Exam for Shadi Jiha

Welcome to Square Enix's examination website.

SEM - Intern Hybrid

A. ALGORITHMIC AND DATA STRUCTURES

1. [Q1] The expression (a && b) || c evaluates the same as:

- ○ (c || a) && (a && b)
- ◉ (c || a) && (c || b)
- ○ (c && a) || (c && b)

2. [Q2] The expression ((a || !a) || false) || ((a && true) && (a && !a)) evaluates as:

- ○ !a
- ○ false
- ◉ true
- ○ a

3. [Q3] When would you use a linked list over a vector? (There may be more than one correct answer)

- ☐ Always
- ☐ For fast search
- ☑ For fast insertion
- ☐ For fast iteration

4. [Q4] Describe two containers. Give their complexity to
a) Insert
b) Search
c) Count

Linked List:
a) O(1)
b) O(n)
c) O(n)

5. [Q5] The Fibonacci sequence is defined by f(n) = f(n-1) + f(n-2), with f(0) = 0 and f(1) = 1. The first iterations are: 0 1 1 2 3 5 8 13… In the language of your choice (preferably C# or C++), design a recursive algorithm that returns the Nth Fibonacci number.

For instance, f(6) = 8.

```
int fibonacci(int n) {

    if (n == 0)
        return 0;
```

6. [Q6] What is the time complexity of the recursive algorithm you design for the Fibonacci sequence of the algorithm?

- ○ O(n^2)
- ○ O(n)
- ○ O(logn)
- ○ O(2^n)

7. [Q7] If your Fibonacci algorithm was design sequentially what would the time complexity be?

- ○ O(logn)
- ○ O(n)
- ○ O(n^2)
- ◉ O(2^n)

8. [Q8] Describe one sorting algorithm you know in a few words. What is its complexity?

Quicksort O(n log n). Quicksort reduces the problem into smaller problem recursively until it is easily solvable. For example, keep dividing the array to sort into smaller partitions until we have only an array of 2 at which point the solution is obvious

9. [Q9] Which of these sorting algorithms provide the best average solving time for most cases?

- ○ Bubble Sort
- ○ Insertion Sort
- ◉ Quick Sort

B. ARCHITECTURE AND DESIGN PATTERNS

1. [Q1] What are design patterns and why are they used in software engineering?

Design patterns are common ways to write code. They are used to write clean more readable code. For example the builder design pattern. When we have a constructor that takes a lot of parameters, it is impractical to call that constructor directly, so it is better to use a builder class.

2. [Q2] Which design pattern is self instantiating and provides a global point of access?

- ○ Abstract Factory
- ◉ Singleton
- ○ Visitor
- ○ Object Pool

3. [Q3] Which pattern allows a class to change its behaviour at runtime by defining a family of algorithms, encapsulating each one, and making them interchangeable?

- ◉ Strategy
- ○ Composite
- ○ Facade
- ○ Visitor

4. [Q4] What are the disadvantages of the singleton pattern?

* Hard or bad for unit testing
* Concurrency problems when dealing with multiple threads singletons can cause problems

5. [Q5] What is the design pattern used in this snippet of code?

```
class Shape
{
    public virtual void Display() { }
}
```

```
class MultiShape : Shape
{
    private List m_Shapes = new List();

    public void Add(Shape shape)
    {
        m_Shapes.Add(shape);
    }

    public void Remove(Shape shape)
    {
        m_Shapes.Remove(shape);
    }

    public override void Display()
    {
        foreach (Shape shape in m_Shapes)
        {
            shape.Display();
        }
    }
}

class Ellipse : Shape
{
    public override void Display()
    {
        Console.WriteLine("Ellipse");
    }
}


class Rectangle : Shape
{
    public override void Display()
    {
        Console.WriteLine("Rectangle");
    }
}

// Program entry point
public class Main
{
    private int main()
    {
        Ellipse ellipse1 = new Ellipse();
        Ellipse ellipse2 = new Ellipse();
        Rectangle rectangle1 = new Rectangle();
        Rectangle rectangle2 = new Rectangle();

        MultiShape multishape1 = new MultiShape();
        MultiShape multishape2 = new MultiShape();
        MultiShape multishape3 = new MultiShape();

        multishape2.Add(ellipse1);
        multishape2.Add(ellipse2);
        multishape2.Add(rectangle1);

        multishape3.Add(rectangle2);

        multishape1.Add(multishape2);
        multishape1.Add(multishape3);

        multishape1.Display();
    }
}
```

polymorphism

6. [Q6] In a FPS game, we have a class to represent bullets: Bullet. We know we're going to create and destroy a lot of instances of this class. One strategy is to allocate dynamically a new instance of the class every time we need a new bullet. What are the drawbacks of such a strategy? What strategy would you use to mitigate those risks?

