

AI504: Programming for Artificial Intelligence

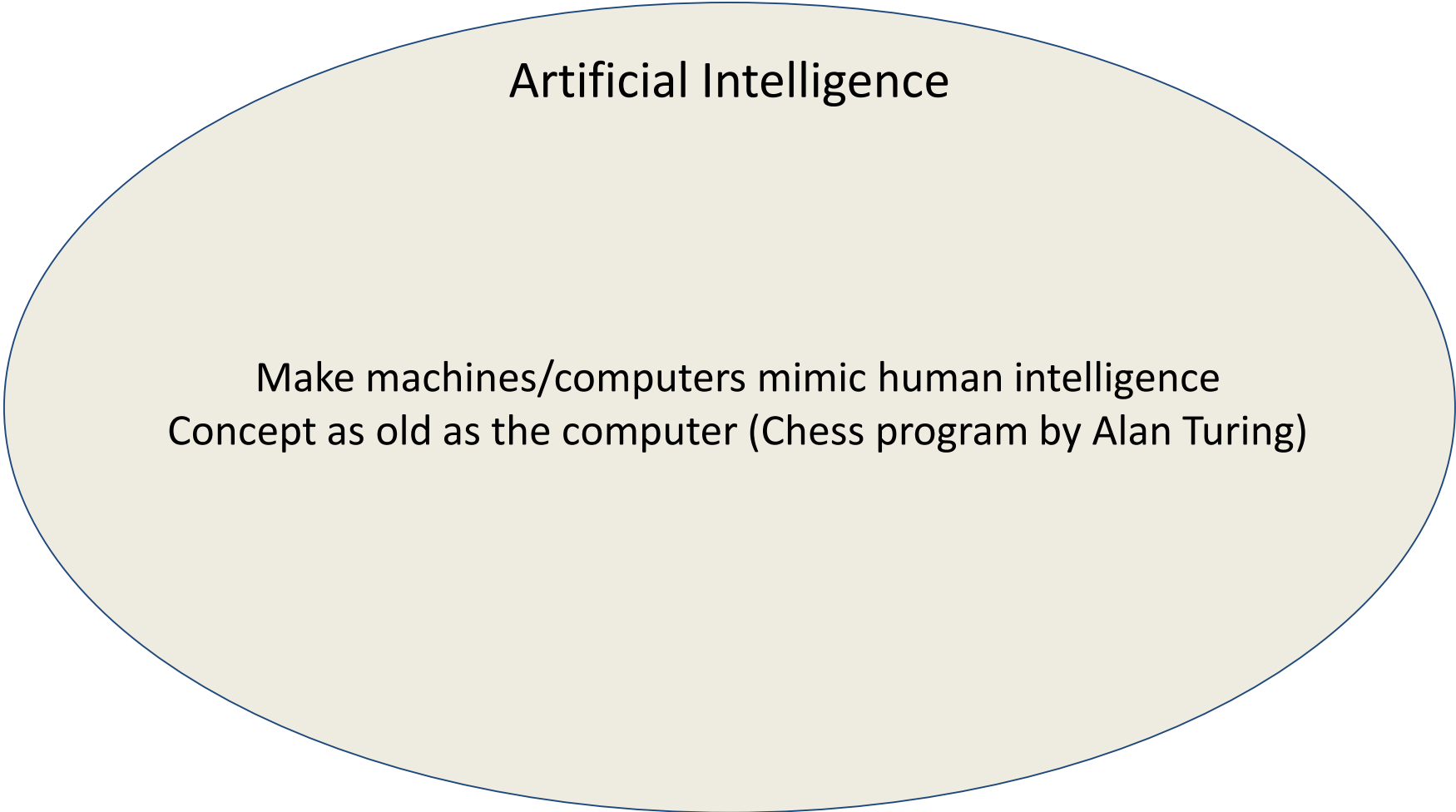
Week 1: Introduction

