

**Tutorial 10**

1. **Write a recursive definition of  $x^y$  (x raised to the power y), where x and y are integers and  $y > 0$ .**

$$x^1 = x$$

$$x^y = x * x^{y-1} \text{ for } y > 1$$

2. **Write a recursive definition of  $i * j$  (integer multiplication), where  $i > 0$ . Define the multiplication process in terms of integer addition. For example,  $4 * 7$  is equal to 7 added to itself 4 times.**

$$1 * j = j$$

$$i * j = j + (i-1) * j \text{ for } i > 1$$

3. **Write a recursive method that returns the value of N! (N factorial) using the definition given in this chapter. Explain why you would not normally use recursion to solve this problem.**

```
public int factorial (int num)
{
    int result;
    if (num == 1)
        result = 1;
    else
        result = num * factorial (num - 1);
    return result;
}
```

*You would not normally use recursion to solve this problem because it can be done more efficiently using iteration and because the recursive solution is no more intuitive than the iterative solution.*

4. An array can be classified as what type of object?
  - a) dynamic
  - b) ordered
  - c) first-in first-out
  - d) heterogeneous
  - e) collection

Answer (e) and explain: An array stores a group of items and is dubbed a collection type (as opposed to other types that can store a single item). There are numerous collection types, the array being one composed only of homogeneous items (the array stores multiple items but they all must be of the same type).

5. Abstract Data Types have which of the following object-oriented features?
- a) Information hiding
  - b) Inheritance
  - c) Polymorphism
  - d) Message Passing
  - e) All of the above

Answer (a) and explain: All of these answers are types of object-oriented features. An Abstract Data Type encapsulates a data structure and the methods to manipulate the data structure such that information hiding is preserved. Therefore, all ADTs make use of information hiding so that the data structure cannot be manipulated directly from outside of the ADT, but the other object-oriented features are not required.