

**CS 14: Data Structures and Algorithms**

Sep 29, 2003

Quiz 1, Form:

First Name: \_\_\_\_\_

Last Name: \_\_\_\_\_

ID Number: \_\_\_\_\_

Signature: \_\_\_\_\_

This quiz is worth **14 points** and lasts **15 minutes**. You may use **ONLY** the test's last sheet (front and back pages) for **scratch work**, and your final answers must be **BRIEF, CLEAN, COHERENT, LEGIBLE**, and written **ONLY** in the spaces provided.

Good luck!

1. [3 points] Write a **simple** implementation of the C++ function **double average(int a[ ], int length)** which takes as arguments an array of integers, **a**, and its length, **length**, and returns the **average** of the integers stored in the array.

2. [3 points] Explain what the *access modifier protected* means within a class definition.

3. [3 points] The first odd integer is 1, the second is 3, the third is 5, and so on. Write a **simple** C++ implementation for a **recursive** function `int odd(int n)` which returns the  $n$ -th odd integer. Note that any odd integer number can be computed from the previous odd integer by the recursive relation  $\text{odd}(n) = \text{odd}(n - 1) + 2$ , with the initial value  $\text{odd}(1) = 1$ .

4. [1 point] Suppose that `p` is declared to be a pointer to an object of class `Foo` and suppose that class `Foo` has a public member function `void f(char c)`. Write an equivalent expression for `p -> f('A')`.

5. [2 points] Explain what an **abstract** class is. I want a short explanation, not examples.

6. [2 points] In C++, what identifies a class as abstract?

# Answer Key for Exam A

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Good luck!

1. [3 points] Write a **simple** implementation of the C++ function **double average(int a[ ], int length)** which takes as arguments an array of integers, **a**, and its length, **length**, and returns the **average** of the integers stored in the array.

**Answer:**

```
double average(int a[ ], unsigned int length)
{
    double sum = 0.0;
    for (unsigned int i = 0; i < length; ++i)
        { sum += a[i]; }
    return (sum / length);
}
```

2. [3 points] Explain what the *access modifier protected* means within a class definition.

**Answer:** Protected member variables and functions of a class are directly accessible by name only within the class itself, within its derived classes, and by functions and classes which are friends of the class where the protected member is defined.

3. [3 points] The first odd integer is 1, the second is 3, the third is 5, and so on. Write a **simple** C++ implementation for a **recursive** function **int odd(int n)** which returns the *n*-th odd integer. Note that any odd integer number can be computed from the previous odd integer by the recursive relation  $\text{odd}(n) = \text{odd}(n - 1) + 2$ , with the initial value  $\text{odd}(1) = 1$ .

**Answer:**

```
int odd(int n)
{
    if (n <= 0)
        exit(-1); // error: n must be > 0
}
```

```
    // base case: odd(1) = 1
    if (n == 1)
        return 1;

    // do the recursion
    return odd(n-1) + 2;
}
```

4. [1 point] Suppose that `p` is declared to be a pointer to an object of class `Foo` and suppose that class `Foo` has a public member function `void f(char c)`. Write an equivalent expression for `p -> f('A')`.

**Answer:** `(*p).f('A')`. The parentheses surrounding `*p` are necessary, since the dot operator (`.`) has higher precedence than the de-referencing operator (`*`).

5. [2 points] Explain what an **abstract** class is. I want a short explanation, not examples.

**Answer:** An abstract class is a class which cannot be instantiated, that is, for which no objects can be created.

6. [2 points] In C++, what identifies a class as abstract?

**Answer:** In C++, an abstract class is a class that has at least one **pure** virtual function.