CSE 3101, Fall 2017

Tutorial 2: September 20, 2017

1. Prove $f(n) = 0.1n^3 + 7n \log n + 8n^2 = O(n^3)$.
2. For the following functions $f(), g()$, $f(n) = O(g(n))$ or $g(n) = O(f(n))$ but not both. Determine which is true.
   (a) $f(n) = n^2 + 3n + 4$, $g(n) = n^3$.
   (b) $f(n) = 4n \log n + n$, $g(n) = (n^2 - n)/2$.
3. Prove $f(n) = 3n^2 + 7n + 8 \in \Theta(n^2)$.
4. Show that $f(n) = 3\lceil n/2 \rceil \in \Theta(n)$.
5. Prove that $9999n + 635 = O(2^n)$.
6. Which is bigger asymptotically, n or $(\lg n)^{\lg n}$? Justify your answer.
7. For what constants a is the following true?

$$2^n + 3^{\frac{n}{2}} = O(a^n)$$

8. Analyze the running time of the following program for matrix multiplication.

```
MatMult(Y, Z, n)
// multiply n x n matrices Y, Z
for i ← 1 to n
do for j ← 1 to n
    do X[i, j] ← 0
        for k ← 1 to n
        do X[i, j] ← X[i, j] + Y[i, k] * Z[k, j]
return x
```

9. Analyze the running time of the following algorithm.

```
power(y, z)
// return y^z where y ∈ R, z ∈ N
x ← 1
while z > 0
do if odd(z)
      then x ← x * y
    z ← ⌊z/2⌋
    y ← y^2
return x
```