AIα Lab

The Future of Investing. Today

The Birthday Paradox

Is there anyone whose birthday is April 3rd?

Bias and Self Awareness

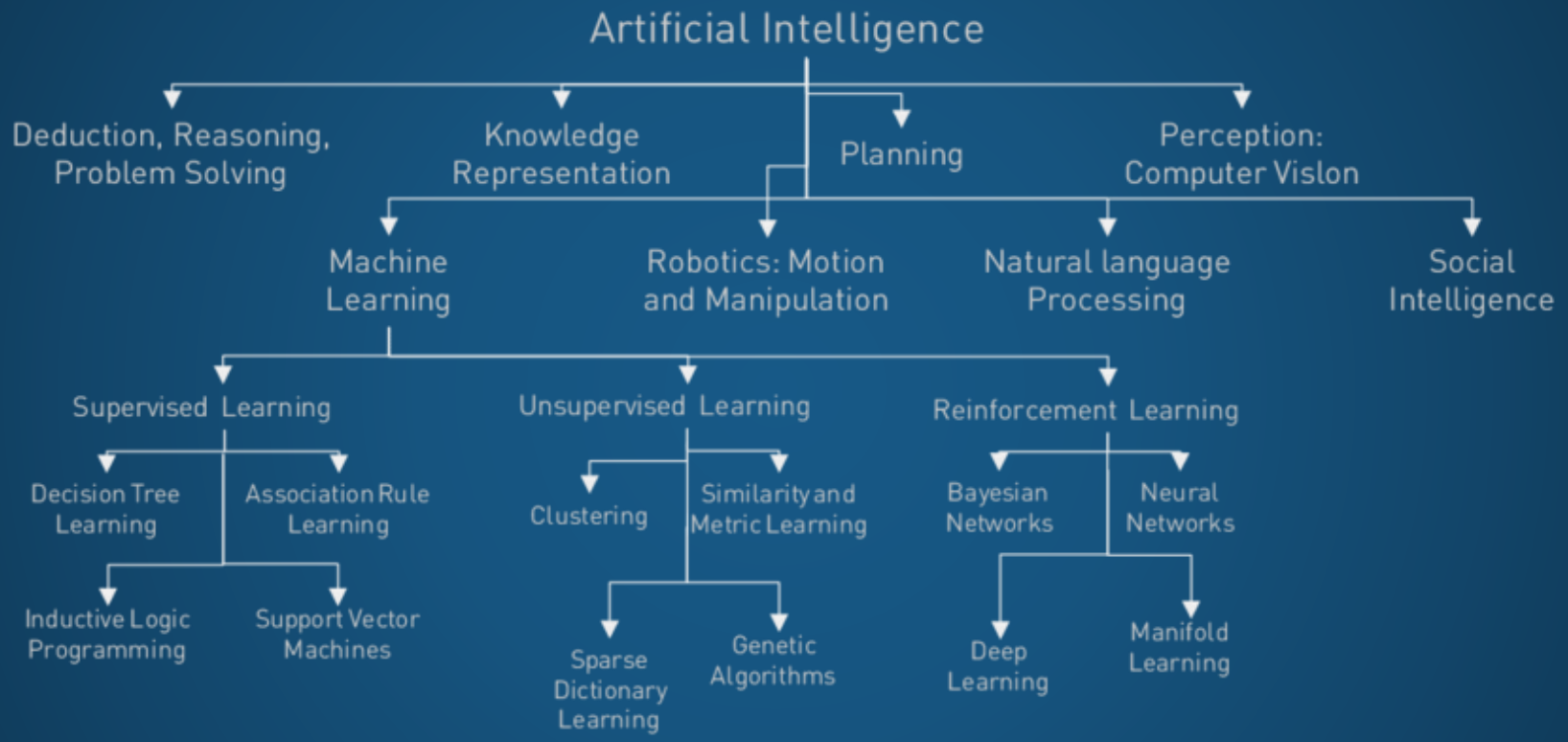
How many of you are below average car drivers?

Bias and Self Awareness

How many of you are below average investors?

AI Requires An Open Mind

The AI Landscape



ANI → AGI → ASI

Forget About Intelligence

- **Intelligence, artificial or human, is very hard to define. Just ask a fruitfly.**
- **It is even more complex to define the relationship between intelligence and good investment results.**
- **Can we, in a non-deterministic world, define a framework that we know for sure will lead to better investment results? YES!**
- **A nescessary condition for good consistent investment decisions is to base them on probabilities. No one quantifies these today and that is a main reason for the lackluster performance of active investors.**
- **Today investors base decisions on the most likely outcome, but there is a big difference between 51% and 85% certainty.**
- **Safe AI is really just about applying models that we already know from the science of physics, capable of quantifying the probability of its own decisions. If investors make decisions aligend with probabilities, they will outperform todays active management over time.**

Empowering investors

Philip Tetlock is a professor in applied psychology and political science.

- He conducted an extensive forecasting experiment between 1984 and 2003.
- The forecasters were expert´s from a variety of fields including finance.
- The experiment solicited roughly 28,000 predictions about the future and found the forecasters were on average not better than random guessing and usually worse than basic extrapolation algorithms.

- BUT, by combining algorithmic anchor-models with the expert predictions, the value of expert forecasts significantly improved.
- Anchoring reduced both bias and (over)confidence in expert forecasts.

The Solution

- Strongest known forecasting framework inspired by the field of physics which has solved some of the most complex tasks in human history.
- Advanced medical diagnostics – COVID tests, cancer screening etc.
- Nuclear physics and quantum physics – describes unmeasurable objects through probabilities.
- Decrypting the Enigma during WWII – combining knowledge and conditional probability.

