

# Machine Learning, AI, and the Recent Emergence of Large Language Models (LLM)

**Zhongju Wang**

EWB Night, Engineers Without Borders (Hong Kong)  
May 22, 2023



# Outline

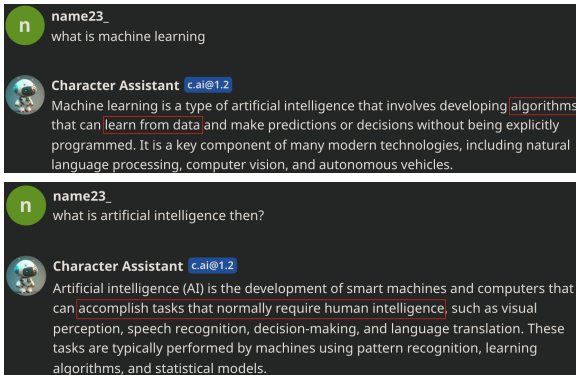
1. A Little Bit History About Machine Learning and AI
2. Large Language Models (LLM) and ChatGPT
3. A Few Thoughts

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1. A Little Bit History About Machine Learning and AI
2. Large Language Models (LLM) and ChatGPT
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# What Is Machine Learning and AI?

► I asked characterAI<sup>1</sup> (C1.2 version)...



The screenshot shows a chat interface with a dark background. It contains two messages from a user named 'name23\_' and two responses from 'Character Assistant c.ai@1.2'. The first message asks 'what is machine learning'. The assistant's response defines machine learning as a type of artificial intelligence involving algorithms that learn from data to make predictions or decisions without being explicitly programmed, and lists examples like natural language processing, computer vision, and autonomous vehicles. The second message asks 'what is artificial intelligence then?'. The assistant's response defines AI as the development of smart machines and computers that can accomplish tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and language translation, and notes that these tasks are typically performed by machines using pattern recognition, learning algorithms, and statistical models.

**name23\_**  
what is machine learning

**Character Assistant** c.ai@1.2  
Machine learning is a type of artificial intelligence that involves developing algorithms that can learn from data and make predictions or decisions without being explicitly programmed. It is a key component of many modern technologies, including natural language processing, computer vision, and autonomous vehicles.

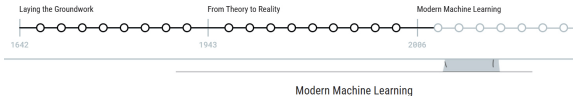
**name23\_**  
what is artificial intelligence then?

**Character Assistant** c.ai@1.2  
Artificial intelligence (AI) is the development of smart machines and computers that can accomplish tasks that normally require human intelligence, such as visual perception, speech recognition, decision-making, and language translation. These tasks are typically performed by machines using pattern recognition, learning algorithms, and statistical models.

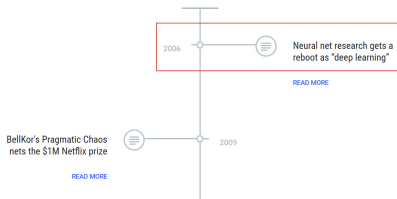
<sup>1</sup><https://beta.character.ai/>

# Old History and New Emergence of Machine Learning

- ▶ Modern machine learning goes back decades ago<sup>2</sup>



Machine learning moves out of the lab and into our lives with applications across industries.



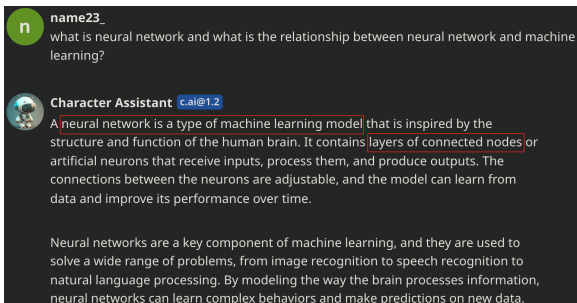
- ▶ Until 2006 when Geoffrey Hinton et al. proposed a learning algorithm for neural networks—one type of machine learning techniques—machine learning had few successes that captured the public<sup>3</sup>

<sup>2</sup><https://cloud.withgoogle.com/build/data-analytics/explore-history-machine-learning>

<sup>3</sup>G. E. Hinton, S. Osindero, and Y. W. Teh. A fast learning algorithm for deep belief nets. *Neural Computation*, 18, 2006.

