MONASH University

FACULTY OF INFORMATION TECHNOLOGY

FIT9137

ASSIGNMENT 1 - Computer Architecture

Purpose	*Assignment will include the material covered in **Weeks 1-3**. In particular, the assignment will consist of questions related to computer architecture. The format of the student submission will be a **report** answering questions on memory management techniques and a **recorded video** demonstrating the understanding of Von Neumann architecture using MARIE. This is an **individual** assignment. Completing this Assignment will contribute to the learning outcomes 1, 2 & 3.* *Students are expected to start working on Assignment 1 from the end of Week 3.*
Your task	*Open-book, non-invigilated*
Value	**20**% of your total marks for the unit
Due Date	**Week-5: 11:55 pm Friday, 4th April 2025 (Melbourne local time)**
Submission	• Via Moodle Assignment Submission.
Assessment Criteria	*Allocated marks or marks breakdown per task is given in the instruction below.*
Penalties	• Late submissions will result in 5% deduction of the total marks per calendar day (up to one week). For example, if you get 70/100 marks originally and submit 2 days late, then you would get a 10-mark deduction (5 marks per day) and your final marks would be 60/100. • Submissions more than 7 calendar days after the due date will receive a mark of zero (0) and no assessment feedback will be provided. • The maximum video limit is 7 minutes. If the video recording exceeds the 7:00 minutes maximum limit, then the remaining video content beyond the time limit will **NOT** be marked. • Speeding up the video recording (e.g. using a software) is not allowed and such submissions will receive a zero "0" mark.
Warning: Important Submission check for every student	It is the student's responsibility that the submitted video file can be opened on a standard Windows computer (without requiring specialised software), and that the images and texts shown in the video are understandable/readable (in English). If the video file cannot be opened, you will receive zero marks. After making a **draft** submission (**before** finalising it), we recommend you to download your submitted file and check that it opens and runs properly. Once you finalise your submission, you will **not** be able to revise it.
Support Resources	See Moodle Assessment page.
Feedback	Feedback will be provided on student work via general cohort performance. specific student feedback ten working days post submission.

INSTRUCTIONS (for all tasks)

In this assignment, you must record yourself and your screen while performing a number of tasks detailed further below. For each task, the allocated marks are indicated in front of it. Your entire presentation cannot be more than 7:00 minutes. At the beginning of your presentation, you must have a slide as shown in Appendix A to show your face and student ID in the recording. Your camera view must remain on at a corner of the video throughout the whole duration of the recording. If you think a task cannot be performed, you have to explain WHY you cannot do it. You are **not** allowed to record a video only and add a voice over later on; your explanations must be provided while you are performing the tasks and presenting your solution.

The submission files should be named as follows: **firstname_studentID.filetype**

Note 0: If you feel uncomfortable recording yourself, you must present this assessment in a live session to Safi/Pasindu/Ammar. You must have a concrete and valid reason for this to be accepted. If you want to arrange for a live presentation (rather than recording yourself), you have to send Safi/Pasindu/Ammar an arrangement email by the Friday of Week 5 (by close of business) and we will arrange the live presentations for students sometime on Monday of Week 6 just after the deadline. This is to achieve fairness for all students.

Note 1: If you do not have your student ID (digital or physical one) yet (to display at the beginning of the recording), you can use your confirmation of enrolment (CoE) from Monash University or Passport copy instead.

Note 2: You may use any software to record yourself. We recommend Zoom, which is free for all Monash students. You can refer to the following links on how to install/use Zoom.

- *Zoom*
- *More details on Zoom*

Note 3: You are allowed to pre-install new software if needed and do not need to display installation in the video.

Note 4: You can do (online) research in advance, take notes and make use of them during video recording. However, you are **not** allowed to simply copy commands from a file and paste them to the terminal. You must perform a live-recording of the tasks and provide a proper (brief) explanation while carrying out the tasks.

Note 5: If you require **extension or special consideration**, refer to https://www.monash.edu/students/admin/assessments/extensions-special-consideration

No teaching team member is allowed to give you extension or special consideration, so please do not reach out to a teaching team member about this. Follow the guidelines in the aforementioned link.

