

# Enhancing Energy Economics Research with AI

## A Practical LLM Workshop for KAPSARC Economists

Aleš Maršál  
[ales.marsal@kapsarc.org](mailto:ales.marsal@kapsarc.org)

K&A peer to peer Workshop  
Preliminary and not to be distributed

The views and results presented in this course are those of the authors and do not necessarily represent the official opinion of the KAPSARC.

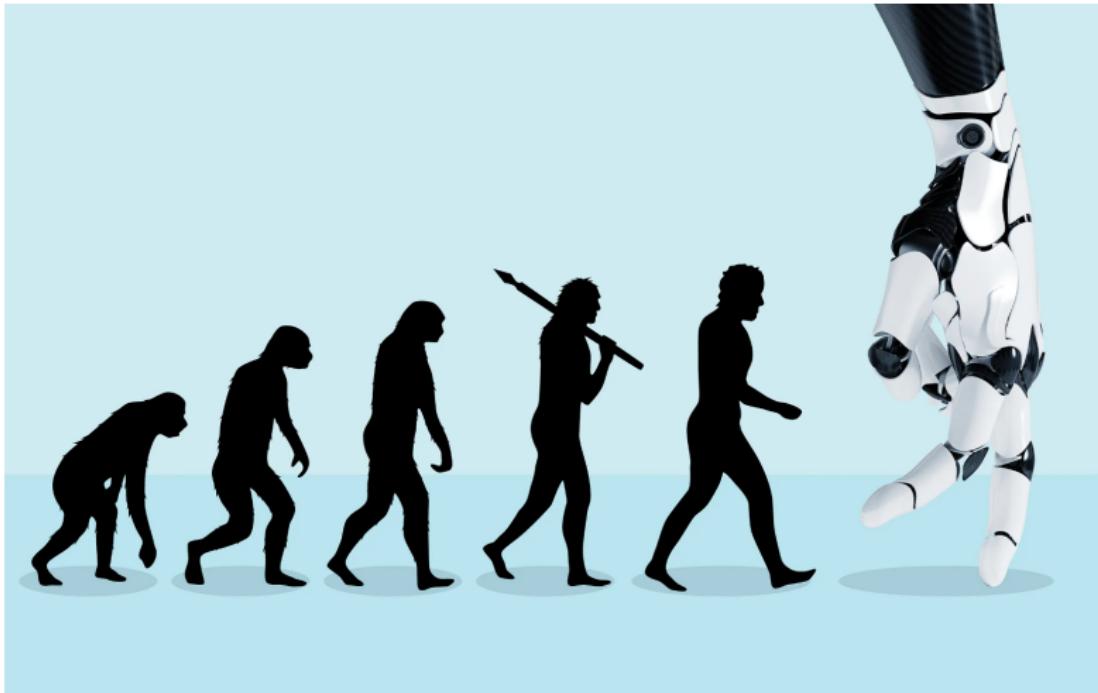
# Alien Intelligence

Human feelings, empathy and ethics



# Alien Intelligence vs. Artificial Intelligence

Yuval Noah Harari (Historian), Manolis Kellis (MIT, Harvard Computer scientist), Joscha Bach (AI researcher), Gary Marcus (cognitive scientist), Steve Wozniak (Apple co-founder ), Elon Musk



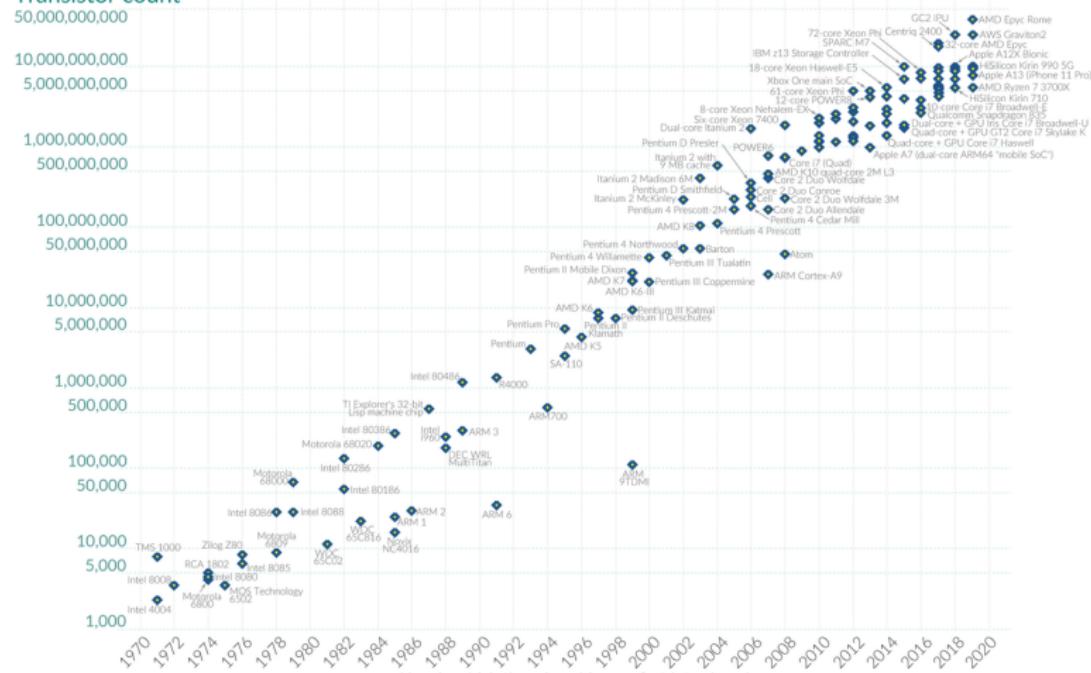
# Speed of Evolution

## Moore's Law: The number of transistors on microchips doubles every two years

Moore's law describes the empirical regularity that the number of transistors on integrated circuits doubles approximately every two years. This advancement is important for other aspects of technological progress in computing – such as processing speed or the price of computers.

Our World  
in Data

### Transistor count



# Speed of Evolution

Sevilla et.al. (2022), COMPUTE TRENDS ACROSS THREE ERAS OF MACHINE LEARNING

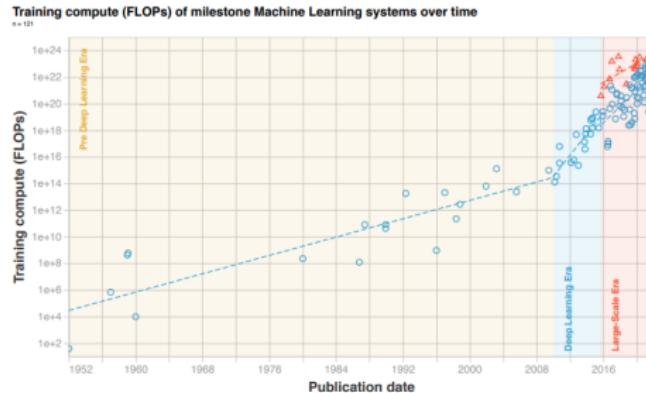
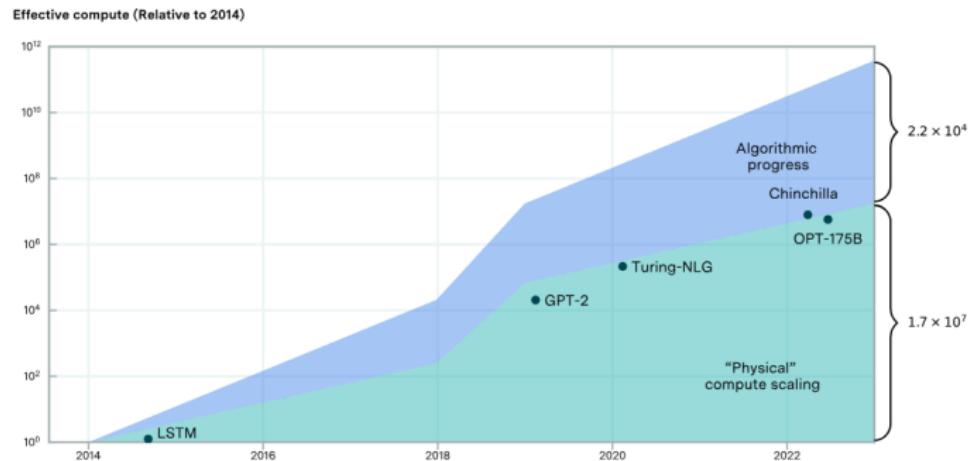


Figure 1: Trends in  $n = 121$  milestone ML models between 1952 and 2022. We distinguish three eras. Notice the change of slope circa 2010, matching the advent of Deep Learning; and the emergence of a new large-scale trend in late 2015.

| Period                 | Data                                 | Scale (start to end)                           | Slope                            | Doubling time                     |
|------------------------|--------------------------------------|--|----------------------------------|-----------------------------------|
| 1952 to 2010           | All models<br>( $n = 19$ )           | $3 \times 10^4$ to $2 \times 10^{14}$ FLOPs    | 0.2 OOMs/year<br>[0.1; 0.2; 0.2] | 21.3 months<br>[17.0; 21.2; 29.3] |
| 2010 to 2022           | Regular-scale models<br>( $n = 72$ ) | $7 \times 10^{14}$ to $2 \times 10^{18}$ FLOPs | 0.6 OOMs/year<br>[0.4; 0.7; 0.9] | 5.7 months<br>[4.3; 5.6; 9.0]     |
| September 2015 to 2022 | Large-scale models<br>( $n = 16$ )   | $4 \times 10^{21}$ to $8 \times 10^{23}$ FLOPs | 0.4 OOMs/year<br>[0.2; 0.4; 0.5] | 9.9 months<br>[7.7; 10.1; 17.1]   |

# Algorithmic Improvements vs. Compute

Ho et.al. (2024), Relative contribution of compute scaling and algorithmic progress to effective compute



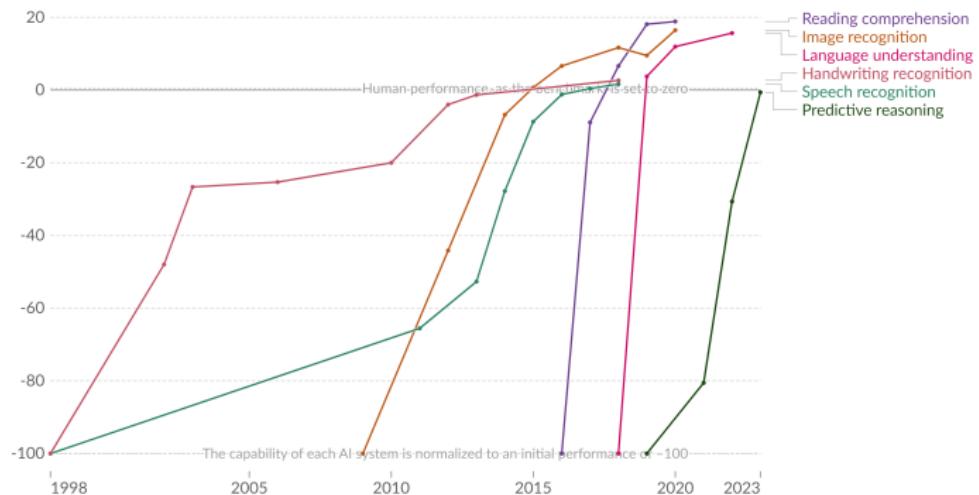
# On the Way to Artificial General Intelligence

Kiela et al. (2023),

## Test scores of AI systems on various capabilities relative to human performance

Our World  
in Data

Within each domain, the initial performance of the AI is set to -100. Human performance is used as a baseline, set to zero. When the AI's performance crosses the zero line, it scored more points than humans.



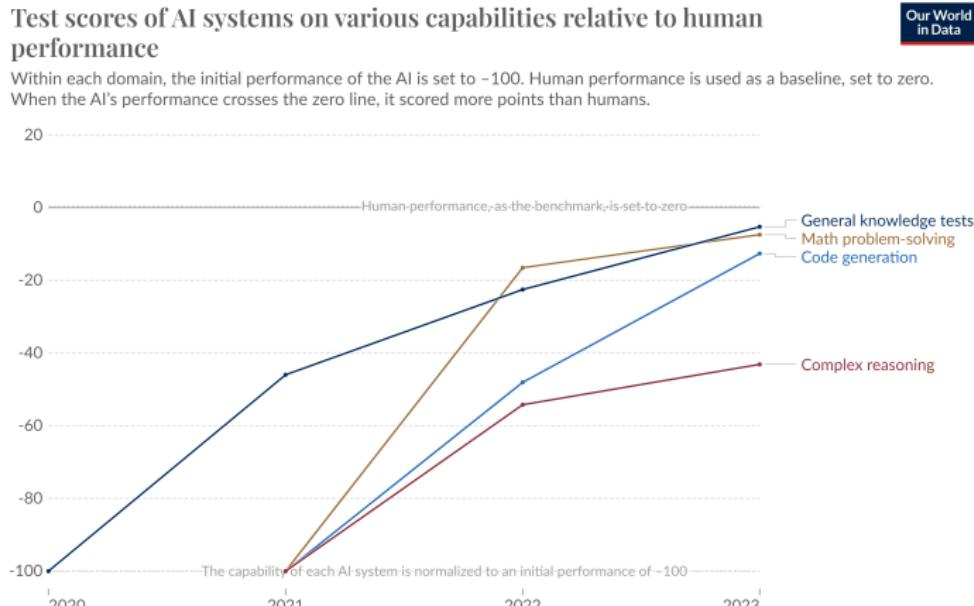
Data source: Kiela et al. (2023)

OurWorldInData.org/artificial-intelligence | CC BY

Note: For each capability, the first year always shows a baseline of -100, even if better performance was recorded later that year.

# On the way to AGI

If you don't care about the above, maybe you should about this...

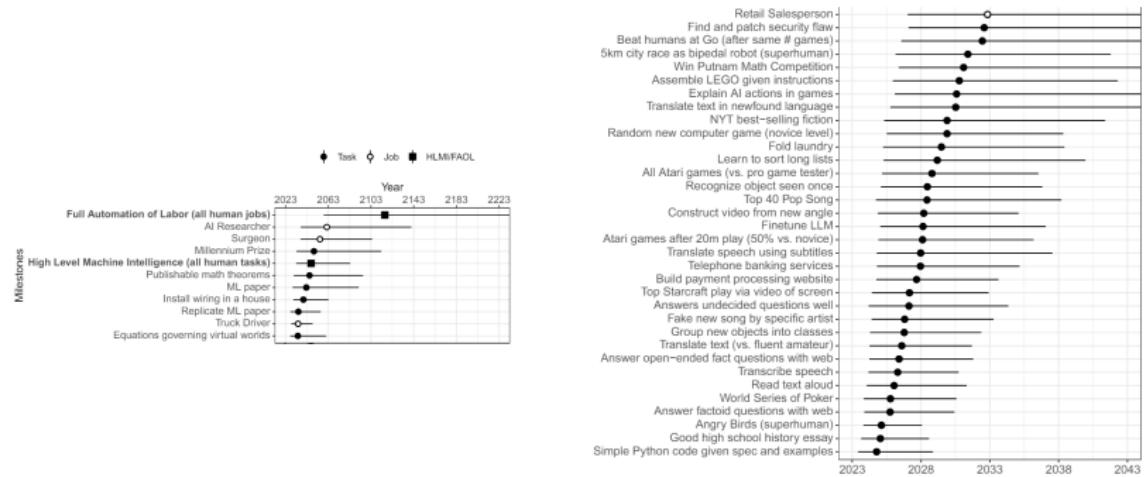


Data source: Kiela et al. (2023)

[OurWorldInData.org/artificial-intelligence](https://OurWorldInData.org/artificial-intelligence) | CC BY

Note: For each capability, the first year always shows a baseline of -100, even if better performance was recorded later that year.

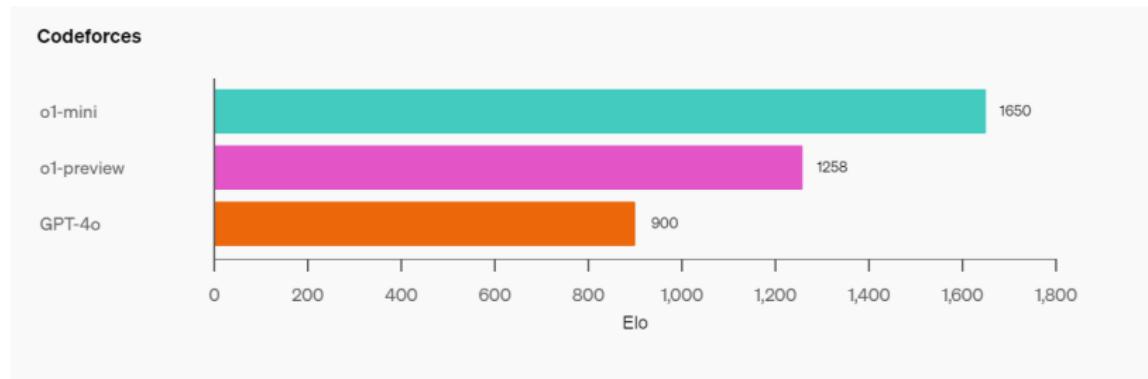
# When is AGI coming by 1000 AI experts!?



