

Use of recommender systems in the Chief Investment Office

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Chief Investment Officer at [Qplum](#)

A.I. conference

by O'reilly and Intel AI

Putting AI to work

See important disclosures at the end of this presentation.

Outline of the talk

- Generational shift in asset management due to AI
- How the Chief Investment Office can use AI in their workflow.
(reference paper on this)
- What do we need to build to implement AI in an organization (teams, workflows, architecture).

References ...

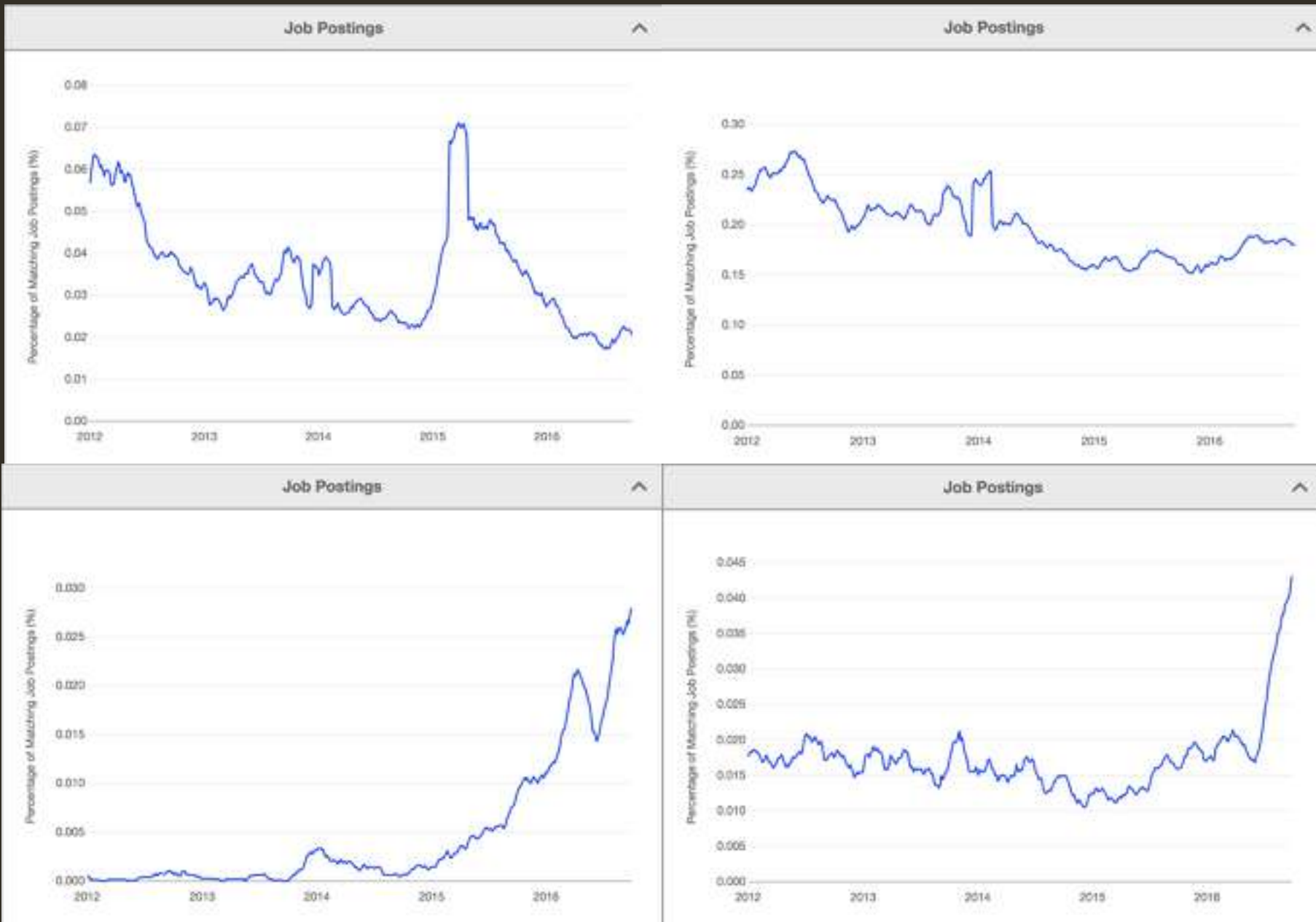
to connect the loose ends of this talk

- Using Deep learning to Trade : STAC
New York keynote
- Reference paper on using recommender
systems in strategic allocation
- Building data set pipelines for Deep
Learning based investment strategies

The story is clear in the jobs numbers ...