Bayesian (probabilistic) problem solving framework

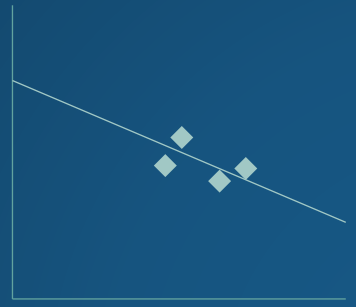
Applied to a deep neural network in order to find causal patterns

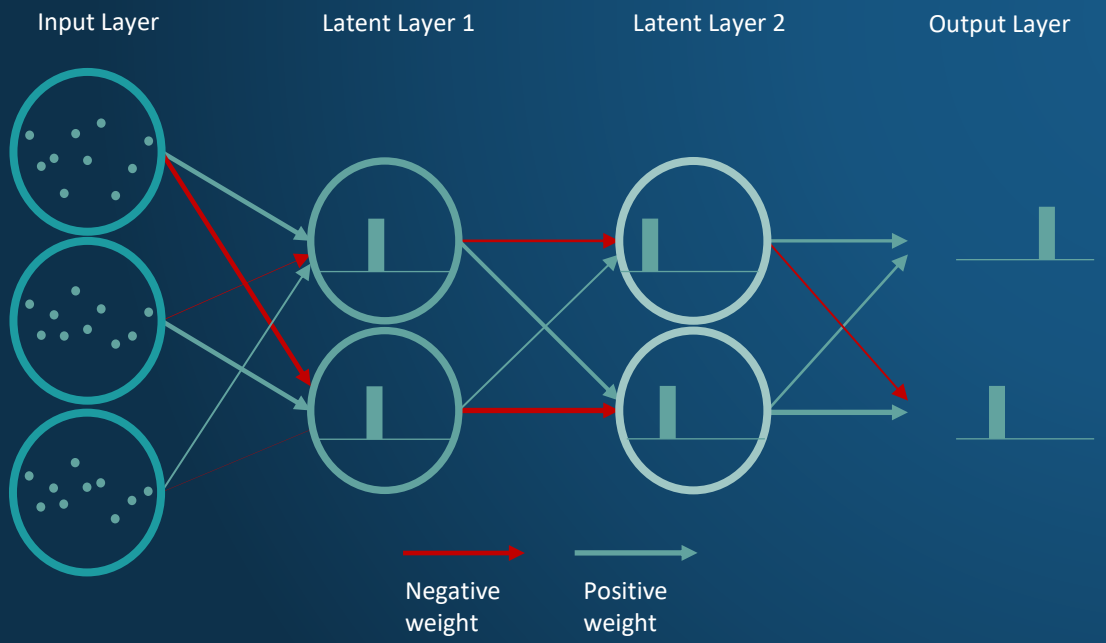
Combined with sound risk first principles to avoid spurious results

Ensemble of output to ensure robustness

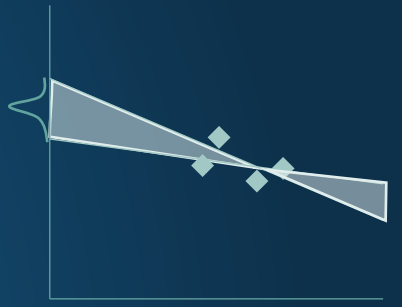
AI That Matters

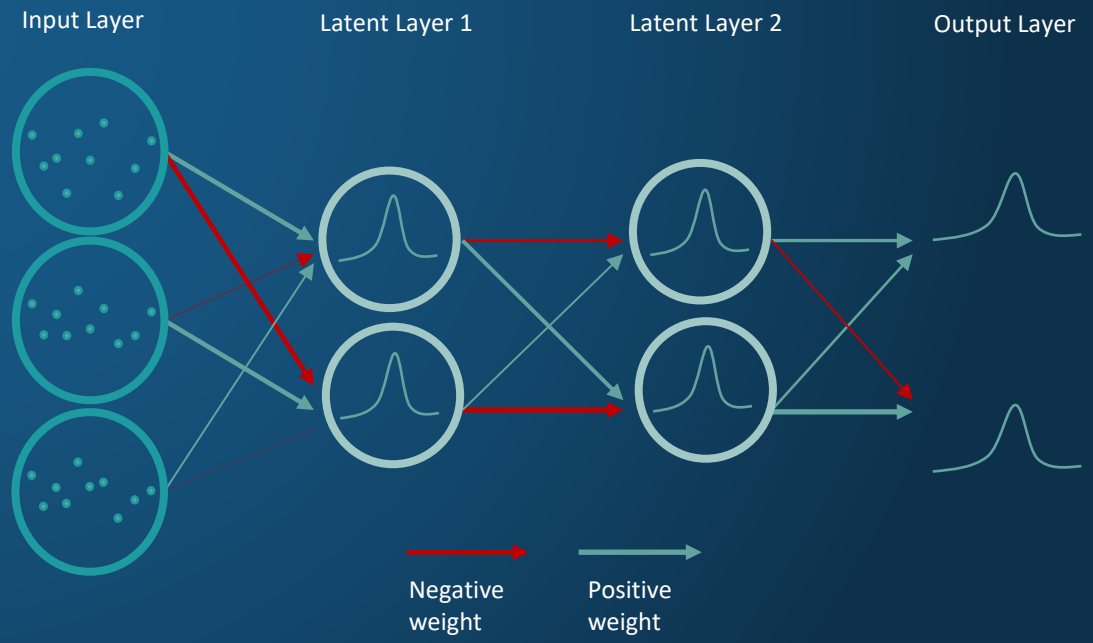
- Neural networks are good at pattern recognition.
- Estimates the best model through optimization and provides no explicit model uncertainty.





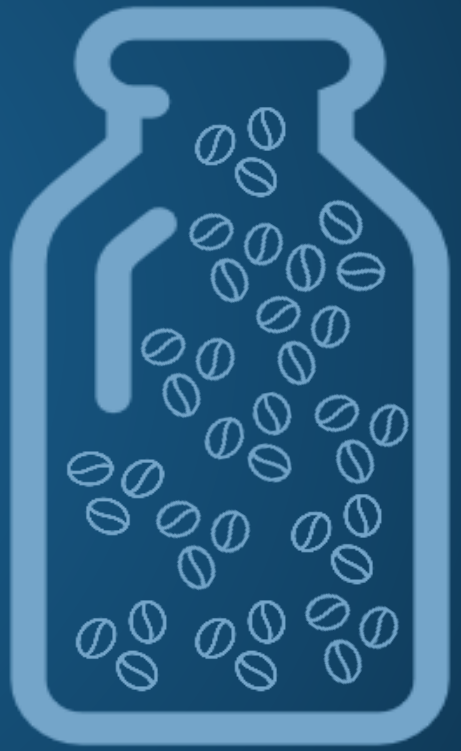
- A Bayesian neural network combines the pattern recognition capabilities of a neural network with the probabilistic features of Bayesian statistics.
- Estimates the best model through sampling and provides explicit model uncertainty.



