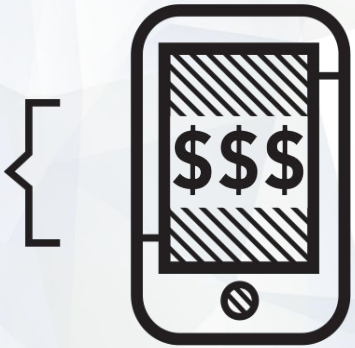

Algorithmic Trading

FinTech

Lesson 14.1

Class Objectives

By the end of this lesson, you will be able to:

- Delineate what algorithmic trading is, how it came to be, and why it's valuable.
- Deconstruct the process for algorithmic trading: obtaining the data, making a trading decision, and evaluating the results.
- Understand how technical indicators, like simple moving averages (SMAs), identify the trading signals that instruct a trading algorithm.
- Compare the differences between technical analysis and fundamental analysis.
- Define what a trading signal is, how it is used, and why it's important.
- Write your own simple trading algorithm based on technical indicators.


WELCOME

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Welcome to Algorithmic Trading

Not long ago, algorithmic trading disrupted the financial sector. It did so by introducing computer algorithms that could buy and sell faster than human traders.

Welcome to Algorithmic Trading

Although the speed of these transactions gave the algorithmic trading systems a competitive advantage, people had to specifically program the systems. So, their ability to adapt to new data was limited.

Welcome to Algorithmic Trading

To improve these systems, FinTech companies developed machine learning algorithms that could adapt to new data.

Now, algorithmic trading systems— which are driven by machine learning — are disrupting the financial market again.

This is because investors can use them to automatically trade and manage assets in highly dynamic environments.

Welcome to Algorithmic Trading

In this lesson, you'll use your knowledge of Python, Pandas, and NumPy to build programs that both analyze the pricing data of stocks and make decisions about when to buy and sell shares.

Introduction to Algorithmic Trading

Introduction to Algorithmic Trading

Normally, a typical day for traders involves the following:

- Manually tracking the transactional history of many stocks.
- Identifying the best opportunity to buy, sell, and hold.
- Maintaining knowledge about the highs and lows for each individual stock, as well as their overall portfolio value and profit/loss.
- Keeping emotions in check.

The sheer number of moving parts and details that need to be considered can make it difficult for the human mind to consistently make performant trades.

This is where algorithmic trading comes in.