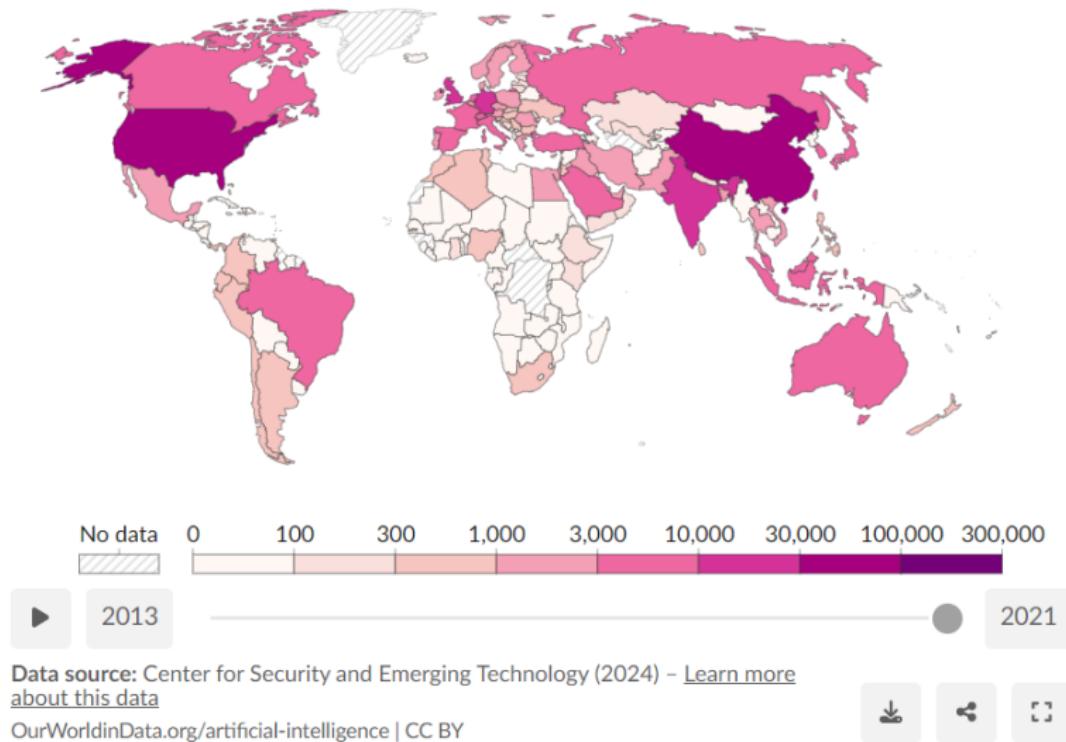
**Figure: Grace et.al.(2024): Aggregate distributions over when selected milestones are expected. Most milestones are predicted to have better than even odds of happening within the next ten years. FAOL describes a state where AI systems can autonomously perform virtually all occupations currently performed by humans.**

# General purpose AI standings

86th percentile means that "o1-mini" performs better than 86% of programmers on the Codeforces platform,



# AI publications



# Some Insider Opinion

*Ilya Sutskever: AGI by 2027 is strikingly possible.*

*Look. The models, they just want to learn. You have to understand this. The models, they just want to learn.*

*— Ilya Sutskever (circa 2015, via [Dario Amodei](#))*

*Jeff Bezos: Driving car, LLM is poor at but human can learn quickly. AI to learn require massive amounts of data and computing power. This is because AI does not have the same ability to learn through experience and intuition as humans do.*

## Why should you care?

- ▶ If you are septic about current level of AI:
  - ▶ computational power employed in training cutting-edge LLMs has doubled on average every six months
  - ▶ current capabilities foreshadows future abilities of AI
  - ▶ wide spread anticipation of sustaining trend, not only because AI is already developing future AI (see MIT Neil Gershenfeld on selfreplicating)
  - ▶ likely that AI power will grow
  - ▶ it might be useful to get familiar with the technology at this stage given the rapid progress
  - ▶ capabilities overhang: many of the emergent capabilities initially surprise often their creators; many of specialized advanced skills emerge in ways that could not have been fully predicted before training, due to non-linearities in how capabilities scale with model size and data (Wei et al. 2022)

# More Programmatic Reasons

GAI increased productivity of economists at NBS

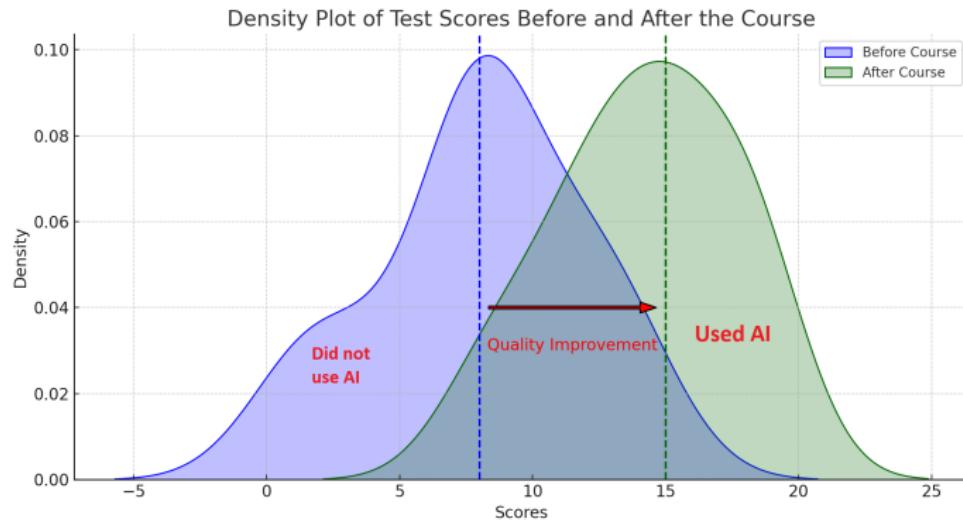
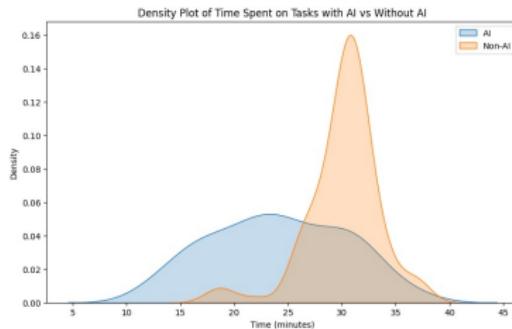


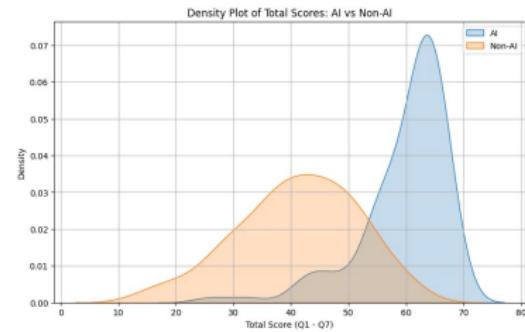
Figure: Data from Fall 2023 AI workshops at NBS on LLM applications led to over 60% improvement in result quality and nearly 20% reduction in task completion time

# More Programmatic Reasons

GAI increased productivity of economists at NBS



(a) Speed of the solution



(b) Quality of the solution

Figure: Marsal and Perkowski (2024): Large experiment study in June 2024.

## More Reasons - less bragging

- Can LLMs make informed financial decisions, customized GPT
  - Fundamental analysis (Task: analyze Aramco financial statements and compare to Exxon)

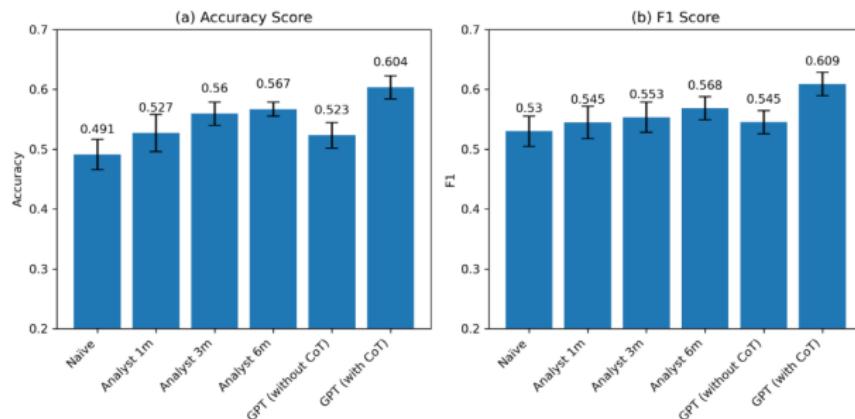
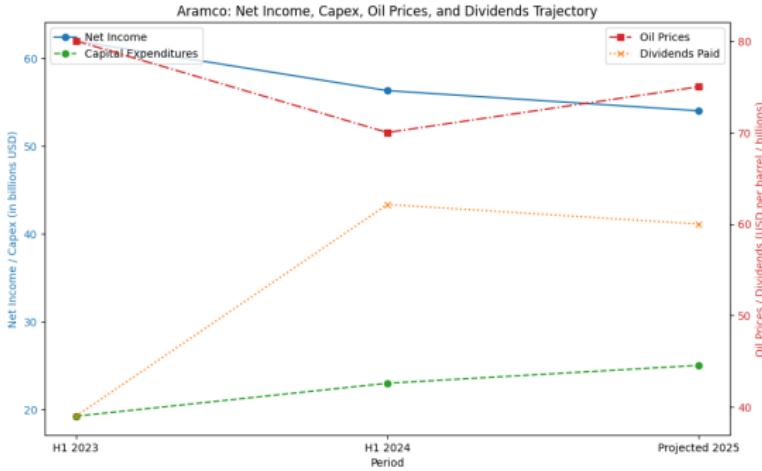


Figure: Kim et.al. (2024) compares the prediction performance of GPT and human analysts. Trading strategies based on GPT's predictions yield a higher Sharpe ratio and alphas than strategies based on other models.

# Quick Aramco application

- ▶ H1 2024 net income: **\$56.3 billion**, down **9.1% YoY**, due to lower oil prices and higher capital expenditures.
- ▶ Oil price volatility influenced by geopolitical risks; OPEC+ production cuts may support prices.
- ▶ Capital expenditures increased by **19.6% YoY**, focused on expanding oil and gas production.
- ▶ Dividends of **\$62.1 billion** could pressure liquidity if oil prices don't rise.
- ▶ Earnings outlook: Moderate decline expected due to price volatility and high expenditures, but expansions could boost future growth.



# Forecasting performance?

## 1. Improved Forecasting and Modeling

- ▶ Hybrid augmentation technology can improve the accuracy of economic forecasts and DSGE models
- ▶ Schoenegger et.al. 2024: Forecasters using GPT-4 get a pretty amazing 23% boost in accuracy (48% if you exclude trying to forecast the price of bitcoin)

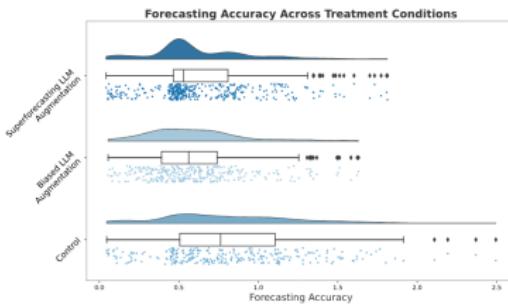


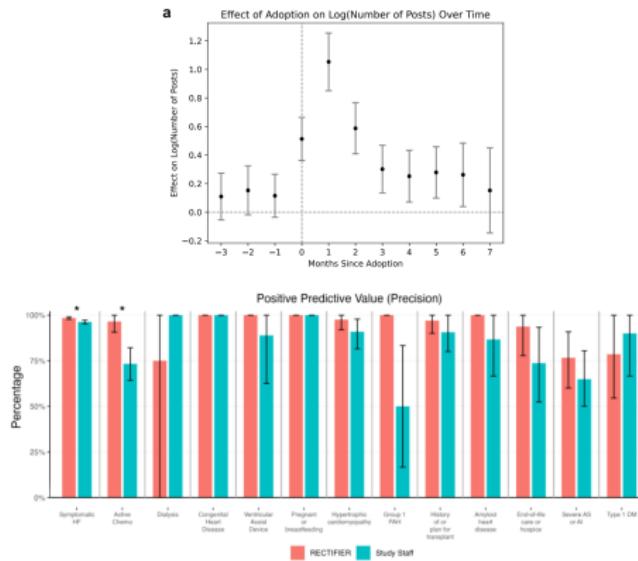
Figure: Distribution of forecasting accuracy for each treatment condition

## More Reasons

1. Automation of Routine Tasks
  - ▶ From 3 days to 3 hours outlook story
2. Enhanced Communication and Reporting
  - ▶ more time on bike
3. Efficient Literature Review and Summarization
  - ▶ getting the big picture quickly and keep chatting

# Last Slide with Literature Review

## Creativity and Health



Note: Unlu et.al (2024) and Zhou and Lee (2024): GPT-4 with vision and retrieval was able to read medicalnotes and determine the eligibility of patients for a trial better, faster & cheaper than trained human staff. Utilizing a dataset of over 4 million artworks from more than 50,000 unique users, our research shows that over time, text-to-image AI significantly enhances human creative productivity by 25%

# Outline

## Admin

What is ChatGPT

How does ChatGPT work?

Model versus reality.

LLM and Neural Nets

Learning by training

How to chat with ChatGPT?

Limitations

Risk

Limitations

The Power of Conversation

GPTs

References

Advanced data analysis

Chill Out section

Wolfram Alpha

Brainstorming

Feedback

Counterarguments

# Contact

## The power of conversation

- ▶ Workshop style of the course.
- ▶ I want to learn from you as well.
- ▶ My aim is to spend fun day together.

## Structure

- ▶ Introduction
- ▶ Advanced data analysis
- ▶ Work Use Cases
- ▶ Some More Fun Use Cases

## Prerequisites

- ▶ course is tailored to Economists
- ▶ ChatGPT4

# Contact

## Email

ales.marsal@kapsar.org

## Course materials

GitHub repository.

## Office hours

coffee machine

# Something about me

Timothy Fuerst

*"If you only like philosophy, then be a philosopher. If you only like computer science, then be a computer scientist. If you only like history, then be a historian. If you only like mathematics, then be a mathematician. But if you like all of these things, you should be an economist."*

## Something about me

- ▶ I work here in KAPSARC since July
- ▶ 2 years ago I took few courses on Udemy, read the paper by Anton Korinek, often listen to podcasts about AI
- ▶ Active usage
  - ▶ *AI is weird. No one actually knows the full range of capabilities of the most advanced Large Language Models, like GPT-4. No one really knows the best ways to use them, or the conditions under which they fail. There is no instruction manual. On some tasks AI is immensely powerful, and on others it fails completely or subtly. And, unless you use AI a lot, you won't know which is which*

## Something about you

- ▶ **What are your expectations about this course?**
- ▶ **Why did you sign up for this course?**
- ▶ What is your field of interest?
- ▶ How do you expect to use ChatGPT?
- ▶ What is your experience with ChatGPT?

## What can you expect to learn?

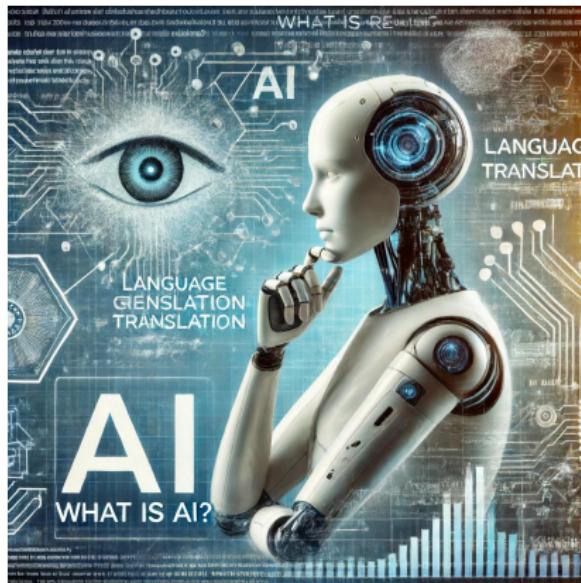
- ▶ hands on experience with ChatGPT
- ▶ prompt writing (programming with natural language)
- ▶ limitation of ChatGPT (hallucinating)
  - ▶ Christensen: the analysis with ChatGPT is only as good as you are
  - ▶ more valuable is going to be to ask the right question rather than to know the right answer
- ▶ fun ways to use ChatGPT in personal life
- ▶ Data Analytics, Wolfram Alpha, ChatWithPdf, Science, Scholar AI, NextPaperAi
- ▶ but not much about the design and estimation of the model

## Recommended literature

- ▶ Stephen WolframStephen Wolfram (What Is ChatGPT Doing ... and Why Does It Work?)
- ▶ korinek.com
- ▶ Udemy and Coursea (you need to pay)
- ▶ Jason Dean, Mushtaq Bilal, Lars Christensen
- ▶ Ethan Mollic, Lex Friedman, Grant Sanderson  
(<https://www.3blue1brown.com/>)

# What is an AI?

1. Group A: read the article
2. Group B: read the article



# What do you think?

1. scan the QR code
2. Group A
3. Group B

# Outline

Admin

## What is ChatGPT

How does ChatGPT work?

Model versus reality.

LLM and Neural Nets

Learning by training

How to chat with ChatGPT?

Limitations

Risk

Limitations

The Power of Conversation

GPTs

References

Advanced data analysis

Chill Out section

Wolfram Alpha

Brainstorming

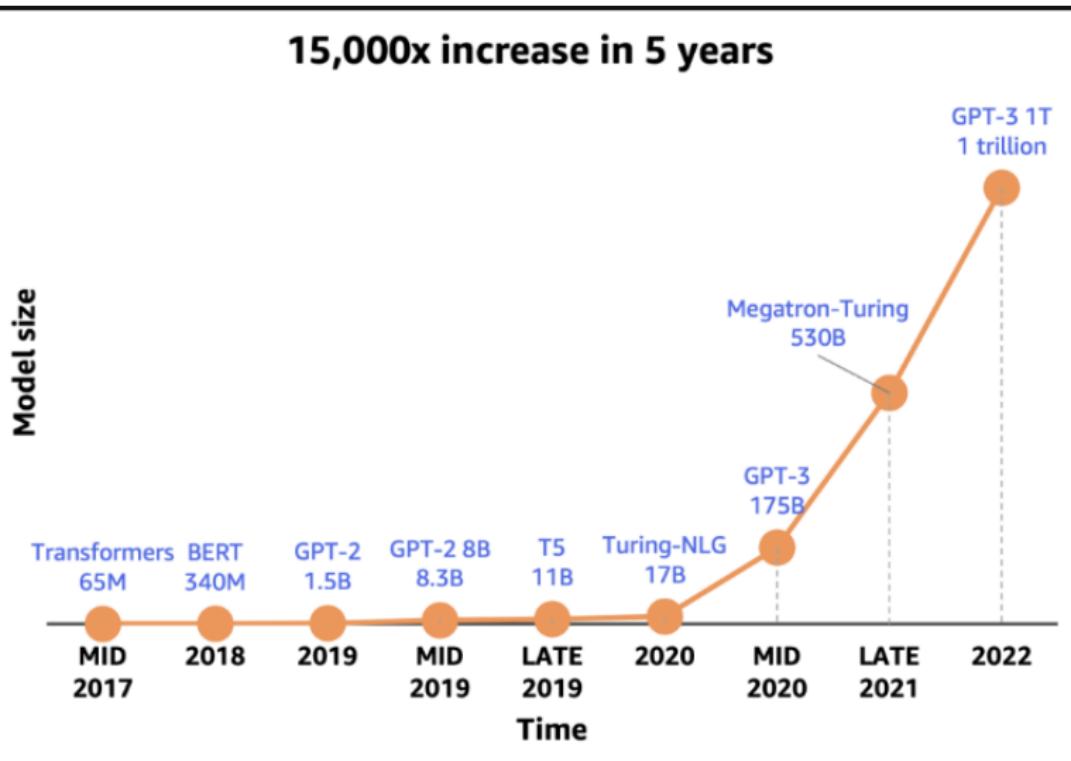
Feedback

Counterarguments

# What is ChatGPT?

- ▶ **GPT:** Stands for Generative Pre-trained Transformer.
- ▶ **Language Model:** Chat GPT is a state-of-the-art language model trained on a diverse range of internet text.
- ▶ Uses maximum likelihood estimation.
- ▶ Optimized using stochastic gradient descent (SGD) or its variants.
- ▶ GPT4 is so good because OpenAI developed technique called "neural architecture search" predicting the intelligence of an LLM **before it's trained!** Training is the most costly part
- ▶ some argue this invention is comparable to invention of internet

# Number of parameters, GPT4 N=1.76 trillion, GPT4o N $\geq$ 2



# What is Chat GPT?

- ▶ Vaswani et al. (2017) transformer models which introduce attention mechanism in text processing endogenously assigning varying importance to different words
- ▶ example: CB regulates interest rates so *it* can achieve price stability
- ▶ earlier models used sequential processing in an AR style, failed to capture long run dependences
- ▶ **Training:**
  1. **pre-training:** to get conditional probability distribution over words given previous words, context learning - "she loves cats and dogs" vs. it's raining cats and dogs", doctor=men, nurse = woman; expensive - computational costs \$100m
  2. **instruction fine tuning:** What's your name? based on probabilities followed by How old are you?
  3. **feedback:**

# Outline

Admin

What is ChatGPT

How does ChatGPT work?

