



# AI in Investing

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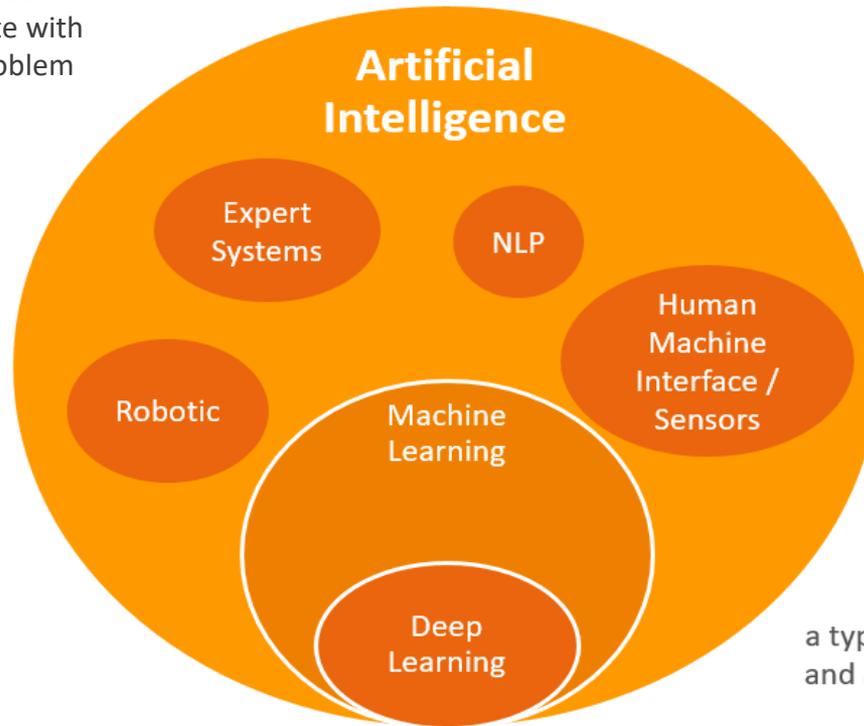
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# What is Artificial Intelligence (AI)?

Artificial Intelligence is intelligence exhibited by machines or software, as opposed to intelligence exhibited by life forms, such as humans and animals.

Machines mimicking cognitive functions that humans associate with the mind, e.g. learning and problem solving



AI is a form of intelligence, a type of technology, and a field of science

# AI and Automation

Hardwired  
/specific  
systems

Adaptive  
systems

Human in  
the loop

No human  
in the loop



## Assisted Intelligence

Using data and analytics to drive business insights within existing decisions and actions

## Automation

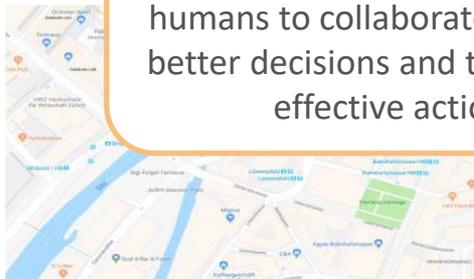
Automating business processes previously performed by humans

## Augmented Intelligence

New ways for computers and humans to collaborate in making better decisions and taking more effective actions

## Autonomous Intelligence

Systems that are adaptive and can autonomously carry out tasks without human intervention



