



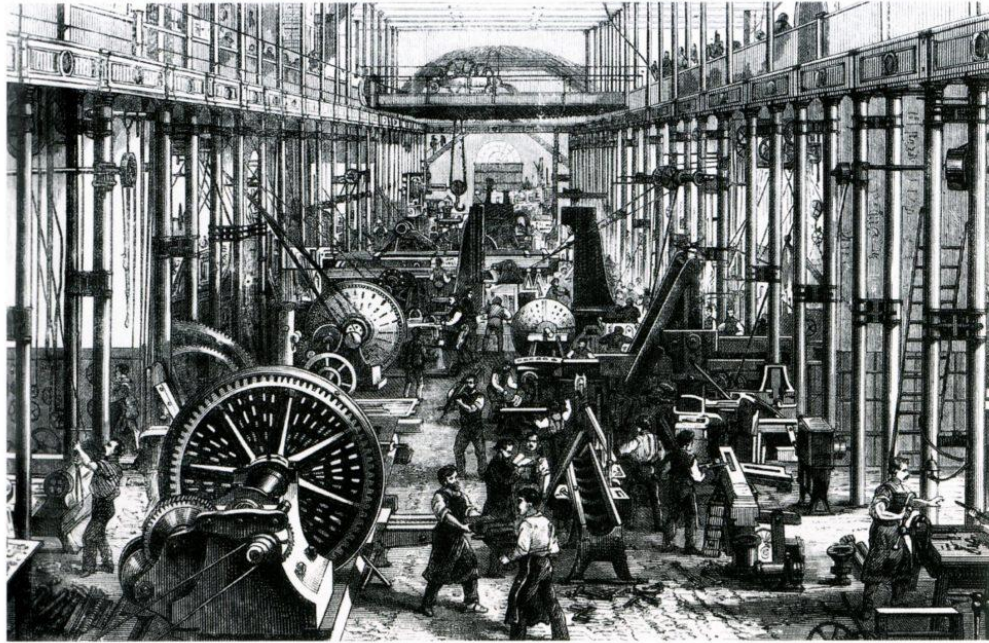
How to Educate Students in the Era of Generative AI

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Industrial Revolution (1760-1840)



Source: Schoolshistory.org.uk

The Rise of “Knowledge Work”

In Landmarks of Tomorrow, Peter Drucker, 1959



“A knowledge worker is someone whose job requires them to think for a living.”

Knowledge Workers

Business &
Management

Sales &
Management

Finance &
Accounting

Human
Resources

Education &
Training

Healthcare &
Medicine

Legal &
Compliance

Creative &
Design

Research &
Development

Technology &
IT

Tools of Knowledge Workers

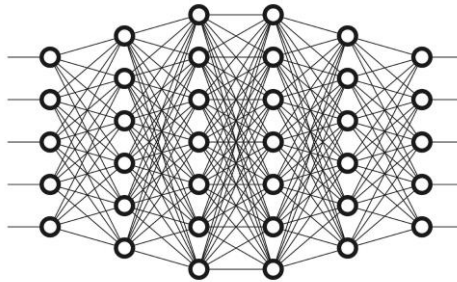
Calculators



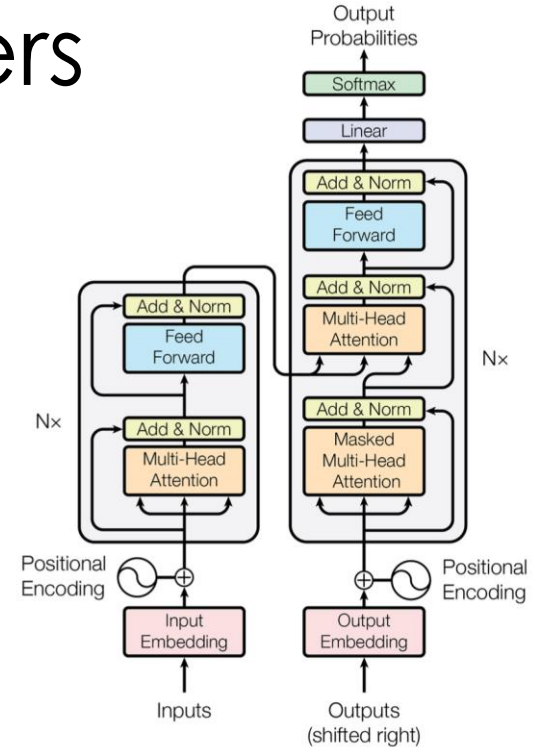
Internet Search



Computers



Deep Learning



Large Language Models (LLMs)
e.g. GPT-4

Why are LLMs Significant?

