**ANKARA UNIVERSITY**

**COMPUTER ENGINEERING DEPARTMENT**

**Computer Programming 1**

**Fall 2020-21**

**Programming Assignment 2**

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In this assignment, you are expected to create a simple calculator using the graphics.py module, which you can download from the course ekampus page. In Figure 1, we provide the design of the calculator; you will try to create your user interface similar to the provided image. The metrics in the image are pixels. One of the most important part of this assignment is that your program should not produce any run-time errors, under any circumstances. For this reason, you will need to consider all possible conditions.

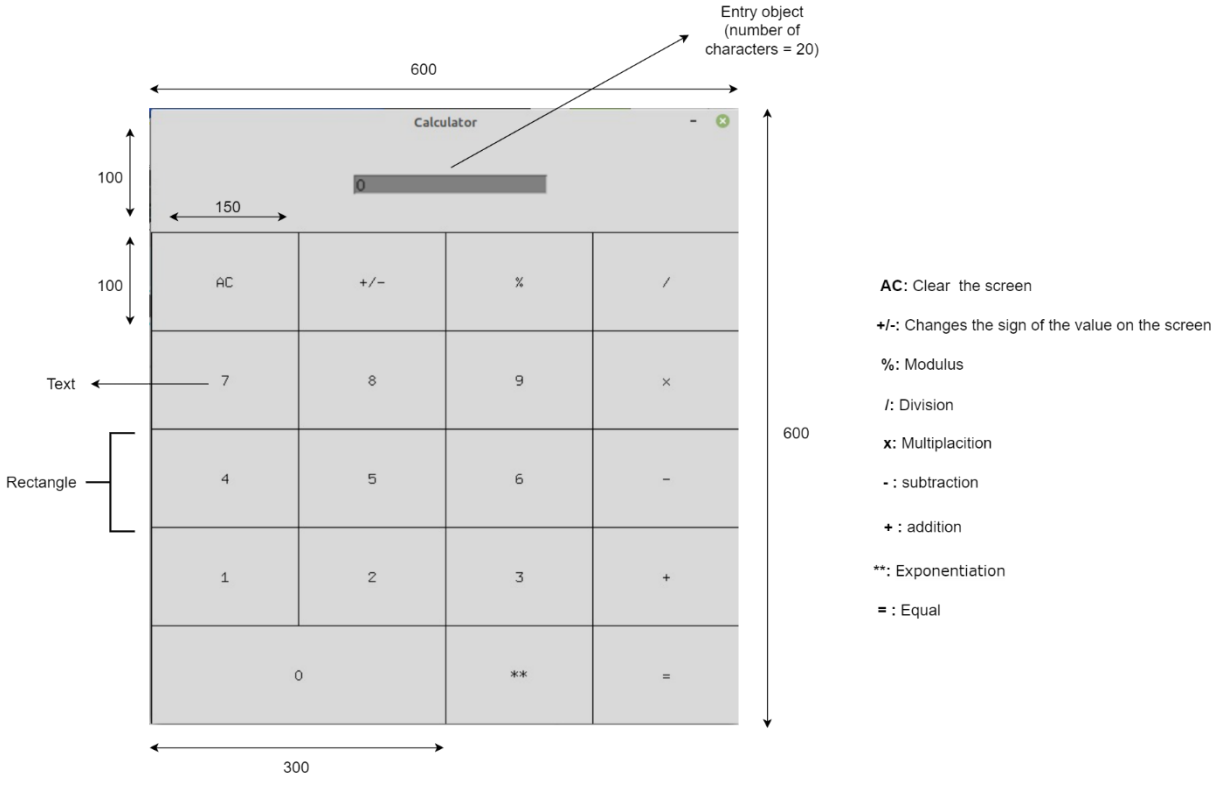



Figure 1: Simple Calculator GUI

**Operators** are special tokens that represent computations (i.e. addition, multiplication, division, modules, subtraction, exponentiation). The values the operator works on are called **operands.** The

operators and operands to be used are depicted in Figure 1. Your calculator design must be the same with ours. The unit of measure is pixels.

