ENCMP 100 – Computer Programming for Engineers
Assignment #3
Due: <mark>Monday, Mar. 6 2017 at 6:00pm MST</mark>

Objective

This assignment is designed to provide you with practice using repetition/loops structures in your program.

Loops allow a set of statement(s) to be repeated. There are basically two types of looping in programming, counted loops and conditional loops. A counted loop allows statement(s) to be repeated for a known number of times, while for the conditional loop, the number of times for the statements to be repeated is not known in advance, but depends on a specified condition in the loop statement.

Marking Scheme

You will get a total of 50 points for completing the following:

TASK	POINTS
Part A: Correct display of results	17
Part B: Correct display of results	17
Quality of code (8 points for each part)	16
TOTAL	50

Points for Quality of Code:
- Complete file header – 2 point
- Design (appropriate use and naming of variables) – 2 points
- Comments in the code – 2 points
- Layout (indentation/spacing) – 2 point

Submission

- Filename to be used for this assignment Assign3_<UofA_ID_Number>.m
    Ex. U of A ID Number: 1234567 filename for assignment #3 is
    Assign3_1234567.m
- Submit only your **.m** file under Assignment 3A and 3B in your eClass/Moodle account.
- The assignment is due Monday, Mar. 6 2017 at 6:00pm MST

Problem and Program Details:

With the help of an RESP (Registered Education Savings Plan), a parent can start putting aside money for a child's post-secondary education. Suppose that a young couple deposits $2,000 to start the savings plan, and each month thereafter they contribute $200. Assume that a fixed interested rate of 6.25% per year compounded monthly is applied.

Each month the balance increases according to the following formula:

$$\textbf{New balance = Old balance + (Old balance * Monthly interest rate)}$$
$$\textbf{+ Monthly contribution}$$

(1)

Since the university tuition fee increases over the years, you are asked to further analyze whether the saving is enough to cover the tuition fee for a 4-year study program. You will help them analyze this for 3 different types University programs: Arts, Science, and Engineering, for which the average tuition fees in the current year are as follows: $5550, $6100, and $6550 respectively. The predicted average percentage of tuition increase *each year* is 7%.

Each year the new fee due to the annual increase is calculated as follows:

$$\textbf{New cost = Old cost + (Old cost * Annual increase rate)} \qquad (2)$$

Part A:

In this part, you are asked to calculate the balance of the saving account in each month over 18 years, so the total saving by the end of the 18th year is known. Then calculate the *predicted total* tuition fee by the 18th year, which should be the total fee over a 4-year university program (i.e. from year 19 to year 22). A **for** loop can be used for the above calculations. Finally, by comparing the total savings and the predicted total tuition fee, determine whether or not the saving goal is achieved by the end of the18[th] year.

Steps:
1. Calculate the monthly balance of the savings plan for the next 18 years, based on the formula in equation (1). Save the amount in a vector or an array.

2. Calculate the predicted tuition fee per year for the next 22 years, and then add up the fees over the last 4 college years (from the year 19 to year 22) to get the predicted total education cost for a 4-year program.

