

Algorithmic Trading

FinTech
Lesson 15.1



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Intro to Algorithmic Trading

Intro to Algorithmic Trading

A typical day for traders involves:



Tracking the transactional history of many stocks



Identify the best opportunity to buy, sell, and hold



Maintain knowledge about the highs and lows for each individual stock, as well as their overall portfolio value and profit/loss



Keeping emotions in check



Intro to Algorithmic Trading

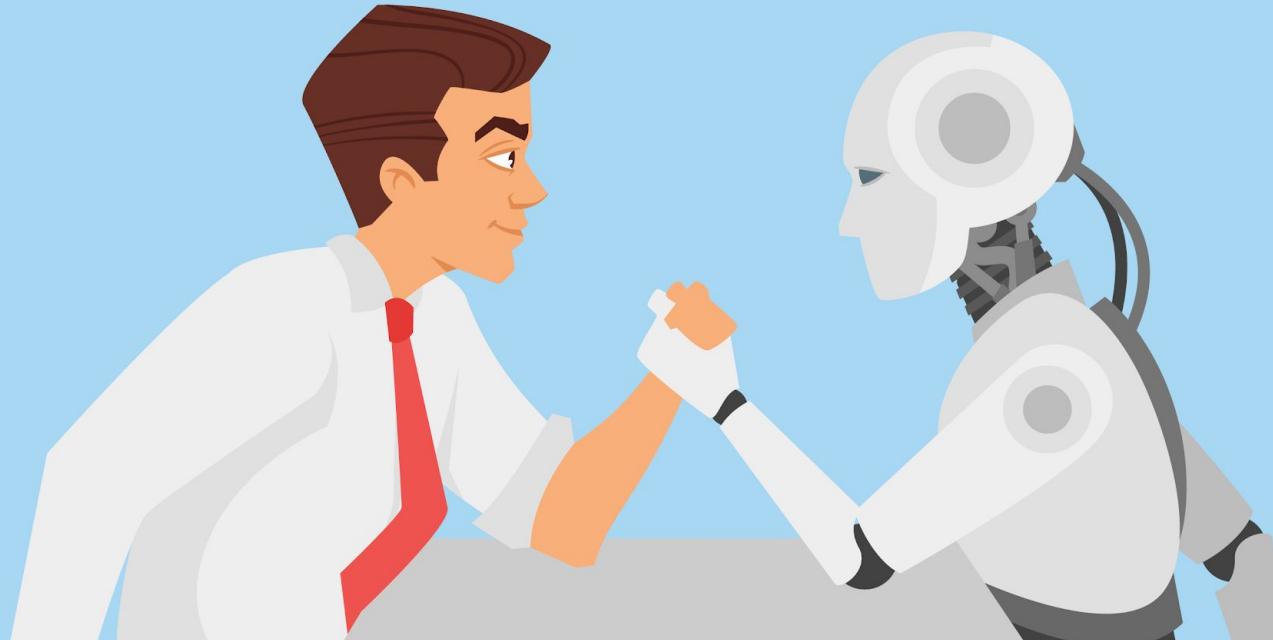
The sheer number of moving parts and details that need to be considered can make it difficult for the human mind to consistently make performant trades.



This is where
algorithmic trading
comes in.

Intro 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.



Intro to Algorithmic Trading

It's common for FinTech firms to use algorithms to make trading decisions across all domains. This applies to trading in stocks, bonds, options, currencies (money transfer), carbon credits, mortgages, or even consumer loans.

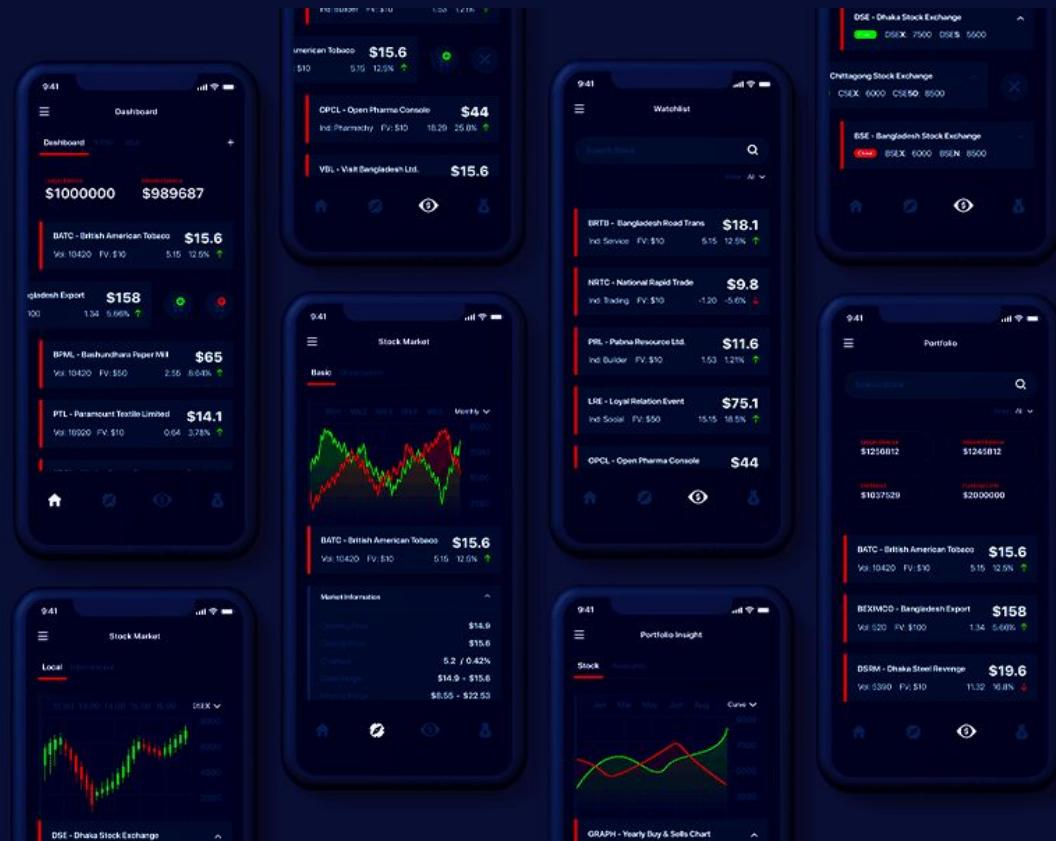




What Is Algorithmic Trading?

