**Faculty of Engineering and Information Technology Al-Azhar University Gaza**

**Take Home Exam [50/2= 25 Marks]**

**Computer Programming I: ITCS 1402**

**Lecturer: Abdelbaset R. Almasri**

**الاسم رباعي**

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**الرقم الجامعي**

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**تعليمات:**

**1 . اكتب اجابتك باللون الازرق لتوضيح الإجابة واهتم في ترتيب اجابتك وبإمكانك الحل علي نفس ملف الوورد MS Word.**

**2 . كلما كانت الإجابة بأسلوبك وبكلماتك ومن شرح المحاضرات كلما حصلت على علامات أكثر. تجنب النسخ واللصق من الانترنت.**

**3 . دعم اجابتك بالأمثلة البرمجية كلما أمكن للأسئلة في القسم الاول والرابع.**

**4 . الإجابات المتشابهة والمنسوخة سوف تحصل على درجة صفر. تميز بإجابتك ولا تعطي جهدك لاحد.**

**5. حسب قرار ادارة الجامعة التسليم عبر الموودل فقط ولن ينظر لأي ملفات ترسل عبر وسائل اخري.**

**6. الامتحان مكون من أربعة اقسام وسوف تصحح الأسئلة من 50 وتقسم لاحقا لتصبح 25.**

**7. تأكد من ملف الإجابة قبل تسليمه.**

**8. حاولت قدر الإمكان تبسيط صياغة الأسئلة فلذلك الرجاء عدم سؤالي عن أي سؤال عبر وسائل التواصل.**

**\*\*مع تمنياتي لكم بالتوفيق\*\***

**Part1 (Object oriented programming (OOP) concepts, 14 marks)**

**Write definitions for key terms or concepts in your own words.**

**Solve all questions of this part. اجب على جميع الأسئلة في هذا القسم**

1. Explain clearly what the terms **class** and **object** mean in the context of object oriented programming (OOP). [2 marks]
2. Briefly explain what **method overriding** is. How does it differ from **method overloading**? [2 marks]
3. What is class **composition**?[2 marks]
4. In OOP, it is recommended that all **object variables** should be defined as **private** and that these variables should be accessed only indirectly from outside the class, by appropriate "**getter** and **setter**" methods. **Explain clearly why this is a good idea**. [2 marks]
5. Explain what the following statements affect memory, **in terms of the number of created objects and where these objects are stored**. [2 marks]  
   String s1= "ABC";  
   String s2= new String("ABC");  
   String s3= "ABC";  
   String s4= s2;
6. Choose a topic, idea you would like to consider, **formulate a key scientific question within "*the topic*" and provide a good answer to the question**. [4 marks]

6. اختر موضوعًا أو فكرة ترغب في التفكير فيها، وقم بصياغة سؤال علمي رئيسي ضمن "الموضوع الذي اخترته" وقدم إجابة جيدة عن هذا السؤال.

**Part 2 (class Design, 10 marks)**

1. Design and define the following class:

**Class Virus**

Class Virus (فيروس) represents virus instances in the real world   
(مثل فيروس كوفيد-19 و فيروس الأنفلونزا و فيروس الجدري الخ)   
the class has two fields, as well as methods that operate on these fields.  Here are the fields, all of which should be private:

* **name**: String
* **discoveryYear** سنة اكتشاف الفيروس)): int
* Write the code below for the Virus class. In this class, you must do the following:   
  i. Define private instance variables for its **name** and **year of discovery**. For example, a virus could have **name** COVID-19 and **discoveryYear** 2019.

ii. Define a **2-parameter constructor** used to initialize the both instance variables.

iii. Define **getter** and **setter** methods for these variables.

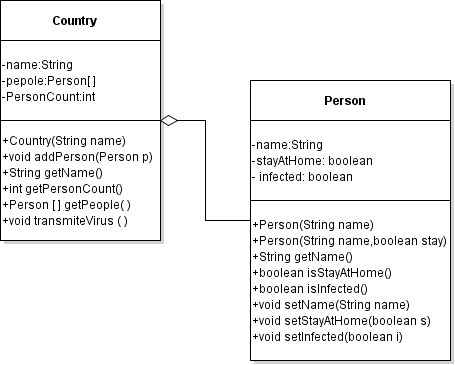
vi. Define following methods:

| **Method** | **Description** |
| --- | --- |
| boolean isOlder(Virus v) | The method returns true if v is not null, and this Virus is older than v —i.e. this virus was discovered before v". |
| boolean isOlder(Virus v1, Virus v2) | Static method. The method returns true if v1 and v2 are not null, and v1 is older than v2—i.e. v1 was discovered before v2". |
| String toString( ) | Return a String representation of this Virus [name+ " "+ discoveryYear] |

