

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

This is a **Programming Project** - you may not collaborate.  
See COMPSCIDEPTINST1531.1.

These functions can be implemented using iteration (loops), but in this assignment you are to implement them using recursion. Write and test each of these functions (make sure your code is formatted neatly and consistently; use descriptive variable names).

Submit, stapled together: (1) a printed copy of the front page of this sheet with your name filled in, (2) a hardcopy listing of one source code file and one header file, (3) a screen snapshot showing a test of each of these functions.

Also submit (4) one email (SUBJECT: **IC210 proj28 lastname alpha code**), with two attachments: your header file and your source code file. Every item submitted must have your name and alpha code. See the reverse for more instructions.

1. dsum

```
// Returns sum of digits in n (assume n > 0)
// e.g.: dsum( 1205 ) = 1 + 2 + 0 + 5 = 8
int dsum( int n );
```

2. mul

```
// Returns n * m (assume n and m > 0)
// Note: (n * m) = (n + n + n + ... + n) (n added m times)
int mul( int n, int m );
```

3. fib

```
// Returns F(n), the nth Fibonacci number
// The Fibonacci numbers are : 1 1 2 3 5 8 13 21 ...
// if n <= 2 then F(n) = 1
// if n > 2 then F(n) = F(n-1) + F(n-2)
int fib( int n );
```

4. gcd

```
// Returns GCD of n and m
// if m is zero then GCD(n,m) = n
// if m is not zero then GCD(n,m) = GCD(m,n%m)
int gcd( int n, int m );
```

5. sumInv

```
// Returns the sum of the inverses of integers from 1 to n,
// i.e., 1 + 1/2 + 1/3 + 1/4 + ... + 1/n
double sumInv( int n );
```

Extra credit:

6. commaInt

```
// Prints n with commas in the correct place
// e.g.: commaInt( 1234567 ) prints 1,234,567
void commaInt( int n );
```

Name your files `lastname_proj28.cpp`, and `proj28.h` (where lastname is your last name). Structure your source code file as follows:

```
// stahl_proj28.cpp  <-- the file name
// Stahl 806816     <-- your last name and alpha code
// etc (other stuff here as required)

#include "proj28.h" // (you must write the contents of proj28.h, of course)

#define PROBLEM 1  // < -- change this and recompile to test each problem

int main()
{
    int n, m;
    cout << "Enter n: ";
    cin >> n;

    #if PROBLEM == 1
        cout << dsum( n ) < endl;

    #elif PROBLEM == 2
        cout << "Enter m: ";
        cin >> m;
        cout << mul( n, m ) < endl;

    #elif PROBLEM == 3
        cout << fib( n ) << endl;

    #elif PROBLEM == 4
        cout << "Enter m: ";
        cin >> m;
        cout << gcd( n, m ) << endl;

    #elif PROBLEM == 5
        cout << sumInv(n) << endl;

    #elif PROBLEM == 6
        commaInt( n );
        cout << endl;
    #endif

    return 0;
}

// Your function definitions here:
```