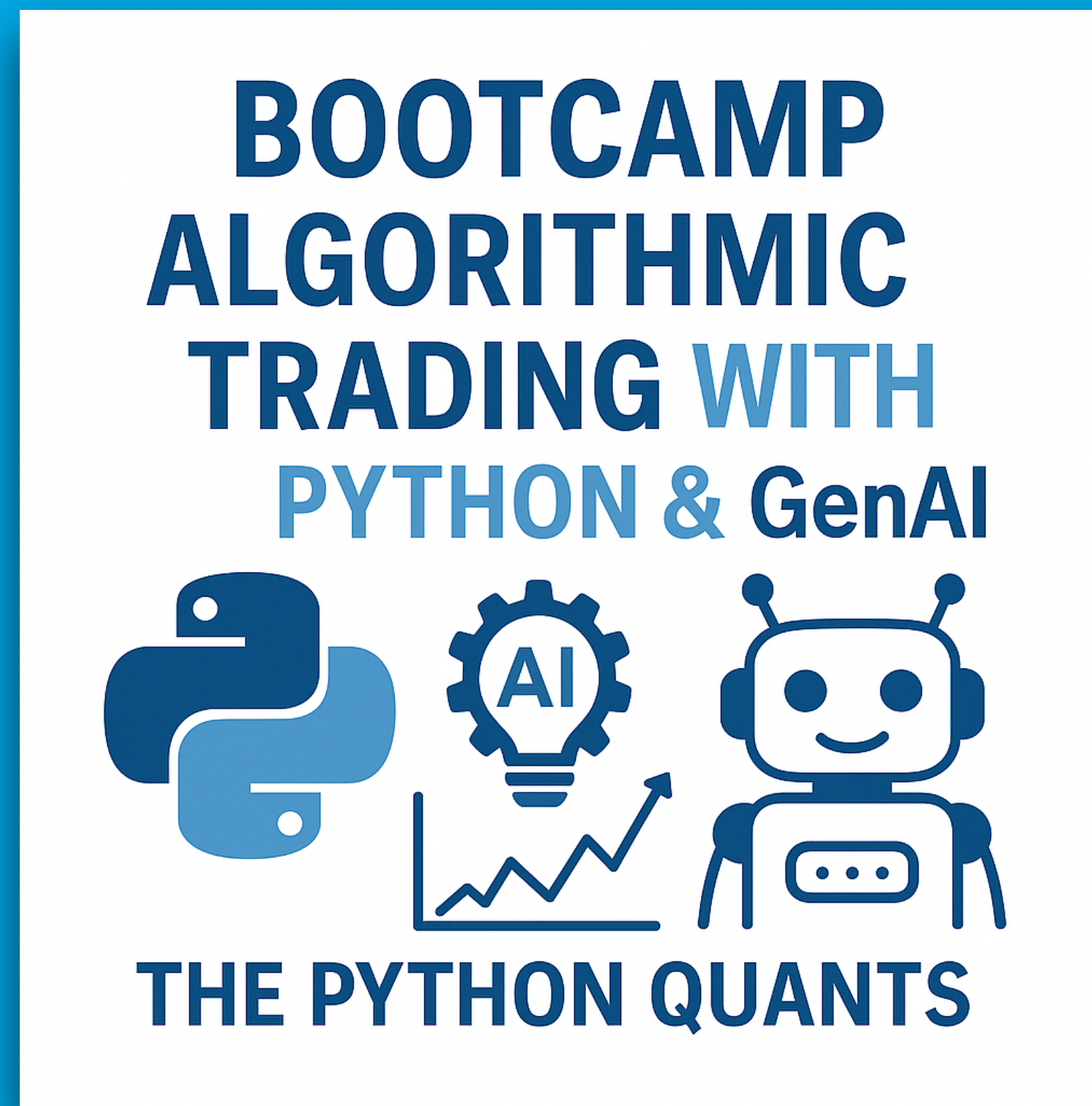


Algorithmic Trading

–with Python and GenAI

Dr. Yves J. Hilpisch



Brave New World

AI ASSISTANTS FOR QUANT RESEARCH & DEVELOPMENT



BROWSER

CLI

COPILOTS

BROWSER

CLI

COPILOTS

chatgpt.com/c/684fec44-c528-8000-ac47-b79d652defbb

ChatGPT 4o

Share

Hi PLUS

Models ⓘ

GPT-4o

Great for most tasks

✓

o3

Uses advanced reasoning

o4-mini

Fastest at advanced reasoning

o4-mini-high

Great at coding and visual reasoning

More models

>

What are the 5 most cited quantitative finance papers in history?

5 most cited and foundational papers in quantitative finance, each with thousands of citations and significant influence across both academia and industry:

1. Black and Scholes (1973)

Title: *The Pricing of Options and Corporate Liabilities*

Authors: Fischer Black and Myron Scholes

Journal: *Journal of Political Economy*

Citation count: ~50,000+

Contribution: Introduced the **Black-Scholes option pricing model**, a breakthrough that laid the foundation for modern derivative pricing.