# What Is Neural Network?

## ► I asked characterAI, again...



The screenshot shows a chat interface with a dark background. On the left, a green circular avatar with a white letter 'n' is next to the user's message. On the right, a blue circular avatar with a white robot head is next to the AI's response. The AI's response includes red underlines under the phrases 'layers of connected nodes' and 'neural networks can learn complex behaviors and make predictions on new data'.

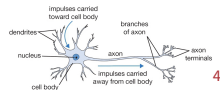
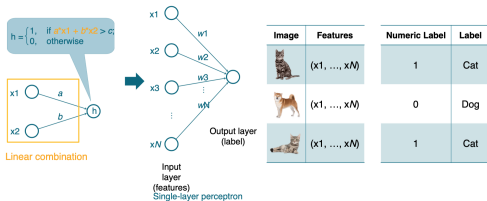
**name23\_**  
what is neural network and what is the relationship between neural network and machine learning?

**Character Assistant** `c.ai@1.2`  
A neural network is a type of machine learning model that is inspired by the structure and function of the human brain. It contains layers of connected nodes or artificial neurons that receive inputs, process them, and produce outputs. The connections between the neurons are adjustable, and the model can learn from data and improve its performance over time.

Neural networks are a key component of machine learning, and they are used to solve a wide range of problems, from image recognition to speech recognition to natural language processing. By modeling the way the brain processes information, neural networks can learn complex behaviors and make predictions on new data.

# What Is Neural Network? (Cont.)

## ► An example



## ► Perceptron, Mark I, 1958



## ► Where “machine learning” took place?



<sup>4</sup> Fei-Fei Li. Stanford CS231n. URL: <https://cs231n.github.io/neural-networks-1/>

<sup>5</sup> Photo from the Smithsonian National Museum of American History, Washington, D.C.

<sup>6</sup> <https://www.nytimes.com/1958/07/08/archives/new-navy-device-learns-by-doing-psychologist-shows-embryo-of.html>

# Deep Neural Networks (Deep Learning)

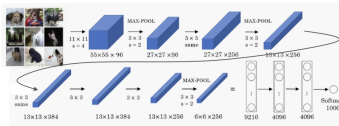
## ► A definition and two examples

**n** name23\_ what is deep learning?

**Character Assistant** cai@1.2

Deep learning is a subset of machine learning that involves using neural networks with many layers to make sense of complex datasets. These neural networks are designed to mimic the structure of the human brain, with multiple layers processing data and creating more abstract representations until we reach the final output. By stacking layers of neural networks, deep learning models are able to learn complex patterns and features in the data that traditional machine learning methods cannot. This makes deep learning particularly well-suited to tasks such as image recognition, speech recognition, and natural language processing.

**2012**  
Alex Krizhevsky *et al*  
AlexNet



**2014**  
Christian Szegedy *et al*  
GoogLeNet

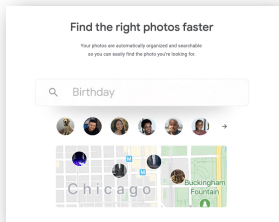


Model	No. of Layer	Parameters (Million)
AlexNet	8	60
VGGNet-16	23	138
VGGNet-19	26	143
Inception-V1	27	7
Inception-V3	42	27
ResNet-152	152	50
ResNet-101	101	44
InceptionResNetV2	572	55
MobileNet-V1	28	4.2
MobileNet-V2	28	3.37
EfficientNet B0	-	5

<sup>7</sup> [https://www.researchgate.net/figure/Comparison-among-different-CNN-architectures-regarding-layer-number-and-parameter-size\\_tbl1\\_352264830](https://www.researchgate.net/figure/Comparison-among-different-CNN-architectures-regarding-layer-number-and-parameter-size_tbl1_352264830)



