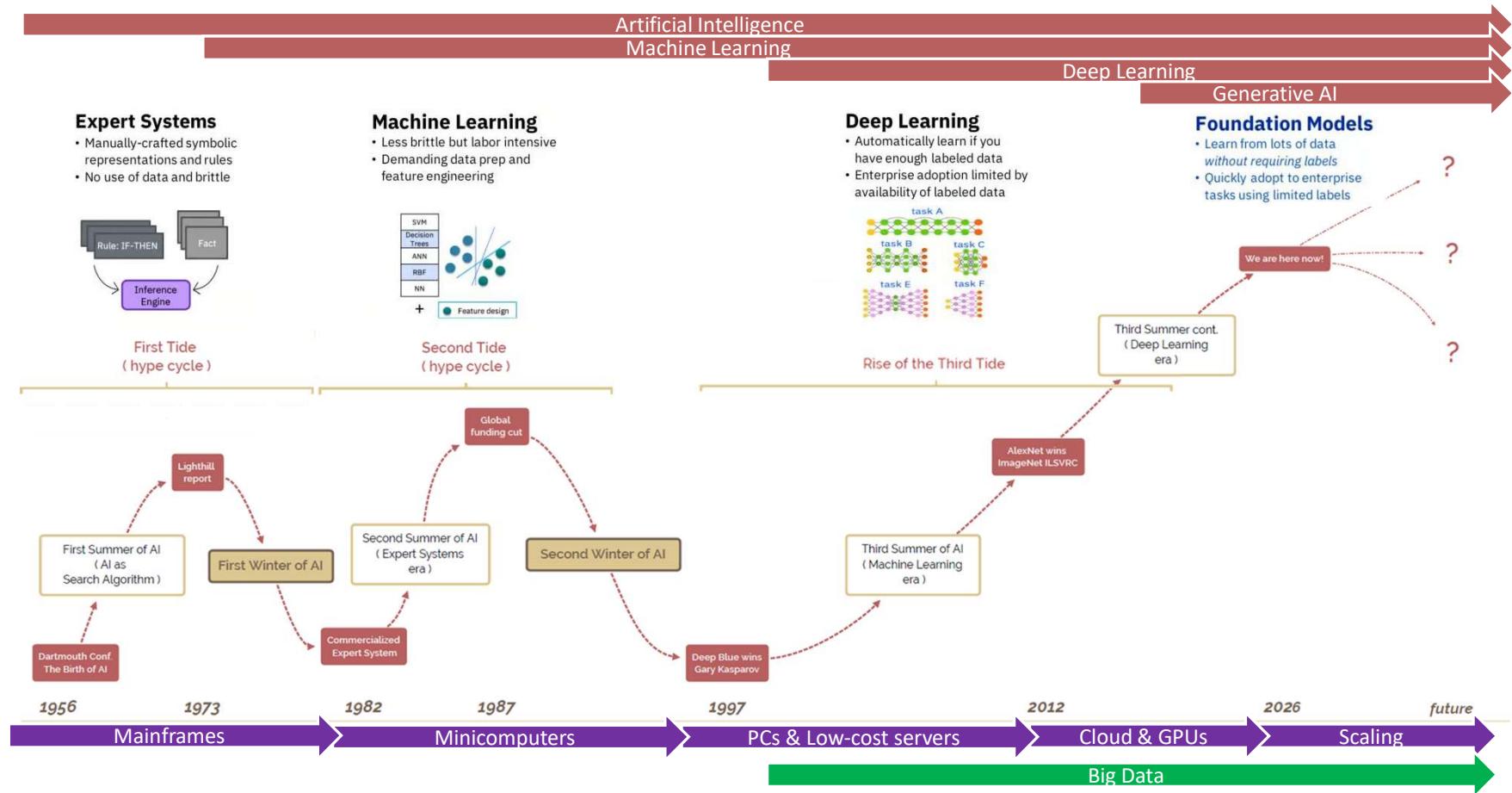
A blue-tinted photograph of a university campus. In the background, a tall, dark rectangular building features a large glass-enclosed clock tower with a white face and black hands. The building has a distinctive pyramid-shaped roof made of glass and metal. To the right, a modern building with a light-colored, angular facade is visible. In the foreground, a paved walkway leads towards the buildings, lined with green trees and bushes. Several students are walking along the path; one man on the left is sitting on a bench, looking at his phone. The overall atmosphere is that of a typical college campus.

