CS2110 Fall 2015

Homework 4

Rules and Regulations

Academic Misconduct

Academic misconduct is taken very seriously in this class. Homework assignments are collaborative. However, each of these assignments should be coded by you and only you. This means you may not copy code from your peers, someone who has already taken this course, or from the Internet. You may work with others **who are enrolled in the course,** but each student should be turning in their own version of the assignment. Be very careful when supplying your work to a classmate that promises just to look at it. If he/she turns it in as his own you will both be charged.

We will be using automated code analysis and comparison tools to enforce these rules. **If you are caught you will receive a zero and will be reported to Dean of Students.**

Submission Guidelines

1. You are responsible for turning in assignments on time. This includes allowing for unforeseen circumstances. If you have an emergency let us know ***IN ADVANCE*** of the due time supplying documentation (i.e. note from the dean, doctor's note, etc). Extensions will only be granted to those who contact us in advance of the deadline and no extensions will be made after the due date.

2. You are also responsible for ensuring that what you turned in is what you meant to turn in. After submitting you should be sure to download your submission into a brand new folder and test if it works. No excuses if you submit the wrong files, what you turn in is what we grade. In addition, your assignment must be turned in via T-Square. When you submit the assignment you should get an email from T-Square telling you that you submitted the assignment. If you do not get this email that means that you did not complete the submission process correctly. Under no circumstances whatsoever we will accept any email submission of an assignment. Note: if you were granted an extension you will still turn in the assignment over T-Square.

3. There is a 6-hour grace period added to all assignments. You may submit your assignment without penalty up until 11:55PM, or with 25% penalty up until 5:55AM. *So what you should take from this is not to start assignments on the last day and plan to submit right at 11:54AM.* You alone are responsible for submitting your homework before the grace period begins or ends; neither T-Square, nor your flaky internet are to blame if you are unable to submit because

you banked on your computer working up until 11:54PM. The penalty for submitting during the grace period (25%) or after (no credit) is non-negotiable.

General Rules

1. Starting with the assembly homeworks, Any code you write (if any) must be clearly commented and the comments must be meaningful. You should comment your code in terms of the algorithm you are implementing we all know what the line of code does.

2. Although you may ask TAs for clarification, you are ultimately responsible for what you submit. This means that (in the case of demos) you should come prepared to explain to the TA how any piece of code you submitted works, even if you copied it from the book or read about it on the internet.

3. Please read the assignment in its entirety before asking questions.

4. Please start assignments early, and ask for help early. Do not email us the night the assignment is due with questions.

5. If you find any problems with the assignment it would be greatly appreciated if you reported them to the author (which can be found at the top of the assignment). Announcements will be posted if the assignment changes.

Submission Conventions

1. All files you submit for assignments in this course should have your name at the top of the file as a comment for any source code file, and somewhere in the file, near the top, for other files unless otherwise noted.

2. When preparing your submission you may either submit the files individually to T-Square or you may submit an archive (zip or tar.gz only please) of the files (preferred). You can create an archive by right clicking on files and selecting the appropriate compress option on your system.

3. If you choose to submit an archive please don't zip up a folder with the files, only submit an archive of the files we want. (See **Deliverables**).

4. Do not submit compiled files that is .class files for Java code and .o files for C code. Only submit the files we ask for in the assignment.

5. Do not submit links to files. We will not grade assignments submitted this way as it is easy to change the files after the submission period ends.

Objectives

1. To learn how to make a state machine
2. To become familiar with different state machine styles
3. To understand K-maps and their usefulness

Overview

For this assignment, we'll be working with state machines and K-maps. This will be a 2 part assignment.