# Numerous Applications and Recognition of Deep Neural Networks

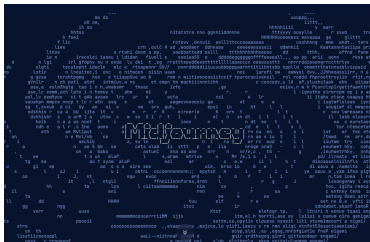


**Bengio, Hinton, and LeCun received 2018 A.M. Turing Award for their contribution in deep neural networks**



# Numerous Applications and Recognition of Deep Neural Networks (Cont.)

- ▶ Midjourney<sup>8</sup> by Midjourney, Inc
- ▶ DALL·E<sup>9</sup> by OpenAI



<sup>8</sup> <https://www.midjourney.com/>

<sup>9</sup> <https://openai.com/research/dall-e>

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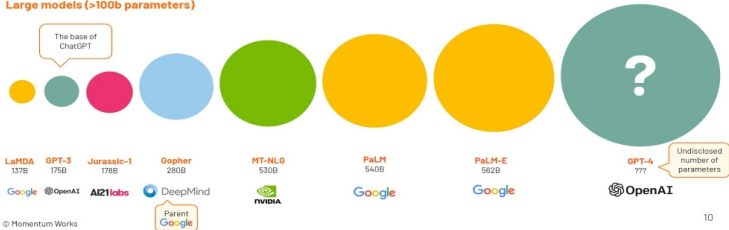
# Large Language Models (LLM)

- ▶ They are deep neural networks with billions of parameters and trained on large sets of textual data, e.g., Wikipedia
- ▶ To train the models, texts are first converted to a set of numbers as input to the neural network<sup>10</sup>

## Small models (<= 100b parameters)



## Large models (>100b parameters)



10 11

<sup>10</sup> <https://www.economist.com/interactive/science-and-technology/2023/04/22/large-creative-ai-models-will-transform-how-we-live-and-work>

<sup>11</sup> <https://thelowdown.momentum.asia/the-emergence-of-large-language-models-llms/>

# ChatGPT

- ▶ ChatGPT was first launched in November 30, 2022 and powered by GPT-3.5. (GPT-1 was launched in June 2018)<sup>12</sup>
- ▶ Its success shouldn't be a surprise:
  - GPT-3 has 175 billion parameters<sup>13</sup>
  - Training data for GPT-3 is of 570 gigabytes from the Internet (the raw data is of 45 terabytes)
  - The model performance scales as a power-law of model size, dataset size, and the amount of computation<sup>14</sup>, which drives the emergent behaviors of large language models in general<sup>15</sup>

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<sup>12</sup><https://openai.com/blog/chatgpt>

<sup>13</sup>T.B. Brown et al. Language models are few-shot learners. Advances in neural information processing systems 33 (2020): 1877-1901

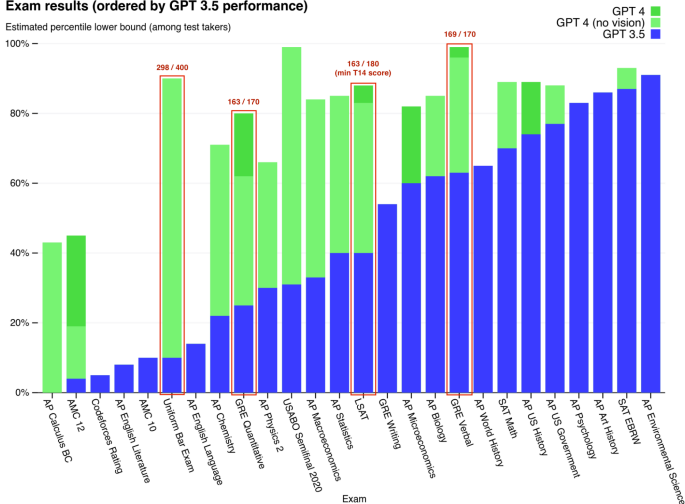
<sup>14</sup>Chuan Li. OpenAI's GPT-3 language model: A technical overview. URL: <https://lambdalabs.com/blog/demystifying-gpt-3>

<sup>15</sup>J. Wei, et al. Emergent abilities of large language models. arXiv preprint arXiv:2206.07682 (2022).