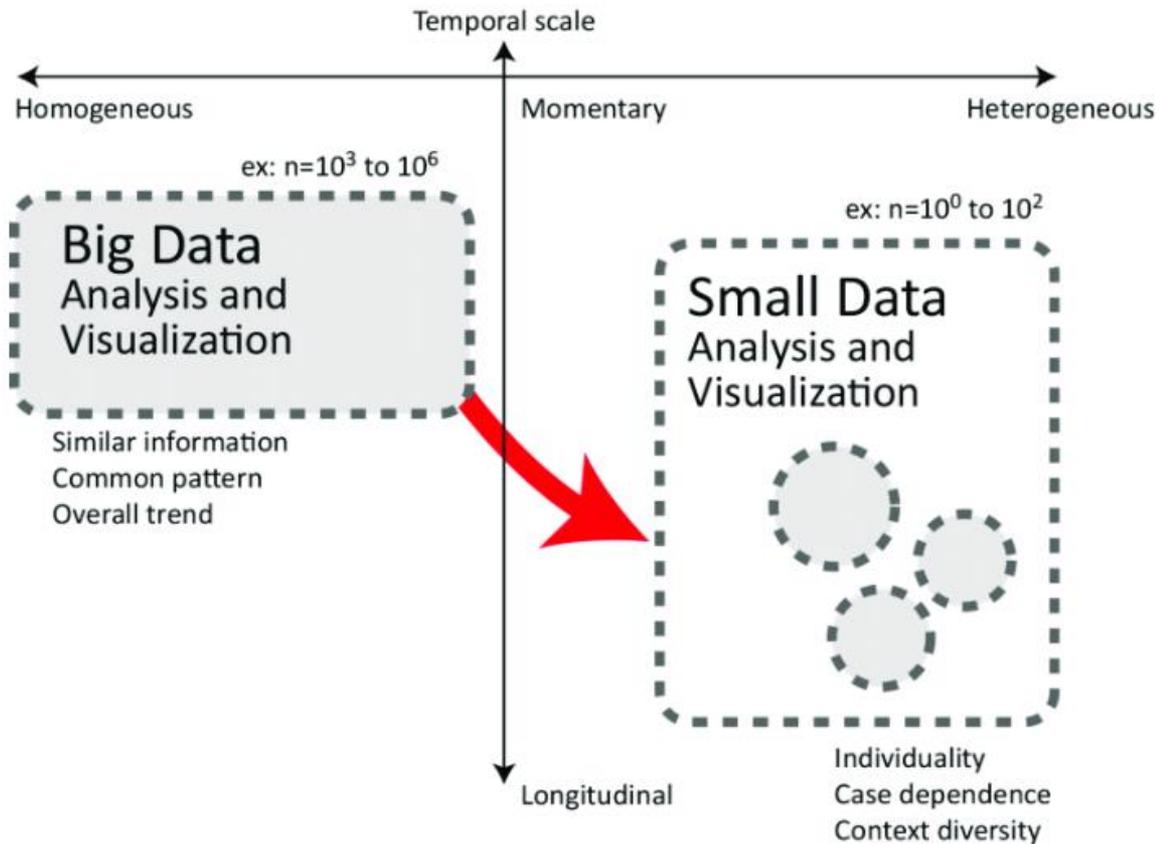
Source: Data Ahead Analytics

# AI in Investing – why now?

Niche area becoming mainstream, enabled by:

1. **Big data**: increasing dimension, availability and access of new data / insights
2. Availability and advancement in **tools**: refinements in analytics and forecasting devices
3. Increasingly **complex** investment landscape
  - Discovery of new sources of return
  - Better forecast in anticipating changes in market structure
  - Increasing visibility of non-linear relationships in the market

# Big Data



- **Faster and cheaper** to record, store, process and retrieve **more** data.
- The flood of data is generated by **humans** (e.g. social media) and **machines** (e.g. sensors).
- Unstructured data adds richness to structured data.
- Traditional data complemented by alternative data.

# Alternative Data

**Traditional data** like company financial releases or government reports is lagged and difficult to access.



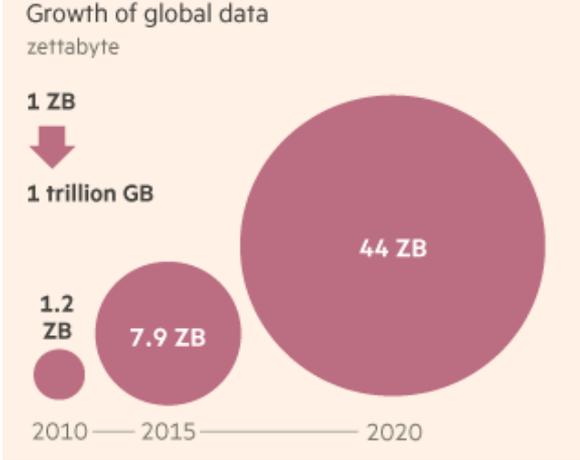
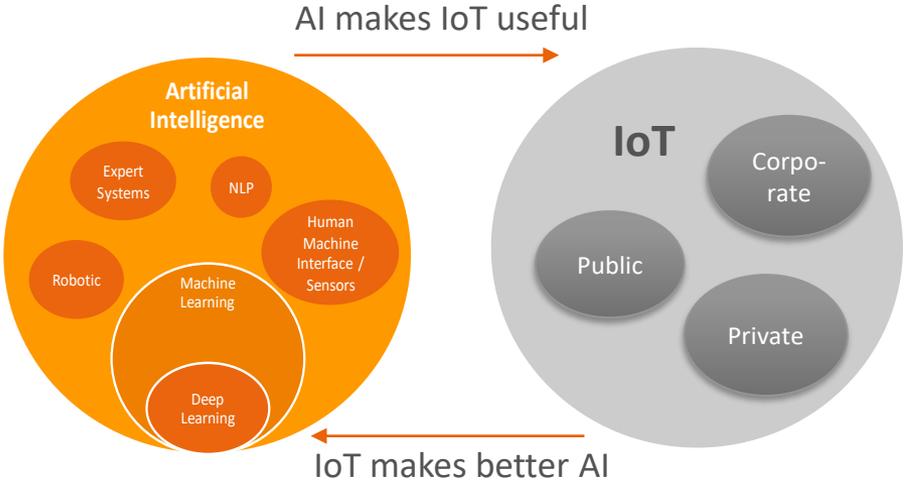
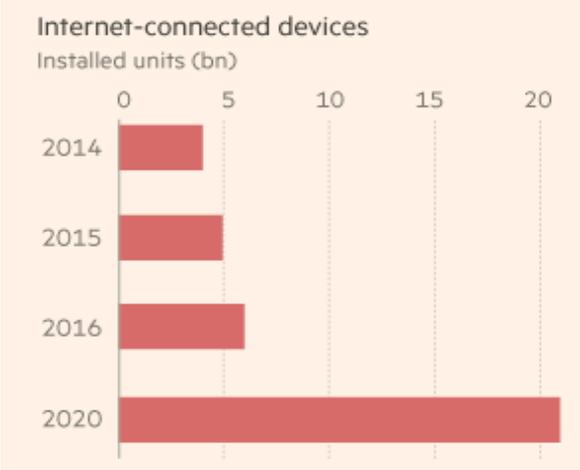
**Alternative data** is collected from new sources such as web tracking or blogs/tweets which can then be structured and converted into a system of information.



