

# MAT-63506 Scientific Computing

## Exercise Set 1

5. – 11. 3. 2018

Don't use `for` or `while` loops in this exercise set. Remember to store the answers into variables with *exactly* the indicated names.

**Exercise 1.** Compute each of the following using a **single** MATLAB statement. Don't use multiple statements, or temporary variables in **this** problem (you can use them in the other problems). Store the answers into the variables `t1a`, `t1b`, ..., `t1e`.

(a)  $\sqrt{1630} + \arcsin(3 + 2i)$ .

(b)  $\sin x$  for  $x = 4, 8, 15, 16, 23, 42$ .

(c)  $\sum_{j=1}^{17} (101 - 34j)$ .

**HINT:** Use `sum` and an appropriate vector.

(d)  $\ln(200) - \sum_{j=1}^{200} \frac{1}{j}$ .

**HINT:** Use elementwise division `./`

(e)  $\sum_{j=1}^{42} 2^{-4j}$ .

**HINT:** Use elementwise power `.^`

**Exercise 2.** Form the  $10 \times 10$  magic square with the command `magic` and using the indexing operations of MATLAB (colon operator and vector indexing) select the following submatrices from it and store them into the variables `t2a`, `t2b`, ..., `t2e`.

(a) Fifth row.

(b) Tenth column.

(c) Rows 1, 3, 6, 8.

(d) Columns 9, 1, 5, 3, in this order.

(e) The submatrix with rows 2, 5, 8 and columns 1, 5, 7, 10.

**Exercise 3.** Make the following substitutions starting from the  $9 \times 9$  magic square. Store the answers into the variables `t3a`, `t3b`, ..., `t3e`.

(a) Remove the third row.

**HINT:** Use the empty matrix `[]`.

(b) Remove the fifth column from the result of (a).

(c) Replace the third row of (b) with the vector `[1 2 ... 7 8]`.

(d) Replace the seventh column of (c) with the vector `[8 7 ... 1]^T`.

- (e) Replace the submatrix of (d) with rows 2, 6 and columns 2, 5, 7 with the matrix

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}.$$

**HINT:** Use the colon operator, vector indexing, `reshape`, and `transpose`.

**Exercise 4.** Form the following block matrices and store the answers into the variables `t4a` and `t4b`.

- (a) An  $9 \times 9$  matrix with first and last rows and columns ones and the rest of the elements zeros.
- (b) The matrix

$$\begin{bmatrix} A & B \\ C & D \end{bmatrix},$$

where  $A$  is the  $3 \times 3$  Pascal matrix (`pascal`),  $B$  is the first three rows of the  $4 \times 4$  identity matrix,  $C$  is the last three columns of the  $4 \times 4$  identity matrix, and  $D$  is the  $4 \times 4$  magic square.

**HINT:** `ones`, `zeros`, `eye`.

**Exercise 5.** The command `rosser` forms the Rosser matrix, which is a useful matrix to test eigenvalue solvers. Find the median of the positive elements and the median of the negative elements of the Rosser matrix and store the answers into the variables `t5pos` and `t5neg`.

**HINT:** `median` and logical indexing.

**Exercise 6.** Let  $M$  be the product of the  $8 \times 8$  magic square and its transpose. Find the largest element of  $M$  and its location(s) (row(s) and column(s)). Store the answers into the variables `t6max`, `t6r` and `t6c`.

**HINT:** `max`, `find`.

**Exercise 7.** Find the sum of the prime numbers that appear on the main diagonal of a  $29 \times 29$  magic square. Store the answer into the variable `t7`. **Don't** use the `find` command, use logical indexing.

**HINT:** `sum`, `isprime`, `diag`.