Use of A.I. is picking up in finance

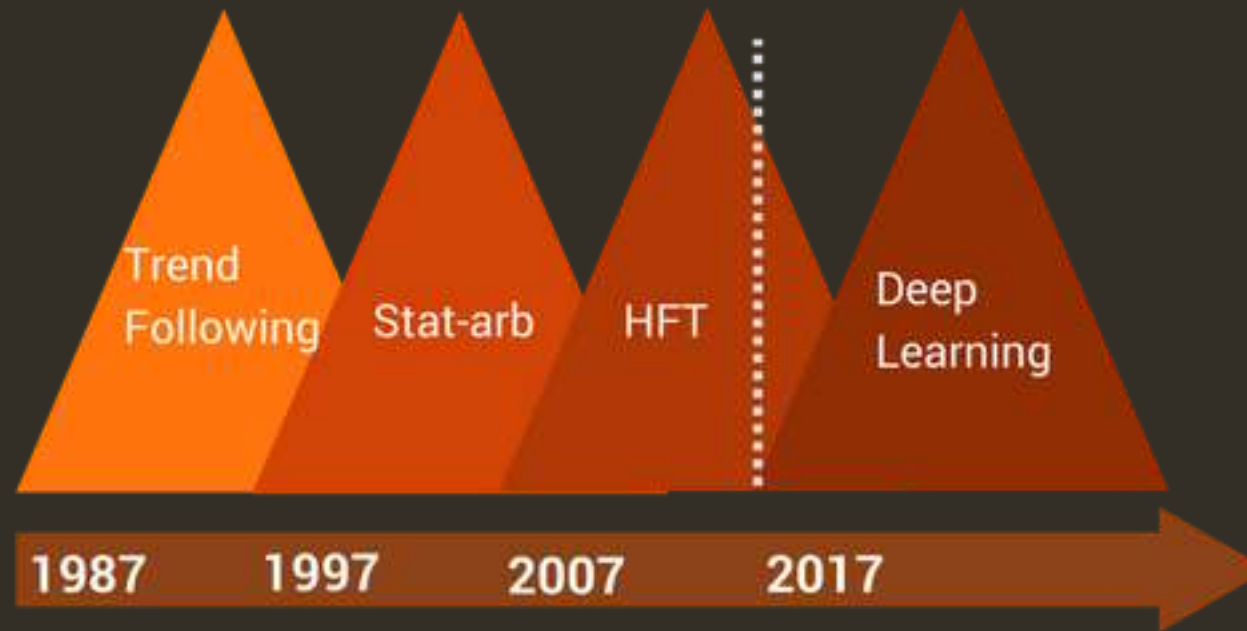
Nobody wants traders



Source: Indeed.com

Nationwide job postings - traders, quants, FinTech, A.I.

The adoption of scientific methods in institutional investing



Ten year cycle of quant trading



Ken Griffin
Citadel



Warren Buffett
Berkshire



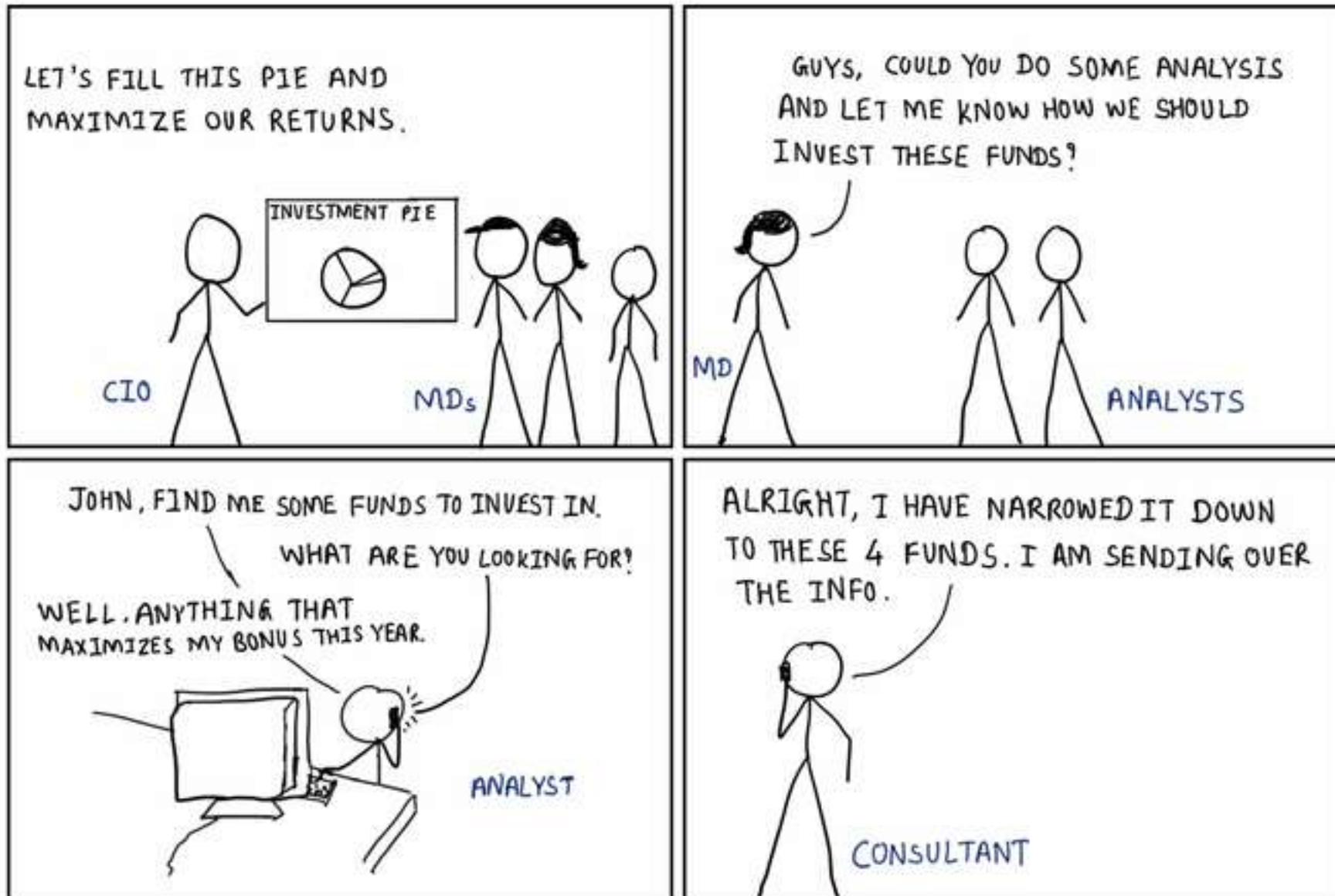
Narv Narvekar
HMC



David Swensen
Yale

What's common to all of their work?