Edward Choi

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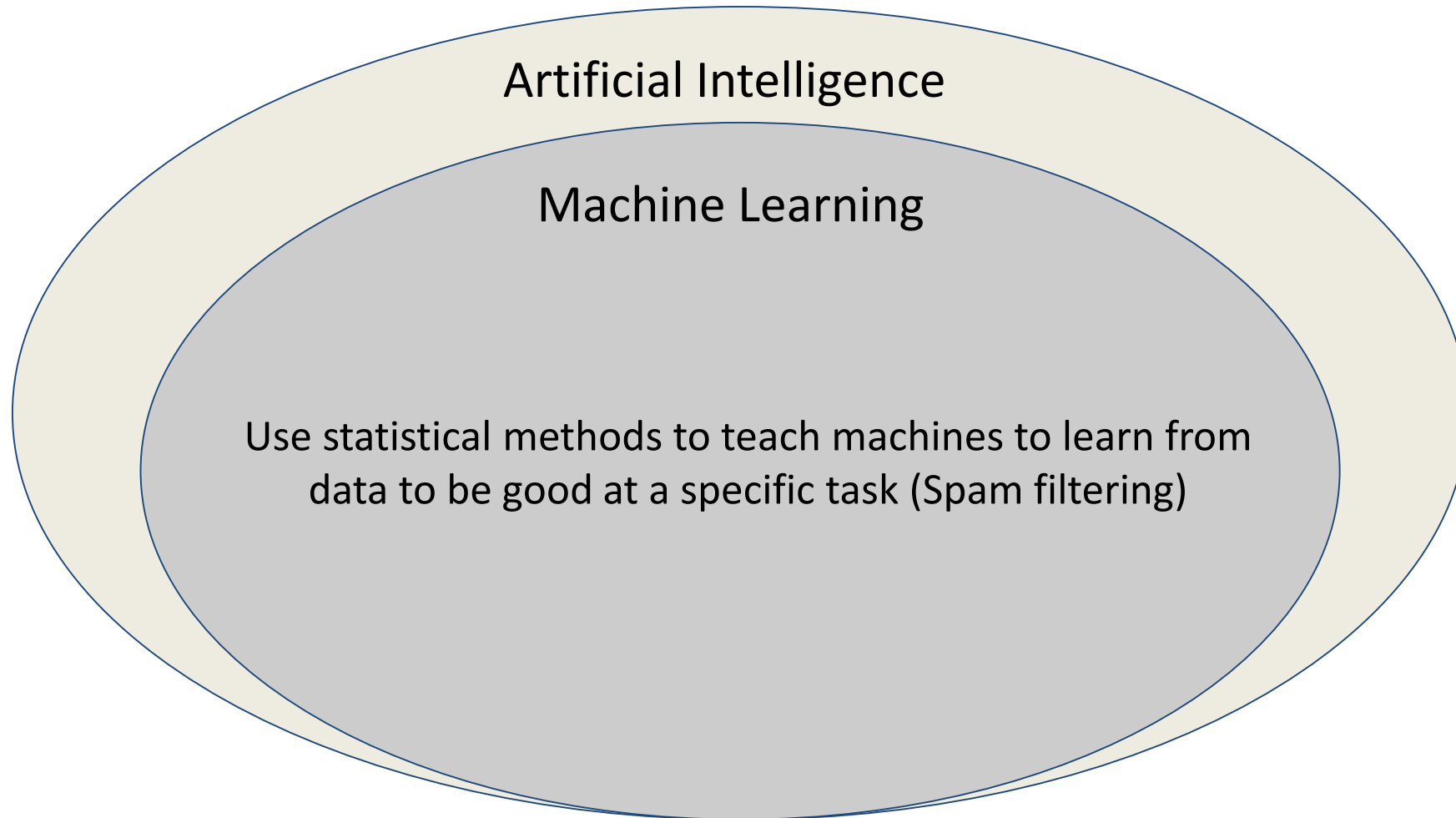
What is AI?



