

# Large Language Models

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# What is LLM

## Large Language Model

- A mathematical model that generates text
- The model produces a list of possible next words

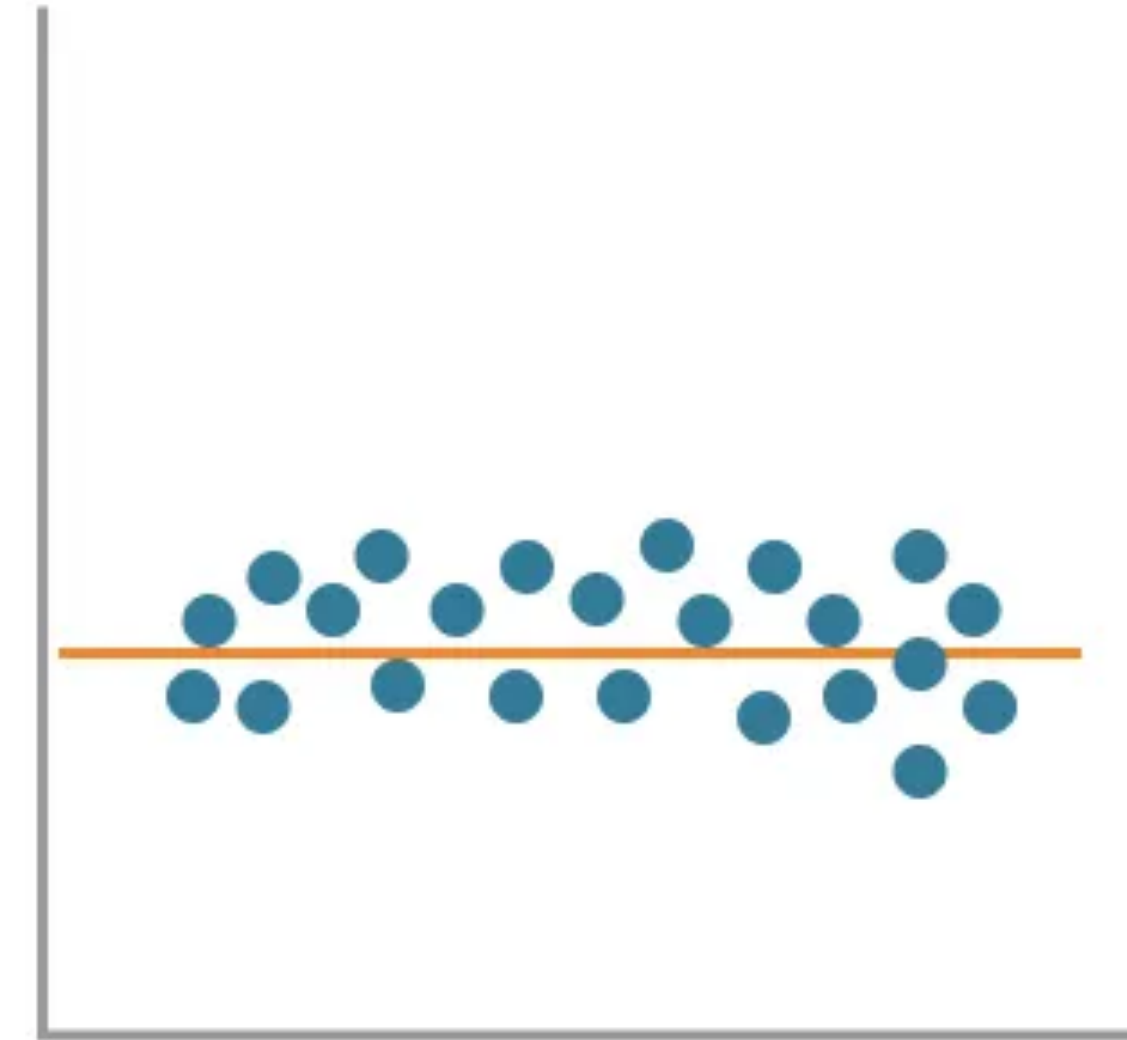