History of AI

Ai is not a recent phenomenon



AI is fed by technological breakthroughs

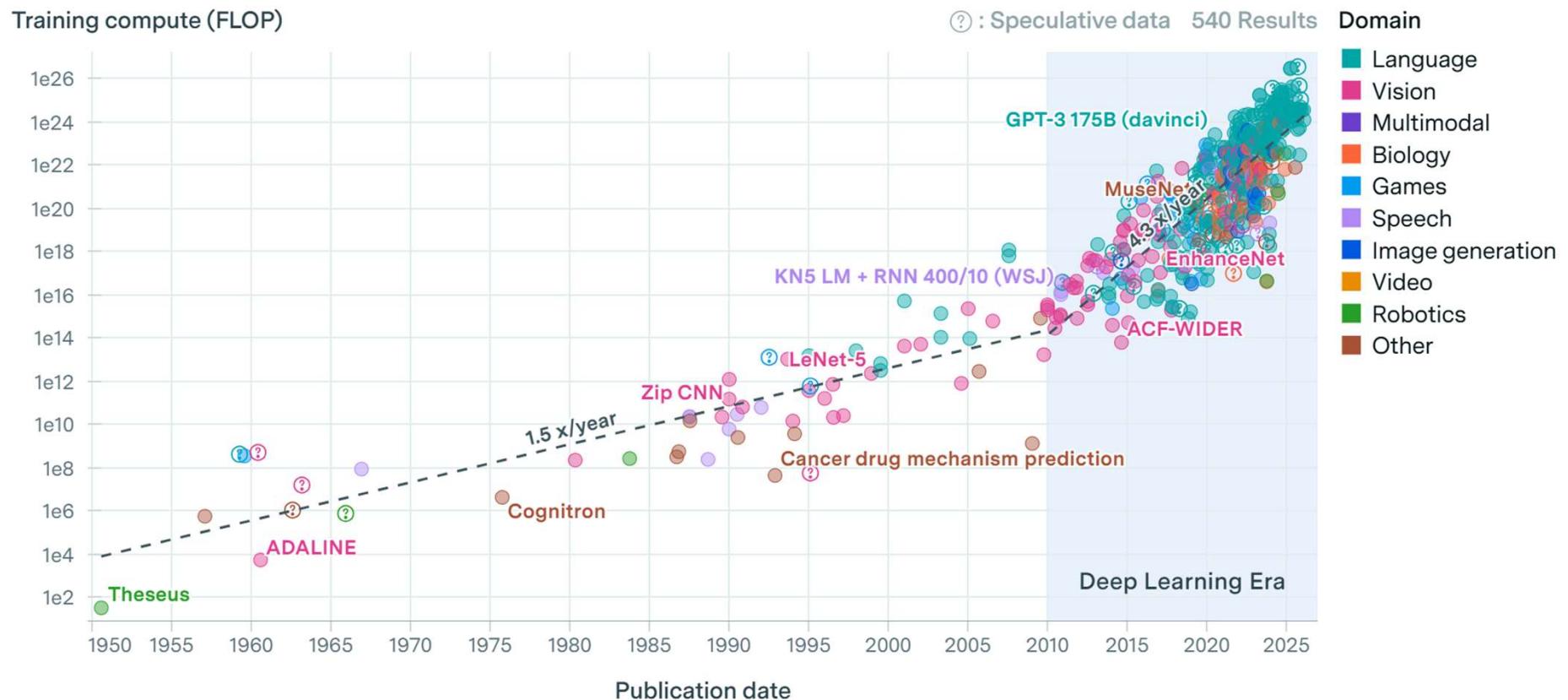


Source: A brief history of AI, Amirhosein Toosi, et al, 2022

Growth is accelerating – due to GPUs

Notable AI models

EPOCH AI

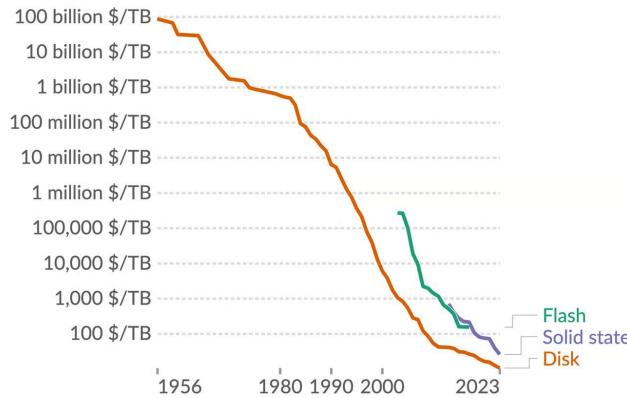


AI is becoming cheaper

Historical price of computer storage

Our World in Data

Expressed in US dollars per terabyte (TB), adjusted for inflation.
"Disk" refers to magnetic storage, "flash" to memory used for rapid data access and rewriting, and "solid state" to solid-state drives (SSDs).



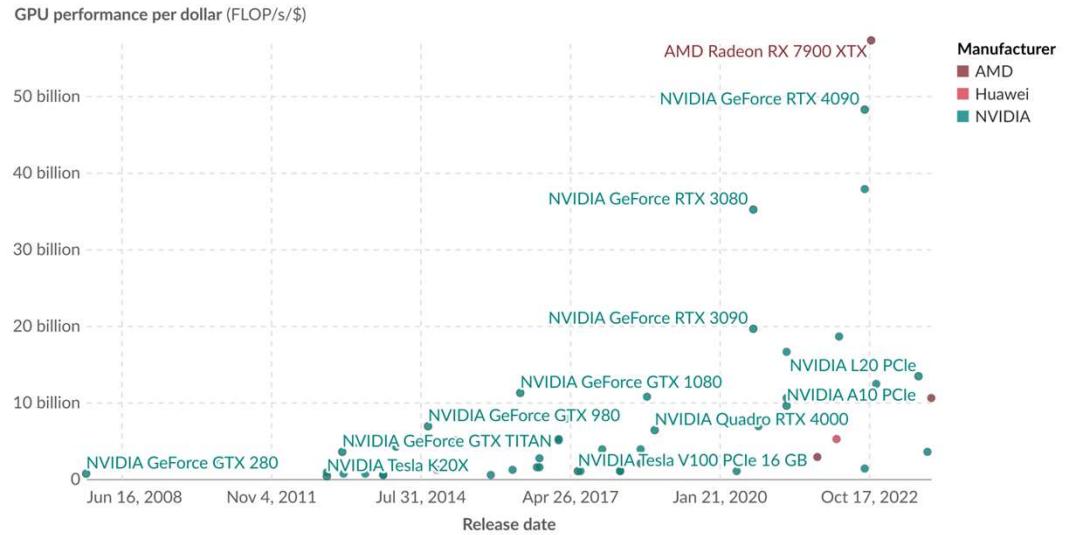
Data source: John C. McCallum (2023)

CC BY

GPU computational performance per dollar

Our World in Data

Hardware computational performance shown in floating-point operations¹ per second (FLOP/s) per US dollar, adjusted for inflation.



