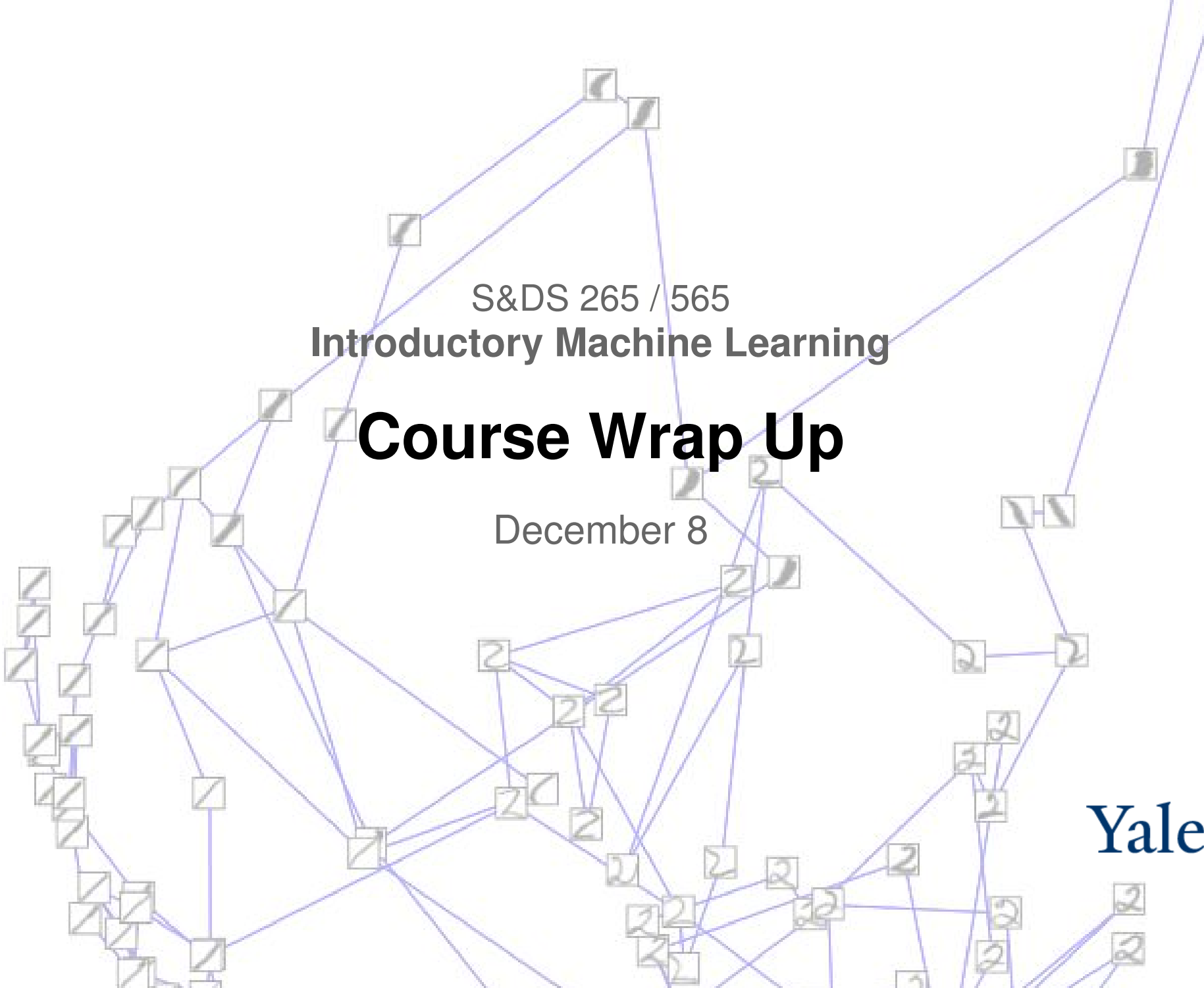


S&DS 265 / 565

Introductory Machine Learning

Course Wrap Up

December 8

Yale

Endgame

- Assn 6 is out; due next Thursday
- Quiz 6 is open; closes Saturday at 10:30am
- Final exam: Monday, Dec 19 at 7pm in Davies Aud
- Practice exam posted
- Review sessions:
  - Friday, Dec 16, 7pm (Wendy)
  - Saturday, Dec 17, 3pm (Hannah)
  - Sunday, Dec 18, 11am (Zhehao)
  - Last-minute Q&A: Monday, Dec 19, 10am (Wendy)