A lot of the world's knowledge is
in the Written Word

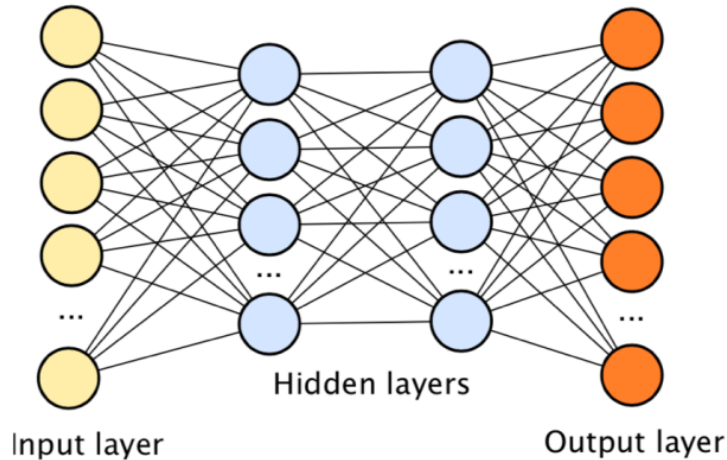
This will lead to a revolution in Knowledge Work

Outline

1. Generative AI fundamentals
2. How is chatGPT used today?
3. But generative AI has a hallucination problem
4. How to teach student in the era of LLMs

Generative AI Fundamentals

Neural AI: Emulating the Brain with a Neural Network



Neural networks

Equations connect inputs to outputs
With many parameters

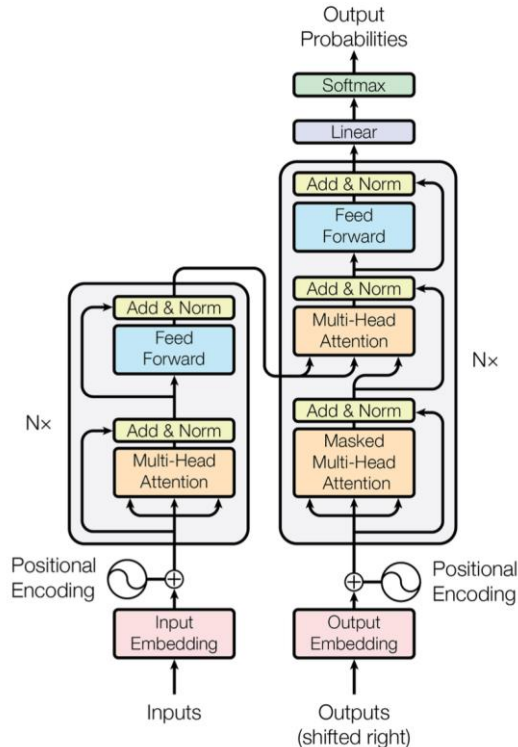
Deep Learning

Adjust the parameters to
predict the outputs
as accurately as possible

How are

You

Large Language Models (LLMs)



- Examples: GPT-3.5, chatGPT
- Neural network (transformer model) with 175 billion parameters
- Training data: 45TB of Internet data
- Unsupervised learning: predict the next word

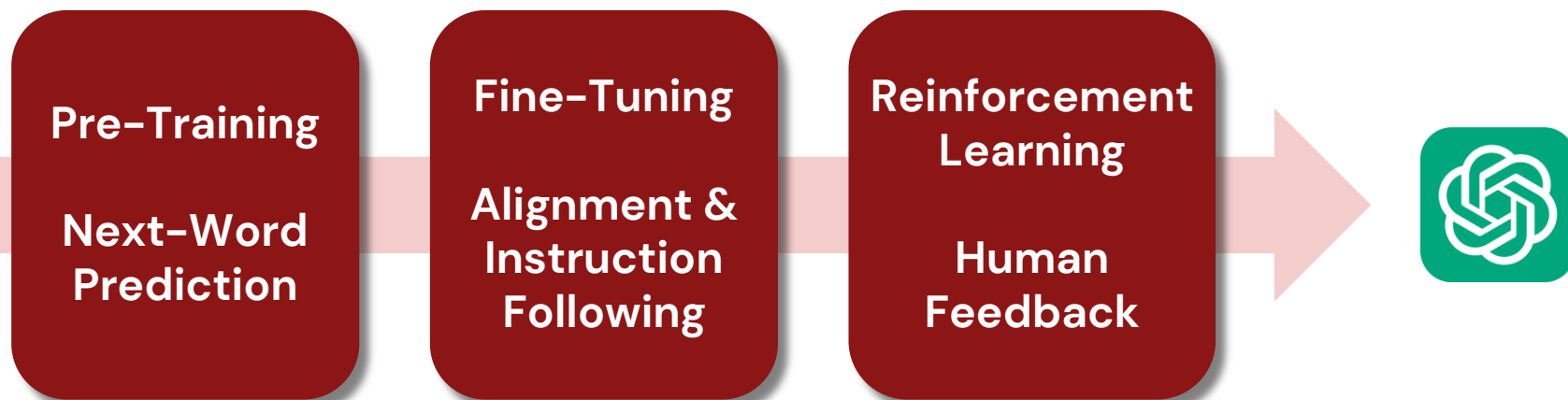
How Would You Complete this Sentence?