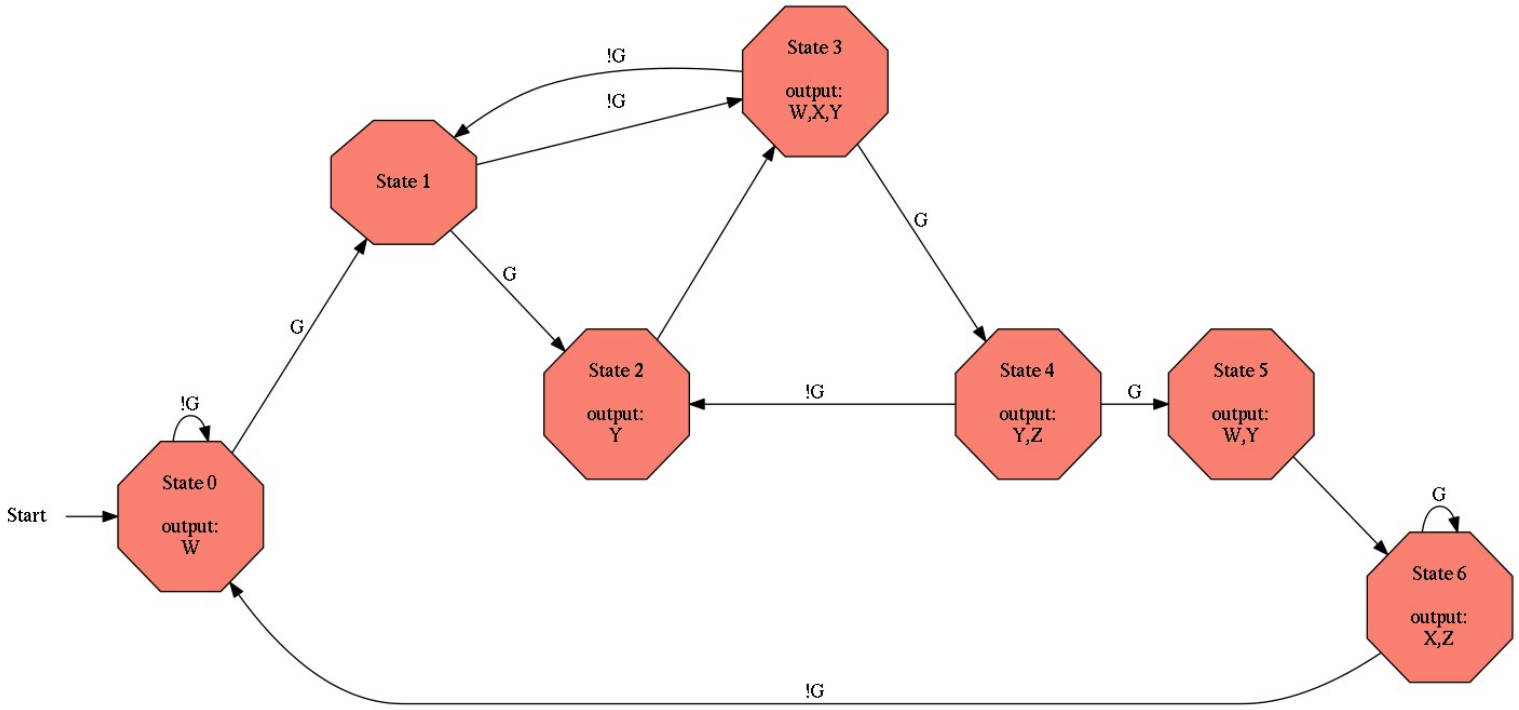
Part 1: Given a simple state diagram, you will build it in Logisim using the "onehot" style of building state machines.

Part 2: Given the same state diagram from part 1, minimize the logic. To do so, you'll need to use K-maps. After you have minimized the logic, implement the circuit in Logisim. Be sure to keep track of your truth table and K-maps! You will be turning them in along with your circuits.

For each part of this homework, you may **ONLY** use 1 register (or the appropriate number of D flip-flops). These are found under Memory in Logisim.

Part 1

Take a look at this state machine transition diagram.