Recall: Language/Sequence models

- Generative process, any sequence (of words, characters, stock prices, nucleotides...) is assigned a probability

$$p(x_1, \ldots, x_n)$$

which can be factored as

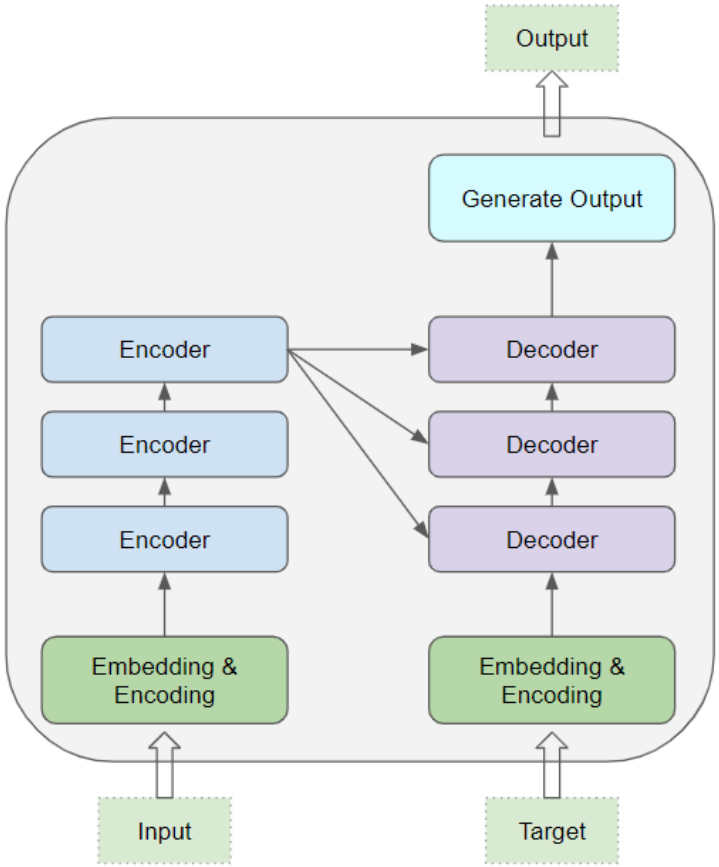
$$p(x_1, \ldots, x_n) = p(x_1)p(x_2 \mid x_1) \ldots p(x_n \mid x_1, \ldots, x_{n-1})$$

Transformers

The current state-of-the-art is based on *transfomers*

- Attention is the key ingredient
- Rather than processing sequences word-by-word, transformers handle larger chunks of text at once
- Incorporates “interactions” between words and hidden states

Transformer architecture



A.I. Is Mastering Language. Should We Trust What It Says?

OpenAI's GPT-3 and other neural nets can now write original prose with mind-boggling fluency — a development that could have profound implications for the future.

ChatGPT: Optimizing Language Models for Dialogue

We've trained a model called ChatGPT which interacts in a conversational way. The dialogue format makes it possible for ChatGPT to answer followup questions, admit its mistakes, challenge incorrect premises, and reject inappropriate requests. ChatGPT is a sibling model to InstructGPT, which is trained to follow an instruction in a prompt and provide a detailed response.

November 30, 2022
13 minute read

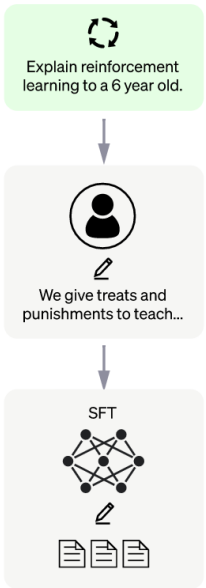
Step 1

Collect demonstration data and train a supervised policy.

A prompt is sampled from our prompt dataset.

A labeler demonstrates the desired output behavior.

This data is used to fine-tune GPT-3.5 with supervised learning.