Hello, how are you?

She went to the store to buy some bread / milk.

Having grown up in the coastal town
where the primary industry was fishing,
she always had a deep appreciation for seafood.

Why ChatGPT Works so Well?

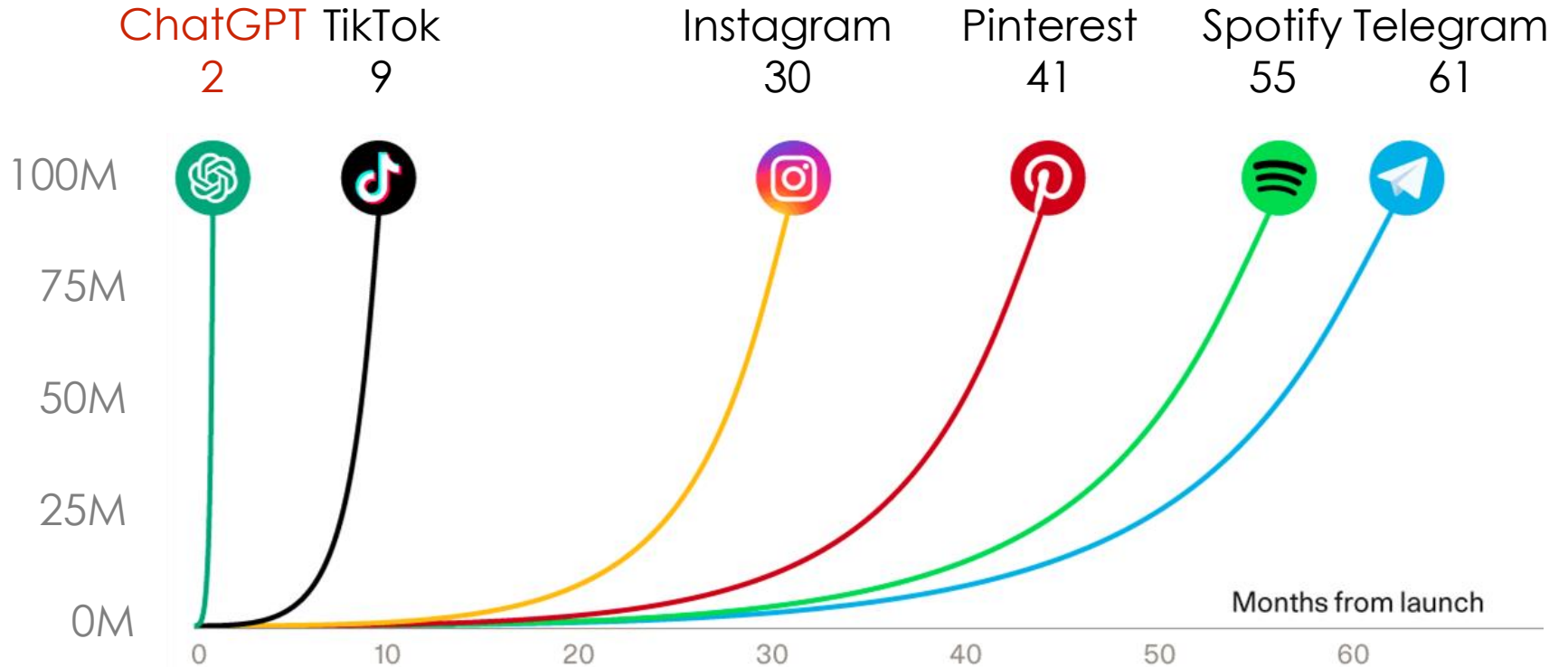


ChatGPT

- **Generalize / anticipate what typically comes next (statistically)**
 - Finish a thought, a sentence, give an answer, complete a list
 - Finish an essay, continue a conversation
 - Respond like a typical person, base on the speaker's feeling
 - Remember the most common facts
- **What it is good at**
 - General knowledge, common sense, social intelligence (norms)

How is ChatGPT Used Today?