The problem is this strategy will allocate memory each time it is created which can be costly. What I would do is reuse that bullet that is technically suppose to be destroyed. So when another bullet should be created, instead of allocating new memory, I reuse the old "destroyed" bullet

7. [Q7] Pick one of the following subjects and briefly explain how it works.
i. Reflection
ii. Resource acquisition is initialization
iii. Inversion of control / Dependency inversion

Resource acquisition is away to control the lifetime of an object and/or transfer the ownership of this object to another function/scope

C. MATHEMATICS

1. [Q1] Find non-zero scalars α, β such that for all vectors a and b, α(a+2b)−βa+(4b−a)=0.

- ◉ α=2,β=1
- ○ α=−2,β=−3
- ○ α=1,β=3
- ○ α=−2,β=3

2. [Q2] Which of the following expressions make sense? (There may be more than one correct answer. Note that A.B is the dot product of A and B, A×B is the cross product of A and B, and ||A|| is the length of A)

- ☐ (A+B)×(A.C)
- ☐ ||A||×(C.B)
- ☑ (A×B).C
- ☑ ||A||*(B×C)
- ☐ A+(B·C)

3. [Q3] How do you quickly find if the angle between two vectors is greater than 90 degrees? (There may be more than one correct answer)

- ☐ The dot product is positive.
- ☑ The dot product is negative.
- ☐ The cross product is positive.
- ☐ The cross product is negative.

4. [Q4] Which of the following statements are true? (There may be more than one correct answer. Note that A.B is the dot product of A and B, ||A|| is the length of A, angle(A,B) is the angle between A and B, and (xA, yA, zA) are the coordinates of A)

- ☐ A.B = ||A|| * ||B|| * sin(angle(A,B))
- ☐ A.B is a vector orthogonal to A and B
- ☑ A.B = (xA * xB) + (yA * yB) + (zA * zB)
- ☐ A.B = (xA + xB) * (yA + yB) * (zA + zB)
- ☐ A.A is the length of A

5. [Q5] Which of the following statements are true? (There may be more than one correct answer. Note that A×B is the cross product of A and B, ||A|| is the length of A, angle(A,B) is the angle between A and B, and (xA, yA, zA) are the coordinates of A)

- ☐ ||AxB|| = ||A|| * ||B|| * cos(angle(A,B))
- ☐ ||AxB|| is a float equal to 0 if A and B are collinear

- ☑ One will typically use cross product to determine which side of a plane a point is.
- ☑ Axb is a vector whose length is equal to sin(angle(A,B)) if A and B are unit vectors

6. [Q6] Name 3 possible mathematical representations of a rotation that are typically used in game programming.

E. C# PROGRAMMING

1. [Q1] Write the output of the following program done in C#:

```
public class Base
{
    public Base()
    {
        Console.WriteLine("Parent Constructor");
    }

    ~Base()
    {
        Console.WriteLine("Parent Deconstructor");
    }

    public void Print()
    {
        Console.WriteLine("Parent Print");
    }

}

public class Derived : Base
{
    public Derived()
    {
        Console.WriteLine("Child Constructor");
    }

    ~Derived()
    {
        Console.WriteLine("Child Deconstructor");
    }

    public void Print()
    {
        Console.WriteLine("Child Print");
    }
}

//Program entry point
public class Main
{
    private int main()
    {
        Derived d = new Derived();
        d.Print();
        Base b = d;
        b.Print();
        return 0;
    }
}
```

Parent Constructor
Child Constructor
Child Print
Parent Print

2. [Q2] What can be optimized in the following program?

```
public string Append(List values)
{
    string outputValue = string.Empty;
    foreach (var value in values)
    {
       outputValue += value;
    }
    return outputValue;
}
```

Use string builder instead of concatenating a string since a string class is immutable (to avoid allocating memory each iteration)

3. [Q3] If you focus on performance, when should you use a for loop and when should you use a foreach loop?

