RECITATION8

Schedule

Mon	Tues	Wed	Thurs	Fri
Today!			malloc checkpoint	
	Exam2			
	malloc final			

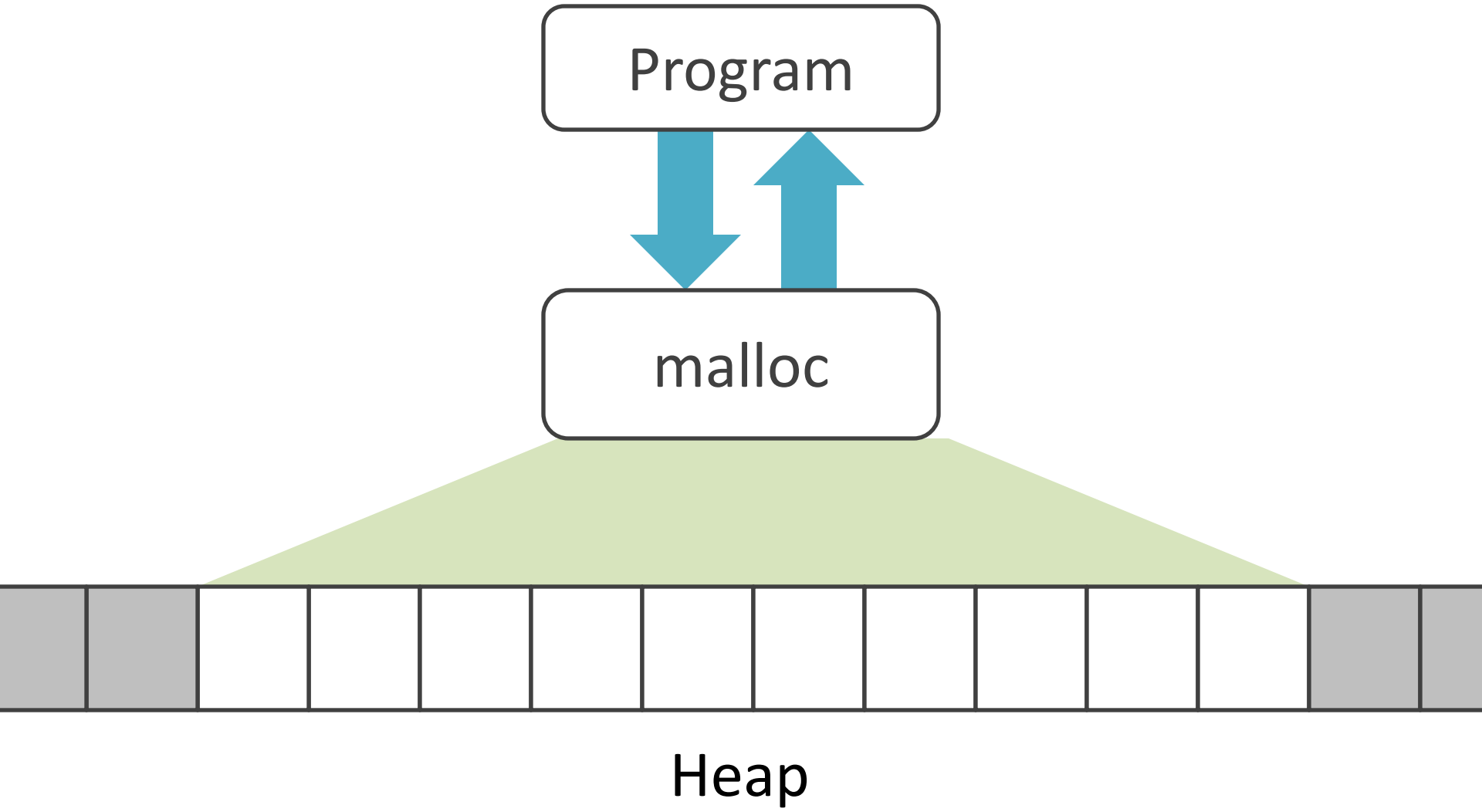
Today

mallocлab

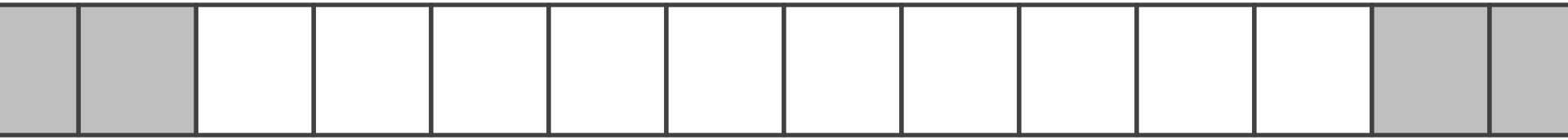
virtual memory

malloclab

Architecture