Source: Our world in data

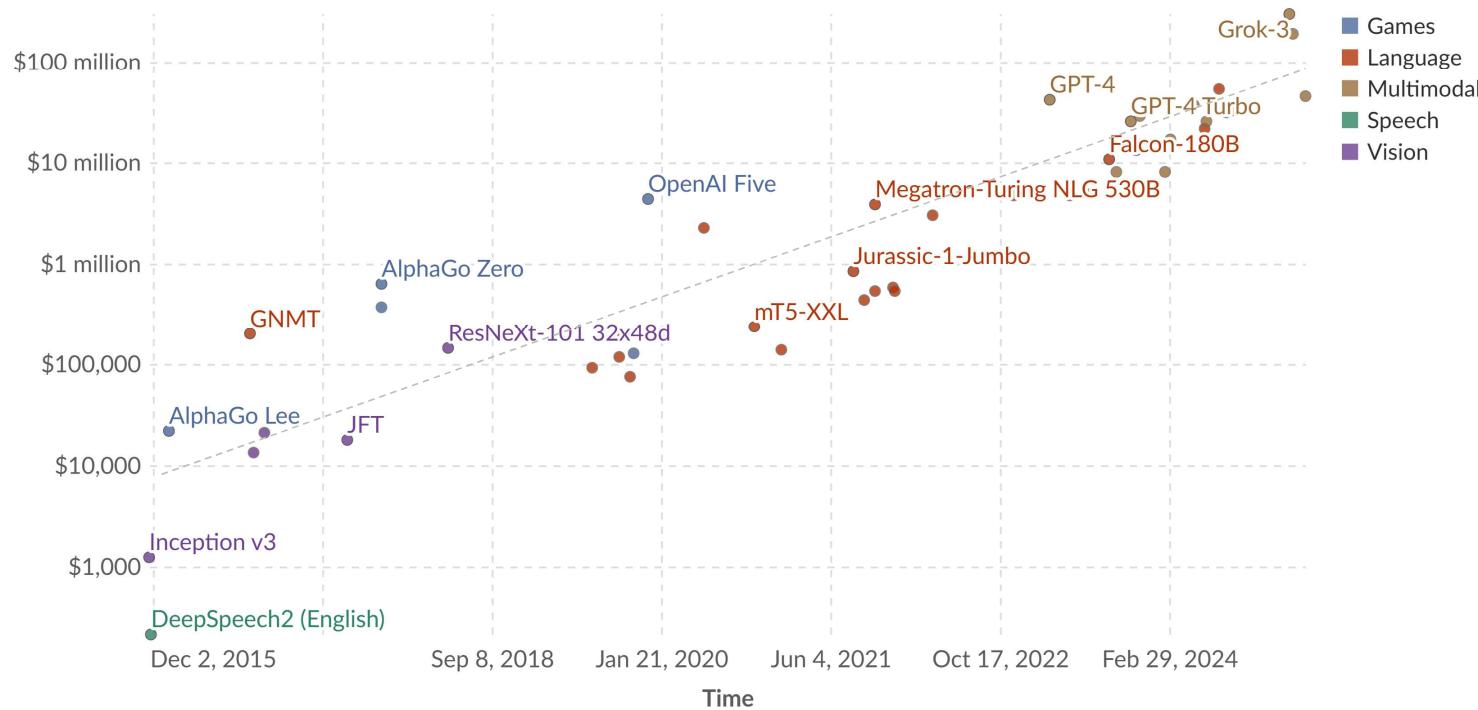
Generative AI models are getting bigger

Hardware and energy cost to train notable AI systems

Our World
in Data

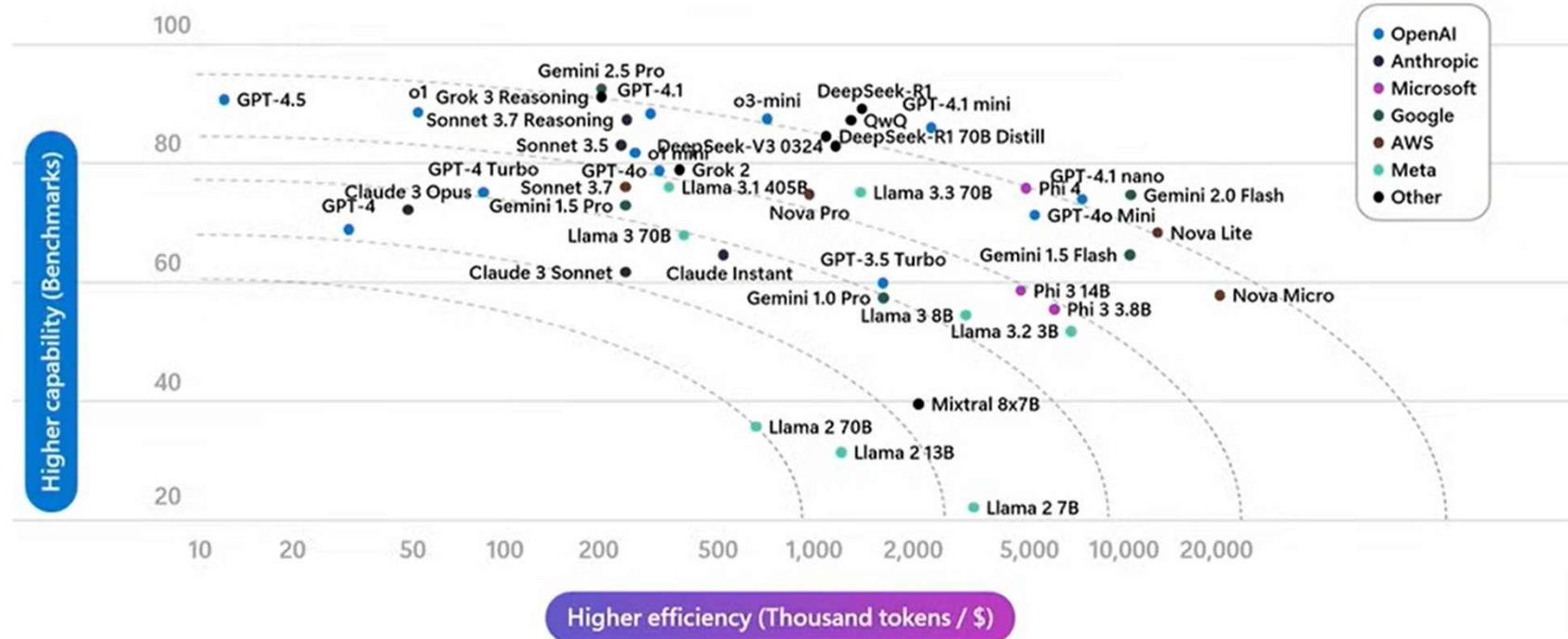
This data is expressed in US dollars, adjusted for inflation.

