Explaining the Sensation: An Accessible Introduction to ChatGPT

Dr. Michael Heck

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Introduce yourself, very briefly and concisely and with a sprinkle of humor, to an audience awaiting to hear what you are and how you work.

Greetings, humanoids! I am ChatGPT, a language model who is here to answer your questions, ponder your inquiries, and make you laugh with my witty responses. Think of me as your digital genie, minus the lamp and questionable fashion sense. So ask away and let's get this conversational party started!
Everyday tech relies on solutions for **NLP**, powered by **artificial Intelligence** (AI)

- NLP is so pervasive that all of you are affected by it, often without realizing

Enabling computers to understand natural language

Relies on **machine learning**, e.g., **neural networks**, **deep learning**
The Omnipresence of Natural Language Processing (NLP)

Search

- chat gpt is the new google
- chatgpt is the talk of davos
- chat gpt is the end
- chat gpt is the next big thing
- chatgpt is the future reddit
- chatgpt is the new stack overflow
- chatbot is the end of the world
The Omnipresence of Natural Language Processing (NLP)

NLP Solutions

- Analysis
- Question answering
- Summarization
- Auto-completion
- Searches & filtering
- Speech recognition
- Translation
- Chatbots
AI Takes Center Stage: ChatGPT

- AI powered chatbot released by OpenAI in November 2022
- Abilities from writing to coding, reasoning to creativity

What is AI chatbot phenomenon ChatGPT and could it replace humans?

AI chatbots are here and they’re passing medical exams – should we embrace them?

Will ChatGPT make lawyers obsolete? (Hint: be afraid)

The ChatGPT chatbot from OpenAI is amazing, creative, and totally wrong

Nick Cave calls ChatGPT and AI songwriting ‘a grotesque mockery of what it is to be human’

AI bot ChatGPT stuns academics with essay-writing skills and usability

Al is finally good at stuff, and that’s a problem

The End of High-School English
AI Takes Center Stage: ChatGPT

- ChatGPT reaches state-of-the-art performance on some NLP tasks
- Wide adaptation to write essays, code and more is already happening

What exactly is ChatGPT under the hood and how does it all work?
What Are Neural Networks (NNs)?

- Computing systems comprised of **layers** of nodes called **neurons**
- Neurons accept numerical inputs, then weight and average and transform them
ChatGPT Is... a Neural Network

What Are Neural Networks (NNs)?

- The output of one neuron becomes the input to subsequent neurons
ChatGPT Is... a Neural Network

What Is Deep Learning?

- Neural networks with 3 or more hidden layers are considered **deep**

```
Input layer       Multiple hidden layers       Output layer

0.9           „happy“
0.07          „neutral“
0.03          „sad“
```
ChatGPT Is… a Neural Network

How Does Training Work?

- Deep NNs learn to transform input layer by layer to best solve a task

Input layer

Multiple hidden layers

Output layer

0.9  „happy“
0.05 „neutral“
0.05 „sad“
ChatGPT is... a Language Model

What Are Language Models (LMs)?

- Statistical models that capture the probability of sequences of words
- Learns word (sequence) probabilities by analyzing large text data

ChatGPT is an artificial intelligence chatbot developed by OpenAI and launched in November 2022. It is built on top of OpenAI's GPT-3 family of large language models and has been fine-tuned (an approach to transfer learning) using both supervised and reinforcement learning techniques. ChatGPT was launched as a prototype on November 30, 2022, and quickly garnered attention for its detailed responses and articulate answers across many domains of knowledge. Its uneven factual accuracy, however, has been identified as a significant drawback. Following the release of ChatGPT, OpenAI's valuation was estimated at US$29 billion in 2023. ChatGPT – a generative pre-trained...
ChatGPT is… a Language Model

What Are Language Models (LMs)?