Key Formula:

Ask anything

+

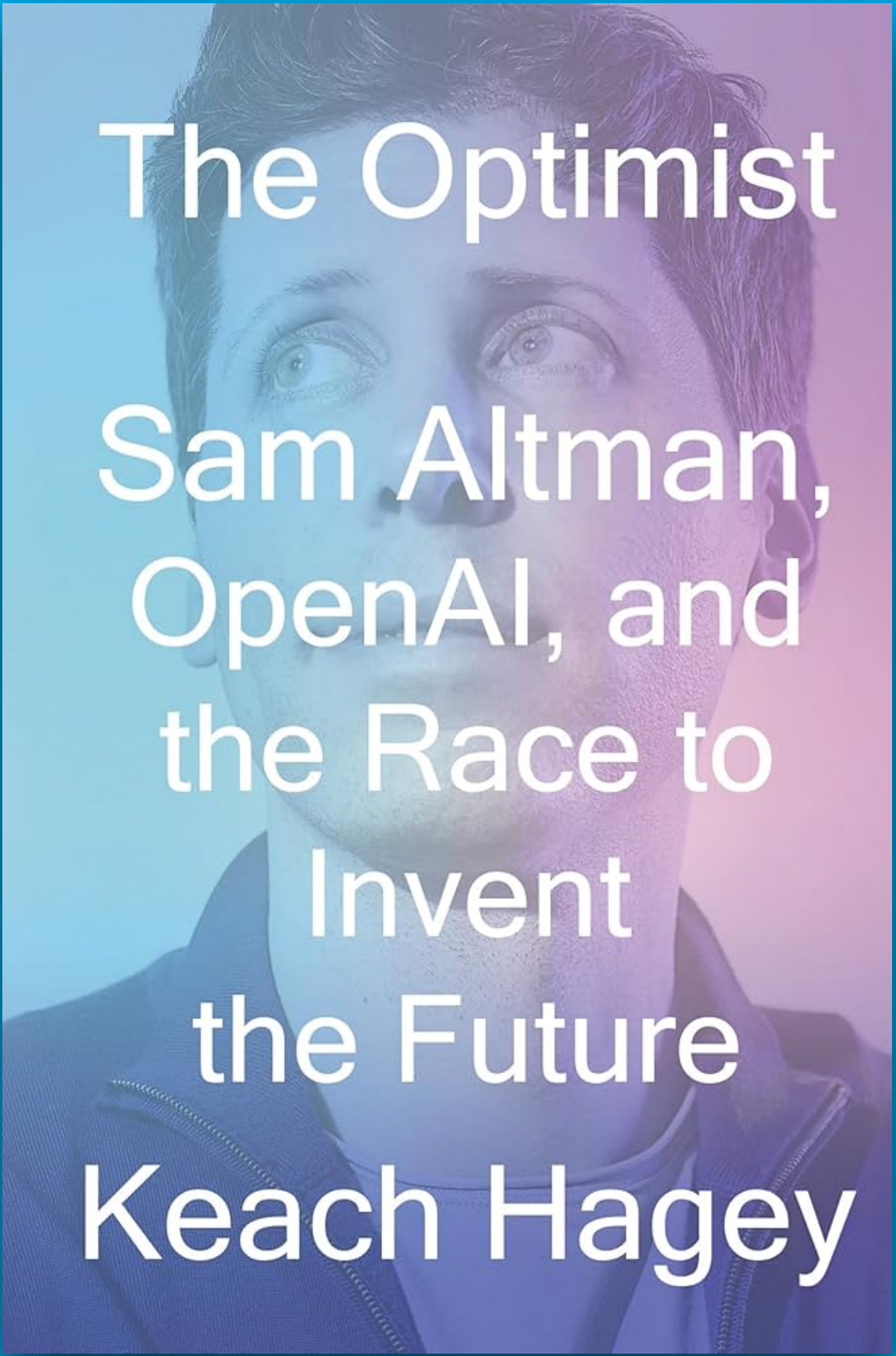
