Digital Systems II - Lecture ?

Exam

- There will be content from the new textbook, Chapter 9

Asynchronous Sequential Circuits

- Synchronous circuits use clocks
- Asynchronous circuits circuits operate in a “Fundamental mode”
- To guarantee robust operation, the system inputs have to change one by one
- A stable state is achieved when all input signals cease changing

Advantages of Asynchronous Circuits

Speed

- Speed of a synchronous circuit is dependant on a global clock
- With Async circuits, operations can be initialized as soon as the previous one has been completed.

Prevention of metastability

- We design a circuit so that it will not be unstable
- Synchronizers are not necessary in “Fundamental mode”

Modularity

- An async circuit is composed of functional modules that communicate along well-defined interfaces
- The interfaces specify the sequence of events that can occur and not the synchronization restrictions of these events

Low Power

- Asynchronous circuits are very suitable for lower power design due to the lack of a clock

Absence of clock bias

- If you have multiple clocks in synchronous circuits, they must work together.

Disadvantages of Asynchronous Circuits

- Hazards communication protocols and encoding.

Modelling of Asynchronous

- Consider the base circuit of S-R latch
- The output Q can change clues without waiting for a clock edge
- We assume that the logic gates are ideal ones without delay
- The **total delay of the logic gates** of circuits is represented by the Δ block
- Q corresponds to the current-state variable (y)
- Y corresponds to the next-state variable (Y)

We have to insert a delta block into our circuit which represents all of the delay by all of the gates.

Present state variables are at the beginning of the circuits (AFTER the delta block)

If Y != y, state is unstable. On a truth table, a circle means it is a safe state.

https://www.geeksforgeeks.org/difference-between-mealy-machine-and-moore-machine/

Moore Machine

1. Output depends only upon the present state.
2. If input changes, output does not change.
3. More number of states are required.
4. There is more hardware requirements.
5. They react slower to inputs(One clock cycle later)
6. Synchronous output and state generation.
7. Output is placed on states.
8. Easy to design.

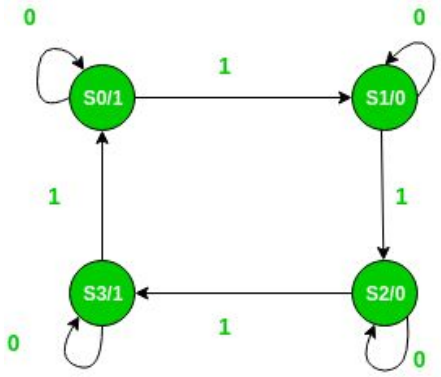

Figure - Moore machine

Mealy Machine

1. Output depends on the present state as well as present input.
2. If input changes, output also changes.
3. Less number of states are required.
4. There is less hardware requirements.
5. They react faster to inputs.
6. Asynchronous output generation.
7. Output is placed on transitions.
8. It is difficult to design.

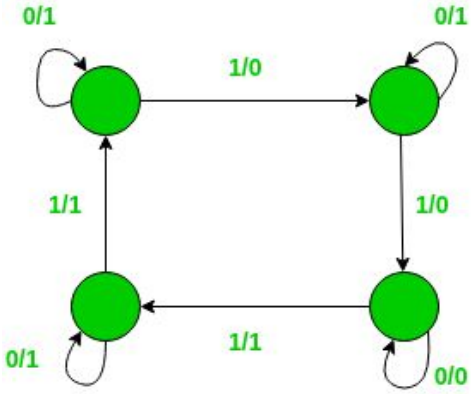

Figure - Mealy machine

Flow Table

- Term used instead of state table
- To indicate how the state changes flow in reference to the changes int input singlaks

Excitation table term is used

- Instead of transition table to indicate the transitions in the state variables

Analysis of Asynchronous circuit using D latch

Y = (C & D) & ((C & !D) & y)
  = CD + !Cy + Dy

Y = CD + !Cy

The term Dy in this expression is redundant and could be deleted without changing the function of y

The reason that the circuit implements the redundant term Dy is that this term solves a race condition known as a hazard.

Arbiter

An arbiter is essentially a resource server. It gives the chance for multiple devices to use a shared resource.

Devices send “requests” to an arbiter and the arbiter sends back grants.