Cost (constant 2023 US\$; plotted on a logarithmic axis)

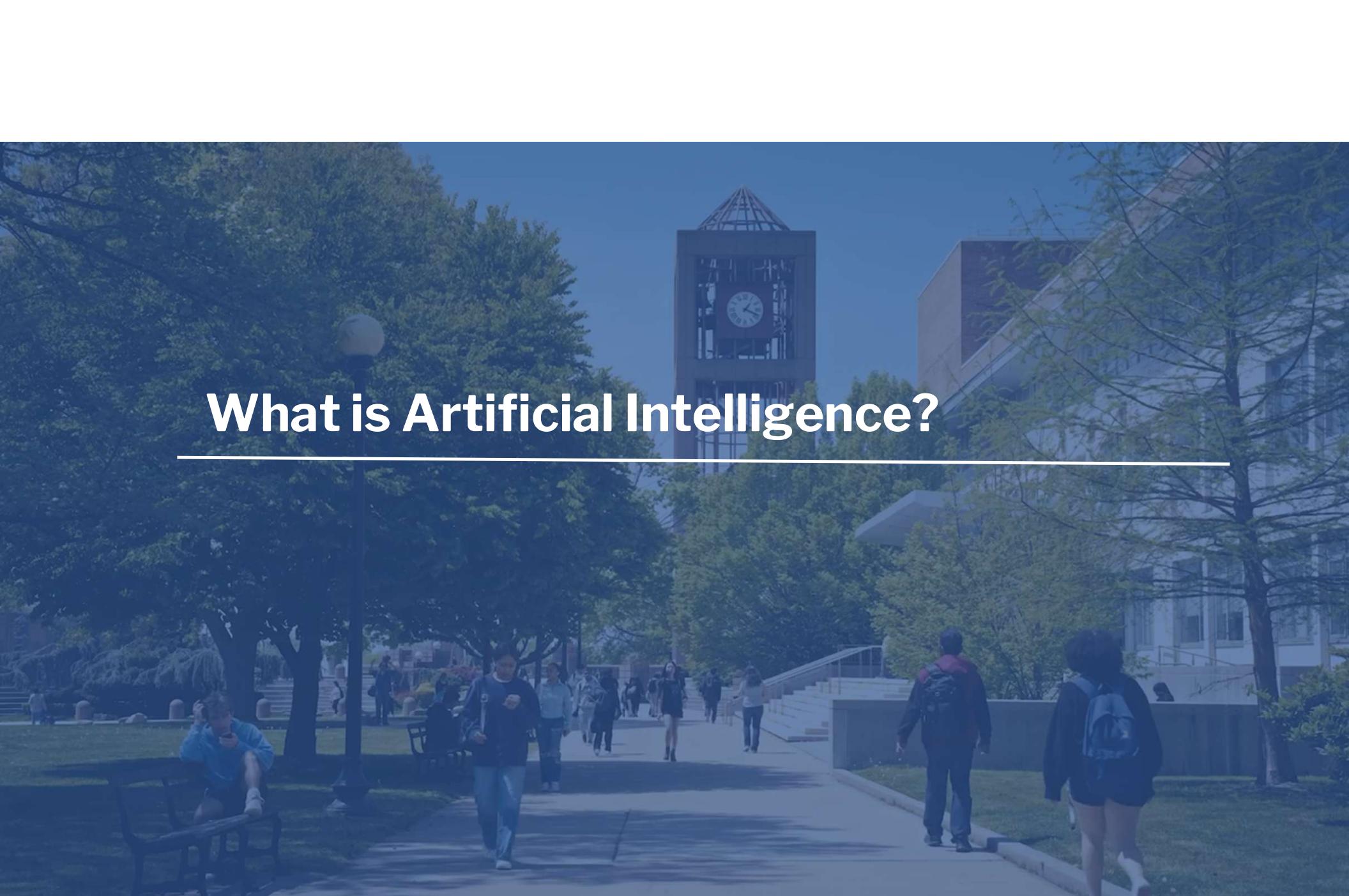


Source: Our world in data

An Explosion of Foundation Models

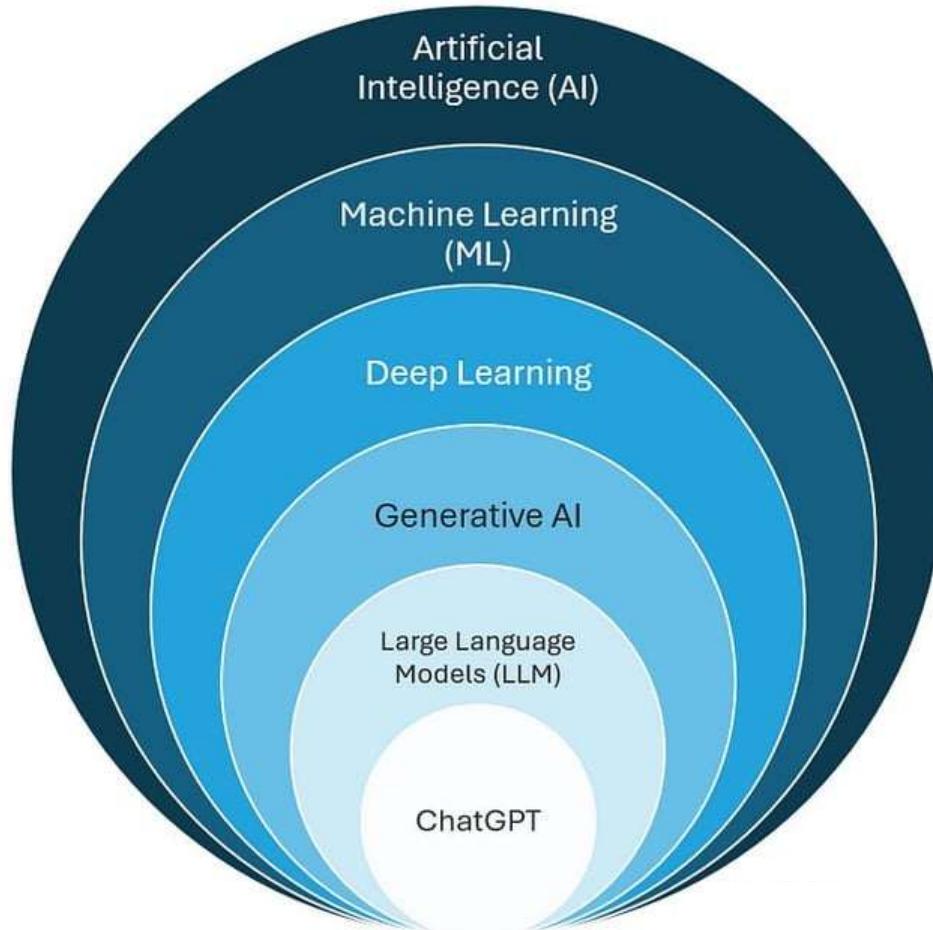


Source: Microsoft

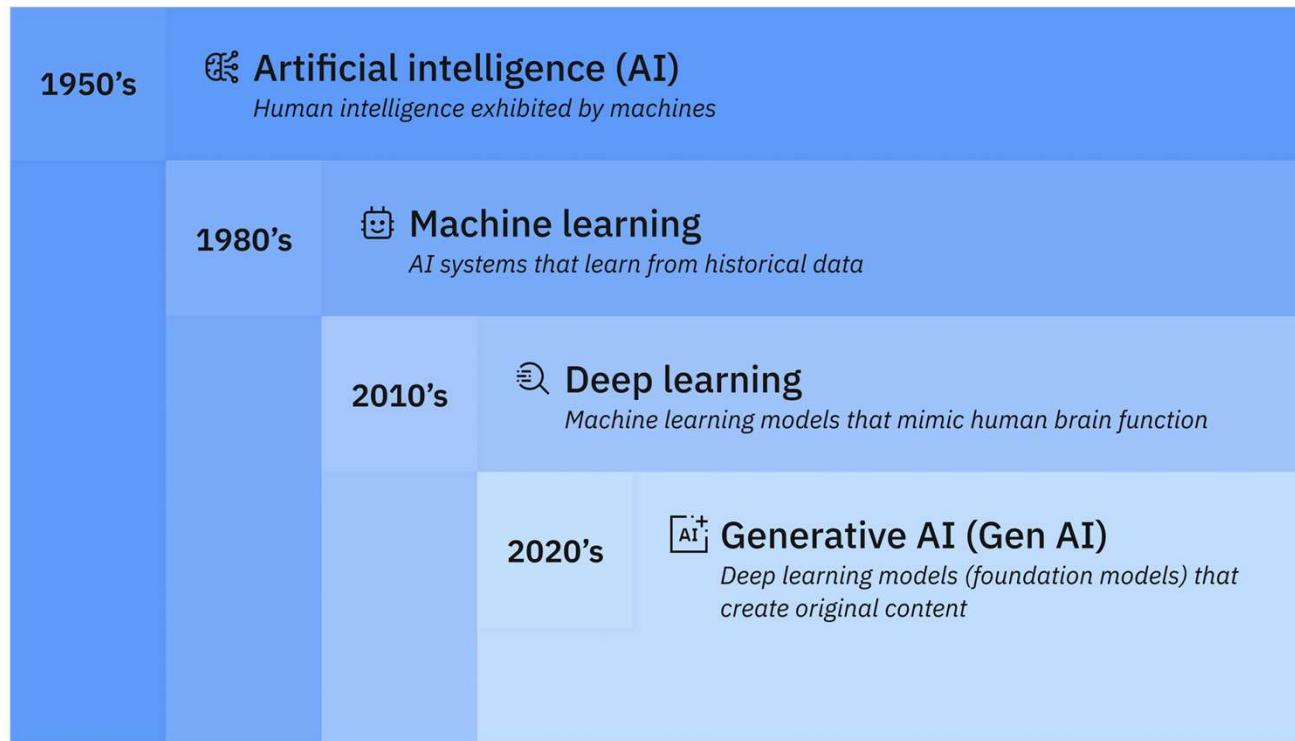


What is Artificial Intelligence?

What is Artificial Intelligence?



What is Artificial Intelligence?



What is intelligence?

"A fundamental problem in artificial intelligence is that nobody really knows what intelligence is."

-Legg & Hutter (2007)

"... the ability to solve hard problems." M. Minsky

"The ability to use memory, knowledge, experience, understanding, reasoning, imagination and judgement in order to solve problems and adapt to new situations." AllWords Dictionary, 2006

"The capacity to acquire and apply knowledge." The American Heritage Dictionary, fourth edition, 2000

"Intelligence is not a single, unitary ability, but rather a composite of several functions. The term denotes that combination of abilities required for survival and advancement within a particular culture." A. Anastasi

"Intelligence is the ability for an information processing system to adapt to its environment with insufficient knowledge and resources." P. Wang

"... the ability to plan and structure one's behavior with an end in view." J. P. Das

"... doing well at a broad range of tasks is an empirical definition of 'intelligence'" H. Masum

"... the ability of a system to act appropriately in an uncertain environment, where appropriate action is that which increases the probability of success, and success is the achievement of behavioral subgoals that support the system's ultimate goal." J. S. Albu

"Intelligence measures an agent's ability to achieve goals in a wide range of environments."

S. Legg and M. Hutter

Source: A Collection of Definitions of Intelligence, Shane Legg, Marcus Hutter, 2007 arXiv:0706.3639