Note 6: If your device does not have a camera (or for whatever reason you can't use your device), you can borrow a device from Monash Connect or Library. It's your responsibility to plan ahead for this. Monash Connect or Library not having available devices for loan at a particular point in time is not a valid excuse.

Note 7: You can create multiple video parts at different times, and combine and submit a single video at the end. Make sure that the final video is clear and understandable.

Note 8: Zero tolerance on **plagiarism and academic integrity violations**: If you are found cheating, penalties will apply, e.g., a zero grade for the unit. The demonstration video is also used to detect/avoid plagiarism.

University policies can be found at

https://www.monash.edu/students/academic/policies/academic-integrity

Note 9: At the end of your presentation, you can add a slide(s) to acknowledge the references you made use of. You do not need to spend time reading through the references, just making sure that they are captured in the recording is fine.

Question 1: Memory Allocation Techniques [50 Marks]

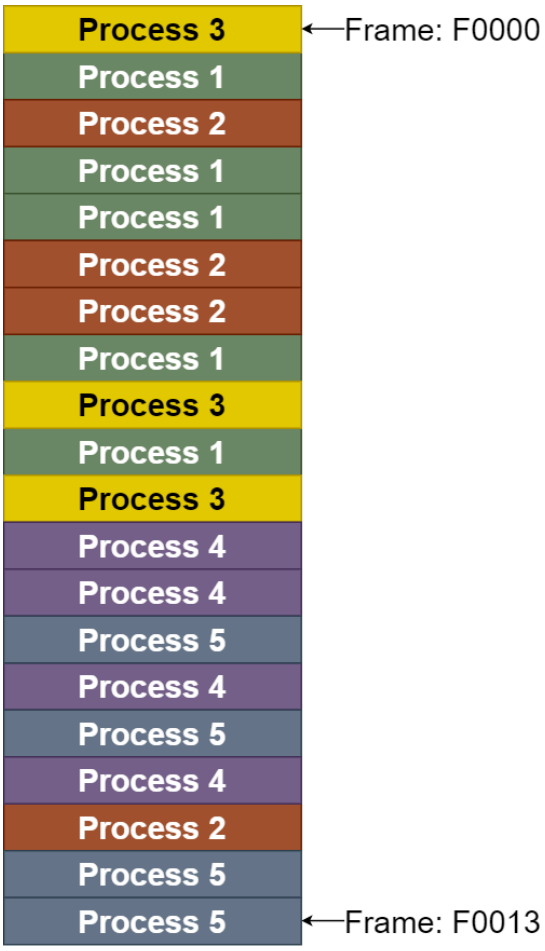


Figure 1: Frames in a physical memory

Above diagram shows 20 frames (from frame number $F0000_{HEX}$ to $F0013_{Hex}$) of a physical memory. All frames are currently occupied with pages from different processes (including the frames not showing in the given diagram).

To accommodate a new **Process A** of size **17,152 bytes** the CPU must swap 2 processes from the RAM to the secondary storage. Based on an algorithm used, **Process X** and **Process Y** were swapped from the RAM to accommodate Process A. Frame size is equal to **4KB** in the given system. Please refer to **Appendix B** for instructions on how to calculate the X and Y values based on your Monash Student ID.

If you solve a question based on an incorrect X and Y value, **you will receive zero marks regardless of the correctness of your answer based on different X, Y values**).

Note: This system uses byte-addressable memory (one memory location stores one byte). This is different to word-addressable memory, such as MARIE, where one memory location stores one word.

1. Fill in the page table for Process A after placing it in the Physical memory. Use the following Format. (There can be more rows in the table). [10 Marks]

Page #	Frame #
0	
1	

Submission Requirement: Report only.

2. The above system uses 32-bit logical addressing. Out of 32-bits, what's the minimum required number of bits to represent the offset portion of the logical address of the given system? Provide the reason for your answer. [5 Marks]

Submission Requirement: Report only.

3. What is the logical address of the last byte of Process A? The answer should be in 16 binary digits. You may add leading zeros to the answer to fit the length of 16 bits. [10 Marks]

Submission Requirement: Report only.

