

**THE PAPUA NEW GUINEA
UNIVERSITY OF TECHNOLOGY**

**DEPARTMENT OF MATHEMATICS AND COMPUTER SCIENCE
FIRST SEMESTER EXAMINATIONS 2023**

BACHELOR OF SCIENCE IN COMPUTER SCIENCE – SECOND YEAR

CS213 - Introduction to Computer Science

TIME ALLOWED – 2 HOURS

INFORMATION FOR CANDIDATES:

1. Write your name, student number, and program of study clearly on the front page of your answer booklet. Do it **now**.
2. You have 10 minutes to read this examination paper. During this time you must **NOT** write **inside** your answer booklet. You can make notes on the examination paper.
3. A scientific calculator is permitted, though **you do not have to use one**. Other electronic devices are not permitted. Notes and headphones are not permitted.
4. At the conclusion of the examination you must **immediately** put your pens down. You are **NOT** permitted to write inside your answer booklet after the "end of examination" announcement.
5. You can answer the questions in any order. Start each question on a new page. After you have finished the exam, indicate the order in which you answered questions in the left column of the marks box on the cover of the answer booklet.

MARKING SCHEME:

Questions 1 to 4 are worth 15 marks each. Question 5 is worth 25 marks.
You must answer questions 1 to 4, and 5 parts of question 5.

QUESTION 1 (4 + 3 + 5 + 3 = 15 marks)

(a) Below is a “reverse Polish” (RP) stack (drawn horizontally), which produces a single number.

5 4 × 3 2 + ÷ 2 + 3 ^

[For numbers x and y , and a binary operator B ,
“ $x y B$ ” in RP notation is “ $x B y$ ” in algebraic notation.]

- (i) What is the number produced by this stack? (show the working that gives the answer).
- (ii) If this arithmetic expression was written in algebraic notation, what would the expression be?
- (iii) Write down an algorithm (as an English description, or pseudo code) that could be used to **evaluate** this stack.
[To mark this question I will apply your algorithm on a different RP test stack – so make sure it is “understandable”.]
- (iv) What is the purpose of the “shunting yard” algorithm?

QUESTION 2 (3 + 4 + 5 + 1 + 1 + 1 = 15 marks)

On the last page of this test paper is a copy of the theoretical processor that we looked at in class.
[Remember that on a 64-bit machine there would be 64 of these flat diagrams in parallel.]

As a hint: Opening AND gate 5 in the diagram places a ‘000...0001’ on bus 2.

In this question the **number in a register set** will be indicated by the name of the register.

- (a) What would you find in a single register box in the processor diagram? Explain.
[Answer carefully, using the information in square brackets above.]
- (b) Suppose the number in register set A is 53 (ie, $A=53$). How could you get 54 into register B? [Your answer will be about opening/closing AND gates, and using busses, adders, etc.]
- (c) Starting with the 53 in register A, how could the 53 be reduced to 51 (as a new value in A)?
[Again your answer will be about opening and closing AND gates, busses, adders, etc.]
- (d) In a high level language what one line instruction would do what (c) does?
- (e) In an assembly language what one line instruction would do what (c) does (using a pseudo notation that the marker can understand)?
- (f) Historically, what is the usual term we use to refer to register A?

QUESTION 3 (7 + 2 + 2 + 4 = 15 marks)

(a) An example permission list in a Unix directory might be:

`- r w x r - - r - -`

The first character indicates the type of file.

The remaining characters occur in groups of three and apply to different users.

- (i) The three types of users are often denoted by U, G and O. Who are these users?
- (ii) According to this permission list, what permissions does each user have?
- (iii) If the first list item was 'd' and not '-', how would you interpret the 'd'?

(b) An absolute home directory name of a user on a Windows workstation could be:

`C:\Users\bjones`

What would be the equivalent absolute directory name of the same user's home directory on a Macintosh or Unix host? [To get full marks here you should supply some extra information about the two file systems.]

