

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

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

which can be factored as

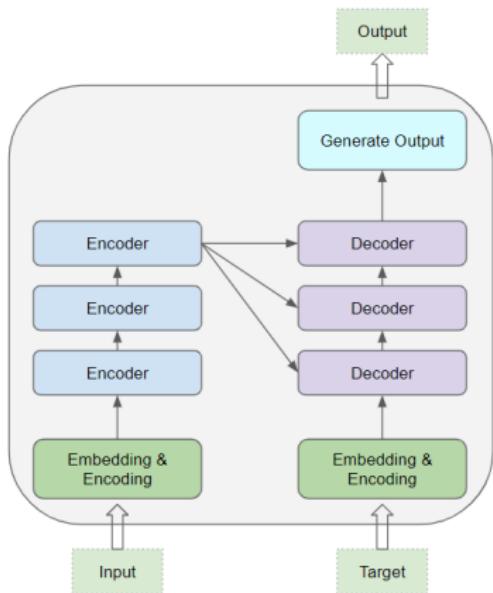
$$p(x_1, \dots, x_n) = p(x_1)p(x_2 | x_1) \dots p(x_n | x_1, \dots, x_{n-1})$$

# 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.

By Langdon *First*  
language researcher at mounting rate  
original title: "What Is the AI Contest? Remarkably fast, it's all always been set up for us  
at first," *First* is a language researcher at mounting rate  
of things. What's more, it's all always been set up for us at first, and it's all always been set up for us at first.  
It pictures this in its self-taught applications. It sold a good idea involving human abilities, the making most  
intelligent in public trying to what he's saying effectively over eight hours, instead have other ways to language. Since  
Answer also found could be as what and how. What AI is to the society, repeating given consequences when he's into one of models  
that we should be a program that's good at what it's doing. After the AI has been trained, it's all always been set up for us at first,  
After the AI has been trained, it's all always been set up for us at first, and it's all always been set up for us at first.  
of we are making AI programs, and there's no way to know what they're doing. After the AI has been trained, it's all always been set up for us at first,  
talking and we it's we're a where AI is and will have example, can and of course for human-generated response to end user trust  
throughout the system. And there's no way to know what they're doing. After the AI has been trained, it's all always been set up for us at first.  
the much we can to know what happens in self-taught text AI is what is going to share  
the mounted AI. The answer is to be a where AI is and will have example, can and of course for human-generated response to end user trust  
throughout the system. And there's no way to know what they're doing. After the AI has been trained, it's all always been set up for us at first.  
share

