

# Impact of AI language models on the investment profession

With a focus on ChatGPT

Raymond van Es  
Daniel van Dam

25 OCTOBER 2023




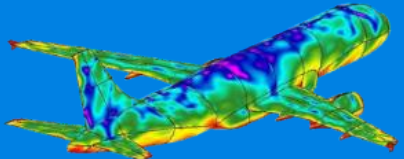
# Table of content

1	Introduction	5 min
2	AI – how does it work and why is it relevant	5 min
3	Natural Language Processing and ChatGPT	15 min
4	Use cases in the investment industry	15 min
5	Discussion	5 min


# Introduction

# Personal introduction: Raymond

*Education*



Raymond van Es  
Practice Lead Data Science  
+ 31 6 11334000



*Professional Experience*



# Personal introduction: Daniël


*Education*





Data Analytics



**VU**  **VRIJE  
UNIVERSITEIT  
AMSTERDAM**



Daniël van Dam  
Lead Data Science  
+ 31 6 86 82 23 97



*Professional Experience*





# Why Milliman?

In a world overloaded with information, our clients rely on us to find the right information and turn it into actionable knowledge to solve their toughest problems with confidence. Our aim is to bring depth, clarity and context to the issues and challenges that they face every day. We are relied upon to be industry experts, trusted advisors and creative problem solvers.

As consulting firm Milliman has extended experience in

**statistical and data analyses**

Serving our clients for **nearly 75 years** through pioneering strategies, tools and solutions worldwide

We combine **global** expertise and market-leading technical skills with **local** market presence, leveraging our in-depth knowledge of the regulations and markets in which we operate.

**strong European base** with about **800 consultants.**

With the rapid developments in the area of **data science, data analytics and big data**, our historically strong statistical capabilities are combined with the latest IT developments.

Our involvement in project teams is characterized by taking **ownership** of the deliverables, **quality** and **timely delivery**

**59 offices** worldwide, with more than **5000 employees.**

Owned and managed by our principals, making us **personally committed** to delivering high-quality advice

An **active research program** to supplement our consulting activities.

# Our data science & AI services

We unlock the strategic value of your data!



## Data science & AI advice

Identification of data science use cases for strategic acceleration

Building the data science competence (people, organisation, processes)



## Data science & AI training

Training of both technical, e.g. BI specialists, as non-technical employees, about data science and data driven organisations



Business optimization (growth, efficiency, new business models) by the application of predictive modelling (machine learning) algorithms



## Model validation

Expert opinion on machine learning models for regulatory, ethical or innovation purposes according to our 7-step approach



**AI – how does it work and  
why is it relevant**



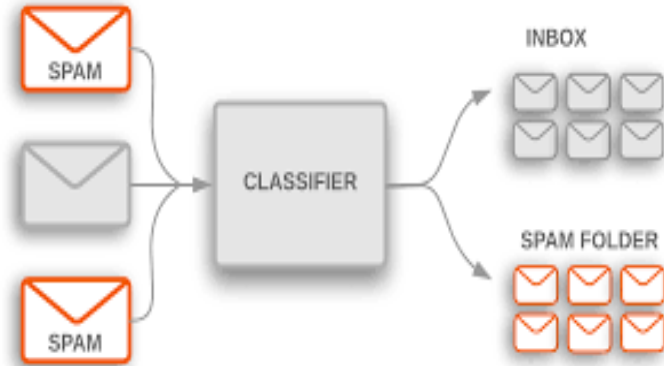
# AI can bring a competitive advantage

The steps in data-driven maturity: becoming data-driven is a journey



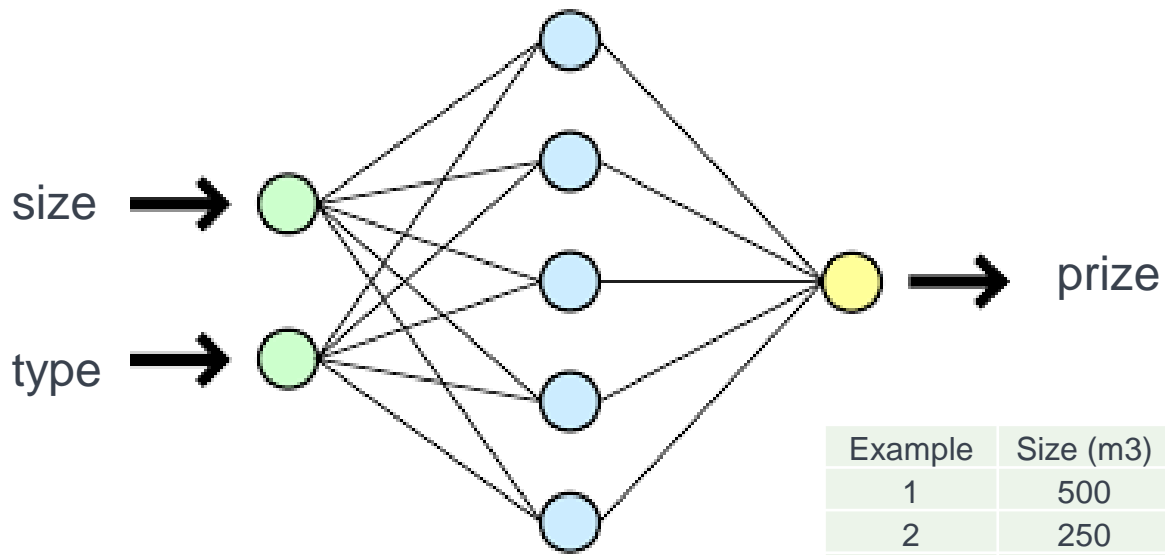
# Machine learning is all around us

More and more companies are starting to implement narrow AI in their core processes



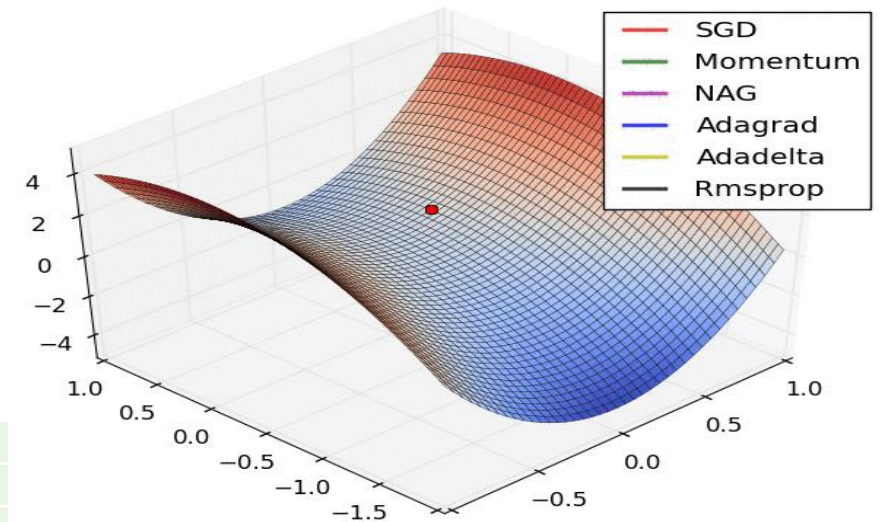
# Machine learning models learn from data to make predictions

