MATRICULATION AND SECONDARY EDUCATION CERTIFICATE EXAMINATIONS BOARD

UNIVERSITY OF MALTA, MSIDA

MATRICULATION EXAMINATION
ADVANCED LEVEL
SEPTEMBER 2013

SUBJECT:	COMPUTING
PAPER NUMBER:	I
DATE:	3rd September 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) in this section.

```
public abstract class SuperClass{

     public void methodA() {
        System.out.println("SuperClass: methodA");
     }

     public void methodB(int num) {
        System.out.println("SuperClass: methodB "+ num);
     }
}

public class SubClass extends SuperClass {

     public void methodA() {
       System.out.println("SubClass: methodA”);
     }

     public void methodB(int num) {
        System.out.println("SubClass: methodB "+ ++num);
     }
}
```

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

```
public static void main(String[] args) {
     SuperClass sup = new SubClass();
     sup.methodA();
     sup.methodB(4);
}
```
[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 sup = new SuperClass();
     sup.methodA();
}
```
[5]

Section B

3. Give the **decimal** equivalent for the following **unsigned** binary numbers:

   i. 1011.01 [2]

   ii. 11111.11 [3]

4. **Sketch**, using appropriate **logic gates**, the function:

$$F = A.B + B.C$$ [5]

5. A list of **ten** numbers are to be **added** using an Arithmetic Logic Unit (ALU) inside the CPU. How many ALU **additions** are needed to perform the operation? Choose **ONE** answer from (a), (b) and (c) below and give a **reason** for your choice.

   a. one addition **OR**

   b. eleven additions **OR**

   c. nine additions [5]

6. **Minimise** the following Boolean logic function

$$X = \overline{A \,.\, (B + C)} \qquad [5]$$

7. Which of the following **memory types** does not retain the memory when the power supply is switched off?

   a. flash memory;

   b. random access memory RAM;

   c. programmable read only memory , PROM . [5]

8. What do ADSL, ISDN, FTP, IMAP, POP3 stand for? [5]

9. What is the **difference** between a "**logical address space**" and "**physical address space**"? [5]

10. **Explain** what is meant by the term **cyber crime** and give **TWO** examples of cyber crime. [5]

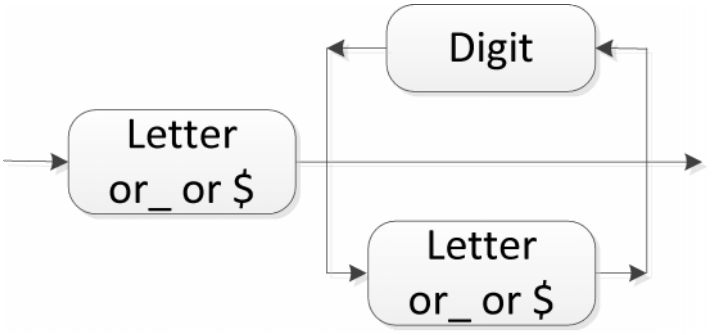
11. **Explain** the difference between an **interrupt** and **polling**. [5]

12. a. What does **TCP/IP** stand for? [2]

    b. Name **THREE** main functions TCP/IP performs. [3]

13. a. **Explain** briefly the **lexical** and **syntax** analysis phases of the **compilation process**. [4]

    b. **Explain** briefly what the **syntax diagram** below shows. [1]



14. Briefly **explain** the following **language-processing** terms:

    a. a dictionary;

    b. syntactically correct;

    c. semantically correct;

    d. meta symbols;

    e. terminal symbols. [5]

15. Mention **two** types of **documents**, used and produced during the **design** stage of the systems development life cycle and briefly **elaborate** on **one** of them. [5]

16. a. Give a **definition** for **modularity**. [2]

    b. Modularity is to be encouraged during the design phase of a system. Give **three advantages** of **modularity** over **monolithic programming**. [3]

17. Jackson Structured Programming (JSP) is a method for **software design**. Use **suitable diagrams**, to show how the following **three** constructs are **implemented** using the JSP diagramming notation.

    a. Sequence; [1]

    b. Selection; [2]

    c. Iteration. [2]

18. a. **Explain** what is meant by the **signature of a method**. [2]

    b. Use an **example** to explain the term **method overloading**. [3]

19. A database management system relies on **three-schemas**.

    a. Which are these **three schemas**? [3]

    b. Briefly describe **one** of them. [2]

20. **Security** is an important feature to consider when maintaining a relational database. **Elaborate** on this statement. [5]

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UNIVERSITY OF MALTA, MSIDA

MATRICULATION EXAMINATION
ADVANCED LEVEL
SEPTEMBER 2013

SUBJECT:	COMPUTING
PAPER NUMBER:	II
DATE:	4th September 2013
TIME:	9.00 a.m. to 12.00 noon

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. The following is an assembly language program. All numbers are in hexadecimal notation.