Workflow of institutional investing today



Pain points of institutional investors

The need for

- Lower fees / costs
- Greater transparency

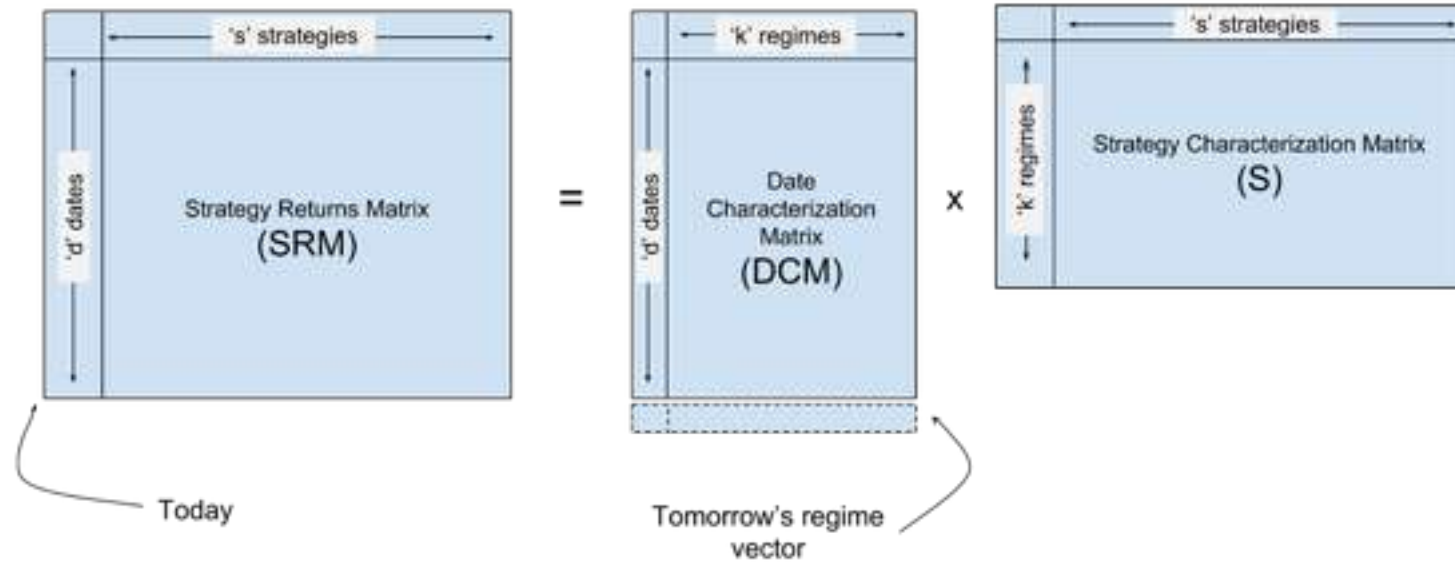
A Machine Learning approach to strategy allocation

It turns out that allocating to investment
strategies is very similar to recommender
systems

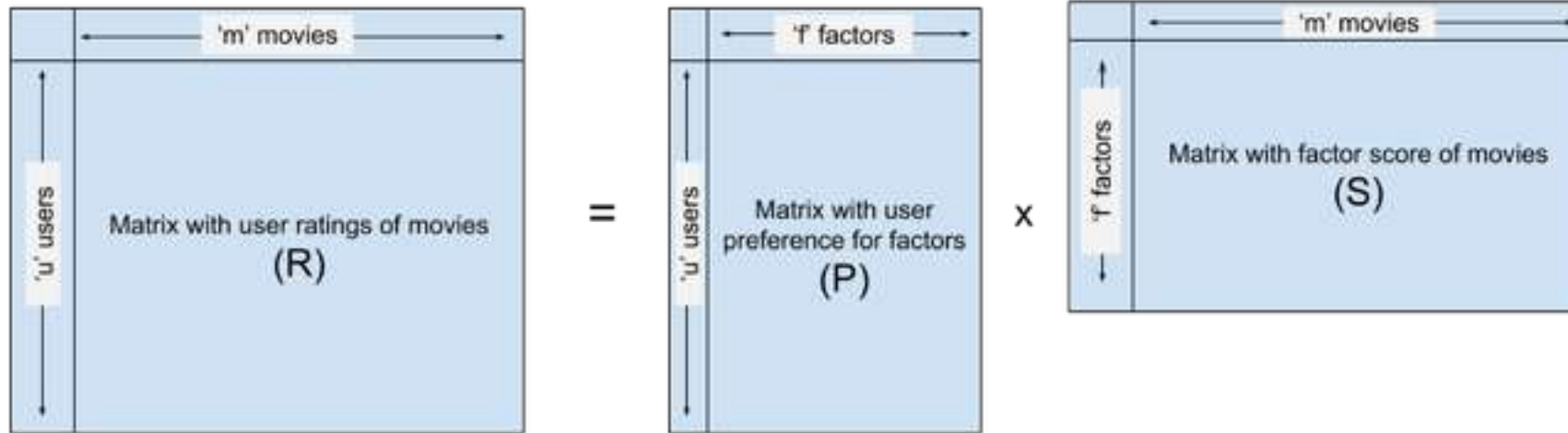
Problem: Given a set of strategies one could allocate to, how much to allocate to each

- Figure out what is similar between the strategies.
- Figure out similarities between the days or periods you are using to backtest them.
- Figure out the easiest prediction problem you can solve that will get your job done.
 - Make a [walk-forward](#) model!