Intro to Algorithmic Trading

Algo trading is the use of models to make trading decisions.



Intro to Algorithmic Trading

Algorithmic trading
is simply using code
to decide and execute
a trade (buy/sell).

For example

A simple algorithm
could be to sell
100 shares of a
stock when the intraday
percentage return of
a stock falls below -3%.

```
# A pseudocode snippet for preventing further intraday loss of a stock
# by selling a stock when the intraday return falls below -3%. There is
# an assumption that a StockMarket account has 100 shares of MU.

# Initialize StockMarket account object
account = StockMarket()

# Set stock ticker and share size
stock = "MU"
shares = 100

# Continuous loop that checks intraday return of a particular stock
while True:
    # Check intraday return
    intraday_return = account.get_intraday_return(stock)

    # If intraday percentage return falls below -3%, sell the stock and shares
    if intraday_return < -0.03:
        account.sell(shares, stock)
```



Why Is Algorithmic Trading So Prevalent Today?

Intro to Algorithmic Trading

Advances in network technology and computing power along with authorization to use electronic exchanges have made it possible for anyone to write code and automate their trading strategy.

The result

Algorithmic trading can be orders of magnitude faster than traditional trading.

The Economist

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March of the machines

The stockmarket is now run by computers, algorithms and passive managers

Such a development raises questions about the function of markets, how companies are governed and financial stability



Satoshi Kambayashi

Print edition | Briefing >

Oct 5th 2019 | NEW YORK

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Why Use Algorithmic Trading?

Intro to Algorithmic Trading

While there are many benefits to using algorithmic trading over traditional/manual trading, the two main benefits are:

01

Algorithmic trading can be backtested using historical and real-time data to see if it is a profitable trading strategy.

02

It reduces the possibility of human error in which traders mistime trades based on emotional and psychological factors.



Who Performs Algorithmic Trading?

Intro to Algorithmic Trading

Anyone who can code can create their own algorithmic trader bot.

Traditionally, Quantitative Analysts, or Quant Traders, create algorithmic trading models and are often required to have at least a master's or PhD degree level with a familiar background in statistics, but with human-friendly programming languages like Python and analytical tools and machine learning libraries, anyone can learn to build a very powerful algorithmic trader.

The screenshot shows a blog post titled "How to Build Your Own Algorithmic Trading Strategy" from September 12, 2014. The post is categorized under "Algo Trading", "Algorithmic Trading", and "Algorithmic Trading Strategy". It is attributed to Chris Vermeulen. Below the title, there is a snippet of text: "Every week we receive numerous emails asking us **how we created our profitable algorithmic trading strategy.**" To the right of the text is a diagram of a "Trading System Framework" consisting of several interconnected boxes labeled "Market Data", "Backtesting", "Strategy", "Optimization", and "Execution".

ALGOTRADES™

Algorithmic Trading Blog

How to Build Your Own Algorithmic Trading Strategy

September 12, 2014 / in Algo Trading, Algorithmic Trading, Algorithmic Trading Strategy
/ by Chris Vermeulen

Every week we receive numerous emails asking us **how we created our profitable algorithmic trading strategy.**

Trading System Framework

```
graph TD; MD[Market Data] --> B[Backtesting]; S[Strategy] --> O[Optimization]; O --> E[Execution];
```

Intro to Algorithmic Trading

Some use algorithms to help inform, with the human making the final trade decision.



Intro to Algorithmic Trading

Others make algorithmic trading “full autopilot:” trade decisions, trade execution, rebalancing, and risk management, reporting are all automated.



Intro to Algorithmic Trading

Basic definitions you will need to know:

Signals

Information that is useful for predicting the future direction of an asset (e.g., a stock)

Entry Rules

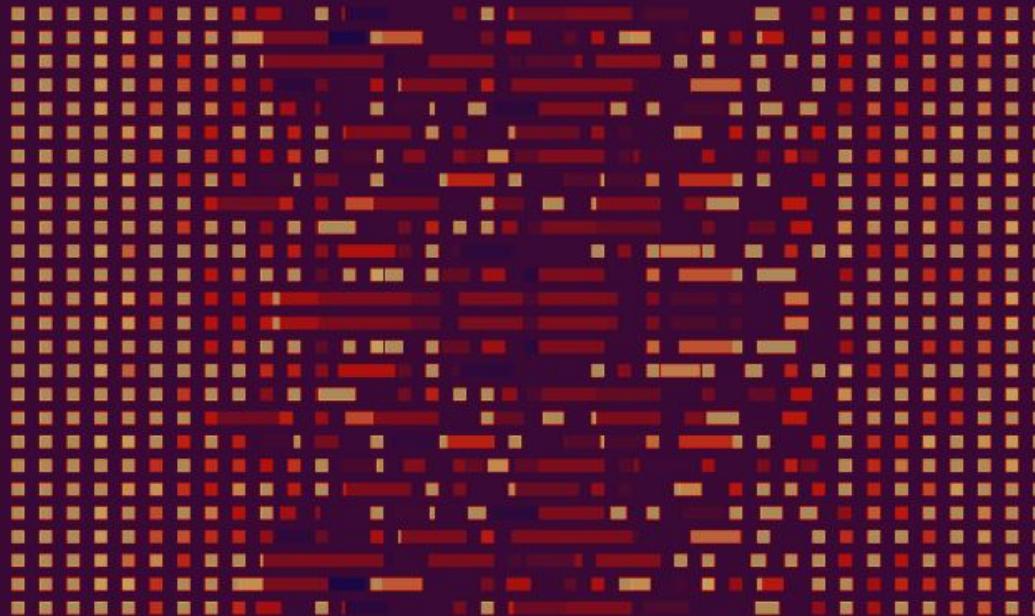
A decision rule telling you when to buy an asset (such as when a signal reaches a pre-specified, high enough level)