Source: Neudata

# Internet of Things

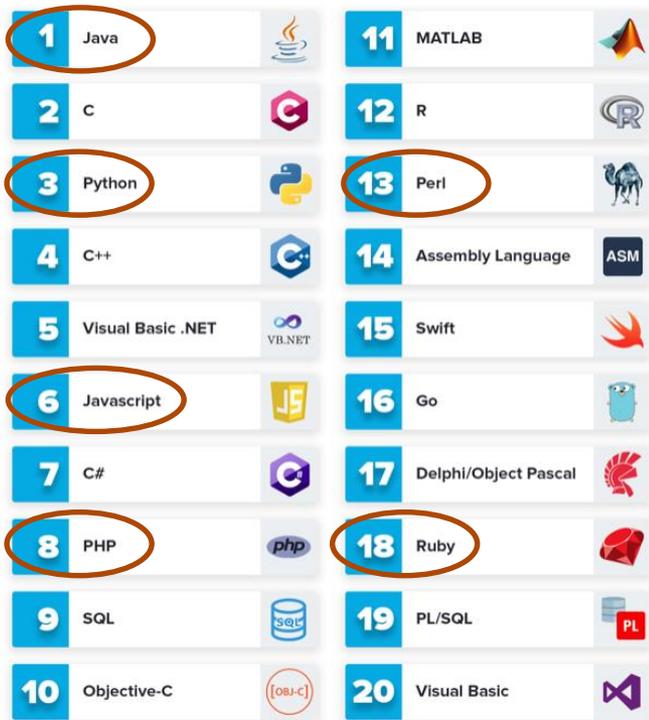
The Internet of things (IoT) is the extension of Internet connectivity into physical devices and everyday objects.



Source: Financial Times

# Open Source Technologies

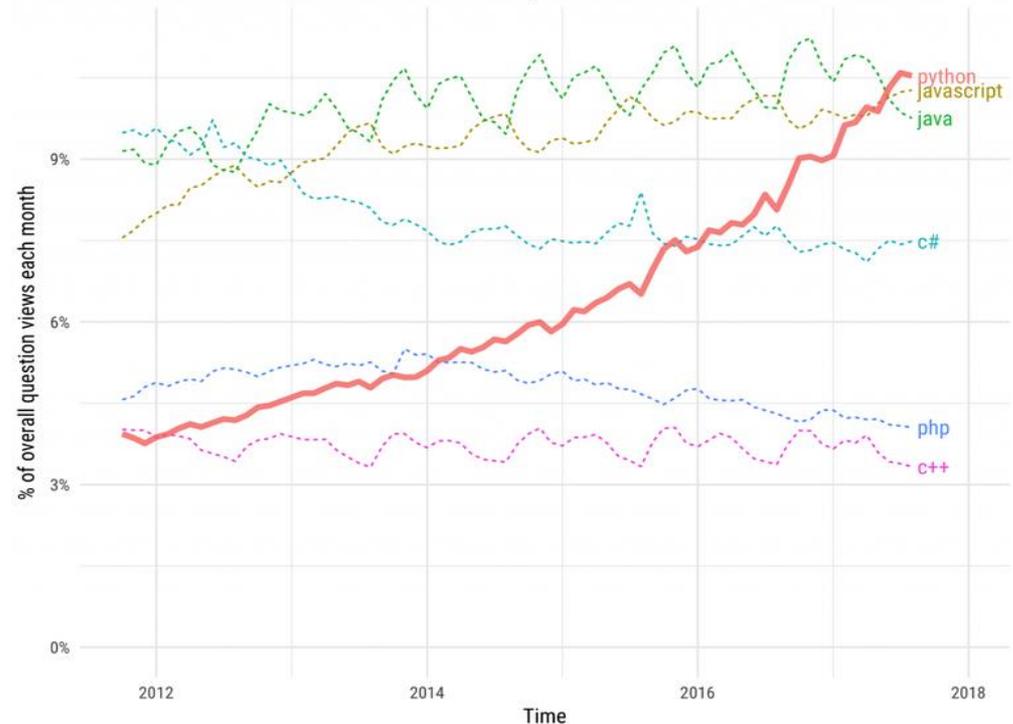
Proliferation of **open source** codes and **free** programming languages propel ability to turn data into information.