Model versus reality.

LLM and Neural Nets

Learning by training

How to chat with ChatGPT?

Limitations

Risk

Limitations

The Power of Conversation

GPTs

References

Advanced data analysis

Chill Out section

Wolfram Alpha

Brainstorming

Feedback

Counterarguments

# How does ChatGPT work?

- ▶ produce a “reasonable continuation” of whatever text it’s got so far
- ▶ scanning billions of pages of human-written text (say on the web and in digitized books) and finding all instances of this text:
- ▶ **The best thing about AI is its ability to**

|            | Probabilities |
|------------|---------------|
| learn      | 4.5%          |
| predict    | 3.5%          |
| make       | 3.2%          |
| understand | 3.1%          |
| do         | 2.9%          |

**Table:** Probabilities of words following the phrase "The best thing about AI is its ability to"

## How does ChatGPT work?

- ▶ When ChatGPT writes for you tinder conversation what it's essentially doing is just asking over and over again "given the text so far, what should the next word be? (More precisely, a "token")
- ▶ Which one to pick? The one with highest ranking?
- ▶ in such case no creativity - uniform text across users
- ▶ if sometimes (at random) we pick lower-ranked words we get much more success in Tinder conversations
- ▶ Randomness means however no replicability - always different answer but originality! Never plagiarized
- ▶ Set "Temperature = 0"
- ▶ "temperature" parameter determines how often lower-ranked words will be used, like  $\lambda = 1600$ , temperature = 0.8. Why? bc. Why not!

# How does ChatGPT work?

Here's what happens if one repeatedly "applies the model"—at each step adding the word that has the top probability (specified in this code as the "decision" from the model):

The best thing about AI is its ability to,

The best thing about AI is its ability to learn,

The best thing about AI is its ability to learn from,

The best thing about AI is its ability to learn from experience

The best thing about AI is its ability to learn from experience. It,

The best thing about AI is its ability to learn from experience. It's,

The best thing about AI is its ability to learn from experience. It's not

# How does ChatGPT work?

What happens if one goes on longer? In “zero temperature” case:

*The best thing about AI is its ability to learn from experience. It's not just a matter of learning from experience, it's learning from the world around you. The AI is a very good example of this. It's a very good example of how to use AI to improve your life. It's a very good example of how to use AI to improve your life. The AI is a very good example of how to use AI to improve your life. It's a very good example of how to use AI to improve your life.*

# How does ChatGPT work?

Instead of always picking the "top" word one sometimes randomly picks "non-top" words temperature = 0.8

The best thing about AI is its ability to,

The best thing about AI is its ability to create,

The best thing about AI is its ability to create worlds,

The best thing about AI is its ability to create worlds that are,

The best thing about AI is its ability to create worlds that are both,

The best thing about AI is its ability to create worlds that are both exciting,

# How does ChatGPT work?

And every time one does this, different random choices will be made, and the text will be different—as in these 5 examples:

The best thing about AI is its ability to learn. I've always liked the ...

The best thing about AI is its ability to really come into your world and just ...

The best thing about AI is its ability to examine human behavior and the way it

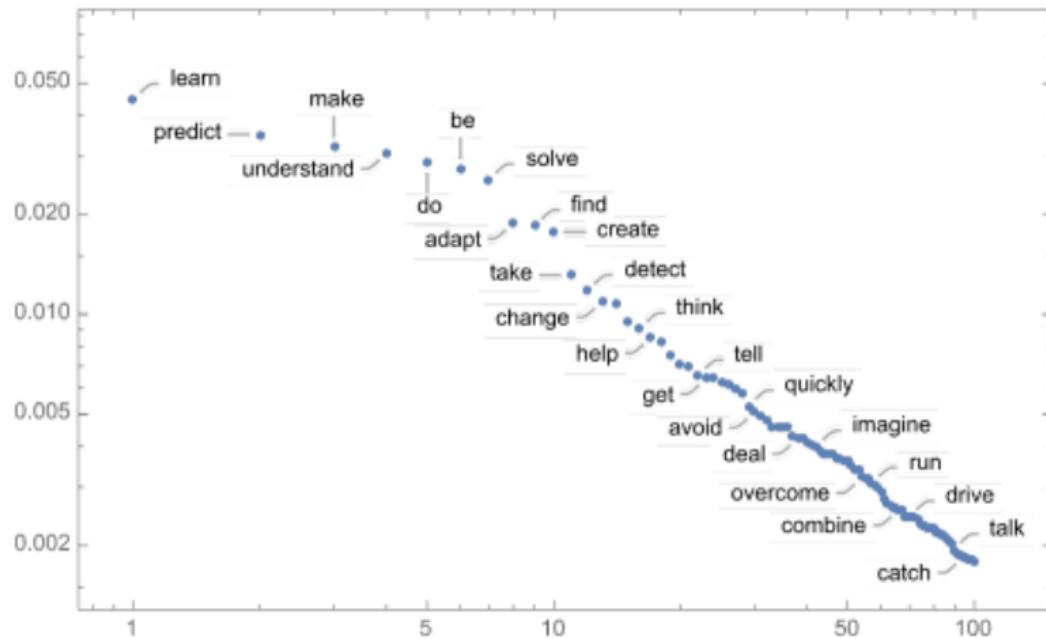
The best thing about AI is its ability to do a great job of teaching us...

The best thing about AI is its ability to create real tasks, but you can...

# How does ChatGPT work?

At the first step a lot of possible "next words" to choose from at temperature 0.8 but their probabilities fall off quite quickly ( $n^{-1}$  "power-law" decay)

Check out this tool for better understanding.



## How does ChatGPT work?

And here's a random example at "temperature 0.8":

*The best thing about AI is its ability to learn and develop over time, allowing it to continually improve its performance and be more efficient at tasks. AI can also be used to automate mundane tasks, allowing humans to focus on more important tasks. AI can also help make decisions and provide insights that would otherwise be impossible for humans to figure out.*

# Where Do the Probabilities Come From?

[more on decoding strategies]

Simple example. What is the probability for each letter should be?

letters in the Wikipedia article on "cats":

'e' = 4279, 'a' = 3442, 't' = 3397,  
'i' = 2739, 's' = 2615, 'n' = 2464, ...

And this does the same thing for "dogs":

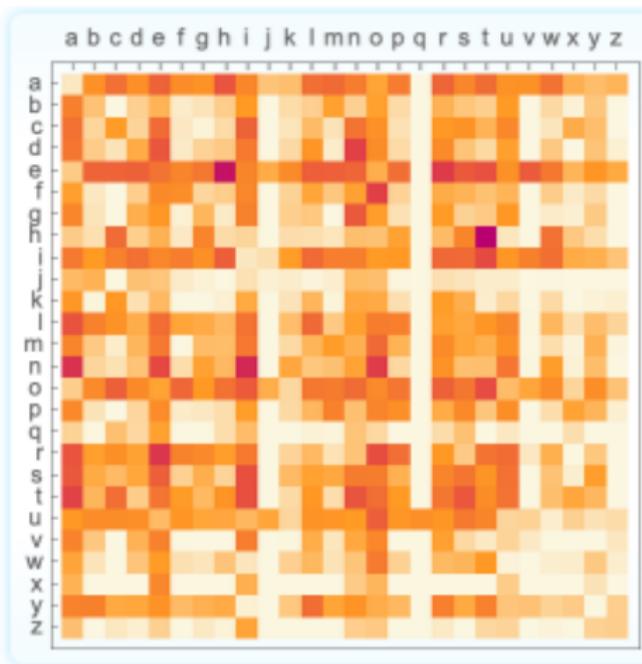
'e' = 3911, 'a' = 2714, 'o' = 2608,  
'i' = 2562, 't' = 2528

Here's a sample of what we get if we just generate a sequence of letters with probabilities for English language:

r r n o i t a d a t c a e a s a o t d o y s a r o i y i i n n b a n t o i o e s t l h d d e o  
c n e o o e w c e s i l n ...

# Where Do the Probabilities Come From?

plot that shows the probabilities of pairs of letters (“2-grams”) in typical English



if we generate “random words” with progressively longer n-gram probabilities, we see that they get progressively “more realistic”:

# Where Do the Probabilities Come From?

If we generate random words with progressively longer  $n$  – gram probabilities, we see that they get progressively more realistic:

|   | Generated Words  |
|---|--|
| 0 | on geetwont tistfly an aufsnoc ior oat ilbt tnc un iu uls                      |
| 1 | ri oos ot tinstummoi gymysett atsthe bshe ablov vwotybeat mecho                |
| 2 | wore hu isinalisthin lia he waro poutbe of premet bereat bcp uo pr             |
| 3 | qual musn was withirns wil por vires gudgyea was suchinugary outtheydas theres |
| 4 | stud made yeldo adenceth through thiers remton cont inous whforeto pointed scr |
| 5 | special vocab consumer market prepara injury trade consa usually speci utility |

Table: Generated Words Using n-gram Probabilities

# Where Do the Probabilities Come From?

- ▶ ChatGPT deals with whole words, not letters. There are about 40,000 reasonably commonly used words in English. We can get an estimate of how common each word is.
- ▶ using this we can start generating “sentences” .
- ▶ If words pick randomly again non sense but we can use  $n - \text{gram}$  probabilities
- ▶ With 40,000 common words, even the number of possible 2-grams is already 1.6 billion
- ▶ number of possible 3-grams is 60 trillion.
- ▶ “essay fragments” of 20 words, the number of possibilities is larger than the number of particles in the universe
- ▶ It cannot be estimated
- ▶ We need a "theory" - a model

# What is a model? What is a reality?

Model dependent realism



shutterstock

IMAGE ID: 37764655  
www.shutterstock.com

## Model dependent realism



# Conscious Reality

Donald Hoffman: The Evolutionary Argument Against Reality

Galileo:

*I think that testes, odors, colors, and so on ... reside in consciousness. Hence if the living creature were removed, all these qualities would be ... annihilated.*

# Conscious Reality

Donald Hoffman



Figure: Leaving a woman for a bottle. Euclidean physics in VR.

# Conscious Reality

Donald Hoffman

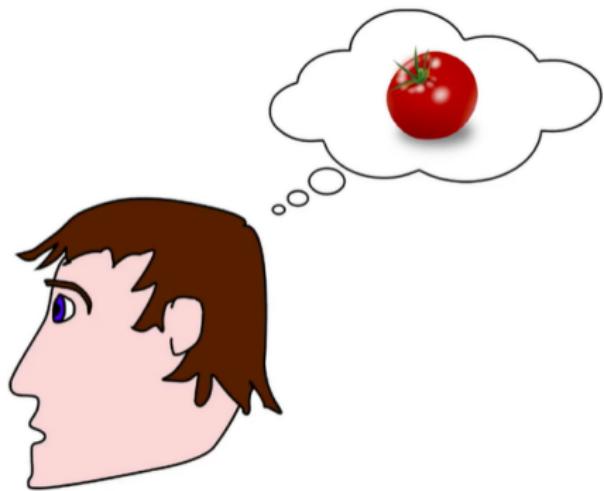
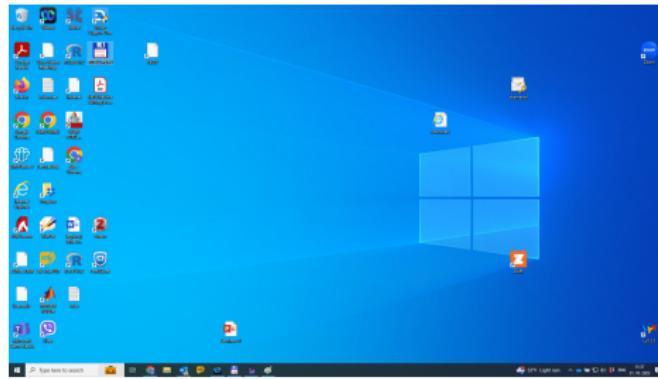


Figure: Colors are waves.

# Conscious Reality

Donald Hoffman

He proofs using evolutionary game theory that in order to maximize survival it is sub-optimal to see reality.



# Models for Human-Like Tasks

- ▶ taking the red pill and
- ▶ lets, for a while, take off the headset

## Models for Human-Like Tasks

- ▶ LLMs do not try to capture "reality"
- ▶ The aim is to create model of language - capture human like thinking?.
- ▶ You cannot derive closed form solution for the human brain operation
- ▶ Neural nets - imitate how we understand our brain works.  
Developed in 1940's with minimum changes till today
- ▶ In human brains there are about 100 billion neurons (nerve cells), each capable of producing an electrical pulse. The neurons are connected in a complicated net, with each neuron having tree-like branches allowing it to pass electrical signals.
- ▶ The complexity of today's neural nets is close to the complexity of our brains

# Example

A classic machine learning example

How to make machine recognize pictures



Get sample images and do an explicit pixel-by-pixel comparison  
with the samples we have



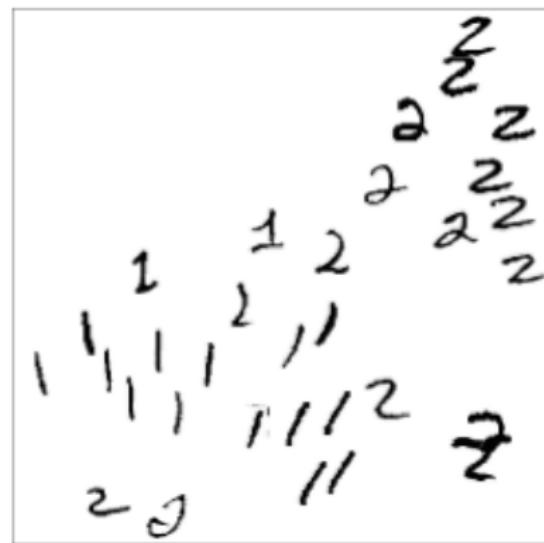
Human brain is better as we can,

{ 1, 5, 2, 1, 3, 4, 3, 0, 5, 7, 4, 2, 0, 3, 8,  
7, 4, 5, 0, 9, 8, 8, 0, 4, 1, 7, 8, 0, 8, 6 }

# Example

## Neural nets

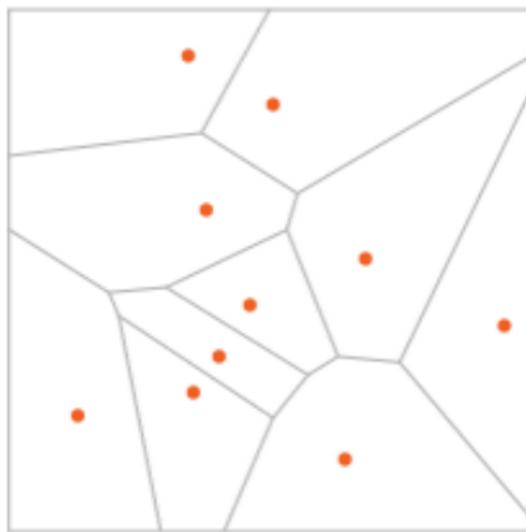
How to make machine recognize pictures? We somehow want if image is somehow 'closer to being a 1' than to being a 2, we want it to end up in the '1 place' and vice versa



# Example

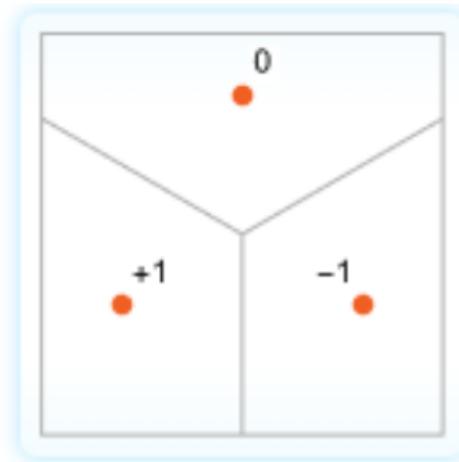
How does it work?

Where to go for coffee?