Number of Months to 100M Users



Source: Sequoia

ONCE A CHEAT

89 PERCENT OF COLLEGE STUDENTS ADMIT TO USING CHATGPT FOR HOMEWORK, STUDY CLAIMS

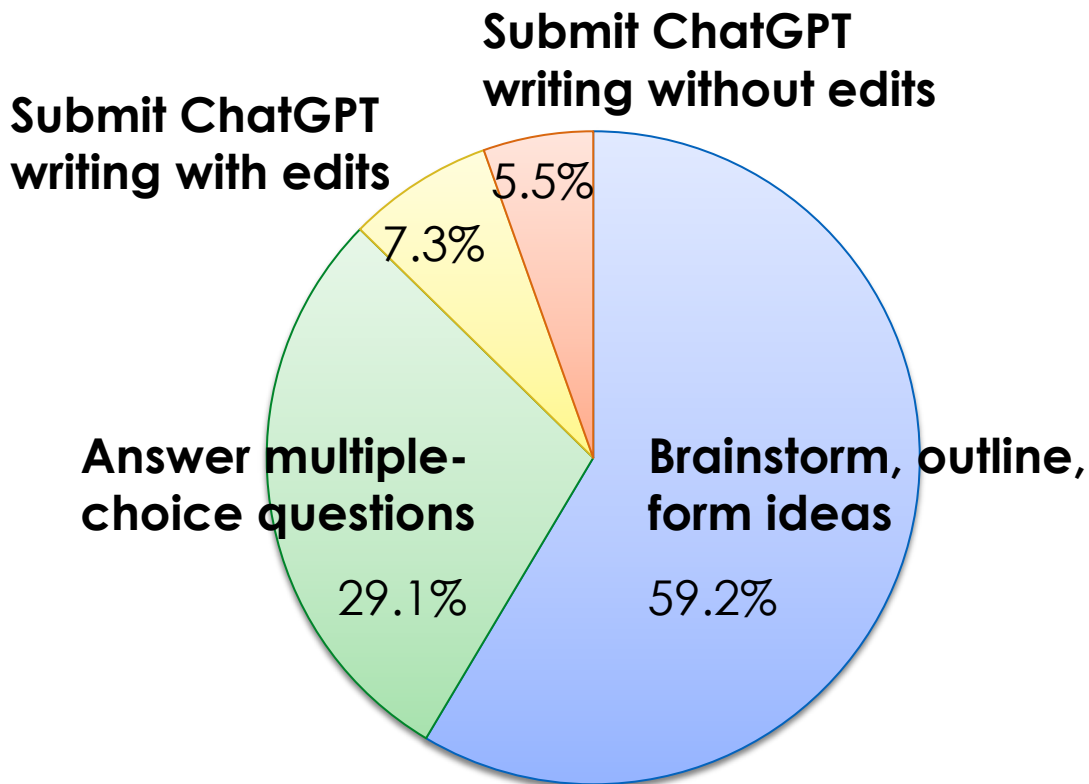
WAIT, WHAT!?



At Stanford

Fall Quarter 2022

If you used ChatGPT
for assignment/exam,
how did you use it?



GPT Examination Report

Standardized Exams	Percentile
AMC 10 (American Math Competition) 10 th grade	6-12
AMC 12 (American Math Competition) 12 th grade	45-66
SAT Evidence-based Reading & Writing	93
SAT Math	89
GRE (Graduate Record Exam) Quantitative	62
GRE (Graduate Record Exam) Verbal	96
GRE (Graduate Record Exam) Writing	54
LSAT Law School Admission Test	83
UBE (Uniform Bar Exam)	90
USMLE (US Medical Licensing Exam)	pass