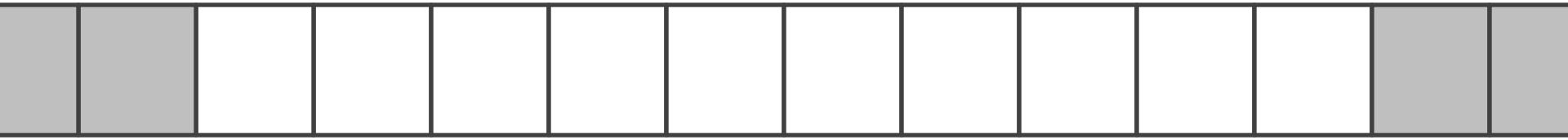


Initial empty heap

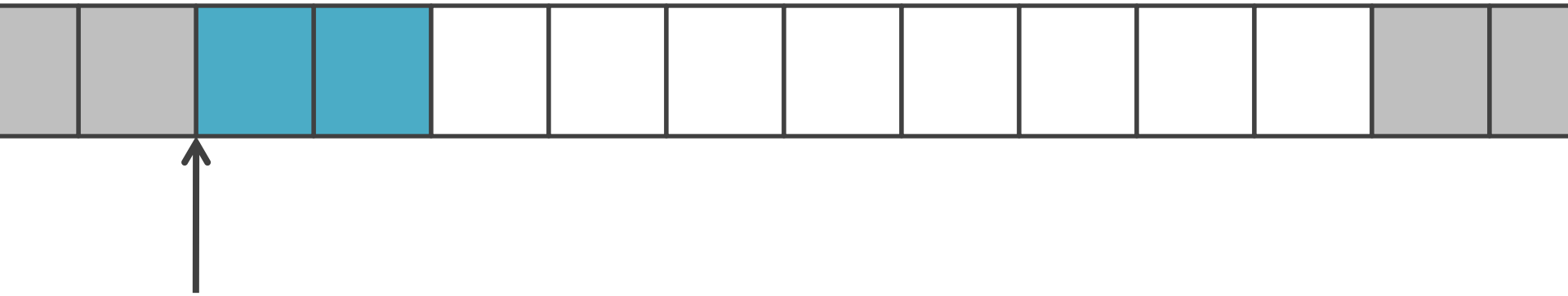


Heap

a = malloc(2);

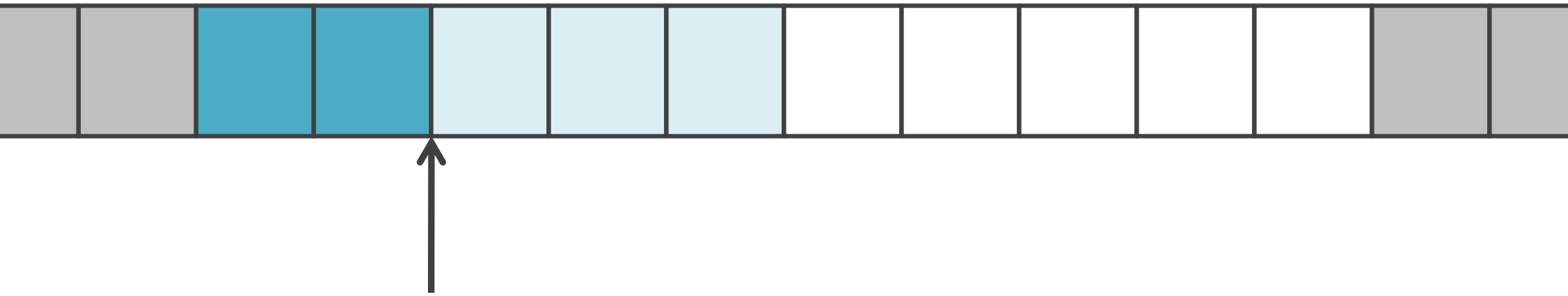


a = malloc(2);



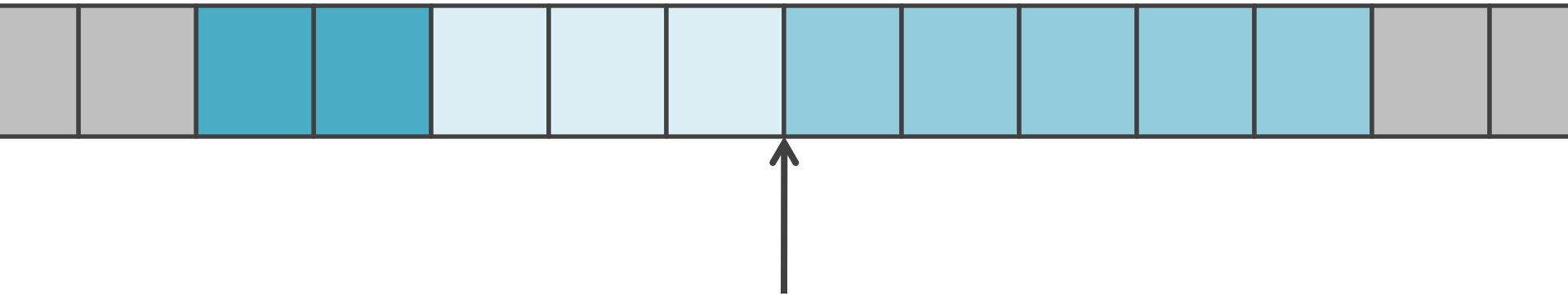
Return this address

b = malloc(3);



