

Homework 1

Assigned: Jan. 15, 2013

Due: Jan. 22, 2013

- (10') Suppose $f(n) = 8n + 16$ and $g(n) = 2n^2 + 3$. Prove that $f(n)$ is $O(g(n))$ by finding $c > 0$ such that $f(n) \leq c \cdot g(n)$ for all n .
- (30') In each of the following situations, indicate whether f is $o(g)$, or f is $\omega(g)$, or f is $\Theta(g)$ and explain or prove why you get the conclusion.

	$f(n)$	$g(n)$
(a)	$n + 100$	$n^2 + 1$
(b)	$3n^{1/4} + 4$	$2n^{3/5} + 9$
(c)	$n \log n$	$5n \log(5n)$
(d)	$\log n$	$\log_5 n$
(e)	$100n + \log n$	$n + (\log n)^2$
(f)	$n^{1.03}$	$n(\log n)^2$
(g)	\sqrt{n}	$(\log n)^3$
(h)	n^2	$7^{\log n}$
(i)	$n^2 / \log n$	$n(\log n)^2$
(j)	$n2^n$	5^n

Note: Assume base=2 for log if not specified, i.e., $\log n = \log_2 n$.

- (30') Implement two programs *pg1.c* and *pg2.c* in C or C++. *pg1.c* uses function *fib1()* to calculate the Fibonacci numbers while *pg2.c* uses function *fib2()* to calculate the Fibonacci numbers.

Let each program try to calculate Fibonacci numbers $F_0, F_1, F_2, F_3, \dots$, until F_{64} . (Note: “try” means that you can terminate your program when it takes more than 30 minutes to calculate a Fibonacci number.) It should print out the time so that you know how long it takes to calculate each Fibonacci number. The output looks like this:

```
Current time: hh:mm:ss
Fib(0) = 0
Current time: hh:mm:ss
Fib(1) = 1
Current time: hh:mm:ss
.....
Fib(64) = ...
Current time: hh:mm:ss
```

You should submit following as your answers:

- For each program, describe what Fibonacci numbers take less than 1 second to calculate, what take 1 to 10 seconds, what take more than 10 seconds and up to 10 minutes, and what take more than 10 minutes.
- Email the two programs and their outputs as attachments to the TA/grader Weihua Liu (weihua.liu@uky.edu) and cc to the instructor (fei@cs.uky.edu) with subject “CS315 HW1”.

Hint: You may declare the type of resulting Fibonacci numbers as `long long int`. To get the time, you can use the following function as a reference.

```
#include <stdio.h>
#include <time.h>
#include <stdlib.h>

void print_time() {
    time_t now = time(NULL);
    struct tm* tm = localtime(&now);
    printf("The current time is: %d:%d:%d\n", tm->tm_hour, tm->tm_min, tm->tm_sec);
}
```