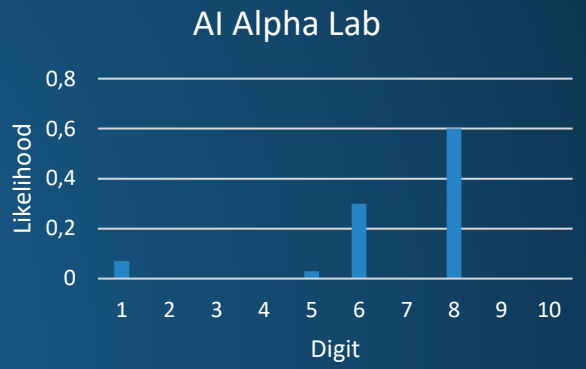


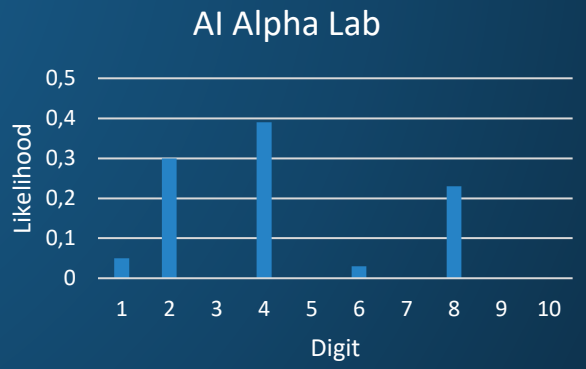
Probabilistic Estimation

- 1 analyst vs. 1000 analysts. Which is better?
- Some of the most challenging problems in human history has been solved by adding weak predictive models.
- How to determine the number of beans in a glass by the help of a dinner party?



Uncertainty - A New Dimension In AI





Our models must tell us, when they don't know.

Improving Decision Making

Stock 1
Expected Return: 8%
Expected Volatility: 8%

Stock 2
Expected Return: 10%
Expected Volatility: 8%

No Model Uncertainty

Investment Decision
Stock 2 is preferred

Stock 1
Expected Return: 8%
Expected Volatility: 8%

Stock 2
Expected Return: 10%
Expected Volatility: 8%

Model Uncertainty

80% Certainty

20% Certainty

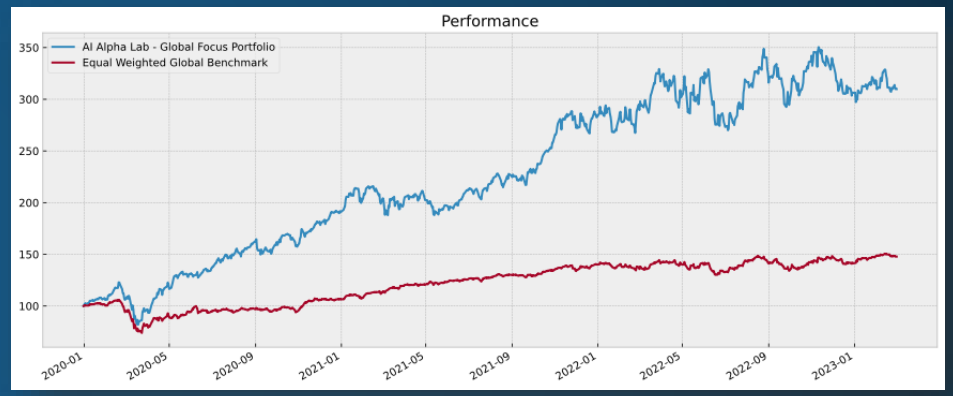
Investment Decision
Stock 1 is preferred

The Uncertainty Difference

Global Equities AI Model - Without uncertainty

- CAGR: 23,2%
- Max Drawdown: -34,0%
- Sharpe Ratio: 1,03
- Rolling 12m win ratio: 97%

Global Equities AI Model - With uncertainty



- CAGR: 42,9%
- Max Drawdown: -33,1%
- Sharpe Ratio: 1,49
- Rolling 12m win ratio: 97%

Uncertainty quantification is our unique alpha source.

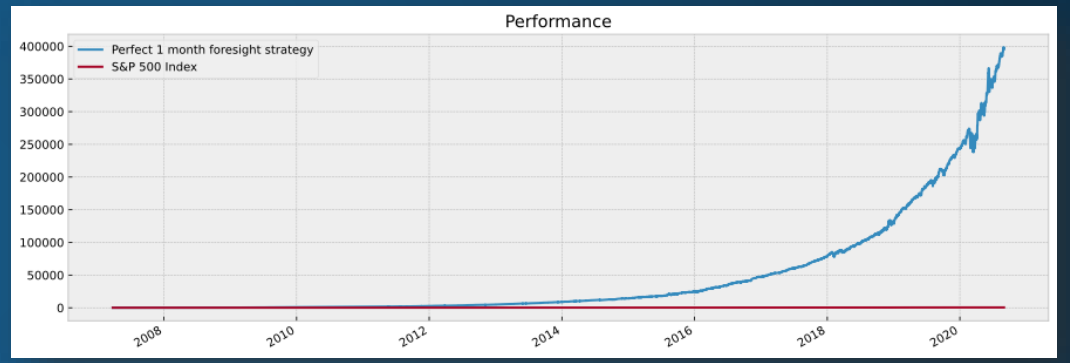
Aligning expectations

For a broad global stock index such as MSCI World, historical data looks roughly like this when investing at a random point in time and holding the investment:

Time horizon	Historical probability of a positive return
1 year	~70–75%
5 years	~85–90%
10 years	~95%+
15 years	Historically close to 100%

Aligning expectations

	Crystal Ball Portfolio (3 years)	S&P 500 Indeks
Yearly Return	19,4%	13,4%
Maximum Drawdown	-42,9%	-47,3%
Sharpe Ratio	1,2	0,9
% Positive Years	90%	87%



	Crystal Ball Portfolio (1 month)	S&P 500 Indeks
Yearly Return	85%	13,4%
Maximum Drawdown	-16,4%	-47,3%
Sharpe Ratio	6,7	0,9
% Positive Years	100%	87%