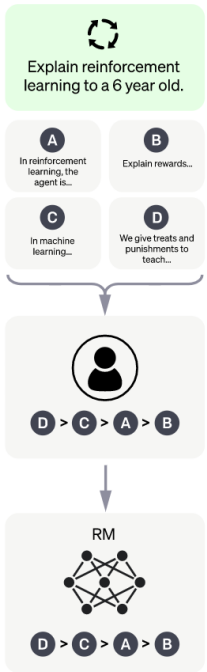
Step 2

Collect comparison data and train a reward model.

A prompt and several model outputs are sampled.

A labeler ranks the outputs from best to worst.

This data is used to train our reward model.



Step 3

Optimize a policy against the reward model using the PPO reinforcement learning algorithm.

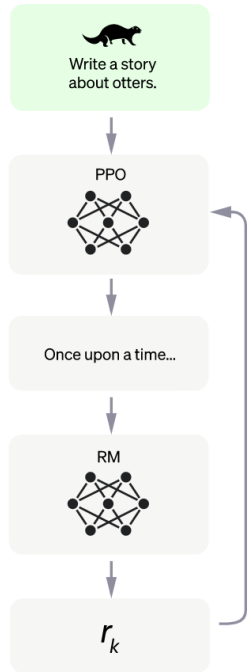
A new prompt is sampled from the dataset.

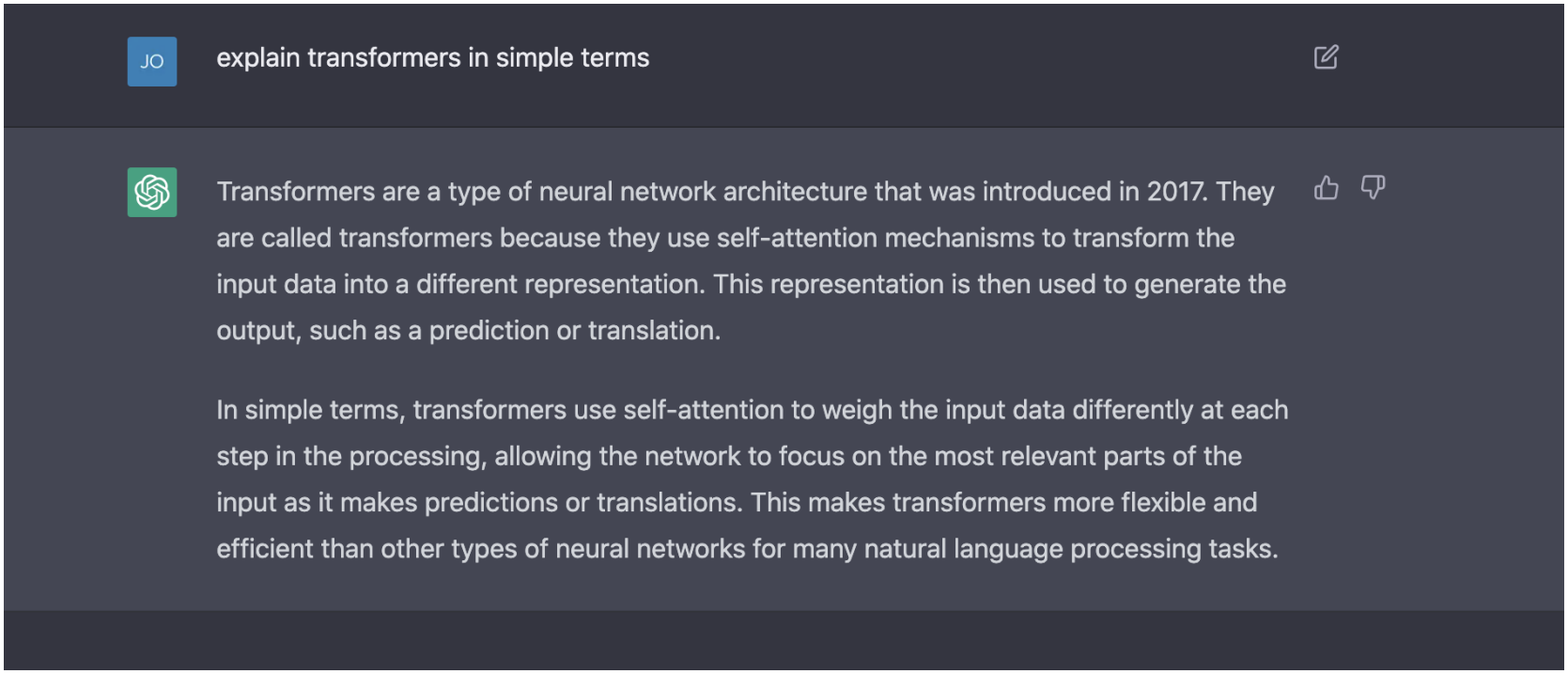
The PPO model is initialized from the supervised policy.

