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Exercise Sheet 1: Matlab

Deadline: see website

The exercises are handed in via PASSR (see link on website). Please run the test scripts (see website) before submitting your solutions.

Exercises

Exercise 1 [3 pts]

Write a function `distmat` in a file `distmat.m` with signature

```
[ D1, D2, td ] = distmat(X)
```

which calculates the distance matrices `D1` and `D2` (in L_2 norm) of the column vectors in `X` using two different methods. Additionally, calculate the running time difference `td` between both: Let

$$X = [x_1, x_2, \ldots, x_n]$$

$(d \times n)$-matrix of column vectors. Then

$$(D_1)_{ij} = (D_2)_{ij} = \|x_i - x_j\|$$

where D_1 is calculated using `for` loops and D_2 is calculated using the equality

$$\|x_i - x_j\|^2 = (x_i - x_j)^\top (x_i - x_j) = x_i^\top x_i - 2x_i^\top x_j + x_j^\top x_j$$

to avoid `for` loops. Calculate the running time difference `td` using `tic` and `toc`, where `td` is positive, if the calculation of D_2 was faster.

Remark: The timer using `tic` and `toc` is not with high-resolution. Therefore, the matrix X should be chosen large enough, to make the time difference measurable. Also, the statements `repmat` and `sum` could be useful to solve the exercise. Try to calculate the three terms of the last equation seperately, and sum them in the end. Notice that the equation calculates the squared norm!

Exercise 2 [2 pts]

Write a function `mydet` with signature

```
d = mydet(A, k)
```

which calculates the determinant of `A` recursively using the Laplace extension of the `k`-th row.

Reminder: The determinant of a $(n\times n)$-matrix A can be calculated using the Laplace expansion of the `k`-th row:

$$\det(A) = \sum_{j=1}^{n} (-1)^{k+j} A_{kj} \det(\tilde{A}_{k,j})$$

where $\tilde{A}_{k,j}$ is the matrix A with the k-th row and j-th column deleted. For a (1×1)-matrix one has $\det(A) = A_{1,1}$. Test your function with some matrices and compare the results with the ones of the built-in function `det`.