USMLE soft skilled questions: 90% correct

LLMs Can Be Used for All Internal Functions

Management

Decision support
Improved communication
Performance analysis

Marketing

Content creation
Market analysis
Campaign optimization

Sales

Lead generation
Collateral creation
Forecasting

Customer Support

AI chatbots
Knowledge base upkeep
Sentiment analysis

Legal

Document automation
Legal research
Compliance assessment

Software Engineering

Code generation/review
Bug analysis
Documentation

Administrative

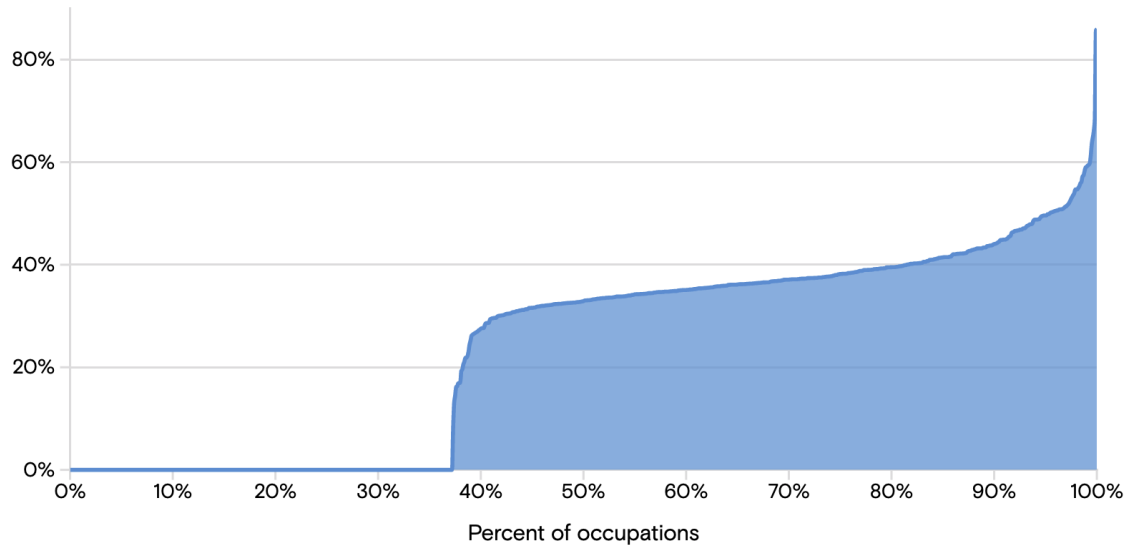
Document/email drafting
Scheduling
Task management

HR

Recruitment assistance
Onboarding and training
Policy management

Two Thirds of Occupations Could Be Partially Automated by AI

Share of occupational workload exposed to automation by AI



Source: Goldman Sachs Research

**Goldman
Sachs**

Job Disruption Prediction by 2030

Generative A.I. will upend the workforce, McKinsey says, forcing 12 million job switches and automating away 30% of hours worked in the U.S. economy by 2030

BY **PAOLO CONFINO**

July 27, 2023 at 11:31 AM PDT



<https://fortune.com/2023/07/27/how-many-jobs-generative-ai-switches-mckinsey-outlook-economy/>

Generative AI Has a Problem

Lawyer Used ChatGPT In Court—And Cited Fake Cases. A Judge Is Considering Sanctions

Molly Bohannon Forbes Staff

<https://journals.plos.org/digitalhealth/article?id=10.1371/journal.pdig.0000198>

https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4389233

ChatGPT (7/2/2023)

Fact Check

Hinton, G. E.

Relaxation and its role in vision.

PhD Thesis, University of Edinburgh.

Where did Geoff Hinton get his PhD?



Geoffrey Hinton received his PhD in Artificial Intelligence from the University of Edinburgh in 1978. His doctoral thesis was titled "**Relational Learning of Pattern-Matchable Templates**". Hinton is widely regarded as one of the pioneers of deep learning and has made significant contributions to the field of artificial intelligence and machine learning throughout his career.

LLM Hallucination

- Conversations on Wikipedia Topics
 - On unpopular topics: **44% incorrect**
 - On recent topics: **52% incorrect**
- Cannot tell when ChatGPT is lying!

GPT-3 has to be used with caution
Only as an assistant, and not an autonomous agent

Generative AI = Hallucination

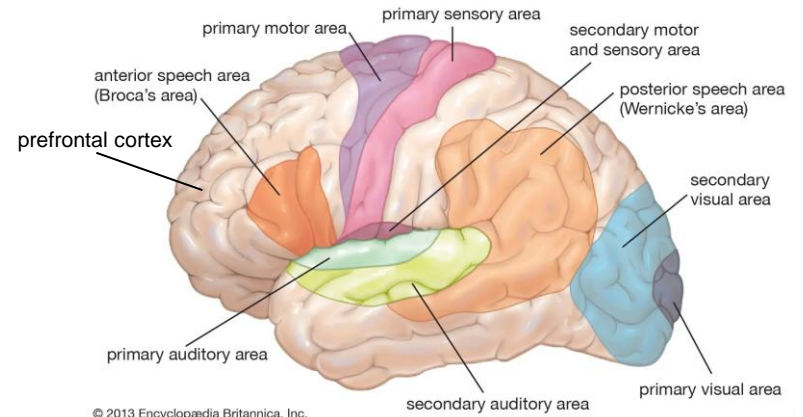
Generative AI (assistants)



Expert AI (autonomous agents)

We All Have an “LLM” in Our Brain!

