CS2100 Exam Report

AY2024/25 Semester 2

This is the report for the CS2100 final assessment held on 3 May 2025.

302 (out of 313) students sat for the final assessment in MPSH6.

(Answer sheets from a few SN students have not been collected at the writing of this report. Statistics will be updated when these answer sheets are graded.)

1. General statistics

	MCQs (36)	Q19 (12)	Q20 (14)	Q21 (13)	Q22 (12)	Q23 (13)	**Total (100)**
Average mark (normalized %)	20.21 (56.1%)	8.34 (69.5%)	4.97 (35.5%)	7.88 (60.6%)	4.99 (41.6%)	4.06 (31.2%)	**50.45 (50.5%)**
Median mark	20	10	4	8.75	5	4	52
Standard deviation	5.97	3.90	3.54	3.91	3.65	2.69	17.44

The chart for the mark ranges is as follows. (To be updated)

2. Part A: MCQs 1 – 18

Please refer to the released answers with working/explanation.

The table below shows the percentage of students who chose the correct answers, and of those who chose the most popular wrong answers:

	Q1	Q2	Q3	Q4	Q5	Q6
%students who chose the correct answer	A (61.3%)	D (7.9%)	B (55.3%)	B (81.1%)	D (64.2%)	B (66.9%)
%students who chose the most popular wrong answer	C (10.9%)	E (35.1%)	C (17.5%)	E (13.2%)	B (14.2%)	C (15.9%)

	Q7	Q8	Q9	Q10	Q11	Q12
%students who chose the correct answer	D (69.2%)	C (94.4%)	B (32.5%)	B (48.7%)	D (44.7%)	C (56.0%)
%students who chose the most popular wrong answer	B (12.6%)	D (2.3%)	A (29.5%)	C (18.9%)	B (25.2%)	D (20.9%)

	Q13	Q14	Q15	Q16	Q17	Q18
%students who chose the correct answer	C (45.7%)	C (57.0%)	E (44.0%)	C (46.0%)	A (68.5%)	A (68.9%)
%students who chose the most popular wrong answer	B (20.5%)	B (19.9%)	A (38.7%)	B (17.2%)	B (20.2%)	C (12.9%)

During the exams, one or two students asked whether logical constants are available, and whether complemented literals are available. In tutorials 6 and 7, and assignments 2 and 3, the following instructions have been given.

By default, we assume that complemented literals are NOT available, unless otherwise stated.

Logic constants (0 and 1) are always available, and they are considered (degenerate form of) SOP and POS expressions.

The above are to be assumed from now onwards and may not be repeated in future tutorials/assignments/final exam.

3. Q19 Sequential circuits (graded by Aaron)

Please refer to the released answers with working/explanation. Breakdown of marks:

	Q19(a) (6)	Q19(b) (1)	Q19(c) (4)	Q19(d) (1)	**Q19 Total (12)**
Average mark (normalized %)	4.84 (80.7%)	0.76 (75.7%)	2.43 (60.7%)	0.32 (31.2%)	**8.34 (69.5%)**
Median mark	6	1	3	0	**10**
Standard deviation	1.99	0.40	1.73	0.47	**3.90**

This question was quite well attempted, judging from the average and median. A median of 6 for part (a) means that more than half the class got the state diagram right.

Some students did not put the dot (AND) operator for their answers for part (c); marks were deducted.

Part (d) was not well attempted, even among students who got part (c) correct.

4. Q20 Combiniational circuits (graded by Aaron)

Please refer to the released answers with working/explanation. Breakdown of marks:

	Q20(a) (4)	Q20(b) (4)	Q20(c) (6)	**Q20 Total (14)**
Average mark (normalized %)	2.60 (65.0%)	1.72 (43.1%)	0.65 (10.8%)	**4.97 (35.5%)**
Median mark	4	0	0	**4**
Standard deviation	1.84	1.93	1.23	**3.54**

Compared to Q19, this question was poorly attempted. A median of 0 for parts (b) and (c) means that more than half the class got zero for these parts.