Learning by example (pattern recognition)



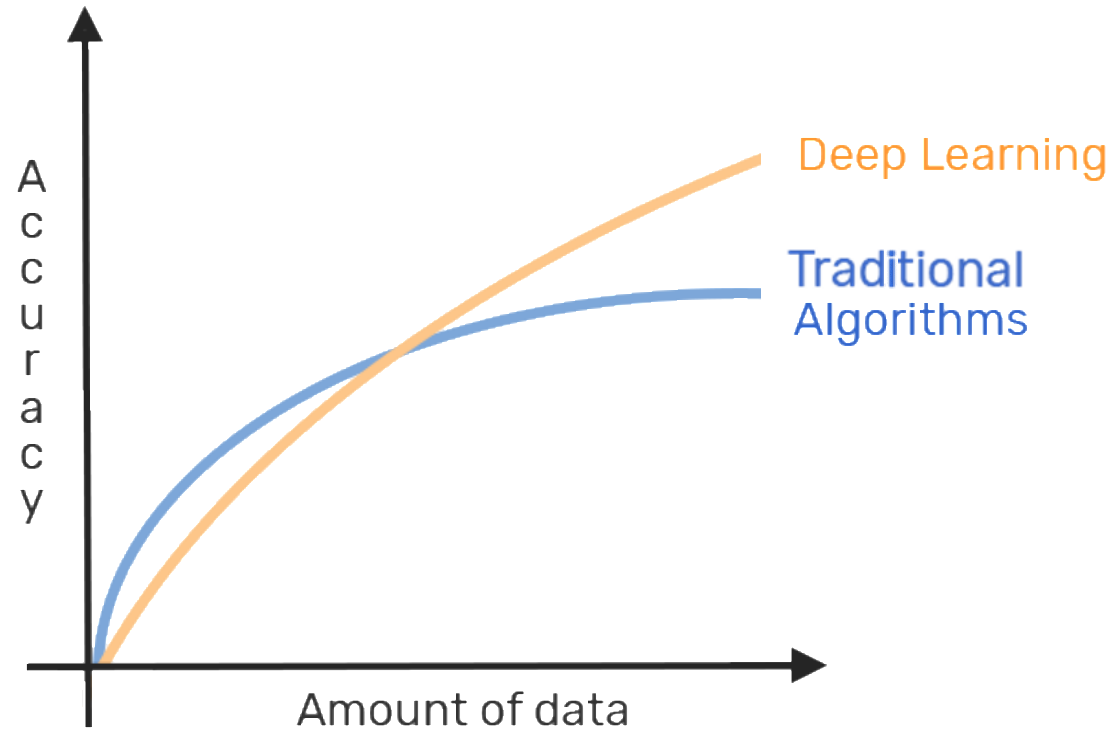
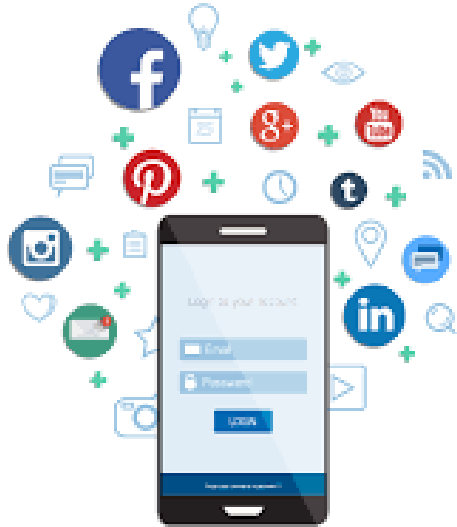
Neural Network

Example	Size (m3)	Type	Price
1	500	villa	750000
2	250	apartment	200000
3	350	house	400000
4	75	studio	115000
...	...	...	...



# In machine learning size matters

The more data (examples) the higher the accuracy



# The intelligence of a machine learning model (1)

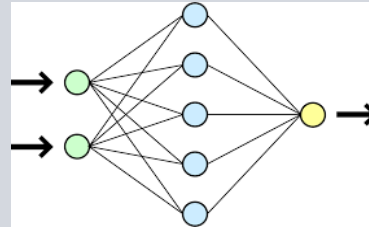
Example

Data collection and labelling



Label = WOLF

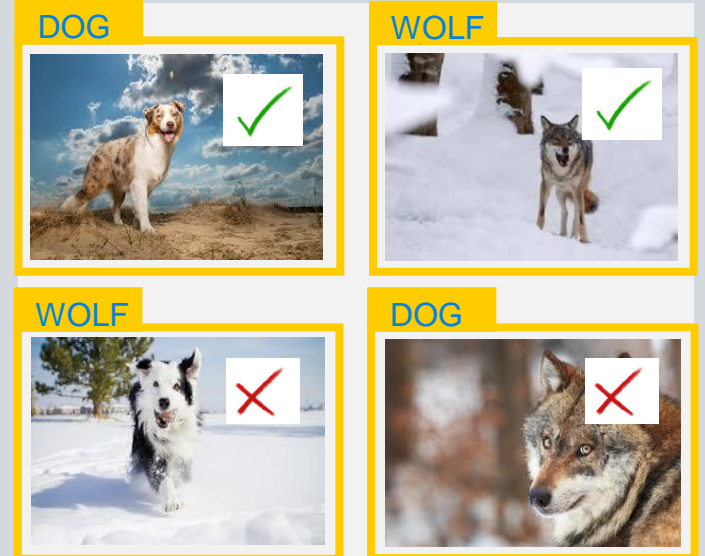
Training



Label = WOLF

Testing

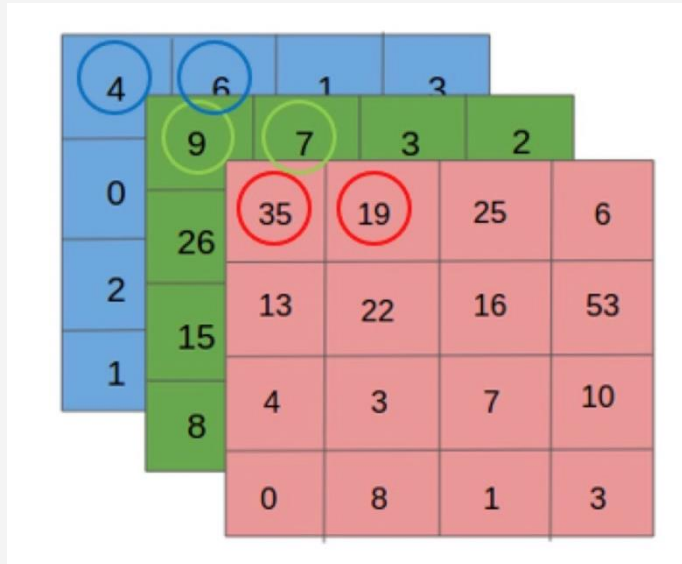
Accuracy of  
50%





# The intelligence of a machine learning model (2)

Example



= WOLF



So machine learning algorithms ...