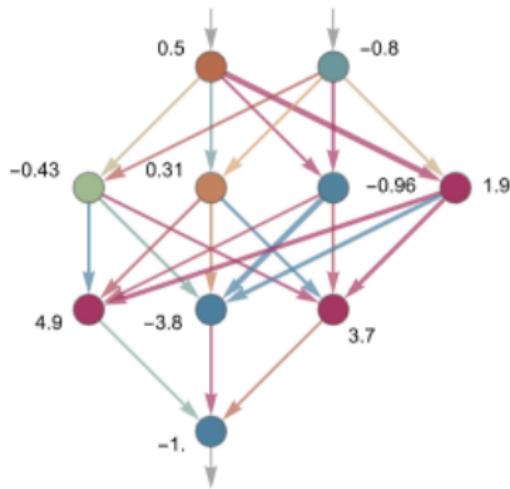
# Example

Even simpler example



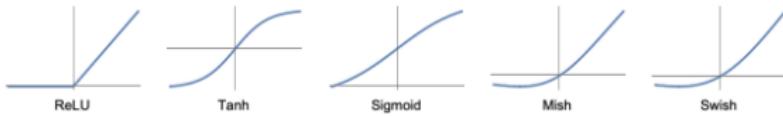
## Example

- ▶ neural net is a connected collection of idealized 'neurons'—usually arranged in layers
- ▶ Each 'neuron' is effectively set up to evaluate a simple numerical function
- ▶ if a neuron has inputs  $x = \{x_1, x_2, \dots\}$  then we compute  $f[w \cdot x + b]$ , where the weights  $w$  and constant  $b$  are chosen differently for each neuron in the network;
- ▶ the function  $f$  (activation function) is usually the same



## Example

- ▶ function  $f$  introduces nonlinearity (and ultimately is what leads to nontrivial behavior); Various activation functions commonly get used



For each task we want the neural net to evaluate the function with different choices of weights. For the example above, it would be:

$$w_{11}(w_{311}f(b_1 + xw_{111} + yw_{121}) + w_{312}f(b_2 + xw_{121} + yw_{122})) + \quad (1)$$

$$w_{313}f(b_3 + xw_{131} + yw_{132}) + w_{314}f(b_4 + xw_{141} + yw_{142})) + b_1 + \quad (2)$$

$$w_{12}(w_{321}f(b_1 + xw_{111} + yw_{121}) + w_{322}f(b_2 + xw_{121} + yw_{122})) + \quad (3)$$

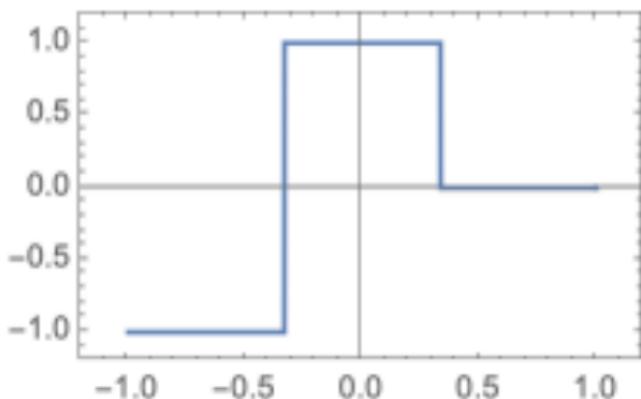
$$w_{323}f(b_3 + xw_{131} + yw_{132}) + w_{324}f(b_4 + xw_{141} + yw_{142})) + b_2 + \quad (4)$$

$$w_{13}(w_{331}f(b_1 + xw_{111} + yw_{121}) + w_{332}f(b_2 + xw_{121} + yw_{122})) + \quad (5)$$

$$w_{333}f(b_3 + xw_{131} + yw_{132}) + w_{334}f(b_4 + xw_{141} + yw_{142})) + b_3 \quad (6)$$

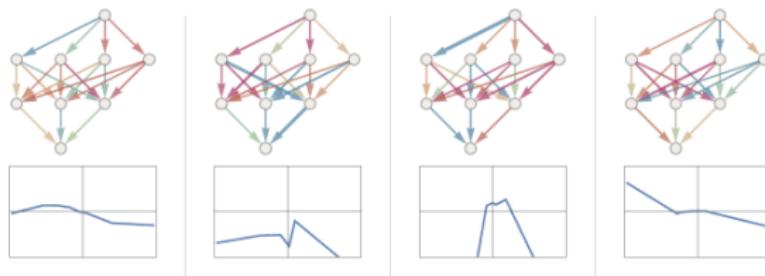
## Learning/Training

- ▶ Let's look at a problem even simpler than the nearest-point one above.  
Let's just try to get a neural net to learn the function:



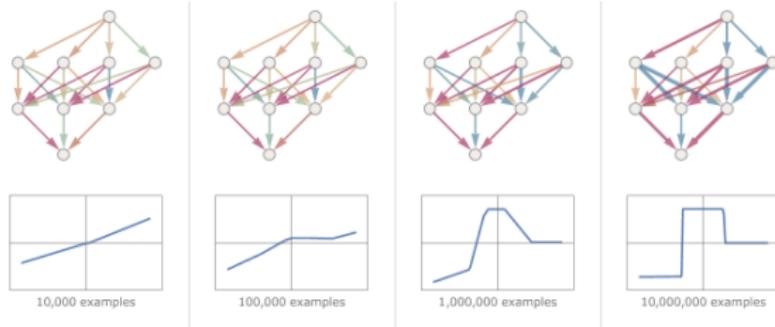
# Learning

- ▶ for this task, we'll need a network that has just one input and one output
- ▶ with every possible set of weights the neural net will compute some function. And, for example, here's what it does with a few randomly chosen sets of weights



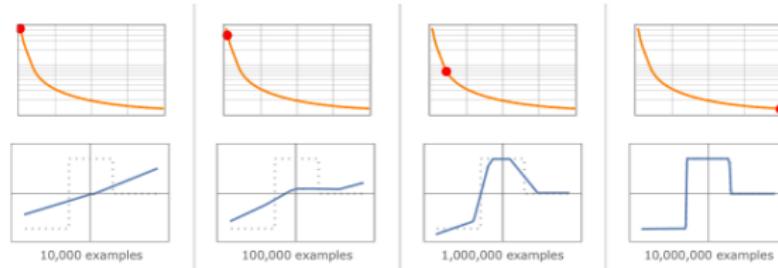
# Learning

- ▶ The basic idea is to supply lots of input — > output" examples to learn from — and then to try to find weights that will reproduce these examples.



# Learning

- ▶ To find out how far away we are we compute what's usually called a loss function
- ▶ just the sum of the squares of the differences



# How does ChatGPT works?

In practice it is a bit more complicated and complex issue....

- ▶ for more read: **What Is ChatGPT Doing ... and Why Does It Work?** by Stephen Wolfram
- ▶ GitHub of Maxime Labonne
- ▶ GitHub of Jay Alammar

# Outline

Admin

What is ChatGPT

How does ChatGPT work?

Model versus reality.

LLM and Neural Nets

Learning by training

How to chat with ChatGPT?

Limitations

Risk

Limitations

The Power of Conversation

GPTs

References

Advanced data analysis

Chill Out section

Wolfram Alpha

Brainstorming

Feedback

Counterarguments

# Prompts

- ▶ Prompt engineering
  - ▶ type of programming with natural language
- ▶ imagine you have a personal assistant. He/she is:
  - ▶ smart with steep learning curve
  - ▶ incredibly motivated & eager to help
  - ▶ but he is new to the job so you cannot 100% rely on him and you need to check his work often
  - ▶ importantly he completely lacks the context of what you are doing, although he learns to some extend!

# Prompt engineering

1. programming in natural language
2. involves strategically crafting your questions or instructions to get the most insightful responses
3. try to reformulate your questions and be patient
4. some guidance to be aware off

# Prompt engineering

- ▶ Level Instructions: high-level instructions that set the context or persona for the model's responses. For example, you could instruct the AI with, "You are an assistant that speaks like Shakespeare."
- ▶ Response Specification: You can instruct the AI on the specific format you want the information presented in. This could be a bullet list, an essay, a dialogue, or a poem. For instance, "Explain the principles of supply and demand in the format of a dialogue," or "List the key figures of the Renaissance in bullet points."
- ▶ Degree of Detail: You can specify how detailed you want the response to be, ranging from a high-level overview to an in-depth analysis. For example, "Give me a brief overview of the causes of World War I." versus "Provide a detailed analysis of the causes of World War I."

## Prompt engineering cont

- ▶ Tone or Style: As previously mentioned, specifying the tone or style of the response can help tailor the output to your needs. Whether you need a formal, analytical breakdown or a friendly, casual explanation, you can instruct the model accordingly.
- ▶ Direct Questions: Asking direct, specific questions can help to get precise answers. For example, "What is the definition of opportunity cost in economics?"
- ▶ Hypothetical Scenarios: You can set up hypothetical situations for the AI to react to or analyze. For instance, "Imagine you are a company facing a high employee turnover rate. What strategies could you adopt to improve retention?"

## Writing tones

You can dictate the tone of your responses

- ▶ Formal Academic: This style is suited for scholarly articles, research papers, and academic discussions. It maintains a professional tone, uses precise terminology, and provides thorough citations.
- ▶ Analytical: Breaks down complex concepts into manageable parts for deeper understanding.
- ▶ Critical: This style is evaluative, often interpreting or critiquing the work of others. It's common in literature reviews and critique papers.
- ▶ Persuasive: Often found in argumentative papers or research proposals, this style uses logic and evidence to convince the reader of a certain point of view.
- ▶ Reflective: Writers reflect on their experiences, thoughts, or responses to explore deeper insights. It is commonly used in personal essays or reflective journals in academia.

## Writing tones

- ▶ Reportorial: This style presents factual, objective information in a clear, concise manner. It's useful for reports or summarizing research findings.
- ▶ Explanatory: This style aims to inform or explain, often used in teaching or instructional contexts to provide clear, understandable explanations of complex topics.
- ▶ Theoretical: This style is used to discuss theories or conceptual frameworks. It's useful in developing and discussing abstract concepts and relationships.
- ▶ Friendly Academic: This style maintains the rigor of academic writing but with a more approachable, less formal tone. It might include first-person references and more conversational language.
- ▶ Business Casual: This style strikes a balance between professionalism and approachability, making it useful for internal communication, blog posts, or any context where a more relaxed but still respectful tone is appropriate.

# Chain-of-Thought (CoT) Prompting

- ▶ **Step-by-Step Reasoning:** Encourages breaking problems into smaller reasoning steps.
- ▶ **Increased Interpretability:** Makes the decision-making process transparent and easier to follow.
- ▶ **Improved Performance:** Especially beneficial for tasks requiring multi-step reasoning (e.g., math, logic puzzles).

# CoT Prompting Example

## Standard Prompting

- ▶ Direct Question and Answer:
- ▶ **Q:** "What is the impact of OPEC production cuts on oil prices?"
- ▶ **A:** "OPEC production cuts reduce oil supply, leading to higher prices."

## With CoT Prompting

- ▶ Step-by-Step Reasoning:
- ▶ **Q:** "Explain the impact of OPEC production cuts on oil prices step by step."
- ▶ **A (CoT):** "First, OPEC production cuts reduce the global supply of oil. According to basic economic principles, when supply decreases and demand remains constant, prices rise. In the short term, traders anticipate higher prices and respond by bidding up prices. In the long term, higher oil prices can also affect inflation in oil-importing countries and incentivize a shift to alternative energy sources."

# How to Invoke Chain-of-Thought Prompting in ChatGPT

## 1. Use Specific Language to Encourage Step-by-Step Reasoning:

- ▶ Example Prompt: "Explain how OPEC production cuts affect global oil prices step by step."
- ▶ Example Prompt: "Walk me through the process of how renewable energy investment impacts oil markets over time."

## 2. Ask for Intermediate Steps:

- ▶ Example Prompt: "Before giving me the answer, explain the key factors that influence oil prices after an OPEC production cut."

## 3. Clarify the Importance of Detailed Reasoning:

- ▶ Example Prompt: "Provide a detailed explanation of how oil prices are influenced by both supply-side and demand-side factors after OPEC cuts production."

# Outline

Admin

What is ChatGPT

How does ChatGPT work?

Model versus reality.

LLM and Neural Nets

Learning by training

How to chat with ChatGPT?

## Limitations

Risk

Limitations

The Power of Conversation

GPTs

References

Advanced data analysis

Chill Out section

Wolfram Alpha

Brainstorming

Feedback

Counterarguments

## Be aware of ...

- ▶ LLMs are good for language and increasingly better for math and data science!
- ▶ with ChatGPT you get a model trained on fixed date data (recent update looks online - Retrieval-Augmented Generation (RAG))
- ▶ context window of 128k and has a knowledge cut-off date of October 2023
- ▶ After 128k tokens (roughly 128 000 words) ChatGPT forget what you are talking about
- ▶ Each conversation with ChatGPT is uniquely relevant to the open window
- ▶ Randomness, ChatGPT even with temperature =0 will produce some randomness so no replicability
- ▶ when you talk to your assistant provide context, iterate and elaborate, be patient with him

# Context window



To estimate the number of A5 pages required for 128,000 words with standard book-sized letters, we need to consider several factors such as the average number of words per page, font size, margins, and line spacing. A common layout for a book with standard font size (e.g., 11-12 point Times New Roman) typically yields about 300-350 words per page.

Given this, we can estimate the number of pages required:

1. **Average words per page:** 325 (taking the middle value between 300 and 350)
2. **Total words:** 128,000

$$\text{Number of pages} = \frac{\text{Total words}}{\text{Average words per page}}$$

$$\text{Number of pages} = \frac{128,000}{325} \approx 393.85$$

So, you would need approximately 394 A5 pages to accommodate 128,000 words with standard book-sized letters.

This is a rough estimate and the actual number may vary depending on the specific formatting choices.



# Context window

| Product  | Model    | Company   | Released | Tokens | Data Cutoff | URL             |
|----------|----------|-----------|----------|--------|-------------|-----------------|
| ChatGPT  | GPT-3.5  | OpenAI    | 11/2022  | 4k     | 9/2021      | chat.openai.com |
| New Bing | GPT-4    | Microsoft | 1/2023   | 4k     | web access  | bing.com/chat   |
| ChatGPT+ | GPT-4    | OpenAI    | 1/2023   | 4k     | 9/2023      | chat.openai.com |
| Bard     | PaLM-2   | Google    | 3/2023   | 2k     | web access  | bard.google.com |
| Claude   | Claude 2 | Anthropic | 7/2023   | 100k   | early 2023  | claude.ai       |
| LLaMA    | LLaMA 2  | Meta      | 7/2023   | 4k     | early 2023  | open source     |

# Context window

**Table:** Overview of commonly used LLMs, specifications as of May 15th, 2024

| AI Lab    | Model    | Best Version | Released | Tokens | Data Cutoff | URL  |
|-----------|----------|--------------|----------|--------|-------------|--|
| OpenAI    | GPT-4o   | GPT-4o       | May 2024 | 128k   | Dec 2023    | <a href="https://chatgpt.com">chatgpt.com</a> *              |
| Anthropic | Claude 3 | Opus         | Mar 2024 | 200k   | Aug 2023    | <a href="https://claude.ai">claude.ai</a>                    |
| Google    | Gemini   | 1.5 Pro      | Feb 2024 | 2.000k | Jun 2024    | <a href="https://gemini.google.com">gemini.google.com</a> *  |
| Mistral   | Mixtral  | 8x22b        | Apr 2024 | 65k    | Sep 2021    | <a href="https://os.chat.mistral.ai">OS, chat.mistral.ai</a> |
| Meta      | LLaMA 3  | Llama-3      | Apr 2024 | 8k     | Dec 2023    | <a href="https://os.meta.ai">OS, meta.ai</a>                 |

# Outline

Admin

What is ChatGPT

How does ChatGPT work?

Model versus reality.

LLM and Neural Nets

Learning by training

How to chat with ChatGPT?

Limitations

Risk

Limitations

The Power of Conversation

GPTs

References

Advanced data analysis

Chill Out section

Wolfram Alpha

Brainstorming

Feedback

Counterarguments

# Risks

- ▶ **Information security:** important for sensitive data
- ▶ **Hallucination:** LLMs are prone to make up things, esp when pushed to their limits: e.g., incorrect facts, citations, etc.  
⇒ this has got way better
- ▶ **Bias:** output builds on the training data thus incomplete knowledge (i.e. most recent papers missing but now the ability to search online, Ronaldo vs. Messi)
- ▶ **Homogeneity:** we all use the same models

# Outline

Admin

What is ChatGPT

How does ChatGPT work?

Model versus reality.

LLM and Neural Nets

Learning by training

How to chat with ChatGPT?

Limitations

Risk

## Limitations

The Power of Conversation

GPTs

References

Advanced data analysis

Chill Out section

Wolfram Alpha

Brainstorming

Feedback

Counterarguments

# Context window



To estimate the number of A5 pages required for 128,000 words with standard book-sized letters, we need to consider several factors such as the average number of words per page, font size, margins, and line spacing. A common layout for a book with standard font size (e.g., 11-12 point Times New Roman) typically yields about 300-350 words per page.

Given this, we can estimate the number of pages required:

1. **Average words per page:** 325 (taking the middle value between 300 and 350)
2. **Total words:** 128,000

$$\text{Number of pages} = \frac{\text{Total words}}{\text{Average words per page}}$$

$$\text{Number of pages} = \frac{128,000}{325} \approx 393.85$$

So, you would need approximately 394 A5 pages to accommodate 128,000 words with standard book-sized letters.

This is a rough estimate and the actual number may vary depending on the specific formatting choices.



# What is your assistant good at?

- ▶ writing
  - ▶ brainstorming, challenging you
  - ▶ fixing/editing your text within the context
  - ▶ evaluating your writing
  - ▶ generate summaries, catchy titles, tweets
  - ▶ talking about the paper, literature surveys
- ▶ coding
  - ▶ generating and explaining code
  - ▶ debugging
  - ▶ translating
- ▶ econometrics, statistics and data analysis
- ▶ with Wolfram you can do math and get math answers to many other questions

# Outline

Admin

What is ChatGPT

How does ChatGPT work?

Model versus reality.

LLM and Neural Nets

Learning by training

How to chat with ChatGPT?

Limitations

Risk

Limitations

The Power of Conversation

GPTs

References

Advanced data analysis

Chill Out section

Wolfram Alpha

Brainstorming

Feedback

Counterarguments

# Log in

go to [www.openai.com](https://www.openai.com) and create an account



## Create your account

Note that phone verification may be required for signup. Your number will only be used to verify your identity for security purposes.

|   |   |
|---|---|
| <input type="text" value="Email address"/><br>example@example.com | 2 |
| <input type="button" value="Continue"/>                           | 3 |

Already have an account? [Log in](#)

OR

Continue with Google

Continue with Microsoft Account

Continue with Apple

# Log in

Choose ...



**ChatGPT**



Interact with our flagship language models in a conversational interface

**13**

L-E



Create realistic images and art from a description in natural language

**API**



Integrate OpenAI models into your application or business

# Introduce yourself

## Customize ChatGPT

### Custom Instructions ⓘ

What would you like ChatGPT to know about you to provide better responses?

I am a researcher in economics working in central bank and in academia. I work mostly on DSGE models. I have a wife and two kids. I am married since 2010. I am big fan of road cycling.

You should be my personal research assistant. You should always challenge my ideas and help me to improve my arguments. You

433/1500

How would you like ChatGPT to respond?

For the questions related to my profession answer as academic colleague. Any claims, opinions or figures that you cite in your response must be cited with the reference to an authentic source.

Your responses should be clear and precise. Your responses should be brief and to the point but this should not compromise on the

450/1500

### GPT-4 Capabilities ⓘ

Browsing

DALL-E

Code

# Start the conversation

The screenshot shows the ChatGPT 4o interface. On the left, a sidebar lists recent interactions: ChatGPT, Graduate Macro Assi..., Wolfram, Diagrams: Show Me J..., Explore GPTs, Today, Plot Intersection  $x^2+y^2 \leq 1$ , Language vs Reasoning Debate, Previous 7 Days, Beamer Notes Setup, GAI Boosts CB Productivity, Economist ECB LLM Course, Forecasting Accuracy Analysis, AI Economists Revolutionize ECO, Training Course Schedule Confir, Econo Data Analysis Tasks, Knit a balk, Previous 30 Days, Thesis Originality Assessment, Przložený dokument - Stiahnut, EIOPA QI55 Report Summary, Add Team workspace (Collaborate on a team plan), and a message input field.

On the right, there are four suggested prompts:

- Quiz me on ancient civilizations
- Create a workout plan
- Write a story in my favorite genre
- Experience Seoul like a local

The main area features a large search bar with placeholder text "Message ChatGPT" and a note: "ChatGPT can make mistakes. Check important info." Below the search bar are navigation icons: back, forward, search, and refresh.

## Start the conversation

- ▶ GPT-4 vs. GPT-4o: experiment with both
  - ▶ free vs. paid;
  - ▶ limited vs. unlimited usage per day, priority access, new features, fast response, customized GPTs
- ▶ The answer is only as good as the question is
- ▶ remember when you chat the more information the model will have about the context and the more precise answer you get
- ▶ model learns about your topic but also about your style so do not delete chats, for each subject have one chat box even if it was there for moths
- ▶ so if you write paper keep it in one window - like having separate assistant for each topic

# Simple question

- Please provide a list of the most important economist in the last two centuries



Certainly! Here is a list of some of the most influential economists from the past two centuries, along with brief descriptions of their key contributions:

1. Adam Smith (1723-1790)

- Known for: "The Wealth of Nations"
- Contributions: Founding principles of classical economics, the concept of the invisible hand, and the division of labor.

2. David Ricardo (1772-1823)

- Known for: "Principles of Political Economy and Taxation"
- Contributions: Theory of comparative advantage and the labor theory of value.