Exit Rules

A decision rule telling you when to sell or dispose of an asset (such as when a signal reaches a pre-specified, low enough level)

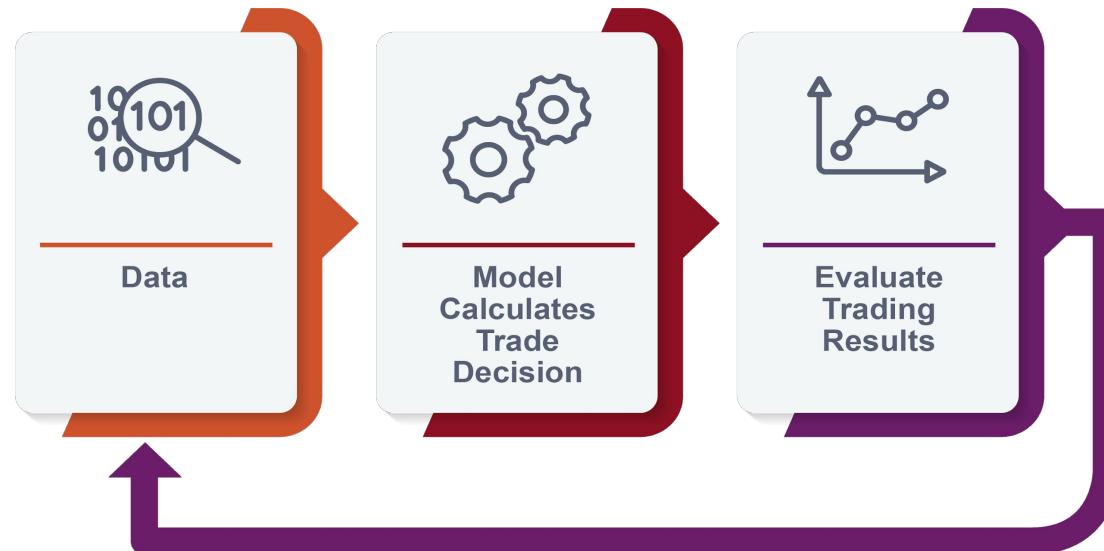
Intro to Algorithmic Trading

Good algo trading is largely about good signal generation. One of the ways to create a good signal is through building good Machine Learning (ML) models.



Intro to Algorithmic Trading

The model takes in data, and outputs a decision of whether to buy or sell.



In this unit, we'll start with some simple rule-based strategies, then move to an ML approach.

Demystifying Algo Trading

Demystifying Algo Trading

Trading algorithms are often misconstrued to be highly complex and esoteric, however, when breaking down the core components of a trading algorithm, there are three fundamental parts:

01

Obtaining
the data

02

Making a
trade decision

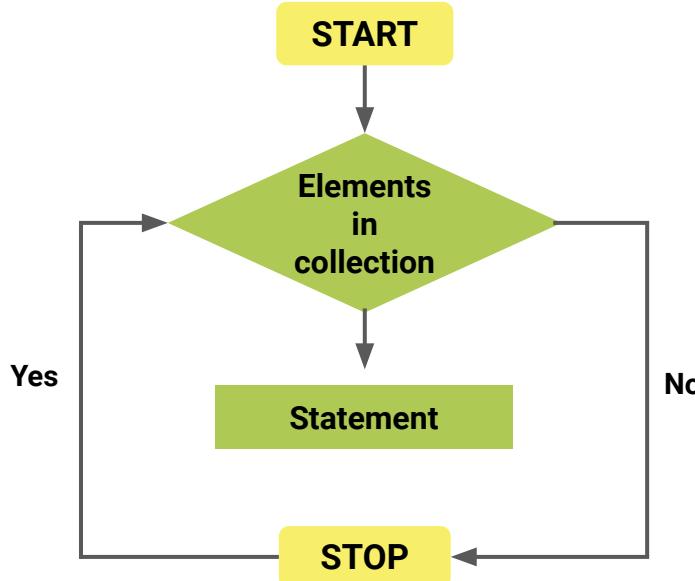
03

Evaluating
the results

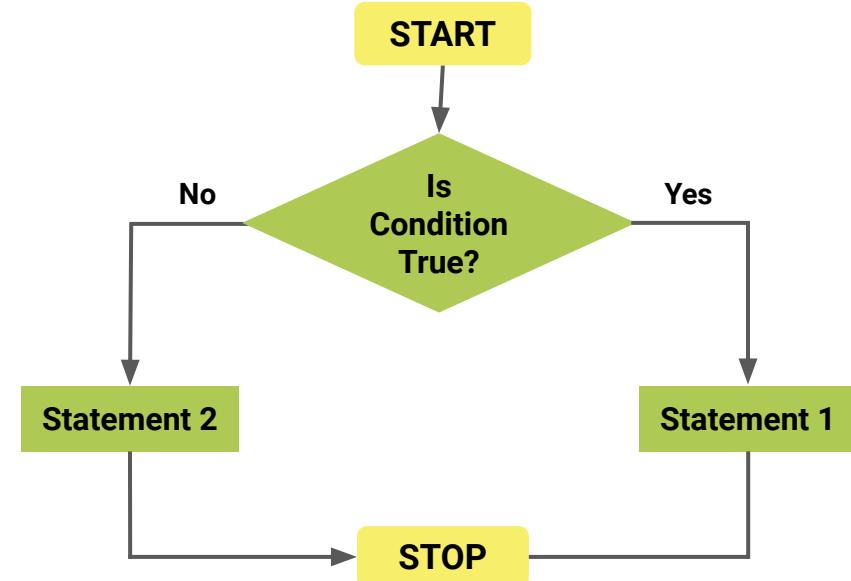
Demystifying Algo Trading

A trading algorithm can be as simple as a loop and a conditional.