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LLM Ecosystem

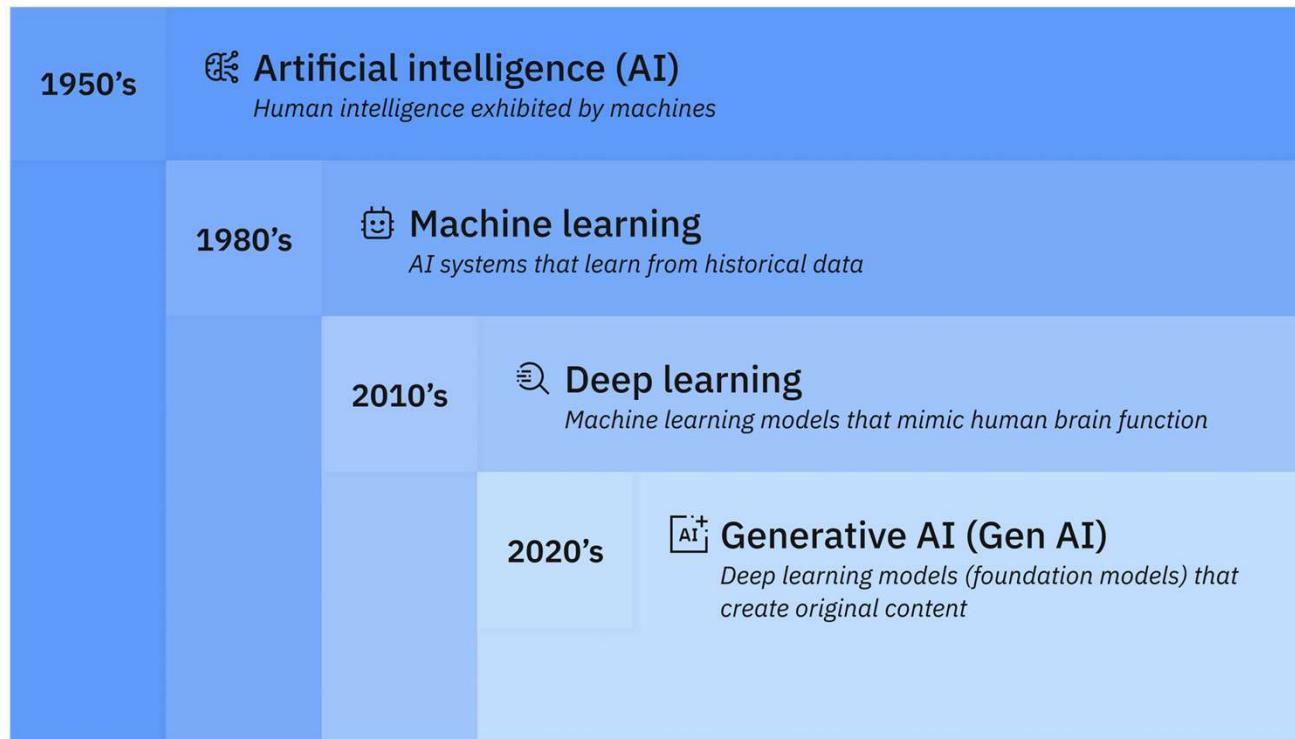
What is Data Science?

“At a high level, data science is a set of fundamental principles that guide the extraction of knowledge from data.”

Principles can be statistical, computational, algorithmic, visual, etc.

Source: NVIDIA DLI Accelerated Data Science

What is Artificial Intelligence?



What is intelligence?

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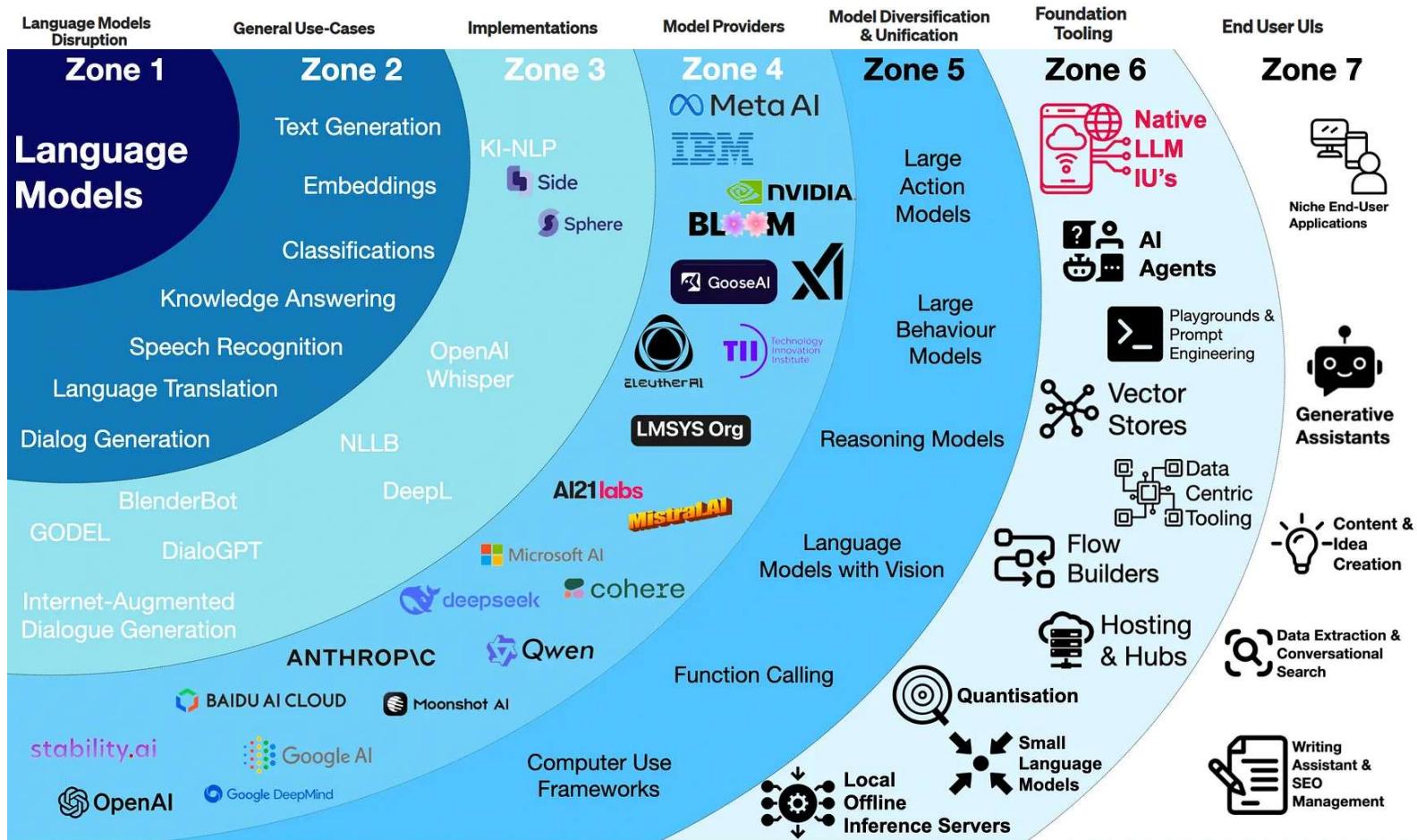
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LLM Ecosystem

