PORTFOLIO OPTIMIZATION PROJECT

Financial Data Analysis with Python

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Project Overview

Scenario

This project is based on a modeled client profile inspired by someone in a similar financial and demographic position as myself. The client is a 23-year-old investor looking to allocate **$20,000** into a **long-term portfolio** with a time horizon of **10+ years**.

Believing in the transformative potential of AI and technology, the client is focused on **high-growth sectors** and is comfortable accepting **above-average risk** in pursuit of long-term capital appreciation. While they **value some level of diversification** to manage downside risk, they are willing to **prioritize return potential** — particularly given their time horizon and risk tolerance.

Key Constraints & Goals:

- Moderate-to-high risk tolerance

- Desired diversification within and slightly beyond tech

- No ESG filtering: investment decisions driven solely by risk-return analysis

- Optimize for capital growth, returns, and risk using Sharpe ratio

- Portfolio data reflects live market conditions as of May 7, 2025, with code designed to auto-update based on the run date

Tools and Methodologies

All data collection, analysis, and visualizations in this project were performed using Python

Key libraries:

yfinance for real-time stock data

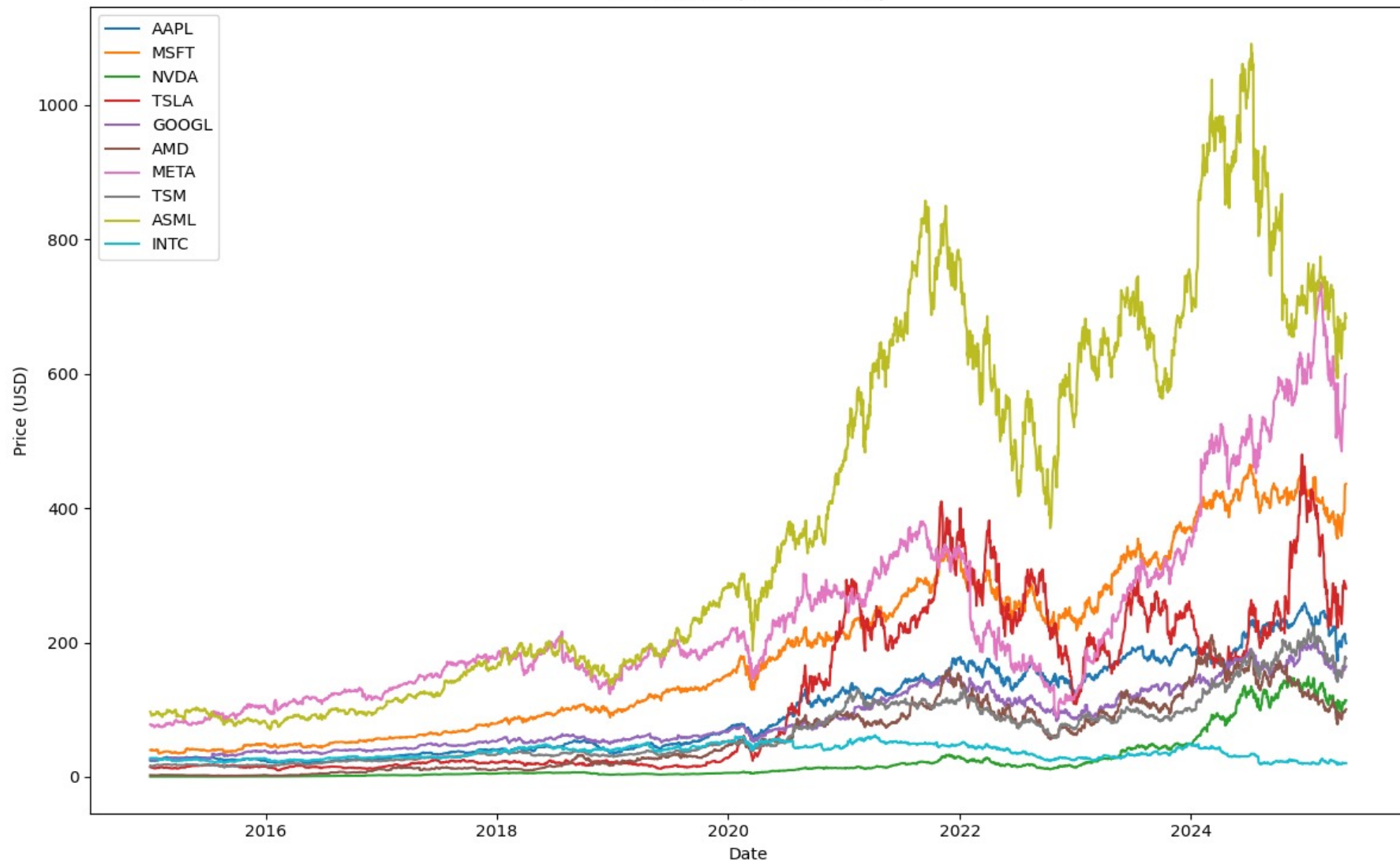**pandas & numpy** for data manipulation and calculations