(c) In class we wrote some regular and assembly language programs in C on a Unix host.

- (i) What is the name of the usual C compiler in Unix (to which we added "-S" to generate the assembly code).
- (ii) On Windows a standard executable is indicated by the suffix ".exe". What is the equivalent way that a C executable is indicated by Unix? [There are two possible answers – either will be accepted.]
- (iii) Here is a snippet of Unix assembly code. Some simplifications have been introduced – so A = the A register, M1 and M2 are two locations in main memory, and the "\$" has been removed from in front of constants:

```
        movl  0, M1
        movl  1, M2
        jmp   L2
L3:
        movl  M2, A
        addl  A, M1
        addl  1, M2          *****
L2:
        cmpl  10, M2
        jle  .L3
```

- (a) What is the code doing, including what will be stored in M2 when it ends.
- (b) What would be the effect of removing instruction labelled *****?

QUESTION 4 (2 + 10 + 3 = 15 marks)

- (a) If you look at the Search/Replace panels in word processors or good editors (like Notepad++) you will see an option about using “Regular Expressions”. When might you use a regular expression in a search?
- (b) Four of the special characters in regular expressions are “^” and “\$” (used for the start and end of a text line respectively) and “.” and “+” (used for any single character and one or more of the preceding character(s) respectively).

In the following, do the RegEx expressions on the left match the **single line** of text on the right? Explain, indicating which “e’s” provide the match.

- | | | | |
|-------|--------------------------|----------|------------------|
| (i) | <code>^e.+e\$</code> | matches? | everyone is here |
| (ii) | <code>^e.+e.+\$</code> | matches? | no one is about |
| (iii) | <code>^.+e.+e.+\$</code> | matches? | no one can hear |

In the remaining three searches the words are buried in text. Does the RegEx on the left match the word on the right? [Both the regex’s and words start and end with a space.] Explain

- | | | | |
|------|-----------------------|----------|--------|
| (iv) | <code>.[qjz].+</code> | matches? | plaque |
| (iv) | <code>.[qjz].+</code> | matches? | zoo |