Use a matrix factorization approach to learn which strategies are similar and which dates are similar

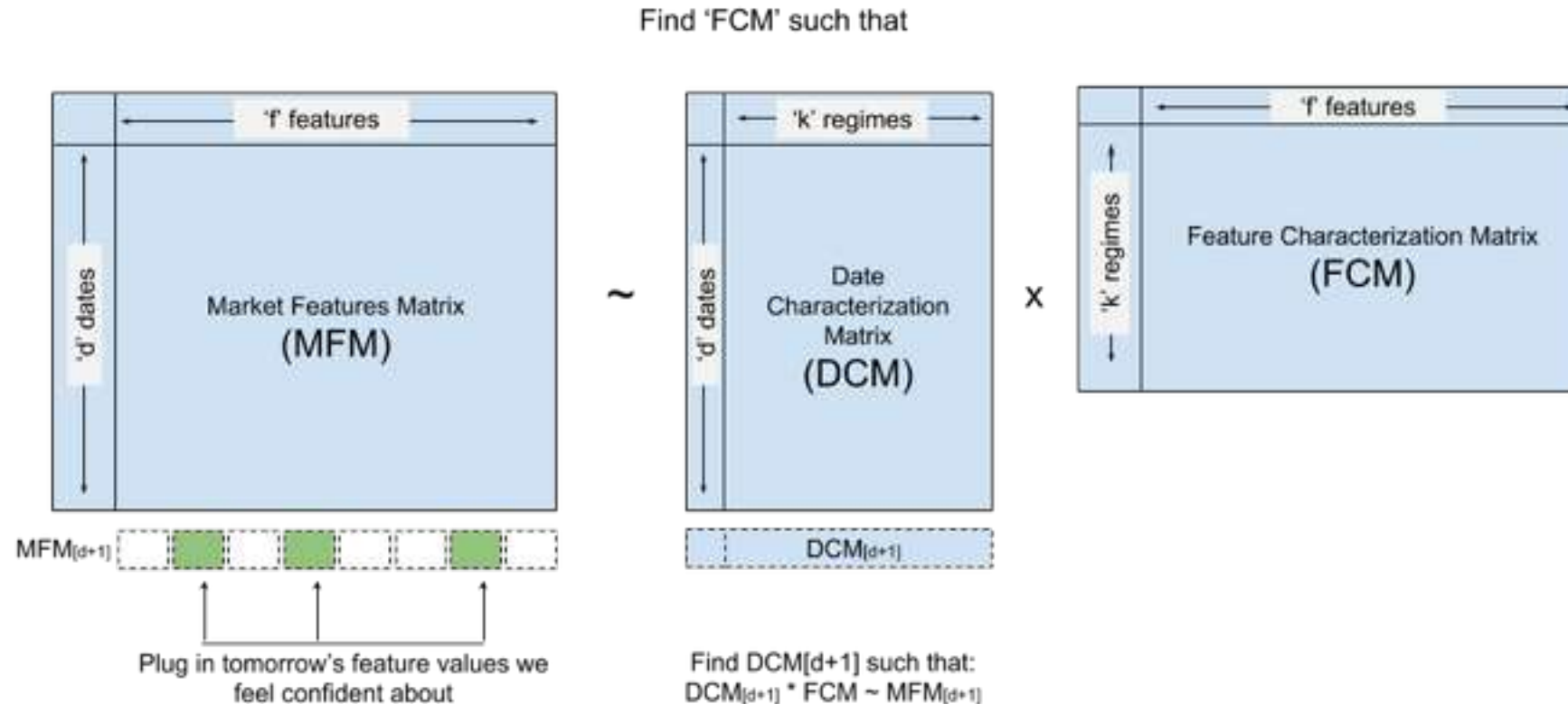


This is very similar to the movie recommendation problem



Visualization of matrix factorization based collaborative filtering

We can extend the matrix factorization approach to include predictable market features like volatility and GDP growth



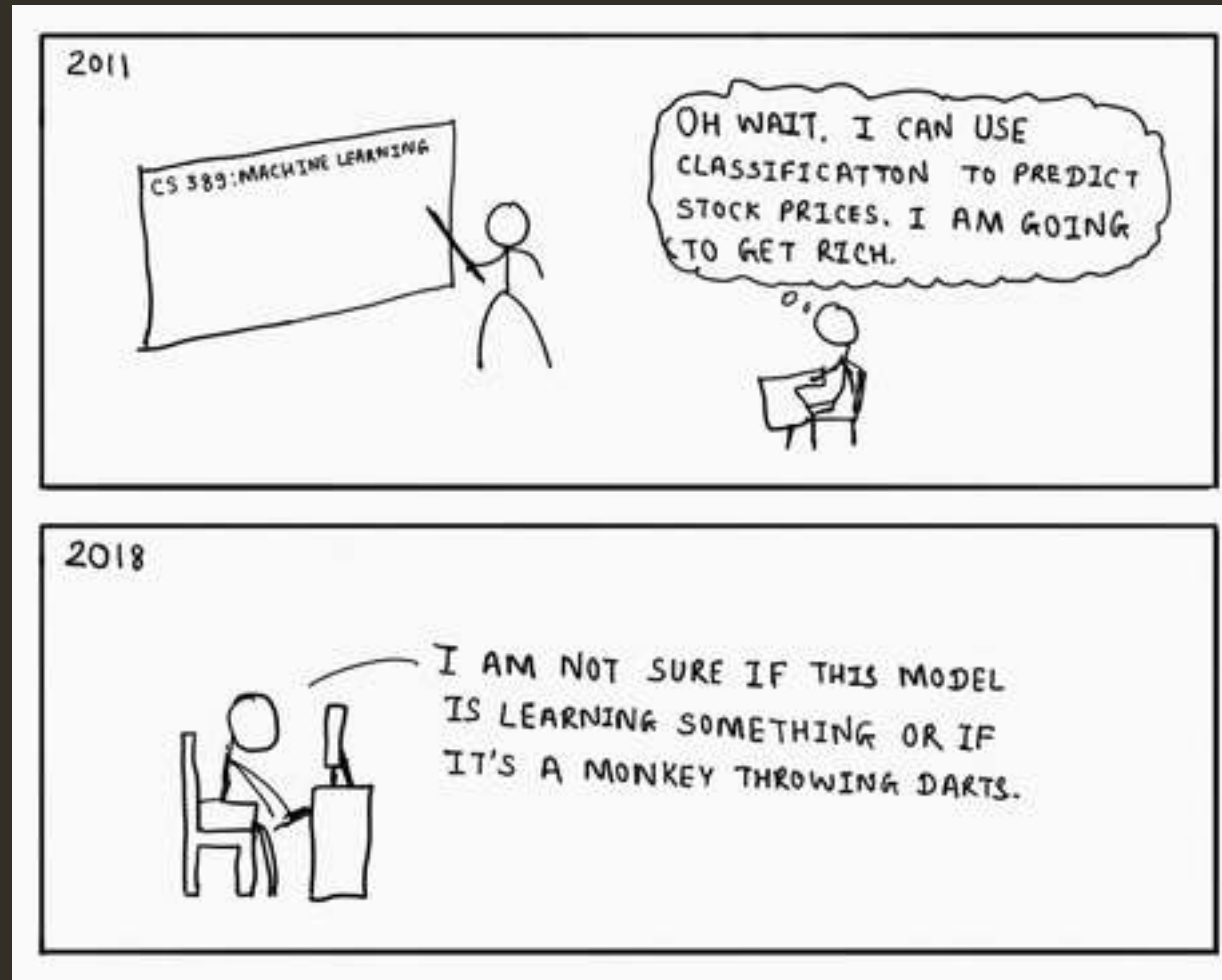
The secret sauce?

