

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD
UNIVERSITY OF MALTA, MSIDA
MATRICULATION EXAMINATION
ADVANCED LEVEL
MAY 2013

SUBJECT:	COMPUTING
PAPER NUMBER:	I
DATE:	29 th May 2013
TIME:	9.00 a.m. to 12.00 noon

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.
-

Section A

Consider carefully the following **two** classes and **answer** the related questions 1) and 2) below.

```
public abstract class SuperClass {  
  
    public SuperClass () {  
        System.out.println("SuperClass: Constructor");  
    }  
    public void methodX() {  
        System.out.println("SuperClass: methodX");  
    }  
}
```

```
public class SubClass extends SuperClass{  
  
    public SubClass(int num) {  
        super();  
        System.out.println ("SubClass: Constructor");  
    }  
  
    public void methodA(int num) {  
        System.out.println("SubClass: methodA "+ num);  
    }  
}
```

1. When the code below is executed, what will be the **output**, if any? **Explain** your answer.

```
public static void main(String[] args) {
    SubClass sub = new SubClass(3);
    sub.methodA(4);
    sub.methodX();
}
```

[5]

2. **Explain** why the code below will not execute. **Modify** it so that it will execute and display the output.

```
public static void main(String[] args) {
    SuperClass superclass = new SubClass(3);
    SubClass sub2 = superclass;
}
```

[5]

Section B

3. Table 1 below shows a small part of main memory with four memory addresses and the data contents at each address. The memory is **8-bits** wide.

Address	Data
401	54
402	42
403	43
404	56

Table 1: Main memory with memory address and data contents

What are the **contents** of the four memory addresses after the **execution** of the following **four** instructions?

- MOV R1, 02 ; put 02 in R1
- MOV R2, 401 ; put 401 in R2
- ADD R2, R1 ; Add R1 to R2 result in R2
- MOV (R2), R1 ; put R1 to memory, using R2 as a
; register indirect memory address

[5]

4. Use the big-“O” notation to **compare** the **worse** and **best** performance of the **bubble sort** algorithm with that of the **quicksort**. In your answer state when these occur. [5]

5. Briefly **explain** the following terms:
 - a) DBMS; [2]
 - b) Entity integrity constraint; [2]
 - c) Candidate key. [1]

6.
 - a) Mention **THREE** ways to logically organise the contents of a file. [3]
 - b) Explain **ONE** of the organisation systems you mentioned. [2]

7. What is meant by the term **multiplexing** in data communications? Briefly **describe** how multiplexing works in **TCP/IP**. [5]

8.
 - a) What is the **main purpose** of a **translator** in computer programming languages? [2]
 - b) Describe briefly how **three** of the most common types of **translators** are used. [3]

9. An **unsigned** binary system uses **six bits** for the **integer part** and **2 bits** for the **fractional part**. Work out the representation, in this system for the numbers:
 - a) 31.75; [2]
 - b) 20. [3]

10. Mention **FIVE** Internet-related **protocols**, outlining their **usage**. [5]

11. What is the main purpose of a **dictionary** during the **compilation process**? Explain. [5]

12. The **relation Articles** below contains information about articles published in scientific journals.

ID	title	journal	issue	year	startpage	endpage	report-ID
42	Pop planning algorithm	JAlg	51	1993	121	133	87
33	Dynamic algorithms	JAlg	41	2001	69	85	62
33	Dynamic algorithms	JAlg	41	2001	69	85	56
39	Dictionaries in less space	SICOMP	31	2001	111	133	47
57	P vs. NP problems	ACM	51	2008	1	3	99
77	What Gödel missed	SICOMP	51	2008	1	5	98
78	What Gödel missed	Nature	2222	2008	22	22	98

Indicate whether the following SQL statements are **valid** or **not**. If valid **display the result** of the queries in tabular form:

- a) SELECT * FROM Articles WHERE endpage – startpage > 10
- b) SELECT SUM(title) FROM Articles
- c) SELECT COUNT(DISTINCT journal) As “Journals” FROM Articles GROUP BY journal [5]

13. Table 2 below shows the **output** of a logic function. **Deduce** the output, **F** in terms of the inputs **A, B** and **C**.