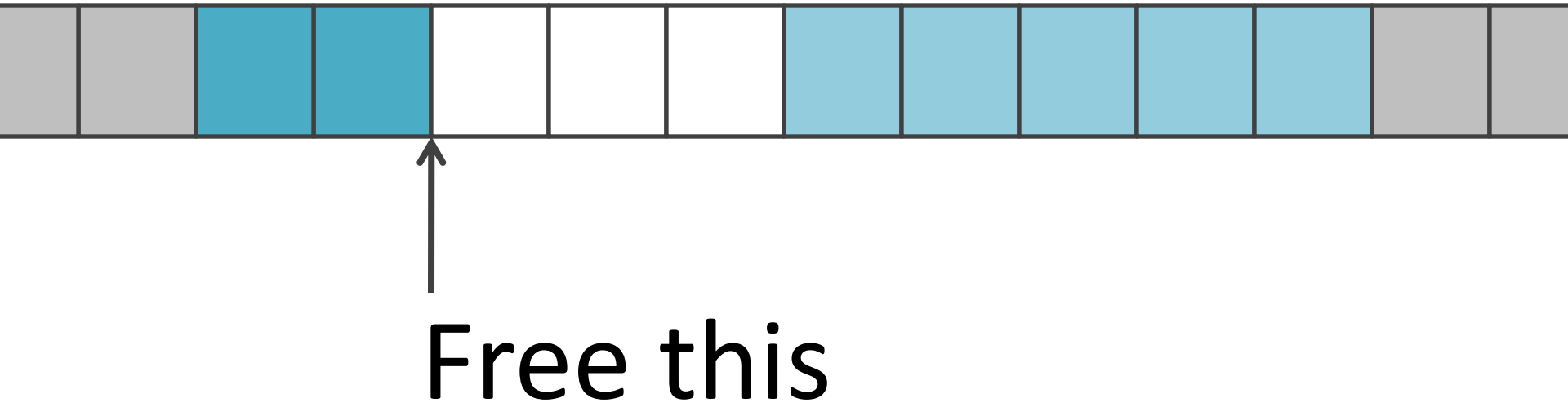
Return this address

c = malloc(5);



Return this address

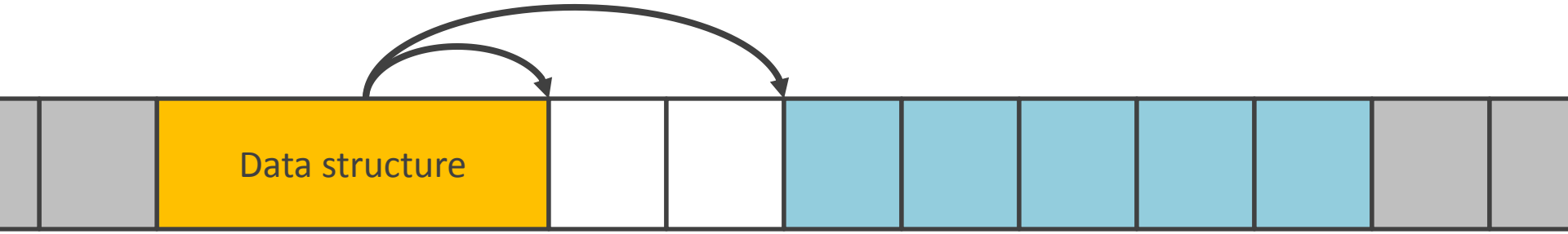
free(b);



Free this

How do we keep track of blocks?

Proposal: use a data structure

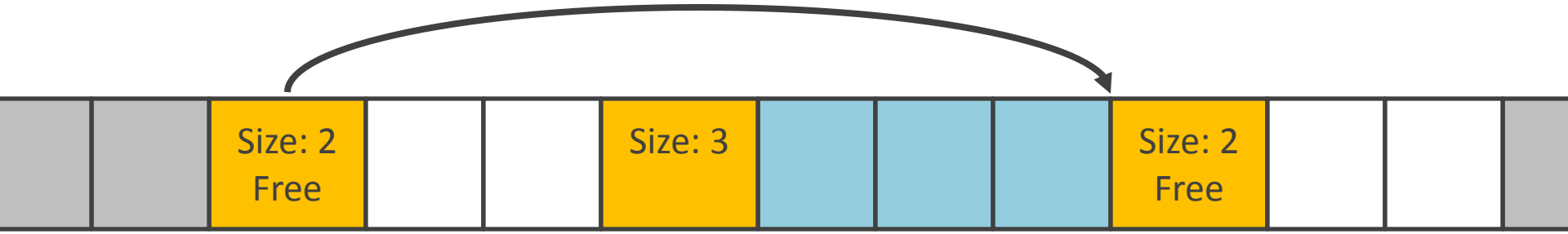


Problems?