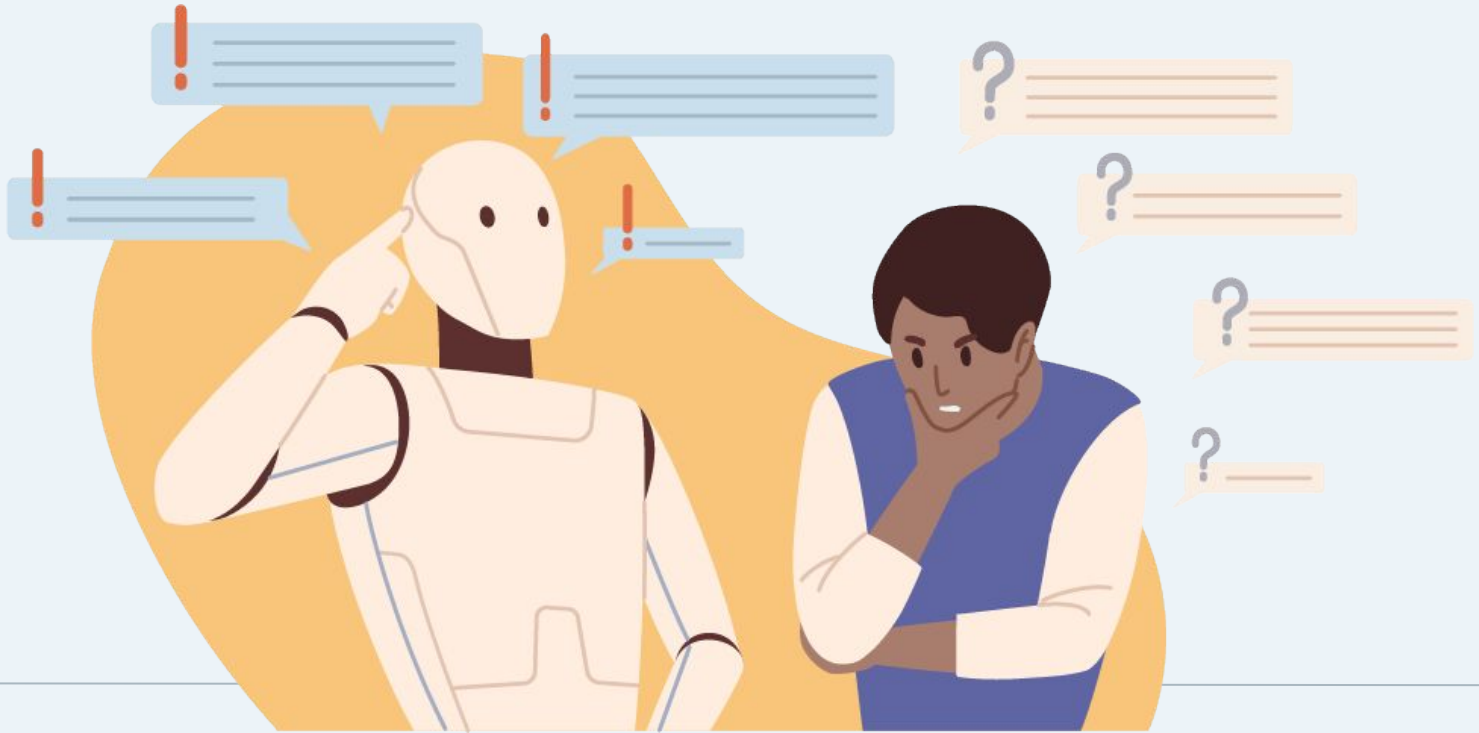
Algorithmic trading consists of an established set of rules that first tell a system when to buy or sell an asset and then execute that trading strategy.

Introduction to Algorithmic Trading

Algorithmic trading is logic based. This means that it's based on a set of conditions that, when triggered, initiate a buy or sell action.

Introduction to Algorithmic Trading

The key difference between human traders and algorithmic trading is that computers can make decisions and predictions much more efficiently and effectively than humans, and they can do so without human emotions getting in the way.



We can build a trading algorithm just by using Python and the Pandas and NumPy libraries.

Instructor Demonstration

Build a Trading Algorithm

Questions?

Activity: Getting Started with Algorithmic Trading

In this activity, you'll write a trading algorithm that uses Python to represent the conditions of a simple trading strategy.

Suggested Time:

15 Minutes

Time’s Up! Let’s Review.

Questions?

Assessing Trading Algorithms

Assessing Trading Algorithms

It's time to calculate the profit that a trading algorithm generates—valuable information for most investors! For this profit-calculation demonstration, we'll slightly adjust the trading strategy of our algorithm.

Then, it will sell all the shares on the final day of the period.

Specifically, we'll change the code so that it only buys (and doesn't sell) shares during the trading period.

Assessing Trading Algorithms

The new algorithm will:

- Accumulate stock shares on those days when the stock price of the current day is less than that of the previous day.
- Hold on to the stock when the price of the current day is greater than that of the previous day.
- Sell all the accumulated shares on the final day of the period.

We'll calculate the profit by subtracting the cost of the shares for each buy from the proceeds that we make by selling our shares on the final day.

Cost and Proceeds

Calculate the Cost and the Proceeds of Each Trade

We calculate:

- The cost of each trade by multiplying the closing price of the stock by the number of shares that we bought.
- The proceeds by multiplying the closing price of the stock by the total number of shares that we accumulated over the period.
- The profit or loss by subtracting the total cost of the shares that we bought from the total proceeds that we made from selling the shares.

Let’s see how we can do this using Python.

Instructor Demonstration

Calculate the Cost and the Proceeds of Each Trade

Questions?

Instructor Demonstration

Calculate the Total Profit or Loss for the Trading Period

Now that our DataFrame contains the cost and proceeds information for our trading strategy, we can assess our trading algorithm by computing the total profit or loss.