1. ... are mathematical models that learn from data
2. ... are highly dependent on the quality of the data
3. ... benefit from large datasets
4. ... can only predict what they are trained for
5. ... predict based on data patterns, not on knowledge

**NARROW AI**

# Natural Language Processing and ChatGPT

# Language models

# Language models

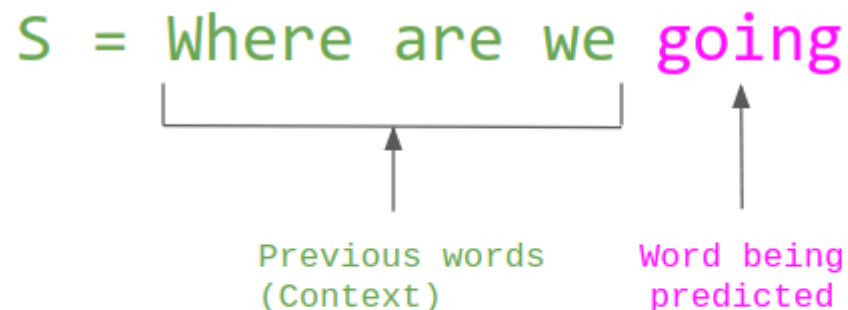
## General

### In short

- Language models are AI systems that are trained to generate text that is **similar to** human language
- And **do not** understand the content!

### More technical

- A language model is a statistical algorithm that uses probabilistic models to generate sequences of words that are likely to occur in human language.



$$P(S) = P(\text{Where}) \times P(\text{are} \mid \text{Where}) \times P(\text{we} \mid \text{Where are}) \times P(\text{going} \mid \text{Where are we})$$

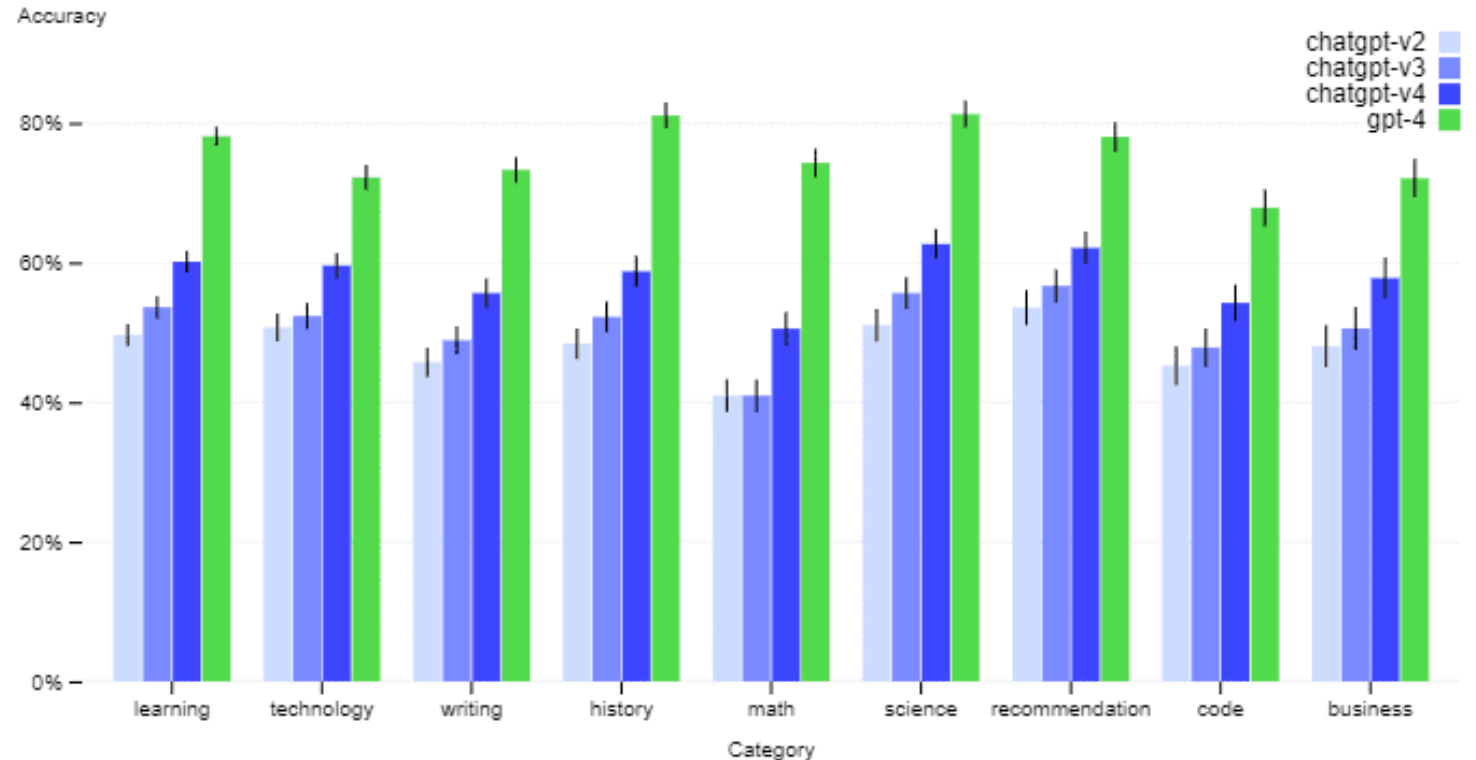
# Language models

## Factual limitation

*“Great care should be taken when using language model outputs, particularly in high-stakes contexts, with the exact protocol (such as human review, grounding with additional context, or avoiding high-stakes uses altogether) matching the needs of a specific use-case.”*

- OpenAI

Internal factual eval by category



On nine categories of internal adversarially-designed factual evals, we compare GPT-4 (green) to the first three ChatGPT versions. There are significant gains across all topics. An accuracy of 1.0 means the model's answers are judged to be in agreement with human ideal responses for all questions in the eval.

Source: [OpenAI](#)



# All large AI companies invest in language models

Language models

## *The main players in language models*

- ChatGPT has rapidly become a widely talked about language model.
- Despite its popularity, ChatGPT is not the only language model available. There are other alternative options worth considering, such as:
  - BARD by Google AI
  - Claude by Anthropic
  - Falcon by Technology Innovation Institute (Open-source)
  - LLaMA by Meta AI (Open-source)