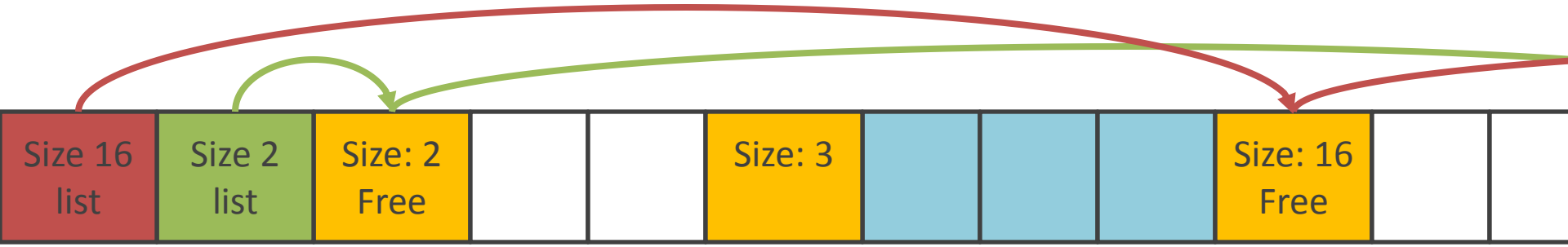
Implicit list

Problems?

