University of Nottingham Ningbo China

SCHOOL OF COMPUTER SCIENCE

A LEVEL 1 MODULE, SPRING SEMESTER 2023–2024

COMP1047: Systems and Architecture (AE1SYS)

Coursework Part 1: Computer Architecture

SUBMISSION DEADLINE: FRIDAY 29th MARCH 2024, 23:59:59 GMT+8

---

1 Synopsis

This is **Part 1** of the COMP1047 coursework. This Part is about MIPS programming implementation, as well as conception of CPU design. You should answer both the **TWO (2)** questions below, before submitting them in Moodle and CS repository. For the MIPS coding problem, you are advised to develop and test your code ONLY using the MIPS simulator adopted in the lab sessions in this module, which is QtSpim. The total mark of this Part is [**20 MARKS**].

Note that the nature of this Part of coursework is exploratory to a certain extent, given its time to complete (more than 2 weeks). Thus, the solutions of the questions cannot be directly obtained from the lecture or lab materials, but require students to explore further from public resources, or recall from what have been learnt from prerequisite modules. Nonetheless, the module content of COMP1047 should be recognized as the essential foundation to achieve the proper answering to the questions of this Part of coursework.

2 Deliverable

Submit the following **THREE (3)** *uncompressed* files to COMP1047 Moodle page, where you will find a submission portal named "Submission for Part 1: Computer Architecture" to be opened later.

1. `COMP1047CWP1-'YourName'-'YourID'-Q1.s` for the code corresponding to Question 1. Example: `COMP1047CWP1-JaneDoe-20511234-Q1.s`.

2. `COMP1047CWP1-'YourName'-'YourID'-Q2.txt`, in which you only need to write down your project name (AE1SYS-CWP1-YourID) in the csproject. Details can be found in Question 2's description.

3. `COMP1047CWP1-'YourName'-'YourID'-readme.txt` for whatever you would like to tell the evaluators. Word count limit is 500, including all components. This item is *optional*.

Unable to follow the file naming conventions would lead to mark deduction. Late submission rules apply, as indicated in the accompanying coursework issue sheet.

3 Assessment

1. This Part has a total of 20 marks, which constitutes 40% of the total coursework marks, equivalent to 20% of the total module marks. Individual marks are shown along each question.

2. Detailed evaluation rubrics for Questions 1 is provided in Appendix 1. Evaluation rubrics for Question 2 is provided in its problem description.

3. For everything in your solution that you believe should highlight to us (e.g., the special considerations in data/control hazards in Q1), please describe it in the readme.txt file.

4. For enquiries on doubts or issues encountered when doing your coursework, please use the Moodle discussion forum, or directly email Dr. Heng Yu.

Question 1 [10 Marks]

Implement a MIPS program which prompts the user to enter two integer inputs M and N from the console, and calculate the following expression in signed 32-bit arithmetic:

$$M^3 + 3M^2N + 3MN^2 + 9N^3$$

Note that you are NOT allowed to use pseudo-instructions with overflow checking for the calculation (e.g. you cannot use the `mulo` instruction). If an overflow occurs during any step of the calculation, you should print an error message instead, and stop the calculation.

Hint: You could simplify the expression before calculation. Remember to test your program with a range of different inputs, for example: $M = 2$, $N = 3$; $M = -3$, $N = 4$; $M = 1000$, $N = 150000$; etc.

Question 2 [10 Marks]

The Scenario

Due to the timing constraints, over the first 5 weeks, our COMP1047 module cannot fully cover all aspects of the computer architecture design. Now, assume that you are invited as a guest speaker to teach for one extra week, on the topic of computer architecture. When outlining your teaching content, you firstly identify 3 aspects that was not covered by the current COMP1047 materials. Then you choose one aspect that you are familiar with, and decide to teach it to the students.

Under this aspect of computer architecture, you organize several sub-topics that together constitutes the major domain knowledge of that aspect. They should be logically connected, but sufficiently different from each other. Then you start to prepare the details of each sub-topic. To give you a better concept of an 'aspect' and its 'sub-topics' – Example 1: in the aspect of ISA (Week 4), the sub-topics could be `R-type`, `I-type`, and `J-type` instructions. Example 2: in the aspect of MIPS's memory instructions (Week 2), the sub-topics could be `load word`, `store word`, and `byte operations`.

Your Task

Prepare a PPT with which you can talk for 5 minutes, specifically addressing the following questions:

1. Introduce the three aspects of computer architecture that you find not covered, or not well covered, in this module. You do not need to dive into much technical details, but your introduction should clearly describe: (1) 'what they are', (2) 'where are they in the big picture of computer architecture', and (3) 'what are their relationships with the architecture you have learnt in this module'.

   Then, pick one of the above aspects talked, describe what are the sub-topics that you have prepared to teach. You don't have to introduce each sub-topic in detail, but only need to give their names, and describe 'what they are'. (5 marks)

2. Choose one sub-topic above, and talk about it in extended technical depth. Moreover, describe the latest industry development or research achievement of this sub-topic. Besides depth, your description should be correct and abundant, in order to let the audience quickly grab the key domain knowledge of this sub-topic. (5 marks)

Make an oral presentation using the PPT developed. Note that your audience is not the students to teach, but Dr. Heng as your assumed mentor to help you prepare for the teaching.