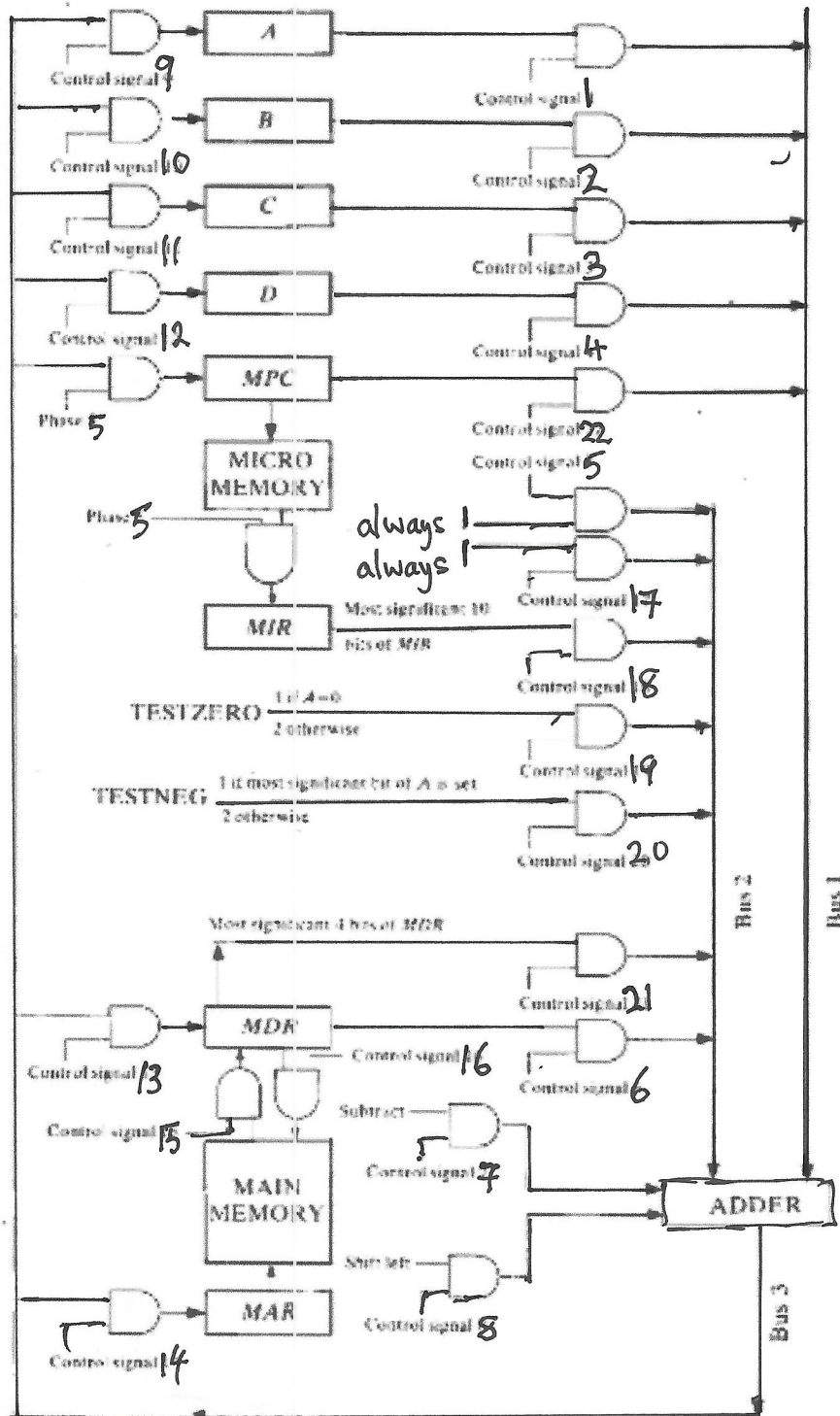
- (c) What is the difference between `\n` and `\r\n` in relation to a Windows and Mac/Unix text document?

QUESTION 5 (5 + 5 + 5 + 5 + 5 = 25 marks)

During the semester we had 29 seminars. The first question is drawn from several seminars, so anyone can answer this. If your name appears at the start of another question the seminar was yours, and you are not permitted to answer the question. I would expect each answer to be perhaps 6 or 8 lines long (more if you decide to use an example or examples).

There are 8 questions below, you have to answer 5 only.

- (a) We looked at three types of generic compression – lossless, lossy, and digest generation.
 - (i) What is the practical difference between the three compression techniques?
 - (ii) If a large source is compressed, it is likely a lossless compression would be larger than a lossy compression, which in turn would be larger than a digest compression. Why?
- (b) [Bagah, Pinia] We looked at three types of random number generators – uniform random, uniform pseudo random, and normal pseudo random. Write some notes on the **difference** between the three.
- (c) [Densen] Some programming languages essentially have a GUI built in. Other have no GUI. For a third set a GUI can be added on as an appendix to the non-GUI code.
 - (i) What is a GUI application?
 - (ii) Write down three programming languages – one which is of each type.
- (d) [Attmankia] What is the difference between a relational database, a XML database and a JSON database?
- (e) [Mulaga] Good program design and coding has many features. Two (for coding) are the use of drivers and stubs. Explain these, plus one other feature that a well designed or coded program should possess.
- (f) [Paka] One application of VPN is to connect to a network while hiding your actual location. More often it is used by organisations for off-site network logins.
 - (i) What does VPN stand for?
 - (ii) Explain how VPN is used in this second mentioned application.
- (g) [Sunu] We have looked at three types of modern hard drive, SATA, SSD and SCSI. Compare the three systems against parameters like capacity, access speed and connectivity.
- (h) [Kopril] Explain the fundamentals of a public key encryption system.



----- END OF EXAMINATION -----