CS 5/7350
Quiz #1 Due Feb 22 for Completion Grade

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1. [1 pt] Given that $(2^n)\%M = 33$ and M is > 100. Given the value for $(2^{n+1})\%M$ 66

Solution:

$$\begin{aligned}
&\because (2^n)\%M = 33 \\
&\therefore 2^{n+1}\%M = (2^n \times 2^1)\%M = (2^n\%M) \times (2^1\%M) = 33 \times (2\%M) \\
&\because M > 100 \\
&\therefore 2\%M = 2 \\
&\therefore 2^{n+1}\%M = 33 \times 2 = 66
\end{aligned}$$

2. [2 pt] Consider the following function:

```
#include <stdio.h>
function (int n)
{
    product = 1;
    for (i = 1; i <= n; i++){
        for (j = 1; j <= i; j++){
            product = product * j;
        }
    }
    printf("%d\n", proudct);
}
```

(a) Write a function for the number of multiplications performed vs n.

Solution:

$$f(n) = (1 + 2 + 3 + \cdots + n) = \frac{n(1+n)}{2}$$

(b) What is the asymptotic running time of the code using "multiplication" as a basic element.

Solution:

$$\lim_{n\to\infty} \frac{n(1+n)}{2} = \Theta(n^2)$$

3. [2 pts] A program can process 3000 item in 11 seconds.

(a) About how long would it take to process 15000 items if the function describing the running time is bounded by $\Theta(n)$?

Solution:

$$\because \Theta(n), 3000\ items\ in\ 11\ seconds$$
$$\therefore \frac{15000}{3000} = 5$$
$$\therefore time = 5 \times 11 = 55\ seconds$$

(b) About how long would it take to process 15000 items if the function describing the running time is bounded by $\Theta(n^3)$?

Solution:

$$\because \Theta(n^3), 3000\ items\ in\ 11\ seconds$$
$$\therefore \frac{15000^3}{3000^3} = (\frac{15000}{3000})^3 = (5)^3 = 125$$
$$\therefore time = 125 \times 11 = 1375\ seconds$$

(c) About how long would it take to process 15000 items if the function describing the running time is bounded by $\Theta(2^n)$

Solution:

$$\because \Theta(2^n), 3000\ items\ in\ 11\ seconds$$
$$\therefore \frac{2^{15000}}{2^{3000}} = 2^{15000-3000} = 2^{12000}$$
$$\therefore time = 2^{12000} \times 11\ seconds$$