CS303 Data Structures Assignment #1

August 26, 2018

1.

Choose an arbitrary n_0, eg. $n_0 = 1$.

$Cn_0^3 > n_0^3 - 5n_0^2 + 20n_0 - 10$

$C * 1^3 > 1^3 - 5 * 1^2 + 20 * 1 - 10$

$C > 1 - 5 + 20 - 10$

$C = 6, n_0 = 1$

For all n, where $n > 1$, $6n^3 > n^3 - 5n^2 + 20n - 10$.

2.

See attached `comparegrowth.cpp`. Output:

```
y1:  10
y2:  2
y1:  1010
y2:  502
y1:  2010
y2:  2002
y1:  3010
y2:  4502
y1:  4010
y2:  8002
y1:  5010
y2:  12502
y1:  6010
```

```
y2:  18002
y1:  7010
y2:  24502
y1:  8010
y2:  32002
y1:  9010
y2:  40502
y1:  10010
y2:  50002
```

The results here are to be expected. y1 is initially larger because of the constant 100 rather than 5, but y2 quickly overtakes it because of how much faster n^2 grows than n. This would be true regardless of what constant y1 used. If $y1 = 10000n + 20$, y2 would still outgrow it.

3.

3.1

The inner loop is run i^2 times, with i being every number from 0 to n-1. Therefore, we get the sum: $T(n) = 1^2 + 2^2 + 3^2 \cdots + n^2$ or
$T(n) = \sum_{i=1}^{n} i^2$, which is simply a geometric series, so $T(n) = \frac{1}{6}n(n+1)(2n+1)$.