Like Q19, some students did not put the dot (AND) operator for their SOP expressions.

For part (a), a number of students provided a correct SOP expression, but not simplified. Partial credit was given.

For part (b), the only correct selector inputs are BD or DB. Only when the selector inputs are correctly answered would I then check the 4 multiplexer inputs, 1 mark for each correct multiplexer input. 116 students got full mark for this part.

Part (c) is the hardest among the 3 parts. The average mark is only 0.64 out of 6. You need to get the table right, and from the table, obtain the simplified expression. Among the students who attempted, most gave the wrong answer. Only 3 students are awarded full marks (6 marks) for this question and 6 students awarded 5 marks. For answers that are wrong, I tried to award partial credit if I can infer some correct logic from the students' answer.

5. Q21 MIPS (graded by Prabhu)

Please refer to the released answers with working/explanation. Breakdown of marks:

	Q21(a) (2)	Q21(b) (3)	Q21(c) (2)	Q21(d) (2)	Q21(e) (2)	Q21(f) (2)	**Q21 Total (13)**
Average mark (normalized %)	1.06 (53.3%)	1.95 (65.0%)	0.78 (39.0%)	1.54 (77.2%)	1.44 (71.9%)	1.11 (55.4%)	**7.88 (60.6%)**
Median mark	1	2.5	0	2	2	1	**8.75**
Standard deviation	0.91	1.23	0.88	0.66	0.80	0.88	**3.91**

Common mistakes:
Parts (a) to (c): Writing i++ instead of i+2. Some students couldn't code divisibility by 4 in C. Some confused the condition with && (logical AND) instead of using & (bitwise AND) with 3. Because of mistakes in (a) and (b), many got (c) wrong. Very few of them have written complicated C code for checking this simple condition. Correct condition to check the divisibility by 4 are:

if (A[i] % 4 == 0)	if (!(A[i] % 4))	if ((A[i] & 3) == 0)	if (!(A[i] & 3))

Parts (d) to (f): Most students got a mistake in calculating the target address for branch and jump instructions. Surprisingly, some got mistakes in the first two hexadecimal digits in the final encoded instruction.

6. Q22 Pipeline (graded by Song Kai)

Please refer to the released answers with working/explanation. Breakdown of marks:

	Q22(a) (1)	Q22(b) (3)	Q22(c) (3)	Q22(d) (3)	Q22(e) (2)	**Q22 Total (12)**
Average mark (normalized %)	0.30 (29.9%)	1.48 (49.4%)	1.68 (56.0%)	1.05 (35.1%)	0.48 (24.0%)	**4.99 (41.6%)**
Median mark	0	1	3	1	0	**5**
Standard deviation	0.46	1.25	1.43	1.13	0.86	**3.65**

The overall performance of students on this MIPS pipeline question varied significantly by part, with parts (b) and (c) being better attempted compared to others.

For part (a), 46.1% of students incorrectly answered 19, likely by counting all instructions without excluding non-executed Instructions 10 and 11. The correct answer is 17, as identified by 29.9% of students. It's crucial to consider only executed instructions when establishing a baseline for parts (b), (c), and (d).

For part (b), 33.8% of students calculated 11 additional cycles correctly. However, 20.1% concluded 13 cycles due to MIPS code misinterpretation, similar to errors in part (a). Other wrong answers, like 12 or 10 cycles, stemmed from miscalculating delays between Instructions 6 to 8, where only a 1-cycle wait was needed due to Instruction 7. Answers within 1 cycle of the correct receive 2 marks, and those within 2 cycles get 1 mark.

For part (c), 53% of students identified the correct answer of 6 cycles. The main error, resulting in an answer of 7 cycles by 9.1%, was from overestimating delays between Instructions 6 to 8. MIPS interpretation did not affect this part, focused on forwarding logic. One mark is awarded for answer 7; no marks for other errors.

