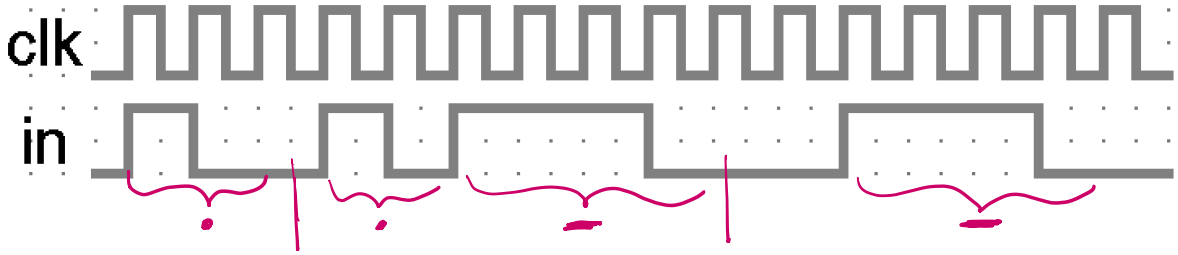
Design of Digital Circuits and Systems, Quiz 1

FSMs

Solution Outlines

Part A:

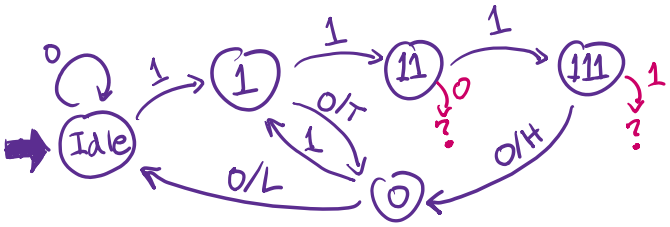


If you're curious, • | • — | — happens to be Morse code for "EAT."

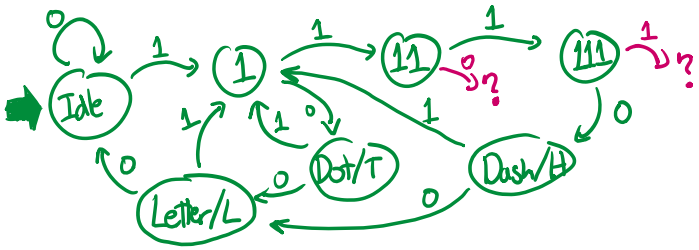
Part B:

There were two main design decisions to make: what do when high signal of 2 clock cycles and 4+ clock cycles were seen. These transitions are shown with a red "?" in the state diagrams below, with possibilities described in Parts C and D.

Mealy:



Moore:



Notes:

- The question stated that you could omit output signals when not asserted, so the state diagrams above have implicit $\overline{T}$, $\overline{H}$, and $\overline{L}$ when not shown.
- All appropriate state names were accepted.

Part C:

Description needed to match the state diagram. The two most common decisions were:

1) Treat the 0 as the end of an invalid symbol (*i.e.*, neither dot nor dash), so transition to the "Idle" state (to avoid outputting L) and output nothing (*i.e.*, $\overline{\mathrm{T}}\overline{\mathrm{H}}\overline{\mathrm{L}}$).
2) Treat this as a dot, so transition to "0" (Mealy) or "Dot" (Moore) and output T (*i.e.*, $\mathrm{T}\overline{\mathrm{H}}\overline{\mathrm{L}}$).

Explanation of why this choice was made needed to be included. #1 generally to reset to a state where we are ready to read the next symbol; #2 generally for some interpretation of the last two cycles being high then low or still being a "short" pulse. #2 is logically inconsistent (a dash sequence also ends with high then low) and breaks the specification, but was still accepted as a reasonable design decision.

Part D:

Description needed to match the state diagram. The three most common decisions were:

1) Treat longer strings of consecutive high inputs as dash inputs by self-looping in state "111" while outputting nothing (*i.e.*, $\overline{\mathrm{T}}\overline{\mathrm{H}}\overline{\mathrm{L}}$).
2) Treat the 1 as a mistake/invalid input and end the non-symbol by transitioning to the "Idle" state (to avoid outputting L) while outputting nothing (*i.e.*, $\overline{\mathrm{T}}\overline{\mathrm{H}}\overline{\mathrm{L}}$).
3) Transition to a new "Dead" state to wait for the next 0 – similar to Option #2, but avoids starting a new symbol in the middle of a continuous string of 1 inputs.

Explanation of why this choice was made needed to be included. #1 generally to maintain that we get a symbol from high inputs (with longer strings being dashes); #2/#3 generally for treating this as an invalid input. #3 is strictly a better option than #2 for logical conversion of inputs. #2 did not receive full credit because it breaks in situations greater than 4 consecutive high inputs (*e.g.*, 5 consecutive high inputs followed by a low input leads to T being incorrectly output).