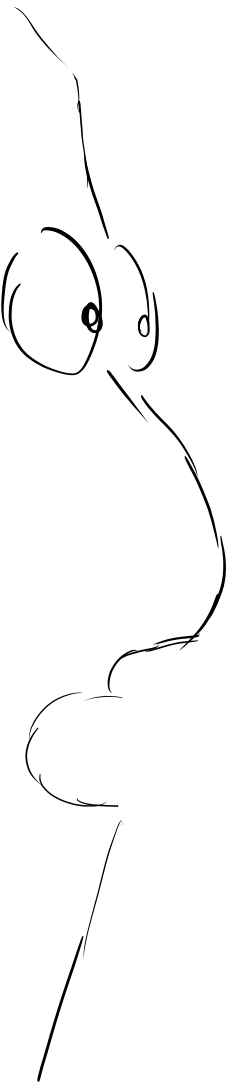




Oops!



WHY DOES IT
HAVE SEVEN
LITTLE LEGS?



Banker's Algorithm

- Each agent state Max resources
- Track used / unused resources
- only allow alloc if someone can finish

max

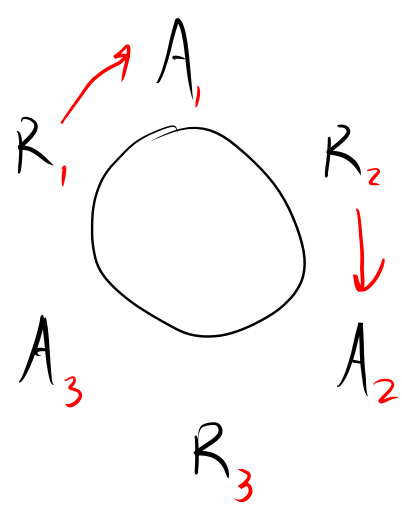
$$A \begin{bmatrix} 1 & 1 & 0 \\ 0 & 1 & 1 \\ 1 & 0 & 1 \end{bmatrix} R$$

avail

$$\begin{bmatrix} 0 & 0 & x \end{bmatrix}$$

leftou

$$\begin{bmatrix} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & x \end{bmatrix} \begin{matrix} x \\ \checkmark \\ x \end{matrix}$$

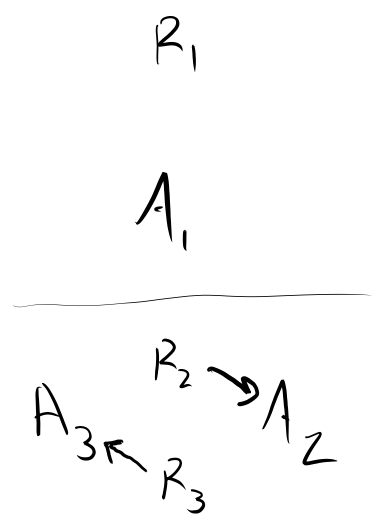


left

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 1 \\ 0 & 1 & 0 \end{bmatrix}$$

avail

$$\begin{bmatrix} 1 & 0 & 0 \end{bmatrix}$$



Hypothetical:

- if allocate to request
- can someone finish
- if so, after they finish can another finish
- until all finish

naive: $O(A^2 R)$ per request

Deadlock ^{most programmer} →

- either hope it doesn't happen
- Detect + kill

→ deadlock-free

- ↳ (correctly) max resor
- ↳ handle failed locks
- ↳ make killed threads ok

1. why? →

• sometimes deadlock

2. message passing

3. DP soln 3

4. R/W on files in reality

1. cost of perfection
vs cost of failure

message passing API



send (io_agent, msg)

```
while (true) {  
    msg = read_a_message()  
    switch (msg) {  
        ==  
    }  
}
```