1806ICT Programming Fundamentals

Bitwise Operators, Enumerations, Macros, Recursion

1. The constant `CHAR_BIT` is defined in the header file `limits.h` to represent the number of bits in a `char` or byte. Now, write two functions that counts the number of bits in a `char` and an `int`.

   Hint: The expression ~0 (complement of 0) will produce a number that contains bits that are all 1's.

2. Left shifting an unsigned integer by 1 bit is the same as multiplying that integer by the value 2. Write a function that takes in two unsigned integer parameters `number` and `power`, and computes the value of (`number x` 2^{power}).

   Sample run:

Input	Output
3 4	48
5 2	20

3. Write a program that computes the area and circumference (or perimeter) for a variety of geometric figures. You can use the following definitions of structure types for a circle, square, and rectangle, and a definition of a union type with a component of each figure type.

```
typedef struct
{
      double area;
      double circumference;
      double radius;
} circleType;

typedef struct
{
      double area;
      double perimeter;
      double side;
} squareType;

typedef struct
{
      double area;
      double perimeter;
      double width;
      double height;
} rectangleType;

typedef union
{
      circleType circle;
      squareType square;
      rectangleType rectangle;
} figureData;

typedef struct
```

```
{
   char shape;   // denotes the correct interpretation of the union
   figureData fig;
} figureType;
```

The `char` variable `shape` can be used to identify the geometric figure for which the computation of area and circumference (or perimeter) is being done.

Your program will ask the user to enter either `c` (for circle), `s` (for square) and `r` (for rectangle) and the corresponding dimensions for those geometric figures. It should also have at least the following functions:

```
figureType computeArea(figureType object)
figureType computePerimeter(figureType object)
void printFigure(figureType object)
```

Sample run:

Input	Output
c 2	Area of circle = 12.57, Perimeter of circle = 12.57
s 3	Area of square = 9, Perimeter of square = 12
r 1 5	Area of rectangle = 5, Perimeter of rectangle = 12

4. Write a recursive function that computes the sum of the first `n` positive integers. Your program will read in the integer value for `n`, and call the recursive function to compute the sum of `1+2+3+…+ n`.

5. The greatest common divisor of integers `x` and `y` is the largest integer that evenly divides both `x` and `y`. Write a recursive function `gcd` that returns the greatest common divisor of `x` and `y`. The `gcd` of `x` and `y` is defined recursively as follows:

   If `y` is equal to `0`, then `gcd(x, y)` is `x`;
   otherwise `gcd(x, y)` is `gcd(y, x % y)` where `%` is the remainder operator.

6. Write a recursive program to find the largest number in an array of integer numbers. The prototype for the recursive function is `largest(int array[], int startIndex, int endIndex)`, where `startIndex` is 0 and `endIndex` is the index of the last element in the array.

   Sample run:

Input	Output
1 2 3 4 5 6	6
1 4 2 65 3 23	65

7. Write a recursive function `stringReverse()` that takes a character array as an argument and prints it back to front.

   Sample run:

Input	Output
hello	olleh
goodbye	eybdoog