Numerical Methods (CS 357)

Worksheet

Part 1. Affine combinations

Consider the set of affine combinations of two point vectors x and y:

$$S = \{\alpha x + \beta y : \alpha + \beta = 1\}.$$

Is this a vector space?

(A) Yes, always.

(B) Only if the null vector is contained in S.

(C) Only if neither x nor y is the null vector.

(D) No, never.

Part 2. Matrices and the Stock Market

Suppose I own two stocks, say General Motors and Kraft. I write down how many shares I own of each in a vector, $x = [10, 15]^T$. I.e. I have 10 shares of GM and 15 of Kraft.

In the middle of last year, GM stock cost 10.3 dollars per share, and Kraft cost 7.5.

At the end of last year, GM stock cost 8.2 dollars per share, and Kraft cost 7.9.

Create a matrix (2×2 `numpy` array, really) in the variable `stock_matrix` so that, when you apply matrix multiplication stock_matrix $\cdot\, x$, I obtain a vector with the value of my portfolio at the middle of last year (first entry) and today.

```
import numpy as np
```

Part 3. Rotating a diamond

The variable `diamond` contains coordinates for the vertices of a diamond, as a `(2, n)` array.

You are given an array `angles` of shape `(m,)` that contains angles (in radians) about which you should rotate the diamond.

Create an array `rotated_diamonds` of shape `(m, 2, n)` that contains each diamond, rotated by the corresponding entry of `angles`.

Plot each rotated diamond.

Hint: `numpy` contains `sin` and `cos`.

```
import numpy as np
import matplotlib.pyplot as pt
```