

# S&P 500 Chart

MATLAB Challenge — Winter Term 2022/23

November 29, 2022

## 1 Motivation

S&P 500 (Standard & Poor's 500) is a stock market index tracking performance of the 500 biggest companies listed on stock exchanges in the US. Other known indices are Nasdaq and Dow Jones. Each company has its unique symbol, a “ticker”. The actual performance of the index is, among others, commonly visualized on “a map”, see Fig. 1.

The map is filled with rectangles, their size is weighted by a capitalization methodology (market cap.), the color represents the actual performance on the market (profit/loss), and their position within one of the sectors depends on a type of industry.

However, as seen in Fig. 1, the rectangles have different side aspect ratios, filling the region dedicated to each industry.



Figure 1: A map of S&P 500 index, taken Nov. 4, 5:21 PM CET.

## 2 Task

Your task is to redo the map, however, this time, with a fixed side aspect ratio of each rectangle representing each company. Areas  $A_i$  of the rectangles are to be normalized to the biggest company in the index, Apple Inc. (AAPL), which will have area  $A_{AAPL} = 1$  (in arbitrary units you prefer).

Fill the rectangular region of side aspect ratio 1.6:1 as best as possible with all the companies enlisted in S&P 500. Each company is represented by a rectangle of area  $A_i$ , which is proportional

to its market capitalization and where the area of the biggest company is normalized to unity (in Nov. 4 2022, it is Apple Inc.). Ignore the division of companies into different industries like Technology, Communication, etc.

Among participants, the map with the highest “filling efficiency” wins. Filling efficiency  $e \in [0, 1]$  is defined as

$$e = \frac{\sum_i A_i}{A_{\text{total}}}, \quad (1)$$

where  $A_{\text{total}}$  is the area of the smallest 1.6:1 rectangle fully containing the map.

### 3 Details and Hints

Companies from S&P 500 are enumerated in the table on [Slickcharts](#), where you can get the market capitalization of each company (use column “Weight”), ticker (“symbol”), and performance. A real-time updated high-quality map is available on [finviz](#). You can take some inspiration regarding style, colors, etc. To have a code independent of a particular data set, implement the project as a function with the following header

```
[hndl, efficiency] = snp500map(tickers, weights, performance),
```

where `tickers` is a cell of all companies represented by their tickers, `weights` is a column vector of relative weights of their capitalization, and `performance` is actual performance (change of price in percents). The output variable `hndl` is a structure of a vector containing references to all graphical objects used (figure, axes, fill, ...), and the variable `efficiency` contains a value  $e$  from (1), *i.e.*, of how efficient the area filling is.

Add a ticker into the top left corner of each rectangle, using a proportional font size. Do it for rectangles of reasonable size only, so the ticker is visible. Background color of each rectangle is set to

$$\mathbf{c}_i = [1 - k_i^+, \quad 1, \quad 1 - k_i^+] \quad (2)$$

for every profitable company, where  $k_i^+ = p_i/p_{\max}$ , and to

$$\mathbf{c}_i = [1, \quad 1 - k_i^-, \quad 1 - k_i^-] \quad (3)$$

for every losing company, where  $k_i^- = p_i/p_{\min}$ . Notice that both  $k_i^+$  and  $k_i^-$  are positive numbers between 0 and 1. You can see some examples of color mapping in Fig. 2.

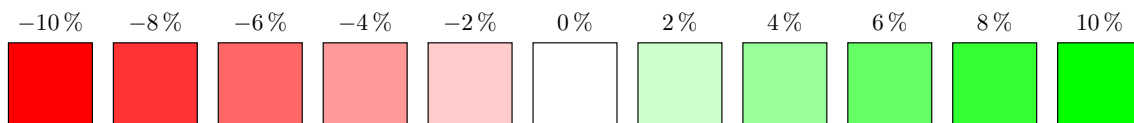


Figure 2: Color scheme used for the map.

## 4 Criteria

### General

- An unlimited number of students can select this project. However, no collaboration between students is expected.
- Complete the challenge till **January 8, 2023, 23:59** and submit it via [BRUTE](#).
- Contact [matlab@fel.cvut.cz](mailto:matlab@fel.cvut.cz) with any questions.

- The project should be submitted, including short documentation for each file describing how it works.
- Like regular projects, a short presentation (a couple of minutes) is expected.
- No external MATLAB toolboxes or third-party libraries are allowed.
- It is possible to always withdraw from the competition and select one of the regular projects. This decision should be discussed with the teachers, and their approval is required.

## 5 List of Awards

By participating in the competition, you will automatically be rewarded with some of the unique MATLAB merchandise, see Figure 3.

The three best solutions will also be rewarded with Humusoft vouchers for MATLAB courses, where you can learn some of the advanced functionalities of MATLAB language, such as Simulink, parallel computations, and embedded coding.



Figure 3: Professionally arranged demonstration of MATLAB merchandise that you can win. 🤖

## 6 Disclaimer

Small changes both in the challenge assignments and in the organization of the contest are reserved.