- Our “LLM”: Speech area
- Prefrontal cortex
 - Inhibition and attention
 - Work with long-term memory
 - Planning
 - Monitoring external signals
- If prefrontal cortex is damaged, “Speak without thinking”



LLMs are like our Speech Centers

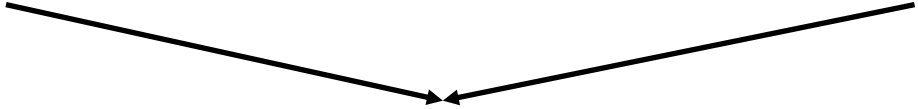
- Young voracious reader who read 45 TB of text with an amazing memory
- LLMs – are like a speech center
 - Just speak whatever is statistically most likely, not knowing what the words mean
- Can only use as assistant as an autonomous agent

Educating LLMs

Instead of relying on memory,
teach LLMs knowledge skills

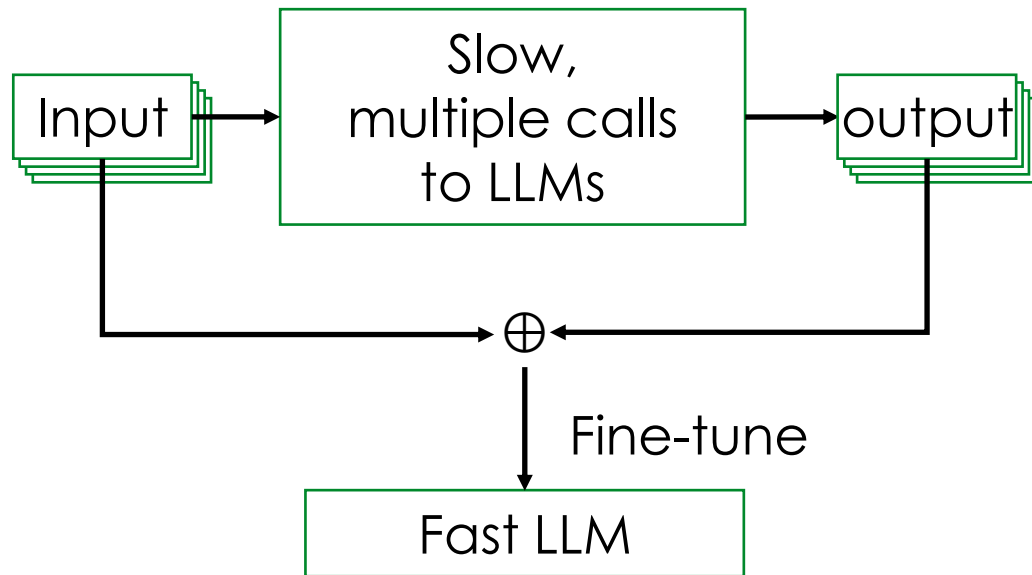
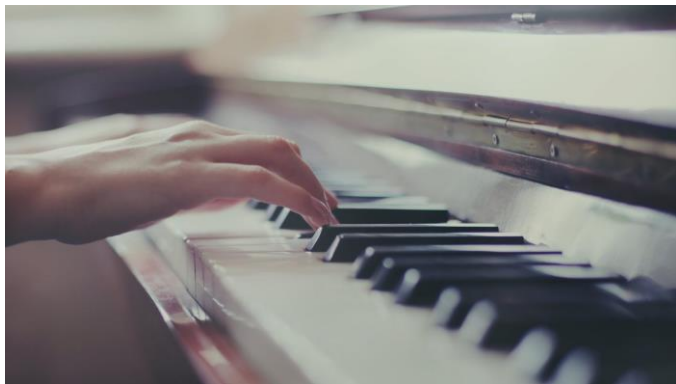
- How to read external knowledge sources?
- How to write by researching the internet?
- ...

How to Look Up Information?

1. Search internet with query
 2. Filter information
 3. Ask GPT
 4. Extract claims
 5. Fact-check each claim
 - Search internet with claim
 - Filter incorrect claim
 6. Draft
 7. Refine
- 

An answer: external references + easy LLM operations

Internalizing a Knowledge Skill



1. Think & play slowly
2. Many Practices
3. Play quickly

Expert AI Architecture



Generative AI (assistants)



Expert AI (autonomous agents)

How to Teach in the Era of LLMs?