Explicit List

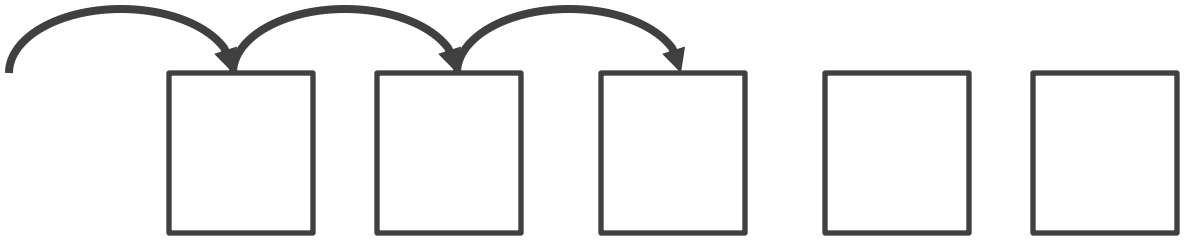


Segregated List



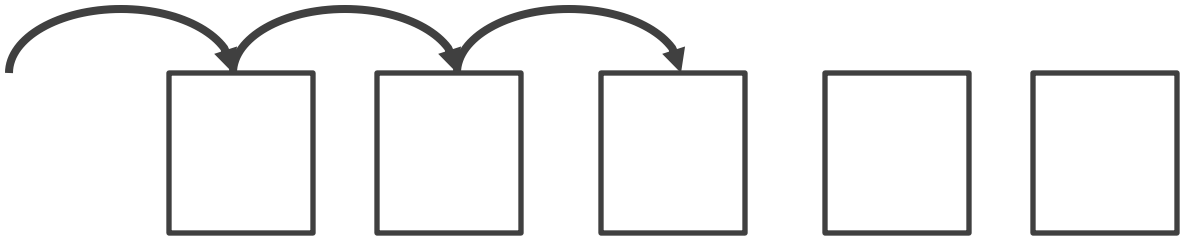
Choosing a block

First fit

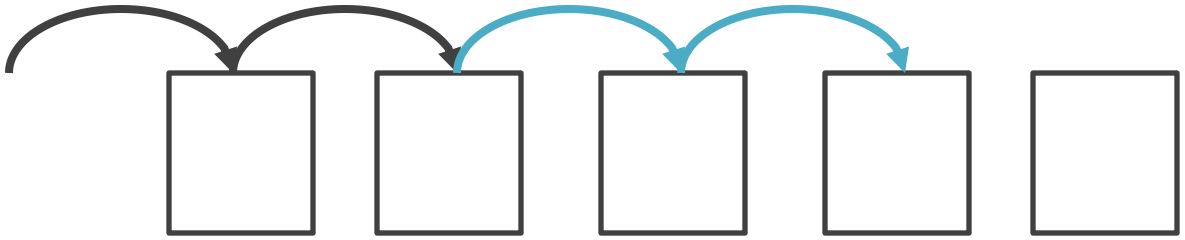


Choosing a block

First fit

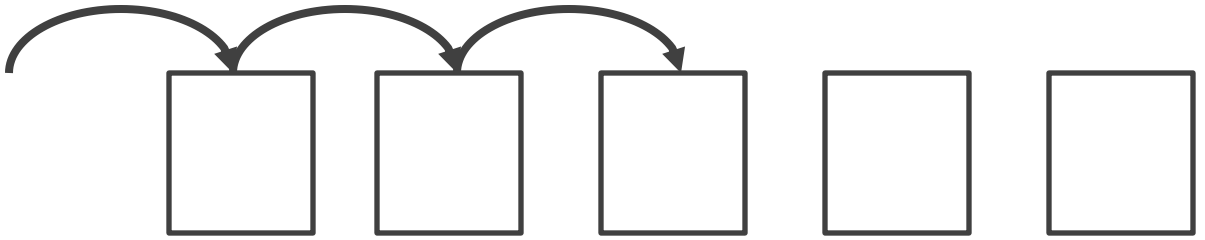


Next fit

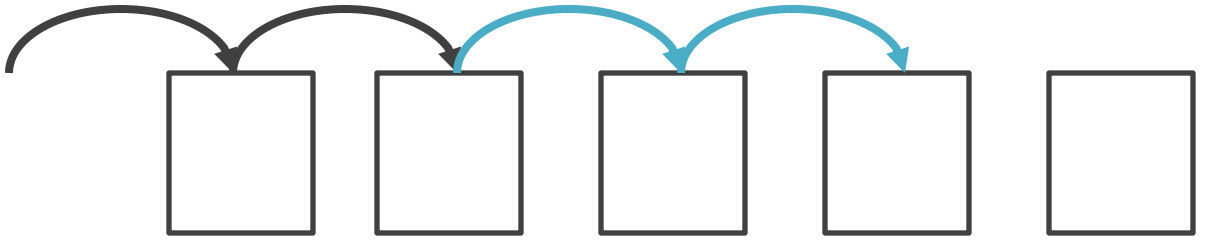


Choosing a block

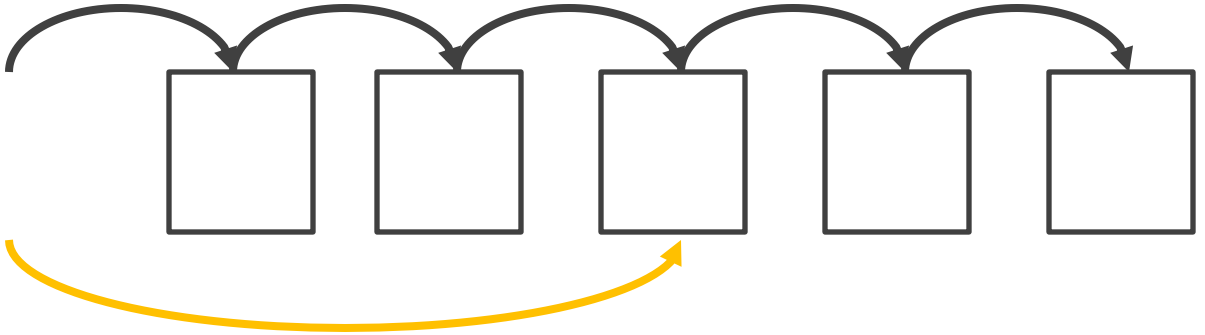
First fit



Next fit



Best fit



When to coalesce?

After freeing a block

When no sized block exists

When searching the list

What are the best options?

Implicit/Explicit/Segregated

First Fit/Next Fit/Best Fit

Coalescing

C Hints/Tricks

Using structs rather than macros

gives one much more flexibility

struct __attribute__ ((__packed__))