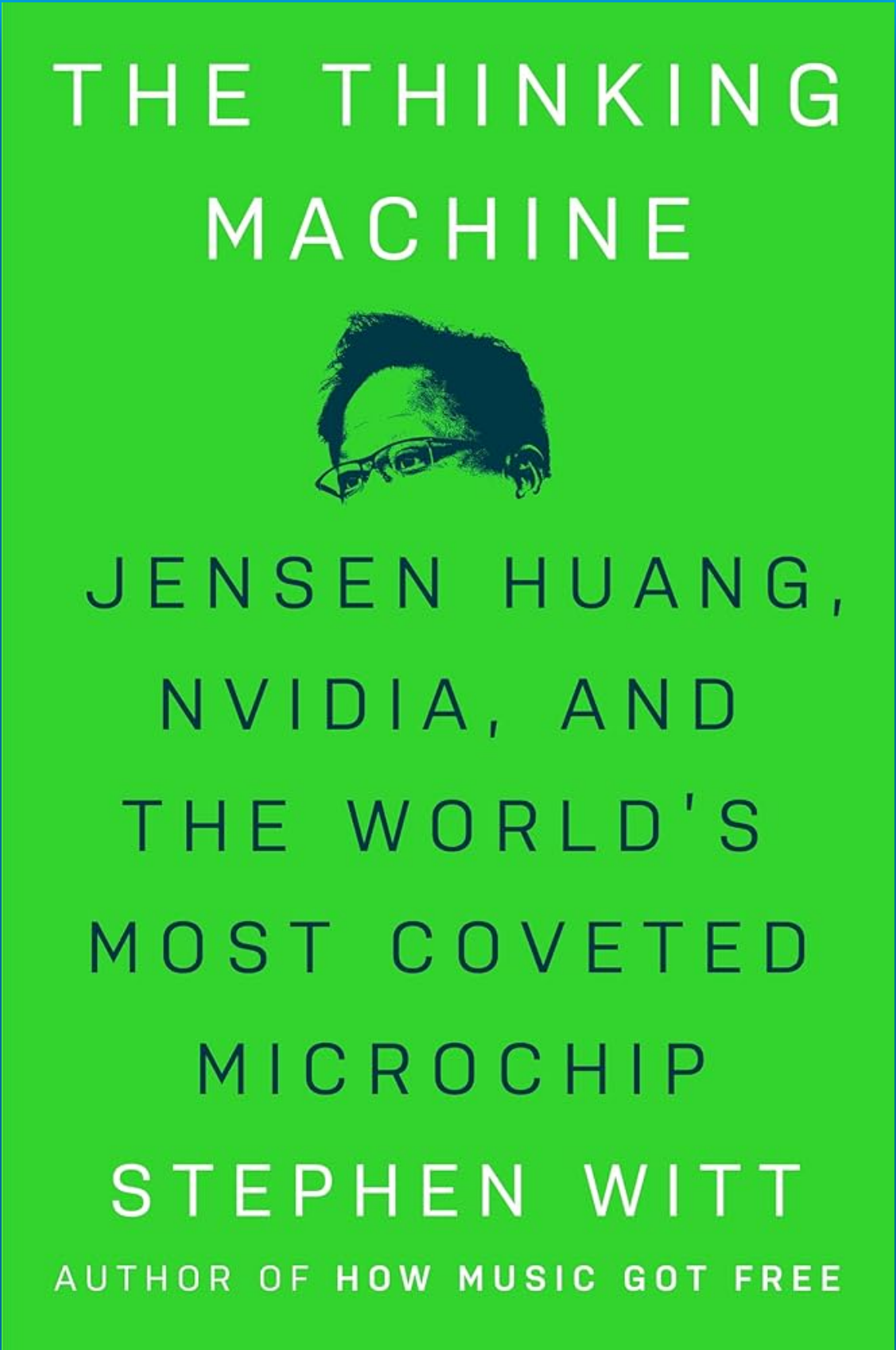
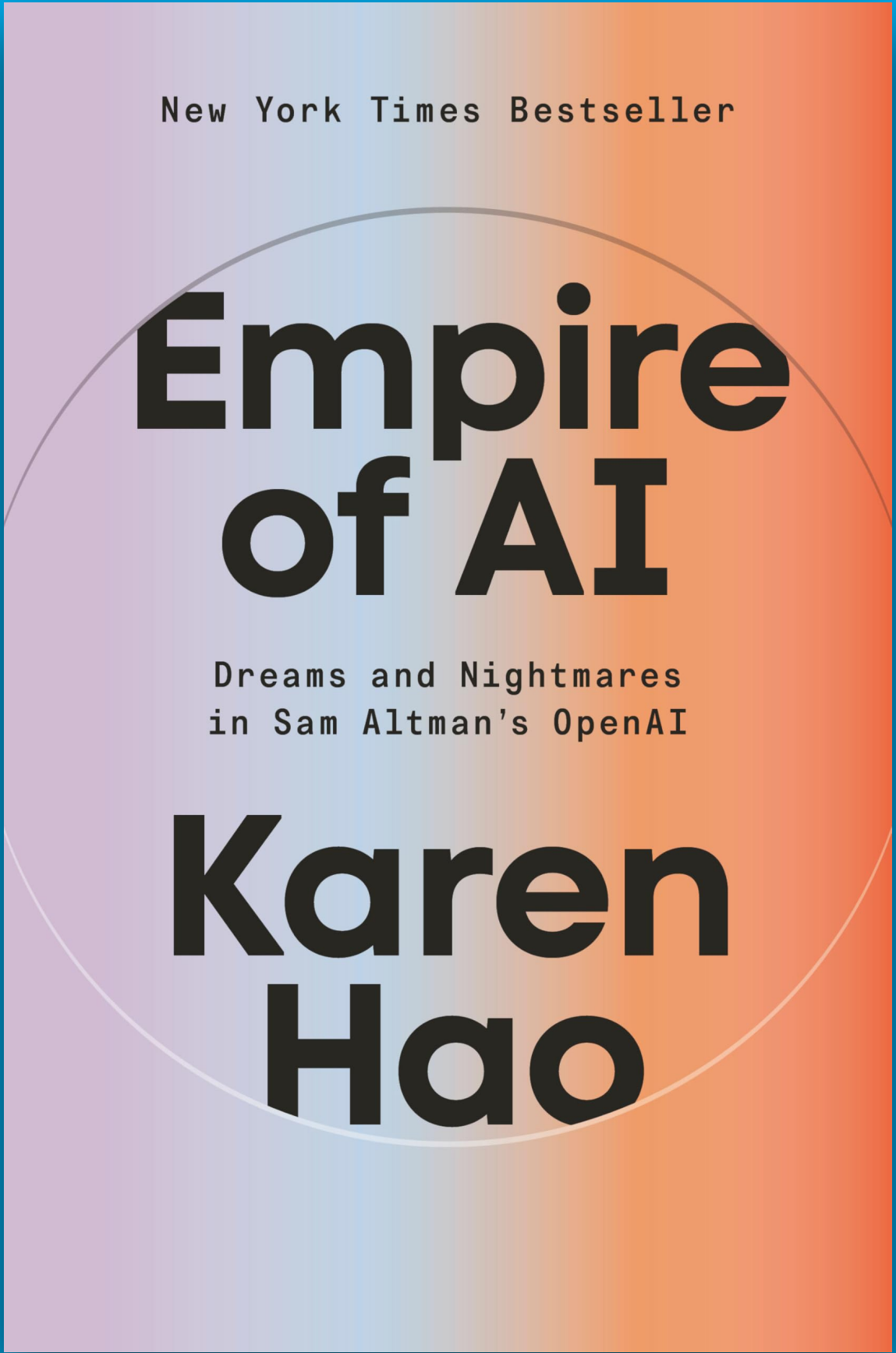