matplotlib & seaborn for charting

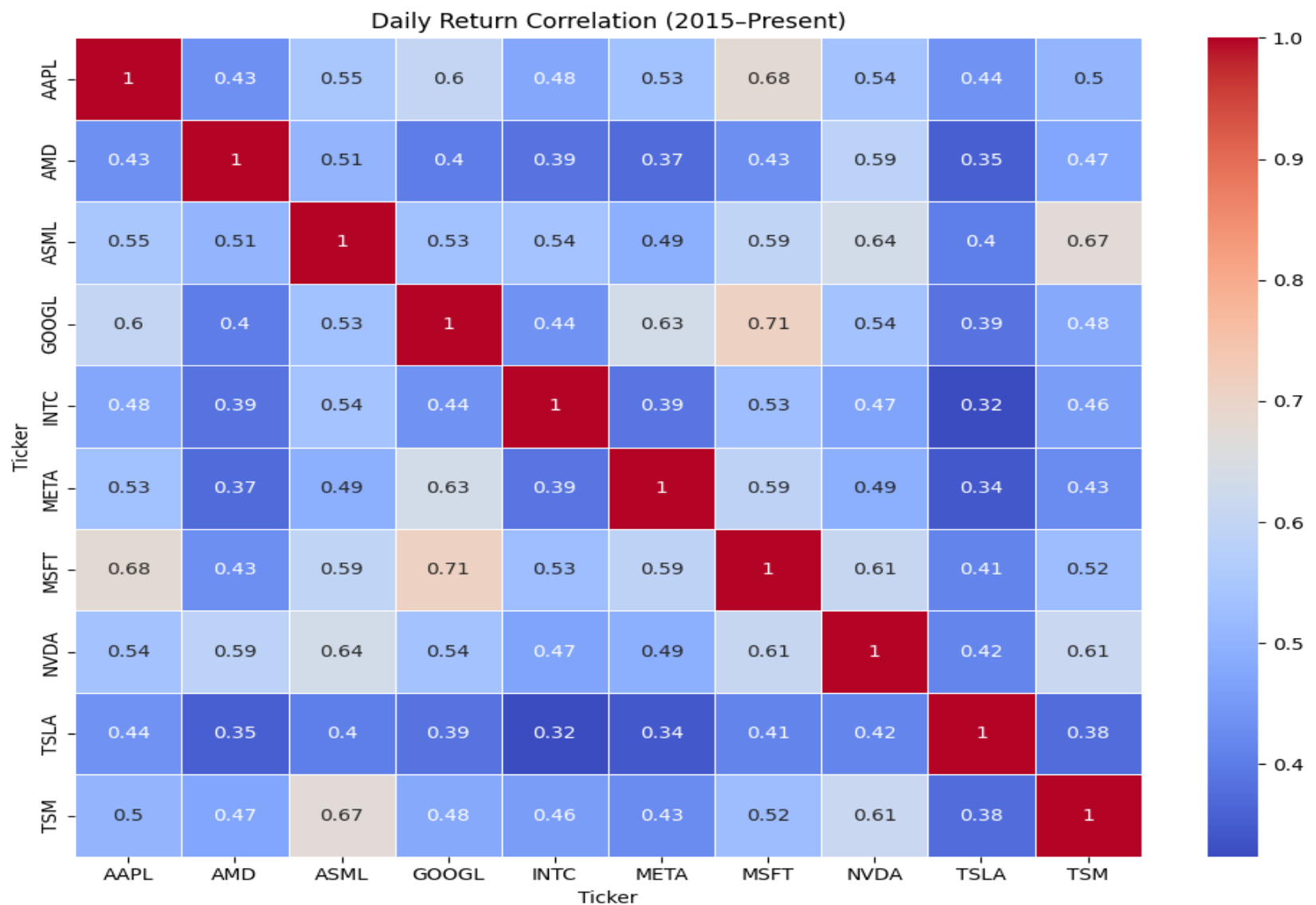**PyPortfolioOpt** for portfolio optimization and efficient frontier modeling