bit-fields

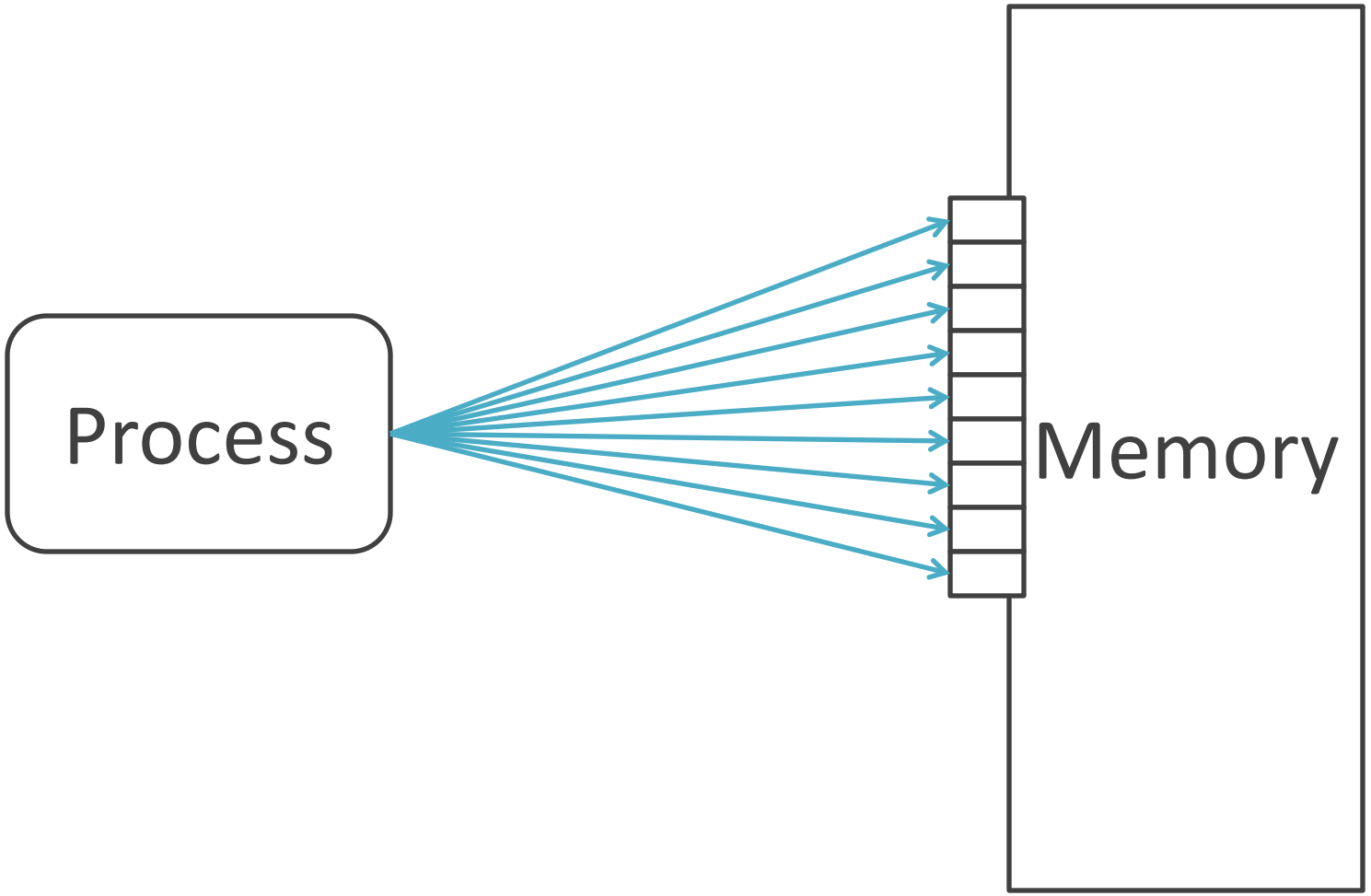
But keep in mind...

"Premature Optimization is the root of all evil"

