
SUBJECT:	COMPUTING
PAPER NUMBER:	I
DATE:	19 th May 2015
TIME:	4.00 p.m. to 7.00 p.m.

Directions to Candidates

- Answer **ALL** questions.
 - Good **English** and orderly **presentation** are important.
 - All answers are to be written on the **booklet** provided.
 - The use of **flowchart templates** is permitted but **calculators** may **NOT** be used.
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Section A

1. Consider the following class

```
public class Dog {
    private String name;

    public Dog(String n) { setName(n); }
    public String getName() { return (name); }
    public void setName(String s) { name = s; }
}
```

- a. What will the following code display?

```
public class Main {
    public static void main(String[] args) {
        Dog aDog = new Dog("Rover");

        changeDog(aDog);

        if (aDog.getName().equals("Rover")) {
            System.out.println("It's Rover");
        } else {
            System.out.println("It's NOT Rover!");
        }
    }

    private static void changeDog(Dog d) {
        d.setName("Fifi");
    }
}
```

[2 marks]

- b. How might one modify the above code such that it behaves as expected? [3 Marks]

2. Identify **FIVE** differences between the *objected-oriented* and *imperative* programming paradigms.

[5 marks]

Section B.

3. An eight-bit register contains the hexadecimal value 0F.
- Write down the decimal representation of the value. [1 mark]
 - Write down the binary representation of the value, and shift the number by three binary digits to the left. [1 mark]
 - Write down the decimal representation of the shifted value. [1 mark]
 - Deduce the arithmetic operation obtained by the shift. [2 marks]

4. Using Boolean algebra, show that:

$$\overline{A}\overline{B}\overline{C} + \overline{A}BC + AB + AC + \overline{B}C = A + C$$

[5 marks]

5. A memory component has a capacity of 256 kilobytes.
- If the data bus is eight bits wide (one byte), what is the size of the address bus required for the component? [3 marks]
 - If the size of the data bus is increased to 16 bits (two bytes), what is the new size of the address bus required? [2 marks]
6. Describe the use of the stack and the stack pointer when:
- a function is called using the CALL assembly instruction; [3 marks]
 - the RET assembly instruction is used to return from a function. [2 marks]
7. For the assembly program snippet below, assume that a call to the subroutine at FN takes 10 instructions including the CALL instruction. Calculate the total number of instructions for the whole snippet.

```

                MOV  CX, 3           ; set CX equal to 3
LOOP:          CALL FN             ; call the subroutine FN
                DEC  CX             ; decrement CX
                JNZ  LOOP           ; if CX is not 0, jump to LOOP

```

[5 marks]

8. For each of the following, identify and mention **ONE** instance where you would use:
- an assembler;
 - a translator;
 - a compiler;
 - an interpreter;
 - a cross-compiler. [5 marks]
9. A popular data structure for many applications is a *binary tree*.
- Explain what is a binary tree. [2 marks]
 - Assume we are using a binary tree data structure. Draw what such a tree would look like after inserting 5, 7, 2, 3, 22, 12 and 0 into the tree. [3 marks]
10. What is the difference between *terminal* and *non-terminal* symbols in a formal language? [5marks]

11. a. Mention any **TWO** stages from the compilation process. [2marks]
 b. Describe in some detail **ONE** of the stages mentioned in a) above. [3marks]
12. a. Explain what is meant by system software. [2 marks]
 b. Identify and briefly highlight the main characteristics of **ONE** software development life cycle. [3 marks]
13. a. In which stage is algorithm representation used during the Systems Development Life cycle? [1 mark]
 b. Briefly explain the following two algorithm representation forms:
 i. Jackson Structured Programming (JSP); [2 marks]
 ii. Flowcharts. [2 marks]
14. It is widely known that using a relational database has many inherent advantages over using a flat file system. Name **FIVE** such advantages. [5 marks]
15. Consider the following database table called 'employees'.
Note the date format is 'YYYY-MM-DD'.