Unsupervised learning

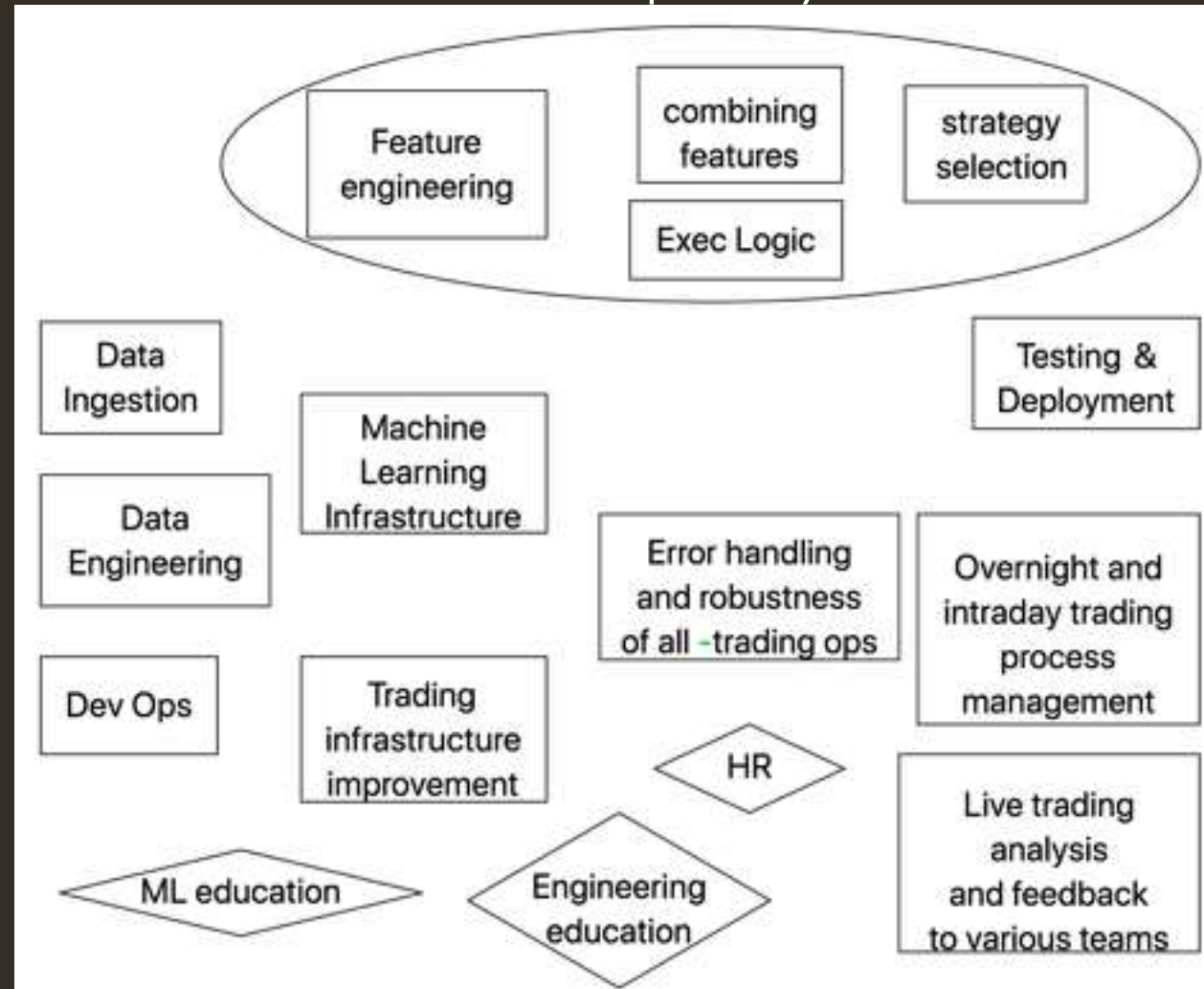
"Unsupervised learning had a catalytic effect in reviving interest in deep learning, but has since been overshadowed by the successes of purely supervised learning. Although we have not focused on it in this Review, we expect unsupervised learning to become far more important in the longer term." - [Geoffrey Hinton et. al., Nature, Deep Learning](#)

- [Investment strategies that learn by themselves](#) (article)