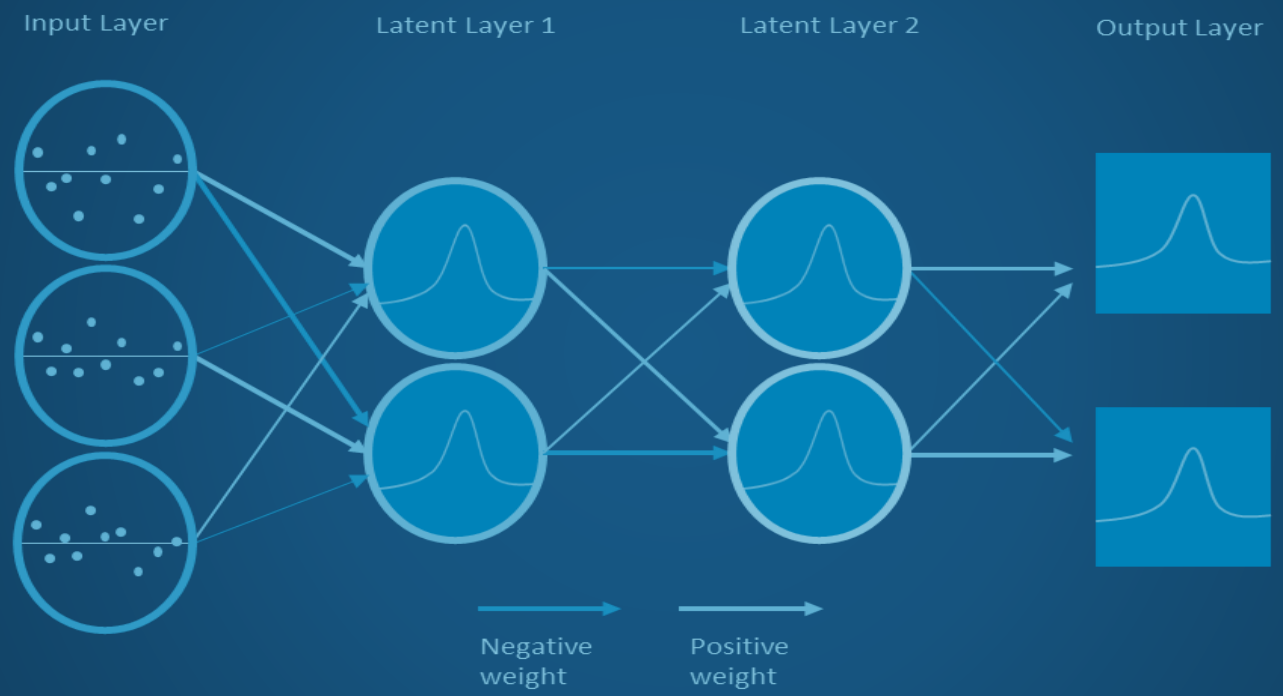
Momentum

The most well documented equity factor across time.

The Momentum AI Model

Input

Price information (various return, volatility and correlation features) on all stocks comprising the investment universe of interest. All data is cleaned and prepared in order to optimize the model's information extraction process.



Output

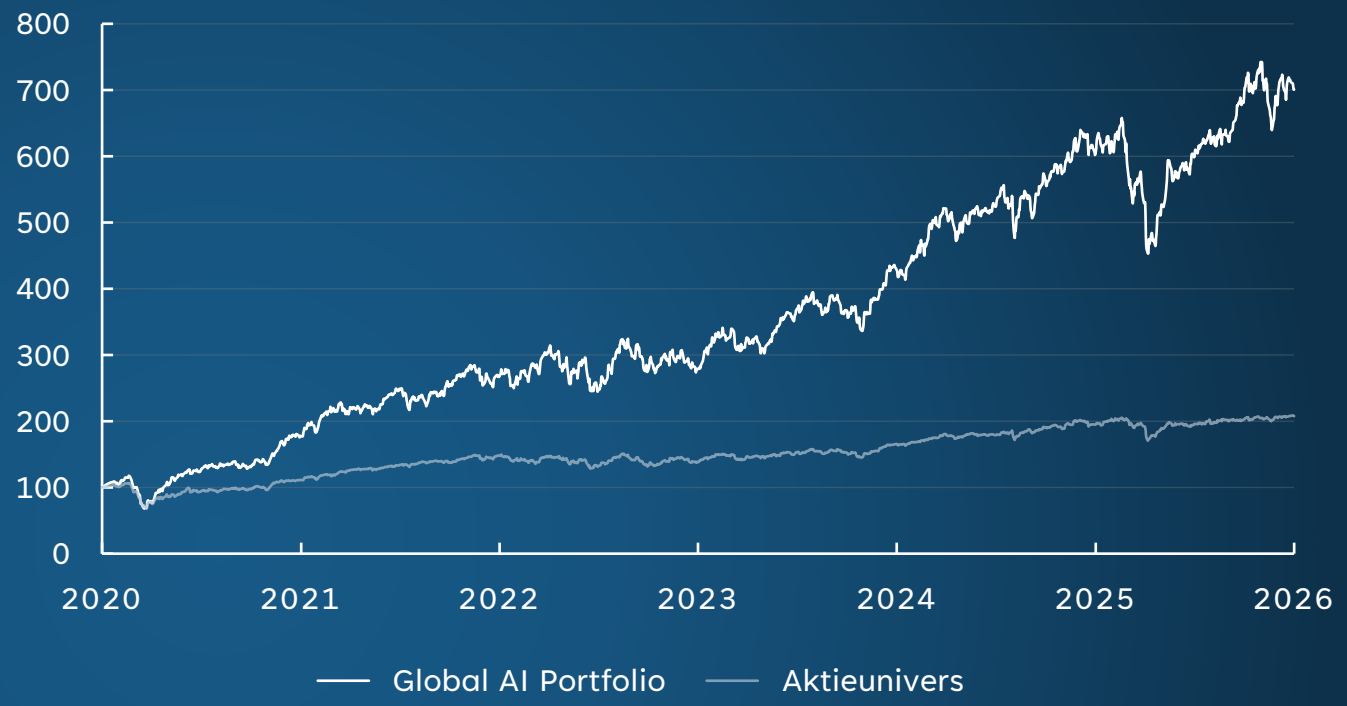
Based on interrelationships in input data, the probabilistic deep learning model calculates all possible future return scenarios explained by data. The model output is the probability of future excess return for the stocks of interest, where stocks with many future scenarios exhibiting future excess return, have a higher probability of actually realizing future outperformance.

We enhance well documented return drivers using probabilistic AI.