For part (d), 22.1% achieved the correct answer of 3 cycles. Errors included 2 cycles (27.6%), due to assumed perfect branch prediction, and 4 cycles (11.7%), from overestimating forwarding delays. Answers of 2 and 4 earn 1 mark, with no marks for other errors.

For part (e), 24% correctly saw no net change ("Same"), while 41.2% and 27.9% chose "Worse" or "Better," respectively, missing that moving the *andi* instruction only redistributed cycles between $s1 and $s3 without affecting the total. No marks for incorrect answers.

Regarding student behavior, blank responses in parts (a) to (e) were 8.1%, 10.7%, 11%, 11.7%, and 6.8%. This suggests students guessed parts with clearer options and skipped complex sections to manage exam time efficiently.

7. Q23 Cache (graded by Nicholas)

Please refer to the released answers with working/explanation. Breakdown of marks:

	Q23(a) (1)	Q23(b) (1)	Q23(c) (3)	Q23(d) (1)	Q23(e) (3)	Q23(f) (1)	Q23(g) (3)	**Q23 Total (13)**
Average mark (normalized %)	0.80 (79.9%)	0.81 (80.5%)	0.36 (12.1%)	0.73 (72.7%)	0.41 (13.6%)	0.69 (69.5%)	0.26 (8.6%)	**4.06 (31.2%)**
Median mark	1	1	0	1	0	1	0	**4**
Standard deviation	0.40	0.40	0.86	0.45	0.86	0.46	0.77	**2.69**

Overall performance of 3-mark questions (counting hits) was poor, likely due to time constraints. More than half the students left it blank or gave a throwaway answer.

For those who did attempt it, we identify 3 main sources of mistakes.

1. Miscounting hits at the ends of the array.
2. Not noticing the code loops over every ***other*** element of the array.
3. Counting hits for only one array (A or B) instead of both combined.

We have awarded partial marks accordingly for the above cases.

1. Deduct 1 mark for +-5 # off from correct answer.
2. Deduct 1 mark for part (c) 768 and part (e) 1797.
3. Deduct 1 mark for halved #hits.

Part (c). If student incorrectly took the loop to be over **every** element, we will get 3 times the number of hits = 256 * 3 = 768 hits. See answers for original.

Index	Word0	Word1	Word2	Word3	Word4	Work5	Word6	Word7
0		A[0]M	A[1]M	A[2]M	A[3]M	A[4]H	A[5]H	A[6]H
1	A[7]M	A[8]M	A[9]M	A[10]M	A[11]M	A[12]H	A[13]H	A[14]H

Index	Word0	Word1	Word2	Word3	Word4	Work5	Word6	Word7
0						B[0]M	B[1]M	B[2]M
1	B[3]M	B[4]H	B[5]H	B[6]H	B[7]M	B[8]M	B[9]M	B[10]M
2	B[11]M	B[12]H	B[13]H	B[14]H	B[15]M	B[16]M	B[17]M	B[18]M

Part (e). If student incorrectly took the loop to be over **every** element, we will get same number of misses for A, 129. But B will have 1 additional miss, 130. Total hits = 2056 – 129 – 130 = 1797. See answers for original.

Miss#	Word0	Word1	Word2	Word3	Word4	Work5	Word6	Word7
0		A[0]M	A[1]H	A[2]H	A[3]H	A[4]H	A[5]H	A[6]H
1	A[7]M	A[8]H	A[9]H	A[10]H	A[11]H	A[12]H	A[13]H	A[14]H
…	…	…	…	…	…	…	…	…
128	A[1023]M	A[1024]	A[1025]	A[1026]	A[1027]			

Miss#	Word0	Word1	Word2	Word3	Word4	Work5	Word6	Word7
0						B[0]M	B[1]H	B[2]H
1	B[3]M	B[4]H	B[5]H	B[6]H	B[7]H	B[8]H	B[9]H	B[10]H
2	B[11]M	B[12]H	B[13]H	B[14]H	B[15]H	B[16]H	B[17]H	B[18]H
…	…	…	…	…	…	…	…	…
129	B[1027]M							

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