

# CSE 241 Programming Assignment 5 (Counts as double. Twice the point of a regular assignment.)

## DUE

May 20, 2022, 23:55

## Description

- Each student will do a short demo and explain his/her implementation.
- This is an individual assignment. Please do not collaborate
- If you think that this document does not clearly describes the assignment, ask questions before its too late.

This assignment is about implementing and testing classes for a logic circuit simulator.

- Your program reads two files:
  - `circuit.txt`
  - `input.txt`
- According to content in `circuit.txt`, the program **dynamically** creates necessary objects for a logic circuit and evaluates the states listed in `input.txt`.
- Your program prints the output to `stdout`. Each line in `input.txt` is a state. For each state, there should be a line of output printed.

### `circuit.txt`

- Each line starts with a **keyword**. Possible keywords:
  - INPUT
  - OUTPUT
  - AND
  - OR
  - NOT
  - FLIPFLOP
  - DECODER
- The first line specifies input labels. Labels are separated by spaces. Example:
  - INPUT a input2 c3 k
- Here there are 4 inputs are defined. Each has an identifier. `a`, `input2`, `c3`, `k`.
- The second line specifies output labels. Labels are separated by spaces. Example:
  - OUTPUT d1 d2 d3 d4
- Here there are 4 outputs are defined. Each has an identifier. `d1`, `d2`, `d3`, `d4`.
- AND keyword specifies that there is an **and** gate defined. AND keyword follows the identifier for its output and two other identifiers for the inputs. Example:
  - AND gate\_A c3 another\_id
- Here the **and** gate has an output identified by the string `gate_A`. Its inputs are identified `c3` and `another_id`. These identifiers can be input identifiers or identifiers for other gates.
- OR keyword specifies that there is an **or** gate defined. OR keyword follows the identifier for its output and two other identifiers for the inputs. Example:
  - OR gate\_B ck id3
- Here the **or** gate has an output identified by the string `gate_B`. Its inputs are identified `ck` and `id3`. These identifiers can be input identifiers or identifiers for other gates.

- NOT keyword specifies that there is a **not** gate defined. NOT keyword follows the identifier for its output and one other identifier for its input. Example:

```
NOT gate_C c5
```

- Here the **not** gate has an output identified by the string **gate\_C**. It has only one input and it is identified by the string **c5**.
- FLIPFLOP keyword specifies that there is a **flip-flop** gate defined. FLIPFLOP keyword follows the identifier for its output and one other identifier for its input. Example:

```
FLIPFLOP gate_F c6
```

- Here the **flip-flop** gate has an output identified by the string **gate\_F**. Its input is identified by **c6**.
- DECODER keyword specifies that there is a **decoder** gate defined. DECODER keyword follows the identifiers for its outputs(o1, o2, o3, o4) and identifiers for its inputs(a1, a2). Example:

```
DECODER d1 d2 d3 d4 g1 another_identifier
```

- Here the **decoder** gate has outputs identified by strings **o1, o2, o3, o4**. Its inputs are identified by **g1** and **another\_identifier**.

### input.txt

- Each line is a list of 1 and 0. Example:

```
1 0 1 1
0 1 1 1
0 0 1 0
1 0 0 1
```

### Example:

- Suppose that **circuit.txt** has the following content:

```
INPUT a b c d
OUTPUT d1 d2 d3 d4
AND and1 a b
OR or1 and1 c
NOT n1 d
FLIPFLOP f1 n1
AND a2 or1 f1
DECODER d1 d2 d3 d4 a2 f1
```

- **input.txt** has the following content:

```
1 1 0 1
1 0 1 0
1 1 1 0
```

- Assume that initially **former-out** of any **FLIPFLOP** is 0.
- Any **FLIPFLOPs** should preserve the state throughout the evaluation of the whole **input.txt**.
- Each line in **input.txt** is assigned to identifiers **a, b, c, d**, defined in **circuit.txt**. According to the truth tables, outputs of gates are calculated.
- For the **input.txt** given, the output of your program should be:

```
1 0 0 0
0 0 0 1
1 0 0 0
```

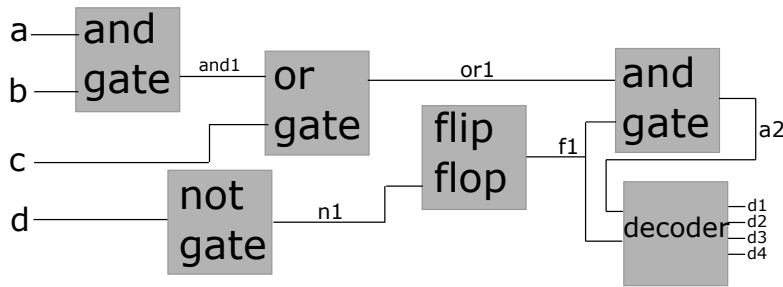


Figure 1: Example Logic Circuit

## Remarks

- Each identifier is unique. You can assume that their length is limited to 15 characters. You can use `std::string`.
- There won't be any errors in the files.
- You have to use **dynamic memory allocation** and C++ classes.
- You have use inheritance and polymorphism. Find a class hierarchy and try to use abstraction.
- You are allowed to used `std::vectors`.
- You cannot use components which are not covered in class.

## Turn in:

- Source code of a complete C++ program and a suitable makefile. You should use c++11 standard. Your code will be tested in a linux-gcc environment.
- A script will be used in order to check the correctness of your results. So, be careful not to violate the expected output format.
- Provide comments unless you are not interested in partial credit. (If I cannot easily understand your design, you may loose points.)
- You cannot get full credit if your implementation contradicts with the statements in this document.

## Truth Tables:

- AND

a	b	out
0	0	0
0	1	0
1	0	0
1	1	1

- OR

a	b	out
0	0	0
0	1	1
1	0	1
1	1	1

- NOT

a	out
0	1
1	0

- FLIPFLOP

a	former_out	out
0	0	0
0	1	1
1	0	1
1	1	0

- DECODER

a1	a2	d1	d2	d3	d4
0	0	1	0	0	0
0	1	0	1	0	0
1	0	0	0	1	0
1	1	0	0	0	1