TIOBE calculates the rating of a programming language based on the number of hits on popular search engines such as Google, Youtube, Yahoo, Wikipedia, Amazon, Baidu, and Bing. They also consider the number of courses offered, third-party vendors and the number of skilled engineers worldwide. <https://tiobe.com/tiobe-index/>

## Growth of major programming languages

Based on Stack Overflow question views in World Bank high-income countries

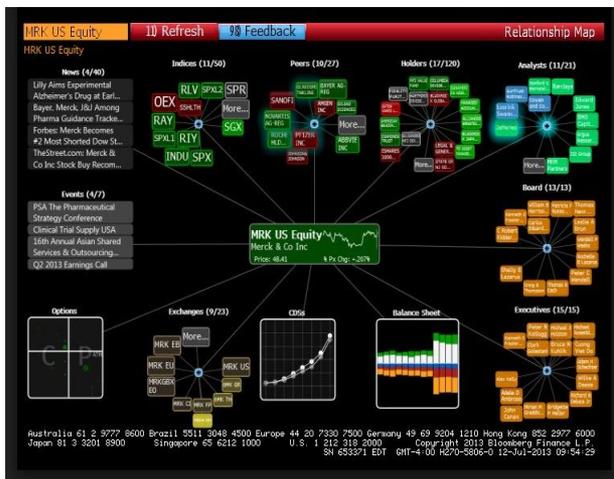


Visits to Python-tagged questions have overtaken Java and JavaScript for the first time.

# Analytics and Forecasting

Increasing number of software, systems and APIs for analytics and forecasting

- Improved visualization
- More flexibility and customization
- Faster and intuitive



# AI Based Techniques for Investing

AI has developed tools in areas that are relevant for investing:

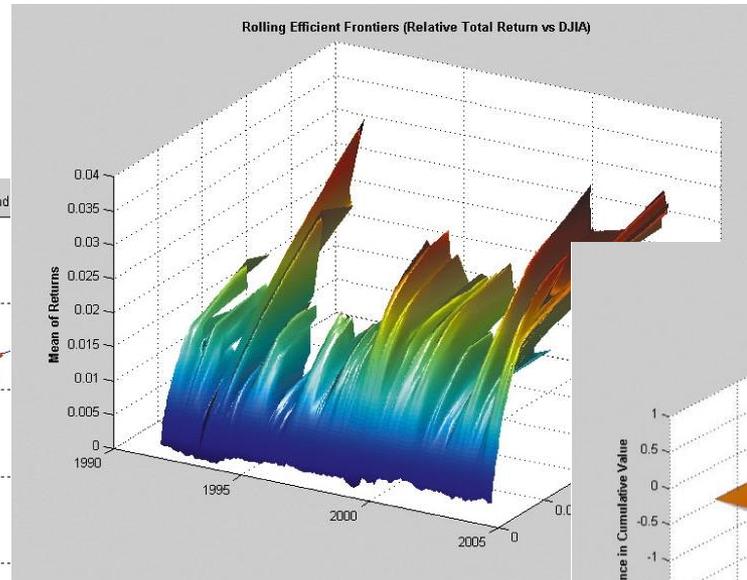
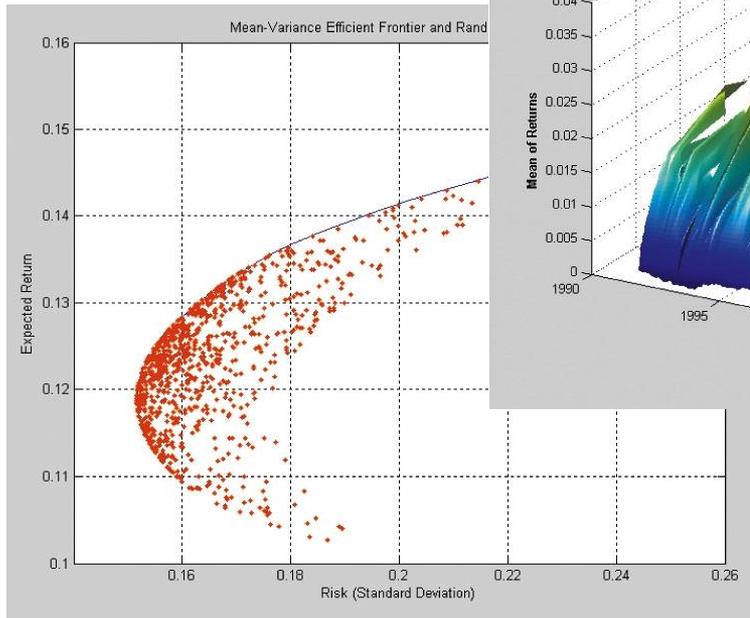
- Search and Optimization
- Classifiers and statistical learning
- Probabilistic methods

