Computer Science

MATLAB

Essential MATLAB for Scientists

Chap 2: Fundamentals -Exercises

2. MATLAB Fundamentals

- Exercise 1: use MATLAB array operations to do the following:
  1. Add 1 to each element of the vector [2 5 -1].
  2. Multiply each element of the vector [1 4 8] by 3.
  3. Find the array product of the two vectors [1 2 3] and [0 -1 1].
  4. Square each element of the vector [2 3 1]

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- Exercise 2

  Compound Interest: An amount of money A invested over a period of n years with an annual interest rate of r grows to an amount $A(1 + r)^n$. Suppose we want to calculate final balances for investments of $750, $1000, $3000, $5000 and $11999, over a period of 10 years, with an interest rate of 9%. The following program uses array operations on a vector of initial investments to do what is requested.

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- Exercise 2

  The program could look like the following:

  - format bank
  - A = [750 1000 3000 5000 11999];
  - r = 0.09;
  - n = 10;
  - B = A * (1 + r) ^ n;
  - disp([A' B']);

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- Exercise 2
  - Notes:
    - In the statement B = A * (1 + r) ^ n, the expression (1 + r) ^ n is evaluated first, because exponentiation has a higher precedence than multiplication.
    - After that, each element of the vector A is multiplied by the scalar (1+ r) ^ n.
    - The operator * may be used instead of .* because the multiplication is between a scalar and a non-scalar.
    - A table is displayed, with columns given by the transposes of A and of B.
  - The process is called vectorization of a formula. Indeed, every element in the vector B is determined by operating on every element of vector A all at once by interpreting one single command line.

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- Exercise 2

  - Modify the program *comp* to find the balances for a single amount A ($1000) over periods of 1, 5, 10, 15 and 20 years. **Hint**: use a vector for n: [1 5 10 15 20]

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- Exercise 3

Use MATLAB to evaluate the following expressions.

a) $\sqrt{2}$

b) $\frac{3+4}{5+6}$

c) Find the sum of 5 and 3 divided by their product

d) 2^{3^2}

e) Find the square of 2π

f) $2\pi^2$

g) $1/\sqrt{2\pi}$

h) $\frac{1}{2\sqrt{\pi}}$

i) Find the cube root of the product of 2.3 and 4.5

j) $\frac{1-\frac{2}{3+2}}{1+\frac{2}{3-2}}$

k) $1000(1 + 0.15/12)^{60}$

l) $(0.0000123 + 5.678 + 10^{-3}) \times 0.4567 \times 10^{-4}$

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- Exercise 4

Try to avoid unnecessary brackets in an expression. Can you spot the errors in the following expression? Check your answer using MATLAB.

```
(2(3+4)/5*(6+1))^2
```

2. MATLAB Fundamentals

- Exercise 5

Set up a vector n with elements 1, 2, 3, 4, 5. Use MATLAB array operations on the vector n to set up the following four vectors, each with five elements.

a) $2\,,4\,,6\,,8\,,10$

b) $1/2\,,1\,,3/2\,,2\,,5/2$

c) $1\,,1/2\,,1/3\,,1/4\,,1/5$

d) $1\,,1/2^2\,,1/3^2\,,1/4^2\,,1/5^2$

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- Exercise 6

Suppose *x* and *y* are defined as follows. Evaluate by hand the vector *z* in the following statements. THEN check your answers with MATLAB.

```
x= [2   -1   5   0];
y=[3   2   -1   4];
```

a) `z = x -y;`

b) `z = y + x-3;`

c) `z = 3 * x + x .^ y;`

d) `z = y ./ x ;`

e) `z = y .\ x;`

f) `z = x .^ y;`

g) `z = 2 .^ y + x;`

h) `z = 2 * y/3 .* x;`

i) `z = y * 2 .* x;`

2. MATLAB Fundamentals

- Exercise 7

Use one MATLAB line to evaluate the expression below

$$\sqrt{\frac{(4.172+9.131844)^3-18}{-3.5+(11.2-4.6)*(7-2.91683)^{-0.4}}}$$

- Exercise 8

Verify that the exponent (exp ()) and natural logarithm (log ()) are inverses of one another (cancel one another).

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- Exercise 9

Use one MATLAB command to evaluate the sine of 30°, 45°, 60°, and 120°. Subsequently, evaluate cosine, tangent and cotangent of the same angles.

- Exercise 10

Find and display all integers between 1 and 10000 which divide by 37.

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- Exercise 11

Create a matrix A of size 4×3, whose elements a_{ij} are calculated from the row and column indices as follows:

$$a_{ij} = (j-4)^2(i+1)^{-3}+ij$$

- Exercise 12

Using a matrix equation, find the intersection point of the lines defined by the following equations:

$$7x - 12y + 4 = 0$$
$$12x - 45y + 26 = 0$$

Note: Command inv (A) will return the inverse of matrix A.

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- Exercise 13

Create a matrix of 100 rows and 100 columns. The odd columns should contain values 2 , and the even columns, values 0.