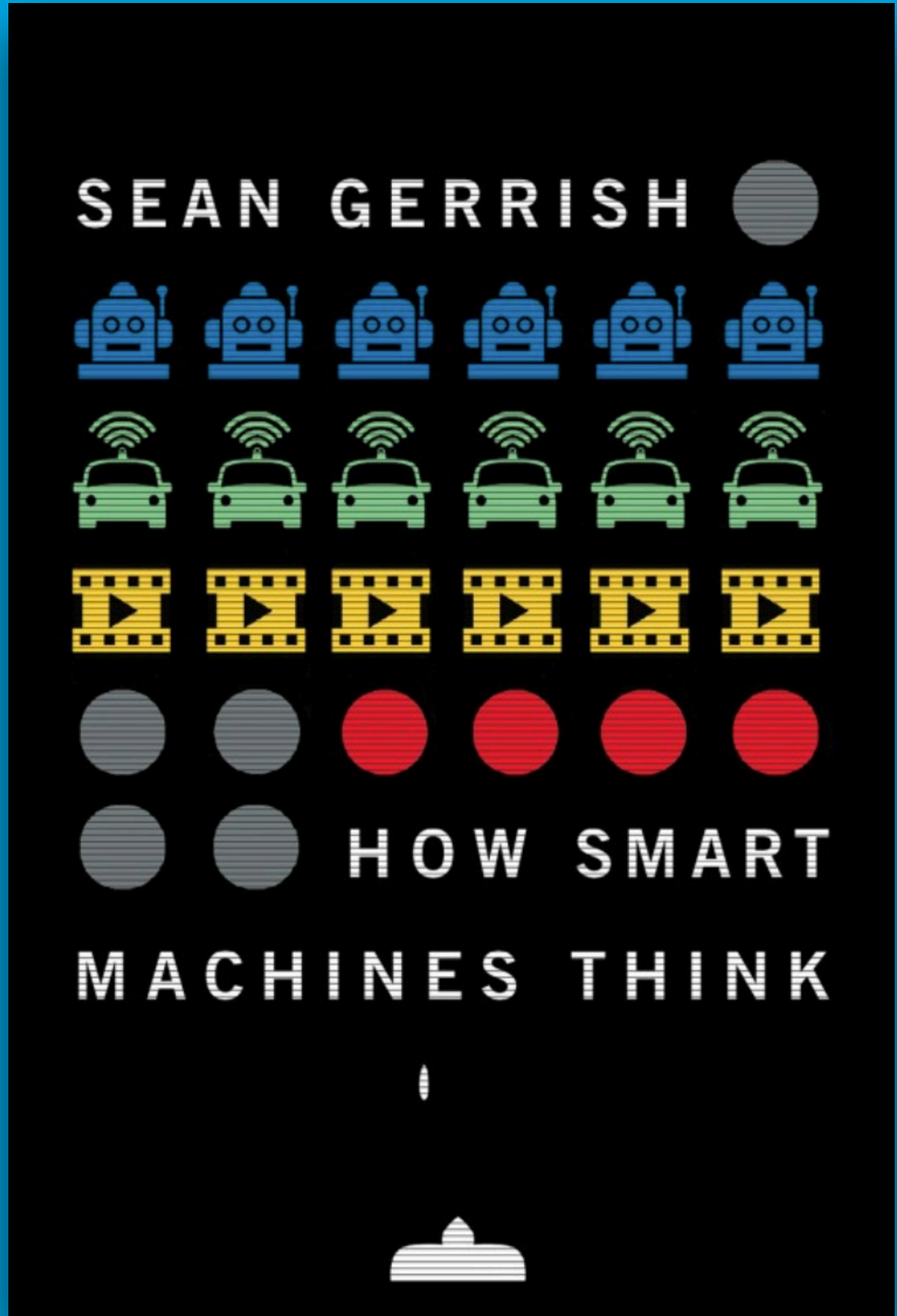
Tools