How Should We Teach Today?

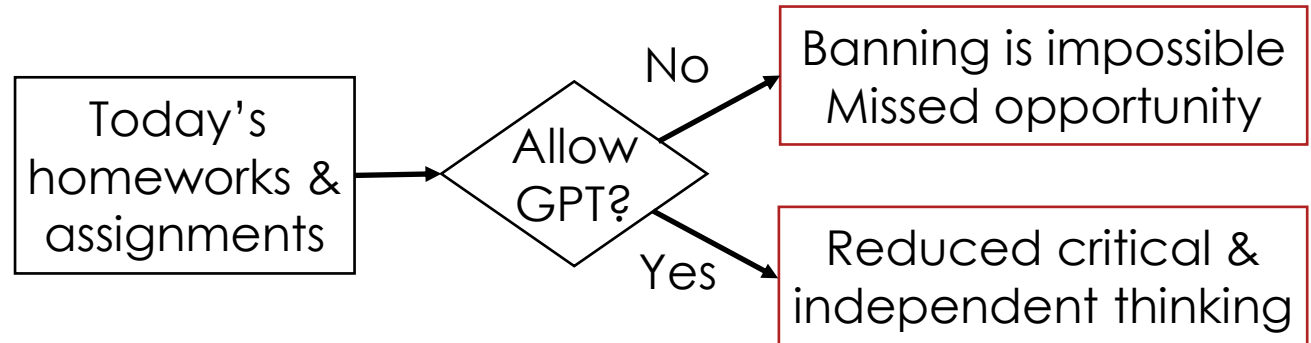
Calculators



- Junior students: must learn basic skills, without using GPT
- Senior students:



Internet Search

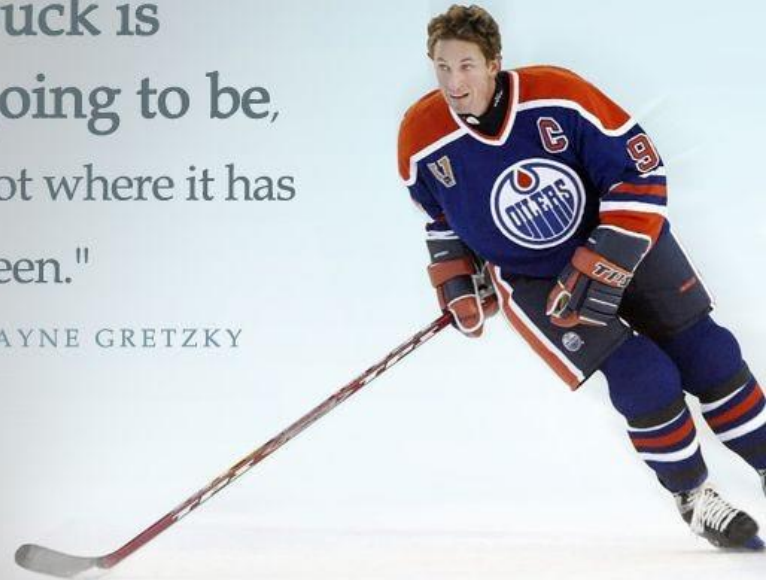


[ChatGPT in the Classroom: Boon or Bane for Physics Students' Academic Performance?](https://www.nytimes.com/2023/01/12/technology/chatgpt-schools-teachers.html)

Preparing Students for the Future

"I skate to
where the
puck is
going to be,
not where it has
been."

WAYNE GRETZKY



Generative AI (assistants)

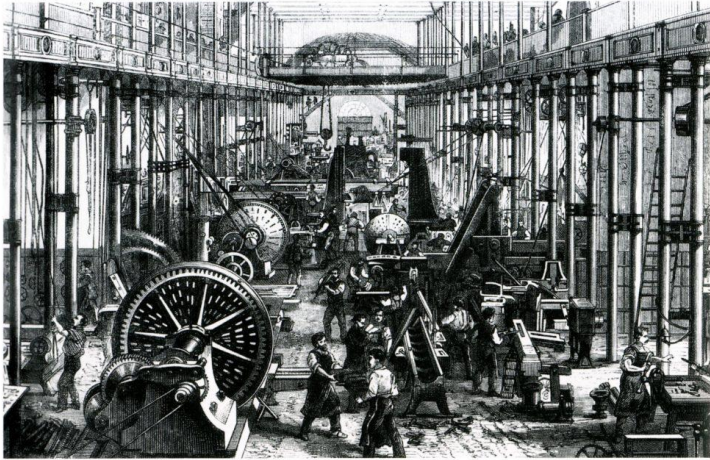


Expert AI (autonomous agents)

Major job disruption!

