CS5800 Assignment 1

Please provide justification for all your answers.

- e.g. function f(n) grows faster than function g(n) because f(n) is polynomial and g(n) is logarithm.
- e.g. when using Master's Theorem to solve recursion, state a, b, c and which case it falls into.

Problem 1 (10 pts)

Take the following list of functions and arrange them in ascending order of growth rate.

- $f_1(n) = 10^n$
- $f_2(n) = n^{1/3}$
- $f_3(n) = n^n$
- $f_4(n) = log_2 n$
- $f_5(n) = n \times log_2 n$

Problem 2 (40 pts)

Textbook Exercise 0.1 (please skip o, p, and q)

0.1. In each of the following situations, indicate whether $f = O(g)$, or $f = \Omega(g)$, or both (in which case $f = \Theta(g)$).

	$f(n)$	$g(n)$
(a)	$n - 100$	$n - 200$
(b)	$n^{1/2}$	$n^{2/3}$
(c)	$100n + \log n$	$n + (\log n)^2$
(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)	$n^2 / \log n$	$n(\log n)^2$
(i)	$n^{0.1}$	$(\log n)^{10}$
(j)	$(\log n)^{\log n}$	$n / \log n$
(k)	$\sqrt{n}$	$(\log n)^3$
(l)	$n^{1/2}$	$5^{\log_2 n}$
(m)	$n2^n$	3^n
(n)	2^n	2^{n+1}
(o)	$n!$	2^n
(p)	$(\log n)^{\log n}$	$2^{(\log_2 n)^2}$
(q)	$\sum_{i=1}^{n} i^k$	n^{k+1}

Problem 3 (50 pts)

Textbook Exercise 2.5 (please skip f and k)

2.5. Solve the following recurrence relations and give a Θ bound for each of them.

(a) $T(n) = 2T(n/3) + 1$
(b) $T(n) = 5T(n/4) + n$
(c) $T(n) = 7T(n/7) + n$
(d) $T(n) = 9T(n/3) + n^2$

(e) $T(n) = 8T(n/2) + n^3$
(f) $T(n) = 49T(n/25) + n^{3/2} \log n$
(g) $T(n) = T(n-1) + 2$
(h) $T(n) = T(n-1) + n^c$, where $c \geq 1$ is a constant
(i) $T(n) = T(n-1) + c^n$, where $c > 1$ is some constant
(j) $T(n) = 2T(n-1) + 1$
(k) $T(n) = T(\sqrt{n}) + 1$