GNG1106
Fundamentals of Engineering Computation

Instructor: **Hitham Jleed**

University of Ottawa

Fall 2023 ~

In-Class Exercises

Outline

1. **Loop Programming Exercise**

Outline

1. Loop Programming Exercise

Write a Program (loop with state)

- The following sequence is called the Fibonacci Sequence:

$$1, 1, 2, 3, 5, 8, 13, 21, 34, \ldots$$

- It is defined by

$$
\begin{aligned}
F_1 &= 1 \\
F_2 &= 1 \\
F_i &= F_{i-1} + F_{i-2}, \text{when } i > 2
\end{aligned}
$$

- The numbers in the sequence are called Fibonacci numbers ("F-numbers").

- Write a program that prints the first K Fibonacci numbers, where K is a value that the user ennters.

Planning

- What is the state?
  $\Rightarrow$ current F-number and previous F-number, which we will store in variables `cur` and `prev` respectively.
- In each iteration, we need to compute a variable, say `out`, by

  ```
  out=cur + prev;
  ```

  and print `out`
- We need to prepare the state for the next iteration by

  ```
  prev=cur;
  cur=out;
  ```

- How should we initialize the state before entering the loop?
  - One way is to start looping from computing/printing the third F-number, and print the first two F-numbers before entering the loop.
  - Here is a more elegant solution:
    Let us create two "ghost" F-numbers, F_0 and F_{-1}, in the sequence before the first F-number. We have

    $$F_0 + F_1 = F_2 \text{ and } F_{-1} + F_0 = F_1.$$

    Plug in $F_1 = F_2 = 1$, we can solve F_0 and F_{-1} as

    $$F_0 = 0 \text{ and } F_{-1} = 1.$$

    Then before entering the loop, we can initialize the state by

    ```
    prev=1;
    cur=0;
    ```

Another Programming Exercise

- Write a program that plays the following game with the user.
  - The the program draws a random number between 1 and 100, and asks the user to guess the number until the user guesses it correctly.
  - For each number the user guesses (i.e., enters), if the guess is not correct, the program hints the user if the guess is "warmer", "colder", or "neither colder or warmer" ("warmer" means that the guessed number is closer to the answer than the previous guess, and "colder" means that the guessed number is farther away from the answer than the previous guess; the first wrong guess will always be given the hint "warmer").
  - After the user gets the correct answer, the program returns the total number of guesses the user has made.