# Search and Optimization

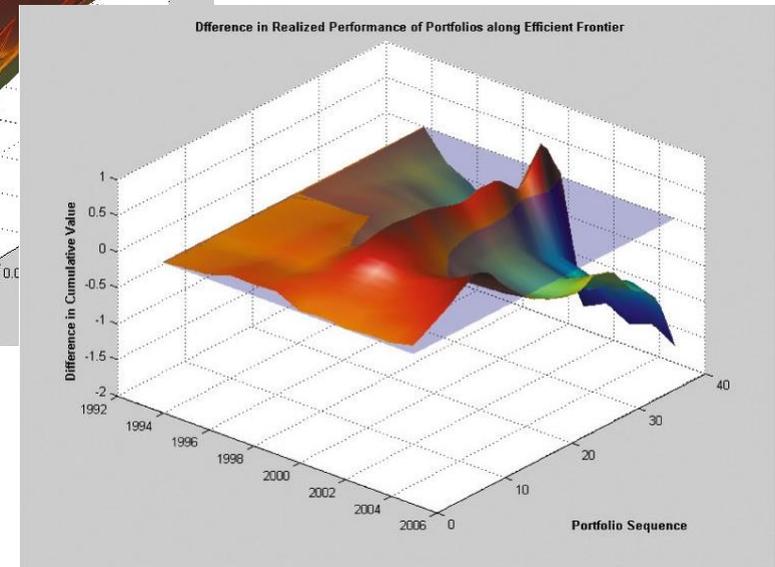
## Robust and Faster Portfolio Optimization

... to finding a stable region ...

From mean-variance...