3. Compare the savings plan balance and the cost calculated from the step 2. Are the parents saving enough? Print the answer in the command window. To visualize the result, you are also asked to plot the annual savings with respect to the number of years; plot a horizontal line (threshold) indicating the total tuition fee on the same plot. Obviously, if the saving plot goes above this threshold at year 18, then the objective of the saving plan is achieved; otherwise, the objective is not achieved, the customer may choose to increase the monthly saving amount.
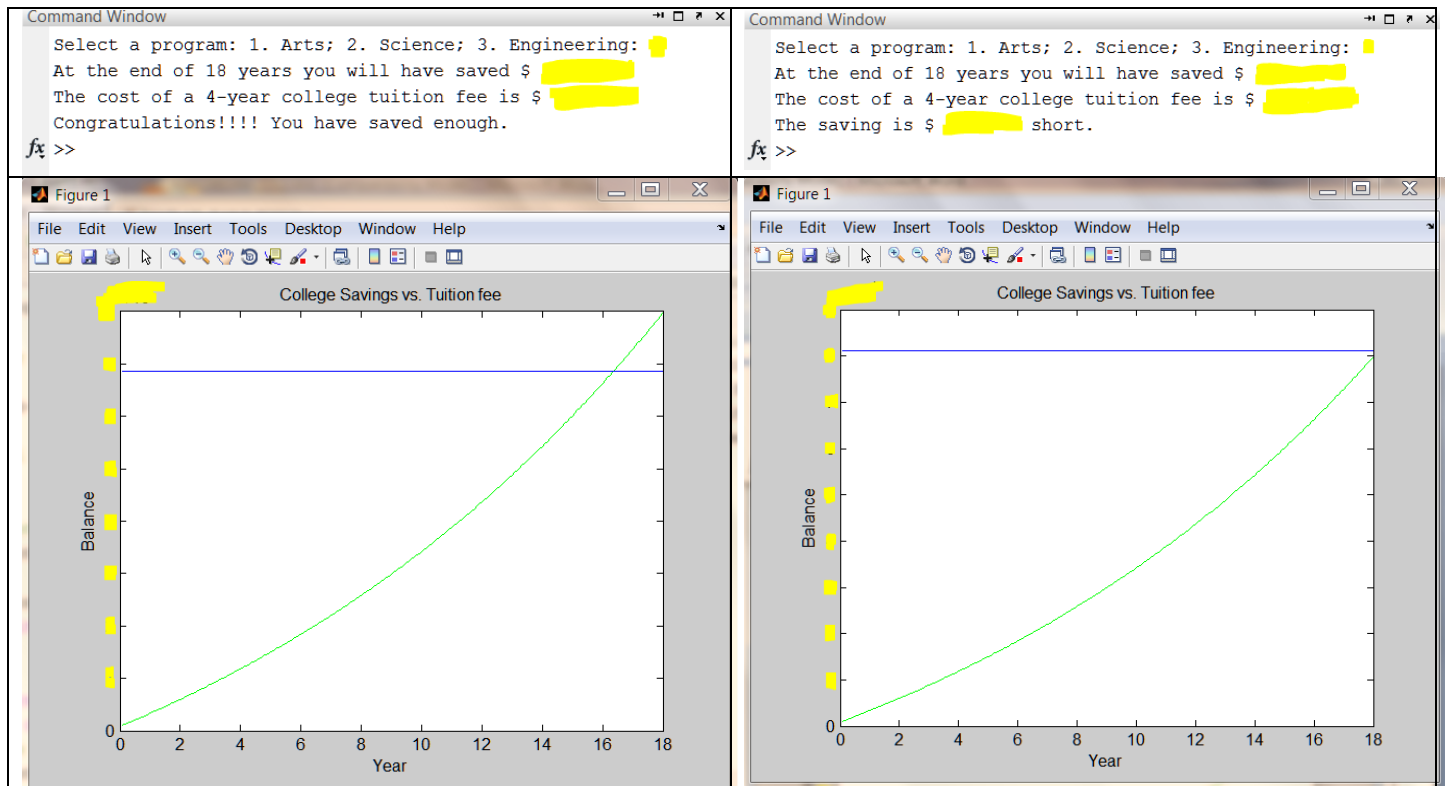
Output:

To summarize, in this Part, your program needs to generate the following outputs:

- An answer to whether or not the parents are saving enough, in the command window;
- A plot showing both the plot of the annual savings vs. the years, and the threshold line (for the cost). Please label your plot properly.

Sample Screenshots should look similar to the ones included.

If it is successful ...   If it is not successful ...

Assignment 3 - Part A Submission:

For part A of this assignment, please submit your solution to eClass under Assignment 3A. With the following naming convention:

> Assign3A_<UofA_ID>.m
> Ex. U of A ID Number: 1234567890 filename will be
> Assign3A _1234567890.m

Part B:

In part A, the monthly contribution of $200 is used in the calculation. For a 'smarter' savings plan, we may ask:

> How much does the couple need to put on a monthly basis in order to achieve the goal of saving enough for the predicted 4-year tuition fee?

In this part, you are asked to help the customer determine the minimum monthly saving amount in order to reach the goal for a given academic program. Assume that the same first payment $2,000 is used as in Part A. Based on the **for** loop structure constructed in part A, a condition **while** loop may be added as an outer loop.

1. Assume that the monthly payment increases from 50 dollars with an increment of $10 each time and repeat the calculations in Part A, until the saving goal is reached. For this, the students are asked to use a **while** loop.

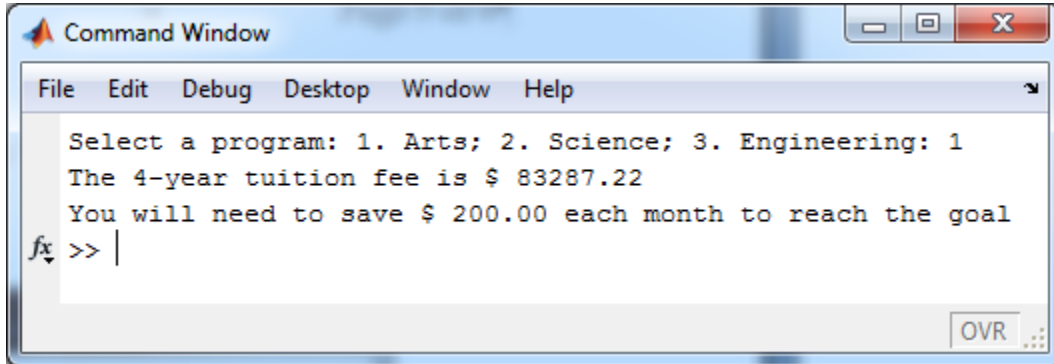2. Save the 'minimum' monthly contribution and print it on the command window.