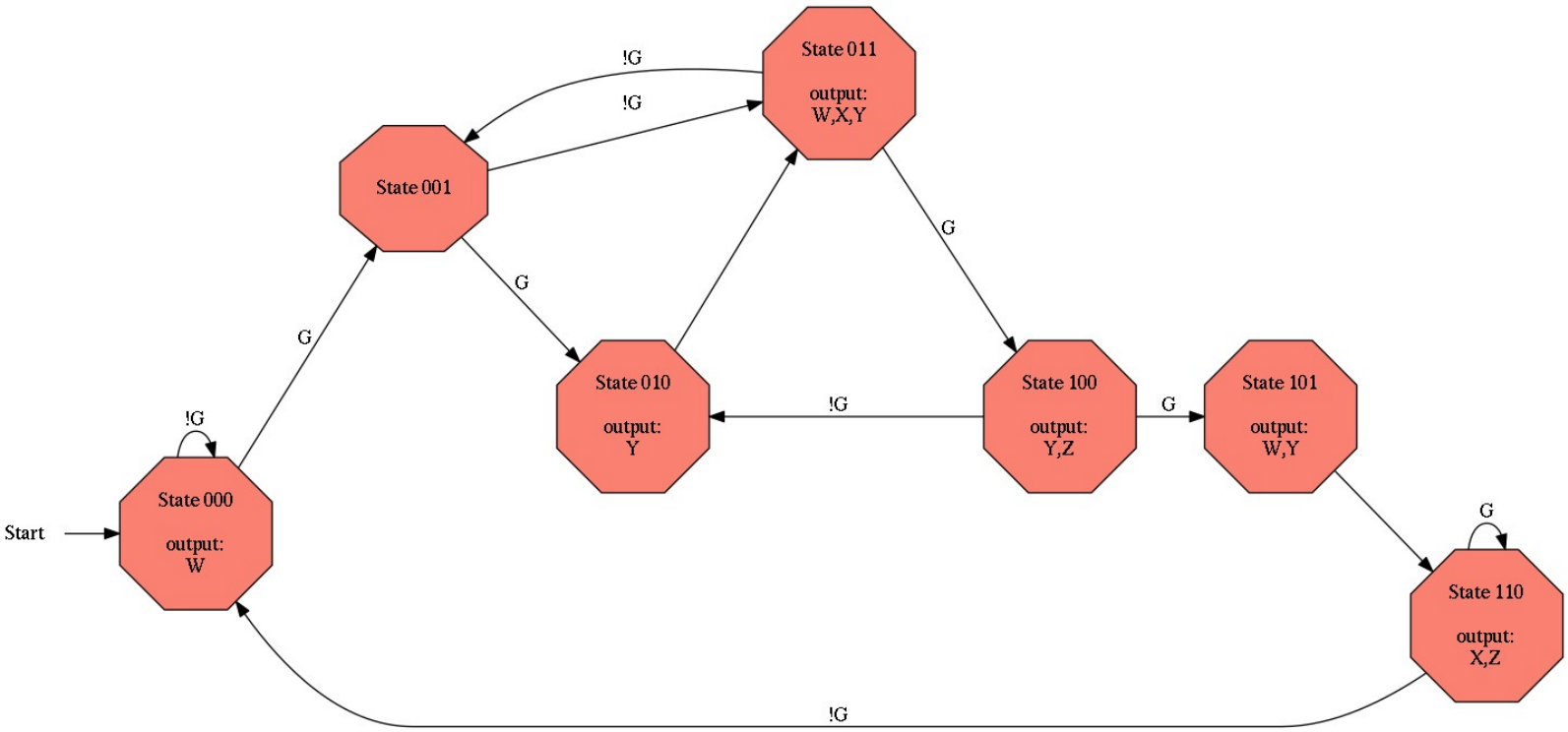


You will be implementing this state transition diagram as a circuit using the **onehot** style. Remember for onehot you will have a register with the number of bits being the number of states you have. Each bit corresponds to a state, and you are in that state if the corresponding bit is a 1. Only one of these bits will be on at a time (the only exception being when the state machine starts up). At most, one of the inputs will be turned on.