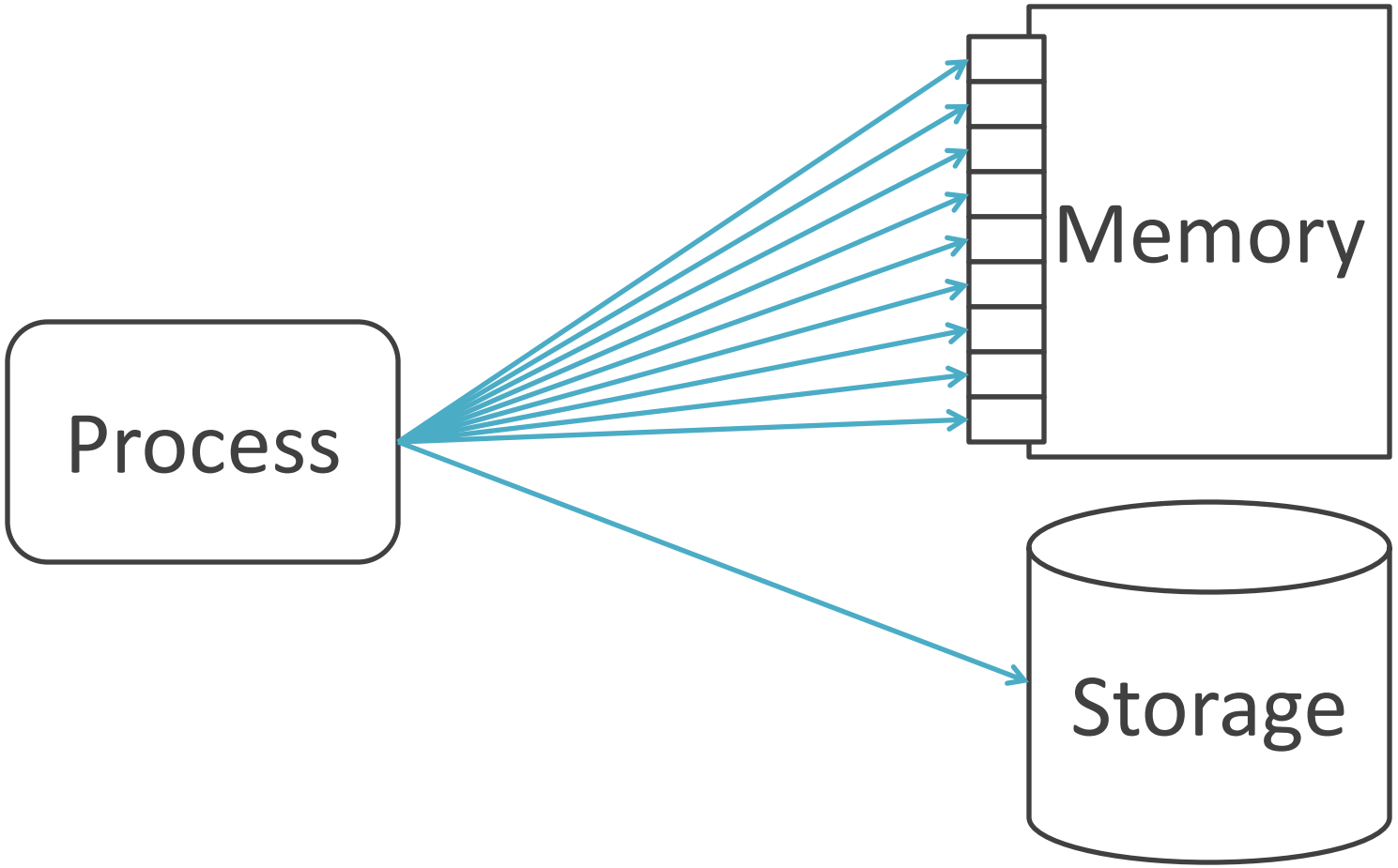
-Donald Knuth

Virtual Memory

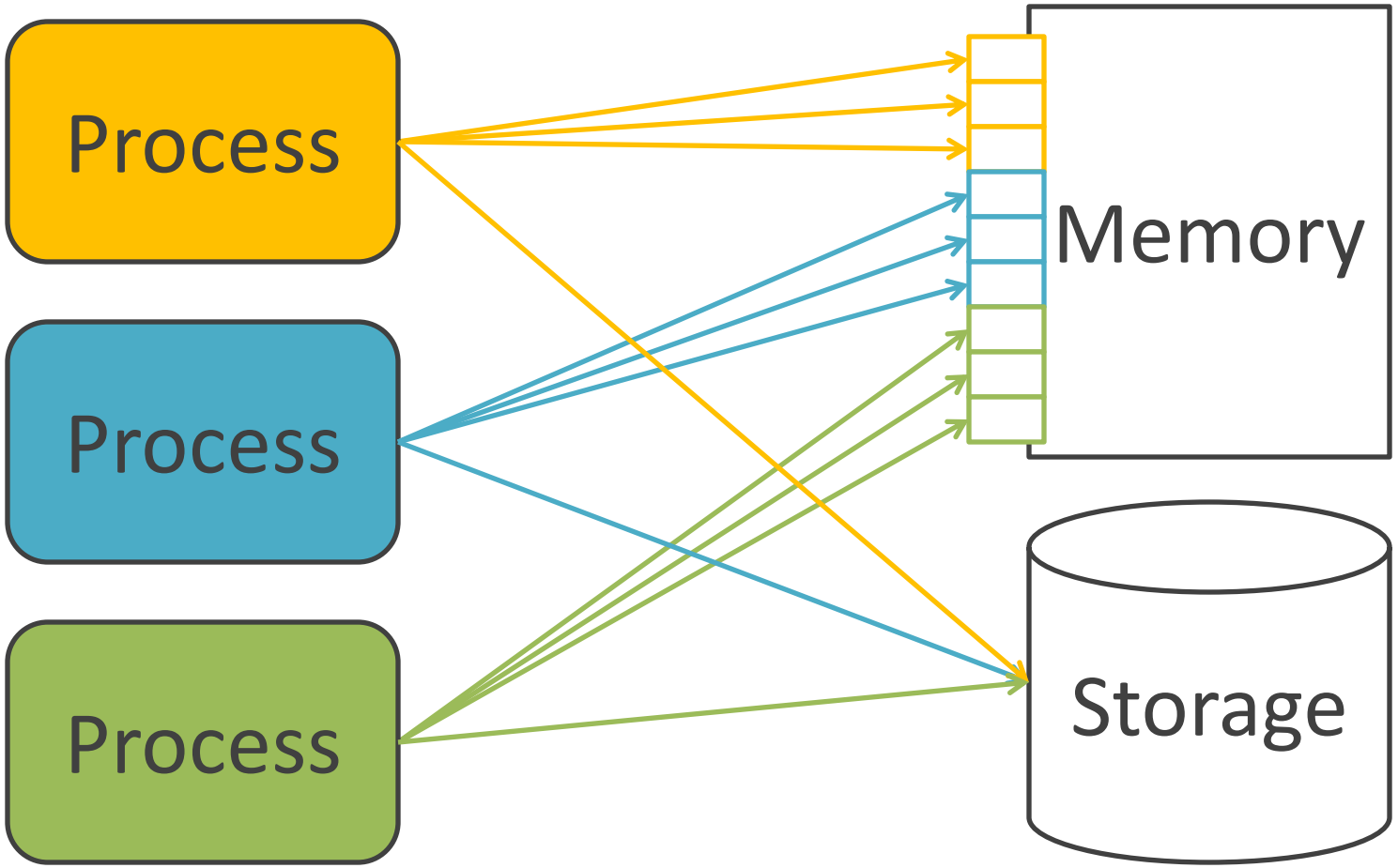
Memory