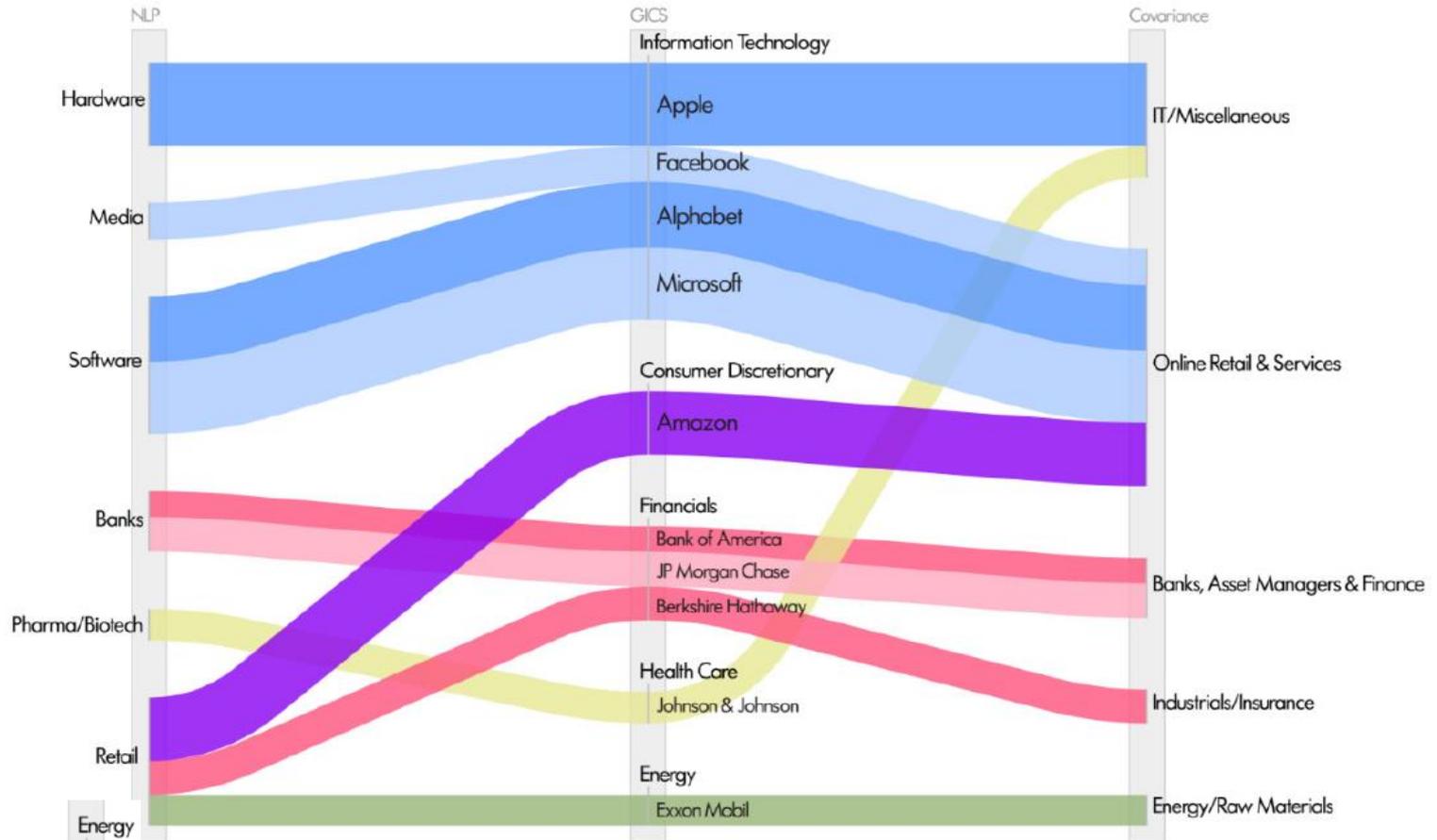
... to portfolio evaluation



Source: Matlab

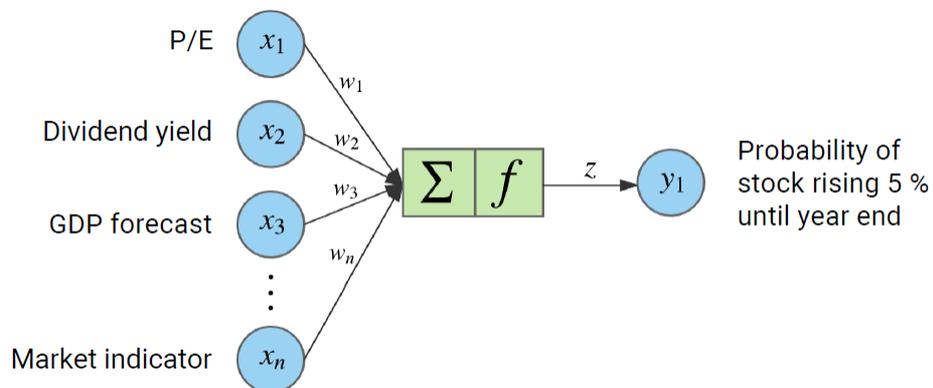
# Classifier and Statistical Learning

How 10 largest US companies are categorized according to AI



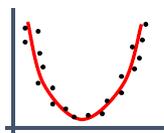
Source: Winton Research

# Probabilistic Methods

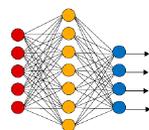


New methods are introduced to explore and generate more accurate economic forecasts.

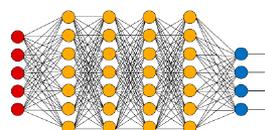
- Machine Learning techniques  
→ not without controversies!
- Inspired by non-finance/economic disciplines
  - Evolutionary biology (e.g. survival of a trading strategy)
  - Thermodynamics (e.g. order and disorder of economic systems)



Simple regression model



Simple neural network



Deep neural network

# Increasing Complexity in Investing

- In theory we have rational investors and efficient markets. In reality, emotions and irrationality play a large role.
- Market structures change from time to time as the dominance by type of participants or investment themes shift
  - Increasing usage of passive instruments and derivatives
  - Increase in speed of information processing
- Relationships in financial markets are far from linear
  - Interaction among and between corporates, investors and regulators are rarely a straight line
  - Cause and effect in financial markets are bounded by conditionality

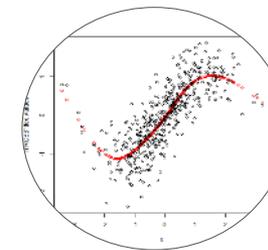


Source: wikipedia, market sentiment



“Watching the ticker tape in 1918”

