Unit Four Lecture Four:

Topic 1: Recursive Methods

A recursive method calls itself to solve a smaller version of its task, until a final call, which does not require a self-call.

Topic 2: Iteration vs. Recursion

An iterative program will determine the solution by continually repeating a part of the program using a looping structure.

If a problem can be solved either iteratively or recursively, which way should be used?

{Be advised, all programs that can be solved recursively also have an iterative solution. But, not all programs that can be solved iteratively have a recursive solution.}

There is not a clear, cut answer to the question of iteration vs. recursion.

Recursive solutions are usually simpler (less code) and more elegant because they reflect the nature of the problem directly. However, since recursive solutions may involve a large number of method calls and since method calls take more time to execute than repetitions, recursive solutions may be quite inefficient.

Example: Write two methods, one which will determine b^e iteratively and the other which will determine b^e recursively.

Iteration:

```
public int Power(int b, int e)
{
     int ans = 1;

     for (int j=1; j<=e; j++)
     {
          ans *= b;
     }

     return ans;
}
```

Recursion:

```
public int Power(int b, int e)
{
     if (e == 0)
          return 1;
     else
          return (Power(b, e-1) * b);
}
```

Power(5,4) -> Power(5,3) -> Power(5,2) -> Power(5,1) -> Power(5,0)

  625   <-   125   <-   25   <-   5   <-   1

AP type Recursive Problems

1) ```
   public int Mystery(int k)
   {
       if (k == 1)
          return 0;
       else
          return (Mystery(k/2) + 1);
   }
   ```

   What value is returned by the call int x = Mystery(16);?

   A) 0   B) 2   C) 4   D) 5   E) 16

2) Which of the following best characterizes the values of k
   for which the call int x = Mystery(k); leads to an infinite
   recursion?

   A) No values   D) All positive values
   B) All non-positive values   E) All odd values
   C) All even values

3) ```
   public int Compute(int x, int y)
   {
       if (x == y)
          return x;
       else
          return (Compute(x+1, y-1));
   }
   ```

   What is returned by the call int x = Compute(1,5);?

   A) 1   B) 2   C) 3   D) 4   E) No value returned because
                                  infinite recursion occurs

4) Which of the following calls leads to infinite recursion?

```
          I                        II                         III
int x = Compute(2,8);    int x = Compute(8,2);    int x = Compute(2,5);
```

   A) I only   D) I and II
   B) II only   E) II and III
   C) III only

Assignment U4A4: The Credit Card Problem