How to implement A.I. within an investment company



An asset management firm needs to look like a tech company now



Infrastructure is key to ML

Hidden Technical Debt in Machine Learning Systems

Google, 2015

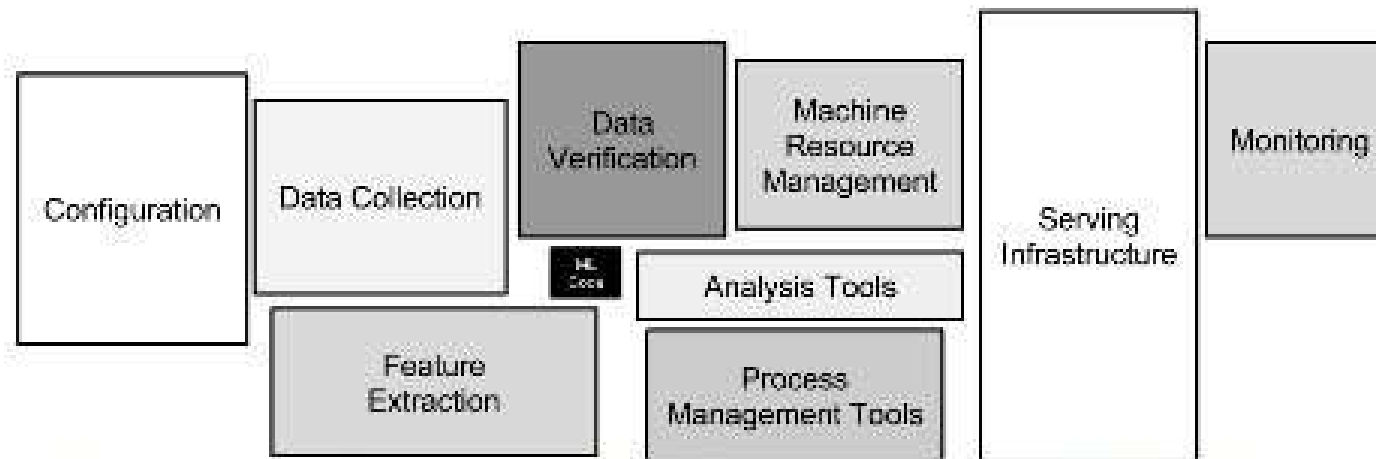


Figure 1: Only a small fraction of real-world ML systems is composed of the ML code, as shown by the small black box in the middle. The required surrounding infrastructure is vast and complex.

<https://papers.nips.cc/paper/5656-hidden-technical-debt-in-machine-learning-systems.pdf>

Investing with a trustworthy tool

*"security analysis may begin--modestly, but
hopefully--to refer to itself as a scientific
discipline "*

Imagining investing with a "*trustworthy tool*"
and not experts!

- Benjamin Graham

Towards a science of security analysis
published 1952



Key Takeaways

Asset management, a \$160 trillion dollar industry is yet to be affected by A.I.

Time is ripe for the move to machine learning methods in institutional investing

- (1) need to reduce costs
- (2) find other sources of returns and
- (3) use of systematic processes

You can make it happen!