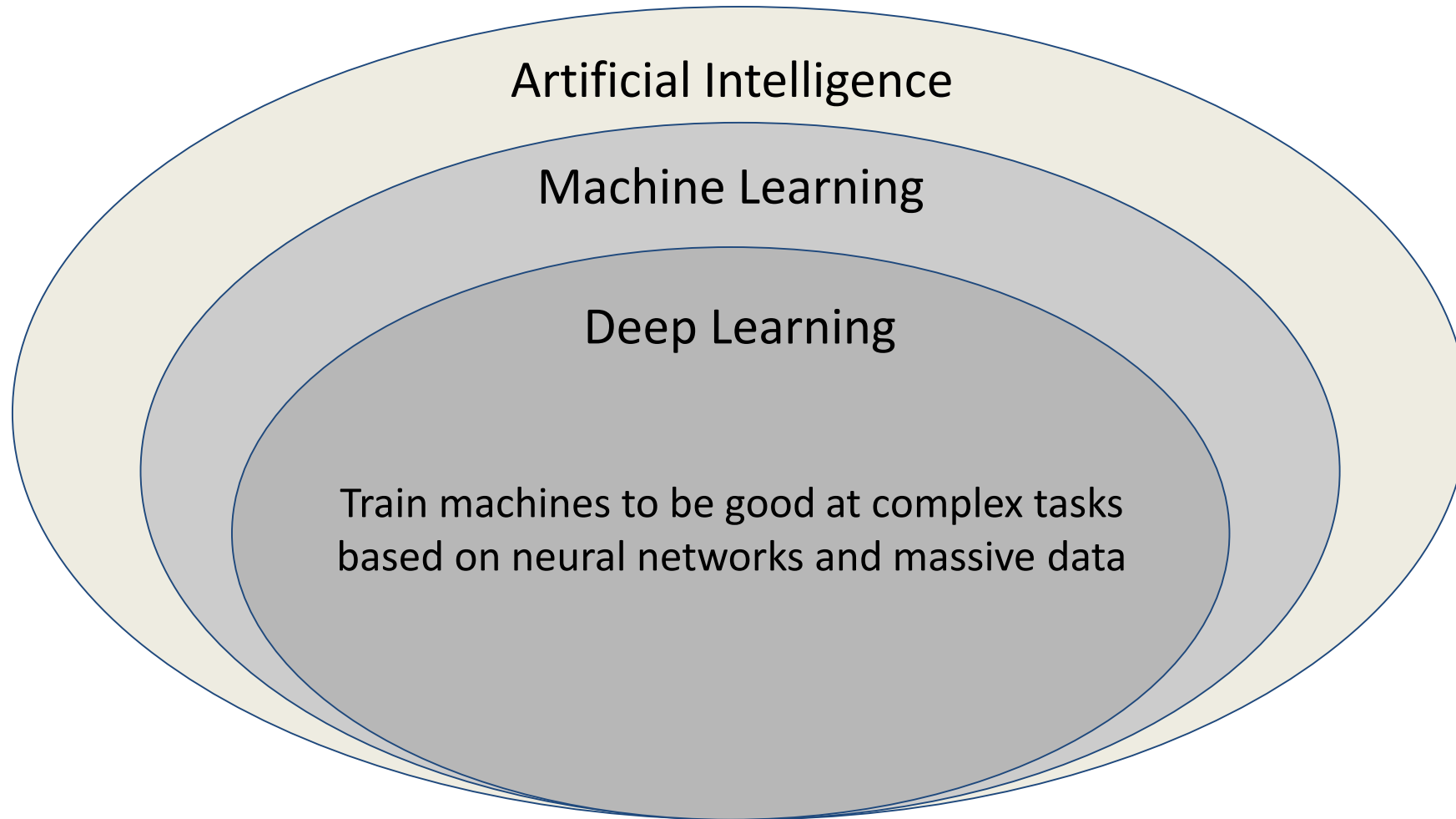
Artificial Intelligence

Make machines/computers mimic human intelligence
Concept as old as the computer (Chess program by Alan Turing)

What is Machine Learning?