Also, it is important to note that, please do not add the content of Computer Networks as part of your answers, as this aspect will be taught in the next few weeks. Record a 5 minutes video of your presentation in `mp4` format, and submit **both your video and PPT** to our CS git server, namely csprojects.nottingham.edu.cn. To upload to csprojects, please:

a. Create a new project named **AE1SYS-CWP1-YourID**, e.g., AE1SYS-CWP1-20511234.

b. Upload your video and PPT into the project, and name them as **Video-YourID** and **PPT-YourID**, respectively. An illustration of your project page is shown below.

c. You must add Dr. Heng as the project **Maintainer** in order for your project to be accessed. This can be done by `Project Information → Members → Invite member`, then input his email address (heng.yu@nottingham.edu.cn), and set him as the Maintainer in the 'Select a role' menu.
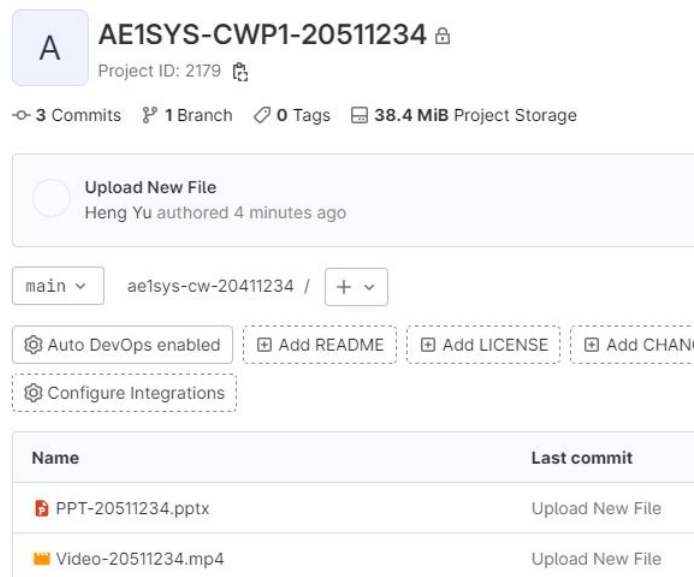

Figure 1: Demonstration of Q2 submission in csproject.

After you upload the video and PPT to csproject, remember to open the Moodle, and submit the `COMP1047CWP1-'YourName'-'YourID'-Q2.txt` file, as described in Section 2 ('Deliverables') of this specification.

Evaluation

Basic marking criteria are `correctness`, `abundance`, and `depth`. For detailed rubrics, an example indicator is provided in the table below, to give you an direct impression on how much effort should be corresponding to which level of grades.

Level	Example indicator
Fail	Nothing presented.
Poor	Provided the names only.
OK	Provided the names, with one or two sentences of description.
Good	In addition to OK level, provided extended elaboration trying to help the evaluator understand what is talked about.
Excellent	The information conveyed is correct and abundant. For sub-task 2, in-depth discussion and/or analysis is provided. High quality PPT. High quality usage of citations.

Besides the above, each item below will incur a penalty of -1 mark:

a. Video length is less than 4 minutes or more than 6 minutes.

b. Not showing your face when talking in the presentation video.

c. Using synthesized or generated voice during your presentation.

d. Not adding Dr. Heng as the maintainer to access your project.

e. Wrong project name, or file names uploaded, especially not showing your student ID.

f. Not uploaded a `COMP1047CWP1-'YourName'-'YourID'-Q2.txt` file into Moodle.

g. Any other factors that obviously lower down the submission quality, or make your project inaccessible.

Good luck! Enjoy MIPS Programming and Computer Architecting. Remember to submit your coursework on time.

APPENDIX 1: Marking Rubrics for Question 1

	Weight (100)	Zero (0%)	Poor (20%)	Pass (40%)	Good (60%)	Excellent (80%)	Outstanding (100%)
Basic Function	40	No answer or all normal test cases failed	There is answer, but errors in normal test cases	There is answer, no error in normal test cases, errors in abnormal test cases	There is answer, no error in normal test cases, no error in abnormal test cases, errors in QtSpim software execution	There is answer, no error in normal test cases, no error in abnormal test cases, no QtSpim software errors	Excellent level + special considerations in data/control hazards (Encourage self-explorations)
Prompt	20	No prompt	Basic prompt to allow user's input	Advanced prompt to guide user's input to ensure normal input cases	Advanced prompt to guide user's input to ensure normal input cases and abnormal input cases	Advanced prompt to guide user's input and warn consequences of abnormal input. Present informative message to let user know of abnormal results	Advanced prompt to guide user's input and warn consequences of abnormal input. Present informative message to let user know of abnormal results. Ensure service availability
Documentation	20	No comment. Very poor coding style	Few comments. Poor coding style	Insufficient comments. Good coding style	Comments on key instructions. Good coding style	Clear comments to explain the logic flow. Good coding style	Professional comments explaining program information, input/output, design considerations, etc. Good coding style
Input Test	20	No input test	Evidence of attempted input test, but failed	Attempted input test, only ensuring normal input	Identify one type of abnormal input, reply with corresponding prompt	Identify and handle two types of abnormal input, reply with corresponding prompt	Identify and handle more than two types of abnormal input. Reply with excellent prompt for user's next input. Exhibit intelligence