Instructor Demonstration

Calculate the Return on Investment

To calculate our ROI, we first calculate the total cost of all the buy trades—which is known as the invested capital.

Activity: Profitable Algorithmic Trading

In this activity, you'll write a trading algorithm that buys 100 shares of AMD stock on the days when the price decreases and that sells the accumulated shares on the last day of the trading period.

Suggested Time:

20 Minutes

Time's Up! Let's Review.

Questions?


Break

Forming Trading Signals

A trading algorithm requires proper **trading signals**, which are point-in-time indications of when to buy a stock (enter a trade) or sell the stock (exit a trade).

Forming Trading Signals

To make intelligent trades, we need to form trading signals that can identify underlying price trends and thus refine our trade entry and exit strategies.

The trading industry has a common saying...

The trend is your friend!

NOTE...

When the trend breaks, this signals it's time to close out the position.

For volatile stocks,
it may be more profitable to be continually buying and selling, rather than following a longer term trend.

An algorithm that makes many trades over a very short period of time (e.g., every 30 seconds, or even shorter) is known as a **high-frequency trading (HFT) algorithm**.

Fundamental vs. Technical Analysis

To define a trading strategy, we need to understand how a stock price might trend in either the short or the long term. There are two schools of thought that exist in the investment world for how to do so:

	Focus	Philosophy	Implementation
Fundamental analysis	**The long-term health of a company** including its historical cash flow, debt-to-equity ratio, and management quality.	The healthier the financial outlook for a company, the higher we expect its stock price to trend.	We can implement fundamental analysis in algorithmic trading. But doing so usually requires analyzing three financial statements from a company: income, balance sheet, and cash flow.
Technical analysis	**The price action of a company's stock—** its behavior as shares are bought and sold.	Because technical analysis is quantitative in nature, algorithmic trading often leans toward this philosophy when determining when to buy or sell.	When using technical analysis, traders often rely on price- derived calculations known as technical indicators to gauge short-term price trends.

Because of the lucrative nature of trading, stock traders have developed many technical indicators that signal when to buy or sell a stock.

Traders can base these indicators on a wide variety of factors, which involve varying amounts of complexity, historical pricing information, and computing power.

One of the most popular technical indicators—and the one that we'll focus on in today's class—is the simple moving average (SMA).

The **Simple Moving Average (SMA)** calculates the average price of a stock over a rolling period of a s pecific number of days. Examples of these periods include 30 days, 50 days, 100 days, and 200 days.

Simple Moving Average (SMA)

