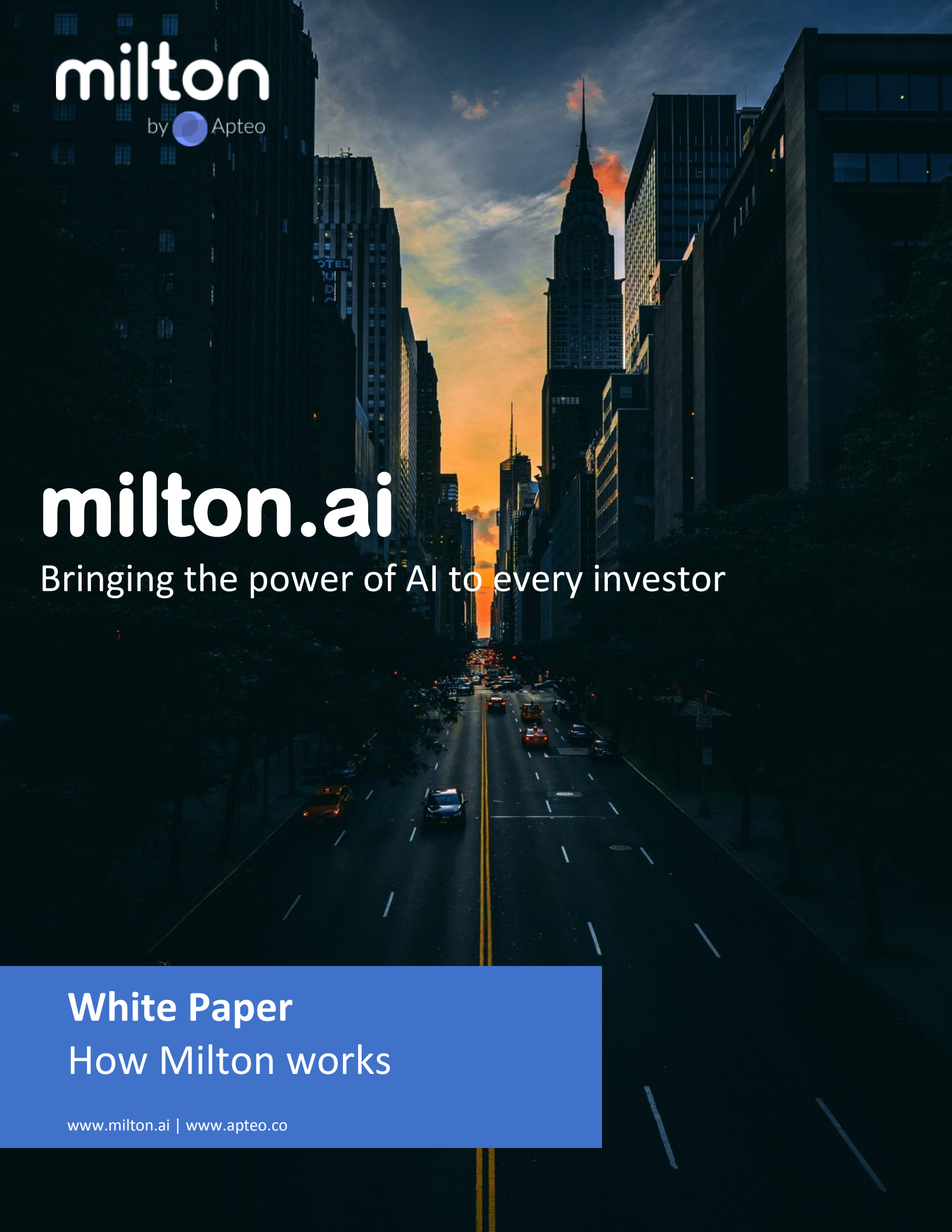

milton
by Apteo

milton.ai

Bringing the power of AI to every investor

White Paper

How Milton works

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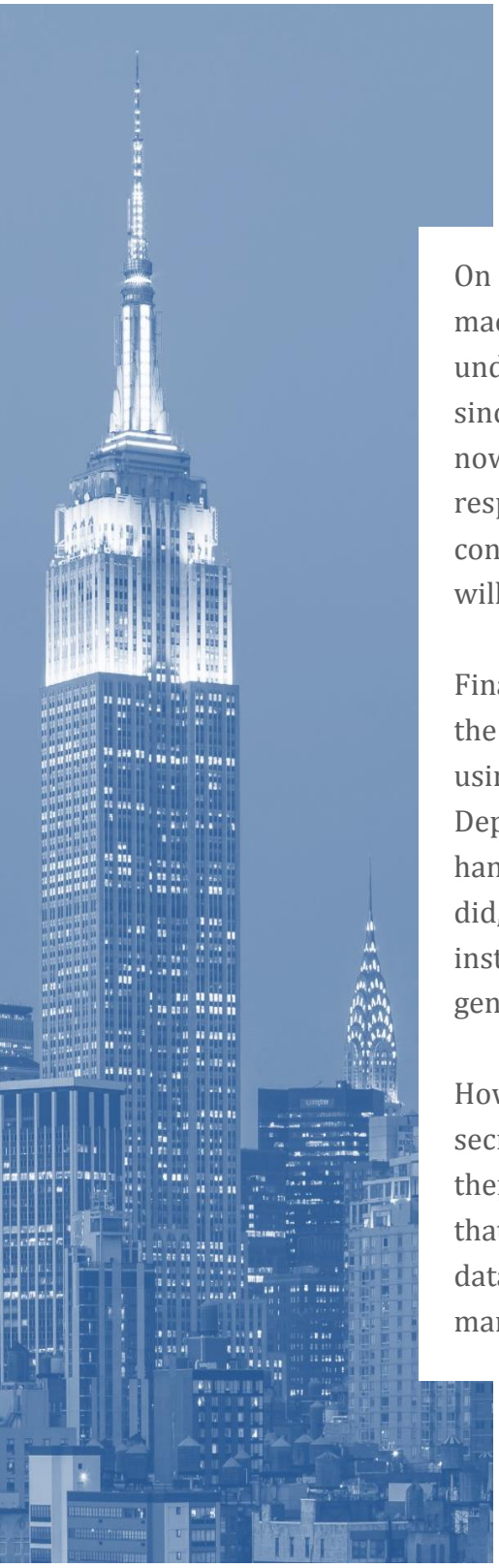

"I would probably bet on the human plus machine"

- ***Gary Kasparov, World Chess Champion***

AI IN FINANCE

On February 10, 1996, IBM's Deep Blue became the world's first machine to win a game of chess against a reigning world champion under regular time controls. In the more than 20 years that have since passed, artificial intelligence (AI) has grown immensely and is now changing nearly every industry. Today, it's driving our cars[1], responding to our voice commands, improving our healthcare[2], and controlling the temperature of our homes[3]. Many people believe AI will change everything[4], and that includes the world of finance.

Financial companies have long been among the earliest adopters of the latest computing technologies. In the 80s, credit issuers began using AI to detect fraudulent charges[5]. In the 90s, the US Department of Treasury created a system that could analyze handwriting in an effort to identify money laundering, which they did, to the tune of $1 billion[6]. Today, sophisticated financial institutions use AI to manage capital[7], run trading systems[8], and generate personalized insights[9].

However, many of these organizations keep their AI technologies secret, which is why we at Apteo think that now is the time to bring them to all investors. That's why we created Milton, an AI system that learns how to use qualitative data (e.g., news), quantitative data (e.g., financials), and alternative data (e.g., FB likes) to analyze markets, stocks, and generate valuable investment insights for all.

