Use of recommender systems in the Chief Investment Office

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

Source: Indeed.com
The adoption of scientific methods in institutional investing

Ten year cycle of quant trading
What's common to all of their work?
Workflow of institutional investing today

1. Let’s fill this pie and maximize our returns.

2. Guys, could you do some analysis and let me know how we should invest these funds?

3. John, find me some funds to invest in. What are you looking for?

4. Well, anything that maximizes my bonus this year.

5. Alright, I have narrowed it down to these 4 funds. I am sending over the info.
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.
"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

Why is ML in finance so hard? - Hardik Patel
An asset management firm needs to look like a tech company now.

Source: Lessons from a panel on emerging AI-driven quant managers.
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.


Ref: Infra is key in ML - NIPS
"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!
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Appendix
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.
“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.
Questions / Critiques / Interested in collaboration

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