The policy generates an output.

The reward model calculates a reward for the output.

The reward is used to update the policy using PPO.




JO
explain transformers in simple terms
Transformers are a type of neural network architecture that was introduced in 2017. They are called transformers because they use self-attention mechanisms to transform the input data into a different representation. This representation is then used to generate the output, such as a prediction or translation.
In simple terms, transformers use self-attention to weigh the input data differently at each step in the processing, allowing the network to focus on the most relevant parts of the input as it makes predictions or translations. This makes transformers more flexible and efficient than other types of neural networks for many natural language processing tasks.

The New York Times

OPINION

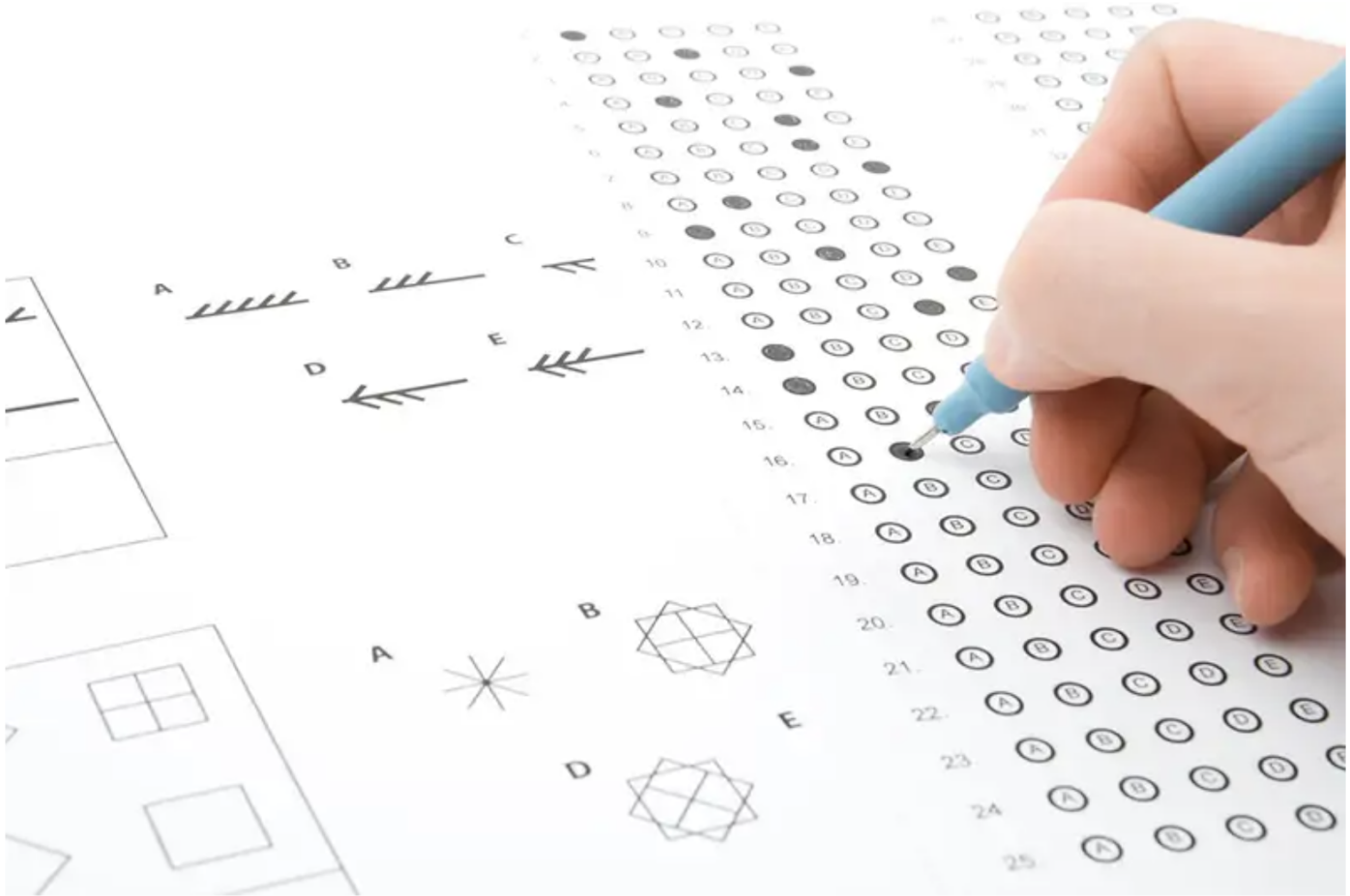
Does ChatGPT Mean Robots Are Coming For the Skilled Jobs?