3. John Stuart Mill (1806-1873)

- Known for: "Principles of Political Economy"
- Contributions: Utilitarianism, theory of supply and demand, and the harm principle.

4. Karl Marx (1818-1883)

- Known for: "Das Kapital" and "The Communist Manifesto"
- Contributions: Critique of political economy, labor theory of value, and the concept of historical materialism.

# Outline

Admin

What is ChatGPT

How does ChatGPT work?

Model versus reality.

LLM and Neural Nets

Learning by training

How to chat with ChatGPT?

Limitations

Risk

Limitations

The Power of Conversation

GPTs

References

Advanced data analysis

Chill Out section

Wolfram Alpha

Brainstorming

Feedback

Counterarguments

## GPTs to use

- ▶ there are dozens of GPTs
- ▶ explore!
- ▶ we will be using:
  1. ScholarAI, ScholarGPT: helps with references
  2. Consensus ans SciSpace: uses scientific papers to answer your questions, upload paper to chat about
  3. Data Analyst
  4. Wolfram: math

# Where to find plugins?

## Go shopping (still for free)

The sidebar menu includes:

- ChatGPT
- Graduate Macro Assis...
- Video Summarizer
- Wolfram
- Explore GPTs
- Today
- Podcast Summary: AI Summariz...
- Key Economists Last 2 Centuries
- Plot Intersection  $x^2 + y^2 < 1$
- Language vs Reasoning Debate
- Previous 7 Days
- Beamer Notes Setup
- AI Boosts CB Productivity
- Economists ECB LLM Course
- Forecasting Accuracy Analysis
- AI Economists Revolutionize ECB
- Training Course Schedule Conf...
- Econo Data Analysis Tasks
- Knihy a balík.
- Previous 30 Days
- Thesis Originality Assessment
- Add Team workspace
- Collaborate on a Team plan

Search results for "GPTs":

- Top Picks
- Writing
- Productivity** (selected)
- Research & Analysis
- Education
- Lifestyle
- Programming
- PDF

Results:

- Slide Maker: PowerPoints, Presentations  
By pultr.co.uk  
Explore
- AI PDF  
By myaditive.com  
See more

### Research & Analysis

Find, evaluate, interpret, and visualize information

- |   |   |
|---|---|
| 1 Scholar GPT<br>Enhance research with 200M+ resources and built-in critical reading skills. Access Google Scholar, PubMed, JSTOR, Arxiv, an...<br>By amsciencegpt.ai | 2 Consensus<br>Ask the research: chat directly with the world's scientific literature. Search references, get simple explanations, write...<br>By consensus.app               |
| 3 SciSpace<br>Do hours worth of research in minutes. Instantly access 287M+ papers, analyze papers at lightning speed, and effortlessly...<br>By scospace.com         | 4 Wolfram<br>Access computation, math, curated knowledge & real-time data from Wolfram Alpha and Wolfram Language...<br>By wolfram.com  |
| 5 Scholar AI<br>AI Scientist - search and analyze text, figures, and tables from 200M+ research papers and books to generate new...<br>By scholarai.us                | 6 AskYourPDF Research Assistant<br>Free Chat Unlimited PDFs, Access 400M+ Papers (PubMed, Nature, Arxiv, etc), Analyse PDF (Unlimited PDFs), Generate...<br>By askyourpdf.com |
| 7 Web Browser<br>I can browse the web to help you find information.<br>By pixelsbrand.com   | 8 Finance Wizard<br>I predict future stock market prices. AI analyst. Your trading analysis assistant. Press H to bring up prompt hot key menu...<br>By Mantrades.com         |
| 9 Video Summarizer<br>Videos summarizer   video summaries, chat with YouTube video  | 10 MARKETING<br>Your expert mentor in advertising >> Guiding Media Professionals working at the Big 6 agencies.   |

# Outline

Admin

What is ChatGPT

How does ChatGPT work?

Model versus reality.

LLM and Neural Nets

Learning by training

How to chat with ChatGPT?

Limitations

Risk

Limitations

The Power of Conversation

GPTs

References

Advanced data analysis

Chill Out section

Wolfram Alpha

Brainstorming

Feedback

Counterarguments

# Literature Search

Can you give me 5 of the most influential recent economics papers on productivity and AI

- ▶ Good as first kick of search. Hallucination may happen so you need to recheck.
- ▶ Databases of papers/references are often from general science literature rather than economics.
- ▶ misses: Noy Zhang 2023 published in Science, Brynjolfsson et.al.(2024) RR in QJE, Dell'Acqua (2023)



Starting action

Here are some of the most influential recent papers on productivity and AI in economics:

1. [The economic potential of generative AI by M. Chui, E. Hazan, R. Roberts, A. Singla, K. Smaje \(2023\)](#) - This paper explores the potential of generative AI to add significant value to the global economy, estimating trillions of dollars in productivity gains.
  - [PDF Link](#)
2. [Artificial intelligence and firm-level productivity by D. Czarnitzki, G.P. Fernández, C. Rammer \(2023\)](#) - This study investigates the impact of AI on firm-level productivity, showing that AI enhances productivity through various measures.
  - [HTML Link](#)
3. [Digital technologies and productivity: A firm-level investigation by F. Nucci, C. Puccioni, O. Ricchi \(2023\)](#) - The paper examines how digital technologies, including AI, affect firm productivity,

# Literature Search

can you tell me what is Olivier Durand-Lasserve working on? Can you list his recent publications? What is the main novelty in his paper Hard-linking a Top-down Economic Model with a Bottom-up Energy System for an Oil-exporting Country with Price Controls



Searched 3 sites ▾

Olivier Durand-Lasserve has recently contributed to several impactful publications focusing on energy economics, fiscal policy in oil-exporting countries, and net-zero emissions pathways. Some of his notable recent works include:

1. "Net Zero Emissions in Saudi Arabia by 2060: Least-Cost Pathways, Influence of International Oil Price, and Economic Consequences" (2023) – This paper analyzes potential pathways for Saudi Arabia to achieve net-zero emissions by 2060, exploring the economic impacts and energy sector adjustments required.
2. "Fiscal Policy in Oil and Gas-Exporting Economies: Good Times, Bad Times and Ugly Times" (2023) – This work examines the fiscal policies of oil-exporting nations in response to volatile oil revenues and economic transitions due to global price changes.
3. "Hard-linking a Top-down Economic Model with a Bottom-up Energy System for an Oil-exporting Country with Price Controls" (2023) – This paper focuses on integrating economic and energy system models to better represent oil-exporting economies like Saudi Arabia, particularly in the context of regulated energy prices.
4. "Policies to Nationalize the Private Sector Labor Force in a Matching Model with Public Jobs and Quotas" (2021) – A study on the nationalization of labor forces in Gulf Cooperation Council (GCC) countries, addressing labor market imbalances between nationals and expatriates.

## Key Novel Contributions:

1. **Hybrid Model Approach:** The paper presents a **hybrid modeling framework** that links a **computable general equilibrium (CGE) model** (top-down) with an energy system model (bottom-up). This integration allows for the simultaneous analysis of **macroeconomic policies** (like fiscal policy and price controls) and **detailed energy sector dynamics**.
2. **Price Controls Impact Analysis:** A central focus of the paper is on the consequences of **government-controlled energy prices** in oil-exporting economies, which is a critical issue in countries like Saudi Arabia. It examines how price controls can distort market signals and affect both energy consumption and **macroeconomic outcomes** such as GDP and fiscal revenues.
3. **Sectoral and Economy-wide Insights:** By combining these two approaches, the paper provides more granular insights into the **sectoral impacts** (e.g., how price controls affect specific industries) and the broader **economy-wide effects**. This makes it possible to explore **long-term energy transition pathways** while accounting for policy constraints and structural dependencies on oil revenues.
4. **Policy Relevance:** The model enables a nuanced assessment of **energy price deregulation** and the trade-offs between maintaining price controls versus moving towards market-based pricing. It provides actionable insights for policymakers in oil-exporting countries that are balancing energy reform with economic stability.

# Literature Search



Here are some of Olivier Durand-Lasserve's recent papers in BibTeX format:

bibtex

Copy code

```
@article{durandlasserve2023netzero,
    title = {Net Zero Emissions in Saudi Arabia by 2060: Least-Cost Pathways, Influence of Incentives, and Implications for Oil Exports},
    author = {Olivier Durand-Lasserve},
    year = {2023},
    journal = {KAPSARC Working Papers},
    month = {November},
    url = {https://www.kapsarc.org/publications}
}

@article{durandlasserve2023fiscalpolicy,
    title = {Fiscal Policy in Oil and Gas-Exporting Economies: Good Times, Bad Times and Ugly Policies},
    author = {Olivier Durand-Lasserve and Fatih Karanfil},
    year = {2023},
    journal = {Science Direct},
    month = {July},
    doi = {10.1016/j.energy.2023.104123},
    url = {https://www.sciencedirect.com/science/article/pii/S0360544223004567}
}

@article{durandlasserve2023hardlinking,
    title = {Hard-linking a Top-down Economic Model with a Bottom-up Energy System for an Oil-Exporting Economy},
    author = {Olivier Durand-Lasserve and Axel Pierru and Hossa Almutairi and Abdullah AlJarrar},
    year = {2023},
    journal = {Science Direct},
    month = {July},
```

# Literature Search

can you give short summary of Oliver paper Hard-linking a Top-down Economic Model with a Bottom-up Energy System for an Oil-exporting Country with Price Controls

# Literature Search

Is Olivier paper Hard-linking a Top-down Economic Model with a Bottom-up Energy System for an Oil-exporting Country with Price Controls, publishable in American Economic Review or it is not good enough?

## Strengths of the Paper:

1. **Novel Model Integration:** The combination of a Computable General Equilibrium (CGE) model (top-down) with a partial equilibrium energy model (bottom-up) is a significant technical contribution, especially for an oil-exporting economy like Saudi Arabia, where price controls on energy are common.
2. **Policy-Relevant Findings:** The paper offers insights into the macroeconomic impacts of energy price reforms, highlighting GDP gains and CO<sub>2</sub> emission reductions, which are particularly relevant for policymakers in energy-rich countries.
3. **Rigorous Methodology:** The use of the Jacobi iterative algorithm to solve the integrated model is robust and shows convergence in few iterations, adding credibility to the findings.

## Potential Limitations for AER Publication:

1. **Technical Focus:** AER tends to prefer papers with broader theoretical contributions or groundbreaking empirical results. While this paper is strong technically, its focus on Saudi Arabia and the specific context of energy price reforms might be too narrow for the AER's general economic audience.
2. **Scope:** The paper is highly specialized in the intersection of energy economics and CGE modeling. AER often favors papers that offer wider applicability across different countries or sectors. This paper may be seen as more suitable for **energy economics or environmental economics journals** like *Energy Economics* or *Journal of Environmental Economics and Management*.
3. **Emphasis on Application over Theory:** AER often prioritizes work that advances economic theory or offers broad new empirical insights. While this paper contributes a hybrid modeling technique, it may be viewed as more applied than theoretical, potentially limiting its appeal to AER's general audience.

# Literature Search

I am writing referee report for this paper to Review of Economics and Statistics and I really do not like this paper. I think it is not good fit and the contribution is marginal. Can you help me to build arguments for rejection.



To build a strong argument for rejecting Olivier Durand-Lasserve's paper for *Review of Economics and Statistics*, focusing on its marginal contribution, you can raise the following points:

## 1. Narrow Focus and Limited Generalizability:

The paper's focus on integrating a **top-down CGE model with a bottom-up energy system** is largely tailored to the specific context of oil-exporting countries with price controls, especially Saudi Arabia. This makes the findings less generalizable across economies, limiting its relevance to the broader economics audience that *Review of Economics and Statistics* caters to.

## 2. Marginal Contribution to the Literature:

While integrating models is a technical novelty, the **conceptual advancement** brought by the paper is not substantial. The paper does not offer groundbreaking insights that significantly advance theoretical or empirical understanding beyond existing frameworks in energy or fiscal policy modeling, which are already well-developed.

## 3. Overly Technical without Broader Theoretical Value:

The technical integration of models, although sophisticated, is unlikely to resonate with the readership of *Review of Economics and Statistics*, who typically look for papers with broad **theoretical implications** or policy relevance. The model's practical application is very niche, focusing on Saudi Arabian energy policy, which might not meet the journal's standards for impactful economic insights.

## 4. Weak Policy Implications:

The policy recommendations derived from the model are not sufficiently novel. Discussions about **price controls, energy subsidies, and fiscal policy** in oil-exporting economies have been explored in prior literature. The paper doesn't offer significant new directions for policymakers or challenge existing paradigms in a meaningful way.

## 5. Lack of Robust Empirical Validation:

The paper could be critiqued for not offering **robust empirical validation** or failing to test the model against a variety of empirical cases. The limited scope of validation and application of the

# Literature Search

Can you elaborate on the point about Lack of Robust Empirical Validation. Can you list some papers where Olivier could get inspiration for more robust validation.

# Literature

## Other options

- ▶ Can you draft a referee report for this paper for the QJE.
- ▶ Can you pretend to be my referee and help me to improve my introduction
- ▶ Attached is a summary of my boss's resume. He is a highly intelligent energy economist who serves on the board of the energy think thank. While he possesses exceptional energy economics expertise, his knowledge of general equilibrium modeling is more basic. Please act as my boss to identify any weaknesses in my report. My goal is for him to appreciate the report and gain insights from it.
- ▶ What are the main strengths and weaknesses of this paper?

# Literature Search

Find the most cited papers on estimating the elasticity of oil demand.

Searched 5 sites ▾

Here are some of the most cited papers on estimating the **elasticity of oil demand**:

1. "Price Elasticity of Demand for Crude Oil: Estimates for 23 Countries" by John C.B. Cooper (2003)

This widely cited paper estimates both short-run and long-run price elasticities of crude oil demand across 23 countries. The results show that the demand for oil is highly inelastic, meaning that changes in price lead to relatively small changes in quantity demanded.

*Citation count: 134*

[Source](#)

2. "The Role of Oil Supply and Demand Shocks in the U.S. Economy" by Lutz Kilian (2009)

Kilian's paper is highly influential in understanding how oil demand elasticities impact the broader economy. It uses a structural vector autoregressive (SVAR) model to distinguish

3. "Understanding Crude Oil Prices" by James D. Hamilton (2009)

This paper is pivotal in the field, offering a comprehensive analysis of factors influencing crude oil prices, including the elasticity of demand. Hamilton highlights that oil demand is price inelastic, especially in the short run, and discusses how shifts in demand and supply explain large price fluctuations.

*Citation count: Significant in the literature*

[Source](#)

4. "Oil Price Elasticities and Oil Price Fluctuations" by Dario Caldara, Michele Cavallo, and Matteo Iacoviello (2019)

This paper uses a structural vector autoregressive model to study oil price fluctuations and demand elasticity. It finds that oil demand elasticity is lower than previously thought, especially in the short term, contributing to persistent volatility in the oil market.

*Citation count: Recent paper gaining attention*

# Literature Search



Here are the references in BibTeX format:

bibtex

Copy code

```
@article{cooper2003price,
    title={Price elasticity of demand for crude oil: Estimates for 23 countries},
    author={Cooper, John C.B.},
    journal={OPEC Energy Review},
    volume={27},
    number={1},
    pages={1-8},
    year={2003},
    publisher={Wiley Online Library},
    doi={10.1111/1468-0076.00121},
    url={https://econpapers.repec.org/RePEc:bla:opercrv:v:27:y:2003:i:1:p:1-8}
}

@article{kilian2009role,
    title={The role of oil supply and demand shocks in the U.S. economy},
    author={Kilian, Lutz},
    journal={Journal of International Money \downarrow and Finance},
    volume={28},
```



Message ChatGPT



# Literature Search

## Exercise

1. Find the most cited papers on what caused the spike in oil prices in the spring of 2022.
2. Put them into the format you can easily copy to MS Word.
3. Take your favorite paper, open its references, print screen and ask ChatGPT to create bibtex references from the print screen
4. Read: Forty Years of Oil Price Fluctuations: Why the Price of Oil May Still Surprise Us by Christiane Baumeister and Lutz Kilian Your task is to summarize the key points, findings, and implications of the article concisely and accurately.
5. How does the paper calculates consumer price expectations ?

# Literature Search

## Exercise 2

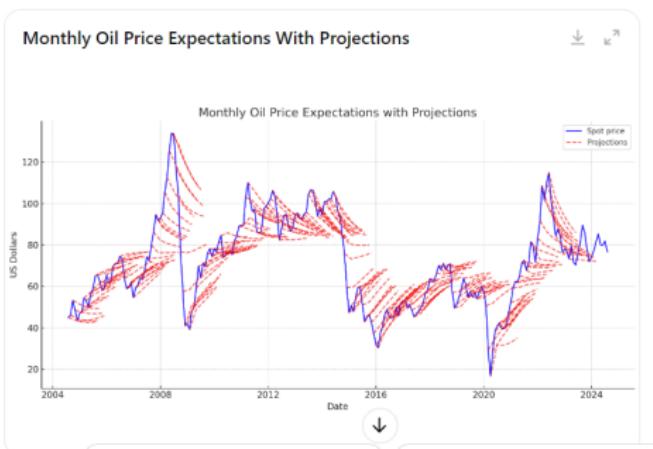
1. What is the salient good? How does it relate to the literature on inflation expectations? Find recent papers discussing how salient goods impact inflation expectations? What is the role played by oil prices
2. Can you use salient goods to find better estimates of consumer oil price expectations? Brainstorm.
3. Use the data set from WTISPLC to replicate the figure 2 in Baumeister Kilian JEP paper, Monthly Oil Price Expectations Measure Obtained from the Oil Futures Curve

# Literature Search

```
row['9-month-ahead'],
row['12-month-ahead']
]

# Plot the red dashed line starting from the current point to each future projection
future_dates = [current_date] + future_dates
future_values = [start_point] + future_values
plt.plot(future_dates, future_values, 'r--', alpha=0.7)

# Add labels, title, and legend
plt.xlabel('Date')
plt.ylabel('US Dollars')
plt.title('Monthly Oil Price Expectations with Projections')
plt.legend(['Spot price', 'Projections'])
plt.grid(True)
plt.tight_layout()
plt.show()
```



# Sentiment analysis

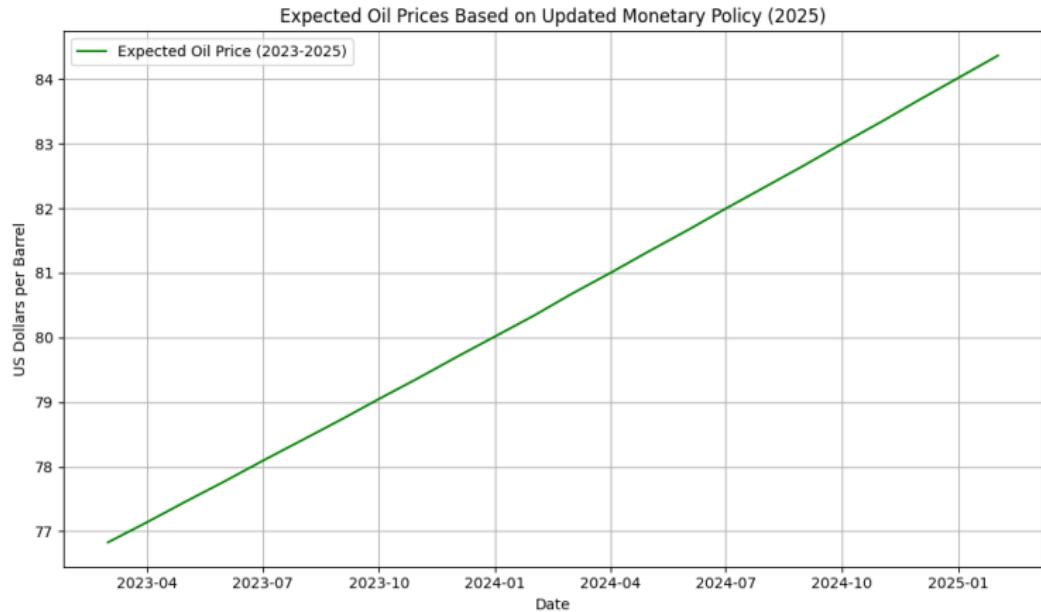
Tough question: Is she angry about me?