Loop

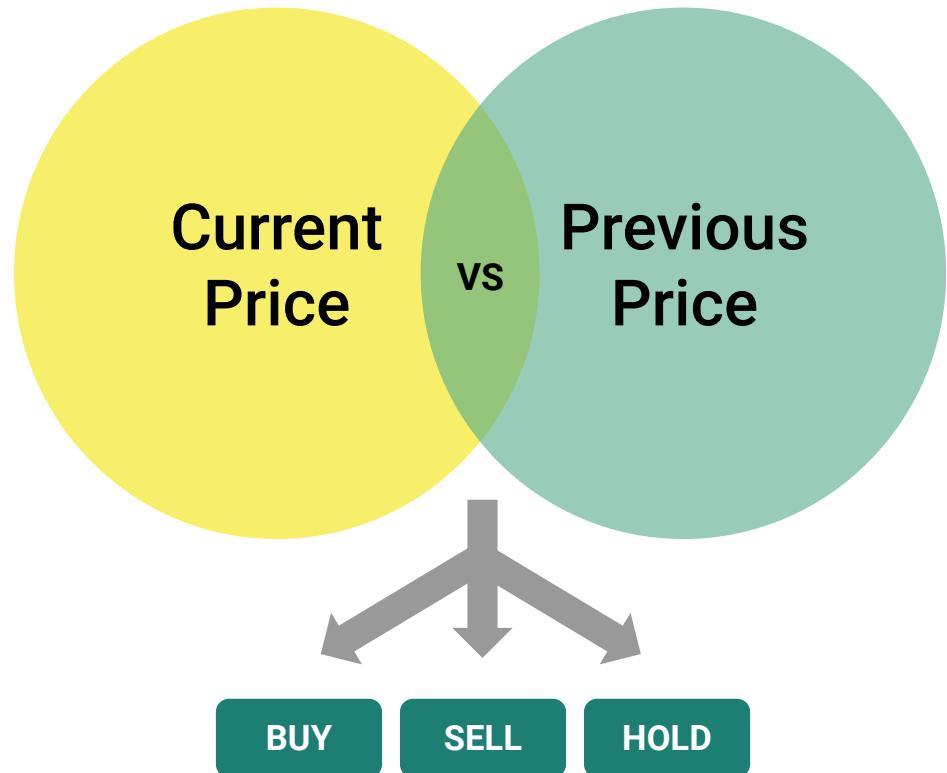


Conditional



Demystifying Algo Trading

This trading strategy iterates through the data and compares the **current price** to the **previous price** to make a buy, sell, or hold decision.



A black silhouette of a person climbing a steep mountain. The mountain has a dashed path leading up its side. The climber is at the top, holding a flagpole with a black flag.

Group Activity:

A Simple Trading Algorithm

In this challenge, we will demystify algorithmic trading by showing a simplified trading strategy in code.

Suggested Time:
10 Minutes



Trading Signals

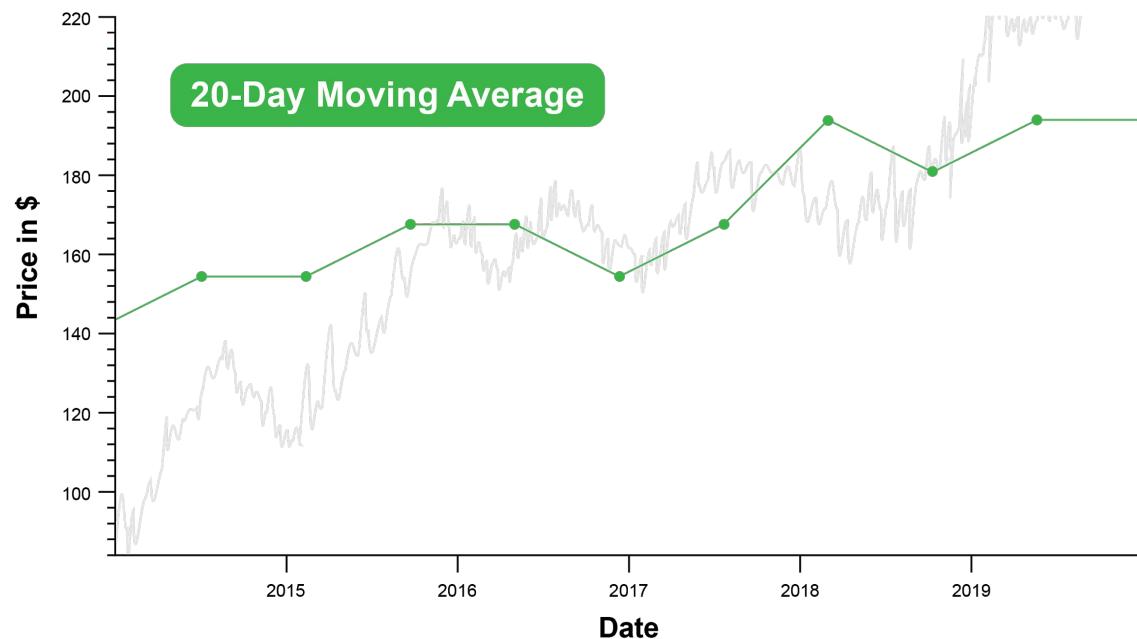


What Is a Technical Indicator?

Trading Signals: Technical Indicator

Falling under the umbrella of technical analysis, a **technical indicator** is a data-driven metric that uses trading data such as closing price and volume to analyze the short or long-term price movements occurring over a specified period of time.

For example, a 20-day simple moving average is a technical indicator representing a rolling 20-day mean of a stock's closing prices.