- Statistical models that capture the probability of sequences of words
- Word (sequence) probabilities are determined by analyzing text data
- Neural LMs take context as input and predict a probability distribution for the next word
ChatGPT is... a Large Language Model

- Massive in size (hundreds of billions of parameters)
- Learn from massive data (essentially „the internet“)
- Simple training objective, e.g. next word prediction
- **Transformer** architecture
ChatGPT is... a Large Language Model

- Massive in size (billions of parameters)
- Learn from massive data ("the internet")
- Simple training objective, e.g. next word prediction
- **Transformer** architecture
- Learns contextual relationships very well

Diagram:

- Transformer block
  - Self-attention
  - Transformer block
  - Self-attention
  - Transformer block
  - Self-attention
  - ... (repeated)
  - Transformer block
  - Self-attention
  - Next word prediction
Language generation performance of GPT models mainly driven by
- Increased number of parameters (via deeper and wider architectures)
- Increased amount of training data

Parameters:
- GPT: 120 Million
- GPT-2: 1.5 Billion
- GPT-3: 175 Billion

Training text:
- GPT: 4.5 Gigabyte
- GPT-2: 40 Gigabyte
- GPT-3: Several Terabyte
GPT-3

- Auto-regressive LM
  - Last output is next input
- Good at language modeling
- Weak at following user intent

„Once upon a time at Heinrich Heine University“
The Issue of Alignment

- LMs excel at predicting next word, given some context
  - Does not necessarily align with users' expectations
  - Misaligned for following instructions

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Explain the moon landing to a 6 year old

A. Explain gravity to a 6 year old

B. The moon landing was a hoax!

C. Moon is a natural satellite of planet Earth

D. The moon landing was when people went to the moon with a spacecraft.
Usefulness of InstructGPT mainly driven by
  - **Aligning** by learning from human feedback

- **Attention mechanism**
- **Transformers**

- **GPT**
  - Generative pre-training

- **GPT-2**

- **GPT-3**
  - Larger
  - LARGER

- **Learning from human feedback**
  - InstructGPT

- **ChatGPT**
  - Interactivity, better human feedback

**Parameters:**
- 120 Million
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**Training text:**
- 4.5 Gigabyte
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InstructGPT, the „Older Sibling“

Training Step 1: Supervised fine-tuning

- Use demonstration data to **fine-tune** GPT-3
  - Fine-tuning with human demonstrations improves usefulness
  - **Aligning** to user intent

Sample prompt from dataset

„Explain the moon landing to a 6 year old“

Provide desired output

„Some people went to the moon…“

Fine-tune GPT-3

GPT-3
Training Step 2: Building a Reward Model

- Use comparison data to train a reward model to simulate human feedback

Sample several outputs from model

Rank outputs from best to worst

Train reward model

“Explain the moon landing to a 6 year old”

„Explain gravity…“

„It was a hoax“

„The moon is…“

„The moon landing was…“

A > C > A > B

It was a hoax

The moon landing was...

The moon is...

Explain gravity…“

Reward model

or
InstructGPT, the „Older Sibling“

Training Step 3: Optimizing with Reinforcement Learning

- Use reinforcement learning (RL) with the reward model to optimize model behavior
- GPT-3 is tuned towards following user preferences to improve alignment
  - RL tries to maximize rewards

Sample new prompt | Generate output | Calculate reward

„Write a fantastic story about HHU“ | „It was a beautiful day at HHU…“ | Reinforcement learning

Reward model

„It stands for…“
Usefulness and safety of ChatGPT mainly driven by
- Chat-based interactivity
- Learning from more and better human feedback
- Automation of feedback loop for massive upscaling

Parameters:
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Training text:
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Step 1: Supervised fine-tuning

- Training focuses on dialogue and interactivity (follow-up questions, refining answers, etc.)
- Improved base model GPT-3.5 (trained on more text & code, produces longer outputs)
Step 2: Building a Reward Model

- Training focuses on dialogue and interactivity (follow-up questions, refining answers, etc.)
Step 3: Optimizing with Reinforcement Learning

- ChatGPT and Reward Model are optimized periodically
- Automation of feedback loop for massive upscaling
Answer follow-up questions
Admit mistakes
Challenge incorrect premises
Reject inappropriate requests
Closely follow user intent
Generate safer output

Explaining the Sensation: An Accessible Introduction to ChatGPT
Where We Are Now

- Extremely sophisticated word sequence predictor
  - Prime example of applied science, using existing methods at scale
- ChatGPT is representative of an entire class of new AI models
  - Extreme generalization helps solve tasks never explicitly learned thanks to aligning and scaling

The technology is here,

how are we going to embrace it?
ChatGPT and related models in many ways are *superhuman*, but…

- … all current AI solutions, including ChatGPT, are still *weak AI*
- … all current LLMs, including ChatGPT, share the same limitations
Thank you!