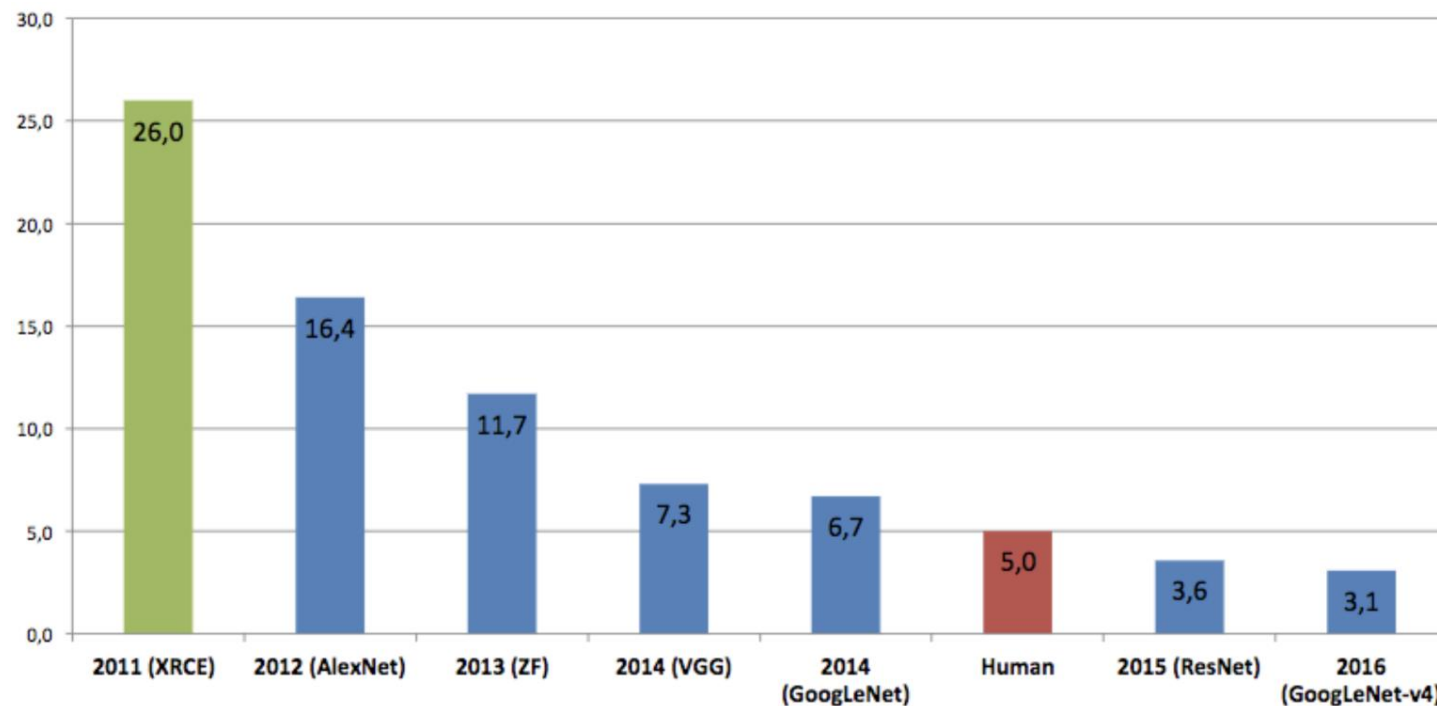


What is Deep Learning?



Why Deep Learning?

State-of-the-art performance



ImageNet Classification Error

Survey of neural networks in autonomous driving, Gustav von Zitzewitz,
Advanced Seminar SS 2017: Survey of Neural Networks in Autonomous Driving

Why Deep Learning?

Less feature engineering



Input

Feature Extraction

Classification

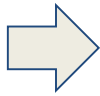
Classical machine learning process

Why Deep Learning?

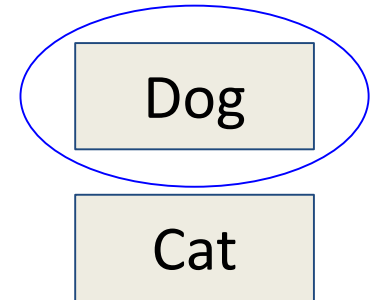
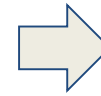
Less feature engineering



Input



Feature Extraction + Classification



Deep learning process

How is this Possible?

Large data

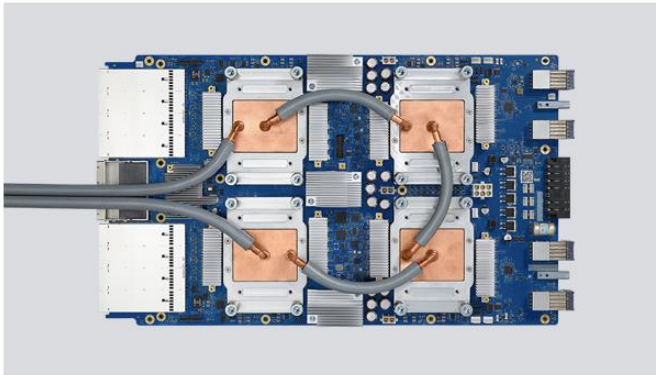
- Social network services
 - Youtube, Instagram, Twitter
- Collective intelligence
 - Wikipedia
- Mass media
 - News articles



ImageNet

How is this Possible?