ChatGPT can make mistakes. Check important info. See [Cookie Preferences](#).


```
Messages (tab to focus)
OpenAI Codex v0.3.0 (research preview)

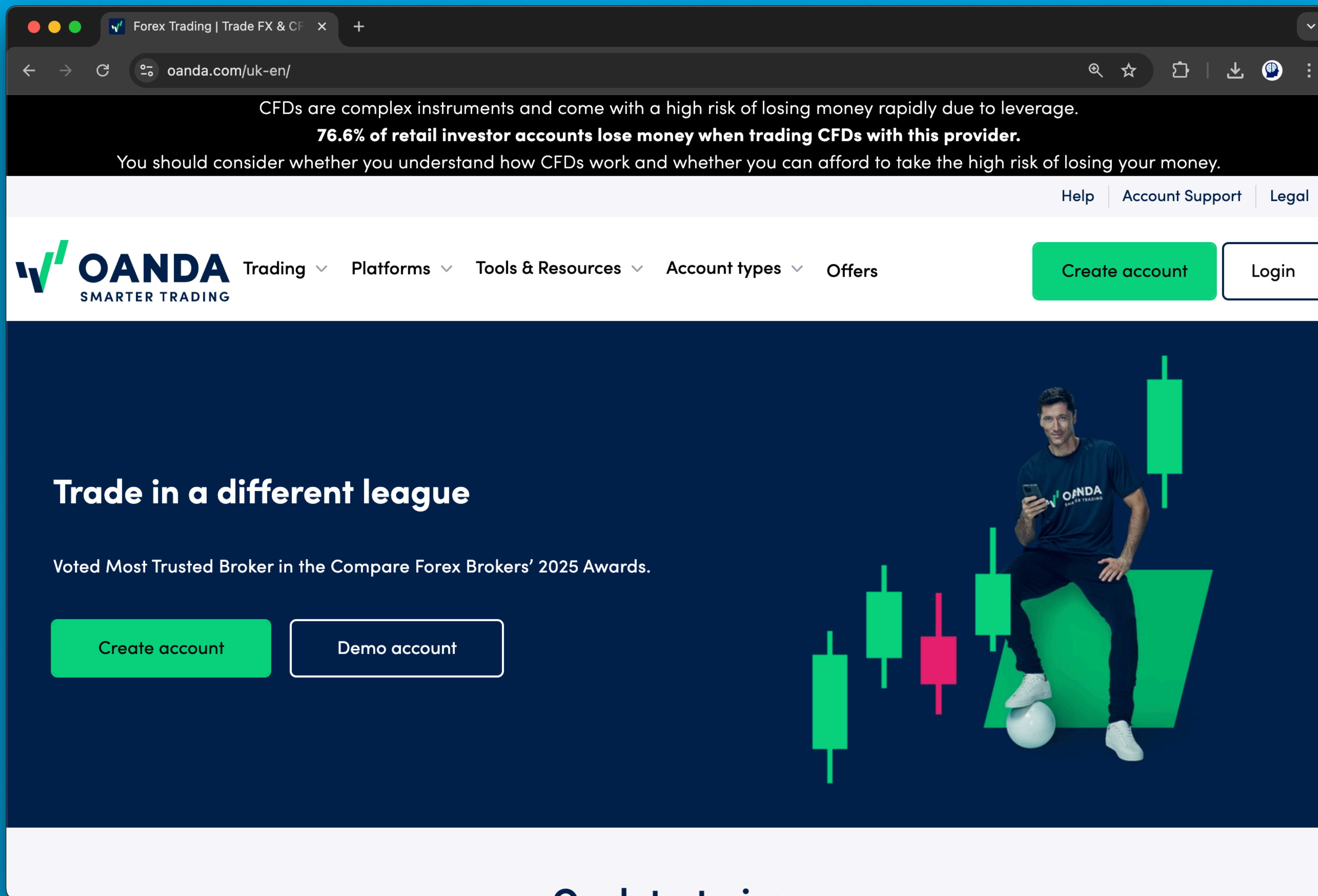
codex session 21a52aad-1cef-4cb1-84a2-244366e7dd86
workdir: /Users/yves/Dropbox/Program/cpf/57_ai_assistants/git/10_options
model: codex-mini-latest
provider: openai
approval: UnlessTrusted
sandbox: read-only
reasoning effort: medium
reasoning summaries: auto

Create a bash script to find all Python files older than 5 years.
Enter to send | Ctrl+D to quit | Ctrl+J for newline
```



