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Helpful Hints for the Capstone Project

Assumptions

1. The benefit of the assumptions task is for you to tell the grader: "These are the limitations of the machine that I am going to build".
2. Assumptions list is like a "Users' Manual" of how to operate the machine that you built. It should be given to the user to let them know the DO's and DONT's.
3. A good designing engineer should take all possible input combinations (2^n where n is the number of inputs) into consideration rather than assuming some of them will not happen. Do not assume that an input combination (for example the input 01) will not happen at any state. All input combinations need to be taken into consideration while writing your state diagram. However, if there is some input combination that is meaningless at a particular state, then mention this in your assumptions and justify it.
4. While filling in the assumptions section, always remember that it is up to you to assume what you want as long as it will make common sense.
5. We don't want a large list of assumptions. 2-3 assumptions are enough.
6. You don't have to list the assumptions before finishing your design. You might need to modify it while designing your machine. That is the nature of any design process.
7. Your assumptions for Design 2 could be the same as those for Design 1, but don't have to.
8. Answers to (some) the following questions might be good candidates to be your assumptions:
    a. Does your machine need/use an asynchronous reset?
    b. What should the state of the system be if there has been a power outage and power turns on again?

Check List

1. First step is to define the inputs and outputs of your design, as well as the values that each input and output might take.
2. Make sure you have included your assumptions for your project.
3. Make sure your state diagram is complete: no missing arrows/states/inputs/outputs.
4. Make sure your state diagram is readable: Which value mentioned on the arrow corresponds to which input.
5. Think about whether you need a synchronization flip flop at the output of the Mealy machine.
6. In Task C-5, the clocks of the flip flops need to be connected to a “Pushbutton”. Some students connect them to a manual switch. If you have a manual switch, don't use it to feed the clock. Remember that the pushbuttons output a logic one when not pushed down!
7. If your system has more than one input, which one is what (on your state diagram)? (Also don't forget to name your input switches in your Quartus files. Graders might consider your Quartus files not working if you did not label your input switches: CLOCK, Reset....etc.).
8. When filling in the column of the output in the Moore transition table, you need to look at the present state, not at the next state because in a Moore state transition table, the output depends on the present state and not the next state. Thus, if you found your output changes with the change in the input when you simulate your Moore circuit, then you have probably missed this fact.

9. Any state diagram should be complete: Each state has to have 2^n arrows coming out of it, where n is the number of inputs to the system. This is the case for both the Mealy and the Moore machine.
10. Don't forget to connect the PRE' and the CLR' of your chips to the Vcc while you build your schematic.
11. Do not build the FFs from scratch when simulating your design on Quartus. Use the FFs built-in already in Quartus. They are found under the "Primitives -> Storage" folder in the Quartus software.

Tasks C-3 and C-4

In Task C-5 you will be asked to build one of these two designs on hardware, so you need to choose one of them to build. Which one will you choose? Answering Tasks C-3 and C-4 will answer this question for you. In these tasks you have to think about some criteria upon which you decide which design to build. These criteria differ from a student to the other. It may include (but is not limited to):

1- Number of gates
2- Number of flip flops
3- Number of wires (tedious to count)
4- Your understanding to the machine
5- Is it working?
6- Amount of time needed to build it on Hardware.

You need to give a weight to each criteria based on how important you think this criteria is (for example: I care about the cost more than I care about the time needed to implement the system, thus, I will give criterion 1 more weight than criterion 6). The sum of weights should add up to 100. Then, I start dividing these weights among the Moore and the Mealy. For example, my weights are:

1- 60 ----> (out of the 60, I will assign 40 points for my first design and only 20 for my second since my second requires more gates).
2- 10 ----> (7 and 3)
3- 0
4- 20----> (5 and 15)
5- 0
6- 10

Then you add the weights for the 1st design and compare them with the sum of the weights for the 2nd. The design giving you higher aggregate weight wins. Note that you don't have to use all these criterion (this is why some of them have 0 weights indicating that I don't care about these criteria). So it's up to you what to choose. Feel free to add more criteria that you care about. The weights do not have to be numerical, although numerical weights will allow you to arrive at a quantitative answer. If you want to arrive at a qualitative judgment, you might choose a weighting system such as 'very important', 'important', or 'somewhat important'. Answer these tasks using a table whenever possible.

Guidelines

Read the following guidelines to get the most out of this project.

1. DO NOT submit a project other than the one assigned. If you happen to know what project we assigned to students in previous semesters, DO NOT submit their project. This is considered an academic integrity violation that will NOT be tolerated.
2. Your design has to be synchronous which means that all clocks of all FFs have to be connected to a single switch. This switch should not be connected to anything else except the FFs' clock inputs. Asynchronous designs will not be accepted.

3. Start ASAP because, unlike previous labs, the project doesn't have step-by-step procedure. It comes based on your understanding to the topic of “Design of Moore and Mealy Machines”.
4. You might need 5-variable K-maps to finish this project completely. Contact your instructor if you don’t know how to use them.
5. Although we allow and encourage cooperation and discussions, inside or outside the Piazza discussion board, we will not tolerate copying or sharing answers. Even if there might be some similarities between your design and the designs of your peers, your solution has to be written by yourself in your own way of presenting it. Ideas allowing you to understand the project can be shared, solutions cannot.
6. If you scanned/photo’d your handwriting to include it in your report, make sure the scanned version is clean and the grader can read it easily.
7. If your design is not working in simulation, make sure to include in your report what the problem is (i.e. how it is working), and what solutions you advice yourself to do if you had more time to spend on the project. The same goes for the hardware task. Please note that there are not many points dedicated to a working simulation as there are points for your correct explanations and showing how much you understand what you are doing. The grader will deduct points depending on how much they see you have accomplished in this project. A working design is not the main goal of the project (although it is important), a deep understanding of the system is.
8. Make sure you have included two designs in your report. We always ask students NOT to just add hardware to one of the designs to make it look different. Rather we ask them to start from scratch and make use of the systematic procedure that we teach them in class to build the second design.
9. Building one Mealy and one Moore machines yields a conceptually different design. This is what most of the students do and what we encourage them to do.
10. Although you will implement two designs in Quartus, only implement one design on the hardware board (Task C-5)