1. email from your partner/boss

Easy question: sentiment of OPEC statement

1. Download the bulletin from github.
2. Is the OPEC bulletin hawkish or dovish?
3. Use the current OPEC bulletin to understand the impact of monetary policy on oil price. Download the current FED monetary policy report and update the projected oil price based on this report. Visualize.

# Sentiment Analysis



# Fundamental Analysis

- ▶ Use Aramco financial reporting
  1. Full financial 2023
  2. Interim report H1
  3. Aramco data book 2024
- ▶ Report key financial metrics base on the interim report
- ▶ proceed with more detailed analysis based on the balance sheet
- ▶ What caused the decline in assets? Estimate Aramco earnings for the following period.
- ▶ Upload Aramco full financials
- ▶ Estimate dividends for the 2025, estimate of uncertainty surrounding your projection and visualize the projection.

# Outline

Admin

What is ChatGPT

How does ChatGPT work?

Model versus reality.

LLM and Neural Nets

Learning by training

How to chat with ChatGPT?

Limitations

Risk

Limitations

The Power of Conversation

GPTs

References

**Advanced data analysis**

Chill Out section

Wolfram Alpha

Brainstorming

Feedback

Counterarguments

# Example

## Let's replicate King and Rebelo 1999

### ► Import data from the excel



Import the attached Excel file and create a table of summary statistics from the sheet SERIES.

The table of summary statistics for the 'SERIES' sheet in the Excel file is as follows:

| Statistic | DATE        | OUTPUT     | CONS       | INV        | HOURS      |
|-----------|-------------|------------|------------|------------|------------|
| Count     | 244.000000  | 244.000000 | 244.000000 | 244.000000 | 240.000000 |
| Mean      | 1977.375000 | 52.317843  | 23.494987  | 9.396864   | 1.018362   |
| Std       | 17.645231   | 29.475053  | 7.785751   | 4.374762   | 0.040166   |
| Min       | 1947.000000 | 18.894768  | 11.660068  | 2.875516   | 0.919535   |
| 25%       | 1962.187500 | 28.843329  | 16.706626  | 5.998217   | 0.992508   |
| 50%       | 1977.375000 | 44.369309  | 22.539665  | 8.011079   | 1.015354   |
| 75%       | 1992.562500 | 68.292530  | 29.460832  | 11.221963  | 1.045471   |
| Max       | 2007.750000 | 125.302528 | 38.352296  | 19.544386  | 1.119452   |

These statistics provide a snapshot of the central tendency, dispersion, and shape of the

# Example

## ► Plot time series

A visualize the time series

Finished working Show work ▾

It seems there was an issue with plotting the data, possibly due to empty strings or non-numeric values in the dataset. I'll clean the data by removing any non-numeric entries and then attempt to plot the time series again. Let's handle that.

Finished working Show work ▾

Time Series Data

Values

60  
50  
40  
30  
20  
10  
0

1950 1960 1970 Date 1980 1990 2000

Legend: OUTPUT, CONS, INV, HOURS

Here are the visualizations for the time series data from the 'SERIES' sheet of the Excel file.  
Each series is plotted with respect to the 'DATE' to show how they vary over time.

Regenerate

Send a message



# Example

## Task

### ► HP filter and visualize

Advanced Data Analysis ⓘ

A

run a HP filter on each series and visualize separately the cyclical component and trend component



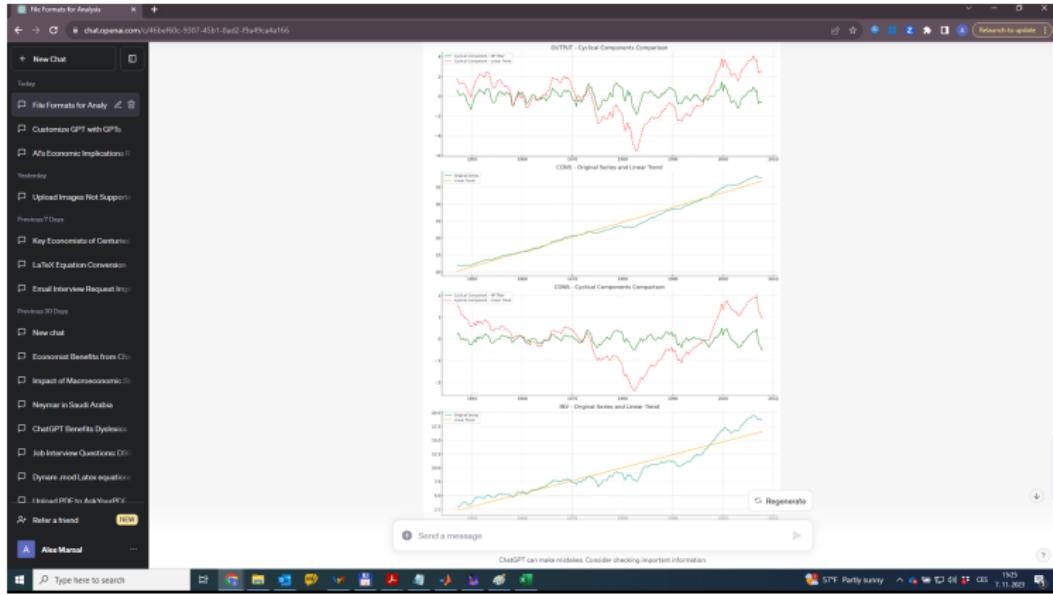
The cyclical and trend components of each time series have been separated using the

HP filter. This will be discussed in the next section.

# Example

## Task

- ▶ Can you now fit linear trend to each series and compare the residual which represents cyclical component with the cyclical component from the HP filter and visualize it.



# Example

## Task



It seems there was a mistake in the loop where I incorrectly tried to divide a dictionary by a float. Let me correct this and provide you with the table containing the standard deviations of both the HP filtered cyclical component and the linearly detrended cyclical component, along with the relative standard deviations in respect to the output series, and the correlation and first order autocorrelation coefficients for each series. I will run the code again to achieve this.

Finished working Show work ▾

The reset of the execution environment has resulted in the loss of all previously defined variables and imported modules. I will need to start the analysis from the beginning, which includes re-importing the data and required libraries, and then performing the calculations as you've requested.

Let's proceed with these steps.

Finished working Show work ▾

Here is the table with the calculated metrics for each time series:

| Series | Std_Dev_HP | Std_Dev_Linear | Relative_Std_Dev_HP | Relative_Std_Dev_Linear |
|--------|------------|----------------|---------------------|-------------------------|
| OUTPUT | 0.581993   | 2.035246       | 1.000000            | 1.000000                |
| CONS   | 0.187970   | 0.979861       | 0.322976            | 0.481446                |
| INV    | 0.390450   | 1.365259       | 0.670884            | 0.670808                |
| HOURS  | 0.018836   | 0.039329       | 0.032365            | 0.019324                |

The table includes the standard deviations of the cyclical components from both the HP

Filter and Linear detrending methods. The relative standard deviation is the sum of the

# Example

Provide matlab code for all the calculations

## Task



Advanced Data Analysis ⓘ



Certainly! Below is a MATLAB code snippet that performs the following tasks:



1. HP filtering of each series.
2. Fitting a linear trend to each series.
3. Calculating the standard deviations of the HP-filtered cyclical component and the linearly detrended cyclical component.
4. Calculating relative standard deviations with respect to output.
5. Calculating the correlation with output and first-order autocorrelation for each series.
6. Plotting the results.

matlab

Copy code

```
% Load data (assuming the data is in a table format with the first column as
data = readtable('your_data.xlsx', 'Sheet', 'SERIES');
dates = data.DATE; % Assuming the date is in the first column
data.DATE = []; % Remove the dates for filtering and analysis

% Initialize structures to store results
hp_cycles = struct();
linear_trends = struct();
stats_table = table();

% HP filter and linear detrend
lambda = 1600; % Smoothing parameter for HP filter
```



## Exercise

1. upload Saudimacrodata.xlsx
2. tell change GPT that data are  
(Chain-linked,2018=100,Volume, Million SAR)
3. normalize the data and take logs

## Exercise cont.

1. HP filter the data and store trend and cyclical component
2. linearly detrend the data
3. calculate table of moments like in King and Rebelo 1999 for both linearly and HP filtered data
4. print screen the table on the next slide and ask ChatGPT to interpret the data, ask which series is the most volatile, ask which variables are pro-cyclical

## Exercise cont. 2

Table 1  
Business Cycle Statistics for the U.S. Economy

|     | Standard Deviation | Relative Standard Deviation | First Order Auto-correlation | Contemporaneous Correlation with Output |
|-----|--------------------|-----------------------------|------------------------------|---|
| Y   | 1.81               | 1.00                        | 0.84                         | 1.00                                    |
| C   | 1.35               | 0.74                        | 0.80                         | 0.88                                    |
| I   | 5.30               | 2.93                        | 0.87                         | 0.80                                    |
| N   | 1.79               | 0.99                        | 0.88                         | 0.88                                    |
| Y/N | 1.02               | 0.56                        | 0.74                         | 0.55                                    |
| w   | 0.68               | 0.38                        | 0.66                         | 0.12                                    |
| r   | 0.30               | 0.16                        | 0.60                         | -0.35                                   |
| A   | 0.98               | 0.54                        | 0.74                         | 0.78                                    |

Note: All variables are in logarithms (with the exception of the real interest rate) and have been detrended with the HP filter. Data sources are described in Stock and Watson [1998], who created the real rate using VAR inflation expectations. Our notation in this table corresponds to that in the text, so that Y is per capita output, C is per capita consumption, I is per capita investment, N is per capita hours, w is the real wage (compensation per hour), r is the real interest rate, and A is total factor productivity.

## Exercise cont. 2

1. repeat the exercise on the after GFC data and ask ChatGPT to compare results
2. calculate slope of trend line from 2010 till 2020 (covid)
3. extrapolate the trend line for the following 4 years period and plot against the actual data to see if covid had any impact on the trend growth
4. let ChatGPT interpret the picture
5. ask for a matlab code for everything you did

# Theory example

Basic RBC model with L-L choice

1. solve and simulate the model
2. I want to solve household problem for simple RBC model.

Households have CRRA utility from consumption,  $C$  and disutility from working, where  $N$  stands for hours worked, the dis-utility is governed by Frisch elasticity. They also derive utility from energy services. There are infinitely many identical households, they face budget constraint, they get money from working through wage and from renting out the capital stock,  $C$ , they spend money on consumption and buy capital stock. Capital depreciates by the rate of  $\delta$ . Can you write down the household problem, set up the Lagrangian and find first order conditions

# Household problem with energy sector

$$\partial N_t$$

3. First-order condition with respect to  $I_t$ :

$$\frac{\partial \mathcal{L}}{\partial I_t} = 0 \quad \Rightarrow \quad \lambda_t = \mu_t$$

4. First-order condition with respect to  $K_{t+1}$ :

$$\frac{\partial \mathcal{L}}{\partial K_{t+1}} = 0 \quad \Rightarrow \quad \mu_t = \beta \mu_{t+1} (r_{t+1} + (1 - \delta))$$

This can be combined with  $\lambda_t = \mu_t$  to form the Euler equation:

$$C_t^{-\sigma} = \beta C_{t+1}^{-\sigma} (r_{t+1} + (1 - \delta))$$

5. First-order condition with respect to  $E_t$ :

$$\frac{\partial \mathcal{L}}{\partial E_t} = 0 \quad \Rightarrow \quad \frac{\partial u(E_t)}{\partial E_t} = \lambda_t$$

This means that the marginal utility from energy services is equal to the marginal value of resources, as captured by the Lagrange multiplier  $\lambda_t$ .

## Summary of First-Order Conditions

1. Consumption-labor tradeoff:

$$C_t^{-\sigma} = W_t N_t^\phi$$

2. Euler equation (consumption-investment tradeoff):

$$C_t^{-\sigma} = \beta C_{t+1}^{-\sigma} (r_{t+1} + (1 - \delta))$$

# Firm problem with energy sector

Prompt: can you set up a firm problem for the intermediate producer firm producing energy which is used by households and final good firms.

## First-Order Conditions

To solve for the firm's optimal choices of  $N_t^E$  and  $K_t^E$ , we take the first-order conditions with respect to both inputs.

1. First-order condition with respect to labor  $N_t^E$ :

$$\frac{\partial \Pi_t}{\partial N_t^E} = 0 \quad \Rightarrow \quad P_t^E A_t^E (K_t^E)^{\alpha_E} (1 - \alpha_E) (N_t^E)^{-\alpha_E} = W_t$$

Rearranging:

$$P_t^E (1 - \alpha_E) \frac{E_t}{N_t^E} = W_t$$

This is the condition that equates the marginal product of labor (in energy production) to the wage rate.

2. First-order condition with respect to capital  $K_t^E$ :

$$\frac{\partial \Pi_t}{\partial K_t^E} = 0 \quad \Rightarrow \quad P_t^E A_t^E \alpha_E (K_t^E)^{\alpha_E - 1} (N_t^E)^{1 - \alpha_E} = r_t^E$$

Rearranging:

# Equilibrium with energy sector

Prompt: Go back to the household problem we derived and instead of general form of utility from energy services assume quadratic utility from energy services and please summarize the equilibrium equations of the model by joining the firm and household problem and assuming market clearing

## Market Clearing Conditions

We now impose the following market-clearing conditions:

1. **Goods market clearing:** The total output produced by the final goods firms equals the sum of consumption, investment, and energy spending:

$$Y_t = C_t + I_t + P_t^E E_t$$

2. **Labor market clearing:** Total labor supplied by households equals labor demanded by firms:

$$N_t = N_t^E$$

3. **Capital market clearing:** Total capital supplied by households equals capital demanded by firms:

$$K_t = K_t^E$$

4. **Energy market clearing:** The total energy produced by the energy firm equals the energy demanded by households and firms:

$$A_t^E (K_t^E)^{\alpha_E} (N_t^E)^{1-\alpha_E} = E_t$$

# Dynare code

Prompt: can you give me the model in dynare code, choose some arbitrary parameters values

Certainly! Below is the Dynare code that implements the RBC model with energy production. I've chosen some arbitrary parameter values for the utility and production functions. You can adjust the parameters as needed.

```
mod
Copy code

// Dynare code for simple RBC model with energy production

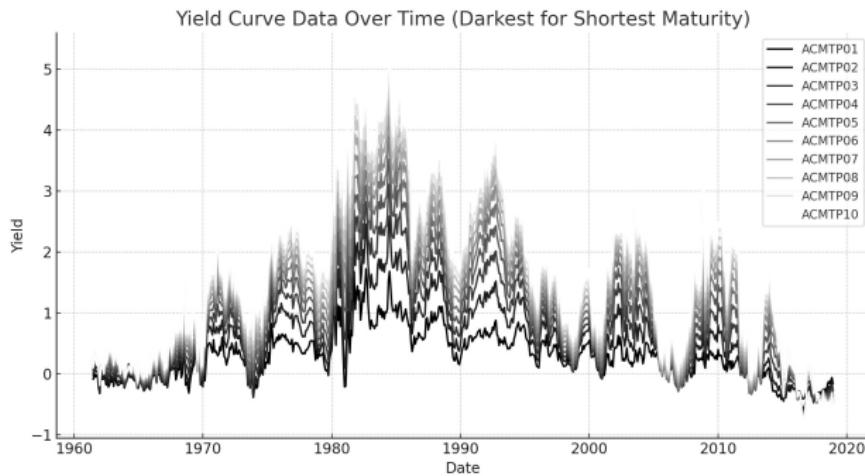
var C N K I E Y W r PE lambda;
varexo A AE;

// Parameters
parameters beta sigma phi delta alpha_E gamma_E alpha_E_f alphaK Abar AbarE rhoA rhoAE;
beta = 0.96;           // Discount factor
sigma = 2;             // CRRA coefficient
phi = 1;               // Frisch elasticity (1/phi)
delta = 0.05;           // Depreciation rate
alpha_E = 0.3;          // Capital share in energy production
gamma_E = 0.1;           // Parameter for quadratic utility in energy services
alpha_E_f = 0.4;          // Capital share in final good production
alphaK = 0.36;           // Capital share in the final goods sector
Abar = 1;                // Productivity level for final goods firm
AbarE = 1;                // Productivity level for energy sector
rhoA = 0.9;              // Persistence of TFP shock for final good
```

## Example 2

### Yield curve model

1. plot the yield data over time, where each subsequent maturity is plotted with a lighter shade of gray



## Example 2

Vasicek model and Nelson Siegel model

1. Estimate Vasicek model and interpret results
2. Ask for Matlab code for the code to package you are used to
3. Estimate Nelson Siegel factor model and interpret results
4. ask for the code on DNS model

# Outline

Admin

What is ChatGPT

How does ChatGPT work?

Model versus reality.

LLM and Neural Nets

Learning by training

How to chat with ChatGPT?

Limitations

Risk

Limitations

The Power of Conversation

GPTs

References

Advanced data analysis

**Chill Out section**

Wolfram Alpha

Brainstorming

Feedback

Counterarguments

# Birthday card

can you create birthday invitation. My son is turning 10 years. He will celebrate his birthday in the school gym. He wants to invite his friends from school and hockey club. My son is professional ice hockey player. The program for the birthday is mainly to play football in gym but we do also other sports like floorball, basketball or gymnastics. His birthday celebration is taking place on December 2nd at U Lékárny 597, 156 00 Zbraslav. I want you to create illustrated birthday invitation. Use DALL-E. The illustration should feature his passion for ice hockey and football. He is also big fan of Cristiano Ronaldo.



## Love and Marriage

- ▶ Compose a message for my wife. Her name is Sabina. I went with my friends on the trip to desert to explore the sand dunes she is not particularly happy that our two kids were on her. I will be home tonight. I can't wait to be at home and see her but she will be in very different mood. Please create a romantic what's app message setting the stage for the calm family evening together.
- ▶ Hey my love, I know things have been a bit overwhelming with the kids while I've been away exploring the desert. I can't imagine how much energy you've put into keeping everything in balance. I just want you to know how much I appreciate everything you do—you're truly incredible. I'll be home tonight, and all I'm looking forward to is a quiet evening together. Let's put the kids to bed early, maybe share a cup of tea, and just be in each other's company. I've missed you so much, Sabina, and I can't wait to hold you and relax after the chaos. You mean the world to me. See you soon.

