

Assignment #1

Introduction to MATLAB Programming

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Objective

This assignment is designed to provide you with an introduction to MATLAB. You will create your own M-file to perform some basic matrix manipulations, and write a program to calculate mortgage interest.

Task

- (a) Part A: Correct display of data
- (b) Part B: Correct code for calculation of monthly payments, total paid, and amount of remaining principal.

Breakdown for Quality of Code

- Design (appropriate use and naming of variables)
- Comments in the code
- Layout (indentation / spacing)
- Complete file header. A sample header is provided below, which must be included in all assignments:

```
1  %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
2  % Course: IASCM 2017
3  % Assignment: 1
4  % Name: Marius Smith
5  % % Student ID: 123/4567
6  % Date: Oct. 28, 2017
7  %
8  % Acknowledgements:
9  % None
10 %
11 % Description:
12 % This program will show some basic matrix manipulations.
13 %
14 %%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

NOTE: When including the header from above, please change the details to contain your information.

Submission

Send me email including:

- Subject e.g. Marius Smith ID Number: 1234567890 assignment #1 solution
- attach your .m MATLAB files

Background

The simplest way to define a matrix is to use a list of numbers. For example, the statement `X = [1 2 3 4]` will return the row vector:

`X =`

```
1     2     3     4
```

A new row is indicated by a semicolon. An example of a matrix containing both rows and columns is created with the statement `y = [1 2 3 4; 2 3 4 5; 3 4 5 6]`, which returns:

`y =`

```
1     2     3     4
2     3     4     5
3     4     5     6
```

The colon operator is very powerful for defining new matrices and modifying existing ones. When a colon is used in a matrix reference in place of a specific index number, the colon represents the entire row or column. For example, the statement `a = y(:,1)` will equate matrix `a` to column 1 of matrix `y`.

`a =`

```
1
2
3
```

MATLAB contains many built-in functions to create and manipulate/analyze matrices. These include *sum*, *max*, *min*, *mean*, *median*, and *mode*, as well as many matrix algebra functions.

Use help command in MATLAB for more details about the build-in functions. For example, to read the description of *sum* function write in the MATLAB command windows:

```
>> help sum
```

MATLAB supports two types of operations between arrays, known as array operations and matrix operations.

Array operations are operations that are performed between arrays on an element-by-element basis. For example, if $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} -1 & 3 \\ -2 & 1 \end{bmatrix}$ then $A + B = \begin{bmatrix} 0 & 5 \\ 1 & 5 \end{bmatrix}$ and $A .* B = \begin{bmatrix} -1 & 6 \\ -6 & 4 \end{bmatrix}$. Note: The number of rows and columns in both arrays must be the same.

Array operations may also occur between an array and a scalar. For example, if $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ then $A + 5 = \begin{bmatrix} 6 & 7 \\ 8 & 9 \end{bmatrix}$.

Matrix operations, in contrast, follow the normal rules of linear algebra, such as matrix multiplication. In linear algebra, the product is defined by $C = AB$ the equation 1.

$$C = \sum_{k=1}^n A(i, k)B(k, j) \quad (1)$$

For example, if $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} -1 & 3 \\ -2 & 1 \end{bmatrix}$ then $A * B = \begin{bmatrix} -5 & 5 \\ -11 & 3 \end{bmatrix}$ and is represented in MATLAB by the expression `A*B`. Recall that matrix multiplication is not commutative – the order in which matrices are multiplied is important. For example, the result of `B*A` is $\begin{bmatrix} 8 & 10 \\ 1 & 0 \end{bmatrix}$.

Note: The number of columns in matrix `A` must be equal to the number of rows in matrix `B`.

Assignment Description

Part A: Basic Operations with Matrices

In this portion of the assignment you will be asked to create two arrays, perform some manipulations on the arrays and print the results to the screen.

Important: For the testing of this portion of the assignment, the automatic echoing of values in the command window must be suppressed. Please ensure you put a semicolon (;) at the end of each statement in order to suppress the echoing of values.

The program must perform the following steps:

1. Populate an array A. Display the array A contents to the command window with the title "Matrix A:". The array A should represent the following:

$$A = \begin{bmatrix} 10 & 0 \\ 8 & -2 \end{bmatrix}$$

2. Populate an array B. Display the array B contents to the command window with the title "Matrix B:". The array B should represent the following:

$$B = \begin{bmatrix} 6 & 13 \\ -7 & 11 \end{bmatrix}$$

3. Select row 2 in matrix A using the colon operator. Display the output to the command window with the title "Row 2 in matrix A:".
4. Select column 1 in matrix B using the colon operator. Display the output to the command window with the title "Column 1 in matrix B:".
5. Use the built-in sum command to find the sum of each column in matrix A. Display the results to the command window with the title "Sum of matrix A:".
6. Add the matrices A and B. Display the results to the command window with the title "Adding matrices A and B:".
7. Find the array (element-by-element) multiplication of A and B. Display the results to the command window with the title "Array multiplication of A and B:".
8. Find the matrix multiplication of A and B. Display the results to the command window with the title "Matrix multiplication of A and B:".
9. Find the matrix multiplication of B and A. Display the results to the command window with the title "Matrix multiplication of B and A:".

Your results must match exactly with the result below:

Matrix A:

```
10    0
 8    -2
```

Matrix B:

```
 6    13
-7    11
```

Row 2 in matrix A:

```
8    -2
```

Column 1 in matrix B:

```
6
-7
```

Sum of matrix A:

```
18    -2
```

Adding matrices A and B:

```
16    3
 1    9
```

Array multiplication of A and B:

```
60    0
-56  -22
```

Matrix multiplication of A and B:

```
60    30
62     2
```

Matrix multiplication of B and A:

```
84    -6
18   -22
```

Part A Submission: Please send me your solution (MATLAB file).

B: Mortgage Calculator

In this portion of the assignment, you are required to develop an m-file that calculates mortgage payments based on compound interest formulas.

The m-file should prompt a user to input the amount borrowed (principal), p , the number of monthly payments, n , and an annual interest rate in R percent.

The program should convert the annual interest rate R into a monthly interest rate $r = R/1200$. The division includes the number of months in a year and a factor of 100 which takes care of the conversion between % and decimal. Next the program should calculate monthly payments m given by equation 2.

$$m = \frac{rp}{1 - (1 - r)^{-n}} \quad (2)$$

The total paid (calculated by multiplying the monthly payment by the number of monthly payments) The amount of principal remaining after 12 months, p_{12} , can be computed by equation 3.

$$p_{12} = p(1 + r)^{12} - \left(\frac{m}{r}\right)[(1 + r)^{12} - 1] \quad (3)$$

Your program should print the results of these computations to the command window with text explaining each value.

Run your code assuming that you want to buy a \$400,000 home and a 30-year mortgage at a fixed annual interest rate of 5%. Your results should match exactly like this:

```
Please enter the principal for the mortgage in dollars: 400000
```

```
Please enter the term of mortgage in years: 30
```

```
Please enter the interest rate in percent: 5
```

```
Monthly Payments:
```

```
2.1473e+03
```

```
Total Paid:
```

```
7.7302e+05
```

```
Principal remaining after 12 months:
```

```
3.9410e+05
```

Note

This assignment is written by L^AT_EX using the overleaf online collaborative writing and publishing system <https://www.overleaf.com>.

Overleaf is a free service that lets you create, edit and share your scientific ideas easily online using L^AT_EX, a comprehensive and powerful tool for scientific writing.

Below you can find the link of this assignment in L^AT_EX. Please look to the entire 'main.tex' L^AT_EXcode and the corresponding PDF file and see how the different part of the assignment is defined in L^AT_EX.
<https://www.overleaf.com/read/kktwxxhgyxtb>

Due date: Nov 2, 2017. 5:00 PM Please send two seprate MATLAB files for part A and Part B of the assignment to mohsen.jenadeleh@uni-konstanz.de