

A dark blue vertical bar runs along the left edge of the page. A blue arrow-shaped banner points to the right from this bar, containing the date '19-4-2020'. In the bottom-left corner, there are several thin, curved lines in dark blue and light grey, resembling stylized grass or reeds.

19-4-2020

Pandemic Tracker

David Langus & Jacob Arteaga
Florida International University

Introduction

In modern times it is hard to imagine what can set humanity back. In a world where medicine and treatments improve each day it is hard to predict what will be humanity's downfall. However, we have found the reason humanity will go extinct if we do not act. The pandemic COVID-19 (a.k.a. coronavirus) has proven to be one of the most difficult challenges for us to overcome. Killing thousands of people and one way or another affecting every single person worldwide, this problem does not seem to have a solution. This was the reason we created this program. At the beginning we wanted to make it specific for this pandemic, COVID-19, but after extent research we noticed that if we just changed a few parameters this program could help predict the spread of any pandemic. We decided to use the S.I.R model to achieve this because it is the foundation of many other pandemic models and makes predictions based on a simple but very accurate system of ordinary differential equations. At first, we wanted to get exact values when solving the equations. However, we found out this wasn't possible, only a numerical approximation could be made. Therefore, we looked into different method for approximating these values: Euler's Method (E.M.), The Improved Euler's Method, and the Runge-Kutta Method. Four purposes, the first mentioned seemed straight forward to implement and highly accurate. We had a few challenges, for example, the iteration that was necessary for the E.M. to work, the navigation using the console interface, and the saving of a file. However, after frustration and a lot of debugging we came with this final product. We hope you enjoy it!

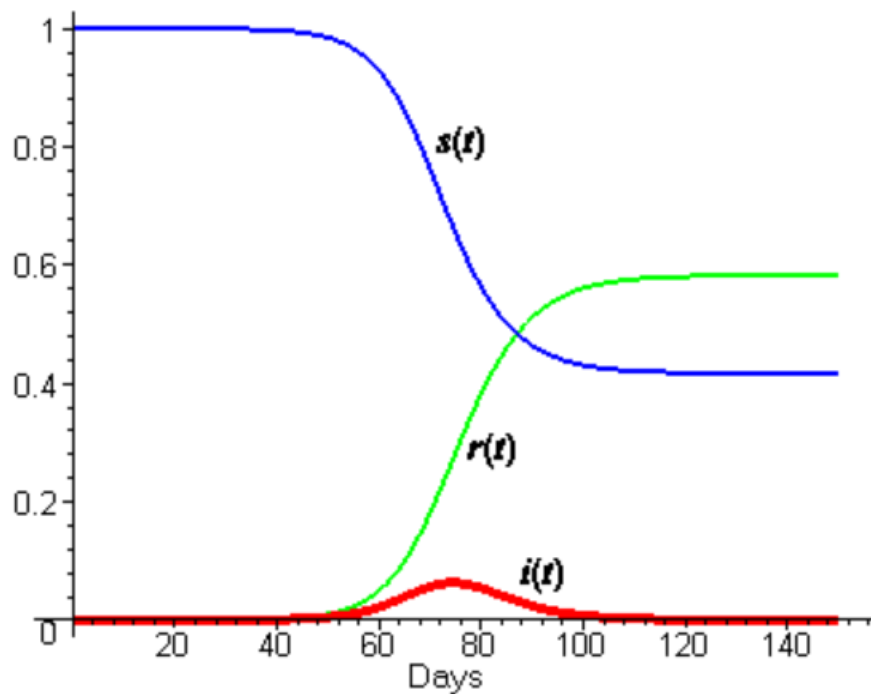
The S.I.R Model

The **SIR model** is a simple mathematical model of epidemics. An epidemic is when the number of people infected with a disease is increasing in a population. S, I, and R stand for:

S - *susceptible*. These are people that are not infected with the disease yet. However, they are not immune to it either and so they can become infected with the disease in the future.

I - *infected* or *infectious*. These are people that are infected with the disease and can transmit the disease to susceptible people.