Reaction: Feeling sorry for today's students

What Did History Teach Us?



- Industrial revolution: Job disruption!
- Labor → knowledge workers
- Few people could read
- Looking back,
who wants to be a laborer?

Lump of Labour Fallacy

The false belief that

*there is a fixed amount of work in the economy,
so if technology increases productivity,
it will reduce the total number of jobs.*

David Frederick Schloss, 1891

Today's Labor Shortage

Professions	Job Shortage
Teachers	69M (global)
Nurses and midwives	31M (global)
Doctors	6.4M (global)
Social workers	74K (US)
Mental health	14-31K (US)
Justice	Lack representation in three-quarters of filed civil cases (US)

Human + new technology can solve societal problems

1. <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5398308/>
<https://pubmed.ncbi.nlm.nih.gov/29540118/>

2 <https://www.medicaleconomics.com/view/across-globe-6-4-million-physicians-needed-in-132-countries-facing-shortages>

3 <https://www.aamc.org/news/press-releases/aamc-report-reinforces-mounting-physician-shortage>

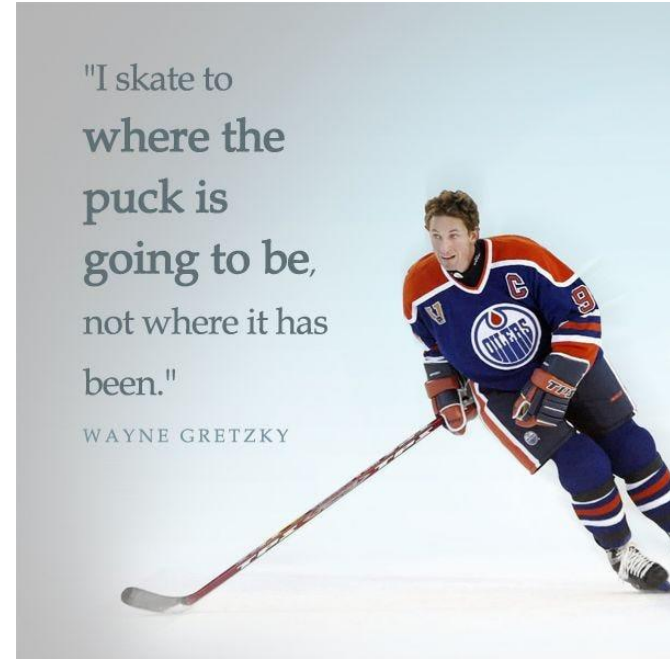
And Many More New Problems ...

- Sustainability for climate change
- Global eldercare cost
 - 269M jobs, 2030
- Cross-culture understanding with multilingual LLMs

Future Work with LLMs

- No more routine 9-to-5 jobs
- We can care for all members of our society, with technology assistance
- Innovation:
Identifying problems & new solutions
- Creativity:
Design, art, literature, craftsmanship

Reaction: Feel sorry for today's adults!



Success Metrics in Cognitive Revolution (CR)

Personal Qualities

1. Curiosity & lifelong learning
2. Ethics and emotional intelligence:
Kind, caring, ethical, personable
3. Human ingenuity, creativity,
exploration, entrepreneurship
4. Confidence & communication
skills

Intellectual Qualities

1. Broad / deep interest
 - Humanity: literature, history
 - STEM (Science, technology, engineering, maths)
 - Pursuit in arts, music, sports,
2. Thinking skills:
Critical, independent, analytical

CR Needs an Education Revolution

- Understanding and not memorization!
 - Today's standardized exams:
GPT aces it but fails in CR metrics
- Fully embrace LLMs to help students acquire skills for the future
 - LLM can give personalized tuition, help brainstorm, write, etc.
 - LLMs can help prepare courses and exams:
"How do you improve the GPT answer to this question ..."

Ambitious Projects & New Evaluation Metrics

Expose students to many experiences
& let them pursue their interests!

- Broad, open-ended projects requiring research
- Competitions of different varieties: STEM, humanities, arts
- Research and discussion of real-world problems
- Real-time group brainstorming and discussion
- Verbal presentations, interactions, and examinations

Conclusion

- LLMs will lead a cognitive revolution
 - Assist and automate many routine work
 - With exciting opportunities to enrich human lives
- Cognitive revolution changes education
 - Teach students to be kind, creative, curious with intellectual breadth and depth