**Specification details:**

1. *Clean the screen for all unaccepted expressions, i.e. erroneous cases, and return to the starting point.*
2. *If at any point "AC" is pressed, the program returns to the starting point.*
3. *If the "+ /-" key is pressed at any point, the sign of the value on the screen must be changed.*
4. *If an operator is pressed again after an operator, it's an error and the program returns to the starting point.*
5. *If an operator is pressed before pressing an operand, the program* returns to the starting point
6. The calculation results shown on the screen could either be an integer or a float, depending on the result of the calculations; if the result is an integer, it needs to be displayed as an integer, otherwise it should be displayed as a floating point number.

   Example1: 12*5 = 60

   Example2: 12/5 = 2.4

7. Operands will be provided by the user as integers. Note that resultant operations can be either integers or floats (refer to 6 for the details)
8. *For other specification details, examine Figure 2 and given examples.*

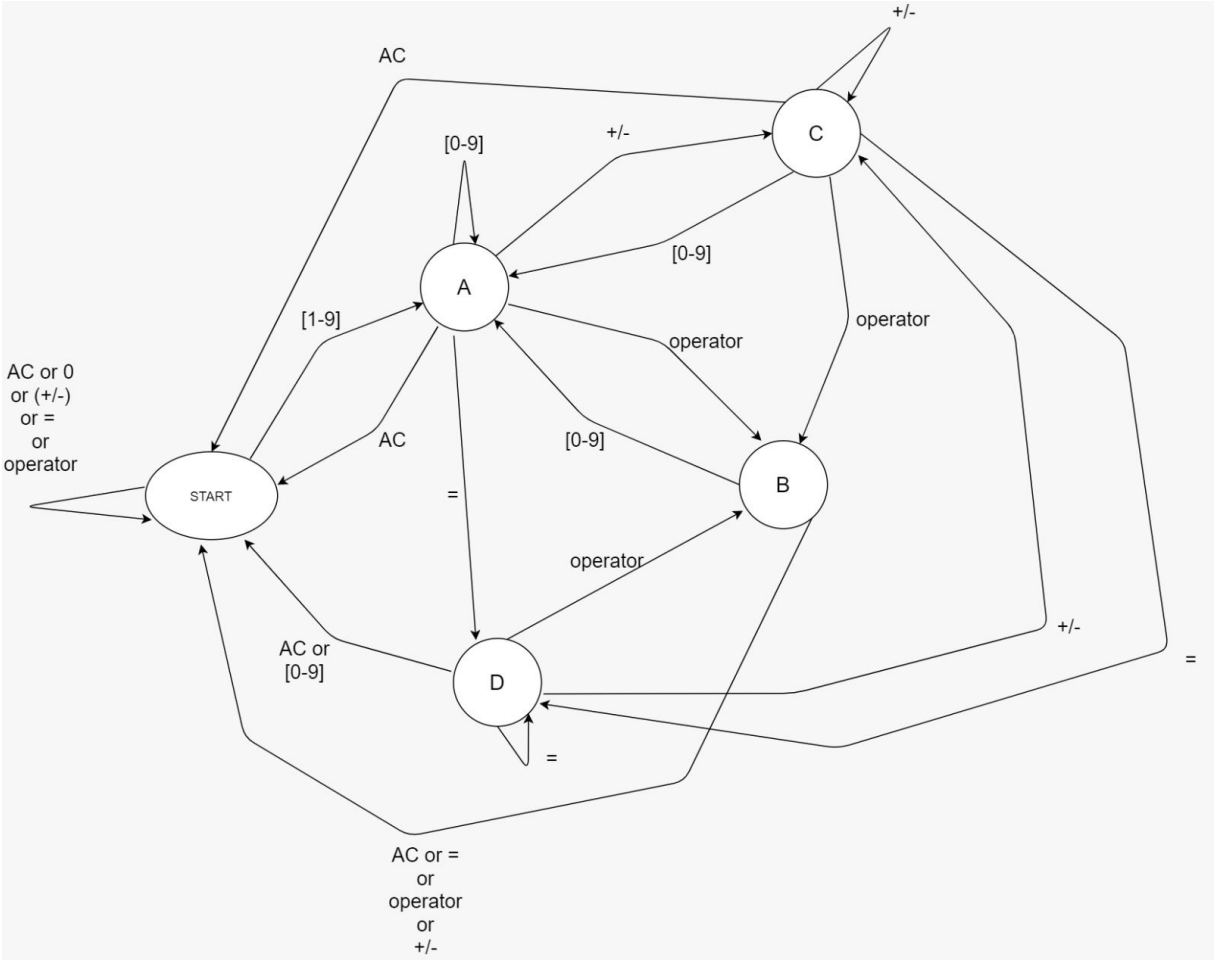



*Figure 2: Deterministic finite automaton (DFA) for our calculator*

1. For example: 12 + 56 =

| Pressed key | Screen | Position |
|---|---|---|
| | 0 | START |
| 1 | 1 | A |
| 2 | 12 | A |
| + | 12 | B |
| 5 | 5 | A |
| 6 | 56 | A |

| | | |
|---|---|---|
| = |  | D |

2. For example: 125 - 15 *

| Pressed key | Screen | Position |
|---|---|---|
| |  | START |
| 1 |  | A |
| 2 |  | A |
| 5 |  | A |
| - |  | B |
| 1 |  | A |
| 5 |  | A |
| * |  | B |

3. For example: 235 +/- * 6 – 2 =

| Pressed key | Screen | Position |
|---|---|---|
| |  | START |
| 2 |  | A |

| | | |
|---|---|---|
| 3 | 23 | A |
| 5 | 235 | A |
| +/- | -235 | C |
| * | -235 | B |