R - *recovered*. These are people who have recovered from the disease and are immune, so they can no longer be infected with the disease.



To get S, I, and R Euler's Method can be used to approximate:

$$S' = -aSI$$

$$I' = aSI - bI$$

$$R' = bI$$

Where a = transmission coefficient & b = recovery coefficient.

Instructions

1. Run program.

```
#####  
#                WELCOME TO PANDEMICS TRACKER                #  
#    A program which given a pandemic's current impact    #  
#            in your area can predic the future.            #  
#####  
  
Transmission Coefficient: 0.000010  
Recovery Coefficient: 0.050000  
  
Type:  
    "R" - TO RUN  
    "A" - ADVANCED SETTINGS  
    "I" - MORE INFORMATION  
  
        ENTER to comfirm.
```

2. To test the program type "R" then hit ENTER, you can use the following values as input:

[Susceptible] = 45400
[Infected] = 2100
[Recovered + Dead] = 2500
Days = 1

After hitting enter you will see the following:

```
RESULTS (1.0 days from today):  
There will be 44245.1 susceptible people.  
There will be 3126.1 infected people.  
There will be 2628.8 recovered/dead people.  
  
Type:  
    "ANYTHING" - TO RE-RUN.  
    "S" - TO SAVE IN FILE  
    "M" - TO MAIN MENU  
  
        ENTER to comfirm.
```

Now type "ANYTHING" then "ENTER" to test other values:

[Susceptible] = 45400
[Infected] = 2100
[Recovered + Dead] = 2500
Days = 50

(Continued...)

```

RESULTS (50.0 days from today):
There will be 6.6 susceptible people.
There will be 5769.6 infected people.
There will be 44223.8 recovered/dead people.

Type:
  "ANYTHING" - TO RE-RUN.
  "S" - TO SAVE IN FILE
  "M" - TO MAIN MENU

      ENTER to confirm.

```

You can observe how as time passes all the susceptible get infected and then they either become immune or die.

Here you can press “S” then “ENTER” to save this file as results.txt, it will appear in ./COVID-19/COVID-19/results.txt

3. To test the advanced option if you saved it type “ANYTHING” then “ENTER” to go to the Main Menu else type “M” then “ENTER”.

Now type “A” then hit “ENTER” for advanced options input the following values:

[Transmission Coefficient] = 2

[Recovery Coefficient] = 1

Type “ANYTHING” then hit “ENTER” to go to the Main Menu, you should see that the coefficients have saved.

```

#####
#          WELCOME TO PANDEMICS TRACKER          #
#   A program which given a pandemic's current impact   #
#           in your area can predic the future.           #
#####

Transmission Coefficient: 2.000000
Recovery Coefficient: 1.000000

Type:
  "R" - TO RUN
  "A" - ADVANCED SETTINGS
  "I" - MORE INFORMATION

      ENTER to confirm.

```

(Continued...)

Now test the program with these coeffs. type “R” then hit ENTER, you can use the following values as input:

[Susceptible] = 0.995
[Infected] = 0.005
[Recovered + Dead] = 0
Days = 6

You should expect the following results:

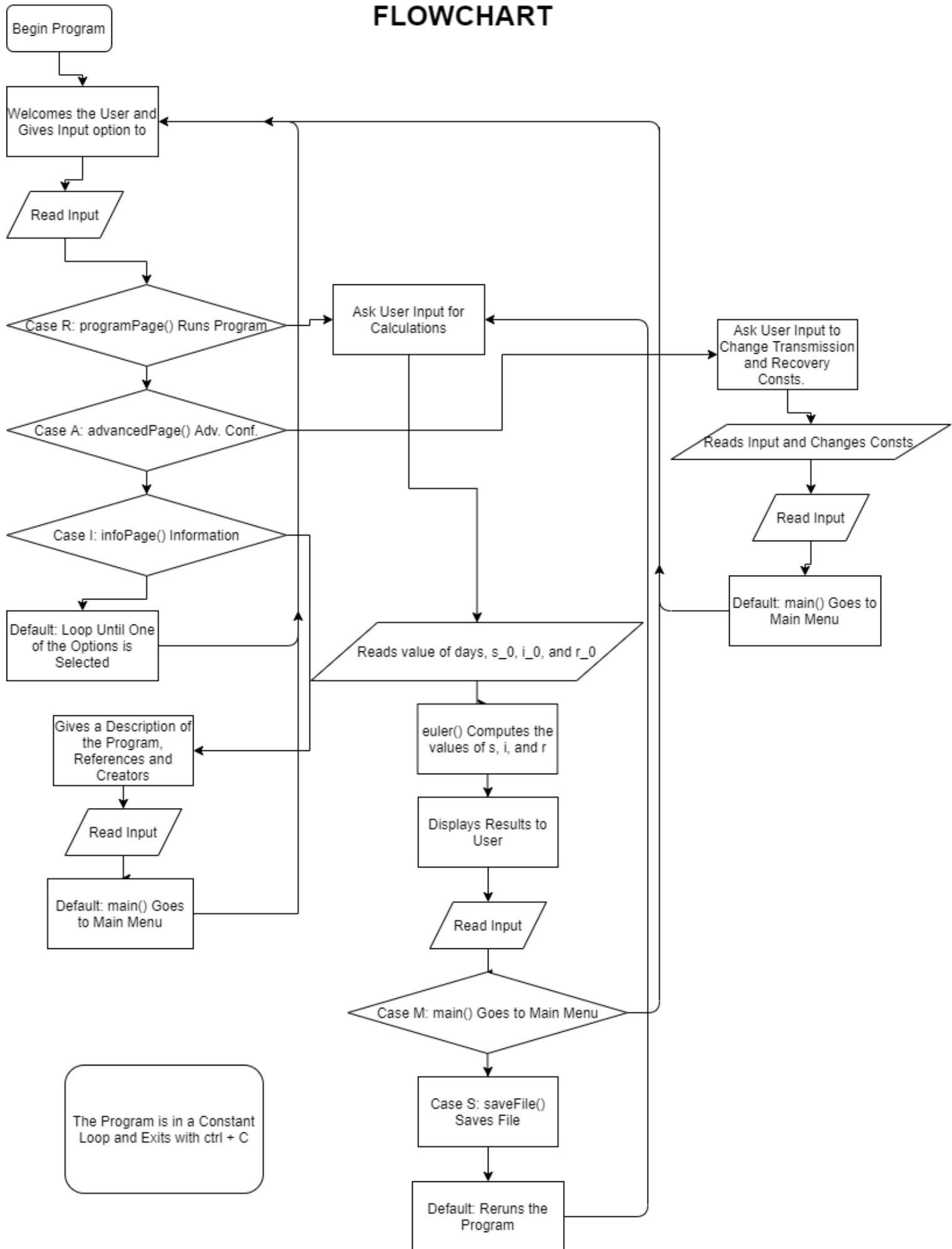
```
RESULTS (6.0 days from today):  
There will be 0.4 susceptible people.  
There will be 0.1 infected people.  
There will be 0.5 recovered/dead people.  
  
Type:  
  "ANYTHING" - TO RE-RUN.  
  "S" - TO SAVE IN FILE  
  "M" - TO MAIN MENU  
  
      ENTER to confirm.
```

You can check these results with the help of this online grapher [click here](#) (leave all values as default).

4. Finally, you can learn a bit more about us and how the program works by typing “M” then hitting “ENTER” to go to the Main Menu and then type “I” and hit “ENTER” here you can see information about how the program works and all the contributors to this project. (*ctrl + C*) to exit at any time.

5. ENJOY!

FLOWCHART



The Program is in a Constant Loop and Exits with ctrl + C

In conclusion, this program demonstrates how computers are powerful and useful tools by iterating and closely approximating equations in a very short fraction of time compared to the years it would take humans to solve. It is also important to mention the learning value of this project, it not only focusses on programming skill and the syntax of a specific coding language, but in the logic and math behind it. We hope this program, as simple as it may seem gives rise to new ideas that could help win wars against pandemics in the future and specially the one we are fighting now. And always remember, wash your hands.