CS2100 Assignment 2 Answer Book

Name:	Neo Haowei
Student ID:	A0264683U
Tutorial Group Number:	41

After completion, save this file as AxxxxxxxY.pdf and submit on Canvas together with your code as per the instructions given in the question paper.

If you do not fill your particulars above, or do not follow the submission instructions you will forfeit up to 3 marks.

Submission information: ______________ / 3

Part A

Question 1. (7 MARKS)
(Use the space to describe the working/thinking behind your code. Think of it as your "working". Marks will be deducted for failure to do so, or simple answers like "Go see the code yourself!" This applies for Questions 1 to 3.)

(a) (3 marks)
Defining a macro so that we can use it for all the multiplexers as the logic is the same.
The logic would be to check if condition is true(control signal is 1), then we would choose in1. If not, we would choose in2.

(b) (4 marks)
Captured all relevant information about instruction regardless of instruction type. This is done by bit masking and right shifting by the required number of bits to purposefully select the positions.

Q1 Total: _________ / 7

Question 2. (10 MARKS)
(a) (3 marks)
Using the opcode to generate the different control signals.
We can then find out the different control signals such as RegDst, ALUSrc, MemRead, MemWrite, Branch, MemtoReg and RegWrite based on the opcode, as different encoding types and instructions would lead to different signal outputs.
Based on the opcode, we can also generate the ALUOp signal. Non R-type instructions do not have funct codes, so we would use the opcode to generate this signal for lw,sw and beq instructions accordingly.

(b) (3 marks)
ALUControl will decode the funct code of R-type instructions to control the ALU. Based on the different funct code, we will return ALUControl signals for each of the different r-type instructions.

If they are Non R-type, we can decide what the output of ALUControl will be : if it is lw/sw (ALUop == 0), we would return 2 (ask the ALU to add). If it is a beq instruction(ALUop == 1) , we would return 6 (ask the alu to do subtraction)

(c) (4 marks)
Based on the different ALUControl signal, we would implement the operations accordingly. At the end, we would also check if result == 0 and store it in ALUiszero signal.

Q2 Total: _________ / 10

Question 3. (10 MARKS)
We start by declaring pointers to the various control signals.
We then move on to the decode stage, where we are able to get the decoding of the instruction.
This would then help us generate the control signals.
In the register file, we are able to get most of the registers required from the decoding.
WR requires a multiplexer to choose the correct write register by using the type of instruction.
We are then able to get the ALU operands: ALUop1 from RD1, and ALUop2 by using another multiplexer to choose between RD2 and the sign extended immediate.
For the PCSrc control signal, we set it to 1 when if it is both a branch instruction and also when ALU result is zero.
We would then calculate the branch target address using a multiplexer to choose between +4 (next instruction) or immediate*4 + 4 (target adress).
In the memory stage, we would do the lw/sw operations using the Memory() method.
In the writeback stage, we would update WD by using a multiplexer to choose between the data from memory or the result calculated from the ALU.
The we would update the register file and the PC address.

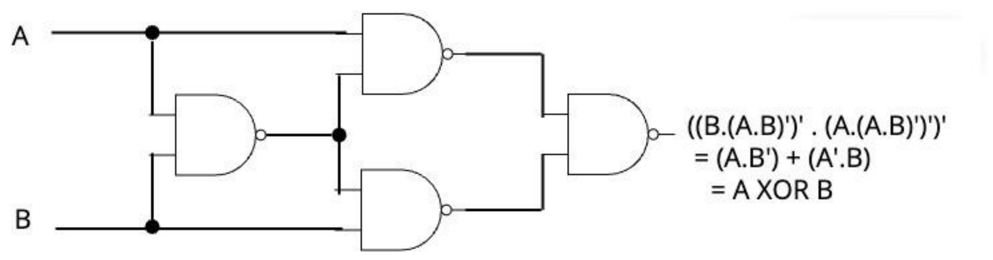
Q3 Total: _________ / 10

Part B

Question 4. (10 MARKS)

You are expected to show working for each of the questions, not merely the final result. Marks may be deducted for failure to do so. Expand on the space as required.

4a. Draw your logic diagram neatly below. (2 marks)



4b. $S_k =$ $(A_k \cdot B_k) + (A_k' \cdot B_k')$ (1 mark)

4c. $F =$ $(A_0 \cdot B_0) + (A_0' \cdot B_0')$ (1 mark)

4d. Prime implicants: (P’·R), (P’·S’), (Q·S), (R·S),(P’·Q) (1 mark)

4e. Essential prime implicants: (P’·S’), (Q·S), (R·S) (1 mark)

4f. Simplified POS for $G =$ (P’+ S) · (Q + R + S’) (2 marks)

4g. Simplified SOP for $H =$ (C’·D’· E’) + (A·C’·E’) + (A’·C·E) + (B·C·E) (2 marks)

Q4 Total: _________ / 10

Total Marks: _____________ / 40 (To be filled by TA only)

=== END OF PAPER ===