- ○ Both can be used interchangeably
- ○ A foreach loop should be used whenever possible
- ○ A for loop should be used whenever possible.
- ◉ A foreach loop should be used for all collections and a for loop for everything else.

4. [Q4] What is the difference between passing arguments by reference and by value in C#? (There may be more than one correct answer)

- ☑ A value type will copy the object in memory.
- ☑ A reference type will pass only a pointer to the object.
- ☐ A value type will only pass a pointer to the object.
- ☐ A reference type will pass a pointer to the duplicated object.

5. [Q5] How is an attribute declared in C#?

- ◉ public class NewAttribute : System.Attribute { }
- ○ public attribute NewAttribute {}
- ○ public class attribute NewAttribute
- ○ public class NewAttribute inherits System.Attribute {}

6. [Q6] Which of the following are reference types in C#? (There may be more than one correct answer)

- ☐ int
- ☑ List
- ☑ string
- ☐ struct MyStruct{}
- ☑ object

7. [Q7] Which of the following statements are correct in C#? (There may be more than one correct answer)

- ☐ Data members of a class are by default public.
- ☑ Data members of a class are by default private.
- ☐ Member functions of a class are by default public.
- ☑ A private function of a class can access a public function within the same class.
- ☑ Member function of a class are by default private.

8. [Q8] What do the following acronyms mean: JIT, AOT, IL?

F. UNITY

1. [Q1] What are all objects in a Unity scene?

- (•) SceneObject
- ( ) UnityObject
- ( ) GameObject
- ( ) MonoObject

2. [Q3] In order for a script to be attached to a scene object what must it inherit from?

- ( ) Scriptable
- ( ) SceneObject
- (•) MonoBehaviour
- ( ) GameObject

3. [Q4] Which objects are naturally serialized by Unity? (There may be more than one correct answer)

- [ ] All public classes
- [x] MonoBehaviours
- [x] ScriptableObjects
- [x] Any class marked with an attribute [System.Serializable]

G. GAMEPLAY

1. [Q1] What is a navigation mesh? Name an algorithm typically used in correlation with this data structure.

It is a data structure usually used in AI for path finding

2. [Q2] A helicopter is observing the launch of a rocket from a location 400m west and 200m above the launch pad. Its location is fixed relative to the launch pad. Visibility is poor and the helicopter pilot can only see for 500m in any direction. The rocket launches at time t=0 and accelerates straight up at a rate of 10m/s^2. At what time will the helicopter lose sight of the rocket? At what speed is the rocket travelling at this time?

3. [Q3] You are writing a simple shooting game. A bullet is fired at muzzle velocity : 800m/s. Assuming there is no wind and no drag on the bullet, what is the vertical drop of the bullet (from gun level), when it hits a wall located 400m away from the gun? (To simplify calculations, assume gravity is -10m/ss)

- ( ) 4 cm
- ( ) 12.5 cm
- (•) 1.25 cm
- ( ) 2.5 m
- ( ) None of the above

G. NETWORKING AND ONLINE

1. [Q1] Which of the following statements are correct?

- [x] TCP is ordered and UDP is unordered.
- [ ] TCP is a connection-oriented protocol while UDP is not.
- [ ] TCP and UDP have built in reliability.

- ☐ TCP has less packet overhead than UDP.

2. [Q2] Which of the following below are capable of the ICMP protocol?

- ☐ Report package count
- ☑ Report network congestion
- ☑ Report availability of remote hosts

3. [Q3] Bits are packaged into frames at what layer of the OSI Model?

- ○ Physical
- ○ Transport
- ◉ Data Link
- ○ Presentation
- ○ Application

4. [Q4] The layer of the OSI Model, from the top down are:

- ○ Physical, Data Link,Network, Transport, Session, Presentation, Application
- ○ Session, Presentation, Data Transport, MAC, Network, Physical
- ○ Application, Encryption, Network, Transport, Logical Link Control, Physical
- ◉ Application, Presentation, Session, Transport, Network, Data Link, Physical

X. MISCELLANEOUS QUESTIONS

1. [Q1] How would you change this exam and/or examination process?

Submit Print