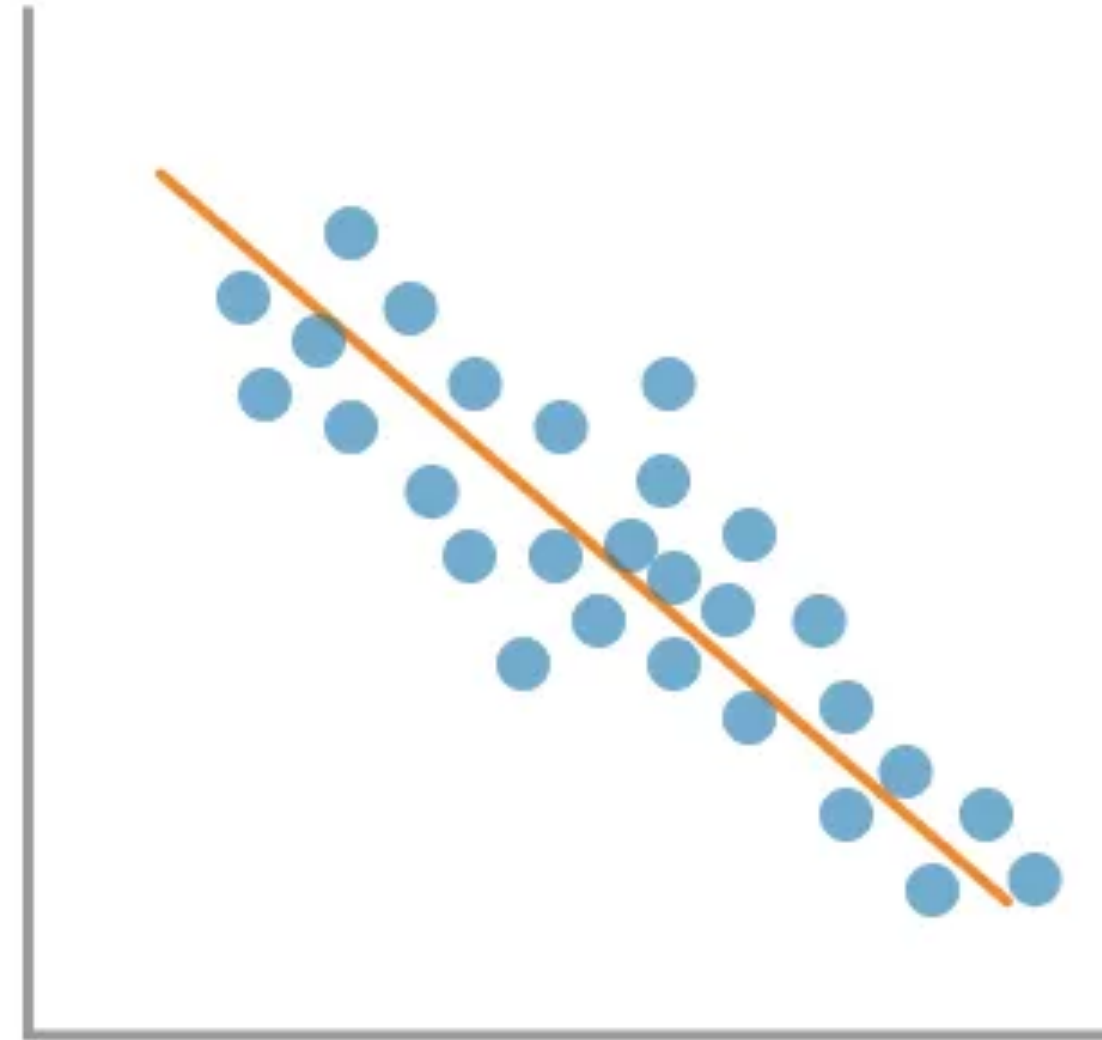
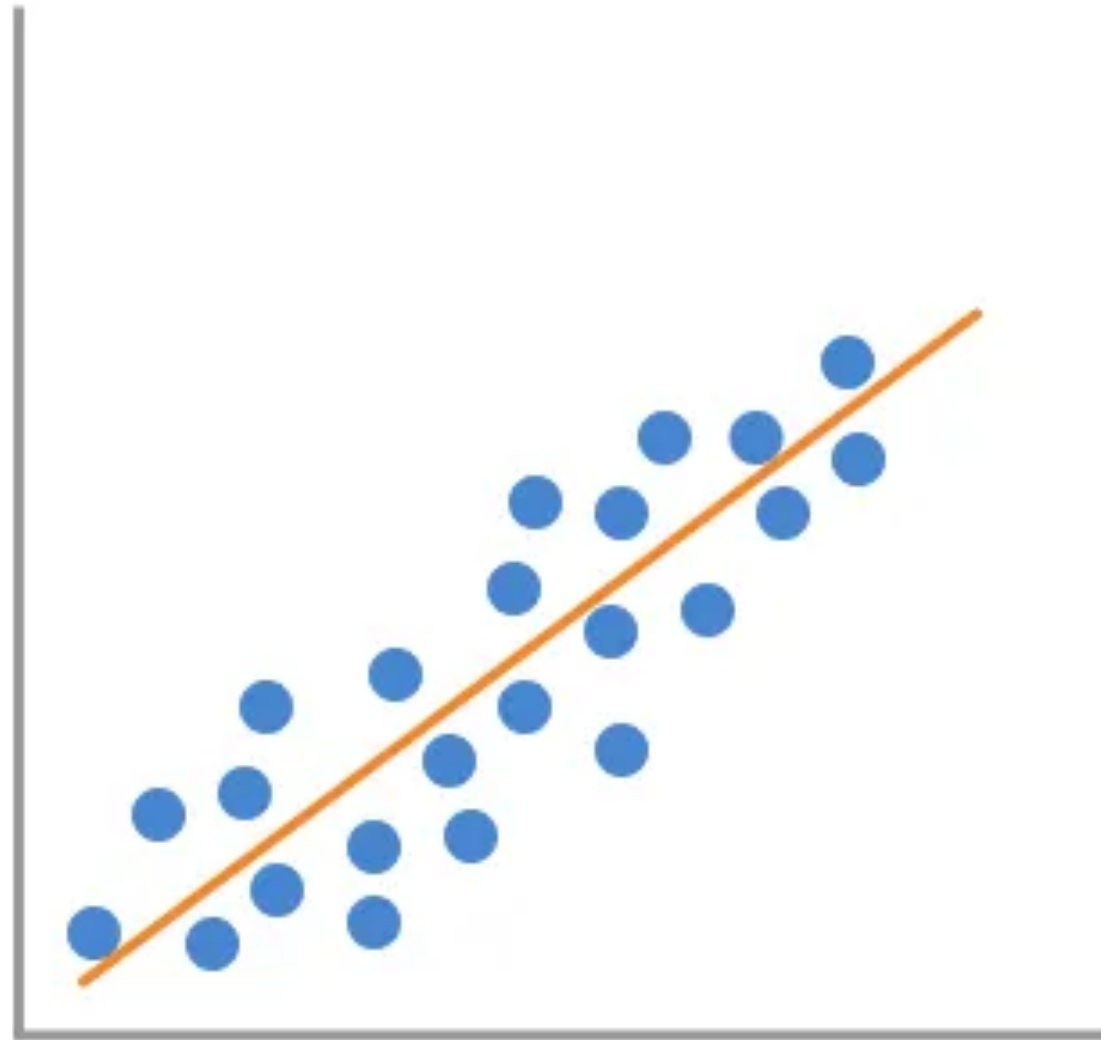
The quick brown fox jumps over the lazy —