[1] The Economist: 25 Jan 2018
[2] The Wall Street Journal: 29 Apr 2018
[3] The Financial Times: 7 Jan 2017
[4] The Wall Street Journal: 2017 Mar 2017
[5] Wikipedia: 11 Jul 2018
[6] Medium: 3 Mar 2018
[7] Bloomberg: 26 Sep 2017
[8] Waters Technology: 9 July 2018
[9] Sigmoidal: 11 Jul 2018

BACKGROUND

As you've likely heard before, the amount of data in the world is growing at an exponential rate[10]. While we at Apteo love data, we understand the proliferation of data poses both enormous benefits and real challenges for investors, both professional and non-professional. On one hand, more data levels the playing field between Wall Street and Main Street. On the other hand, it makes any diligent investor's job more difficult, since the sheer magnitude amount of information we see every single day increasingly overwhelms all of us.

We believe active investors who do their homework should have access to a powerful, objective, and data-driven AI perspective when investing their hard-earned money on behalf of themselves, or clients. While there is no shortage of market pundits, television programs, news publications, stock forums, and conferences for professional & non-professional investors to exchange ideas, access to sophisticated AI tools has largely been limited to a few market participants. Therefore, we want to provide every investor an AI tool that provides access to unbiased and data-driven insights to help them make better decisions. And we mean unbiased, at Apteo, we don't invest capital on behalf of clients, employees, or ourselves.

WHAT IS MILTON?

Milton is an AI tool that reduces the amount of time and effort necessary to find and analyze stock investments. Its goal is to produce informed stock forecasts and surface broad market trends, which it does by analyzing tens of millions of historical text and financial data points to learn what pieces of information are associated with stock performance.

[10] Mary Meeker Internet Trends: 30 May 2018

The data that Milton uses to analyze stocks is the same data that professional stock analysts use. It includes company fundamentals, which help it to learn the associations between hundreds of key performance metrics and future performance. It examines interest rates, commodities prices, and foreign exchange rates to understand how changes in macroeconomic conditions may affect price movements across sectors. It incorporates larger market trends, index composition, and industry inclusion to understand how changes in the composition of the market (e.g., passive versus active investing) may impact individual stock performance. It includes technical indicators that are frequently used by traders so that it can contextualize how stocks tend to behave based on common price movements. It analyzes and processes text documents in the form of analyst opinions, news, and reports in order to learn from qualitative, human-created analyses.

Most importantly, it analyzes all these data points together using an objective, data-driven methodology that optimizes for learning the unique combinations of data points that are predictive of future performance on a per-stock basis.

QUICK PRIMER ON AI

We've mentioned the term "artificial intelligence" several times now, but we find that there's so much confusion around this phrase that it could be helpful to provide a quick description of what it actually is and how it works.

At its core, the terms "artificial intelligence" and "AI" simply refer to an area of research, development, and application that's dedicated to creating machines that work more intelligently. There are multiple areas of study within AI, and arguably the most popular one today is machine learning (ML).

"Machine learning" refers to a variety of algorithms that can use sophisticated statistics and mathematical functions to find patterns in data and then use those patterns to do something of interest (this process is known as "training a model"). One of the most powerful and sophisticated of these algorithms that has recently experienced great success in a variety of tasks is known as "deep learning."

Deep learning is a specific set of machine learning algorithms and techniques that excel at processing large amounts of unstructured data (think images, movies, and text instead of Excel spreadsheets or tables). These algorithms are now able to do things that only humans have traditionally done, like categorize images (see), respond to voice commands (hear), and process text documents intelligently (read).

Deep learning algorithms are loosely modeled on the structure of the human brain. They are essentially a series of "neurons" (mathematical functions) that transform and transmit data to one another. This structure of interconnected "neurons" is referred to as a neural network. In the case of deep learning, these neural networks contain multiple layers of generalized neurons as well as groupings of neurons that are dedicated to processing specialized data found in images, text, and sound. These networks are referred to as deep neural networks (or simply, deep networks) and the process used to train them is known as deep learning. Figure 1 below provides a visualization of the general structure of a deep network.