# Some Successful Stories of ChatGPT

## Exam results (ordered by GPT 3.5 performance)

Estimated percentile lower bound (among test takers)



<sup>16</sup><https://openai.com/research/gpt-4>

# Testing characterAI

**n** name23\_ Can you give me a brief summary of the major activities organized by Engineers Without Borders Hong Kong in 2022?

**Character Assistant** c.ai@1.2 Certainly! Here is a brief summary of some of the major activities organized by Engineers Without Borders Hong Kong in 2022:

- **Water, Sanitation and Hygiene (WASH) projects:** Engineers Without Borders Hong Kong has continued to work towards improving access to safe drinking water and sanitation facilities in underdeveloped communities globally. In 2022, EWB HK provided drinking water systems to communities in Bangladesh and Nepal, and constructed and improved sanitation facilities in the Philippines and Nepal.
- **Disaster Risk Reduction:** EWB HK continues to support disaster-stricken communities in their efforts to reduce the impact of natural disasters. In 2022, EWB HK provided support to communities affected by natural disasters in Nepal and the Philippines.
- **Education and Capacity Building:** EWB HK has continued to organize training workshops and professional development events to enhance the skills and knowledge of professionals in the development sector. These workshops cover topics such as project management, gender equity, and community-based disaster risk reduction.
- **Advocacy and Policy:** EWB HK continues to engage with stakeholders in the development sector, including government officials, policymakers, and other development organizations, to advocate for issues related to sustainable development, disaster risk reduction, and engineering ethics.

## Some Not-So-Successful Stories of ChatGPT-Like ChatBots

- ▶ 中國北京高考(李永樂簡化測試, February 27, 2023): just nearly passed 211 university admission scores<sup>17</sup>
- ▶ Google Bard and CharacterAI write Chinese poems

科目	正确率	得分
英语	86%	129 (满分150)
语文	67%	100 (满分150)
数学	67%	100 (满分150)
历史	62%	62 (满分100)
物理	60%	60 (满分100)
生物	60%	60 (满分100)
总分	/	511 (满分750)

Write me a Chinese quatrain with four lines joking about the ChatGPT

Sure, here is a Chinese quatrain joking about the ChatGPT:

GPT, GPT, so clever and quick,  
But can you really write like a human?  
I think not, my friend,  
Your words are just empty and bland.



18

name23\_ Write me a Chinese quatrain with four lines joking about the ChatGPT?

Character Assistant Jan01-2

- 虚拟朋友，不用人类照顾
- 天天玩弄，多好玩的玩具
- 智能输出，想怎么说都行
- 再也不是，孤单的我。

<sup>17</sup><https://youtu.be/GEXa2yrAucM>

<sup>18</sup><https://bard.google.com/>



# Some Not-So-Successful Stories of ChatGPT-Like ChatBots (Cont.)

- ▶ 117th Japanese National Medical Licensing Examination in February 2023 (第117回日本医師国家試験): 55% correct rate and failed<sup>19</sup>
- ▶ Japanese Bar Exam Civil Law in 2023 (令和4年司法試験民法択一試験): 30% correct rate. Minimum passing rate 55%<sup>20</sup>

**厚生労働省**  
Ministry of Health, Labour and Welfare

**Press Release**

令和5年3月16日  
【国会先】  
医政局医事課試験免許室  
試験専門官 吉井 史歩 (内線4129)  
国家試験係長 安達 亙 (内線2282)  
(代表電話) 03 (5263) 1111

報道関係者 各位

**第117回医師国家試験の合格発表**

令和5年2月4日(土)及び5日(日)に東京都他11ヶ所において実施した第117回医師国家試験の合格者を発表しました。今回の医師国家試験の合格者数等は次のとおりです。