Stock Prices (2021–Present)

Explanation

This chart highlights the price movement of selected tech and AI-related stocks from 2015 to the present. Notably, many of these stocks experienced substantial growth following 2020, reinforcing the client's belief in the long-term potential of the tech sector and their desire for exposure to it.

Daily Return Correlation (2015–Present)

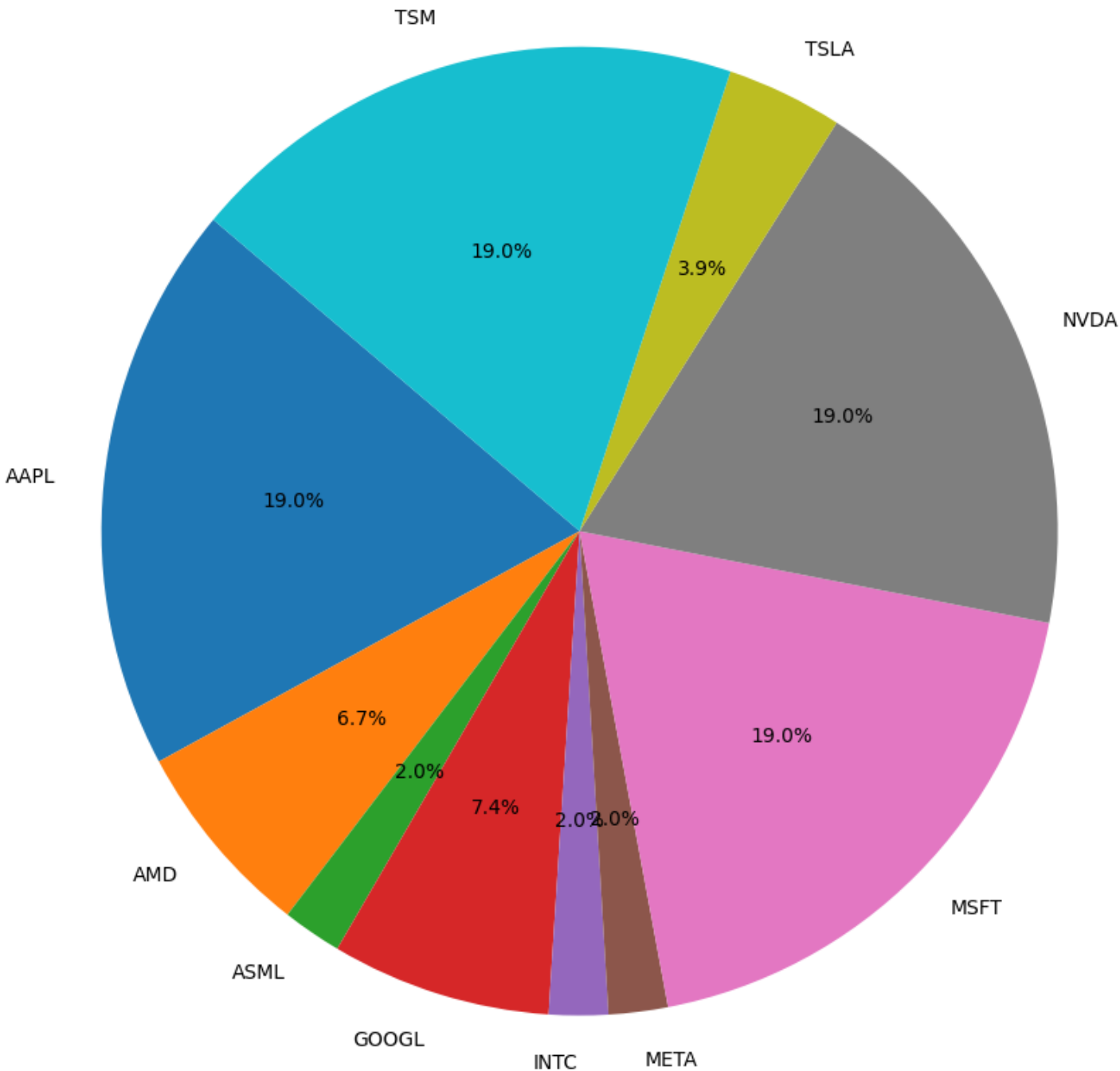|	AAPL	AMD	ASML	GOOGL	INTC	META	MSFT	NVDA	TSLA	TSM
AAPL	1	0.43	0.55	0.6	0.48	0.53	0.68	0.54	0.44	0.5
AMD	0.43	1	0.51	0.4	0.39	0.37	0.43	0.59	0.35	0.47
ASML	0.55	0.51	1	0.53	0.54	0.49	0.59	0.64	0.4	0.67
GOOGL	0.6	0.4	0.53	1	0.44	0.63	0.71	0.54	0.39	0.48
INTC	0.48	0.39	0.54	0.44	1	0.39	0.53	0.47	0.32	0.46
META	0.53	0.37	0.49	0.63	0.39	1	0.59	0.49	0.34	0.43
MSFT	0.68	0.43	0.59	0.71	0.53	0.59	1	0.61	0.41	0.52
NVDA	0.54	0.59	0.64	0.54	0.47	0.49	0.61	1	0.42	0.61
TSLA	0.44	0.35	0.4	0.39	0.32	0.34	0.41	0.42	1	0.38
TSM	0.5	0.47	0.67	0.48	0.46	0.43	0.52	0.61	0.38	1