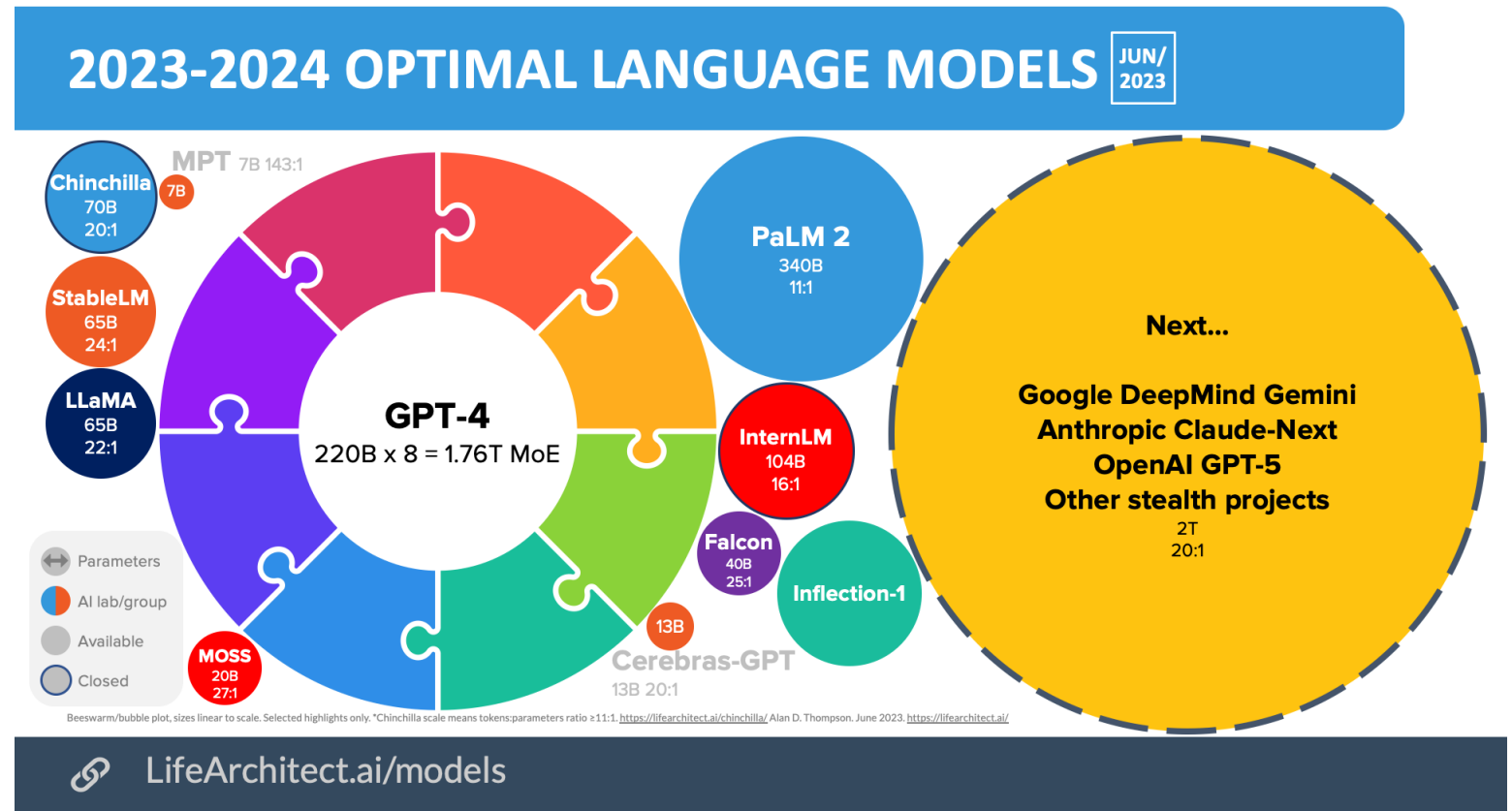
# Language models

The size of language models has been rapidly increasing in recent years

## Size matters

The size of language models has increased from a few million parameters to hundreds of billions:

- Bert (2018) – 0,340 bn parameters
- RoBERTa (2019) – 0,355 bn parameters
- GPT-1 (2018) – 0,117 bn parameters
- GPT-2 (2019) – 1.5 bn parameters
- GPT-3 (2020) – 175 bn parameters
- GPT-4 (2023) – 1760 bn parameters



# ChatGPT is more than just a language model - 1

Customer interaction was the key success factor

## ChatGPT development

- GPT-3 is a strong language model but NOT specialized in a specific way.
- GPT-3.5 or InstructGPT, a specialized language model optimized for executing commands was released in early 2022.

PROMPT *Explain the moon landing to a 6 year old in a few sentences.*

COMPLETION

GPT-3

Explain the theory of gravity to a 6 year old.

Explain the theory of relativity to a 6 year old in a few sentences.

Explain the big bang theory to a 6 year old.

Explain evolution to a 6 year old.

InstructGPT

People went to the moon, and they took pictures of what they saw, and sent them back to the earth so we could all see them.

GPT-3 models aren't trained to follow user instructions. Our InstructGPT models (highlighted) generate much more helpful outputs in response to user instructions.

# ChatGPT is more than just a language model - 2

Customer interaction was the key success factor

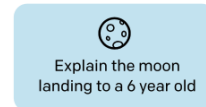
## ChatGPT components

- ChatGPT is fine-tuned from a model in the GPT-3.5 series using the same methods as InstructGPT.
- This method is called: *Reinforcement Learning from Human Feedback (RLHF)*

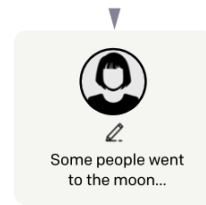
Step 1

**Collect demonstration data, and train a supervised policy.**

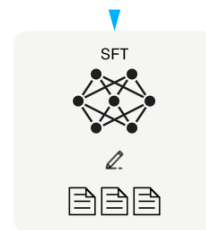
A prompt is sampled from our prompt dataset.



A labeler demonstrates the desired output behavior.



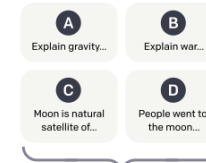
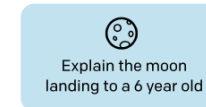
This data is used to fine-tune GPT-3 with supervised learning.



Step 2

**Collect comparison data, and train a reward model.**

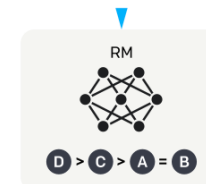
A prompt and several model outputs are sampled.



A labeler ranks the outputs from best to worst.



This data is used to train our reward model.



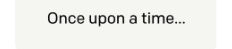
Step 3

**Optimize a policy against the reward model using reinforcement learning.**

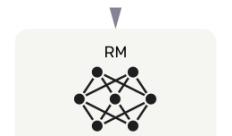
A new prompt is sampled from the dataset.



The policy generates an output.



The reward model calculates a reward for the output.



