50.004 Introduction to Algorithms, Fall 2018
Singapore University of Technology and Design 18 Sep, 2018
Gemma Roig, Ioannis Panageas, Subhajit Datta Home Exercises - Week 1&2

Student Information

Name: _____ Student ID: _____
Due Date: 25 Sep, 11:59PM.
Submit answers on eDimension in pdf format. Submission without student information will **NOT** be marked! Any questions regarding the homework can be directed to the TA through email (contact information on eDimension).

Week 1

For all answers that are FALSE to a (T/F) question, please provide a short reason why as well.

1. The asymptotic complexity of $n^3 + 2n^2 + 1000$ is $O(n^3)$. **(T/F)**
2. The asymptotic complexity of $100n^2 + n + \cos n + 1000$ is $\Theta(n^2)$. **(T/F)**
3. The asymptotic complexity of $100n^{10} + n^{2.3} + 1000$ is $\Omega(n^9)$. **(T/F)**
4. The asymptotic complexity of $n^2 + n + 1000$ is $\Theta(n^{1.5})$. **(T/F)**
5. Given a program that performs the following (assuming printing takes $\Theta(1)$):

   ```
   for(int i = 0; i < n^2; i++)
     for(int j = 0; j < n; j++)
       for(int k = 0; k < 10; k++)
         print(Hello)
   ```

   The asymptotic complexity is $\Theta(n^2)$. **(T/F)**
6. Given a program that performs the following (assuming printing takes $\Theta(1)$):

   ```
   for(int i = 0; i < 100; i++)
     for(int j = 0; j < n; j++)
       print(Hello)
   ```

   The asymptotic complexity is $\Theta(n)$. **(T/F)**
7. Given a program that performs the following (assuming printing takes $\Theta(1)$):

   ```
   for(int i = 0; i < 100; i++)
   ```

for(int $j = 0$*;* $j < 500$*;* j*++)*
print(n*)*

The asymptotic complexity is $\Theta(n)$. **(T/F)**

8. Given $f(n) = n^3 + n^2$ and $g(n) = 10n^2$, $f(n) = \Theta(g(n))$. **(T/F)**
9. Given $f(n) = n^{0.5} + 10$ and $g(n) = n + 10$, $f(n) = O(g(n))$. **(T/F)**
10. The ranking of the functions below, sorted in **ascending** order of growth is ( ).
    A. $n^2 < nlog(n) < 2^n < n^n$
    B. $nlog(n) < n^2 < 2^n < n^n$
    C. $nlog(n) < n^2 < n^n < 2^n$
    D. $n^2 < nlog(n) < n^n < 2^n$

Week 2

1) Use the Master Theorem to give tight asymptotic bounds for the following recurrences. Please show how you derive your answer.

1. $T(n) = 2T(n/4) + n^2$
2. $T(n) = 2T(4n/5) + \log n$
3. $T(n) = 2T(n/4) + \sqrt{n}$
4. $T(n) = \sqrt{2}T(n/4) + n \log n$