AI Alpha Lab Global AI Portfolio

Afkast	AI-model	Aktieunivers
Siden start	600,7%	107,7%
ÅTD	16,4%	6,7%
1 år	16,4%	6,7%
3 år (ann.)	36,0%	14,5%
Hele perioden (ann.)	38,3%	13,0%

Risiko	AI-model	Aktieunivers
Største tab	-42,0%	-36,2%
Årlig volatilitet	29,7%	15,6%
Sharpe Ratio	1,25	0,86
Sortino Ratio	2,84	1,54
Calmar Ratio	0,91	0,36



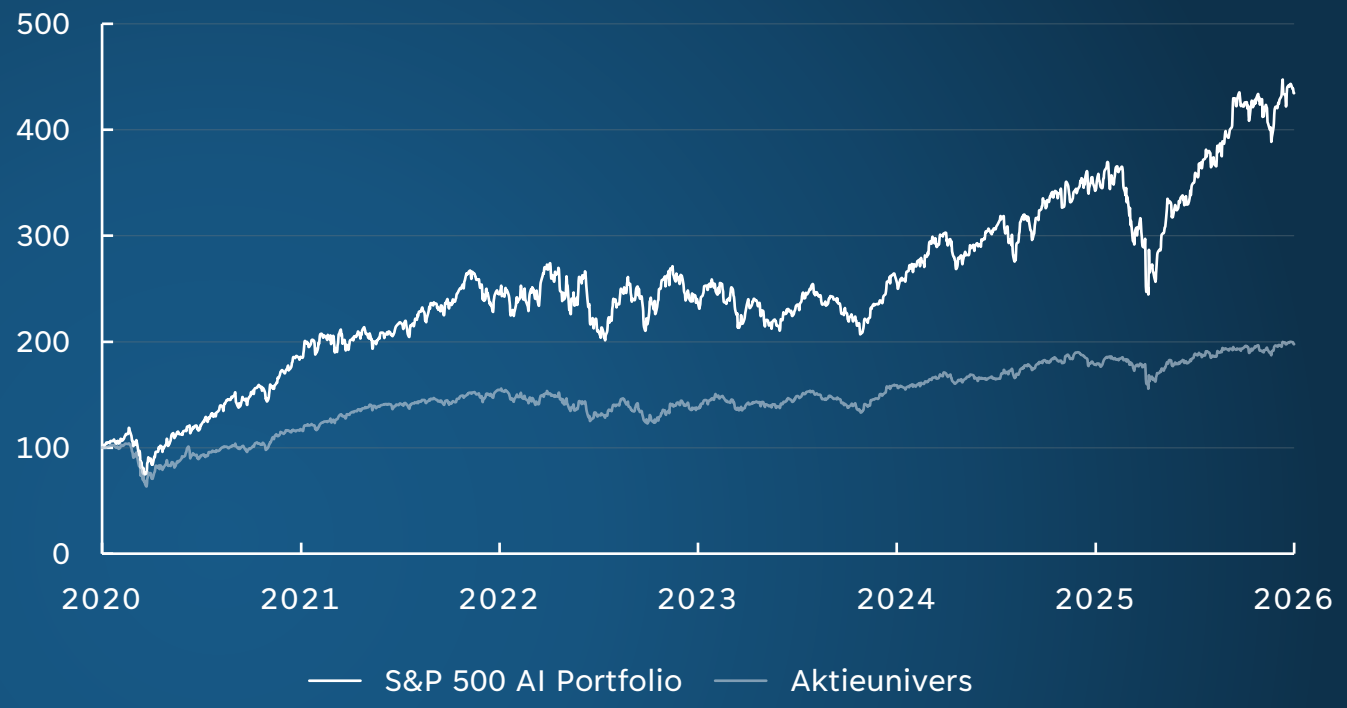
Alle afkasttal er baseret på simuleret modelporteføljeafkast for perioden 01.01.2020 - 31.12.2025. Valuta: EUR. Aktieunivers: Portefølje bestående af alle aktier fra investeringsuniverset med samme vægt. Inklusive transaktionsomkostninger på 0,2% på alle handler. Gebyrer afholdt af investor såsom administrationsgebyr og depotomkostninger er ikke inkluderet.

De viste afkast er simulerede og udgør derfor ikke afkast fra en faktisk investering i perioden. Det understreges, at historiske afkast, hvad enten de er faktiske eller simulerede, ikke er en garanti for fremtidige afkast, ligesom afkastet kan variere som følge af udsving i valutakurser.

AI Alpha Lab S&P 500 AI Portfolio

Afkast	AI-model	Aktieunivers
Siden start	334,6%	97,7%
ÅTD	26,9%	10,7%
1 år	26,9%	10,7%
3 år (ann.)	23,5%	13,0%
Hele perioden (ann.)	27,7%	12,0%

Risiko	AI-model	Aktieunivers
Største tab	-36,9%	-38,9%
Årlig volatilitet	27,3%	19,1%
Sharpe Ratio	1,04	0,69
Sortino Ratio	2,06	1,26
Calmar Ratio	0,75	0,31



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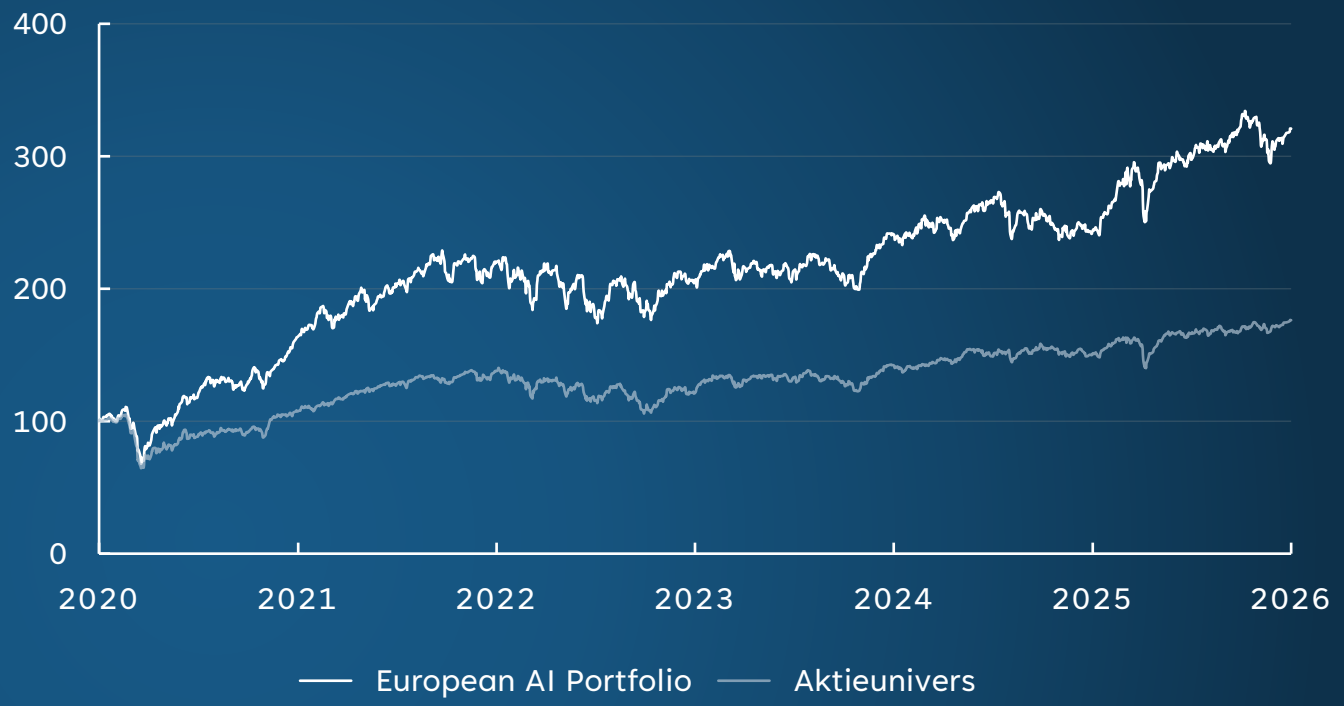
AI Alpha Lab European AI Portfolio

