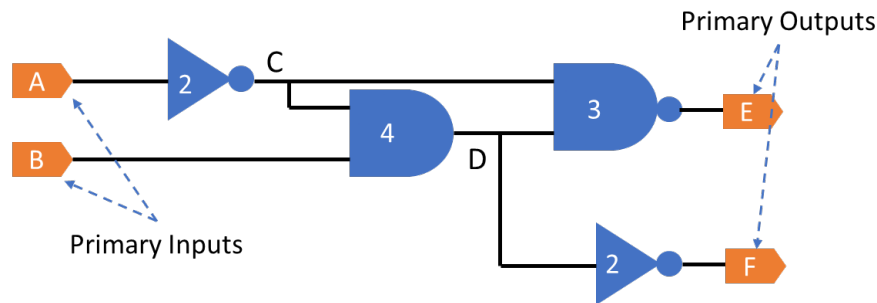


COL215: Digital Logic and System Design
Software Assignment 1
Submission Deadline: 20 August 2023, 11:55 PM

Consider the following diagram representing a combinational digital circuit – each gate implements a Boolean function of its inputs and there are no cycles in the circuit. The numbers annotated on the gates represent the delay d through the gate, in nanoseconds. If the inputs of a gate are ready at time t , then the output is ready at time $t+d$.



- (a) How much time does such a circuit take to compute its primary outputs? For the example above, the maximum delay *for E is $2+4+3=9$, and for F is $2+4+2=8$* . Write a program to compute the **delay** of every primary output in a combinational circuit (defined as the earliest time when the output is ready), given the circuit representation and delay information of the individual gates.

Input: Circuit file (see example file *circuit.txt* for diagram above)

Input: Gate Delay file (see example file *gate_delays.txt* for diagram above)

Output: Output Delay file (see example file *output_delays.txt* for diagram above)

- (b) Extend your program to answer the converse question: suppose we require the output to be ready at a specific time. When do we require each input to be ready so that the output timing requirement is met?

Input: Circuit file (see example file *circuit.txt* for diagram above)

Input: Required Output Delay file (see example file *required_delays.txt* for diagram above)

Output: Input Delay file (see example file *input_delays.txt* for the diagram and *required_delays.txt* file above)

Use Python or C/C++ for implementation. Submit the following:

- (a) A short document with the following details:
- Your algorithm.
 - Explain the time complexity of your algorithm.
 - Your *testing strategy*. What test cases did you write to check your implementation? Why? Make sure that the test cases validate the features of your algorithm.
- (b) Your implementation.
- Code
 - Test cases