Questions / Critiques / Interested in collaboration

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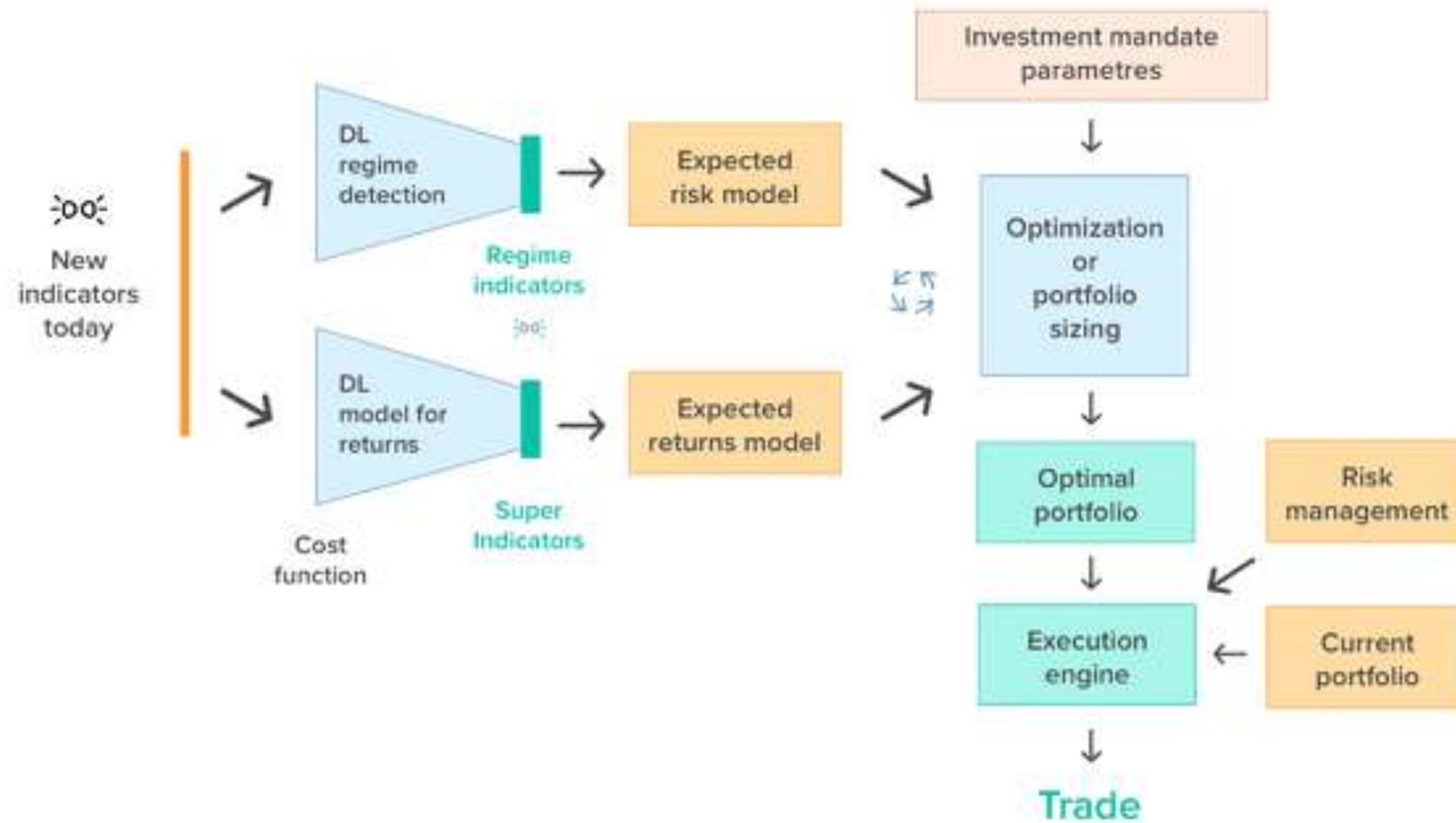
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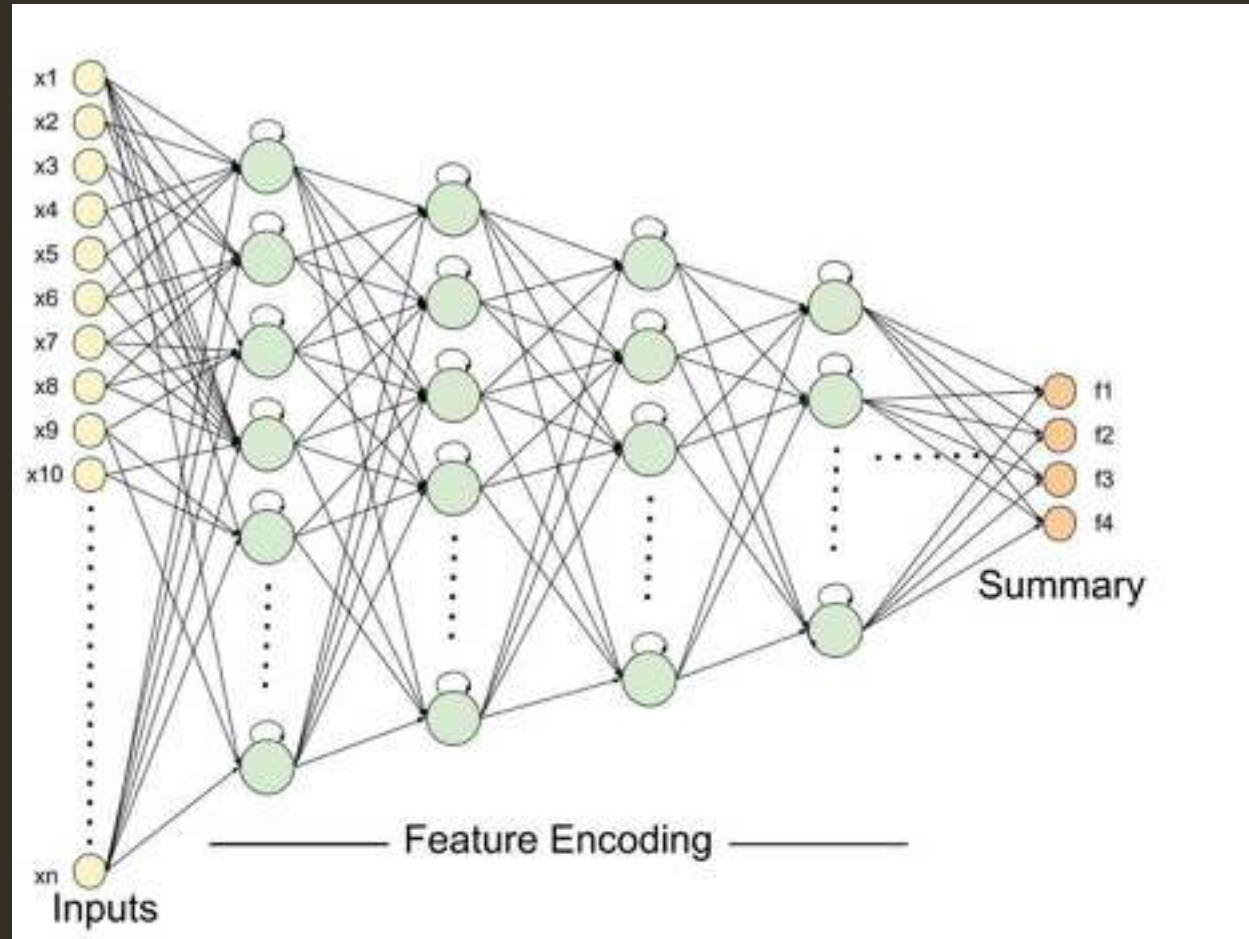
Appendix