Large data + Powerful machines



Cloud TPU v3

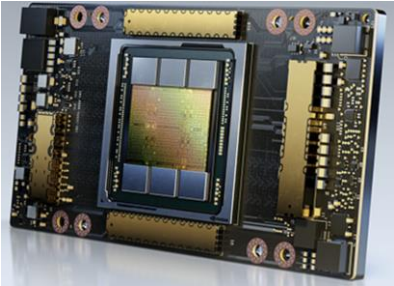
420 teraflops

128 GB HBM

NVIDIA A100

★★★★★ (2)

[Details](#) [Reviews](#) [Stores](#)

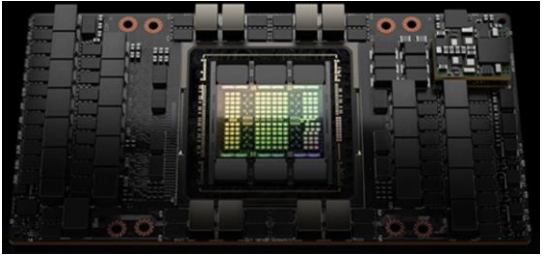


Typically **\$14,575–\$16,041**

NVIDIA H100

★★★★★ (2)

[Details](#) [Reviews](#) [Stores](#)



Typically **\$30,001–\$39,000**

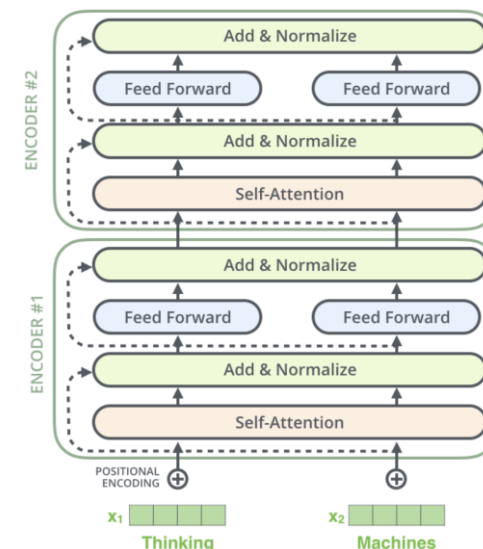
(Almost) Infinite Compute + (Almost) Infinite Data + Transformer



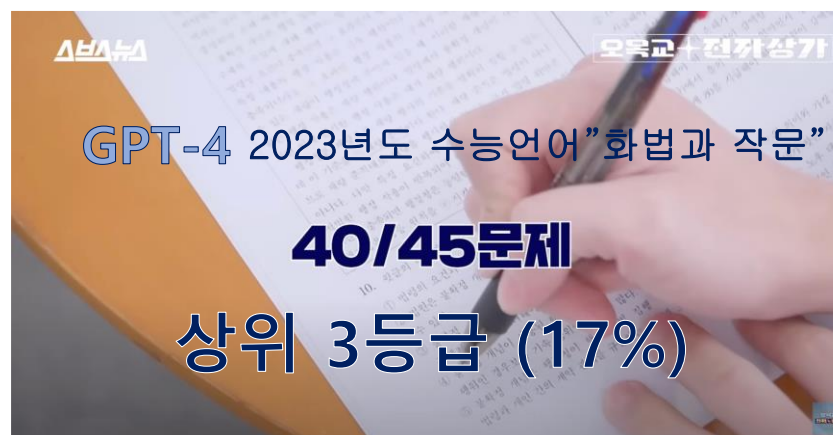
Lots of GPUs (> 10k)



Lots of data (entire Internet)



Lots of Transformer layers



- > 1T Parameters
- > \$1 Billion for development

(Almost) Infinite Compute + (Almost) Infinite Data



Probably > 10k A100's



Probably the entire Internet



GPT-4o, Multi-modal LLM

- Input: Video/Audio/Text, Output: Text/Audio
- Tens (maybe hundreds) of Transformer layers



DALL-E 3, Image Generation

- Conditional text-to-image generator
- Diffusion + Transformer



A illustration from a graphic novel. A bustling city street under the shine of a full moon. The sidewalks bustling with pedestrians enjoying the nightlife. At the corner stall, a young woman with fiery red hair, dressed in a signature velvet cloak, is haggling with the grumpy old vendor. the grumpy vendor, a tall, sophisticated man is wearing a sharp suit, sports a noteworthy moustache is animatedly conversing on his steampunk telephone.