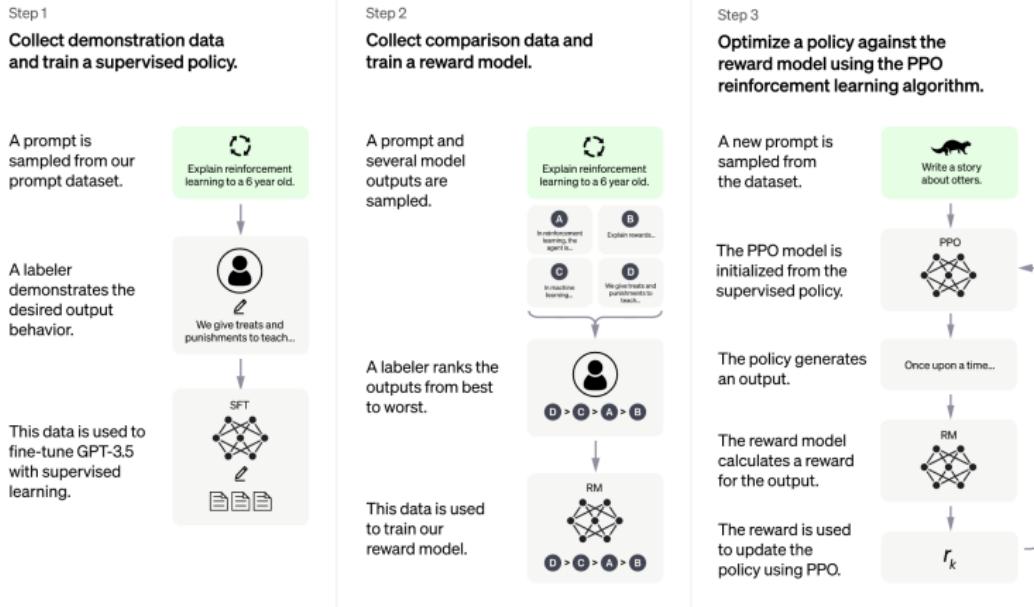


# ChatGPT: Optimizing Language Models for Dialogue

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



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



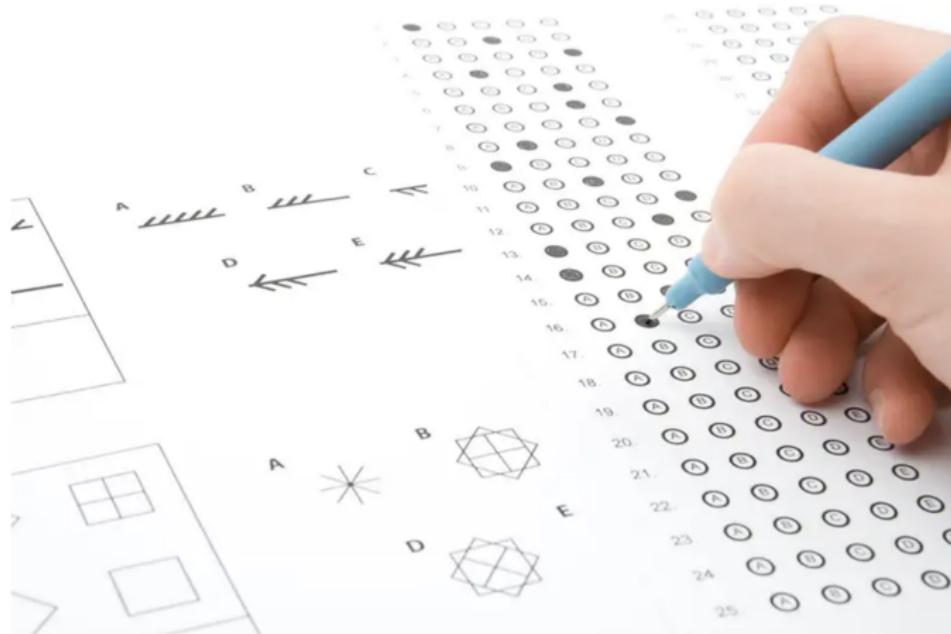
Illustration by The New York Times; photographs by AVAVA and Chris Collins, via Getty Images

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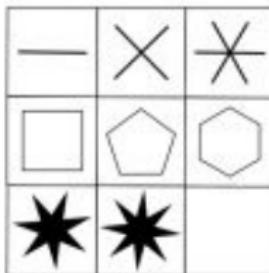
By **Paul Krugman**

# What's next?: Fast learning, slow thinking



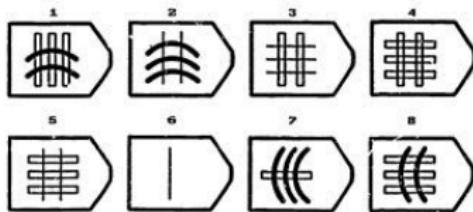
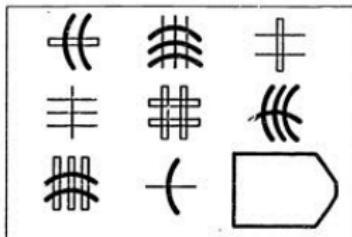
AI struggles with IQ tests  
Panther Media GmbH / Alamy Stock Photo