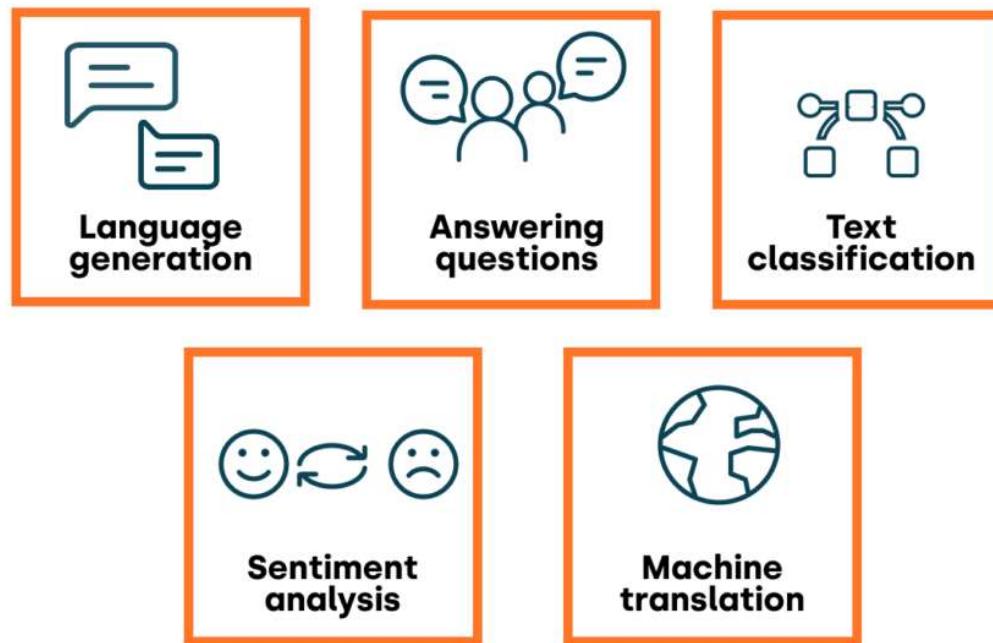
LLM Landscape



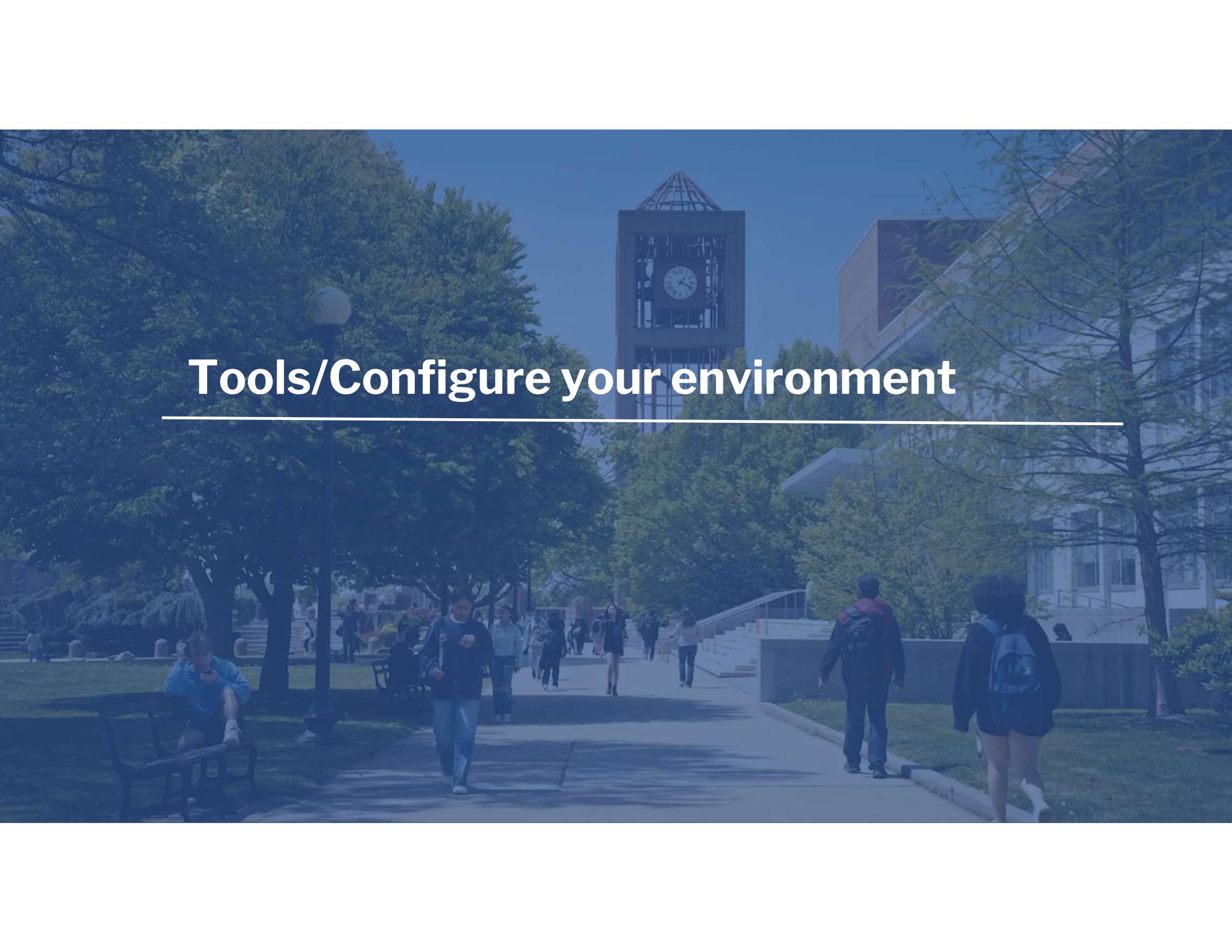
Source: Cobus Greyling

Natural Language Processing

NLP is the process through which **AI is taught to understand the rules and syntax of language**, programmed to develop complex algorithms to represent those rules, and then made to **use those algorithms to carry out specific tasks** like these.