| 6 | 6 | A |
| - | -1410 | B |
| 2 | 2 | A |
| = | -1412 | D |

4. For example: 235 +/- * 6 – 2 = * 2 /

| Pressed key | Screen | Position |
|---|---|---|
| | 0 | *START* |
| *2* | 2 | *A* |
| *3* | 23 | *A* |
| *5* | 235 | *A* |
| +/- | -235 | *C* |
| * | -235 | *B* |
| *6* | 6 | *A* |
| - | -1410 | *B* |
| *2* | 2 | *A* |

| | | |
|---|---|---|
| = | -1412 | *D* |
| * | -1412 | *A* |
| *2* | 2 | *A* |
| / | -2824 | *B* |

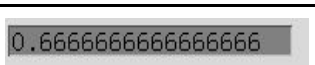
5. For example: 3 +/- * 25 / AC

| Pressed key | Screen | Position |
|---|---|---|
| | 0 | *START* |
| 3 | 3 | A |
| +/- | -3 | C |
| * | -3 | B |
| 2 | 2 | A |
| 5 | 25 | A |
| / | -75 | B |
| AC | 0 | START |

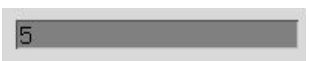
1.

6. For example: 3 * 5 +/- * + 2 / 3 =

| Pressed key | Screen | Position |
|---|---|---|
| | 0 | *START* |

| | | |
|---|---|---|
| 3 |  | A |
| * |  | B |
| 5 |  | A |
| +/- |  | C |
| * |  | B |
| + |  | START |
| 2 |  | A |
| / |  | B |
| 3 |  | A |
| = |  | D |

7. For example: / 5 * * 3 + 2 –

| Pressed key | Screen | Position |
|---|---|---|
| |  | *START* |
| / |  | START |
| 5 |  | A |
| * |  | B |
| * |  | START |
| 3 |  | A |
| + |  | B |

| | | |
|---|---|---|
| 2 |  | A |
| - |  | B |

**Testing:** You do not need to use input and output files in this assignment.

> python3 PA2.py

**Submission:**

1. Name your Python source file as <student_id>.py; replace <student_id> using your student id number.
2. Upload your python file using the interface provided in e-kampüs course page.
3. Do not upload any files, other than your source file.

**Important:**

Please direct your questions about the PA2 specifications to Yahya Doğan (yahyadogan@ankara.edu.tr) or Zeynep Özdemir (zynpozdemir@ankara.edu.tr)

Have fun :)