A	B	C	F
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

Table 2

[5]

- 14. a) **Define** the **FOUR** types of **maintenance** that a system can undergo. [4]
- b) Why is the **Waterfall** development model defined as **rigid**? [1]

15. If a CPU has **FIVE** peripherals that can raise an interrupt and it uses **software polling** to identify the source of an interrupt, explain how the CPU decides which **ONE** of the **FIVE** peripherals raised the interrupt. [5]
16. **Explain** what is meant by the term **social networking sites** and give **TWO** examples. [5]
17. a) **State ONE** reason why formal languages are more suited for programming than natural languages. [1]
b) Why is it **difficult** for a **translator** program to translate a **metaphor** from one natural language to another? Briefly **explain**. [2]
c) **Explain** why **translators** are suitable for **formal languages**. [2]
18. **Define** the use of the following **special registers** in the CPU
a) Memory Address Register (MAR); [2]
b) Program Counter (PC). [3]
19. **Write** a short paragraph on **ONE** of the **earlier stages** of the software development life cycle. [5]
20. a) What is an **index register** in a CPU? [2]
b) Give **ONE** application where an **index register** is used in programming. [3]
-

MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD
UNIVERSITY OF MALTA, MSIDA
MATRICULATION EXAMINATION
ADVANCED LEVEL
MAY 2013

SUBJECT:	COMPUTING
PAPER NUMBER:	II
DATE:	30 th May 2013
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.
 - The use of **flowchart templates** is permitted but **calculators** may **NOT** be used.
-

1. a. **Four** logic inputs to a system are used to obtain a logic output '1', whenever an **even** number of inputs are at logic '1'.
- i. Build a **truth table** with **four inputs**, named A, B, C, D, and an **output** named F. Show clearly the output F for each of the sixteen minterms. [8]
 - ii. Hence draw a **Karnaugh map**, showing clearly the logic value in each cell. *Do not minimise the Karnaugh map.* [6]

- b. i. **Minimise**, using Boolean logic identities, the Boolean equation:

$$X = (A.B.C) . (A + B + C) \quad [3]$$

- ii. **Implement** using **ONLY 2** – input logic gates. [3]

2. a. The following instructions are used in assembly language programming

CALL ; call a subroutine

PUSH ; push on the stack

POP ; pop from the stack

RET ; return from subroutine

Identify which of these, if any,

- i. can be used **ONLY** in a main program. [2]
- ii. can be used **ONLY** in a subroutine; [2]
- iii. can be used in **both a main** program and in a **subroutine** [2]

- b. Do user programs in **main memory** occupy the area where the **stack memory** is? Give **reasons** for your answer. [4]
- c. The **editor, assembler, linker and loader** are all software program utilities used in the development of computer programs. **Describe** how the **four** programmes are related to each other starting from when the program is being developed to arriving at an executable program. [6]
- d. **Distinguish** between the **current instruction register, (CIR)**, and the **memory buffer register, (MBR)**, as used in a processor. [4]
3. **Explain** the characteristics, benefits, limitations and application of the following network topologies:
- a. Bus; [5]
- b. Ring; [5]
- c. Star; [5]
- d. Mesh. [5]
4. In relation to an **operating system, describe** in detail:
- a. The **three states** of a **process**. [9]
- b. What is meant by **deadlock**? [6]
- c. How can **deadlock** be **minimised**? [5]
5. a. Formal languages are much easier to translate than Natural languages. **Distinguish** between the following **three** translator types: **assembler, compiler and interpreter**. [6]
- b. **Identify and expand** all the stages within the **compilation process**. In your explanation, clearly point out the different stages, what files are being handled (if any), processed and created, and any types of errors that may be encountered. [12]
- c. What is an **Integrated Development Environment (IDE)** and how does this fit in the **compilation process**? [2]
6. a. One of the tools used during the system analysis or requirement analysis stage is the **Data Flow Diagram**. Using a short sentence, state why this tool is used during the mentioned stages? [2]
- b. Gamer's Haven is a shop that caters for all types of video games for consoles and PC's. The owner decides to go online by commissioning a developer to build the web site. Before creating the website, the software developer needs a plan on how the information will flow through the different functionality of the site. The following is a general overview of the information flow for the e-commerce part of the web site.