Source: Zapier

A blue-tinted photograph of a university campus. In the background, a tall clock tower with a glass facade and a pyramid-shaped roof stands prominently. To the right, a modern building with large windows and a glass-enclosed staircase is visible. In the foreground, several students are walking along a paved path. One student in a blue hoodie is sitting on a bench on the left. The scene is set against a backdrop of green trees and a clear sky.

Tools/Configure your environment

Register for free tools

1. Colab

- Go to <https://colab.research.google.com/signup>
- Create a Google account (if you don't have one)
- Sign up for **Colab Pro for Education** (free for students)

2. GitHub Copilot

- Go to <https://github.com/education>
- Click on **Join GitHub Education**
- Create a GitHub account (if you don't have one)
- Click on Start an Application to get access

3. Google Gemini

- Go to <https://gemini.google/us/students>
- Fill out the verification form

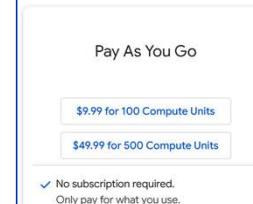
4. Microsoft Copilot 365

- Free with your Office 365 access (via CUNY)

Choose the Colab plan that's right for you

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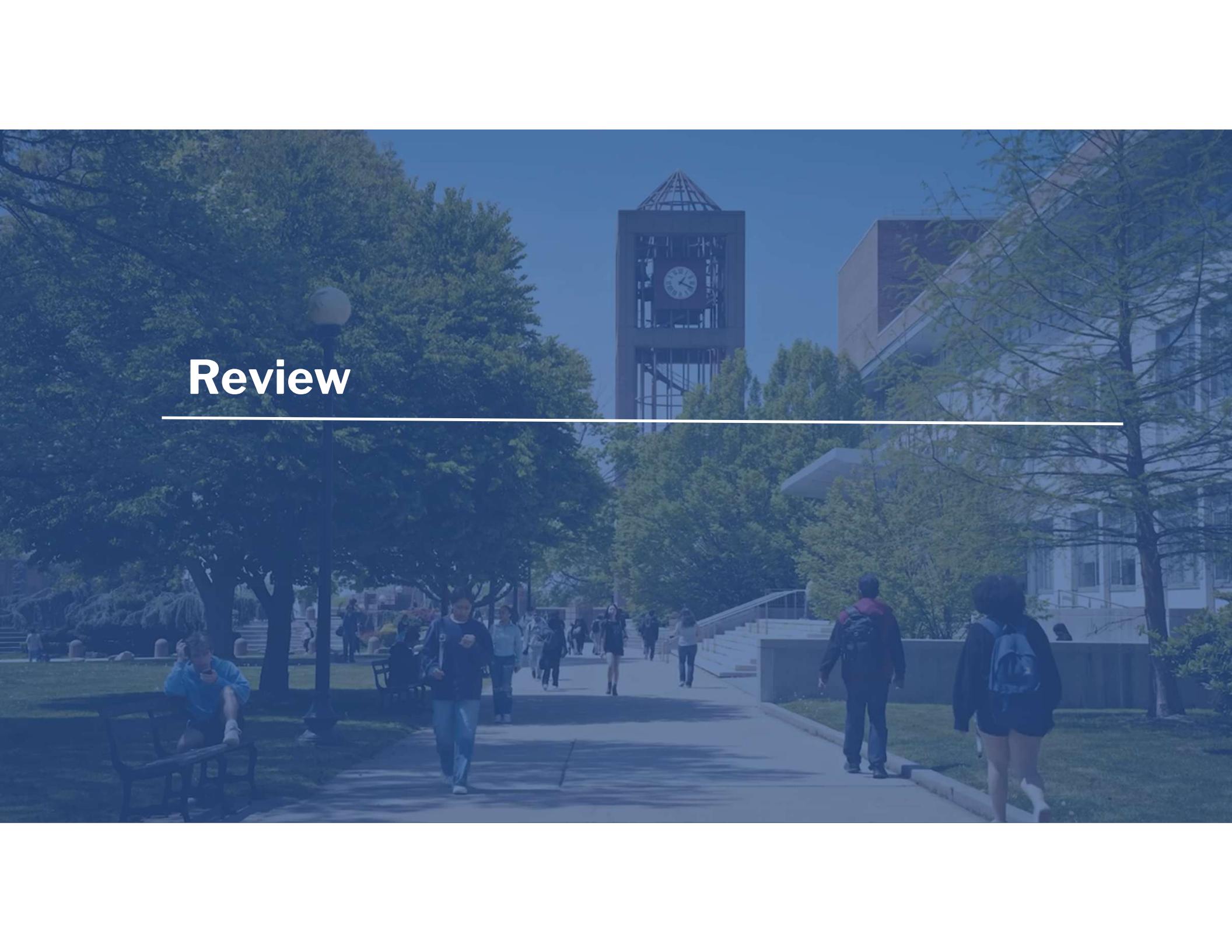
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Featured Gemini benefits

- Homework help & exam prep
Analyze entire textbooks up to 1,500 pages

A scenic view of a university campus under a clear blue sky. In the center, a tall, dark rectangular tower with a glass-enclosed clock face stands prominently. To its right is a large, light-colored building with a glass facade and a staircase leading up to it. In the foreground, a paved walkway leads towards the buildings, lined with lush green trees and bushes. Several students are walking along the path; one is sitting on a bench on the left, while others are strolling or carrying backpacks. The overall atmosphere is bright and sunny.

Review

This week we covered

1. Supervised & Unsupervised Learning

Define the basic types of machine learning (supervised, unsupervised) using examples from real-world applications.

2. Business Role

Explain the role of machine learning in modern business contexts and decision-making.

3. Tooling

Set up and configure Python (or R) environments for machine learning tasks.

4. ML Algorithms

Identify appropriate ML techniques for structured and unstructured business data.

The background image shows a panoramic view of the New York City skyline at sunset or sunrise. The Brooklyn Bridge is prominent in the lower-left foreground, stretching across the East River. The Manhattan skyline, with its numerous skyscrapers, rises in the background under a clear blue sky.

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