employee_id	first_name	last_name	date_joined	salary
1	Donald	Trump	2014-10-15	10000.00
2	Will	Smith	2010-01-29	7500.00
3	Lionel	Messi	2011-10-14	50000.00
4	Alan	Azzopardi	2005-01-05	25000.00
5	Wendy	Bertuzzi	2009-05-12	15000.00
6	Fred	Borg	2011-01-21	8500.00
7	Sharon	Falzon	2008-08-23	5000.00
8	Helen	Beresford	2013-06-12	83000.00

Write down the result (in a table format) returned by the following SQL queries:

- a.

```
SELECT first_name, last_name
FROM employees
WHERE salary > 10000 AND salary < 40000
      AND date_joined >= '2009-05-01'
```

[3 marks]
- b.

```
SELECT employee_id, first_name, salary
FROM employee
WHERE salary >
      (SELECT salary FROM employee WHERE employee_id = 1)
ORDER BY first_name
```

[2 marks]
16. a. Name **FOUR** types of operating systems. [4 marks]
 b. Explain the function of **ONE** operating system mentioned in part a) above. [1 mark]
17. a. Explain why the operating system manages processes. [2 marks]
 b. Identify and explain **THREE** states of a process. [3 marks]

18. a. Contiguous memory partitioning is a technique employed by the operating system to do what? Explain. [2 marks]
- b. Name **THREE** other ways employed by operating systems to do the same job. [3 marks]
19. a. What is an IP address used for? [2 marks]
- b. Name **THREE** Internet applications. [3 marks]
20. a. Data could get corrupted when travelling over a network. What kind of error is this? [2 marks]
- b. Name **THREE** different methods to overcome such errors. [3 marks]

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UNIVERSITY OF MALTA, MSIDA
MATRICULATION EXAMINATION
ADVANCED LEVEL
MAY 2015

SUBJECT: COMPUTING
PAPER NUMBER: II
DATE: 20th May 2015
TIME: 4.00 p.m. to 7.00 p.m.

Directions to Candidates

- Answer any **FIVE** questions.
- Good **English** and orderly **presentation** are important.
- All answers are to be written on the **booklet** provided.
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1. a. Data transfer can be controlled using software polling or interrupts. Describe the difference between the two methods, giving one advantage of each. [4 marks]
- b. Write down two advantages of Dynamic RAM (DRAM) over Static RAM (SRAM), and two advantages of SRAM over DRAM. [4 marks]
- c. The following is an assembly program.

```

                JMP  MAIN          ; jump to label MAIN
FN:            MOV  CX, AX         ; set CX equal to AX
                MOV  DX, AX         ; set DX equal to AX
                MOV  AX, 0          ; set AX equal to 0
L1:            CMP  CX, 0          ; compare CX with 0
                JE   L2            ; jump if CX is equal to 0
                ADD  AX, DX         ; add DX to AX
                DEC  CX            ; decrement CX
                JMP  L1            ; jump to label L1
L2:            RET                ; return

MAIN:         MOV  AX, 3           ; set AX equal to 3
                CALL FN           ; call subroutine at label FN
                PUSH AX           ; push AX onto the stack
                MOV  AX, 2         ; set AX equal to 2
                CALL FN           ; call subroutine at label FN
                POP  DX           ; pop the stack onto DX
                ADD  AX, DX        ; add DX to AX

```

- i. Determine the number of instructions executed, and the final value inside register AX. [10 marks]
- ii. Deduce the arithmetic operation performed by the function FN in the assembly program snippet. [2 marks]

2. Two unsigned integers A and B are represented using two bits each.
 - a. What is the range of possible values for an unsigned number using two bits? [2 marks]
 - b. A comparator is used to compare the numbers A and B . The output F is false when $A < B$, and true when $A \geq B$. Draw a truth table for this function. The inputs should be A_1, A_0, B_1 and B_0 . [4 marks]
 - c. Draw a Karnaugh map for the truth table, and hence obtain an optimized expression for F in terms of A_1, A_0, B_1 and B_0 . [8 marks]
 - d. Using only NAND gates and NOT gates, draw a diagram of a logic circuit to implement the optimized expression for F . [6 marks]