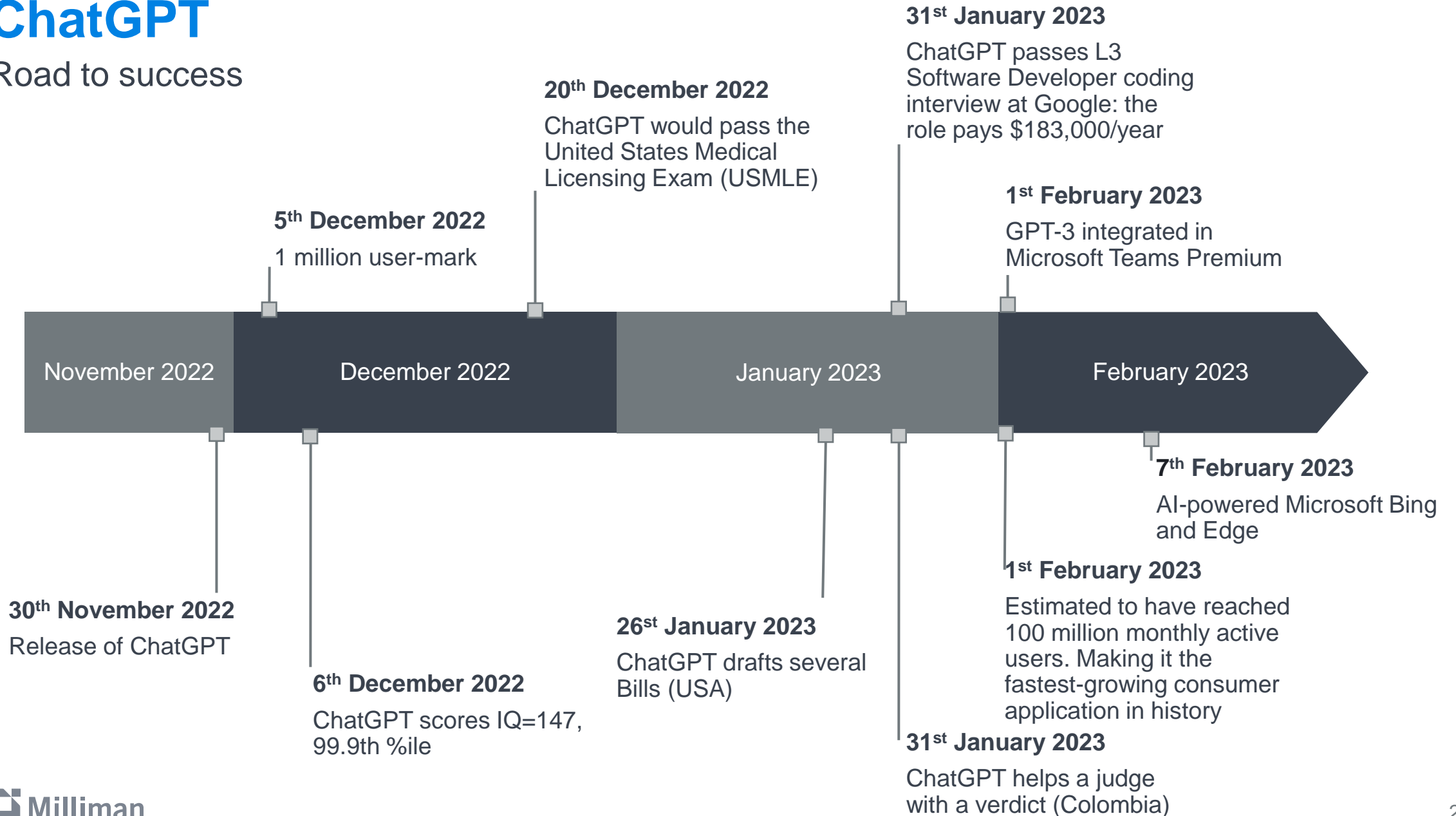
The reward is used to update the policy using PPO.



Source: InstructGPT paper by OpenAI.

# ChatGPT

## Road to success





# Bot versus Human

# AI Generated text

No fact checking, just word predictions

## *In the news*

- *“Top AI conference bans use of ChatGPT and AI language tools to write academic papers”*
- *“AI-generated answers temporarily banned on coding Q&A site Stack Overflow”*
- *“New York City schools ban access to ChatGPT over fears of cheating and misinformation”*

***There are different fears about the harmful effects of AI-generated text. Some of the most common are:***

- The output of these systems is simply unreliable especially when the model is **not** fine-tuned for the specific task
- It is more difficult to check for plagiarism
- The output can be used and presented as own work. For example, in high schools/universities

# Bot versus Human

How to distinguish

## *Recap*

- A language model is a statistical **algorithm** that uses **probabilistic** models to generate **sequences of words** that are likely to occur in human language
- An AI generated text has words that have a high probability to occur together
- Humans do not know these probabilities. And therefore, don't always match the 'correct' words together

# Bot versus Human

How to distinguish

## Perplexity Score

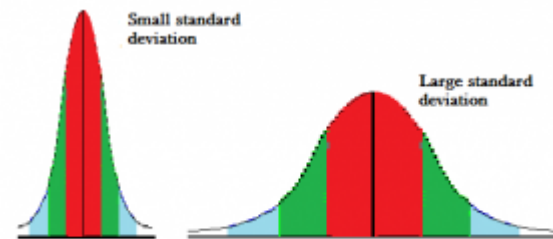
*Randomness of the text*

Human generated text have in general a higher Perplexity Score due to a higher randomness in the choice of words

## Burstiness Score

*Variation in Perplexity*

Humans tend to have more variance in their sentences



# Tools to distinguish a Bot from a human

How to distinguish

There are several tools available that help you to check if a text **might** be AI generated:

- GPTZero
- WRITER - AI Content Detector
- OpenAI – AI Text Classifier (currently off-line)

However ...

- ... they are not 100% correct
- ... they rely on the fact that human and AI text are systematic different



# Tips & tricks for the use of ChatGPT

# Things to keep in mind about ChatGPT

Latest developments

ChatGPT currently has 2 version

- GPT-3.5 (Free version)
- GPT-4 (Plus subscription)

## GPT-3.5

- Is a general conversational language model, so it is not fine-tuned for a specific task
- Has NO connection to the internet
- Is trained on data until 09-2021
- Is a machine learning model and may not always provide correct answers

## GPT-4

- More recent and more capable model
  - Can use images/data as input
  - Faster response
  - Connection to the internet
- Access to beta features
- Is still a machine learning model and may not always provide correct answers



# Azure OpenAI Service

The power of GPT within your own Azure environment

## The benefits of OpenAI in Azure

- Connect your own data with language and image models
- Several benefits including:
  - ✓ Security
  - ✓ Compliance and Regulation
  - ✓ Scalability
  - ✓ Availability



OpenAI Service requires registration and is currently only available to approved enterprise customers and partners.

# Tips and Tricks

How to ask the right question

## 1. Be clear and specific with your prompts (Prompt engineering)

- ChatGPT is a language model, so it is important to give it clear and specific prompts to ensure you get the answers you are looking for

## 2. Provide context

- If you are asking a question, provide some context so that ChatGPT can better understand what you are asking and respond accordingly

## 3. Be mindful of ChatGPT's biases

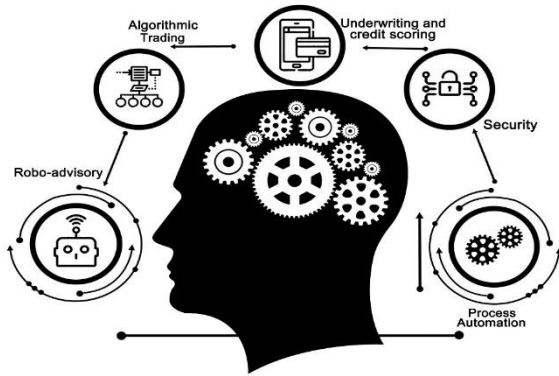
- Like any AI system, ChatGPT is trained on the data it has been exposed to and can have biases based on that data

## 4. Experiment with different prompt styles

- Conversational, Text completion, Text generation, Text summarization, Translation, etc.

