CS1112 Exercise 04

When you have completed the exercise, show this sheet and any associated programs to your discussion instructors, who will record that you have completed the exercise. If you do not finish this exercise in class, you have until *Sunday, 9/18, at 9pm* to get your exercise checked off during *consulting hours* or during *TAs' office hours*.

1 Fibonacci numbers

Download the script `Fibonacci`:

```
% Fibonacci
clc
f_old = 0;
f_cur = 1;
n = 1;
% f_cur is the nth Fibonacci number
while (n<=10)
   fprintf('%2d %10d\n',n,f_cur);
   % Update:
   f_new = f_old + f_cur;
   f_old = f_cur;
   f_cur = f_new;
   n = n+1;
end
```

It displays the first ten Fibonacci numbers $f_1, \ldots, f_{10}$. Check out the Wikipedia page for Fibonacci Numbers `https://en.wikipedia.org/wiki/Fibonacci_number` if you are interested in learning more. Create 3 copies of this script and name them `Fib_ten.m`, `Fib_1m.m`, and `Fib_1kto1m.m`. Modify these three scripts based on the documentation provided below.

(a) Modify `Fib_ten.m` so that it only prints f_{10}.

(b) Modify `Fib_1m.m` so that it prints all Fibonacci numbers that are less than one million.

(c) Modify `Fib_1kto1m.m` so that it prints all Fibonacci numbers that are greater than one thousand but less than one million.

The learning objective for the next two problems is to master `while`-loop and nested loops and *practice program development*: (1) reading a problem with abstract/mathematical notations, (2) understanding it by writing out small/short examples, (3) laying out the program "skeleton" by choosing appropriate loop and/or conditional structures, and (4) finally filling in the detailed computation.

You will write a script to solve each problem below. Do **not** write *functions* or use *arrays*. Functions and arrays are our topics for next week.

2 Binomial Coefficients

The number of ways that you can select k objects from n objects is given by the binomial coefficient

$$\binom{n}{k} = \frac{n!}{k!(n-k)!}$$

Thus,

$$\binom{10}{1} = \frac{10!}{1!9!} = 10$$

$$\binom{10}{2} = \frac{10!}{2!8!} = 45$$

$$\binom{10}{3} = \frac{10!}{3!7!} = 120$$

Recall that if a positive integer is stored in `x`, then the value of `floor(log10(x))+1` is the number of base-10 digits that are required to write the value of `x`. Write a script `binaryCoef` that produces **ten lines of output**. The nth line, where $n = 1, \ldots, 10$, should display the number of digits required to write down each of the binomial coefficients

$$\binom{n}{1}, \binom{n}{2}, \ldots, \binom{n}{n}$$

Thus, the nth line of output will display n numbers. Make use of the function `factorial`.

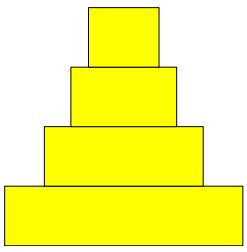
Let's start by writing out the necessary binary coefficients then the output from the script you write:

Binary coefficients:	Computer output:
$\binom{1}{1}=$ _____	_____
$\binom{2}{1}=$ _____ $\binom{2}{2}=$ _____	_____ _____
$\binom{\ }{\ }=$ _____ $\binom{\ }{\ }=$ _____ $\binom{\ }{\ }=$ _____	_____ _____ _____
⋮	⋮

Now that you understand the math, code your solution in MATLAB to print 10 lines of output as specified above.

3 Build your own step pyramid

Download the file `stepPyramidSkeleton.m` and save it as `stepPyramid.m`. Complete the script to draw a step pyramid. The base rectangle is L-by-H where $H \leq L$. Each step has the same height H. The next rectangle up is 2/3 the length of the rectangle below, and so forth. The top step must have a length no less than H.



You will need function `DrawRect`—download it from the course website and put it in your current directory (the directory from which you will run your script). Use a `while`-loop.