```
        MOV     R1, 40      ; put 40H in R1
        MOV     R2, 1A      ;put 1AH in R2
LAB1    CALL    SUB1        ;call subroutine
        SHL     R2          ;shift left R2
        DEC     R3          ; decrement R3
        CMP     R1, R2      ; compare contents of R1 and R2
        JNE     LAB1        ; jump if not equal to LAB1
        END                 ;pseudodirective to stop program

SUB1    PUSH    R1          ; push R1 on stack
        MOV     R3, 4F      ; put 4FH in R3
LAB2    DEC     R3          ; decrement R3
        CMP     R1, R3      ; compare contents of R1 and R3
        JLE     LAB2        ; jump if contents of R1 are less or equal to contents
                            ;of R3
        POP     R1          ;pop R1 from stack
        RET                 ;return from subroutine
```

For the assembly language program above:

a. **calculate** the number of instructions executed; [10]

b. is the pseudodirective **END** an executable instruction? Give **reasons** for your answer; [2]

c. can the instructions **PUSH R1** and **POP R1** be removed from the subroutine without altering the program? Give **reasons** for your answer; [4]

d. what are the **contents** of R1 and R3, in hexadecimal, at the end of execution of the program? [4]

2. a. A **computer memory** is 64 Megabytes. The **databus** connecting the memory to the processor is 32 bits wide. If the memory is still **byte addressable**,

i. How many **bits** are necessary for the **address bus**? [2]

ii. How many **bits** are necessary for the **data bus**? [2]

b. A **processor** executes on average one instruction per one microsecond, (μs). A **printer** takes one millisecond, (ms) to print one character, and has a **buffer** that can contain 1024 characters.

i. How many **instructions** can the **processor execute** in the time the printer **prints a buffer**? [4]

ii. **Suggest** a **scheme** that allows the processor to continue working while the printer is printing? [4]

c. In a **vectored interrupt system** do the interrupting sources need to be **daisy-chained**? Give **reasons** for your answer. [4]

d. i. What does the term '**flash memory**' mean? [2]

ii. How does it **differ** from the **main memory** in a computer? [2]

3. **Explain** what is meant by the following **FOUR** terms in relation to **file protection**:

a. File access restrictions [5]

b. File attributes [5]

c. Hardware failure [5]

d. Viruses [5]

4. **Explain** the meaning of the following **FOUR** terms.

   a. Virtual Learning Environment [5]

   b. Blended Learning [5]

   c. Synchronous Learning [5]

   d. Asynchronous Learning [5]

5. a. The compilation process can be split into **three** main stages – **Syntax Analysis**, **Code Generation** and **Lexical Analysis**.

      i. **List** these **three** stages in their correct **order**. [1]

      ii. **Discuss** what the **Syntax Analysis** and the **Lexical Analysis** stages do. [4]

   b. What is the **difference** between a **compiler** and an **interpreter**? [2]

   c. Give **examples** to showcase the **difference** between the **two** translators mentioned in (b) above. [3]

   d. Consider the following BNF rules and answer the questions below.

      <number> := twelve | eleven | ten | today

      <noun> := monkey | monkeys | lab | experiment | rats

      <quark> := the |army | of | the | <number> monkeys

      <q2> := of | on | is

      <gab> := <quark> | <quark> <quark>

      <gib> := the <gab> | a <gab>

      <adjnoun> := <number> <noun> | <noun>

      <article> := the | a

      <sentence> := <article> <noun> <q2> <article> <adjnoun>

      Which of the following are **correct sentences** according to the **BNF grammar** for **<sentence>** and **why**?

      i. the army of the twelve monkeys;

      ii. a army on a monkeys;

iii. the rat escaped out of the lab;

iv. a lab is the ten rats;

v. lab monkeys escaped today. [10]

6. a. **Write** a **definition** for System Development Life Cycle. [1]

b. **Write** short notes on any **THREE** of the phases in the System Development Life Cycle. [6]

c. During the initial phases of the System Development Life Cycle it is critically important to examine the present system to be computerised. **Why** do you think this is **critically important**? [2]

d. Mention **ONE** standard method that may be used during the System Development Life Cycle to describe the **flow** of data within a system. [1]

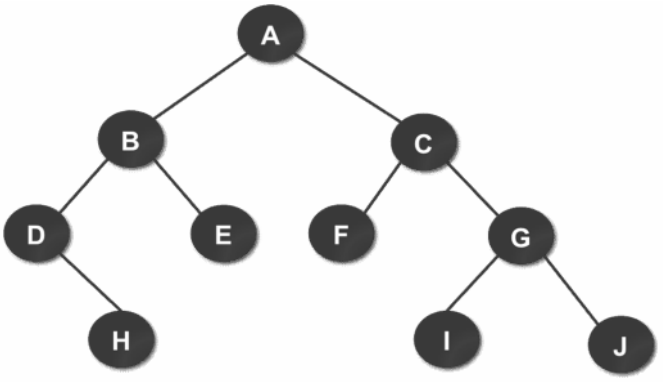
e. Elaborate on **the main** symbols defined by the standard chosen in (d). In your explanation include a **drawing** and **brief description** for each symbol. Support your explanation with a simple, suitable **example** of your choice. [4]

f. **Mention** and **describe** the main features of **TWO** changeover methods. Your answer should include **ONE** advantage of each changeover method. [6]

7. a. **Explain** what a **pointer** is by making reference to its **use** within a **suitable data structure** of your choice. [4]

b. **Explain**, using suitable **examples**, the **difference** between passing parameters by **reference** and by **value**. [4]

c. Traverse the **binary tree** shown in Figure 1 below using **in-order**, **pre-order** and **post-order** traversals and **explain** the output in each case.



[6]

Figure 1: Binary Tree

d. i. Explain why the **binary search** (**not** binary search tree) algorithm, is said to **use** a **divide and conquer technique**. [2]

ii. Use **pseudocode** to **describe** this algorithm. [4]

8. **Consider** the following SQL DDL schema:

```
CREATE TABLE Country (
id INT PRIMARY KEY,
name VARCHAR(50)
);

CREATE TABLE Location (
locId INT,
countryId INT NOT NULL REFERENCES Country(id),
name VARCHAR(50),
population INT,
PRIMARY KEY (locId, countryId)
);

CREATE TABLE Department (
id INT PRIMARY KEY,
name VARCHAR(50),
numberOfEmployees INT,
location INT NOT NULL,
country INT NOT NULL,
manager INT,
FOREIGN KEY (location, country) REFERENCES Location (locId, countryId),
);

CREATE TABLE Employee (
id INT,
name VARCHAR(50),
birthYear INT,
boss INT REFERENCES Employee(id),
worksAt INT NOT NULL REFERENCES Department(id),
PRIMARY KEY (id, worksAt)
);
```

a. **Draw** a detailed **ER diagram** using the Crow's Foot notation, which clearly shows the **degree** of the relationships that exist between the proposed entities. [8]

b. **Explain** why the table **Employee** is not in **3rd** normal form (3NF). [2]

c. **Express** the **Employee** table in **3rd** normal form. [4]

d. Consider the following **queries** related to the DDL schema defined above. **Indicate** whether each of the statements that follow, are **true** or **false**. In each case provide a **brief explanation**.

Q1.
```
SELECT sum(population) FROM Department D, Location L
WHERE D.location = L.locId AND D.country = L.countryId;
```

Q2.
```
SELECT sum(DISTINCT population) FROM Department D, Location L
WHERE D.location = L.locId AND D.country = L.countryId;
```

Q3.
```
SELECT sum(population) FROM Location WHERE (locId,countryId)
IN (SELECT location, country FROM Department);
```

i. **Q1** and **Q2** always return the **same result**. [2]

ii. **One** of the queries computes the **total population** in **locations** where there is at least **one** department. [2]

iii. **One** of the queries computes the **total population** in **all countries**. [2]