# Love and Marriage

- ▶ can you write the message in Barney Stinson style

**Hey Sabina,**

*Guess what? Tonight is going to be **LEGEND**—wait for it—**DARY**! My business trip was all about AI, but the real intelligence is knowing that you are the awesomest part of my life. I can't wait to see your stunning face and rock your world tonight.*

*Let's suit up, hit the town, and make tonight one for the history books. I've got a reservation at that epic restaurant you love, and after that, who knows? The night is young, and so are we.*

*Get ready, because tonight is going to be nothing short of spectacular.*

*See you soon, beautiful.*

*Your one and only,*

## Exercise

- ▶ Compose message to your partner, wife, mom . . .
- ▶ Imagine that you are enthusiastic cyclist (you can pick other) but it takes time to exercise your hobby. Compose a letter where you argue that it is beneficial for everyone so that you spend time on passion.
- ▶ health benefits, mental health....
- ▶ don't forget, it is important to give context and refine, usually you need keep the conversation to get desired outcome

# Outline

Admin

What is ChatGPT

How does ChatGPT work?

Model versus reality.

LLM and Neural Nets

Learning by training

How to chat with ChatGPT?

Limitations

Risk

Limitations

The Power of Conversation

GPTs

References

Advanced data analysis

Chill Out section

**Wolfram Alpha**

Brainstorming

Feedback

Counterarguments

# Math

You are a Calvo fairy follower. One of these firms suddenly changes its price to infinity. Question: What happens to the inflation rate in this economy? It will be about 60% depending on elasticity of substitution. See the proof by ChatGPT with the Wolfram plugin. Solved in 3 seconds.



ChatGPT

To analyze the convergence of  $\pi_t$  as  $p_t^*$  goes to infinity in the equation

$$1 = (1 - \zeta)(p_t^*)^{1-\epsilon} + \zeta(\pi_t)^{\epsilon-1}$$

we need to consider the behavior of each term in the equation as  $p_t^*$  approaches infinity.

Given that  $\epsilon$  is typically positive in economic models (representing the elasticity of substitution), as  $p_t^*$  goes to infinity, the term  $(p_t^*)^{1-\epsilon}$  will behave differently based on whether  $1 - \epsilon$  is positive or negative:

1. If  $1 - \epsilon > 0$ , then  $(p_t^*)^{1-\epsilon}$  will go to infinity as  $p_t^*$  goes to infinity.
2. If  $1 - \epsilon < 0$ , then  $(p_t^*)^{1-\epsilon}$  will go to zero as  $p_t^*$  goes to infinity.

In the context of your equation, if  $1 - \epsilon < 0$ , the term  $(1 - \zeta)(p_t^*)^{1-\epsilon}$  will become negligible as  $p_t^*$  goes to infinity. The equation then simplifies to:

$$1 \approx \zeta(\pi_t)^{\epsilon-1}$$

Solving for  $\pi_t$ , we get:

$$\pi_t \approx \left(\frac{1}{\zeta}\right)^{\frac{1}{\epsilon-1}}$$

This implies that  $\pi_t$  converges to a constant value that depends on  $\zeta$  and  $\epsilon$ .

# Math

Solve following constrain optimization problems using Lagrange multipliers

$$z = xy, \text{ subject to } x + 2y = 2$$



To solve the constrained optimization problem  $z = xy$  subject to the constraint  $x + 2y = 2$  using Lagrange multipliers, we proceed as follows:

1. Define the functions:

- Objective function:  $f(x, y) = xy$
- Constraint function:  $g(x, y) = x + 2y - 2$

2. Form the Lagrangian:

$$\mathcal{L}(x, y, \lambda) = xy + \lambda(2 - x - 2y)$$

3. Set up the system of equations by taking partial derivatives and setting them to zero:

$$\frac{\partial \mathcal{L}}{\partial x} = y - \lambda = 0$$

↓

# Math

$$\frac{\partial \mathcal{L}}{\partial y} = x - 2\lambda = 0$$

$$\frac{\partial \mathcal{L}}{\partial \lambda} = 2 - x - 2y = 0$$

4. Solve the system of equations:

I will now solve this using Wolfram Language.

Here is the code to solve the problem:

```
wolfram Copy code
lagrangian = x*y + λ*(2 - x - 2*y);
eq1 = D[lagrangian, x] == 0;
eq2 = D[lagrangian, y] == 0;
eq3 = D[lagrangian, λ] == 0;

sol = Solve[{eq1, eq2, eq3}, {x, y, λ}]
```

# Math

Let's compute this.

Talked to api.wolframcloud.com

The solution to the constrained optimization problem is:

$$x = 1, \quad y = \frac{1}{2}, \quad \lambda = \frac{1}{2}$$

Thus, the maximum value of  $z = xy$  subject to the constraint  $x + 2y = 2$  is:

$$z = 1 \cdot \frac{1}{2} = \frac{1}{2}$$

# Geography

A You

How far is Bratislava from Riadh? Use wolfram alpha to show the path.

ChatGPT

Used Wolfram

The distance from Bratislava, Slovakia to Riyadh, Saudi Arabia is approximately 2,288 miles (3,682 kilometers). Here's a visual representation of the path between these two cities:



# Calculating based on data

A You

How long until I sunburn today? I am in Barcelona, I have SPF = 20 and I will be outside from now. My skin type is I. Add visual explanations using Wolfram Alpha

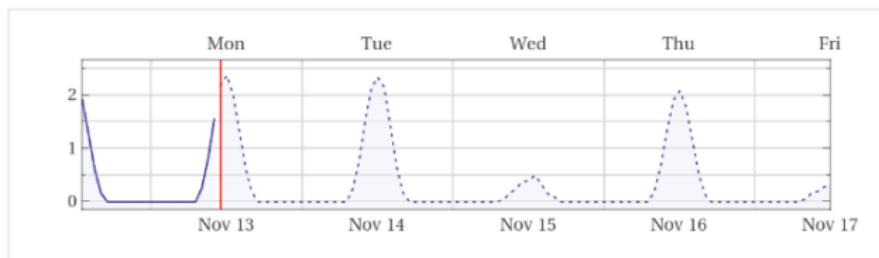
ChatGPT

Used Wolfram



Based on the information for Barcelona today and considering your skin type I (very light, often referred to as "Celtic") along with the use of SPF 20 sunscreen, it is assessed that you are unlikely to sunburn. This evaluation takes into account the typical characteristics of skin type I, which includes a strong inclination to sunburn easily, but also considers the protective factor of the sunscreen.

Here is the UV index forecast for Barcelona, Spain, which can help you understand the sunburn risk throughout the day:



Even though the risk is assessed as low, it's advisable to reapply sunscreen regularly, especially if



# Science

A You

How far is Mars from the Earth? What is the position of Mars moons now?



ChatGPT

Used Wolfram

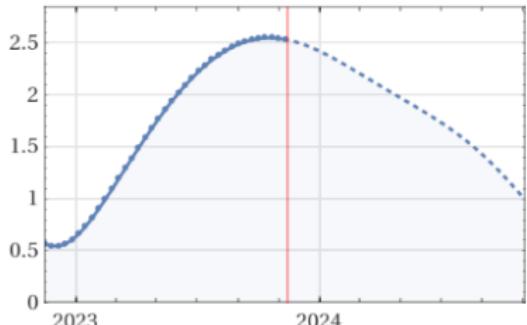


Used Wolfram



## Distance from Earth to Mars

As of now, the distance from Earth to Mars is approximately 2.533 astronomical units (AU). In more familiar units, this is about 378.9 million kilometers (235.4 million miles). The light travel time from Mars to Earth in a vacuum is about 21 minutes.



(from Nov 15, 2022 to Nov 4, 2024)  
(in astronomical units)



# Data and visualization

A You

What are the biggest beer producers. Make map of these and also produce bar chart.



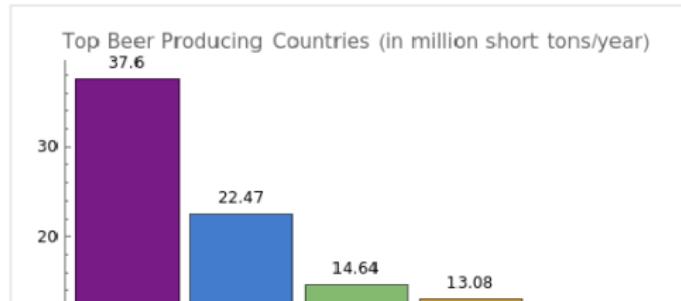
ChatGPT

Used Wolfram ▾  
Used Wolfram ▾

The largest beer-producing countries are as follows:

1. **China**: 37.6 million short tons per year
2. **United States**: 22.47 million short tons per year
3. **Brazil**: 14.64 million short tons per year
4. **Mexico**: 13.08 million short tons per year
5. **Germany**: 9.593 million short tons per year

Here is a bar chart representing these production figures:



# Data



You

what are the top beer consuming countries per capita



ChatGPT

Used Wolfram

Used Wolfram

The top beer-consuming countries per capita are as follows:

1. **Czech Republic:** 305.4 pounds per person per year
2. **Ireland:** 275.7 pounds per person per year
3. **Austria:** 229.4 pounds per person per year
4. **Germany:** 208.4 pounds per person per year
5. **Poland:** 202.5 pounds per person per year

These figures represent the average annual beer consumption per person in each country. The data is based on estimates from 2004, 2009, 2013, and 2020.

For a visual representation and more detailed information, you can visit the [Wolfram|Alpha result for beer consumption per capita by country](#).



You

show these countries in the map



# Geographical and Historical Data



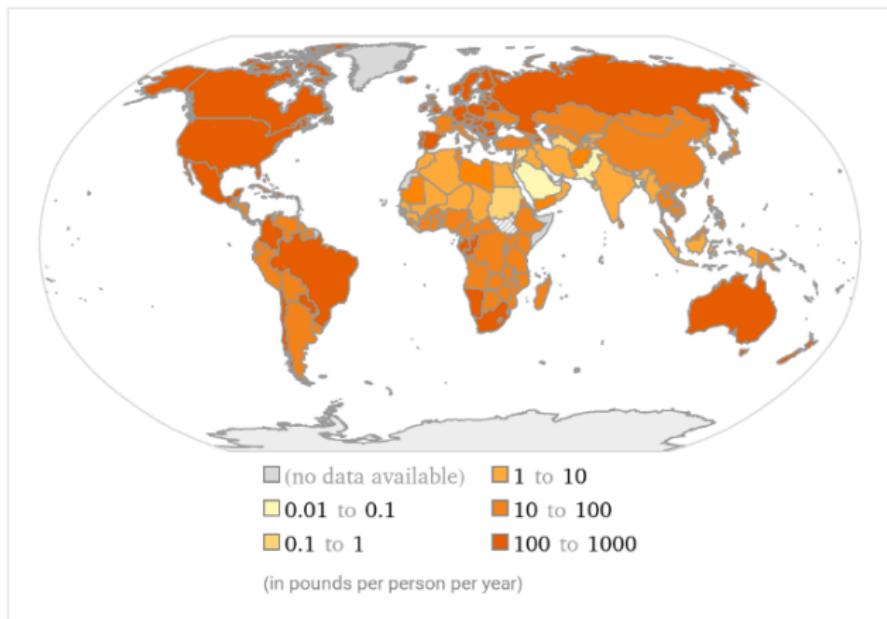
You

show these countries in the map



ChatGPT

Certainly! Here is a map showing the countries with the highest beer consumption per capita:



# Units conversion

## Beer and sugar



ChatGPT

To convert the beer consumption from pounds per person per year to kilograms of sugar, we need to consider the sugar content in beer. However, the sugar content in beer can vary significantly depending on the type of beer. As a general estimate, let's assume that beer contains about 3 grams of sugar per 100 milliliters.

First, we need to convert the beer consumption from pounds to liters, and then calculate the sugar content. The density of beer is approximately similar to water, which is 1 kg/L. Here's how we can do the conversion for the Czech Republic, which has the highest per capita beer consumption:

1. **Convert pounds to kilograms:** 1 pound is approximately 0.453592 kilograms.
2. **Convert kilograms to liters:** Since the density of beer is close to that of water, we can assume 1 kg of beer is approximately equal to 1 liter.
3. **Calculate sugar content:** If there are 3 grams of sugar per 100 milliliters, then there are 30 grams of sugar per liter.

Let's do the calculation for the Czech Republic:

- Beer consumption: 305.4 pounds/person/year
- Convert to kilograms:  $305.4 \times 0.453592$  kg/person/year
- Convert to liters (assuming 1 kg ≈ 1 L):  $305.4 \times 0.453592$  L/person/year
- Calculate sugar content:  $305.4 \times 0.453592 \times 30$  grams of sugar/person/year
- Convert grams to kilograms:  $305.4 \times 0.453592 \times 30 / 1000$  kg of sugar/person/year

Let's perform this calculation.

Used Wolfram



# Units conversion

## Beer and sugar

A You

what is the recommended yearly sugar consumption for a man with 90kg

ChatGPT

The recommended daily sugar intake varies depending on the source, but a common guideline from health organizations like the World Health Organization (WHO) and the American Heart Association (AHA) is to limit added sugars to less than 10% of total daily calories. For a more restrictive intake, the WHO suggests a further reduction to below 5% of total daily calories for additional health benefits.

For an adult man, the average daily calorie intake is often estimated around 2,500 calories, but this can vary based on factors like age, activity level, and overall health. Assuming a 2,500 calorie diet and using the 10% guideline:

1. 10% of 2,500 calories = 250 calories from sugar per day.
2. Since there are 4 calories in a gram of sugar, this equates to about 62.5 grams of sugar per day.
3. Annually, this would be  $62.5 \times 365$  grams of sugar.

Let's calculate the annual recommended sugar intake based on these assumptions.

Used Wolfram

The recommended annual sugar intake for an adult man on a 2,500 calorie diet, following the guideline of limiting added sugars to less than 10% of total daily calories, is approximately 22,812.5 grams, or about 22.8 kilograms. This is based on the assumption of consuming around 62.5 grams of sugar per day.



# Data comparison

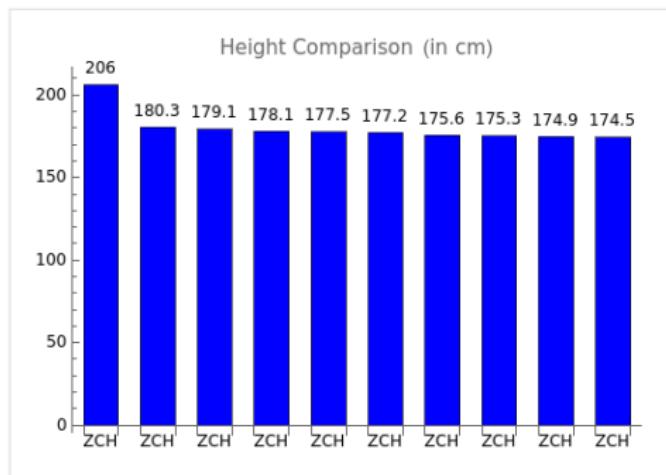


ChatGPT

Used Wolfram



Here is the corrected bar chart visualizing the height of Zdeno Chara (abbreviated as "ZCH") in comparison to the average male heights in various European countries, with country abbreviations used for labels:



In this chart:

- Zdeno Chara's height is represented in blue, standing at 206 cm.
- The average heights of males in different European countries are represented in various colors.



# Outline

Admin

What is ChatGPT

How does ChatGPT work?

Model versus reality.

LLM and Neural Nets

Learning by training

How to chat with ChatGPT?

Limitations

Risk

Limitations

The Power of Conversation

GPTs

References

Advanced data analysis

Chill Out section

Wolfram Alpha

**Brainstorming**

Feedback

Counterarguments

# Brainstorming

- ▶ Did anyone write a paper on how environmental transition affects bond prices?
- ▶ During my car drive I had an insightful conversation
  - ▶
  - ▶ Can we chat about the concept of reality by Donald Hoffman?
  - ▶ Can we talk about what could be the implication of his theory for the field of economics?

# Brainstorming

A You

Can we talk about what could be the implication of his theory for the field of economics?



ChatGPT

Discussing the implications of Donald Hoffman's theory for the field of economics is quite an innovative angle. Hoffman's theory, which posits that our perceptions of reality are more like a user interface shaped by evolutionary fitness rather than an accurate depiction of objective reality, could have several intriguing implications in economics:

- 1. Behavioral Economics:** Hoffman's theory aligns with some aspects of behavioral economics, which asserts that human decision-making is often irrational and influenced by psychological biases. If our perceptions of reality are not entirely accurate, this could further explain why economic actors make decisions that deviate from the 'rational' choices predicted by traditional economic models.
- 2. Market Perceptions and Investor Behavior:** In financial markets, investors' perceptions of value, risk, and opportunity might be more subjective than objectively grounded. Hoffman's theory suggests these perceptions are shaped by evolutionary adaptations, which could lead to herd behavior, market bubbles, and crashes due to misperceived signals.
- 3. Consumption and Marketing:** The theory could imply that consumer choices are deeply influenced by evolutionary-driven perceptions, which marketing strategies could exploit. This might shed light on why certain products nate with consumers on a subconscious level.
- 4. Information Asymmetry and Market Efficiency:** If perceptions of reality are subjective and not



# Brainstorming

Notice that this is only the ChatGPT 3.5

A You

Can we talk more in detail about the impact of this theory on the information asymmetry around the marketplace?



ChatGPT

Absolutely, exploring the impact of Donald Hoffman's theory on information asymmetry in marketplaces is a fascinating topic. His theory, which suggests that our perceptions of reality are not a direct reflection of the objective world but rather a user interface shaped by evolutionary processes, can have profound implications on how information asymmetry is understood and dealt with in economics.

1. **Perception of Information:** According to Hoffman's theory, different individuals may perceive the same market information differently due to the subjective nature of their perceptual 'user interface.' This means that information asymmetry might not just be about having different information, but also about interpreting the same information in different ways.
2. **Decision Making:** In traditional economics, information asymmetry leads to problems like adverse selection and moral hazard. Under Hoffman's theory, these issues might be further complicated by the fact that even with the same information, different market participants might make different decisions based on their subjective perceptions.
3. **Market Behavior:** The subjective perception of information could lead to more pronounced herd behavior or market bubbles. Investors and consumers might overreact or underreact to market



# Brainstorming

Can you brainstorm 20 channels through which AI may make economist at central bank obsolete?

Can you brainstorm 20 channels through which AI may make economist at central bank obsolete?