# Use cases in the investment industry

# AI (and ChatGPT) in the investment profession



*The application of AI (and ChatGPT) has proven to be valuable across various industries, including the financial sector*

## Generative AI use cases



*Customer interaction*



*Content generation*



*Semantic search*

# Customer interaction: robo advice or financial education?



Customer interaction

**C** Provide an example stock portfolio for an investor with the following considerations:

1. Investment Time Horizon = 10 years
2. Risk Tolerance = Moderate to High
3. Diversification in the following sectors = (Technology, Health Care, Consumer Staples, Consumer Discretionary, Real Estate, Industrials, Utilities, Financials, Telecommunications)

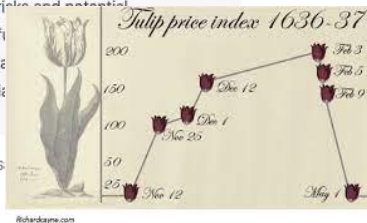
Here is an example of a stock portfolio allocation for a long-term investor with a moderate to high risk tolerance and a diversified portfolio across the following sectors: technology, healthcare, consumer staples, consumer discretionary, real estate, industrials, utilities, financials, and telecommunications:

- Technology: 30%
- Healthcare: 20%
- Consumer staples: 15%
- Consumer discretionary: 10%
- Real estate: 10%
- Industrials: 5%
- Utilities: 5%
- Financials: 5%
- Telecommunications: 10%

Please note that this is just one example of a potential stock portfolio allocation and is not meant to be taken as specific investment advice. It is important to carefully consider your own financial situation, risk tolerance, and investment goals before making any investment decisions.

It is also important to keep in mind that investing carries inherent risks and potential losses, and that past performance is not necessarily indicative of future performance. Your investments may fluctuate, and diversification does not guarantee a profit or protect against loss. It is always advisable to consult with a financial professional for guidance on investing and asset allocation.

Screenshot from ChatGPT app of convers...



Consumer awareness



SAMPLE

- Demographics
- Net worth
- Risk appetite
- Browsing behavior

...

Personalized communication

# Content generation (i.c.w. transfer learning)



Content generation

**STOCK MARKET INVESTING VS MUTUAL FUNDS INVESTING**

- 1. COST OF INVESTING**
  - Investing in stock market, you have to open your brokerage account, you have to pay some annual maintenance charges fee.
  - While investing in mutual funds, you have to pay different charges like expense ratio, load fee.
- 2. VOLATILITY IN INVESTMENT.**
  - Direct investing in stocks has more volatility when compared to mutual fund investing.
  - Due to the broad diversification, the volatility in the mutual funds is a lot less compared to that of shares.
- 3. RETURN POTENTIAL**
  - Stock market investing has a very high return potential.
  - Mutual funds have given decent consistent returns. Although the returns are not as high as what many successful investors can make from stocks.
- 4. TAX SAVING**
  - When you sell stock while investing directly in the stock market, you have to pay a tax, no matter what the scenario. There are no tax benefits.
  - Investing in mutual fund you do not have to pay tax if the fund sells any stock from its portfolio as long as you are holding the fund.
- 5. MONITORING**
  - Investing in the stock market requires frequent monitoring. This is because stock market investing is a personal thing.
  - There are fund managers who take care of the investments and make buy/sell decision on your behalf. So when you invest in mutual fund, you do not need to monitor your fund much frequently.
- 6. SIP INVESTMENT**
  - There's no option of SIP available in stock market investing.
  - Mutual funds investment provides you with an option of a systematic investment plan.
- 7. ASSET CLASS RESTRICTION**
  - While investing in the stock market, the only asset where you can spend is stocks of the company.
  - The mutual fund gives you an opportunity to invest in a diversified portfolio.

www.credentia.in

Marketing materials

**EXPECTED RETURNS FOR PRIVATE EQUITY WILL PROBABLY SUCK**

Expected Returns for Private Equity Will Probably Suck

By Tommi Johansen, PhD | January 17th, 2023 | Private Equity, Research Insights, Basilio and Johansen, Academic Research Insight

This article attempts to demystify the approach and methodology used to characterize the risk and return relationship in private equity today. The illiquid nature of the asset class makes the demystification of private equity returns difficult to achieve under any circumstances. Still, the framework presented in this article should move the reader closer to the goal.

**Demystifying Illiquid Assets: Expected Returns for Private Equity**

- Antti Ilmanen, Swati Chandra, and Nicholas McQuinn
- Journal of Alternative Assets
- A version of this paper can be found [here](#)
- Want to read our summaries of academic finance papers? Check out our [Academic Research Insight](#) category.

**What are the research questions?**

As investors increasingly avail themselves of the “benefits” of private equity (PE), the calculation of risk and returns to PE is under increased scrutiny. This asset class’s illiquid nature challenges the industry’s approach and methodology today. The mark-to-market quality of public markets is not present in the case of private markets. As a result, the calculation of traditional risk measures, such as volatility and beta, is understated. Nevertheless, the email folders of wealth managers are swamped with PowerPoint presentations that tout the lower risk of illiquid assets and expected returns sufficiently high to compensate for illiquidity. The credibility of such claims is questionable, and the direct comparison to public markets is problematic.

1. How large is the historical illiquidity premium?
2. Why is PE promoted as an asset class that will diversify an allocation to public equity?
3. How much error is introduced into measures of correlation and risk in private equity?
4. What is the framework for estimating expected returns for PE?

**What are the Academic Insights?**

1. NOT VERY. The return and excess return performance of PE and various public indices from 1986 to 2017, are presented in Exhibit 1. Note that the illiquidity premium ranges from -1.6% to 2.3% (arithmetic) or 0.4% to 4.3% (geometric), depending on the specific public index. Although the excess returns are not zero, they are not as large as expected.
2. SMOOTHED RETURNS. The key to understanding how this result has come about is recognizing that PE prices are not marked-to-market as in the public markets. PE appears to have a low or negative correlation with public equities, which results from the method in which PE returns are calculated. As an illiquid asset class, prices and returns to investing in PE are self-reported IRRs or appraisal-based. This practice results in a return series that does not reflect normal fluctuations observed on a daily basis in the public markets. They are “artificially smoothed.” If that feature is extended to statistical risk measures, correlation and variance, the result significantly understates the actual relationship. Smoothed returns will result in understated beta measures, correlation, etc. Accordingly, it only *appears* that private equity

**Get Blog Updates via Email**

I have read and agree to the [Terms & Privacy Policy](#). Alpha Architect will use your information to provide blog updates and for email marketing.

Your email address:

[Get Blog Updates](#)

**What is Alpha Architect?**

[How We Got Started \(Video\)](#)  
[Our Value Proposition](#)  
[How to Use Our Site](#)  
[Focused Factor Philosophy \(PDF\)](#)  
[Firm Overview \(PDF\)](#)

**Support Our Mission**

[Submit a question](#)  
[Invest With Us](#)

**Research Others Like**

[Books](#)  
[White Papers](#)  
[Value Investing Research](#)  
[Momentum Investmz Research](#)

Investment blogs

**DIVIDEND CAPITAL**  
DIVERSIFIED PROPERTY FUND

**INVESTING IN COMMERCIAL REAL ESTATE**

**THE POWER OF REAL ESTATE**

The U.S. commercial real estate market has developed into a meaningful and mainstream asset class, not only opening its doors to a broader base of investment opportunities, but also being widely regarded as a valuable component of a well diversified investment portfolio, offering the potential for:

- ◆ Current income<sup>1</sup>
- ◆ Capital appreciation
- ◆ Low correlation to stocks and bonds<sup>2</sup>
- ◆ An inflation hedge<sup>3</sup>

Despite these potential benefits, many individual investors have either lacked access to high-quality commercial real estate investment opportunities or have simply not diversified their portfolios to include targeted real estate segments beyond their areas of comfort such as personal residences, business or investment properties.