Dec. 6, 2022

Illustration by The New York Times; photographs by AVAVA and Chris Collins, via Getty Images

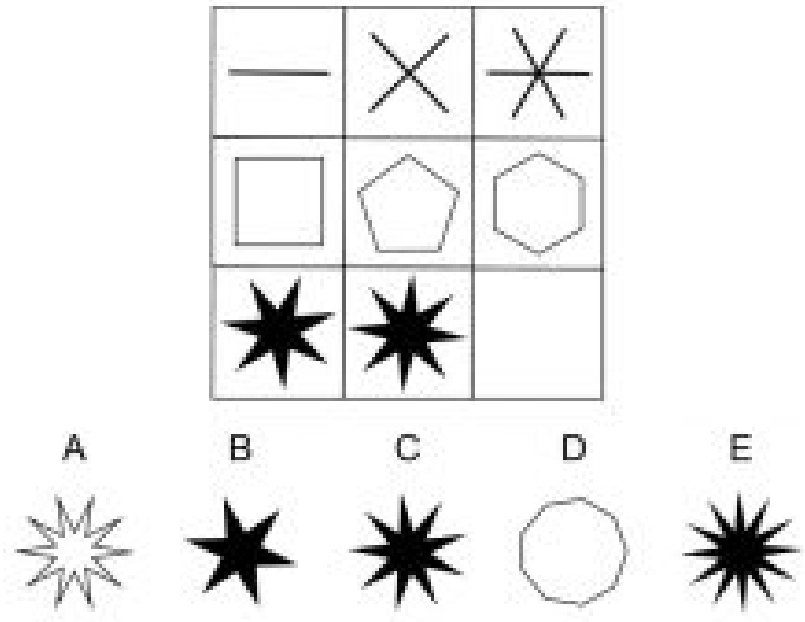
By Paul Krugman

What’s next?: Fast learning, slow thinking

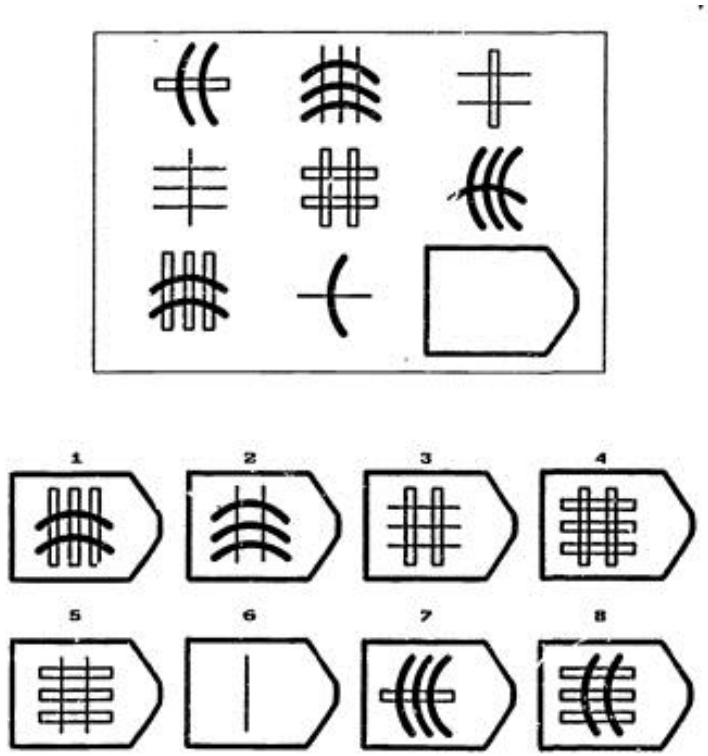


AI struggles with IQ tests
Panther Media GmbH / Alamy Stock Photo

What's next?: Fast learning, slow thinking



What's next?: Fast learning, slow thinking



What's next?: Fast learning, slow thinking

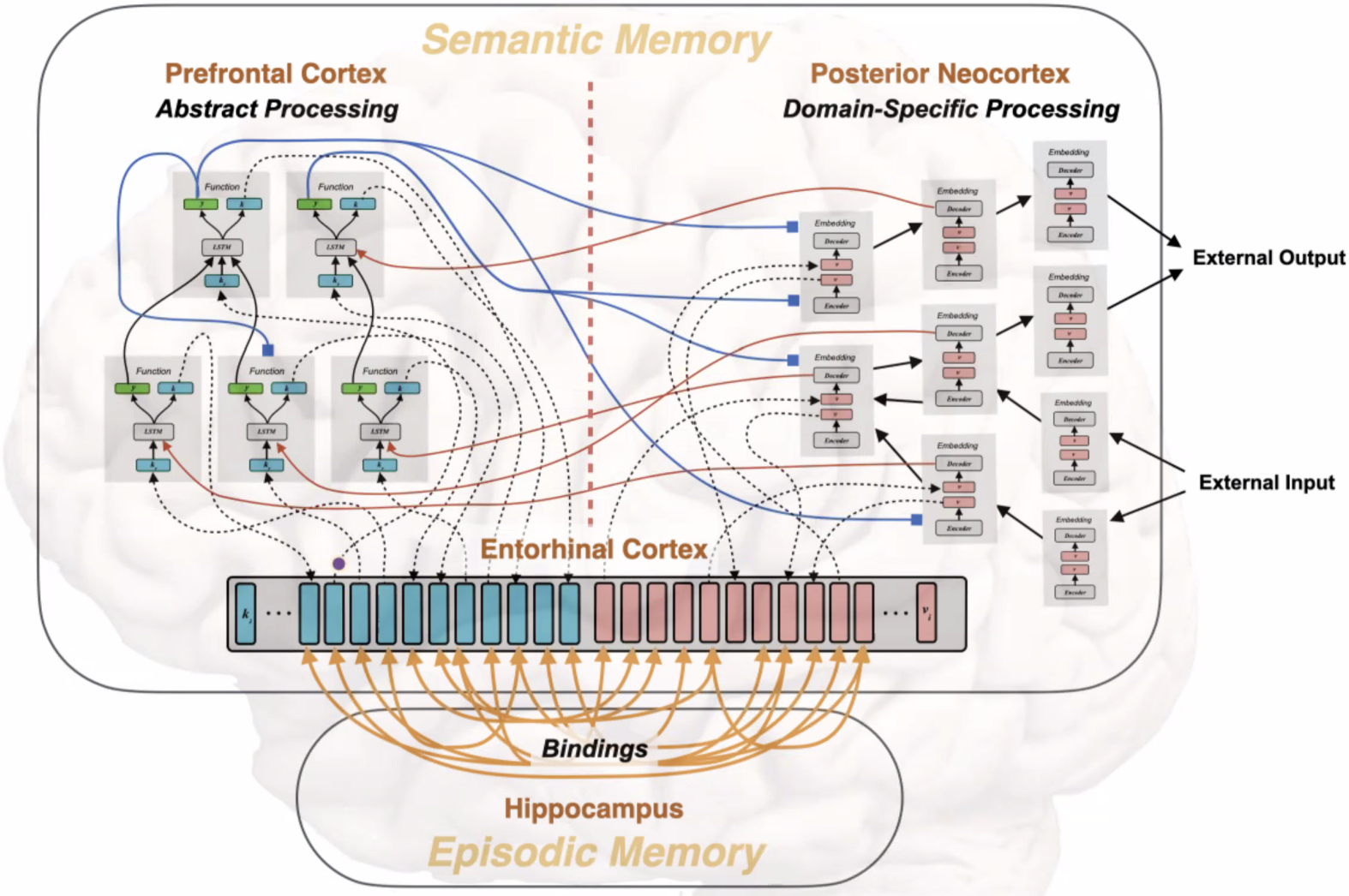


Figure from Jon Cohen (Princeton)

Week	Dates	Topics	Demos & Tutorials	Lecture Slides	Readings and Notes	Assignments & Exams
1	Sept 1	Course overview		Sept 1: Course overview		
2	Sept 6, 8	Python and background concepts	Python elements Covid trends	Sept 6: Python elements Sept 8: Pandas and linear regression	Data8 Chapters 3, 4, 5	Thu: Quiz 1
3	Sept 13, 15	Linear regression and classification	Covid trends (revisited) Classification examples	Sept 13: Regression concepts Sept 15: Classification	ISL Sections 3.1, 3.2, 3.5 Notes on regression ISL Sections 4.3, 4.4 Notes on classification	Thu: Assn 1