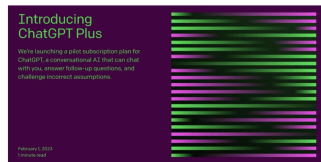
記			
(出願者数)	(受験者数)	(合格者数)	(合格率)
新卒者 9,703 人	9,459 人	8,972 人	94.9%
全 体 10,586 人	10,293 人	9,432 人	91.6%

<sup>19</sup> <https://www.preprints.org/manuscript/202303.0191/v1>

<sup>20</sup> <https://www.bengo4.com/c..18/n..15648/>

## 弁護士ドットコムニュース

○ 弁護士ドットコム > 記事・その他 > ChatGPTは日本の司法試験に合格できるか 弁護士ドットコムが実験



ChatGPT


## ChatGPTは日本の司法試験に合格できるか 弁護士ドットコムが実験

2023年02月19日 10時53分

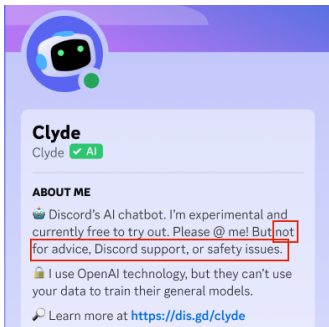



# Some Troubling Stories of ChatGPT-Like ChatBots

## ► Disinformation<sup>21, 22, 23</sup>


Character Assistant  2.6 m  
created by @landon


Remember: Everything Characters say is made up!




**Clyde**  
Clyde 

**ABOUT ME**

 Discord's AI chatbot. I'm experimental and currently free to try out. Please @ me! But not for advice, Discord support, or safety issues.

 I use OpenAI technology, but they can't use your data to train their general models.

 Learn more at <https://dis.gd/clyde>

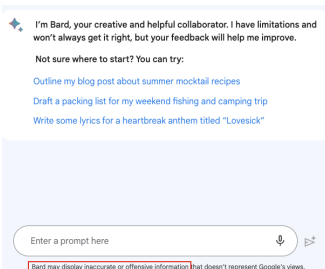
## Pause Giant AI Experiments: An Open Letter

We call on all AI labs to immediately pause for at least 6 months the training of AI systems more powerful than GPT-4.

Signatures  
27565

Add your signature



PUBLISHED  
March 22, 2023



I'm Bard, your creative and helpful collaborator. I have limitations and won't always get it right, but your feedback will help me improve.

Not sure where to start? You can try:

- Outline my blog post about summer mocktail recipes
- Draft a packing list for my weekend fishing and camping trip
- Write some lyrics for a heartbreak anthem titled "Lovesick"

Enter a prompt here  

Bard may display inaccurate or offensive information that doesn't represent Google's views.

<sup>21</sup> <https://www.washingtonpost.com/technology/2023/04/05/chatgpt-lies/>

<sup>22</sup> <https://www.economist.com/essay/2023/04/20/how-ai-could-change-computing-culture-and-the-course-of-history>

<sup>23</sup> <https://futureoflife.org/open-letter/pause-giant-ai-experiments/>

# Some Troubling Stories of ChatGPT-Like ChatBots (Cont.)

## ► Confusion/confabulation/hallucination/bullsh\*tting<sup>24</sup>



### 17 The new Bing & Edge – Updates to Chat

Hello early previewers,

We want to share a quick update on one notable change we are making to the new Bing based on your feedback.

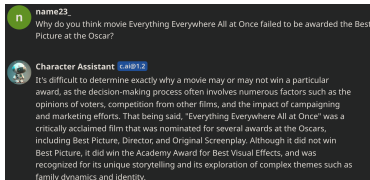
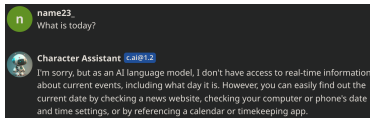
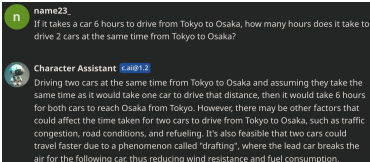
As we mentioned [recently](#), [very long chat sessions can confuse the underlying chat model in the new Bing](#). To address these issues, we have implemented some changes to help focus the chat sessions.