You must implement this using onehot. A template file hw4part1.circ has been given to you. Implement the state machine in the subcircuit provided.

Part 2

Take a look at the following state diagram.



You will be required to make a K-map and minimize the logic here.

• First, convert this state diagram to a truth table.

• Next, produce a K-map from the truth table. You will need one K-map per output and one per next state bit for a total of 7 K-maps (S2, S1, S0, X, Y, Z, W). Please be clear in labeling your K-maps. In the above diagram, the binary numbers on each state represent the state number. You must use these numbers in your K-map. For instance, if you see the number 011 then S2 = 0, S1 = 1, S0 = 1. This means that S2 is the most significant bit. Note that the state 111 isn't shown above. This is an invalid state, and we don't care about the behavior of this state nor which state it goes to next. Use this when making your K-map. In your K-map, you must circle the groups (or highlight the groups) you have elected to use in your minimized SUM OF PRODUCTS expression. **Your K-map must give the BEST minimization possible to receive full credit. This means you must select the BEST values for the don't cares in your K-maps to do this.**

• Implement this circuit by adding onto the template file hw4part2.circ template already provided for you. You will lose points if your circuit does not correspond to your K-map or if your circuit is not minimal. You should use only the minimal components possible to implement the state machine.

• It may be helpful to check with others on piazza to see if your circuit is optimal. In order to do this without giving away your answer you may share the number of AND and OR gates used. For example in the K-map below if you thought the answer was BD + ABC then you might ask if someone got better than 2 + 3.

• For the outputs in your K-map. **The outputs should depend only upon the current state you are in.** That is if the state is 011 and G is pressed, then W and Y should be on. If the current state is 011 and G is not pressed, then W and Y should be on. You see, the output does not depend on the G input, but only what state you are in.

• Your K-map must also choose the BEST values for the don't cares to achieve the minimal logic necessary to implement the state diagram as a circuit. For instance consider the following K-map (that is unrelated to the state machine we gave you):

AB\CD	00	01	11	10
00	0	0	0	0
01	0	1	X	0
11	0	X	1	X
10	0	0	0	0

Doing this the naïve way, you would select the two 1's in this K-map and be done, however this is not minimal. The X's in this K-map are don't cares, meaning you don't care if it is a 1 or a 0. You can use these don't cares to make your expression even more minimal. For this K-map you can let the X's in the center be 1's this way you can select a 2x2 square in the center. Also note the other don't care we will let be 0 as you do not get a better minimization by having it be a 1. You must do your minimization this way or else your K-maps will be wrong and you will lose points.

Summary of the rules

Failure to follow these will result in a heavy point deduction, if not a zero, for this part. **This is your only warning!**

1. Outputs are ONLY to depend upon the current state.
2. Your K-maps should show the labeled groups and the minimized boolean expression as a sum of products. Do not factor anything else out. Your expression should not include any parenthesis, and the circuit shouldn't use XOR gates as part of the logic.
3. Your K-maps should give the BEST minimization. You should choose the BEST values for all of the don't cares.
4. States 111 is not used so we DON'T CARE what is outputted or what the next state is.
5. Your K-map should match your circuit.
6. The left most bit of the state is S2, the right most is S0.
7. You are to do your truth table and K-maps on paper (and scan it or take a clear picture of it) or in Excel/LibreOffice Calc and submit them with your circuits.
8. Make sure your name is clearly visible in all of your files (including K-maps and truth table).

Deliverables

Part 1
Your modified version of hw4part1.circ

Part 2
1. Truth table and K-maps complete with circled groups and your sum of products expressions.
2. The modified hw4part2.circ file that implements your minimized state machine from the K-Maps.

Practice safe submissions! Make sure to redownload your files from T-Sqaure after submitting to ensure that you uploaded the correct files. You alone are responsible for what you submit, and you risk getting a zero if you submit the wrong files, or forget some. **You have been warned!**