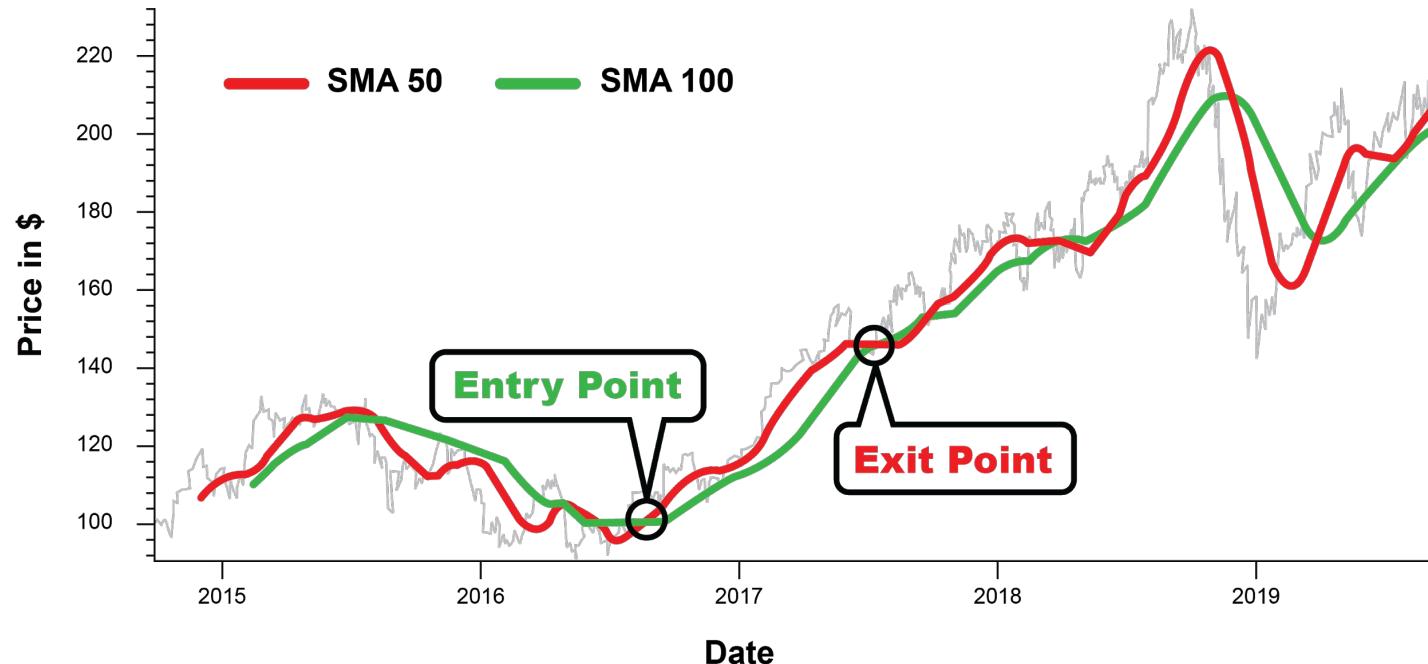


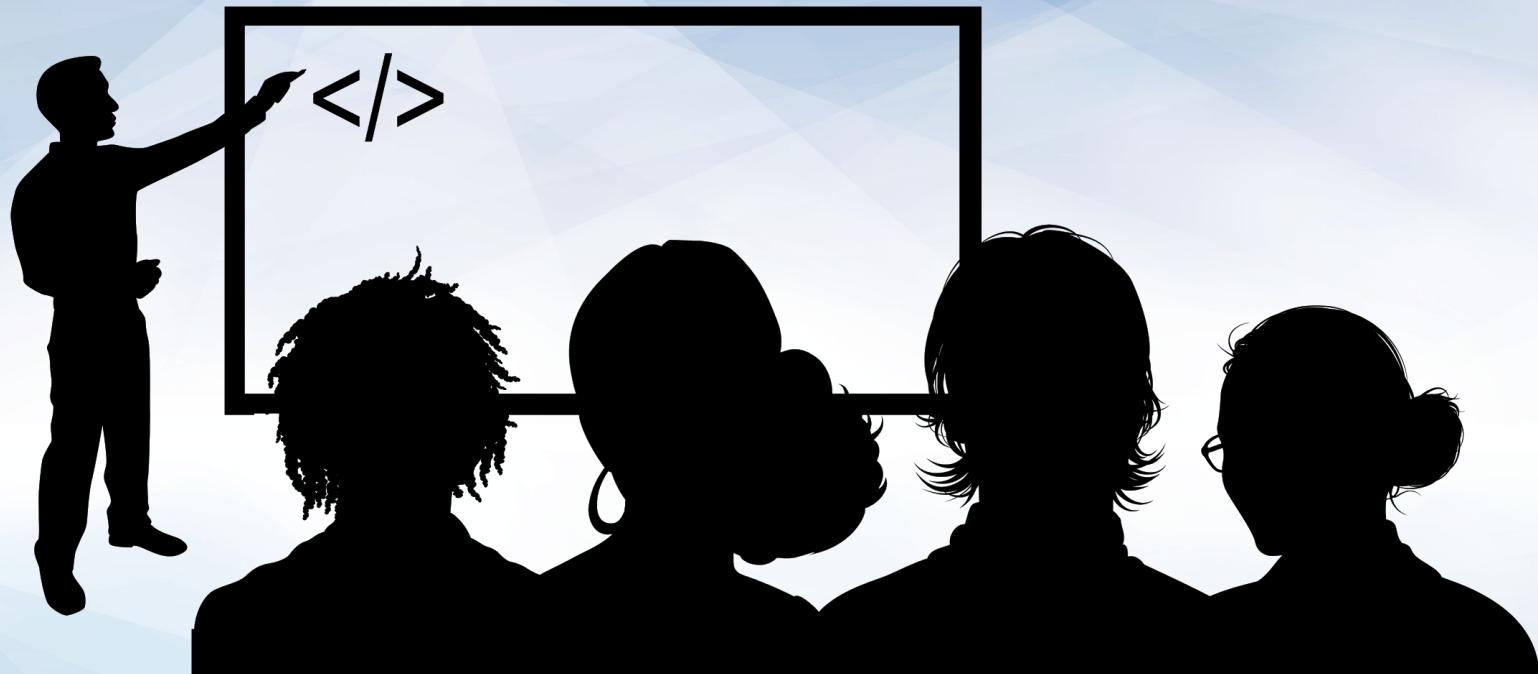


What Is a Trading Signal?

