

When you have completed the exercise, show your 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, 2/16, at 9pm* to get your exercise checked off during *consulting hours* or during *TAs' office hours*.

Objectives for this exercise: 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.

1 Fibonacci numbers

You should read *Insight* §3.2 before doing the following exercise. 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 ten Fibonacci numbers f_1, \dots, f_{10} .

- (a) i. Add a **breakpoint** to the line where **n** is incremented, then run the script. When it pauses, you will see a green arrow next to that line. Look at the value of **n** in the Workspace; did Matlab pause *before* or *after* executing that line?
- ii. **Step** the program once; the green arrow should move next to the **end** keyword. What value does **n** have now?
- iii. **Continue** the program; it should stop at your breakpoint again. Which variables have changed?
- iv. Use the Command Window to assign to **n** the value 10, then continue the program. How many more iterations of the loop body were run before the program exited?
- v. Remove the breakpoint. Discuss with your neighbor what you were able to use the *debugger* to do.
- (b) Save the file as `fib1mil.m` (you will need the original file for part (c)). Modify the script so that it prints all Fibonacci numbers that are greater than ten thousand but less than one million.
- (c) (finish questions 2 & 3 first) Start from the original file `Fibonacci.m`. Modify the script so that it prints the smallest n such that

$$\left| \frac{f_{n+1}}{f_n} - \frac{1 + \sqrt{5}}{2} \right| \leq .000001$$

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,

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

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

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

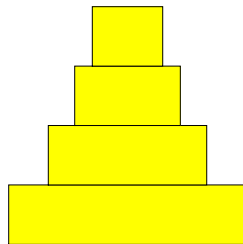
Recall that if x houses a positive integer, then the value of `floor(log10(x))+1` is the number of base-10 digits that are required to write the value of x . Write a script that produces **ten lines of output**. The n th line should display the number of digits required to write down each of the binomial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

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

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

3 Build your own step pyramid

Complete the script `stepPyramidSkeleton.m` 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 *Insight* page of the course website and put it in your current directory (the directory from which you will run your script). Use a `while`-loop.

Be sure to log off the lab computer before leaving the lab!