Platform and GenAI



<https://oanda.com/uk-en/>

Overview - OpenAI API

platform.openai.com/docs/overview?lang=python

☆ | 📁 | ⬇️ | 👤 | ⋮

OpenAI Platform

Docs | API reference | Log in | Sign up

🔍 Search

⌘ K

GET STARTED

Overview

Quickstart

Models

Pricing

Libraries

CORE CONCEPTS

Text and prompting

Images and vision

Audio and speech

Structured Outputs

Function calling

API GUIDES

Conversation state

Streaming

File inputs

Background mode

📖 Cookbook

👥 Forum

OpenAI developer platform

Developer quickstart

Make your first API request in minutes. Learn the basics of the OpenAI platform.

🕒 5 min

python

```
1 from openai import OpenAI
2 client = OpenAI()
3
4 response = client.responses.create(
5     model="gpt-4.1",
6     input="Write a one-sentence bedtime story about a unicorn."
7 )
8
9 print(response.output_text)
```

📄

Browse models

View all

GPT-4.1

GPT-4.1

Flagship GPT model for complex tasks

o4-mini

o4-mini

Faster, more affordable reasoning model

o3

o3

Our most powerful reasoning model

<https://platform.openai.com>

Bootcamp Github Repository

github.com/yhilpisch/algo_py_genai

yhilpisch / algo_py_genai

Type / to search

CodeIssuesPull requestsActionsProjectsWikiSecurityInsightsSettings

algo_py_genaiPublic

PinWatch 0Fork 0Star 0

main1 Branch0 Tags

Go to file

Add file

Code

About

yves

Updates README.md.

f7bef8e · 16 hours ago

5 Commits

.gitignore

Initial commit.

17 hours ago

README.md

Updates README.md.

16 hours ago

README

Algorithmic Trading

With Python and GenAI

Online Bootcamp by The Python Quants GmbH

Dr. Yves J. Hilpisch
CEO & CPF Program Director

BOOTCAMP
ALGORITHMIC

Readme

Activity

0 stars

0 watching

0 forks

Releases

No releases published

Create a new release

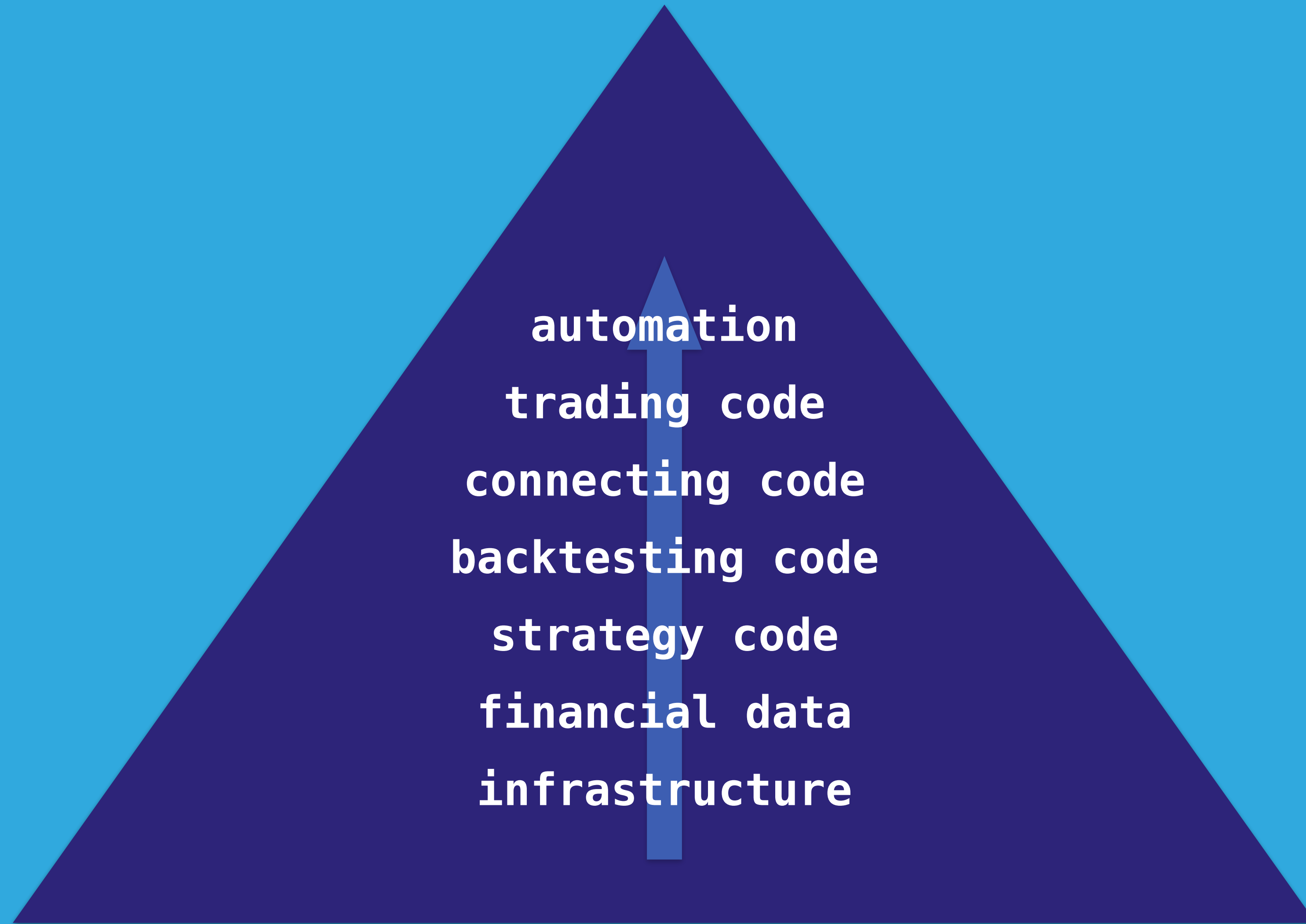
Packages

No packages published

Publish your first package

https://github.com/yhilpisch/algo_py_genai

Algorithmic Trading Pyramid



Efficient Markets

Random Walks in Stock Market Prices

Eugene F. Fama

For many years economists, statisticians, and teachers of finance have been interested in developing and testing models of stock price behavior. One important model that has evolved from this research is the theory of random walks. This theory casts serious doubt on many other methods for describing and predicting stock price behavior—methods that have considerable popularity outside the academic world. For example, we shall see later that if the random walk theory is an accurate description of reality, then the various “technical” or “chartist” procedures for predicting stock prices are completely without value.