**In this Part, you are required to:**

1. Write the code for the virus class as shown in the above description. [6 marks]
2. Write a test class (called TestVirus) to test the Virus class. In The test class, you must do the following: [4 marks]
   1. Declare and create an **array of size 5 from Virus references**.
   2. Create **5 objects of Virus class and store these objects in the declared array**.
   3. **Compare the created virus objects to print the newest discovered virus**. [hint: use isOlder method to compare between the viruses]

**Part 3 (Composition, 17 marks)**

Design a class Person (الشخص) and a class Country (البلد) as shown in a class diagram:

* 1. **Class Person**

Write a class to represent a Person in the context of COVID-19 crises. The class has the following attributes:

- **name**: String

- **stayAtHome**: boolean

- **infected**: boolean

* Define two overloaded constructors used to initialize a Person instance variables

| **Constructor** | **Description** |
| --- | --- |
| Person(String name) | Create a new Person object with a given name |
| Person(String name, boolean stay) | Create a new Person with a given name and stay At Home property |

* Define getter and setter methods for these variables.

| **Getter Method** | **Description** |
| --- | --- |
| getName() | Returns the name of this Person (a String) |
| isStayAtHome() | Returns the stayAtHome variable ( Boolean) |
| boolean isInfected( ) | Returns the infected variable ( Boolean) |
| String toString( ) | Returns a String representation of this Person. |

| **Setter Method** | **Description** |
| --- | --- |
| void setName(String s) | Sets the name of this Person to s. |
| void setStayAtHome(boolean s) | Sets the stayAtHome of this Person to s. |
| void setInfected(boolean i) | Sets the infected of this Person to i. |

* 1. **Class Country**

Define a class called **Country**, which models a country with a name and a people (Array of persons with default size 100), the class is designed as shown in the class diagram. The Country class uses array of type Person (created in the previous) as its people.

The class Country contains:

* Three private instance variables: **name** (String), **people** (Person []) and **personCount**(int value used as a counter which increments when a person is added)
* A **constructor** that constructs a country with a given name.
* **void addPerson(Person p)** method that adds person p (would be the initial not infected) to country people (Person array)
* **Person [ ] getPeople( )** method that returns People array
* **void transmiteVirus ( )** method that selects **random person** "p" from the country people and set infected true for that person "p" [hint: use p.seInfected(true)]. The selected person infected only **if he/she is not staying at home**. [hint: use random method to select random Person from People array]

**Int this part, you are required to:**

1. Write the code for the Person class. [6 marks]
2. Write the code for the Country class. [7 marks]
3. Write a test class (called TestCountry) to test the Country class. In the test class, you must do the following: [4 marks]
   1. Declare and create one country object with given name.
   2. Create and add many persons to that country.
   3. To simulate the virus transmission, call **transmiteVirus ( )** method several times on that country.
   4. Print the names of the infected persons of that country.

1-قم بتعريف وإنشاء كائن بلد واحد باسم معين.  
2-قم بإنشاء وإضافة العديد من الأشخاص إلى هذا البلد.  
3-. لمحاكاة انتقال الفيروس، قم باستدعاء دالة transmiteVirus () عدة مرات على هذا البلد.  
4-اطبع أسماء المصابين بهذا البلد.

**Part 4 (Inheritance, Polymorphism, 9 marks)**

**Choose and solve three questions only.اختر و أجب علي ثلاثة أسئلة فقط من هذا القسم**

1. Explain what **class inheritance** is, using a simple example to show your solution. [3 marks]
2. In languages like Java, we make a distinction between **dynamic and static types for reference variable**. Explain the difference between these two typing concepts. Show your explanation using a simple code example. [3 marks]
3. Define what the terms **upcasting** and **downcasting** mean. In each case, you should explain your definition with a simple example, which shows how these type casts done in Java. You should also describe the cases in which one of these type casts would raise a **ClassCastException**. [3 marks]
4. What is **polymorphism**? Give an example to show the use of polymorphic variables in Java. [3 marks]
5. Give a code example, which illustrates the **method overriding** and **dynamic binding**. Explain how the code in your example will behave when it is run and how that behavior depends on the fact that method calls are **dynamically bound** (Dynamic Binding) in Java. [3 marks]
6. Below are two class declarations. **Complete the bodies of the constructor and function toString in class House**. Be careful; pay attention to access modifiers. [3 marks]

**class** Building {

**private** String address;

/\*\* A building at address ad. \*/

**public** Building(String ad) {

address = ad;

}

/\*\* Return this building’s address \*/

**public** String toString() {

**return** address;

}

}

**class** House **extends** Building {

**private** **int** numRooms; // number of rooms

/\*\* Constructor: instance at address ad with r rooms \*/

**public** House(String ad, **int** r) {

}

/\*\* Return the building’s address and number of rooms. \*/

**public** String toString() {

}

}