Trading Signals: Trading Signal

A **trading signal** is the point at which a technical indicator, such as the crossover of two moving averages (short MA and long MA), suggests an opportunity for action—namely whether an individual trader or algorithmic trading program should issue a buy or sell order for a security (such as a stock) at that point in time.





Instructor Demonstration

A Dual Moving Average Crossover Trading Signal

THE BIG SHORT





Activity: The Big Short

In this activity, you will take what you've learned about generating trading signals and implementing a corresponding trading strategy to perform the inverse:

Create a trading strategy that profits off of price declines by shorting (selling) and covering (buying) the stock.

Suggested Time:
15 Minutes



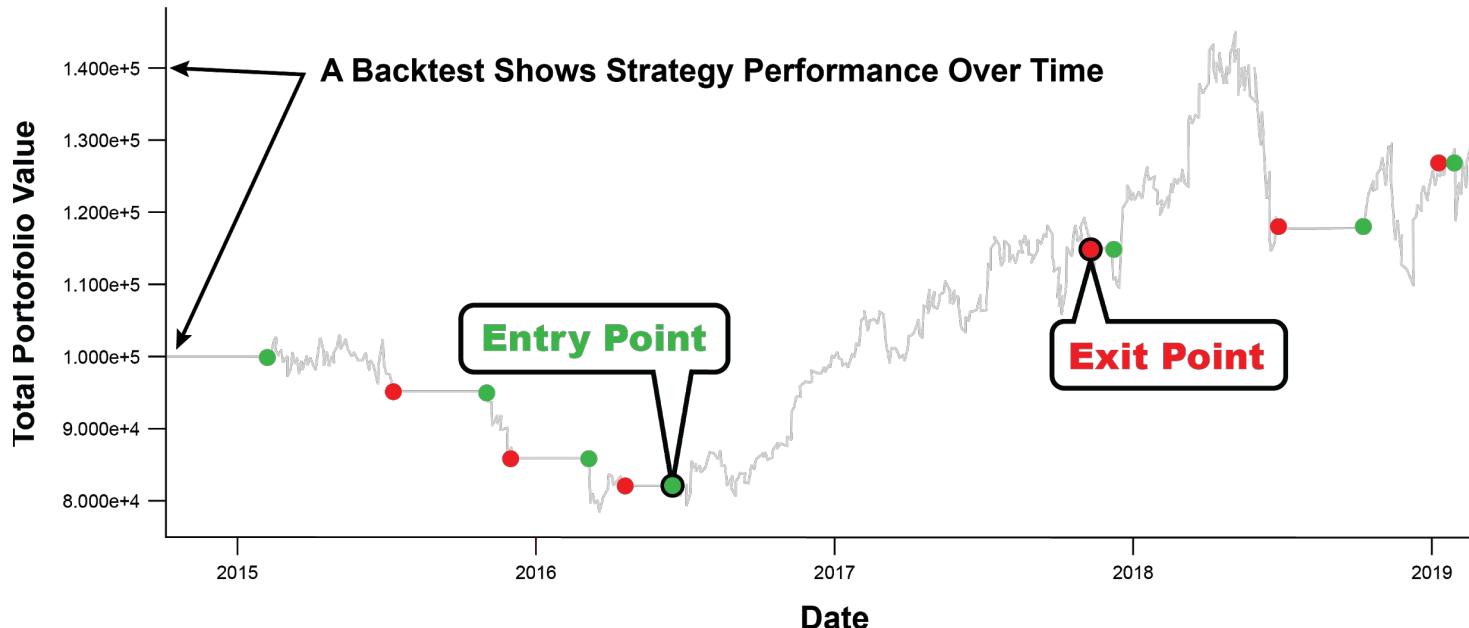


Time's Up! Let's Review.

Backtesting

Backtesting

Backtesting is the process for measuring the overall performance of a trading strategy using historical stock prices to simulate executed trades dictated by the calculated trading signals and trade decision logic.





Why Do You Think Backtesting Is Important?