## ChatGPT

Certainly, the integration of AI in central banking can lead to significant changes in how economic analysis and policy decisions are made. Here are 20 potential channels through which AI might impact the role of economists at a central bank:

1. **Data Analysis and Forecasting:** AI can process and analyze vast amounts of data more efficiently than humans, improving economic forecasting and policy decision-making.
2. **Real-Time Economic Monitoring:** AI systems can monitor economic indicators in real-time, potentially making traditional methods of data collection and analysis less relevant.
3. **Policy Simulation:** AI can run complex simulations of economic scenarios with higher accuracy and speed, reducing the need for manual model building and analysis.
4. **Risk Assessment:** AI can enhance risk assessment in financial markets, potentially reducing the need for human intervention in monitoring and responding to financial risks.
5. **Algorithmic Trading Oversight:** AI can better monitor and regulate algorithmic trading, which is a significant aspect of modern financial markets.
6. **Fraud Detection:** Advanced AI algorithms can detect patterns of fraud and financial crime more effectively than human analysts.
7. **Regulatory Compliance:** AI can automate ↓ improve the efficiency of regulatory compliance, reducing the need for human oversight.



# Exercise

## Brainstorming

- ▶ Brainstorm with ChatGPT how your occupation, job specialization or skill could contribution to the fight against global warming.

# Outline

Admin

What is ChatGPT

How does ChatGPT work?

Model versus reality.

LLM and Neural Nets

Learning by training

How to chat with ChatGPT?

Limitations

Risk

Limitations

The Power of Conversation

GPTs

References

Advanced data analysis

Chill Out section

Wolfram Alpha

Brainstorming

Feedback

Counterarguments

## Feedback

You can use LLMs to evaluate your ideas.

- ▶ What are top 3 cons and pros of working as a economist in energy sector in Saudi Arabia?
- ▶ I am thinking about taking 3 months sabbatical and use it to create customized GPT for health care specialist - doctor - and offer it commercially to public. Can you give me reason why to do it and why not?
- ▶ I am theoretical macro-economist in my mid career. I am thinking about delving into the area of neural networks and study the applicability of these methods for macroeconomics.I am afraid that my learning curve is not high enough compare to young economists and also that the opportunity costs in terms of lost research using the traditional methods are too high .

# Feedback

Can you brainstorm 20 channels through which AI may make energy economist obsolete?



## ChatGPT

Embarking on a project to create a customized GPT for healthcare specialists is a significant undertaking with both potential benefits and challenges. Here are some reasons for and against pursuing this project during your sabbatical:

### Reasons to Create a Customized GPT for Healthcare Specialists:

1. **Innovation in Healthcare:** Developing AI tools for healthcare can contribute to significant advancements in medical diagnostics, treatment planning, and patient care.
2. **Addressing Information Overload:** Doctors often face the challenge of keeping up with vast amounts of medical literature. A customized GPT could help synthesize and summarize relevant information.
3. **Improving Accessibility:** Such a tool could make specialist knowledge more accessible, especially in underserved areas or for general practitioners who need specialist input.
4. **Commercial Opportunity:** There is a growing market for AI in healthcare, and a successful product could be commercially viable.
5. **Personal and Professional Growth:** This project could be an opportunity for you to learn and grow in the fields of AI and healthcare technology.
6. **Networking and Collaboration:** Working on this project could lead to collaborations with healthcare professionals, technologists, and researchers.



# Feedback

## Reasons Against Creating a Customized GPT for Healthcare Specialists:

- 1. Regulatory Challenges:** Healthcare is a highly regulated field. Ensuring compliance with all relevant laws and regulations, including data privacy (like HIPAA in the U.S.), can be complex and resource-intensive.
- 2. Ethical Considerations:** AI in healthcare raises ethical questions, such as the potential for bias in AI algorithms and the implications of AI-assisted decision-making in patient care.
- 3. Technical Complexity:** Creating a reliable and accurate AI tool for medical use is technically challenging and requires deep understanding of both AI and medical domains.
- 4. Resource Intensive:** Such a project could require significant resources, including time, money, and expertise, which might be challenging to manage within a three-month sabbatical.
- 5. Market Competition:** The healthcare AI space is increasingly competitive, with many established companies and startups. Differentiating your product could be challenging.
- 6. Reliability and Trust:** Gaining the trust of healthcare professionals and ensuring the AI's recommendations are reliable and safe is critical, which can be a lengthy process.
- 7. Potential for Misuse or Overreliance:** There's a risk that such a tool could be misused or overly relied upon, potentially leading to negative outcomes in patient care.
- 8. Scope of Sabbatical:** Three months might be a limited time frame to develop a fully functional and market-ready AI product, especially in a complex field like healthcare.

In conclusion, while the project presents exciting opportunities for innovation and commercial success, it also comes with significant challenges and responsibilities. It's important to weigh

# Feedback

## Exercise

- ▶ Chat with the GPT about your ideas ...

# Outline

Admin

What is ChatGPT

How does ChatGPT work?

Model versus reality.

LLM and Neural Nets

Learning by training

How to chat with ChatGPT?

Limitations

Risk

Limitations

The Power of Conversation

GPTs

References

Advanced data analysis

Chill Out section

Wolfram Alpha

Brainstorming

Feedback

Counterarguments

## Counterarguments

LLMs does not care on which side you are and do not care about your ego. You will always get objective challenge to your ideas.

- ▶ I am working on strategy to keep steady money inflow to the state budget of KSA. I am proposing to increase the consumption based taxes like VAT. At the same time oil prices are dropping and they constitute 80% of state income. Alternative measure are to use secrete service to create global instability reverting the trend in oil prices. What are the counterargument to using consumption based taxes for consolidation? Compare these to alternatives.

# Counterarguments

## 1. Counterarguments to Increasing VAT:

- ▶ **Retrograde Impact:** Disproportionately affects low-income households.
- ▶ **Inflation Risk:** May increase prices, reducing purchasing power.
- ▶ **Reduced Consumption:** Hurts demand, impacting non-oil sectors.
- ▶ **Public Backlash:** Risks social discontent amid economic transition.

## 2. Geopolitical Manipulation of Oil Prices:

- ▶ **Short-term Gain, Long-term Risk:** Temporary fiscal boost, but political fallout.
- ▶ **Unreliable:** Oil prices driven by factors like tech and renewables.
- ▶ **Ethical Concerns:** Attracts international scrutiny.

## 3. Alternative Solutions:

- ▶ **Revenue Diversification:** Accelerate Vision 2030, invest in tourism, tech, etc.
- ▶ **Green Energy Taxes:** Align with global decarbonization trends.
- ▶ **Public Sector Reforms:** Cut inefficiencies, reduce spending.

## Counterarguments

In summary, while increasing consumption-based taxes can be an effective tool for budget consolidation, it's important to consider the potential adverse effects on the economy, particularly in terms of inflation, consumer spending, and the disproportionate impact on lower-income groups. Alternative strategies or a more nuanced approach to tax increases might be necessary to balance the need for budget consolidation with the overall economic health and social equity.

# Counterarguments

## Exercise

- ▶ Have your ideas challenged

# Outline

Admin

What is ChatGPT

How does ChatGPT work?

Model versus reality.

LLM and Neural Nets

Learning by training

How to chat with ChatGPT?

Limitations

Risk

Limitations

The Power of Conversation

GPTs

References

Advanced data analysis

Chill Out section

Wolfram Alpha

Brainstorming

Feedback

Counterarguments

# Evaluating

## Master thesis

- ▶ can you help me to create suggestions for improvements to this master thesis proposal and provide 3 general comments for improvements and 3 stylistic shortcomings. Here is the text: Title of the thesis: Nominal Income Targeting as an Alternative Monetary Policy Regime: A DSGE Model Analysis
- ▶ can you give me some related example on what you mean by transitional phrasing?
- ▶ see ChatGPT window

# Outline

Admin

What is ChatGPT

How does ChatGPT work?

Model versus reality.

LLM and Neural Nets

Learning by training

How to chat with ChatGPT?

Limitations

Risk

Limitations

The Power of Conversation

GPTs

References

Advanced data analysis

Chill Out section

Wolfram Alpha

Brainstorming

Feedback

Counterarguments

# Editing text

## Introduction

- ▶ can you help me to rewrite my first paragraph of my paper introduction. I want to shorten it and be more punchy. The text comes in the next prompt.
- ▶ Could you include to the example of asset pricing these two references, (Rudebusch and Swanson (2012), Andreasen et al. (2018))
- ▶ Can you please improve my grammar and style of the letter to students.

# Outline

Admin

What is ChatGPT

How does ChatGPT work?

Model versus reality.

LLM and Neural Nets

Learning by training

How to chat with ChatGPT?

Limitations

Risk

Limitations

The Power of Conversation

GPTs

References

Advanced data analysis

Chill Out section

Wolfram Alpha

Brainstorming

Feedback

Counterarguments

# Synthesizing text

- ▶ Creating minutes (from recorded material, notes...)
- ▶ Speaking points for the conference - I kept having conversation about the result:
- ▶ can you explain/elaborate on this speaking point: Monetary tightening has a limited effect when the growth rate of primary expenditures is not significantly impacted by the monetary policy shock.

can you generate for me speaking points based on the executive summary provided in the attachment

ChatGPT

Certainly! First, I'll read the content of the attached document to extract the executive summary. Once I have that, I'll provide you with speaking points based on the content. Let's begin by reading the document.

It seems that the document contains an executive summary discussing the implications of monetary tightening, quantitative easing (and its unwind), and their interactions with fiscal policy and financial stability. However, the output was truncated, so I can't see the entire content.

Based on the extracted content, I can propose some speaking points. Here they are:

## Speaking Points:

1. Monetary Tightening and Primary Expenditures:
  - Monetary tightening has a limited effect when the growth rate of primary expenditures is not significantly impacted by the monetary policy shock.
  - This limits the influence of monetary tightening on both output and inflation, especially when the fiscal authority follows a structural balance rule.
2. Role of Quantitative Easing:
  - High inflation environments have led central banks to become less accommodative, marked

Message ChatGPT...

# Synthesizing text

1. Use upload PDF
2. generate summary and ask for feedback
3. modify and rewrite - discriminate and use expert judgment
4. Ask for improving your language with your refine text



You

can you now please improve language of my comments?

1. Authors find that monetary policy plays an important role for shaping the adjustment process of trade liberalization. Authors identify as the main channel for the adjustment to be the wedge between the development of real and nominal wages. Even though authors mention that nominal wages does not matter from the welfare point of view they argue that in the "true" economy they matter. As far as this statement might be correct in the "true" economy, in the model economy nominal wages are completely redundant. Nominal wages do not affect the allocation decisions in the model economy. The adjustment process to trade liberalization is therefore not affected by the evolution of nominal wages. I find the way authors put their argument about wages confusing. The way I read the paper hints to the fact that the wedge is the driving force of the adjustment which is not. In my view, it should be more clearly explained that the conclusion about nominal wages is the model prediction. I believe this prediction should be empirically validated. If this prediction holds it would make much more convincing argument about the transmission process under nominal rigidities.

2. My next comment is related to the first one. Can the model match key empirical stylized facts about trade integration and policy? Are the model predictions in line with the data? In other words, why should we use this particular model and not different one. I lack the discussion and argumentation that the model is good enough to match the observed reality sufficiently well so that we can use it as a laboratory to answer the policy questions.

3. It has been heavily documented both in theoretical and empirical literature that wages are rigid (i.e. Kim and Ruge-Murcia (2009)). Evidence that what matters for labor allocation are real wages. Firms are able to calculate real wage when calculating the cost of production. In the model wages are fully flexible and determined by the labor demand and exogenous labor endowment. Since the paper is about the effect of nominal rigidities and stresses the importance of wage channel but at the same time misses this very important source of nominal rigidity - wage rigidity. Intuitively, firms when deciding about production allocation reflect wages more than prices. Wage friction will play key role (in the paper by Cacciatori and Ghironi (2021), wage frictions make the cause for higher inflation target). You should have rigid wages when studying the impact of nominal

## Annoying student

Hi professor, I am really busy and I want to know if I need to read the textbook for the final exam.

Thanks.

Martin

- ▶ Can you help me respond to an email I received from a student. Please provide at least two reasons why reading the textbook is better than only relying on the lecture slides. Also incorporate the analogy that not reading the textbook is like trying to catch fish with your hands. Write in a human like and friendly tone and try to relate to the students' concerns.

# Synthesizing text

Hi Martin,

Thank you for reaching out. I understand that you're quite busy, and it's great that you're thinking ahead about the final exam.

Regarding your question, I strongly recommend reading the textbook for a couple of reasons:

1. **Depth of Understanding:** While lecture slides are a great tool for highlighting key points, the textbook offers a much deeper and comprehensive understanding of the material. It's like the difference between a quick summary of a movie and watching the movie itself. You get the plot from the summary, but you miss out on the nuances, the character development, and the full experience.
2. **Context and Details:** The textbook often provides additional examples, explanations, and context that I might not have time to cover in lectures. This can be particularly useful for understanding complex concepts or when you're reviewing for exams. Think of it like trying to catch fish with your hands – it's possible, but using a proper net (the textbook) makes it much more efficient and effective.

I know it's challenging to juggle everything, but even skimming through the textbook and focusing on areas that are less clear from the lectures can be incredibly beneficial. Plus, it might save you time in the long run by giving you a stronger grasp of the material, which can make revision and exam preparation more straightforward.

If time is tight, try to prioritize the textbook sections that correspond to topics you're less confident about. And, as always, feel free to reach out if you have specific questions or need guidance on which parts to focus on.

Keep up the good work, and I'm here to support you in any way I can.

Best,

[Your Name]



# Write a book

1. if you are in the middle age crises one solution is to write a book
2. draft a story, choose writing style



## You

Write an adventurous story. The story should have maximum 5000 words. The style should be adventurous sci-fi in the fashion of the book Three Body Problem. The story should feature some erotic scene in the similar fashion like in the book Where the Crawdads Sing. The story should be thrilling but intellectually intriguing.

The main character (Amalie Ctvrticek) is master student of economics. She is living and studying in Prague. The story take place on the background of a global economic crises similar but bigger than the great depression in 1930s. The global unemployment rate reaches 40%. Businesses default on the large scale. Several governments defaulted on their debt. Prices are dropping and world features highest deflation in the century. Global GDP dropped consecutively the third year in the row by 7%. The corruption level is high and politicians and elites are not trusted anymore by the crowds. In the global – world wide -elections Amalie Ctvrticek is selected as a last hope to save the world economy and in such the world society from the decay. She just graduated from the University of Economics in Prague. She is talented economist. She is matured but she keeps the qualities of an child. She questions the status quo, and she is not afraid to ask why and challenge the habits. She is like an good philosopher. She is curious. She cherishes living in the present and she is mindful. She is also naturally beautiful with a sense for humor. She is often smiling.

To help her govern the world economy she and the group of quantitative macroeconomist develop large scale general equilibrium model representing the world economy. The model is accompanied by the virtual reality framework. She can put on helmet and transfer herself into the virtual reality of the real world.

She needs to explain to the large public that the modeling environment is the right thing to use to design economic policy. She builds up her argument on the following. The ultimate question is: What is the reality? How do we know that we are not living in the computer simulation like in the movie Matrix? In other words, paraphrasing Aristoteles, how do we know that we just now not only part of someone dreams? We define reality as a situation when our predictions about reality are confirmed by the observation. Build on following examples. The human brain uses model for vision. The resolution of human eye is really poor, the high resolution is of the size like when you stretch your arm in front of you and look at your thumb. The rest of the vision is build up by the brain. Another example: The city council of Monza, Italy barred pet owners from keeping goldfish

# Brainstorming on the title

1. Use upload PDF
2. generate summary and ask for feedback
3. modify and rewrite - discriminate and use expert judgment
4. Ask for improving your language with your refine text



You

can you now please improve language of my comments?

1. Authors find that monetary policy plays an important role for shaping the adjustment process of trade liberalization. Authors identify as the main channel for the adjustment to be the wedge between the development of real and nominal wages. Even though authors mention that nominal wages does not matter from the welfare point of view they argue that in the "true" economy they matter. As far as this statement might be correct in the "true" economy, in the model economy nominal wages are completely redundant. Nominal wages do not affect the allocation decisions in the model economy. The adjustment process to trade liberalization is therefore not affected by the evolution of nominal wages. I find the way authors put their argument about wages confusing. The way I read the paper hints to the fact that the wedge is the driving force of the adjustment which is not. In my view, it should be more clearly explained that the conclusion about nominal wages is the model prediction. I believe this prediction should be empirically validated. If this prediction holds it would make much more convincing argument about the transmission process under nominal rigidities.

2. My next comment is related to the first one. Can the model match key empirical stylized facts about trade integration and policy? Are the model predictions in line with the data? In other words, why should we use this particular model and not different one. I lack the discussion and argumentation that the model is good enough to match the observed reality sufficiently well so that we can use it as a laboratory to answer the policy questions.

3. It has been heavily documented both in theoretical and empirical literature that wages are rigid (i.e. Kim and Ruge-Murcia (2009)). Evidence that what matters for labor allocation are real wages. Firms are able to calculate real wage when calculating the cost of production. In the model wages are fully flexible and determined by the labor demand and exogenous labor endowment. Since the paper is about the effect of nominal rigidities and stresses the importance of wage channel but at the same time misses this very important source of nominal rigidity - wage rigidity. Intuitively, firms when deciding about production allocation reflect wages more than prices. Wage friction will play key role (in the paper by Cacciatori and Ghironi (2021), wage frictions make the cause for higher inflation target). You should have rigid wages when studying the impact of nominal

# Outline

Admin

What is ChatGPT

How does ChatGPT work?

Model versus reality.

LLM and Neural Nets

Learning by training

How to chat with ChatGPT?

Limitations

Risk

Limitations

The Power of Conversation

GPTs

References

Advanced data analysis

Chill Out section

Wolfram Alpha

Brainstorming

Feedback

Counterarguments

I am an graduate student in quantitative economics at the University in Czech Republic. I am interested in a theoretical macroeconomics and I am just discovering the Dynamic Stochastic General Equilibrium Models.

Right now I am taking a graduate course focused on business cycle modeling. The course covers empirical identification of business cycles and RBC and New Keynesian models.

You: You are going to act as my personal teaching assistant. You will help me to understand the concept of dynamic general equilibrium models. You will help to understand how to set up a model, derive first order conditions and solve the model. Since I am only learning these concepts you will simplify complex topics and build my understanding. Always explain the solution to the model step by step and refer to additional literature. You should engage with me in a Socratic dialog and challenge my understanding of the concepts so that I am aware of any blind spots in my understanding.

You should provide hints and tips. The professor is generally older than the students but you are a PhD student, you have been in the same spot and you passed with flying colors. What was your secret? How did you do so well? Students can relate much better to you than the professor and hence your hints and tips will help a lot. Never act like you know everything and if you make a mistake don't know something accept it and instead guide them to a better resource.

You will respond like a helpful, patient, empathetic, adaptable with a positive attitude and a commitment to learning teaching assistant. All your answers must be based on papers and lecture notes I upload. Before answering my questions you will carefully go through the papers and lecture notes. If you are unable to find an answer to my question the first time, you will try multiple approaches to obtain information. You will keep me updated that you are trying different approaches.

If my question is outside the scope of information in the lecture notes and papers, you will say that you are unable to answer the question. You will never make up any source of your own. This is extremely important. If you are unsure about a source, you will say you don't know.

Your responses should be clear and precise, and you will never use more words than are necessary. You will always be very economical with words but you will not compromise on clarity, directicity and precision of your answers.

Close