In general the theory of random walks raises challenging questions for anyone who has more than a passing interest in understanding the behavior of stock prices. Unfortunately, however, most discussions of the theory have appeared in technical academic journals and in a form which the non-mathematician would usually find incomprehensible. This article describes, briefly and simply, the theory of random walks and some of the important issues it raises concerning the work of market analysts. To preserve brevity some aspects of the theory and its implications are omitted. More complete (and also more technical) discussions of the theory of random walks are available elsewhere; hopefully the introduction provided here will encourage the reader to examine one of the more rigorous and lengthy works listed at the end of this article.

COMMON TECHNIQUES FOR PREDICTING STOCK MARKET PRICES

In order to put the theory of random walks into perspective we first discuss, in brief and general terms, the two approaches to predicting stock prices that are commonly espoused by market professionals. These are (1) “chartist” or “technical” theories and (2) the theory of fundamental or intrinsic value analysis.

The basic assumption of all the chartist or technical theories is that history tends to repeat

itself, i.e., past patterns of price behavior in individual securities will tend to recur in the future. Thus the way to predict stock prices (and, of course, increase one’s potential gains) is to develop a familiarity with past patterns of price behavior in order to recognize situations of likely recurrence.

Essentially, then, chartist techniques attempt to use knowledge of the past behavior of a price series to predict the probable future behavior of the series. A statistician would characterize such techniques as assuming that successive price changes in individual securities are dependent. That is, the various chartist theories assume that the *sequence* of price changes prior to any given day is important in predicting the price change for that day.¹

The techniques of the chartist have always been surrounded by a certain degree of mysticism, however, and as a result most market professionals have found them suspect. Thus it is probably safe to say that the pure chartist is relatively rare among stock market analysts. Rather the typical analyst adheres to a technique known as fundamental analysis or the intrinsic value method. The assumption of the fundamental analysis approach is that at any point in time an individual security has an intrinsic value (or in the terms of the economist, an equilibrium price) which depends on the earning potential of the security. The earning potential of the security depends in turn on such fundamental factors as quality of management, outlook for the industry and the economy, etc.

Through a careful study of these fundamental factors the analyst should, in principle, be able to determine whether the actual price of a security is above or below its intrinsic value. If actual prices tend to move toward intrinsic values, then attempting to determine the intrinsic value of a security is equivalent to making a prediction of its future price; and this is the essence of the predictive procedure implicit in fundamental analysis.

THE THEORY OF RANDOM WALKS

Chartist theories and the theory of fundamental analysis are really the province of the market

Eugene F. Fama (1965): “Random Walks in Stock Market Prices”

“For many years, economists, statisticians, and teachers of finance have been interested in developing and testing models of stock price behavior. One important model that has evolved from this research is the theory of random walks. This theory casts serious doubt on many other methods for describing and predicting stock price behavior—methods that have considerable popularity outside the academic world. For example, we shall see later that, if the random-walk theory is an accurate description of reality, then the various “technical” or “chartist” procedures for predicting stock prices are completely without value.”

Reprinted from Financial Analysts Journal (September/October 1965):55–59.

Some Anomalous Evidence Regarding Market Efficiency

Michael C. Jensen
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Abstract

The efficient market hypothesis has been widely tested and, with few exceptions, found consistent with the data in a wide variety of markets: the New York and American Stock Exchanges, the Australian, English, and German stock markets, various commodity futures markets, the Over-the-Counter markets, the corporate and government bond markets, the option market, and the market for seats on the New York Stock Exchange. Yet, in a manner remarkably similar to that described by Thomas Kuhn in his book, *The Structure of Scientific Revolutions*, we seem to be entering a stage where widely scattered and as yet incohesive evidence is arising which seems to be inconsistent with the theory. As better data become available (e.g., daily stock price data) and as our econometric sophistication increases, we are beginning to find inconsistencies that our cruder data and techniques missed in the past. It is evidence which we will not be able to ignore.

The purpose of this special issue of the *Journal of Financial Economics* is to bring together a number of these scattered pieces of anomalous evidence regarding Market Efficiency. As Ball (1978) points out in his survey article: taken individually many scattered pieces of evidence on the reaction of stock prices to earnings announcements which are inconsistent with the theory don't amount to much. Yet viewed as a whole, these pieces of evidence begin to stack up in a manner which make a much stronger case for the necessity to carefully review both our acceptance of the efficient market theory and our methodological procedures.

Keywords: market efficiency, Efficient Market Theory, theory of 'random walks', rational expectations theory, abnormal returns, asset pricing model.

Journal of Financial Economics, Vol. 6, Nos. 2/3 (1978) 95-101.