Afkast	AI-model	Aktieunivers
Siden start	220,9%	76,3%
ÅTD	32,3%	17,1%
1 år	32,3%	17,1%
3 år (ann.)	15,7%	13,1%
Hele perioden (ann.)	21,4%	9,9%

Risiko	AI-model	Aktieunivers
Største tab	-38,7%	-38,5%
Årlig volatilitet	20,5%	17,7%
Sharpe Ratio	1,05	0,62
Sortino Ratio	2,31	1,07
Calmar Ratio	0,55	0,26



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Appendix

Active vs. Passive

Why low tracking error makes outperformance unlikely
Many “active” funds have very low tracking error (TE) and therefore effectively function as closet indexers.
Excess return depends on active risk and is described by:

$$\text{Excess return} = IR \times TE$$

To beat the benchmark after fees, the following applies:

$$IR \geq \text{Fee} / TE$$

If TE is only 1–3× higher than fees, an unrealistically high Information Ratio (IR) is required:

TE = Fee → IR = 1.0 → practically impossible

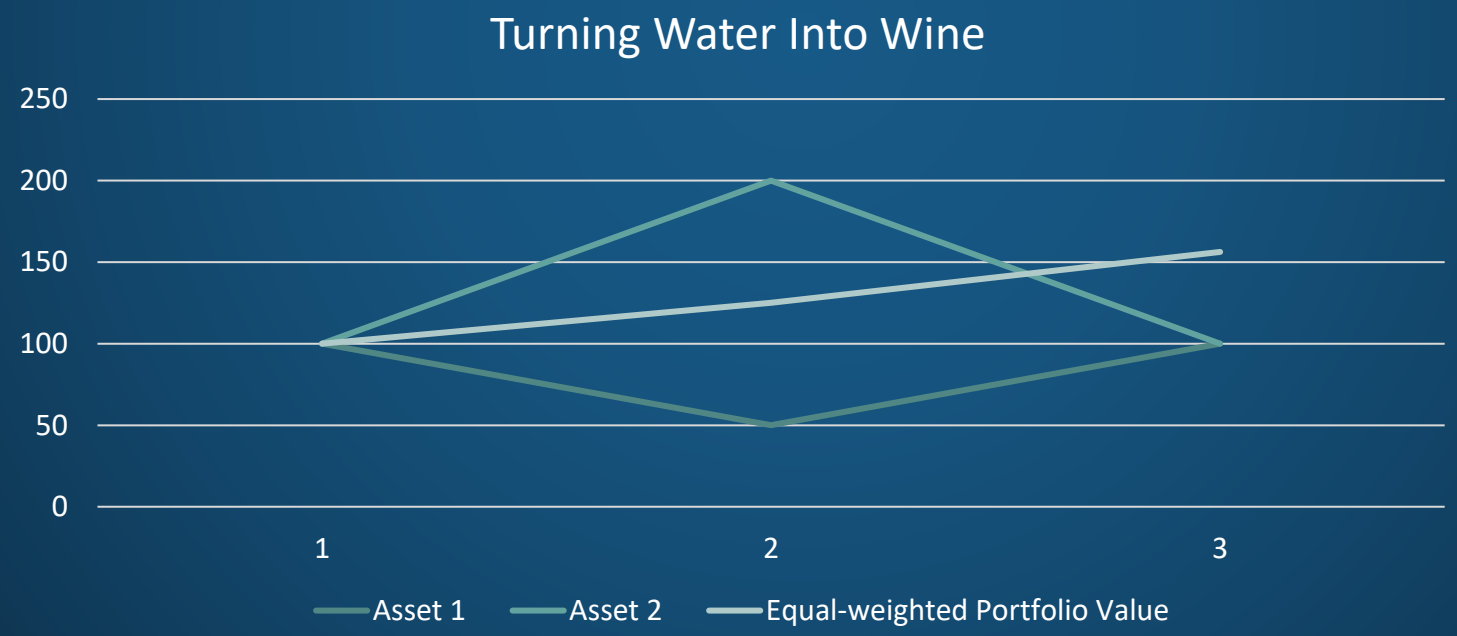
TE = 2× Fee → IR = 0.5 → extremely rare

TE = 3× Fee → IR = 0.33 → still very unlikely

The conclusion is therefore that low-TE managers can hardly create sustained excess returns after costs.
By removing these managers, the probability of finding truly active managers with real potential for outperformance increases.

Volatility Harvest

- In the presence of “sufficient intrinsic volatility", volatility harvesting is an excess return captured by exploiting the natural short term volatility in the markets (mean reversion). By frequently rebalancing back to efficient target weights, a volatility premium can be added to the return of the strategy. This is the focus in Stochastic Portfolio Theory (SPT).