{ dog 0.91  
cat 0.88  
box 0.70  
cart 0.65  
mat 0.60  
...

# Large Language Models

## Large number of parameters

- Besides the size of the training data, the other large quantity in these models is the number of parameters they have, each one with the possibility of being adjusted (tuned)
- Linear Regression has two parameters  $y = ax + b$  ( $a$  = slope,  $b$  = intercept)

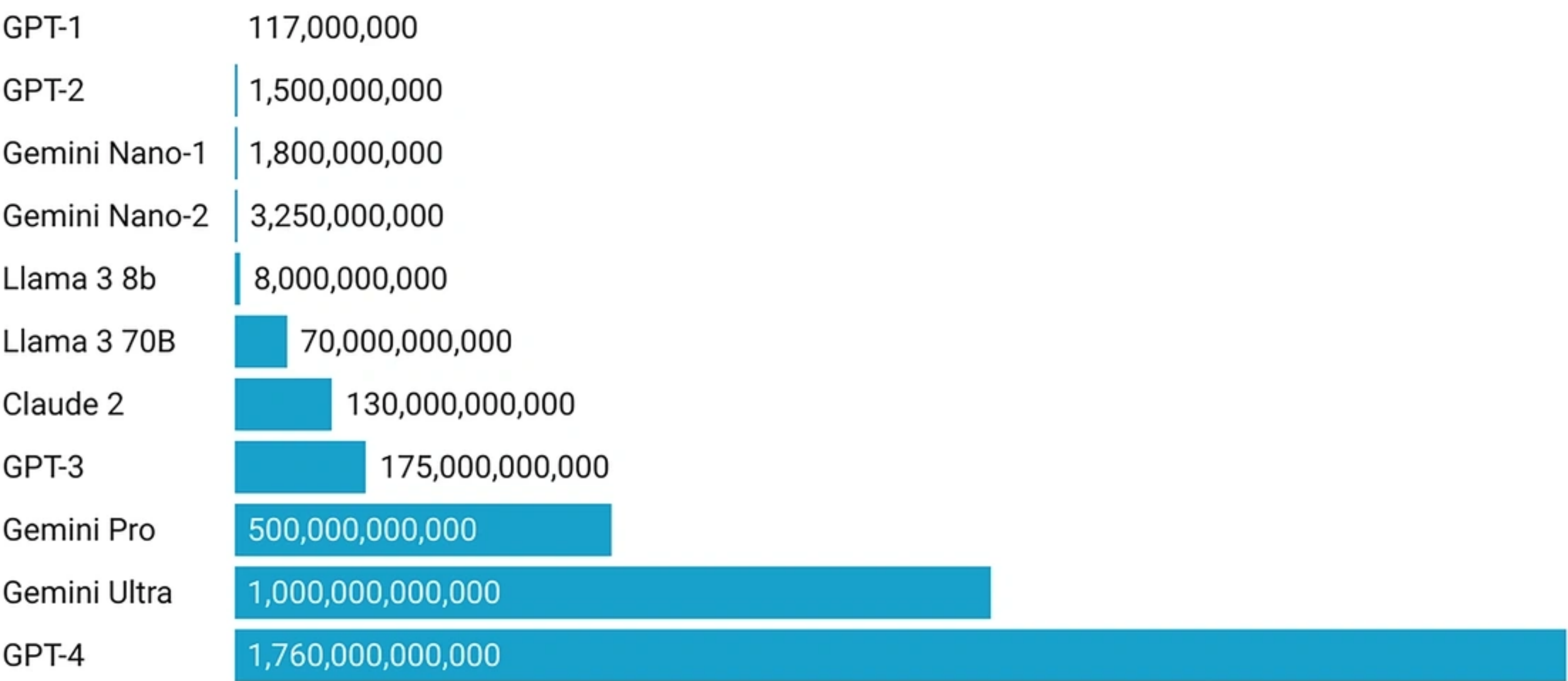


# Large Language Models

## Large number of parameters

### Parameters in Selected AI Models

Some of these figures are estimates. Newer models are many times larger than their predecessors.