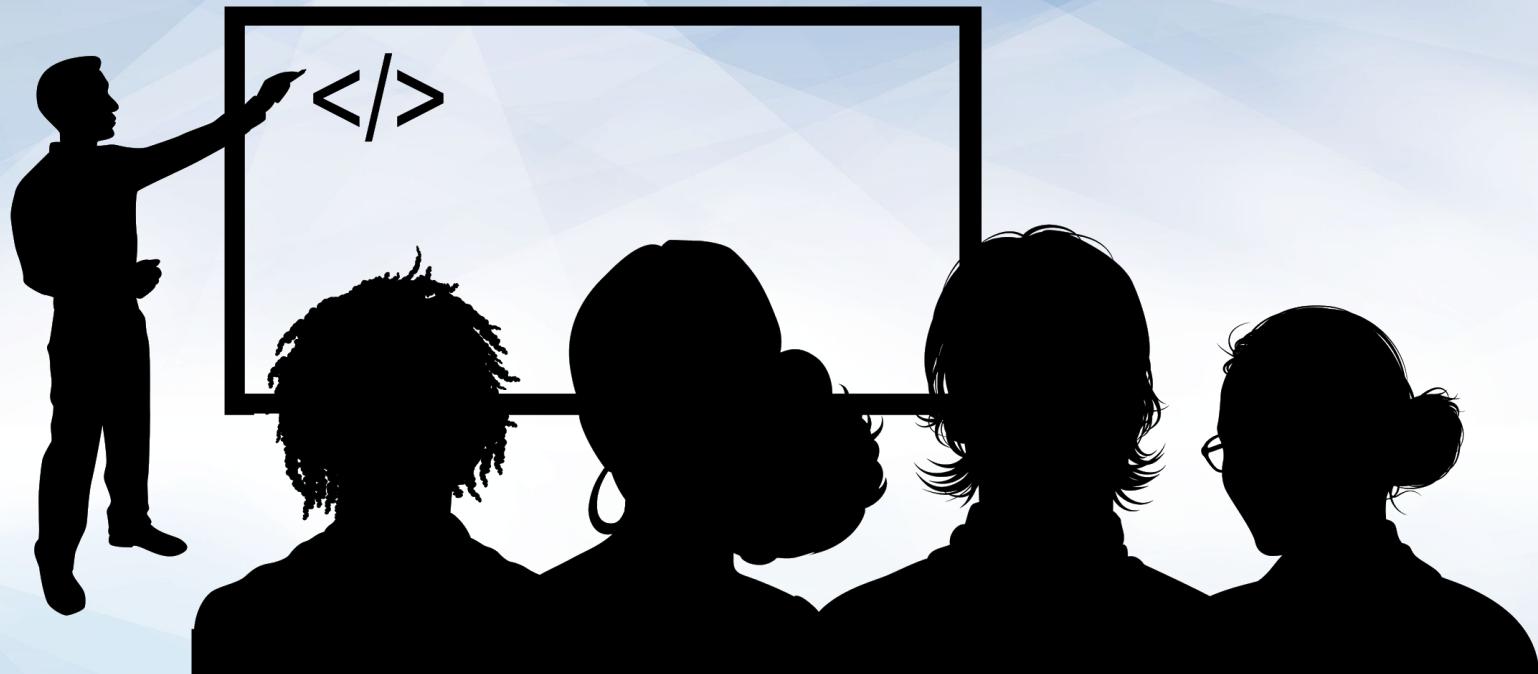
Backtesting

Backtesting helps to assess the validity or profitability of a trading strategy over time and provides a benchmark for how it may perform going forward.

While backtesting is important, the results of the backtest correspond to historical prices **not** future prices.

Therefore, backtesting may provide a reliable benchmark for the stock prices that have already occurred, but may prove to be less reliable as new stock data arises.





Instructor Demonstration Backtesting



THE BIG SHORT

PART II



Activity: The Big Short Part II

In this challenge, you will take the **short position dual moving average crossover** trading strategy you made in the previous activity and run a backtest to quantify the performance of your trading strategy.

Suggested Time:
10 Minutes





Time's Up! Let's Review.

Break



Trading Evaluation

Trading Evaluation

Evaluating securities, trades, and portfolios is important regardless if it is a human or algorithm making the trade. The following metrics can be used to evaluate securities/trades:

01

Cumulative Return

04

Sharpe Ratio

02

Annual Return

05

Downside Deviation/Return

03

Annual Volatility

06

Sortino Ratio

These metrics can be calculated historically with backtesting, or they can be used to measure future trades and opportunities for portfolio growth.

01

Cumulative Return

The total/aggregated amount of gains and losses for an investment. Cumulative return is measured across time and not for a given time period.

02

Annual Return

A time weighted annual percentage representing the return on an investment over a period of time.

03

Annual Volatility

The annualized degree of variation in trading prices over time.

04

Sharpe Ratio

The return of investment compared to its risk, measured by the difference between the return on investment and the risk-free return.

05

Downside Deviation/Return

The measure of risk for returns that are below the minimal acceptable return.

06

Sortino Ratio

The quotient of expected return to harmful volatility. The Sortino ratio focuses on downside deviation rather than standard deviation.

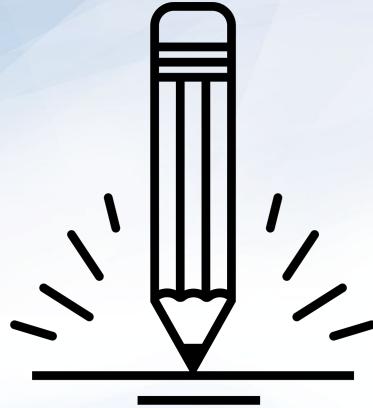


Instructor Demonstration Evaluation Metrics



THE BIG SHORT

PART III



Activity: The Big Short Part III

In this challenge, you will receive a walkthrough of the various evaluation metrics that can be used to evaluate their trading algorithms, namely portfolio and trade-related evaluation metrics.

Suggested Time:
10 Minutes





Time's Up! Let's Review.