Principal Component Analysis

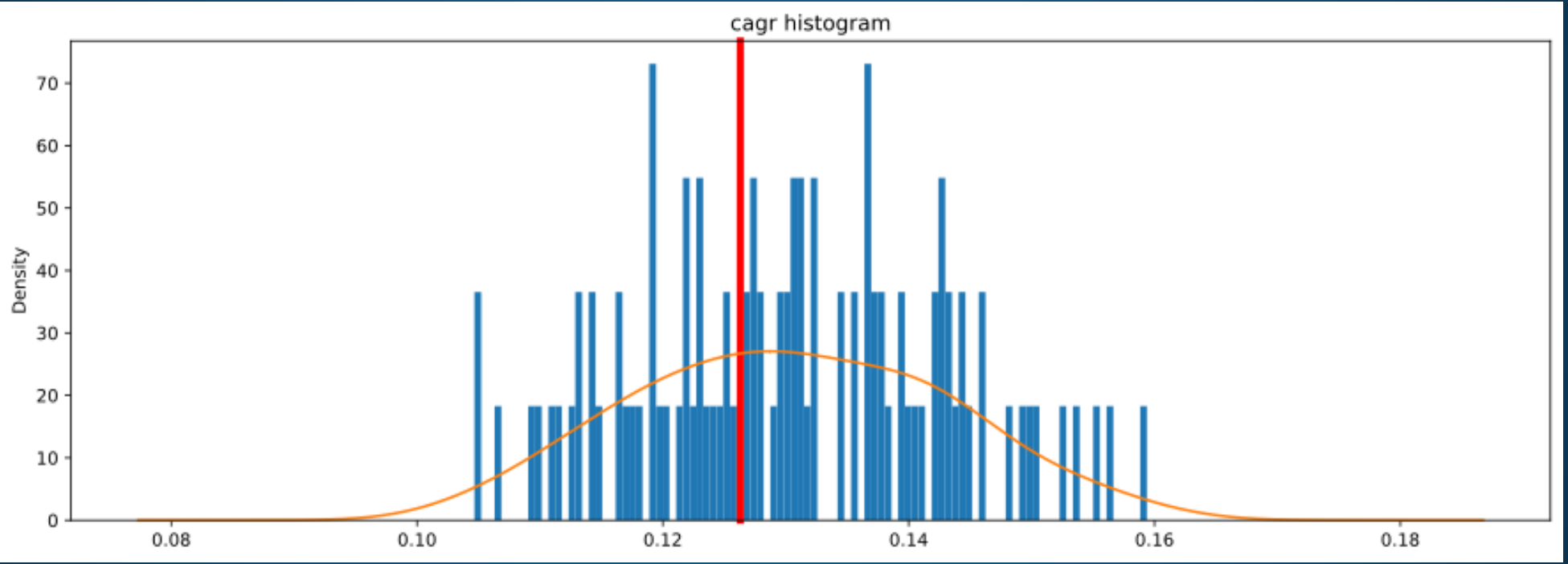
Principal Component Analysis (PCA) is used to identify the most important underlying risk factors in a stock universe. The analysis transforms many correlated stocks into a smaller number of independent components (“bets”) that explain the majority of the variation in returns. Typically, a few factors – e.g. market, sector, style or macro themes – will dominate the risk, even in very large portfolios.

This means that the number of truly independent investment opportunities is often far lower than the number of stocks. If a universe of 500 stocks is in practice only driven by, for example, 5-6 dominant factors, this sets a natural upper limit on both diversification and the potential for outperformance. When most positions are exposed to the same underlying factors, it becomes more difficult to create true diversification and sustainable alpha through active stock picking alone.

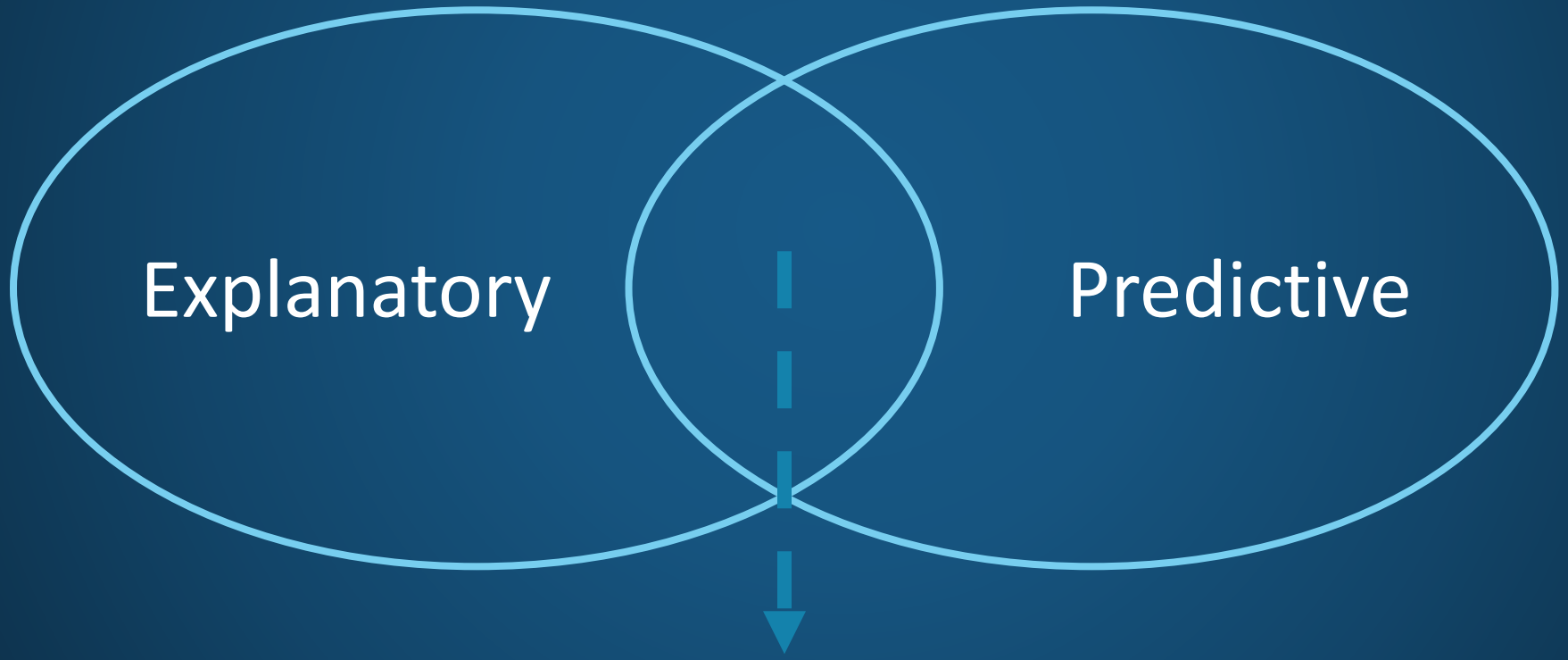
PCA can therefore be used as a tool to quantify how many “independent bets” a stock universe actually contains – and thus how much risk can realistically be diversified away, as well as how much information advantage an active investor can potentially exploit.