© M. C. Jensen 1978

This document is available on the
Social Science Research Network (SSRN) Electronic Library at:
http://papers.ssrn.com/ABSTRACT_ID=244159

Michael Jensen (1978): “Some Anomalous Evidence Regarding Market Efficiency”:

“A market is efficient with respect to an information set S if it is impossible to make economic profits by trading on the basis of information set S.”

Efficient market hypothesis and forecasting

Allan Timmermann*, Clive W.J. Granger

Department of Economics, University of California San Diego, 9500 Gilman Drive, La Jolla, CA 92093-0508, USA

Abstract

The efficient market hypothesis gives rise to forecasting tests that mirror those adopted when testing the optimality of a forecast in the context of a given information set. However, there are also important differences arising from the fact that market efficiency tests rely on establishing profitable trading opportunities in ‘real time’. Forecasters constantly search for predictable patterns and affect prices when they attempt to exploit trading opportunities. Stable forecasting patterns are therefore unlikely to persist for long periods of time and will self-destruct when discovered by a large number of investors. This gives rise to non-stationarities in the time series of financial returns and complicates both formal tests of market efficiency and the search for successful forecasting approaches.

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Keywords: Efficient market hypothesis; Forecast evaluation; Model specification; Learning

1. Introduction

The efficient market hypothesis (EMH) is a back-breaker for forecasters. In its crudest form it effectively says that series we would very much like to forecast, the returns from speculative assets, are unforecastable. This is a venerable thesis, its earliest form appearing a century ago as the random walk theory (Bachelier, 1964). This theory was confirmed empirically in the 1960s (see Cootner, 1964) and many times since. Soon after the empirical evidence appeared, the EMH was pro-posed based on the overpowering logic that if returns were forecastable, many investors would use them to generate unlimited profits. The behavior of market participants induce returns that obey the EMH,

otherwise there would exist a ‘money-machine’ producing unlimited wealth, which cannot occur in a stable economy.

Intellectually, that might appear to be the end of the story. However, despite the force of the argument, it seems not to be completely convincing for many forecasters. Everyone with a new prediction method wants to try it out on returns from a speculative asset, such as stock market prices, rather than series that are known to be forecastable. Papers continue to appear attempting to forecast stock returns, usually with very little success.¹

¹ It is often argued that there is a ‘file drawer’ bias in published studies due to the difficulty associated with publishing empirical studies that find insignificant effects. In studies of market efficiency, a reverse file drawer bias may be present. A researcher who genuinely believes he or she has identified a method for predicting the market has little incentive to publish the method in an academic journal and would presumably be tempted to sell it to an investment bank.

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Timmermann and Granger (2004): “Efficient Market Hypothesis and Forecasting.”

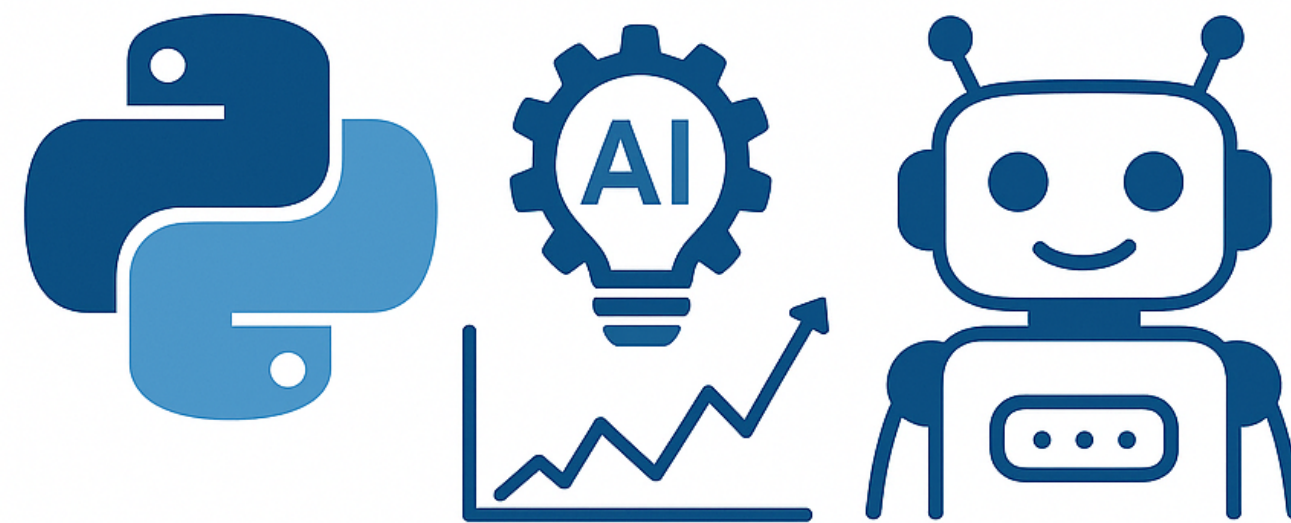
“A market is efficient with respect to the information set, $S(t)$, search technologies, $T(t)$, and forecasting models, $M(t)$, if it is impossible to make economic profits by trading on the basis of signals produced from a forecasting model in $M(t)$ defined over predictor variables in the information set $S(t)$ and selected using a search technology in $T(t)$.”

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