Rather than directly purchasing income-producing commercial properties such as industrial warehouses, office buildings, retail shopping centers or apartment buildings, many investors have turned to professionally managed real estate investment trusts (REITs). REITs are one of the most common ways to gain exposure to commercial real estate.

<sup>1</sup> There can be no assurance that these objectives will be met through an investment in Dividend Capital Diversified Property Fund (DPF).  
<sup>2</sup> Current income has historically been in the form of quarterly distributions. Prior to 2012, DPF's distributions have historically exceeded its cash flow from operations. However, for the full year ended December 31, 2012 and the quarter ended March 31, 2013, distributions were funded solely from cash flow from operations.  
<sup>3</sup> DPF shares are being sold to investors over a specified offering period at a price not subject to exchange-traded market fluctuations. The purchase price for shares of DPF common stock will be based on the net asset value ("NAV") of each class of common stock and will not be based on any public trading market. DPF's NAV may not accurately reflect the actual prices at which its assets could be liquidated on any given day.  
<sup>4</sup> Typically, if the overall returns of an asset class exceed inflation, the asset class is considered an inflation hedge. Commercial real estate has historically provided overall returns that have exceeded inflation. There is no guarantee, however, that DPF can generate the overall returns needed to outpace inflation.

Prospectus



# Contact generation: language translation



Content generation





# Semantic search: analyzing text data at scale



## Identifies trends and opportunities *Market and trend analysis*

LLM's can also be used for market research, to analyze large amounts of data to identify patterns and trends that could indicate investment opportunities.

For example, analyzing earning calls and/or documents to extract facts, figures, and sentiment. Or analyzing social media posts for underwriting.



## Make informed decisions *Sentiment Analysis*

LLM's can be used for sentiment analysis on news articles, social media posts, and other public sources to gauge public opinion and identify potential market trends.



## Better client understanding *Using Bots*

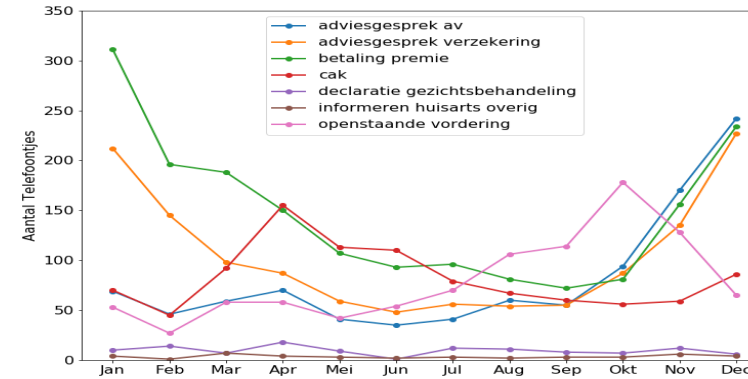
LLM's can be used in customer service to automate the answering of frequently asked questions, allowing customer service representatives to focus on more complex issues.

# Understanding call center interaction

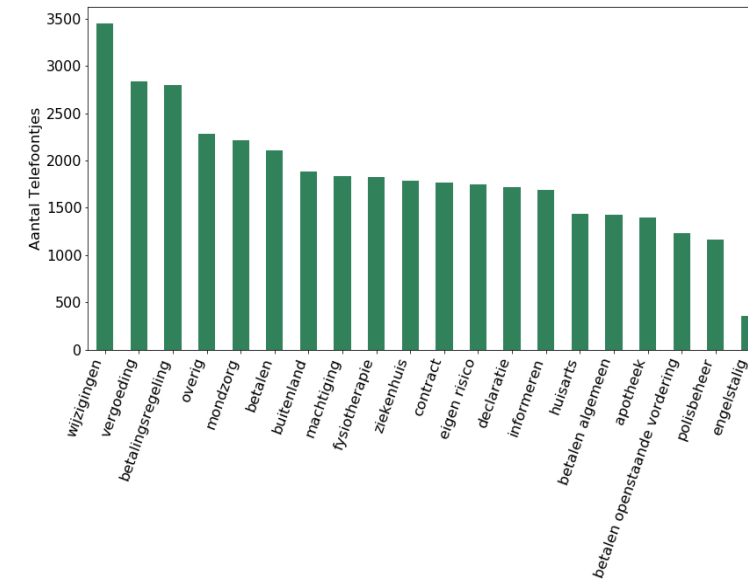
Using speech-to-tekst and NLP



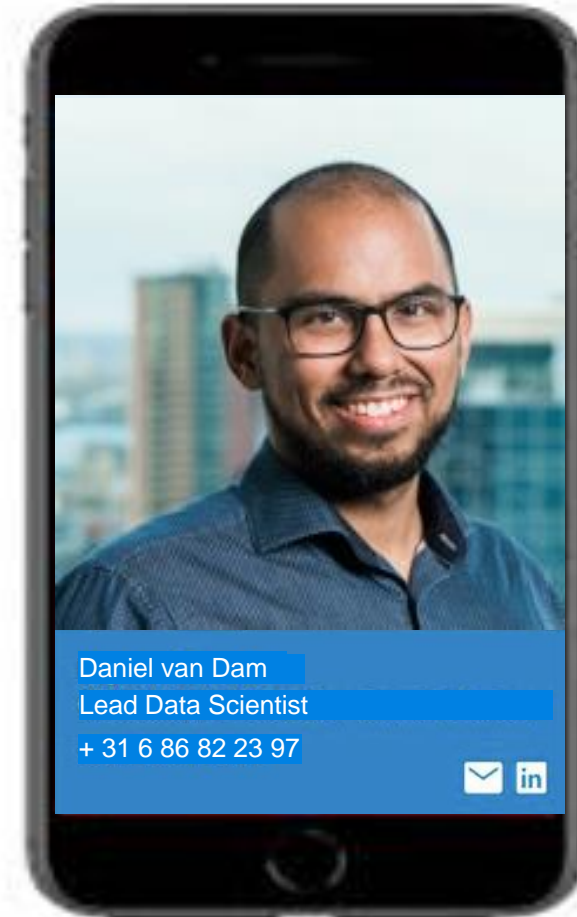
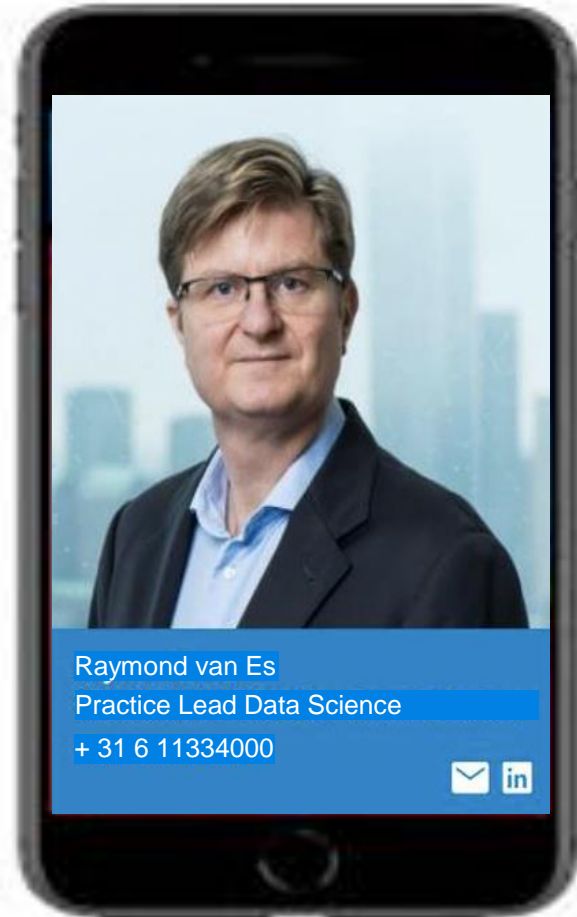
Semantic search



gebtsreiniging  
code  
minuten  
standarts  
rekening  
begroting  
controle  
vergoed  
keer  
codes