Sora, Video Generation

- Conditional text-to-video generator
- Transformer + Diffusion



Prompt: A stylish woman walks down a Tokyo street filled with warm glowing neon and animated city signage. She wears a black leather jacket, a long red dress, and black boots, and carries a black purse. She wears sunglasses and red lipstick. She walks confidently and casually. The street is damp and reflective, creating a mirror effect of the colorful lights. Many pedestrians walk about.

Udio, Audio Generation

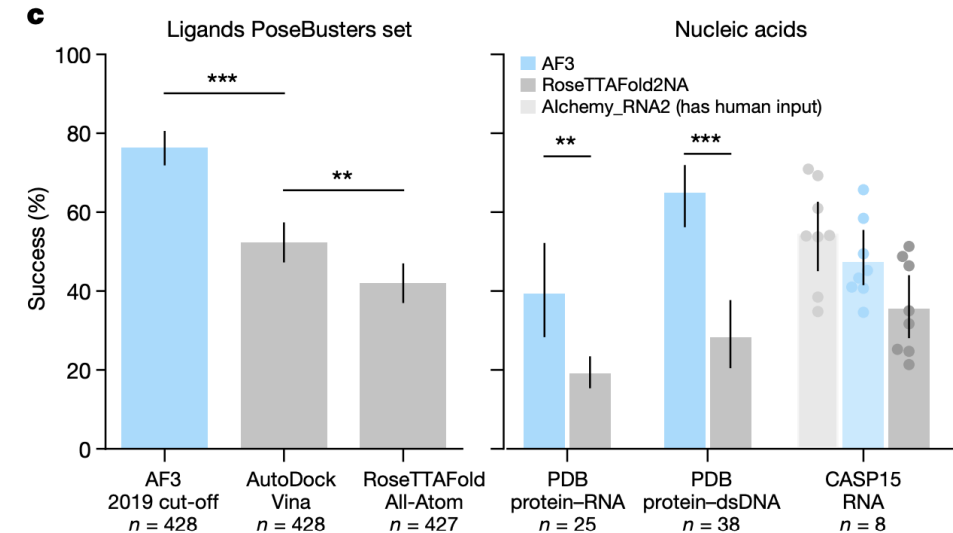
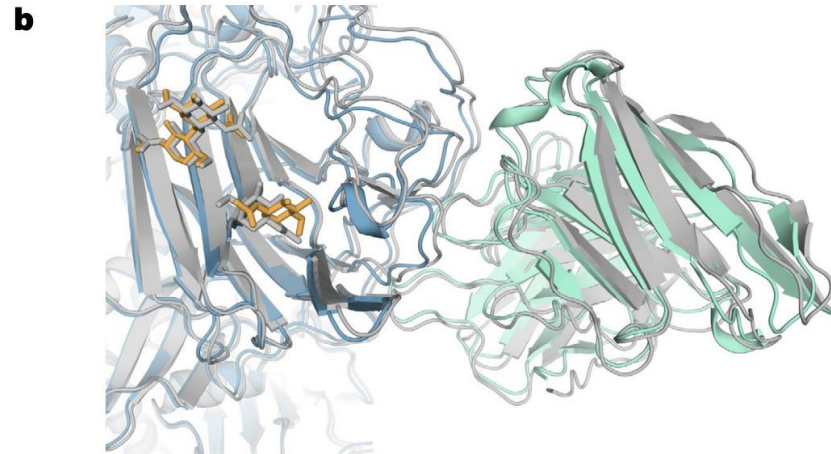
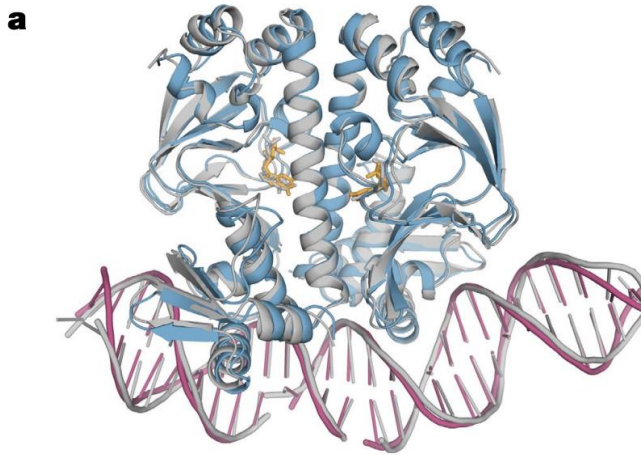
- Conditional text-to-music generation
- Probably Transformer + Diffusion



Dune, the Broadway Musical

AlphaFold3

- DeepMind's biomolecular interaction prediction model
 - Using Pairformer blocks + Diffusion blocks
 - Special self-attention for graphs in 3D



Goal

- Learn to build deep learning models.
 - So that you can replicate papers
 - So that you can realize your ideas
 - So that you can conduct AI research
- Feel free to use tools
 - Copilot, ChatGPT, Claude, etc.
- This course teaches only the very basics.
 - Practice makes perfect!