Explanation

This heatmap illustrates the degree to which the selected stocks' daily returns move in relation to each other (representing a covariance matrix). While many of the tech stocks are moderately to highly correlated, there are pockets of lower correlation, especially across different sub-sectors. Understanding these relationships helped balance growth potential with risk management and diversification.

Efficient Frontier (PyPortfolioOpt)

Explanation

This chart displays the efficient frontier, representing the set of optimal portfolios that offer the highest expected return for a given level of risk. By applying mean-variance optimization, we identified the portfolio with the maximum Sharpe ratio—balancing return and volatility. This visualization reinforces the rationale behind the client's specific asset allocation within the tech and AI space.

Optimized Portfolio Allocation

Explanation
This pie chart shows the final asset allocation derived from the efficient frontier analysis. Using mean-variance optimization, we selected the portfolio that maximized the Sharpe ratio within the client's constraints—prioritizing growth while limiting exposure to any single stock. The result is a diversified, tech-focused portfolio tailored to the client's long-term goals and risk profile.

Constraints
- 19% max allocation
- 2% min allocation

Final Investment Breakdown ($20,000 Portfolio)

Ticker	Shares	Price per Share	Total Value
MSFT	9.00	436.17	3925.53
TSM	22.00	176.40	3880.80
AAPL	19.00	198.89	3778.91
NVDA	33.00	113.82	3756.06
GOOGL	9.00	164.21	1477.89
AMD	13.00	100.59	1307.67
TSLA	3.00	280.26	840.78
META	1.00	599.27	599.27
INTC	21.00	20.27	425.67
CASH	nan	nan	7.42

Explanation

This table translates the optimized portfolio into real-world share purchases based on current stock prices. It shows how the client would allocate their $20,000 across individual stocks, rounding to whole shares. The model achieved near-full capital deployment with only minimal unallocated cash, making the portfolio both efficient and actionable.

PORTFOLIO OPTIMIZATION PROJECT ANALYSIS

Based on historical performance, risk-return analysis, and optimization modeling, the recommended portfolio offers a strategic blend of high-growth tech and AI stocks, tailored to the client's long-term horizon and moderate-to-high risk tolerance.

While the portfolio is tech-heavy by design, constraints on individual weights and covariance analysis help maintain diversification within the sector. The client's $20,000 investment is efficiently allocated into whole shares, with minimal cash left unallocated.

This model not only meets the client's goals, but also adapts dynamically to market data, providing a robust foundation for future rebalancing and performance monitoring. Furthermore, the model is fully adaptable—allowing future clients to input their own list of stocks, sectors, and constraints to generate personalized, data-driven investment portfolios.