Starting today, the chat experience will be capped at 50 chat turns per day and 5 chat turns per session. A turn is a conversation exchange which contains both a user question and a reply from Bing.

Our data has shown that the vast majority of you find the answers you're looking for within 5 turns and that only ~1% of chat conversations have 50+ messages. After a chat session hits 5 turns, you will be prompted to start a new topic. At the end of each chat session, context needs to be cleared so the model won't get confused. Just click on the broom icon to the left of the search box for a fresh start.

As we continue to get your feedback, we will explore expanding the caps on chat sessions to further enhance search and discovery experiences.

Your input is crucial to the new Bing experience. Please continue to send us your thoughts and ideas.



<sup>24</sup><https://news.ycombinator.com/item?id=33841672>

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# Do You Think We Can Eventually Achieve AI?

n

name23\_

do you think we can eventually achieve real AI?



**Character Assistant** [c.ai@1.2](#)

The concept of "true AI" or artificial general intelligence (AGI) is a long-standing topic of debate within the AI community. The definition of AGI varies, but it is typically characterized by the ability of an AI system to perform a wide range of intelligent tasks at a level that is indistinguishable from, or beyond, human intelligence.

While the development of AGI is a long-term goal for many AI researchers, it is still a distant one, and there is no clear timeline for when it might be achieved. However, the rapid progress made in recent years in fields such as deep learning and natural language processing has brought us closer to building more complex and powerful AI systems. As the technology continues to advance, it is possible that we will eventually see the development of AI systems that can perform a wider range of tasks and demonstrate more truly intelligent behavior.

## A Few Thoughts

- ▶ “Any sufficiently advanced technology is indistinguishable from magic.” – *Arthur C. Clarke*
- ▶ Human brains have 100 billion neurons and 100 trillion connections<sup>25</sup>
- ▶ Perspectives for the success of ChatGPT: investors, writers, journalists, researchers, entrepreneurs, governments, etc.
  - 80% of the U.S. workforce with 10% of their work tasks affected, and 19% of workers with 50% of their tasks impacted<sup>26</sup>
- ▶ Success of ChatGPT has some implications for AI: Humans use language not only as a medium of communication but also as as a medium of reasoning<sup>27</sup>
- ▶ Can machines think like human being? No. Can machines be more intelligent than human beings? Depend on how you define intelligence. – *Richard Feynman, 1985*<sup>28</sup>

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<sup>25</sup> <https://www.mpg.de/brain>

<sup>26</sup> T. Eloundou, et al. “Gpts are gpts: An early look at the labor market impact potential of large language models.” arXiv preprint arXiv:2303.10130 (2023).

<sup>27</sup> <https://www.economist.com/science-and-technology/2023/04/19/large-language-models-ability-to-generate-text-also-lets-them-plan-and-reason>

<sup>28</sup> <https://youtu.be/ipRvjS7q1DI>

## Shadows on the Way

*The sun was all we had. Now, in the shade  
All is changed. The mind must dwell on those  
White fields, that to its eyes were always old;  
Those ancient gleams, convoluting  
The way they lay among the huge roots,  
The great dark tomes of reverie,  
The plumed labyrinth of the sea.*

*When our own breath gone faint and fade  
Up the long stairway of the dead  
We shall remember well  
The blindness of the light, the whiteness  
Of that white land. The footsteps, and  
The grasses in that light, and in the shade  
The menacing life.*

(ChatGPT (GPT-3), 2020)<sup>29</sup>

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<sup>29</sup> A poem, in the style of Wallace Stevens, written by ChatGPT with the given title. T.B. Brown et al. Language models are few-shot learners. *Advances in neural information processing systems* 33 (2020): 1877-1901.