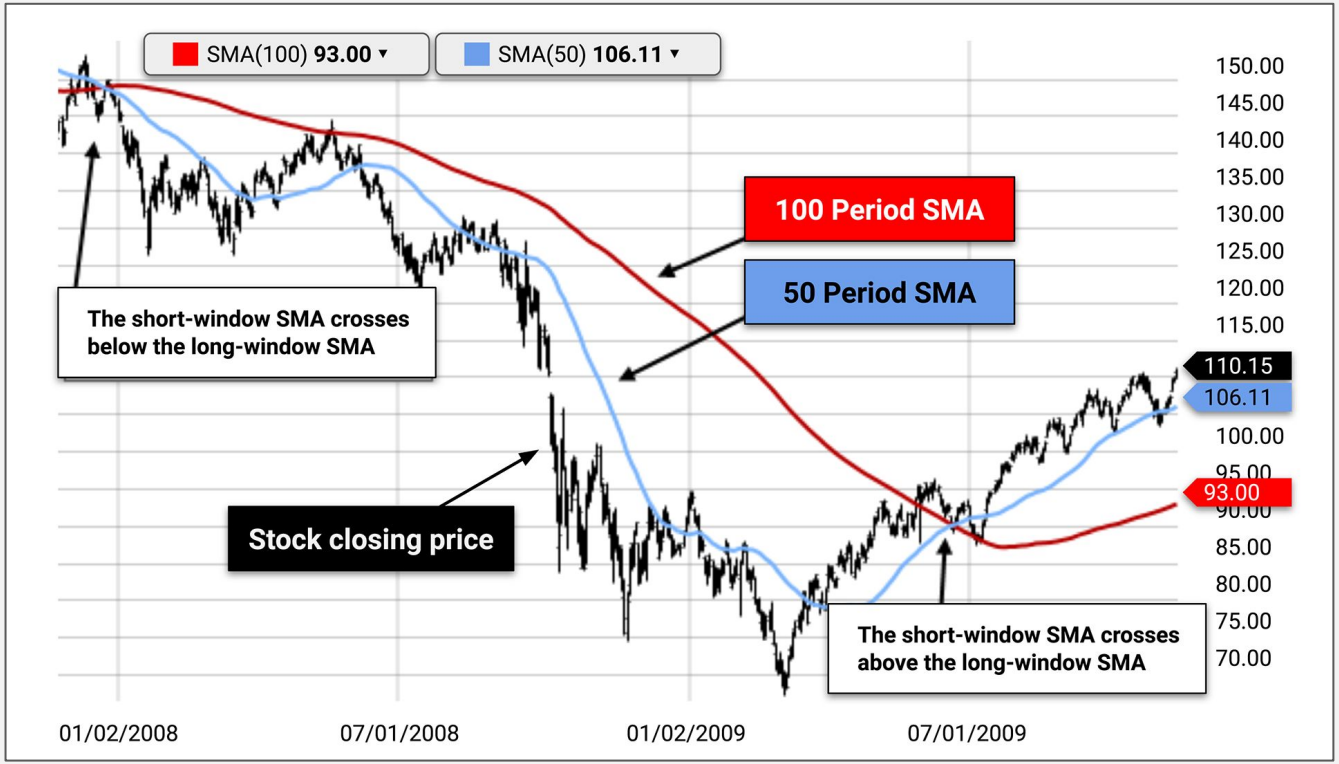
When trading, we can consider using both a long-window SMA (say, for 100 or 200 days) and a short-window SMA (say, for 30 or 50 days).

When the short-window SMA **is greater than** the long-window SMA, we can assume that the price trend is positive over the short term.

When the short-window SMA **is less than** the long-window SMA—we can assume a negative price trend.

Simple Moving Average (SMA)

This image shows a plot of a short-window (50-day) SMA and long-window (200-day) SMA for the closing price of a stock.



Simple Moving Average (SMA)

Points exist on the plot where the two SMA lines cross one another. These crossover points indicate when the short-term price trend changes. We consider such changes as opportunities to either enter or exit a trade.

Trending lower (sell)

Consider the point on the plot where the short-window SMA crosses below the long-window SMA (that is, where the short-window SMA now has a lower value than the long-window SMA).

That point indicates that **the asset price is expected to trend lower**, so we should **sell our stock** before the price decreases further.

Trending Higher (buy)

Consider the point on the plot where the short-window SMA crosses above the long-window SMA (that is, where the short-window SMA has a higher value than that of the long-window SMA).

That point indicates that **the asset price is trending higher**, so we should **start buying stock** before the price increases too much.

Crossover points become the trading signals that define the entry and exit points for our trading algorithm. This particular strategy is known as **dual moving average crossover (DMAC)** trading.

Time to Code

Writing an Algorithm that Uses DMAC Trading

Suggested Time:

What are long and short positions?

Long and Short Positions

Long position (going long)

A trading strategy that focuses on first buying the stock, then holding it, and then selling it only when the short-term price trend turns lower.

The trader makes a profit by **“buying low, selling high.”**

Short position (going short)

A trading strategy that focuses on first selling the stock, then buying back the stock when the price goes down.

A trader makes a profit by **“selling high, buying low.”**

Review these articles to learn more about these trading strategies:

Short (Short Position) from Investopedia

The Difference Between Long and Short Trades from The Balance

Questions?

Activity: Create a Short-Position Algorithm

In this activity, you'll create an algorithm to identify the entry and exit points for a short-position trading strategy. The algorithm will still use a short-window (50 days) SMA and a long-window (100 days) SMA.

Suggested Time:

30 Minutes

Backtesting is the process of testing an algorithm by using historical stock prices, which we'll explore more deeply in the next class.

Time's Up! Let's Review.

Questions?


The End