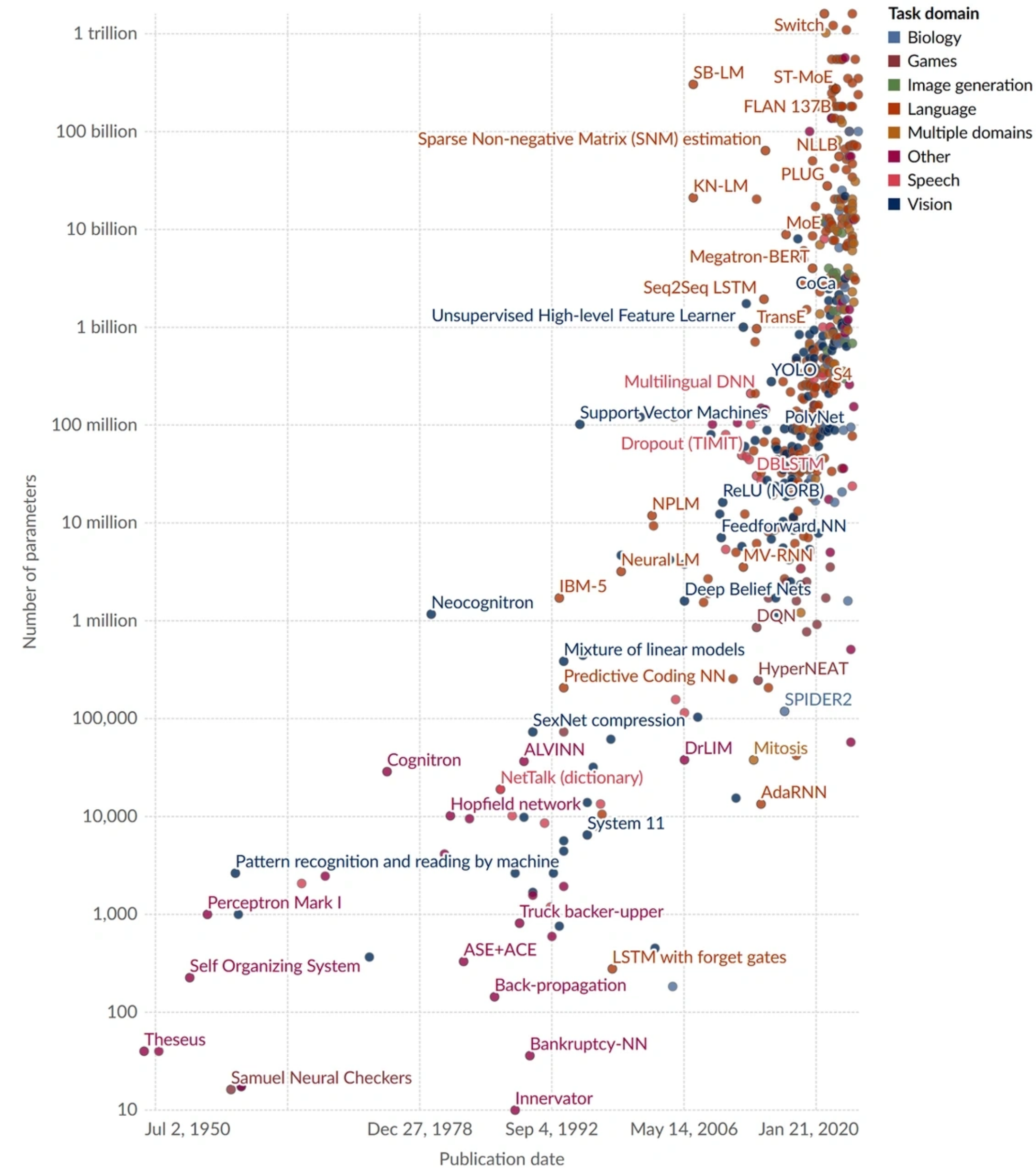


# Pre-training

- Billions of parameters all start with random values, at the beginning of the training process
- Backpropagation tweaks and adjusts these parameters