Source: National Archives and Records Administration

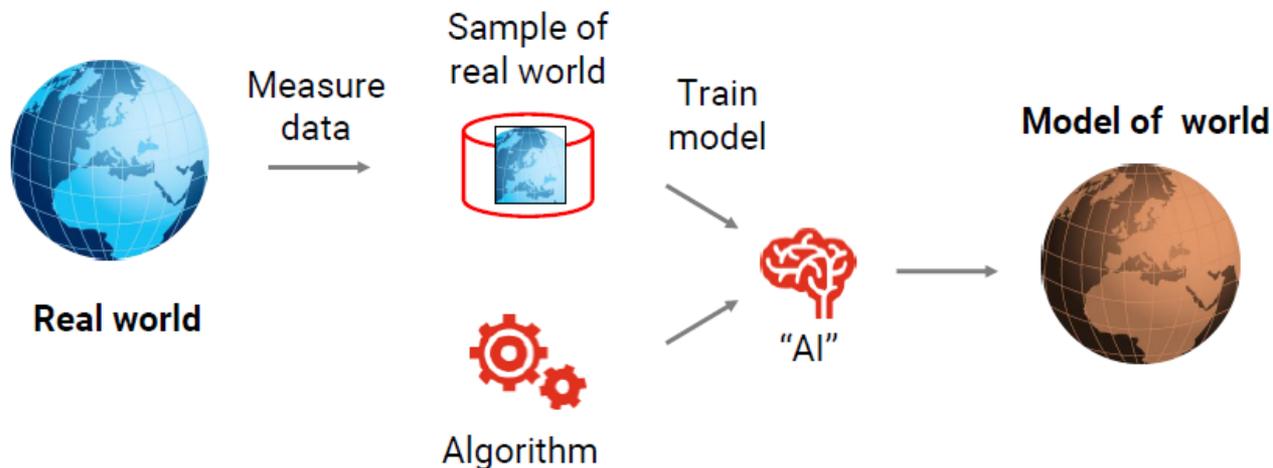


Source: NNIP Research

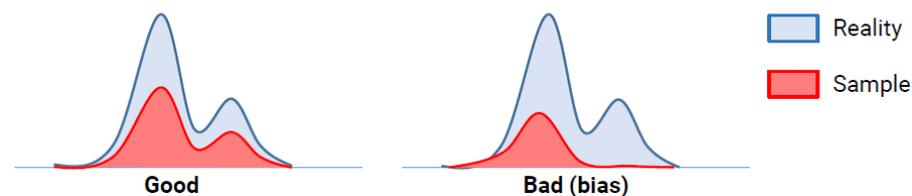
How to bring into practice

**AI**  
in  
**Investment  
Management**

# Understand and Build Data Culture



- The foundation of artificial intelligence is **data**.
- Even perfectly implemented algorithms will fail without the right data.
- Data is not equivalent with 'reality'.



# Understand and Build Data Culture

*Data is oil, but information is fuel.*

*Big Data needs refinement to generate added value.*

*Works with:*

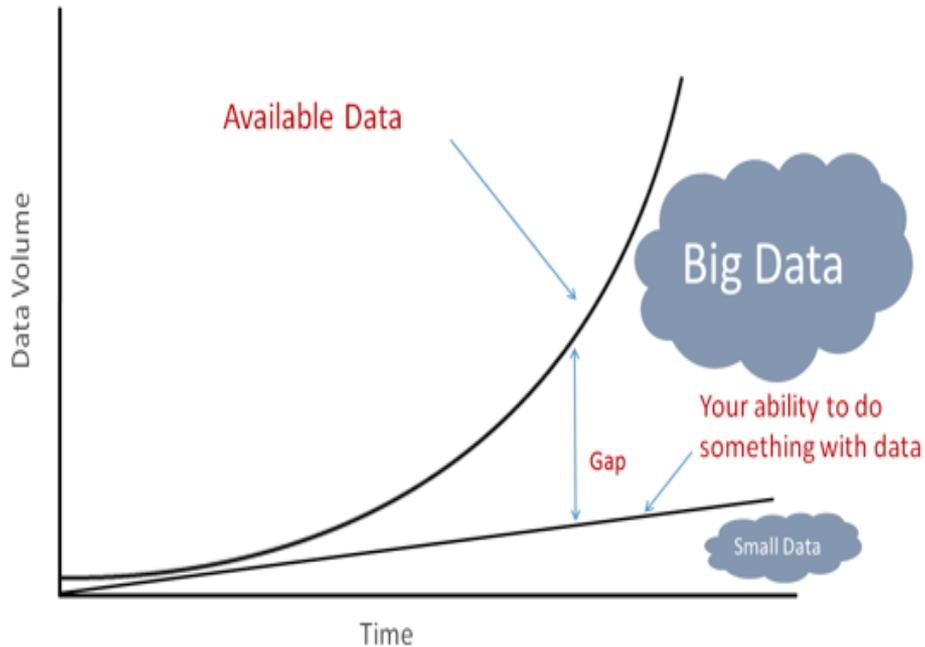
- **Disciplined teams**, in
- **Explorative settings**, where
- Use / **business cases have yet to be identified** / shaped

*Otherwise, much effort in data management for minimum return.*

## Challenges

- **Data acquisition** and heterogeneity : Data are existing, but neither accessible across system boundaries, nor of sufficient quality
- **Data analytics** : Expert knowledge is required to develop effective models with data
- **AI value chain** : Models and software architectures hardly allow dynamic changes and exist in their own silo