Scenario:

A gamer places an on-line order for a game; the gamer’s details are checked against the customer file to check whether the customer already has an account. If not, the client is directed to a membership form and asked to register. If the gamer has an account, the order details are checked with the item file to check the price of each item and to produce a final bill. The cost of the game is sent to the credit card company, which sends the payment. The order is then sent to the warehouse, which sends the game-DVD to the gamer.

For the scenario above and **using** any **DFD** notation you are familiar with, **draw**:

- i. the **context level** (DFD Level 0); [6]
- ii. the **Level 1** DFD. [12]

7. In a terminal, containers are organised in such a way that makes their transfer onto berthed ships as efficient as possible. The general layout involves a number of closely-positioned container piles, with each pile, uniquely numbered and contains a maximum of 5 and a minimum of 1, containers, as shown in the Figure 1 below.

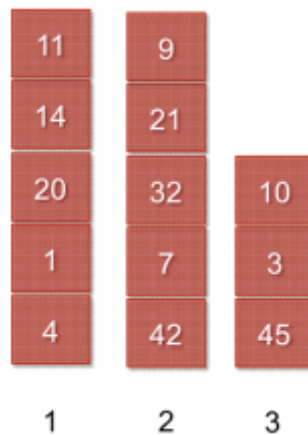


Figure 1: Container Layout

In a simulation software program, a **linked list** and a **stack** data structures are used to keep track of the number of uniquely identified, piles and containers within each pile.

- a. **Describe**, using **pseudocode**, the stack’s **push** and **pop** algorithms. [4]
- b. Use **pseudocode** to **describe** an algorithm called **layoutContainers** that allows *n* containers to be laid out according to the scheme described above. Any assumptions made must be justified. [6]
- c. A ship has berthed and the *n* containers laid out in part (b) above will need to be transferred onto this ship. Use pseudocode to **describe** an algorithm called **loadShips** that allows these containers to be **transferred** onto the ship. Any assumptions made must be justified. [4]

- d. Use pseudocode to **describe** an algorithm called, **searchContainerLocation** that **searches** for the **location** of a particular container within a layout of n containers. The location information must include both the **stack number** and the **location** within the stack: “*location: stack 3 position 2*”. Any assumptions made must be justified. [6]
- 8. a. The **Database Administrator** (DBA) has an important role to play in the correct functioning of a Database Management System (DBMS). Briefly elaborate on **four tasks** that fall under his responsibility. [4]
- b. You have been asked to **design** a database for your school’s football teams, with the following constraints:

Each team has a unique team ID and a team name. Each team player has a unique player number, a name, and belongs to exactly one team. It is impossible for a player not to belong to a team. The player number is unique within a team, but is not unique across teams. In other words, it is not possible for example, that two players on the same team both have the number 10. However, it is possible that two players on two different teams both have the same number.

Teams play with each other in games and each game consists of exactly two teams. Each game has a unique game ID and a date. Players play in games, and over a number of games, a player might play in one, many or no games. Each game will have several players playing.

- i. **Draw** a detailed **ER diagram** for this database. Use the Crow’s Foot notation to clearly show the **degree** of the relationships that exist between the proposed entities. [8]
- ii. **Translate** the ER diagram from i.) above into a **relational schema** using a **short notation**, as shown below, clearly specifying the **key** for each relation:

ENTITY (attrb1, attrb2,....attrbN) [8]