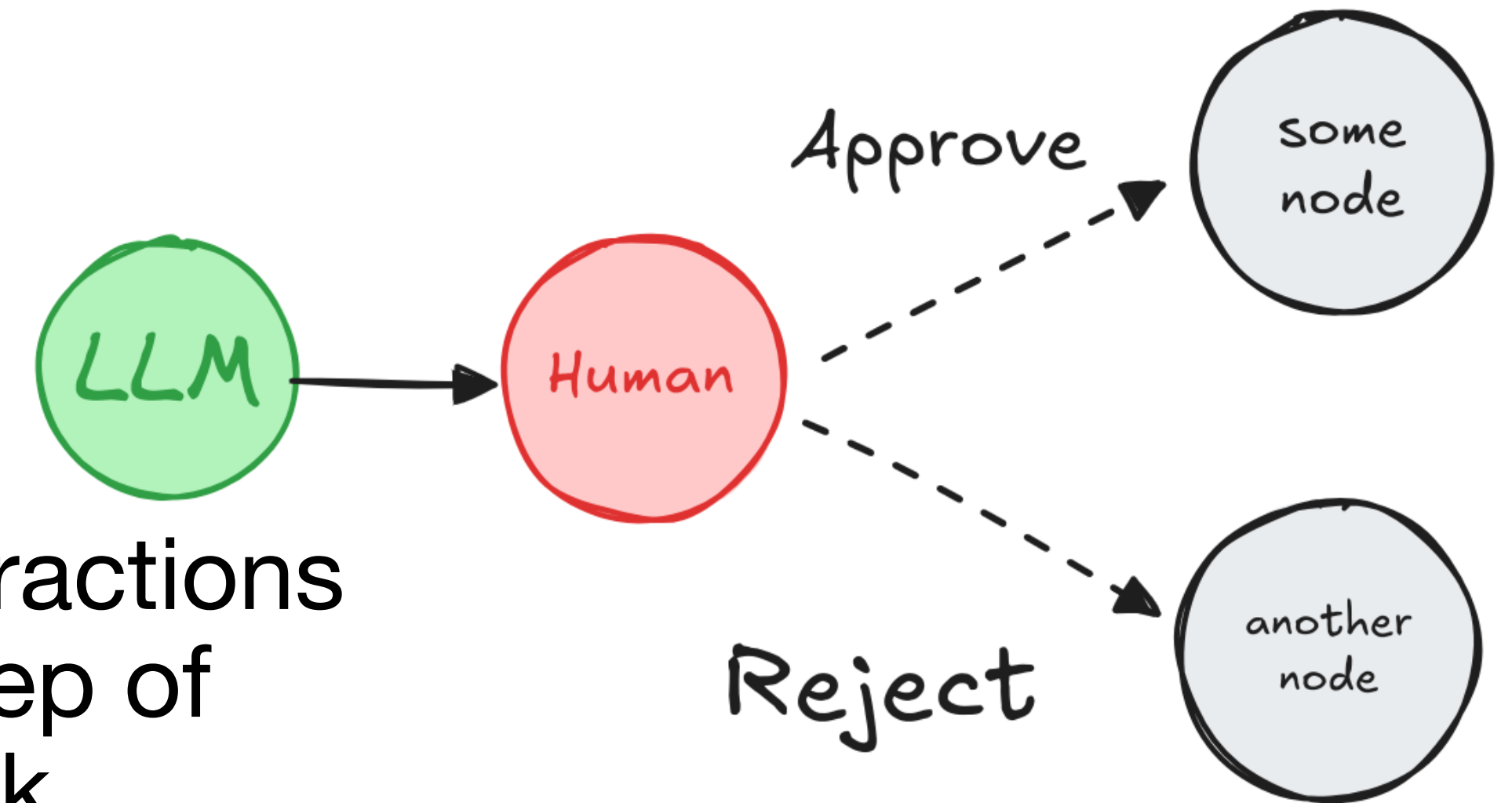
## Parameters in notable artificial intelligence systems

Parameters are variables in an AI system whose values are adjusted during training to establish how input data gets transformed into the desired output; for example, the connection weights in an artificial neural network.




# RL with human Feedback

- In order for the model to have really good interactions with a human, the LLM has to go through a step of Reinforcement learning with Human Feedback



How do I write confident emails to my colleagues and other professionals?

You're giving feedback on a new version of ChatGPT.  
Which response do you prefer? Responses may take a moment to load.


 Response 1

Writing confident emails to colleagues and other professionals is all about being clear, concise, and professional while maintaining a positive tone. Here are some key tips to help you craft emails that convey confidence:

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**1. Start with a Clear Subject Line**

- Be specific and direct about the purpose of your email.
- Example:
  - ✓ "Project Update: Milestone 2 Completed"
  - ✗ "Quick Question"

 Response 2

Writing confident emails is about striking a balance between professionalism, clarity, and assertiveness. Here's a simple guide to help you craft emails that leave a strong impression:

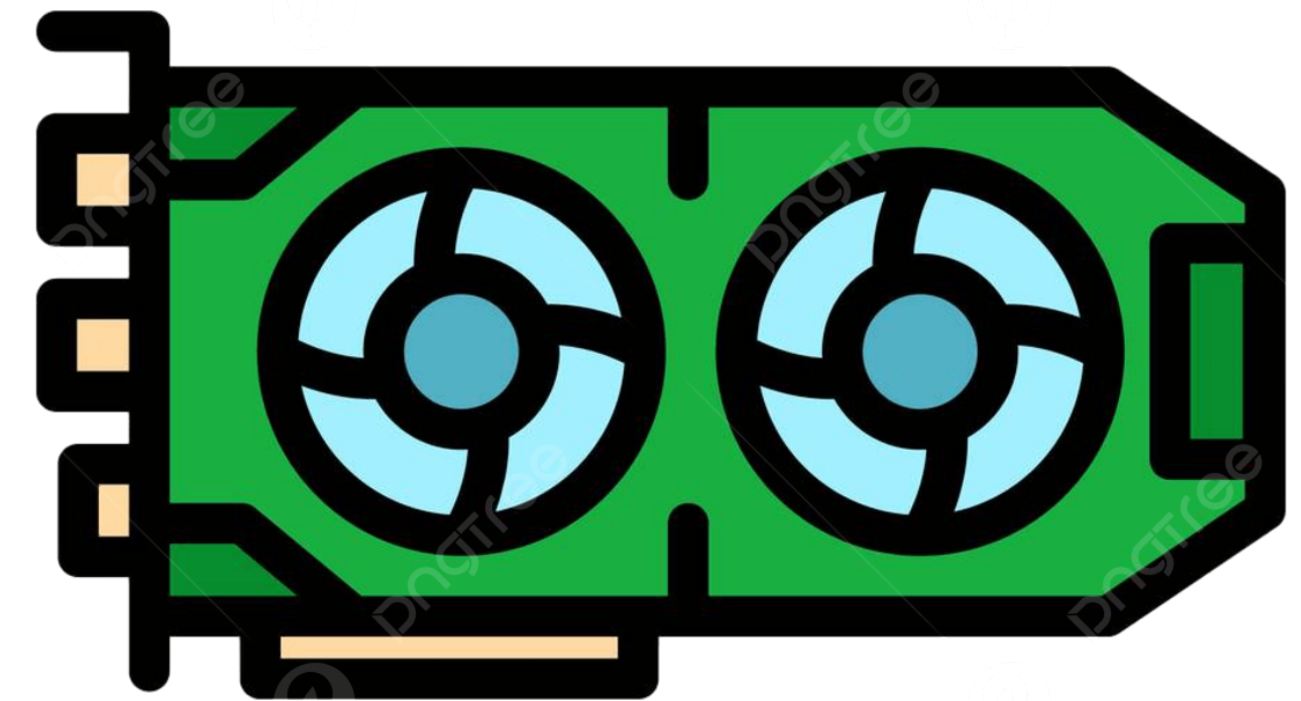
- 1. Start with a Clear Subject Line:**  
Keep it concise and relevant so the recipient knows what the email is about at a glance.
- 2. Use a Polite Yet Direct Greeting:**  
Address the recipient respectfully (e.g., "Hi [Name]," or "Dear [Name],").
- 3. State Your Purpose Early:**  
Get to the point quickly. If you're requesting something or sharing important information, mention it in the first few lines. For example:



# Compute power

## Compute with GPUs

- This high-intensity compute required a novel architecture, at the model level with transformers and for compute with GPUs
- Compared to CPUs, GPUs have the ability to effortlessly run many parallel computations





# Novel architecture

## Transformers

- Transformers is a new type of architecture developed by Google, which makes it such that each operation done during model training can be parallelized
- It process the entire text all a the same time, in parallel
- It associates each word processed with a long array of numbers that give meaning to that wordt

# Attention

- Attention is an operation that makes it possible to look at all the context around a word, even if it occurs multiple times in different sentences:

*At the end of the show, the singer took a bow multiple times.*

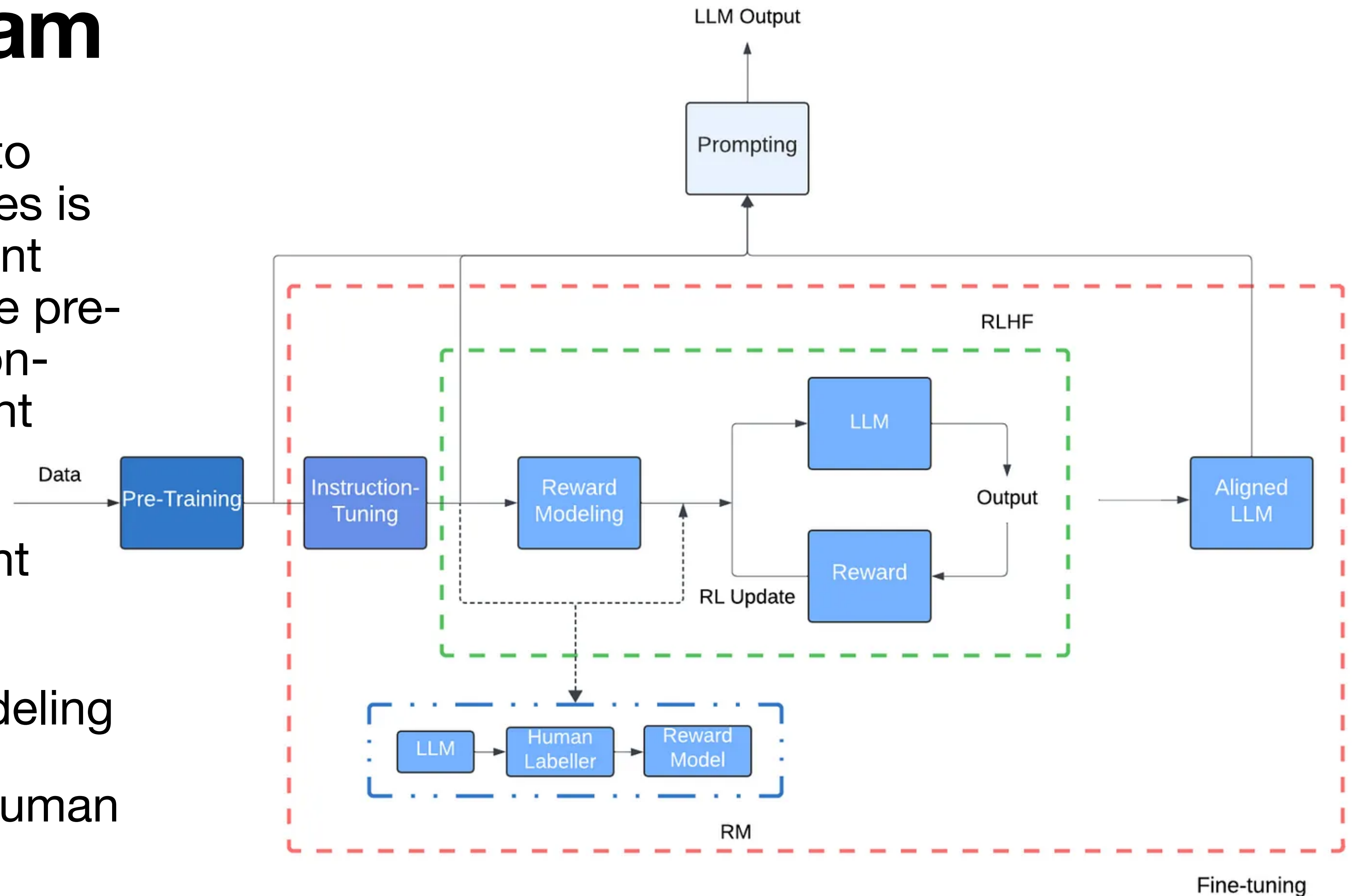
*Jack wanted to go to the store to buy a new bow for target practice.*

- The wordt bow has a different meaning. Attention allows the model to refine the meaning each word encodes based on the context around them



# Flow diagram

- Prompting LLMs to generate responses is possible at different training stages like pre-training, instruction-tuning or alignment tuning
- RL = reinforcement learning
- RM = reward-modeling
- RLHF = RL with human feedback



# New opportunities

- LLMs can process enormous amounts of text examples and then predict with a high accuracy, the next word in a sentence
- This combined with other AI frameworks, many natural language and information retrieval tasks became much easier to implement and productize



# Fast paced evolution

- LLMs has been evolving at a lightning fast pace