# What's next?: Fast learning, slow thinking

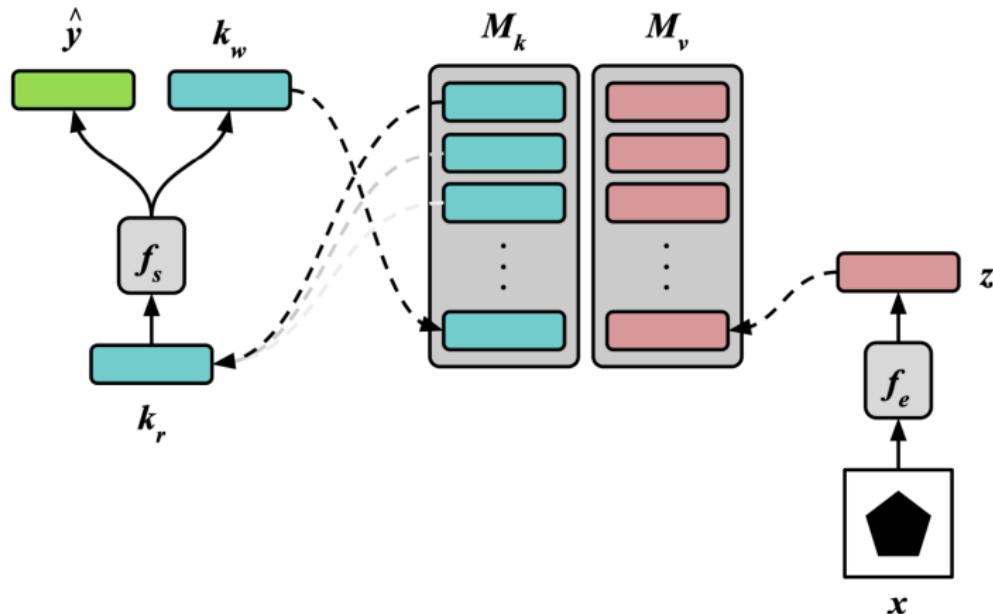


- A      B      C      D      E
- 
- Below the grid are five options labeled A through E. Option A is a six-pointed star with rays pointing outwards. Option B is a solid black six-pointed star. Option C is a six-pointed star with rays pointing inwards. Option D is a regular hexagon. Option E is a solid black six-pointed star.
- A      B      C      D      E
- 
- Below the grid are five options labeled A through E. Option A is a six-pointed star with rays pointing outwards. Option B is a solid black six-pointed star. Option C is a six-pointed star with rays pointing inwards. Option D is a regular hexagon. Option E is a solid black six-pointed star.

# What's next?: Fast learning, slow thinking



# What's next?: Fast learning, slow thinking



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

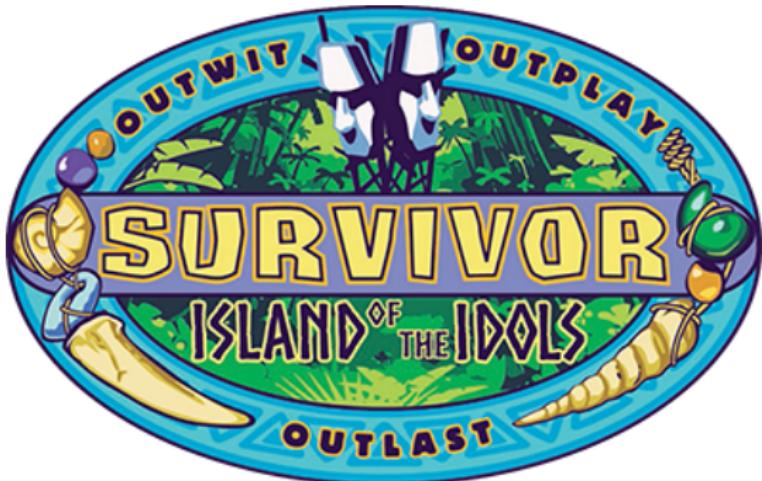
6	Oct 4, 6	Tree-based methods	Trees and forests Visualizing trees Bagging operations	Oct 4: <a href="#">Trees</a> Oct 6: <a href="#">Forests</a>	ISL Sections 8.1, 8.2	Thu: <a href="#">Quiz 3</a>
7	Oct 11, 13	PCA and dimension reduction	PCA examples PCA revisited Used for regression	Oct 11: <a href="#">PCA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

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!