3. An operating system has the function to handle I/O operations.
 - a. Describe **TWO** ways how the operating system communicates with I/O devices? [10 marks]
 - b. Explain how device handshaking is possible through polling. [10 marks]

4.
 - a. What are Media Access Methods used for? [4 marks]
 - b. What does CSMA/CD stand for? [3 marks]
 - c. Explain in detail each of CS, MA and CD. [9 marks]
 - d. Explain in detail how CSMA/CD works. [4 marks]

5.
 - a. What is an Integrated Development Environment (IDE) and how does it fit in the compilation process? [2 marks]
 - b. Identify and expand all the stages within the compilation process. Clearly point out what files are being handled, processed and created, together with types of errors that are handled. [12 marks]
 - c. Write short notes on each to clearly distinguish between *assemblers*, *compilers* and *interpreters* in view of the answer given in part 5(b) above. [6 marks]

6.
 - a.
 - i. Why does a good system analysis effort lead to better system development? Clearly explain your answer. [2 marks]
 - ii. Given the choice, where should one exercise creativity, in analysing the system or in implementing it? Clearly explain your answer. [3 marks]
 - iii. What are the components of a software development life-cycle called? [1 mark]
 - iv. Briefly explain the development activities that happen within the System design and Coding & Testing components of the SDLC. [4 marks]
 - v. Describe *and* differentiate between **top-down** and **bottom-up** approaches. [2 marks]
 - vi. Mention **ONE** respective **top-down** and **bottom-up** advantage. [2 marks]
 - b. Through the following questions explain why **system modularisation** is more than simply dividing the system up into “pieces”.
 - i. What are the qualities of a good module? [2 marks]
 - ii. How would modularisation affect system maintenance? [2 marks]
 - iii. Give **ONE** practical example of how good modularisation would affect system maintenance. [2 marks]

7. Consider the following array of values:

54	8	23	22	7	16	12
----	---	----	----	---	----	----

- a. Suppose the values are sorted in a list in ascending order using the **bubble sort** algorithm. Assume that the implementation of bubble sort sorts the largest unsorted value with each pass. Show the state of the list after the 2nd and 4th pass of the algorithm. [8 marks]
- b. With regard to the same sorting algorithm (bubble sort) consider the following list of numbers:

4	3	2	1
---	---	---	---

- i. How many compares are required to sort this list?
 - ii. How many swaps are required to sort this list?
 - iii. What would the list of numbers to be sorted have to look like in the best case (minimal) of (ii) above? [6 marks]
- c. Consider a special kind of data structure called a *self-sorting list*. This list sorts itself over time. Every time a search is carried a linear search algorithm is employed. If a matching item is found, it is then placed at the *front* of the list. Over time the most commonly accessed items will be near the front of the list.
 - i. Under what conditions is it possible that this approach may be more efficient than a sorted list employing a binary search algorithm? [2 marks]
- d. The quicksort algorithm has a time complexity of $O(n \log_2(n))$. For a given problem set, assume the quicksort algorithm takes 4 minutes to sort a given list. Approximately how long will it take the algorithm to solve a problem that is two times as large on the same computer? [4 marks]

8. A local hospital clinic has set up a database for the nursing staff. This database keeps track of the personal details of staff. The database looks as follows with its one table titled “nurse_staff”:

ID	Name	Address	Type
4	Wendy Smolenski	1 Tourist Street, Qawra	AMBULATORY
5	John Bezzina	23 Market Street, Mqabba	AMBULATORY
1	Bob Borg	13 Main Street, Valetta	CARDIAC
6	Stephanie Azzopardi	2 High Street, Qrendi	CARDIAC
2	Brenda Camilleri	123 Old Road, Balzan	GERIATRIC
2	Brenda Camilleri	123 Old Road, Balzan	PEDIATRIC

The staff has been having various problems with the database (updating someone’s address or updating the nursing “type” [skillset] of a nurse).

- a. What are your initial observations about this employee table? What issues are there? [6 marks]
- b. Create a new schema for the table(s) required to solve the problems identified above. [14 marks]