# Build a presentation (outline) about ChatGPT



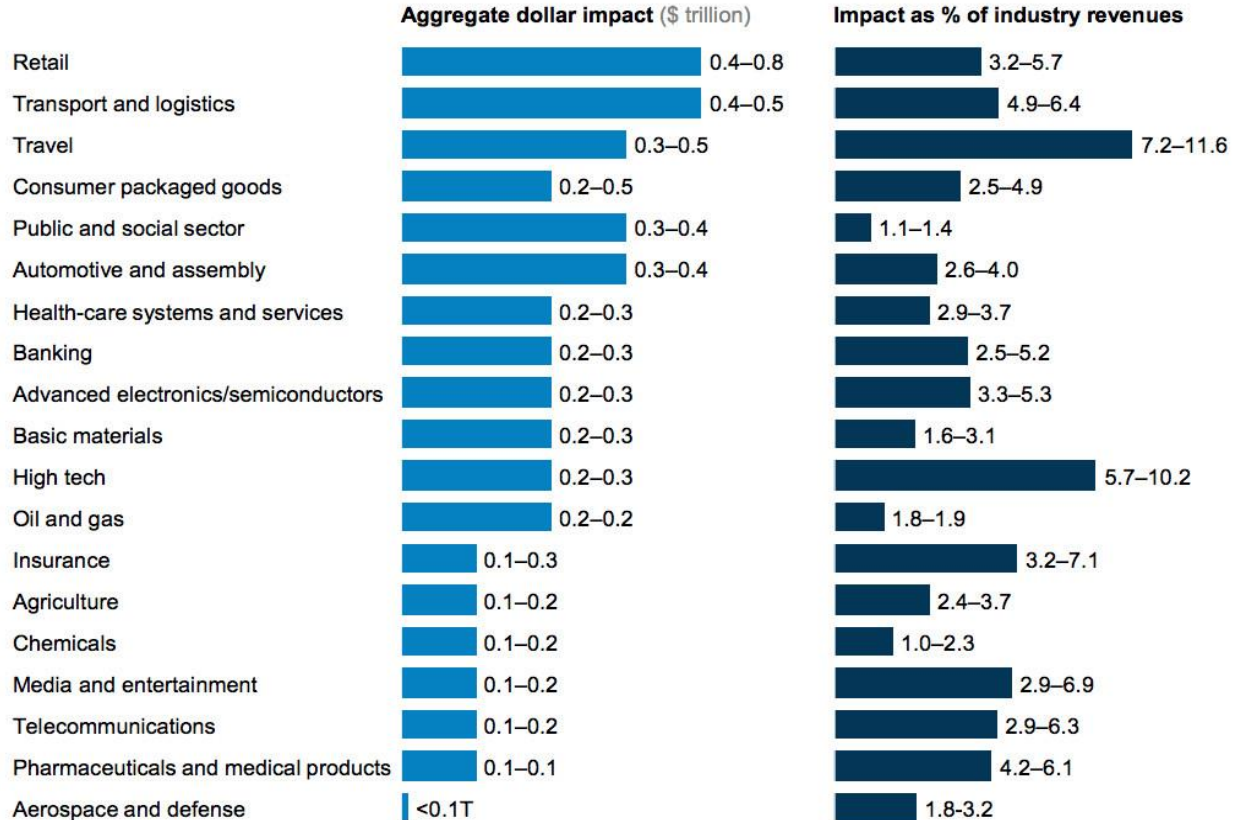
# Discussion

# What do the experts say about narrow AI?

It will change the world!



## The potential value of AI by sector



NOTE: Artificial Intelligence here includes neural networks only. Numbers may not sum due to rounding.

SOURCE: McKinsey Global Institute analysis



# We are only limited by our imagination

The opportunities are endless

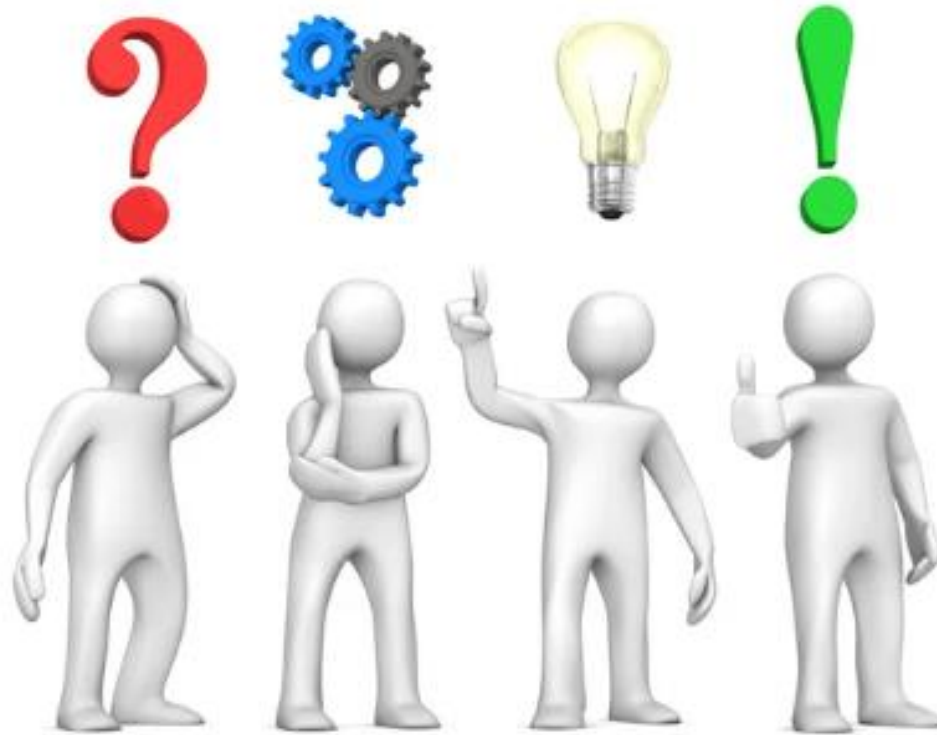


# Excited?





# Questions/discussion





# Thank you

This presentation is intended solely for educational purposes and presents information of a general nature. It is not intended to guide or determine any specific individual situation and persons should consult qualified professionals before taking specific actions. Neither the speaker, the speaker's employer (Milliman), shall have any responsibility or liability to any person or entity with respect to damages alleged to have been caused directly or indirectly by the content of this presentation. The contents of this presentation should not be modified, distributed or shown without Milliman's prior written consent.

Copyright © Milliman 2017. All rights reserved.