Output:
For this part, your program should generate the following output
> - Print out the minimum monthly contribution for the savings plan with respect to each chosen academic program

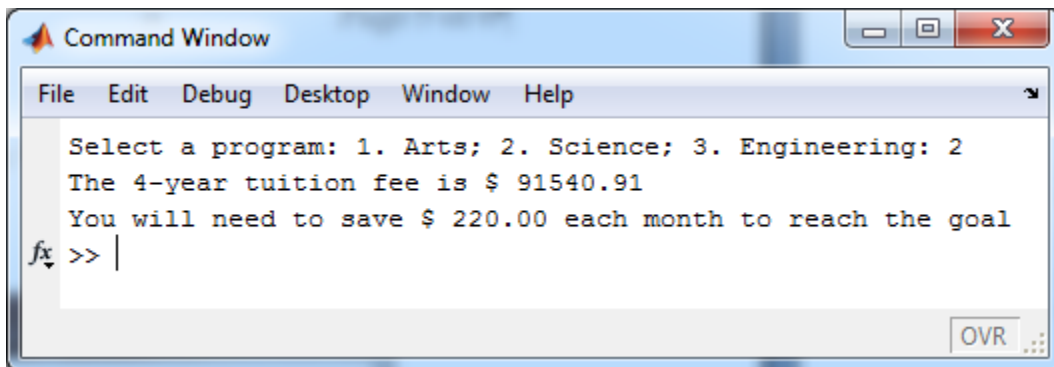Your output should look like the example screenshots below.

 For Arts:

```
Command Window

File   Edit   Debug   Desktop   Window   Help

  Select a program: 1. Arts; 2. Science; 3. Engineering: 1
  The 4-year tuition fee is $ 83287.22
  You will need to save $ 200.00 each month to reach the goal
fx >> |
                                                              OVR
```
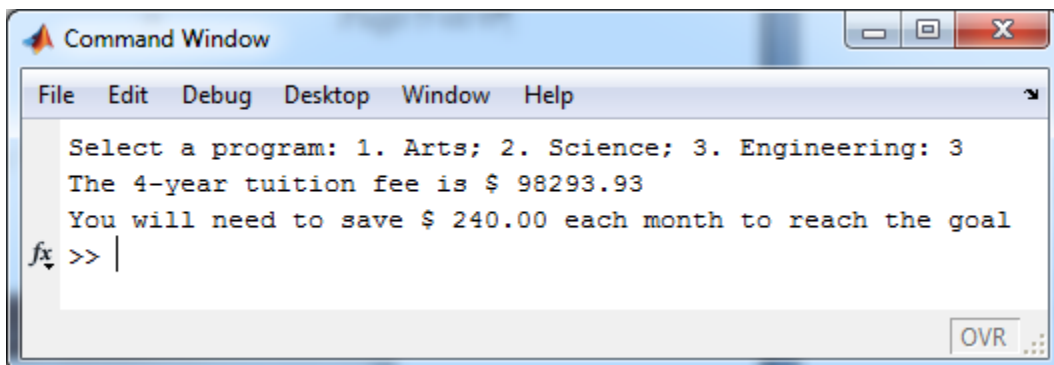
For Science:

```
Command Window

File   Edit   Debug   Desktop   Window   Help

  Select a program: 1. Arts; 2. Science; 3. Engineering: 2
  The 4-year tuition fee is $ 91540.91
  You will need to save $ 220.00 each month to reach the goal
fx >> |
                                                              OVR
```

For Engineering:

```
Command Window

File   Edit   Debug   Desktop   Window   Help

  Select a program: 1. Arts; 2. Science; 3. Engineering: 3
  The 4-year tuition fee is $ 98293.93
  You will need to save $ 240.00 each month to reach the goal
fx >> |
                                                              OVR
```

Assignment 3 - Part B Submission:

For part B of this assignment, please submit your solution to eClass under Assignment 3B. With the following naming convention:

> Assign3B_<UofA_ID>.m
> Ex. U of A ID Number: 1234567890 filename will be
> Assign3B _1234567890.m

Code Requirements

1) You must use the fprintf function to display your results to the command window for assignment #3 for parts A and B.
2) You must use two types of loops (for and while loop) in your solution for part B of this assignment.
3) Use the input function for both part A and B (Do not use the menu function)

Hints

1. Before you even begin to write out any MATLAB code, sit down and sketch out your program design in abbreviated English. This kind of high-level program design is called pseudo code (Please refer to page 59 – 60 of the course notes).

2. At the beginning of the program, you can use an **input** statement together with a **switch/case** statement for selecting from 3 academic programs, and assigning the initial tuition fee with respect to the chosen program.

3. Use the built-in MATLAB functions, such as **sum**, **plot**, and **fprintf** (for **fprintf**, please refer to page 78 of the course notes)

4. Please remember to include your header at the top of your ***.m** file.

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% Course: ENCMP 100
% Assignment: 3
% Name: Joe MacDonald
% CCID: jmac
% U of A ID: 1234567
%
% Acknowledgements:
% I received help from Jason Smith on using for loops
%
% Description:
% This program calculates savings for college education.
%
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```