University of Nevada, Las Vegas Computer Science 477/677 Spring 2024

Assignment 1: Due Tuesday January 23, 2024

Name:_____

You are permitted to work in groups, get help from others, read books, and use the internet.
To turn in the homework, follow instructions given by the teaching assistant, Sabrina Wallace.

1. Problem 0.1 on page 8 of the textbook. Write either O, Ω or Θ in each blank. Write Θ if that is correct, otherwise write O or Ω.

   (a) $n - 100 =$ _____ $(n - 200)$

   (b) $n^{1/2} =$ _____ $(n^{2/3})$

   (c) $100n + \log n =$ _____ $(n + \log^2 n)$

   (d) $n \log n =$ _____ $(10n + \log(10n))$

   (e) $\log(2n) =$ _____ $(\log(3n))$

   (f) $10 \log n =$ _____ $(\log(n^2))$

   (g) $n^{1.01} =$ _____ $(n \log^2 n)$

   (h) $n^2 / \log n =$ _____ $(n \log^2 n)$

   (i) $n^{0.1} =$ _____ $(\log^2 n)$

   (j) $(\log n)^{\log n} =$ _____ $(n / \log n)$

   (k) $\sqrt{n} =$ _____ $(\log^3 n)$

   (l) $n^{1/2} =$ _____ $(5^{\log_2 n})$

   (m) $n2^n =$ _____ (3^n)

   (n) $2^n =$ _____ (2^{n+1})

   (o) $n! =$ _____ (2^n)

   (p) $\log_2 n^{\log_2 n} =$ _____ $(2^{(\log_2 n)^2})$

   (q) $\sum_{i=1}^{n} i^k =$ _____ (n^{k+1})

2. Look up Fibonacci numbers $F_1, F_2, F_3 \ldots$ if you are not familiar with them. Recall that $F_i + F_{i+1} = F_{i+2}$. The first few Fibonacci numbers are 1, 1, 2, 3, 5, 8, ...

   Find the smallest constant C such that $F_n = O(C^n)$.

3. Consider the following C++ program.

```
void process(int n)
 {
  cout << n << endl;
  if(n > 1) process(n/2);
  cout << n%2;
 }

int main()
 {
  int n;
  cout << "Enter a positive integer: ";
  cin >> n;
  assert(n > 0);
  process(n);
  cout << endl;
  return 1;
 }
```

   The last line of the output of `process(n)` is a string of bits. What does this bitstring represent?

4. The C++ code below implements a function, "mystery." What does it compute?

```
float squre(float x)
 {
  return x*x;
 }

float mystery(float x, int k)
 {
  if (k == 0) return 1.0;
  else if(x == 0.0) return 0.0;
  else if (k < 0) return 1/mystery(x,-k);
  else if (k%2) return x*mystery(x,k-1);
  else return mystery(squre(x),k/2);
 }
```