4. What is the physical address of the last byte of Process A? The answer should be in 32 binary digits. You may add leading zeros to the answer to fit the length of 16 bits. [10 Marks]

Submission Requirement: Report only.

5. How much internal fragmentation is caused in the above memory allocation of Process A? [5 Marks]

Submission Requirement: Report only.

6. If the system was using Fixed Partitioning of size 2MB, how much internal fragmentation could it have caused for allocating the same process. [10 Marks]

Submission Requirement: Report only.

Question 2: Von Neumann Architecture [50 marks]

1. Reconstruct the MARIE program by looking at each memory cell and extracting the instruction and address argument. All memory locations referenced from the code need to be labeled. [20 marks]

	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+A	+B	+C	+D	+E	+F
000	5000	200B	300A	200C	5000	200B	100A	400B	200D	7000	0032	0000	0000	0000	0000	0000
010	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000
020	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000	0000

Figure 2: A section of MARIE memory

Submission Requirement: MARIE code in the report. NO demonstration required.

2. Assemble your code and run the program step by step using the Micro-Step button in MARIE. If the program requests user inputs, provide the following inputs.

   Input 1: StudentID mod 20

   Input 1: (StudentID mod 20) + 100

   2.1 Open the “Data Path” view in the MARIE simulator and demonstrate the data and instruction movement in every micro-step. Each step needs to be explained in detail along with the RTL log entry. [20 marks]

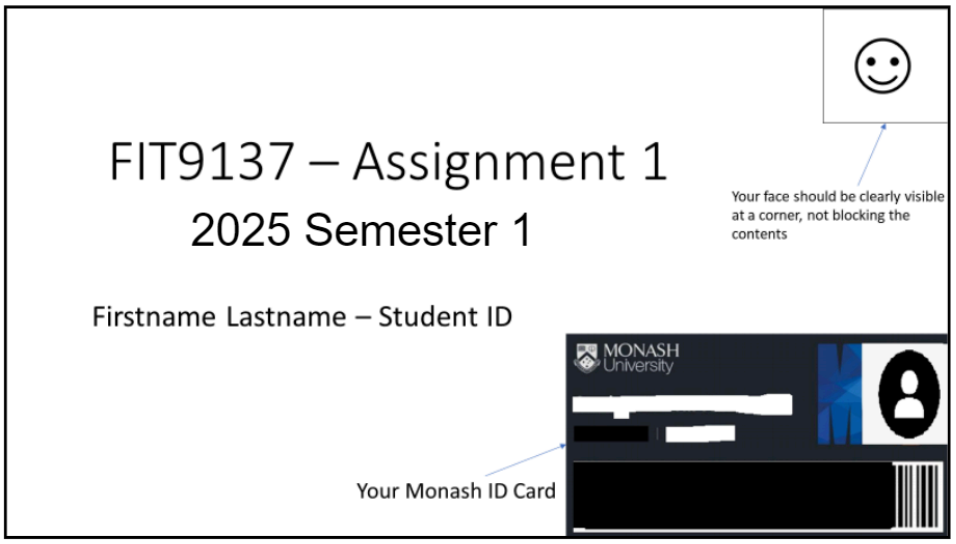
Submission Requirement: Video demonstration only.

   2.2 Provide a screenshot of the memory after running the program. Provide the value of memory location 00C and 00D, in decimal. Show the workings of the conversions from HEX -> Binary (2’s complement) -> Decimal [10 marks]

Submission Requirement: Report only.

Appendix A

Sample first-slide to be shown in the beginning of the video recording.



Appendix B: Calculating X and Y values for Q1.

For Question 1, find X and Y values using your student ID following the table below.

(StudentID **mod** 4)	X value	Y value
0	2	4
1	3	1
2	5	2
3	1	4

*StudentID is your Monash student ID number.

Example: If your Student ID is 11112222, then find X and Y as below:

Step 1: Find the result of mod operation: 11112222 mod 4 = 2

Step 2: Find your X and Y from the table: X=5, Y=2

As your answer to the mod operation is '2', using the table above, you will select the X and Y values from the 3rd row, and that is X=5, Y=2.