Trading Dashboards in Python

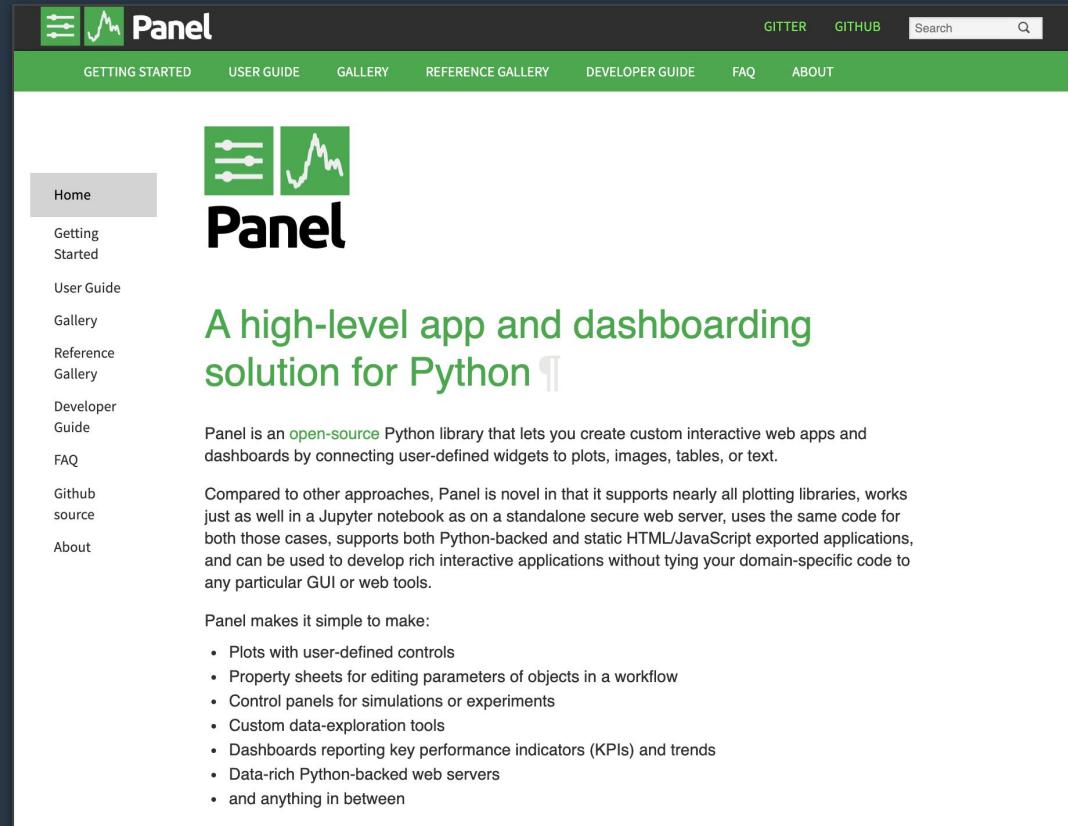


What Is Panel?

Trading Dashboards in Python

Panel is a high-level dashboarding library that allows a user to create custom interactive web apps and dashboards by connecting user-defined widgets, plots, images, tables, or text.

In addition, Panel works with other visualization libraries such as Plotly Express or Hvplot via extensions.



The screenshot shows the official website for Panel. The header features a green navigation bar with the Panel logo (a stylized chart icon) and the word "Panel". To the right of the logo are links for GITTER, GITHUB, and a search bar. Below the header is a green secondary navigation bar with links for GETTING STARTED, USER GUIDE, GALLERY, REFERENCE GALLERY, DEVELOPER GUIDE, FAQ, and ABOUT. On the left side, there is a sidebar with a vertical list of links: Home (which is highlighted in grey), Getting Started, User Guide, Gallery, Reference Gallery, Developer Guide, FAQ, Github source, and About. The main content area contains the Panel logo and the text "A high-level app and dashboarding solution for Python" followed by a small Python logo icon. Below this, a paragraph explains what Panel is and how it compares to other approaches. A section titled "Panel makes it simple to make:" lists several bullet points about the library's capabilities.

Panel

GETTING STARTED USER GUIDE GALLERY REFERENCE GALLERY DEVELOPER GUIDE FAQ ABOUT

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FAQ
Github source
About

A high-level app and dashboarding solution for Python

Panel is an [open-source](#) Python library that lets you create custom interactive web apps and dashboards by connecting user-defined widgets to plots, images, tables, or text.

Compared to other approaches, Panel is novel in that it supports nearly all plotting libraries, works just as well in a Jupyter notebook as on a standalone secure web server, uses the same code for both those cases, supports both Python-backed and static HTML/JavaScript exported applications, and can be used to develop rich interactive applications without tying your domain-specific code to any particular GUI or web tools.

Panel makes it simple to make:

- Plots with user-defined controls
- Property sheets for editing parameters of objects in a workflow
- Control panels for simulations or experiments
- Custom data-exploration tools
- Dashboards reporting key performance indicators (KPIs) and trends
- Data-rich Python-backed web servers
- and anything in between



What Is a Dashboard?

Trading Dashboards in Python

A dashboard is an information management tool that organizes, stores, and displays important information from multiple data sources into one, easy-to-access place.





Why Use a Dashboard?

Trading Dashboards in Python

Having a **single interactive interface** for key information and visualizations allows a user to monitor the health of an existing process, business function, or application, and therefore aids in measuring performance and identifying any discrepancies that may arise.



Trading Dashboards in Python

Volunteers! Who'd like to summarize one of the following concepts:



What is algorithmic trading? What does the process entail?



What are trading signals?



What is backtesting? Why is it important?



What kinds of portfolio evaluation metrics exist?



What kinds of trade evaluation metrics exist?



Give yourselves a round of applause.

You're on your way to becoming
your own investment fund managers!

Trading Dashboards in Python

By learning how to algorithmically trade, you're already way ahead of those who only know how to manually invest. You now have the tools to do both, and can choose which method you prefer:

01

Algorithmic
Trading

02

Manual
Trading

03

A Hybrid of
Algorithmic
Trading and
Manual Trading

A black silhouette of a person climbing a steep mountain. The mountain has a dashed path leading up its side. The climber is at the top, holding a flagpole with a black flag.

Group Activity:

Trading Dashboard

In this challenge, you'll create a trading dashboard with Panel using the evaluation metrics generated from previous activities.

Suggested Time:
15 minutes



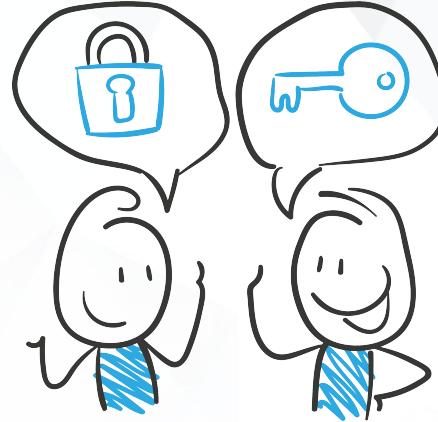
Reflect

Next Steps

Create an Algorithmic Trading Framework

Take what you've learned today to create a full-fledged trading application that you can use in real-world scenarios.





**Take a moment to reflect on
what you just learned.**

Questions?

*The
End*