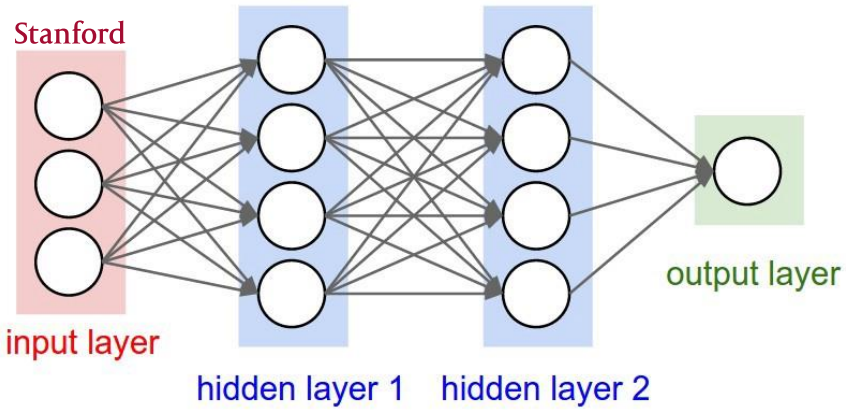

Figure 1: Visualization of a deep network, credit to Stanford's CS231N class

Because of its ability to contextually understand textual data, along with its ability to pick up on subtle patterns in very large datasets, deep learning lies at the heart of Milton's learning abilities.

TRAINING MILTON

Milton uses deep learning to identify and analyze patterns from historical financial data to learn how to generate valuable stock insights based on publicly-available company data. At a high level, it accomplishes this by analyzing millions of historical data points within the context of historical stock performance. As it learns how these data points correspond to stock movements, it adjusts each of the neurons in its deep network such that those neurons slowly produce better and more accurate forecasts.

More specifically, the process of training Milton looks similar to the following:

1. Create an initial neural network where each neuron has a randomly generated set of initial parameters (these will be adjusted as the network learns).

2. For each one of the millions of historical documents that are available in our dataset (each of which is associated with one or more stocks), create a snapshot of the various pieces of financial data that were available at the time the document was written, along with the document itself (you can think of this snapshot as a row of data in an Excel spreadsheet).

3. For each of the snapshots from Step 2, annotate it with the relevant stock's return over the given time horizon (we develop different networks for each time horizon). This step is akin to adding a final column into an Excel sheet.

4. Feed the snapshots into the start of the network, where it will use that data to calculate a value for how it thinks each stock will perform over the given time horizon. Note that at the beginning of this process, when the network has mostly random values, these predictions will be very inaccurate, however they get better as the network continues to learn from more

examples.

5. Next, using information about how the referenced stock actually performed in the past, go back and tweak the values in the network's neurons based on how much error each neuron contributed to the difference between the calculated value and the actual stock return over the specified time horizon.

6. Repeat steps 4 and 5 until the neurons in the network have been sufficiently optimized.

This process is essentially a repetitive effort of educated guessing and checking with a feedback loop that allows the network to improve its guesses when it finds out where it was wrong. After going through this process enough times, it can eventually learn how the data it has can be used to make forecasts for the future. This process can be repeated for different time horizons, resulting in multiple networks, each optimized for a different holding period. For example, Milton has a network built to optimize for shorter-term stock forecasts (e.g., 3 months) and longer-term forecasts (e.g., 2 years).

Once we have a fully trained network, we can use it to forecast stock performance using data from today. Milton generates these forecasts on a daily basis, applying a well-defined set of filters. For example, we eliminate stocks with small market caps and low daily trading volume. Finally, Milton generates a report with stock forecasts, which are then delivered as valuable investment insights on milton.ai.

ABOUT US

Apteo, the company behind Milton, is made up of curious data scientists, engineers, and financial analysts based in Silicon Alley, the vibrant Flatiron neighborhood in New York City. We have a passion for technology and investing, and we strongly believe that investing is one of the most reliable and effective ways to build long-term wealth.

We build AI tools to help informed investors make better decisions. We created Milton to help investors save time and gain confidence when making investment decisions. To learn more about us, please reach out to us at info@apteo.co, join our mailing list at milton.ai, or subscribe to Milton's blog at blog.milton.ai.