# Develop and Stimulate Domain Experts

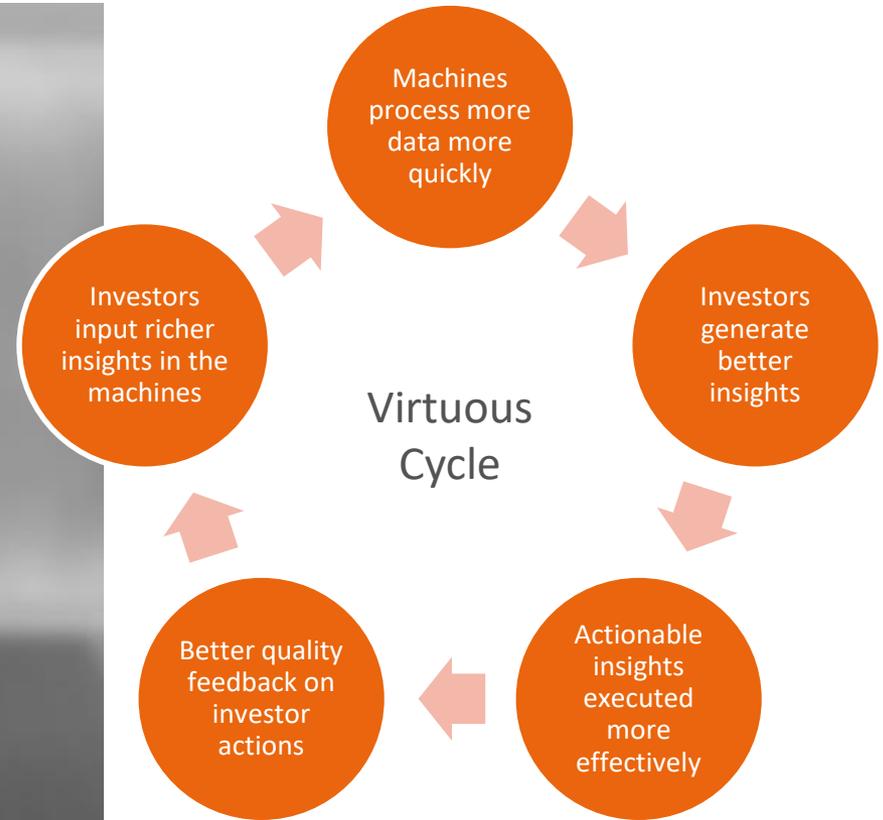
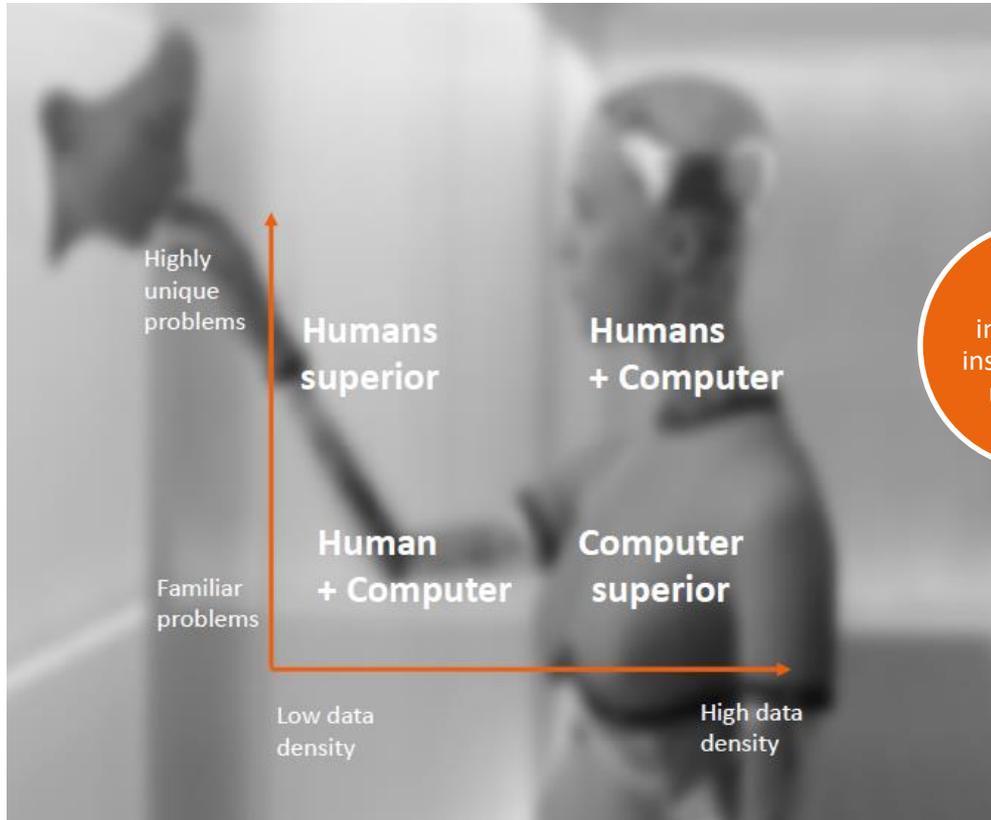


Prescriptive	Data and models show recommendations for action
Predictive	Data and models show how processes will happen
Analytic	Data and models show why processes happen as they do
Descriptive	Data show how processes happen today and in the past

- Knowledge Gap: The difference between collecting data and understanding data
- Execution Gap: The difference between understanding data and acting on it

# Man and Machine

How do man and machine synergize each other?



# CONCLUDING REMARKS

- Big Data and Artificial Intelligence are here to stay. They are means for **evolution** - not *revolution* - of investors, investments and markets.
- What does it mean for investment professionals? How to be future proof?
  - Take the driving seat
  - Increase numerical literacy and invest in technological skills & tools
  - **Keep the big picture and the problem at hand**

*AI can only help you solve the problems, if you know how to **identify the problem** and **formulate it in a solvable form**.*

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