

COP 3502 8/29/25

- 1) Schedule
- 2) P1, P2 both posted
- 3) Recursion
- m - no CLASS
w - QUIZ
F - DON'T COME, WATCH ZOOM

- ✓ Fib
- ✓ Tip chart
- ✓ factorial
- ✓ power
- ✓ fast modular expo
- binary search
- towers of hanoi

start	10	1.50
	11	1.65
	12	1.80
end	20	3.00

TC(11, 20, 15)
start, end, r

int int double
TC(start, end, tiprate)

1. Print row start
2. TC(start+1, end, tiprate)

$$n! = (1 \times 2 \times 3 \times \dots \times (n-1)) \times n$$

$$= (n-1)! \times n \quad (\text{fact}(n) = \text{fact}(n-1) \times n)$$

$$0! = 1, 1! = 1$$

$$b^e = b^{e-1} \times b$$

$$b^x \cdot b^y = b^{x+y}$$

↑
Alg rule

$$\text{power}(b, e) = \text{power}(b, e-1) * b$$

$$b^e = \boxed{b^{e/2}} \times \boxed{b^{e/2}}$$

if e is even

Since same index 1 rec
call and SQUARE IT!
NOT PRACTICAL FOR LARGE
EXP BECAUSE ANS LARGE

Ans What is $b^e \bmod m$?

MODULAR EXPONENTIATION.

MAX INTERMEDIATE CALC $\leq m^2$
SPEED RUN TIME

if e is even

$\text{ans} = \text{fastmodexpo}(b, e/2, m)$

return $(\text{ans} * \text{ans}) \% m;$

Towers (START, END, N)

In order to move disk n ,
I must move all $n-1$ disks
above to a ~~to~~ different tower

⇓
TOWERS PROBLEM