Number of independent return drivers:
Global stock market: 6.5
S&P 500: 3.5
Danish stocks (C25): 1.5

Be Systematic About Randomness



All Models Are Wrong But Some Are Useful



Predictive models where we understand the underlying scientific rationale for model predictions.

Process-Diversification

- We want to approach the selection of securities as general as possible, in order to get exposure to the concept and not a certain specification. Ensemble learning has shown that generalization to signal extraction produce superiour and more stable results.

- Ensemble methods combines a wide range of models and specifications to give the most robust estimate. This advanced signal extraction technique makes a portfolio robust to a wide spectrum of future market conditions.

- Ensemble momentum strategy example (2002-2019 period, (SPY,SHY)):

Metric	Momentum 1	Momentum 2	Momentum 3	Momentum 4	Momentum 5	Momentum 6	Combined Momentum Strategy
Yearly Sharpe	0.94	0.80	0.73	0.83	0.82	0.55	0.88
Yearly Sortino	5.68	3.61	4.14	3.99	4.15	1.22	5.70

This is the difference...

Maximum likelihood paradigm

$$P(H|e) \neq P(e|H)$$

Full Bayesian inference paradigm

Likelihood
How probable is the evidence given that our hypothesis is true?

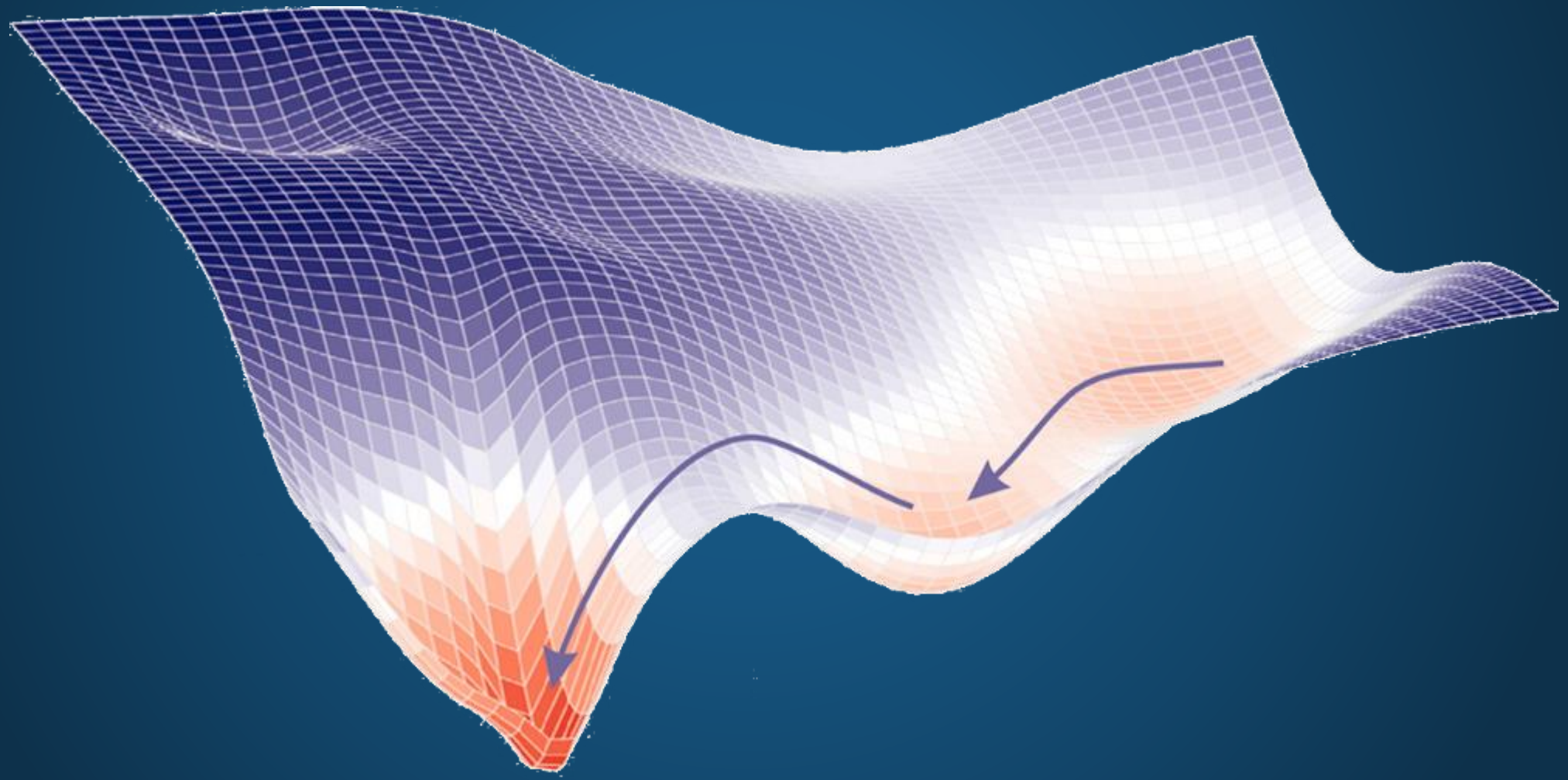
Prior
How probable was our hypothesis before observing the evidence?

$$P(H|e) = \frac{P(e|H)P(H)}{P(e)}$$

Posterior
How probable is our hypothesis given the observed evidence?

Marginal
How probable is the evidence under all possible hypotheses?

This Is What Everybody Is Doing



The Company

The leading AI company within asset management in the Nordics.

- At AI Alpha Lab we optimize the intersection between, the scientific method, solid investment principles and the newest technology.
- Our team has more than 15 years of experience within asset management and probabilistic machine learning.
- From the investment side our team has strong competencies within quant strategy building, portfolio construction and risk management.
- Our highly specialized AI team has a background in physics and machine learning and together with our investment team they have developed a unique probability based neural network showing strong results both in and out of sample (running live since December 2019).
- Our AI model has numerous applications i.e. stock selection, portfolio construction, tactical asset allocation, manager selection etc.