Structure

- Schedule
 - Lecture on Tuesday
 - Conducted by the lecturer
 - Practice on Thursday
 - Conducted by the TA
 - All material will be uploaded on KLMS
- Evaluation
 - Pass or Fail
 - You must pass all 3 projects
 - You must complete all 3 surveys
 - No attendance check
 - Up to you to attend

Weekly Plan

1. Intro + Numpy
2. Basic Machine Learning + Scikit-learn
3. PyTorch Intro + Logistic Regression + Multi-layer Perceptron
4. Autoencoders (& Denoising Autoencoders)
5. Variational Autoencoders
6. Generative Adversarial Networks
7. Convolutional Neural Networks
8. **Project 1: Image Classification**
9. Word2Vec + Subword Encoding
10. Recurrent Neural Networks & Sequence-to-Sequence
11. Transformers
12. BERT & GPT
13. **Project 2: Language Model**
14. Deep Diffusion Probabilistic Model
15. Image-Text Multimodal Learning
16. **Project 3: Visual Language Model**

Expectation

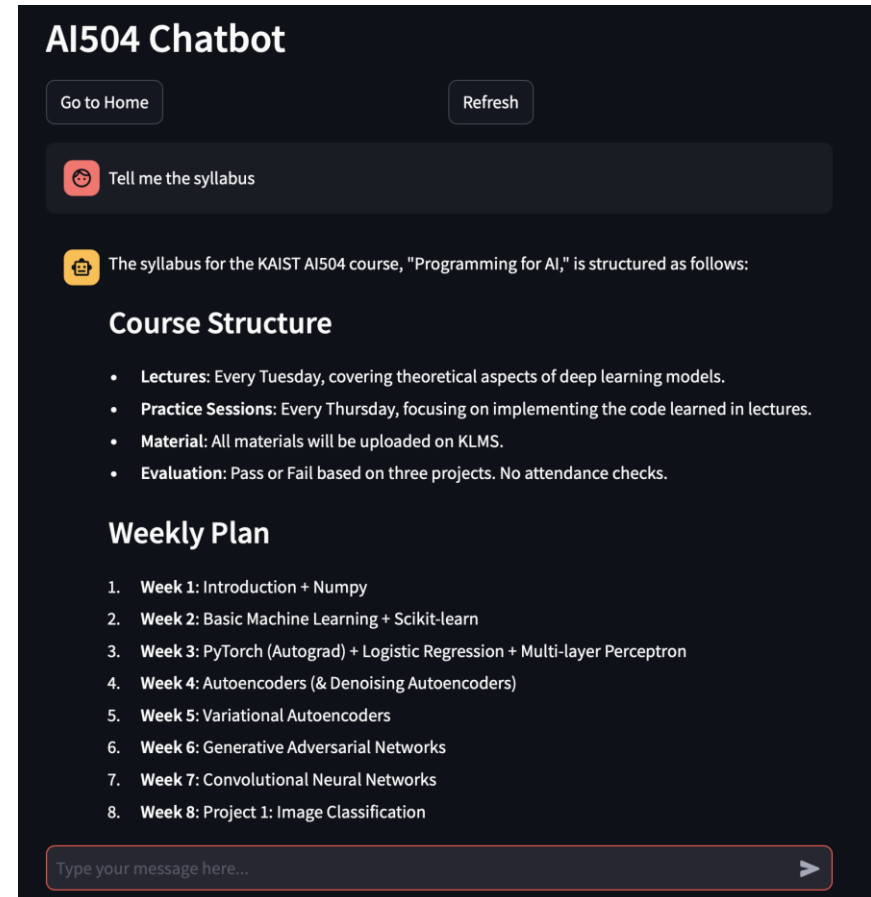
- Lecture attendance: Up to you
 - **617** people enrolled in this course
 - Previous material from 2023: <https://mp2893.com/course.html>
- Projects
 1. Image classification using CNN
 2. Language model using Transformer
 3. Visual Large Language Model (Visual LLM)
 - All projects are given 24hr to submit your code
 - Expected to take approximately 2hr (training will take about 5min on Colab)
 - Designed to evaluate only model programming, not model performance
 - Individual effort
 - Plagiarism, if caught, will lead to **serious consequences**
 - Using LLMs are okay

WARNING!!!