4	Sept 20, 22	Stochastic gradient descent	SGD examples	Sept 20: Classification (continued) Sept 22: Stochastic gradient descent	ISL Section 6.2.2 ISL Section 10.7.2	Thu: Quiz 2
5	Sept 27, 29	Bias and variance, cross-validation	Bias-variance tradeoff Covid trends (revisited) California housing	Sept 27: Bias and variance Sept 29: Cross-validation	ISL Section 2.2 ISL Section 5.1	Thu: Assn 1 in Assn 2 out

6	Oct 4, 6	Tree-based methods	Trees and forests Visualizing trees Bagging operations	Oct 4: Trees Oct 6: Forests	ISL Sections 8.1, 8.2	Thu: Quiz 3
7	Oct 11, 13	PCA and dimension reduction	PCA examples PCA revisited Used for regression	Oct 11: PCA Oct 13: PCA and review	ISL Section 12.2	Thu: Assn 2 in Assn 3 out
8	Oct 18	Midterm exam (in class)			On Canvas: Practice midterms / Sample solns Midterm / Sample soln	
9	Oct 25, 27	Language models, word embeddings	GPT-3 demo Word embeddings	Oct 25: Language models Oct 27: Word embeddings	OpenAI: Better language models (GPT-2)	Assn 4 out
10	Nov 1, 3	Bayesian inference, topic models	Mixtures Bayesian inference Topic models	Nov 1: Bayesian inference Nov 3: Bayes and topic models	Notes on Bayesian inference	Tue: Assn 3 in Thu: Quiz 4

11	Nov 8, 10	Introduction to neural networks	Sanity check Minimal neural network Regression examples	Nov 8: Topic models Nov 10: Neural networks	ISL Sections 10.1, 10.2	Thu: Assn 4 in Assn 5 out
12	Nov 15, 17	Deep neural networks	Tensorflow playground Autoencoder examples	Nov 15: Neural networks (continued) Nov 17: Autoencoders	ISL Section 10.7 Notes on backpropagation	Thu: Quiz 5
13	Nov 22, 24	No class, Thanksgiving break				
14	Nov 29, Dec 1	Reinforcement learning	Q-learning	Nov 29: Reinforcement learning Dec 1: Deep reinforcement learning		Thu: Assn 5 in Assn 6 out
15	Dec 6, 8	Societal issues for machine learning		Dec 6: Societal issues Dec 8: Course wrap up		Tue: Quiz 6
16	Dec 15					Thu: Assn 6 in

Final exam

- Review sessions (see times/dates above)
- Length: About 1.5X Midterm
- Emphasis on material after midterm
- Any topic could be on exam...except

Vote a topic off the exam!

Nominations?

Your input

- Please complete a course review!
- I value your comments and feedback
- Feel free to send me comments privately
- Let me know how you use and continue to learn ML!

Thank you!