Workflow

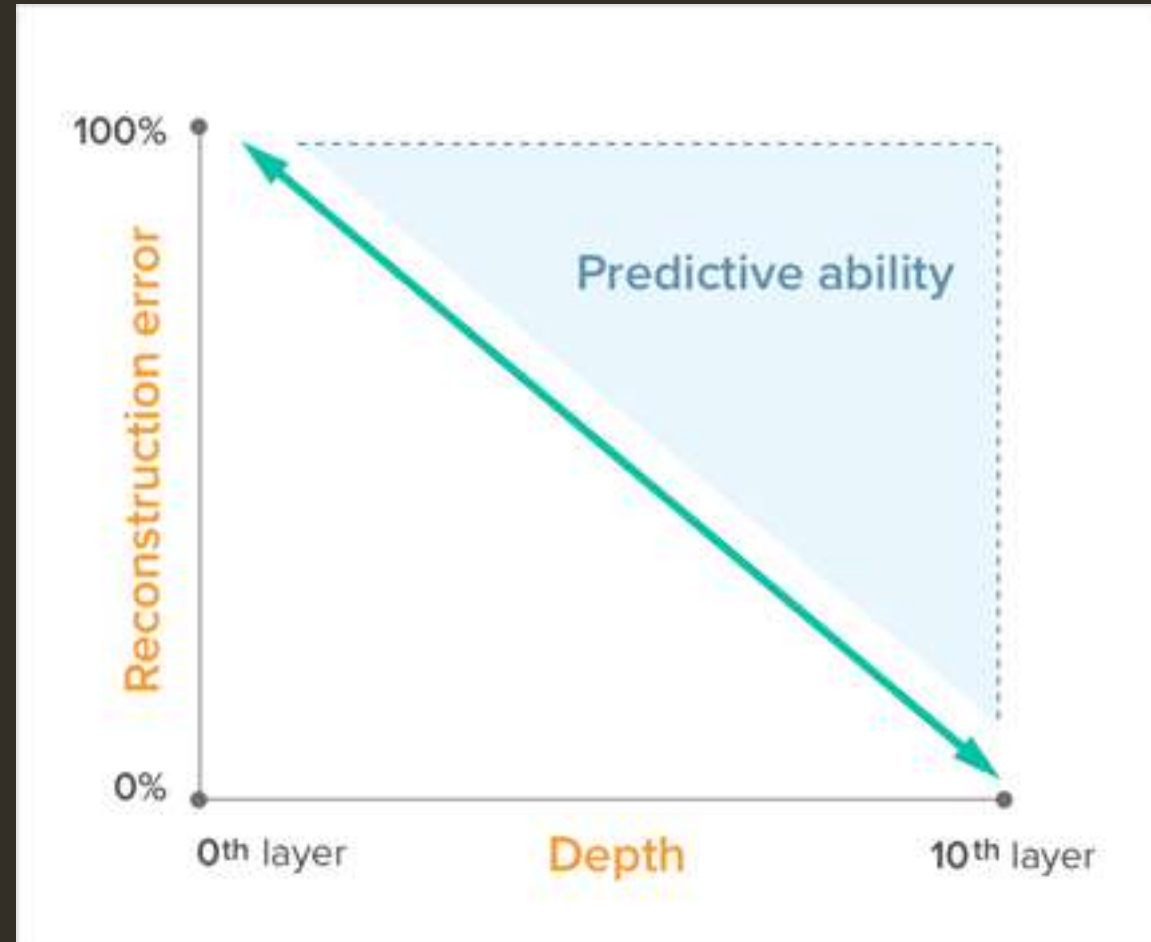
Workflow of using deep learning in tactical asset allocation



Using unsupervised learning in the cost function

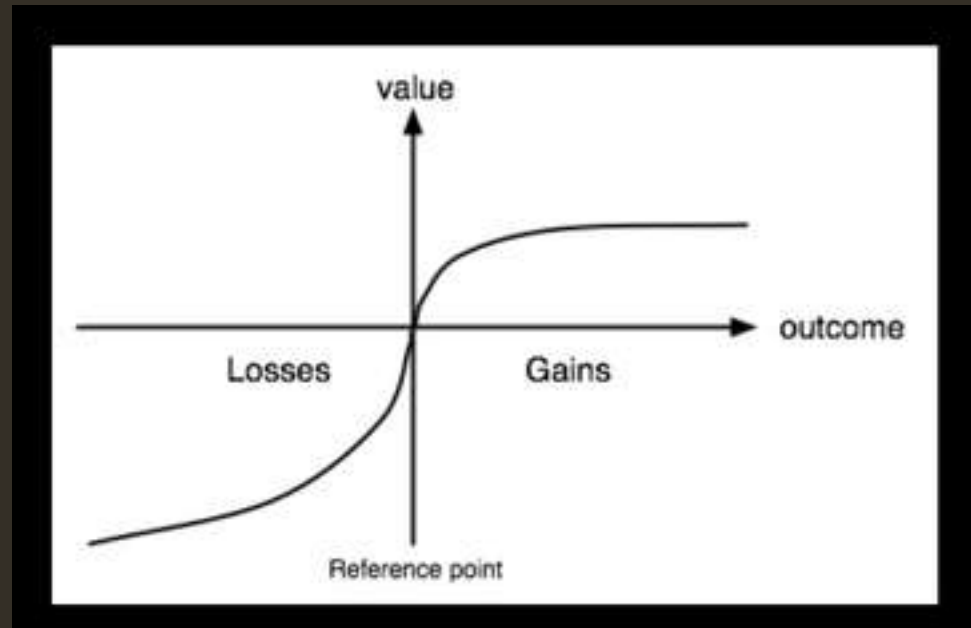


Using unsupervised learning in the cost function



Other pain points of institutional investors

I. Aversion to losing



It is not always just about higher returns.
Utility function is not uniformly distributed.
Utility function is not the same.

II. Anchoring around a sustainability rate

Most pension funds have a nominal target yield.

Not meeting the target yield is a big deal compared to outperformance

III. Capacity:

Investments that have scale and capacity to get in and to get out

IV. Should work with illiquid assets:

Illiquid investments are a part of everyone's portfolio.

One cannot look at liquid investments without considering the illiquid assets that are a part of the portfolio already.

Asset Allocation >> Security Selection

“By choosing to place asset allocation at the center of the investment process, investors ground the decision-making framework on the stable foundation of long-term policy actions.

Focus on asset allocation relegates market timing and security selection decisions to the background, reducing the degree to which investment results depend on mercurial, unreliable factors.

Selecting the asset classes for a portfolio constitutes a critically important set of decisions, contributing in large measure to a portfolio’s success or failure. Identifying appropriate asset classes requires focus on functional characteristics, considering potential to deliver returns and to mitigate portfolio risk. Commitment to an equity bias enhances returns, while pursuit of diversification reduces risks. Thoughtful, deliberate focus on asset allocation dominates the agenda of long-term investors.”

– David Swensen

Goals of asset allocation:

- (a) Target constant risk in the portfolio.
- (b) Optimize portfolio for the specified utility function.
- (c) Constrain any studies to a specified, systematic risk management threshold.

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