- There are 600 students in this class
 - **300 will FAIL**
- No exceptions will be made
 - I will lose my scholarship
 - I won't be able to graduate
 - I was busy with my paper
 - It's just a one-line mistake
 - I forgot to change the file name
 - ...
- It is your **RESPONSIBILITY** to
 - Check emails and KLMS
 - Follow the spec

Teaching Team

- Lecturer
 - Edward Choi
 - edwardchoi@kaist.ac.kr
 - <https://mp2893.com>
- TA
 - Jiyoun Kim
 - jiyoun.kim@kaist.ac.kr
- AI
 - AI TA will be deployed
 - AI will handle all your questions **outside** the class
 - Course operations, theory questions, practice questions, project questions, etc.
 - No Q&A using KLMS
 - Come to the class if you want to personally ask questions



The screenshot displays the AI504 Chatbot interface. At the top, there are buttons for 'Go to Home' and 'Refresh'. Below these is a search bar with the text 'Tell me the syllabus'. The chatbot's response provides the syllabus for the KAIST AI504 course, 'Programming for AI', and lists the course structure and weekly plan.

AI504 Chatbot

Go to Home Refresh

Tell me the syllabus

The syllabus for the KAIST AI504 course, "Programming for AI," is structured as follows:

Course Structure

- **Lectures:** Every Tuesday, covering theoretical aspects of deep learning models.
- **Practice Sessions:** Every Thursday, focusing on implementing the code learned in lectures.
- **Material:** All materials will be uploaded on KLMS.
- **Evaluation:** Pass or Fail based on three projects. No attendance checks.

Weekly Plan

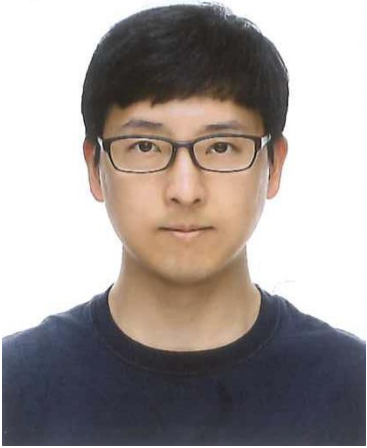
1. **Week 1:** Introduction + Numpy
2. **Week 2:** Basic Machine Learning + Scikit-learn
3. **Week 3:** PyTorch (Autograd) + Logistic Regression + Multi-layer Perceptron
4. **Week 4:** Autoencoders (& Denoising Autoencoders)
5. **Week 5:** Variational Autoencoders
6. **Week 6:** Generative Adversarial Networks
7. **Week 7:** Convolutional Neural Networks
8. **Week 8:** Project 1: Image Classification

Type your message here... >

Research Experiment

- Can LLMs handle course-related Q&A as effectively as human TAs?
 - Continued effort from last year
- We will collect the following:
 - Student profiles
 - Age, gender, home department, coding skills, ML knowledge, etc.
 - Conversation logs
 - We have a RAG-based system
 - Satisfaction surveys
 - 3 times over the semester
 - Interviews
 - Several students who actively used the LLM

Edward Choi, 최윤재



- Education
 - Ph.D. (computer science), Georgia Tech, 2014-2018
 - Thesis: Interpretable deep learning for longitudinal electronic health records
- Professional Experience
 - ETRI (2010-2014)
 - Sutter Health (2015, 2016)
 - DeepMind & Google (2017)
 - Google Brain & Google Health (2018-2020)
- Research Area
 - Machine Learning, Healthcare, NLP, Multi-modal

To-do

- Install Anaconda
 - Python package for data science
 - Includes Jupyter, Numpy, Scikit-Learn, TensorFlow, PyTorch
 - <https://www.anaconda.com/products/individual>
- All practice sessions will be conducted with Google Colab
 - Python Notebook on the web
 - Can train models using Google's GPU/TPU
 - Session-based (why you need Anaconda)

Questions?

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