MATLAB Excercises

These exercises should help you to get used to vector and matrix notation in MATLAB, indexing, matrix-wise and element-wise operations and elementary MATLAB functions. Do not use any loops (for, while) or if-else statements. Find general solutions, not solutions for the given numerical values.

1. Create a vector x containing integer numbers from 1 to 100. Create a vector y containing numbers 1, 0.9, 0.8, 0.7, ...0.1, 0 in this order.

2. From x create y containing first 25 elements of x, z containing elements of x with indexes from 50 to 75 and w containing elements with even indexes.

3. Create a 3 by 3 matrix with all ones. Create an 8 by 1 matrix with all zeros. Create a 5 by 2 matrix with all 0.37.

4. Create a 1 by 25 vector containing random element with the uniform distribution in the interval $[-0.5, 0.5]$.

5. Create a vector $x = [3, 1, 2, 5, 4]$. From x create y containing the same elements in the reverse order, find indices of elements greater than 2, create z containing elements of x less than 4.

6. Create a vector s containing elements of x sorted in ascending order. Clear x from workspace. From s create back a vector with elements in the same order as were in x.

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Example:        >> x = [3 1 2 5 4];
                >> s = ......              % create s from x
                >> clear x
                >> x = ......              % create x back from s
```

7. Given the matrix $m = [1, 2, 3; 2, 1, 5; 4, 6, 4; 2, 3, 2]$, create its submatrix n containing the first two rows and the first and third column (i.e., row indices $i = 1, 2$ and column indices $j = 1, 3$).

8. Given the same matrix $m = [1, 2, 3; 2, 1, 5; 4, 6, 4; 2, 3, 2]$, create a matrix n with rows sorted in descending order of the elements in the second column.

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Example:        1 2 3           4 6 4
                2 1 5    =>     2 3 2
                4 6 4           1 2 3
                2 3 2           2 1 5
```

9. Calculate the outer product of two vectors $x = [1, 2, 3]$ and $y = [0.1, 0.2, 0.3]$. Multiply these two vectors element by element.

10. Given a vector $a = [8, 6, 4]$ and an integer number $n = 4$, create a matrix b containing n-times $a(1)$ in the first row, n-times $a(2)$ in the second row, etc.
(i.e. $b = [8, 8, 8, 8; 6, 6, 6, 6; 4, 4, 4, 4]$).

11. Given a matrix $a = [0, 2, 1; 3, 1, 0; 4, 6, 4; 2, 0, 2]$, create a matrix with 1's at locations where a has zeros and 0's elsewhere. Create a matrix containing all 0's except the maximal elements in each row of a (i.e., $b = [0, 2, 0; 3, 0, 0; 0, 6, 0; 2, 0, 2]$).

12. Given a vector $x = [3, 1, 4]$ and an integer number $n = 5$, create a vector y containing n-times $x(1)$, n-times $x(2)$, etc. (i.e., $y = [3, 3, 3, 3, 3, 1, 1, 1, 1, 1, 4, 4, 4, 4, 4]$).

13. Evaluate the function of two variables $z = y + x.e^{-3|y|}$ over the range $x = -1 : 0.1 : 1$, $y = -1 : 0.1 : 1$. Plot a 3-D mesh surface and a contour plot of this function.

14. Z is an $N \times M$ matrix which contains integers from 1 to 255 (an image, perhaps). There are only K unique integers in the matrix ($K < 255$). Write a function that maps the integers in the the matrix from the range $(1, 255)$ to $(1, K)$ while preserving the order of the numbers (see example). This operation is similar to compressing the colormap of an image.

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Example:    1   10  25              1  2  3
            123 233 255     =>      5  8  9
            172 201 54              6  7  4
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