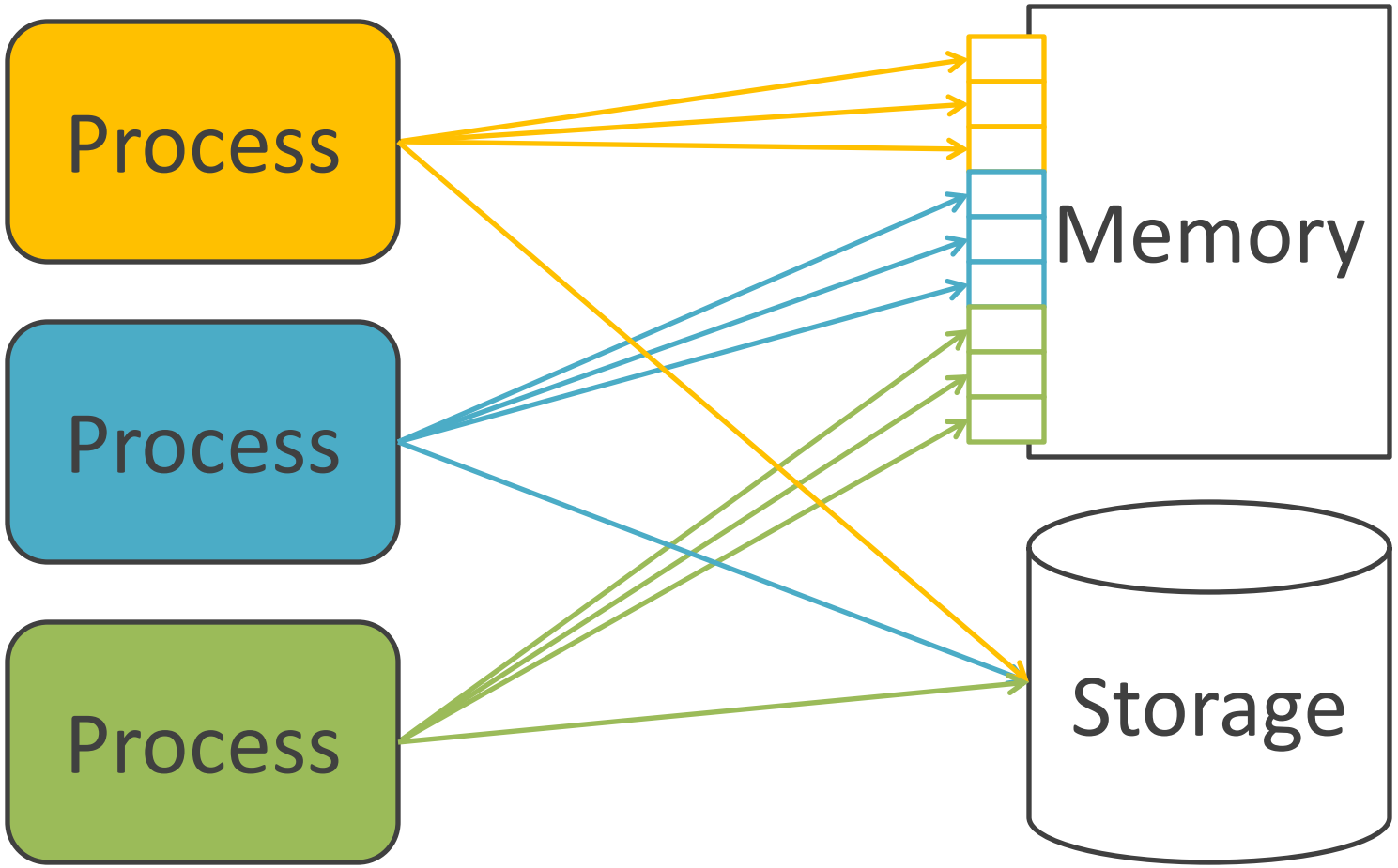
Secondary Storage



Multiple Processes



How do we deal with all this?



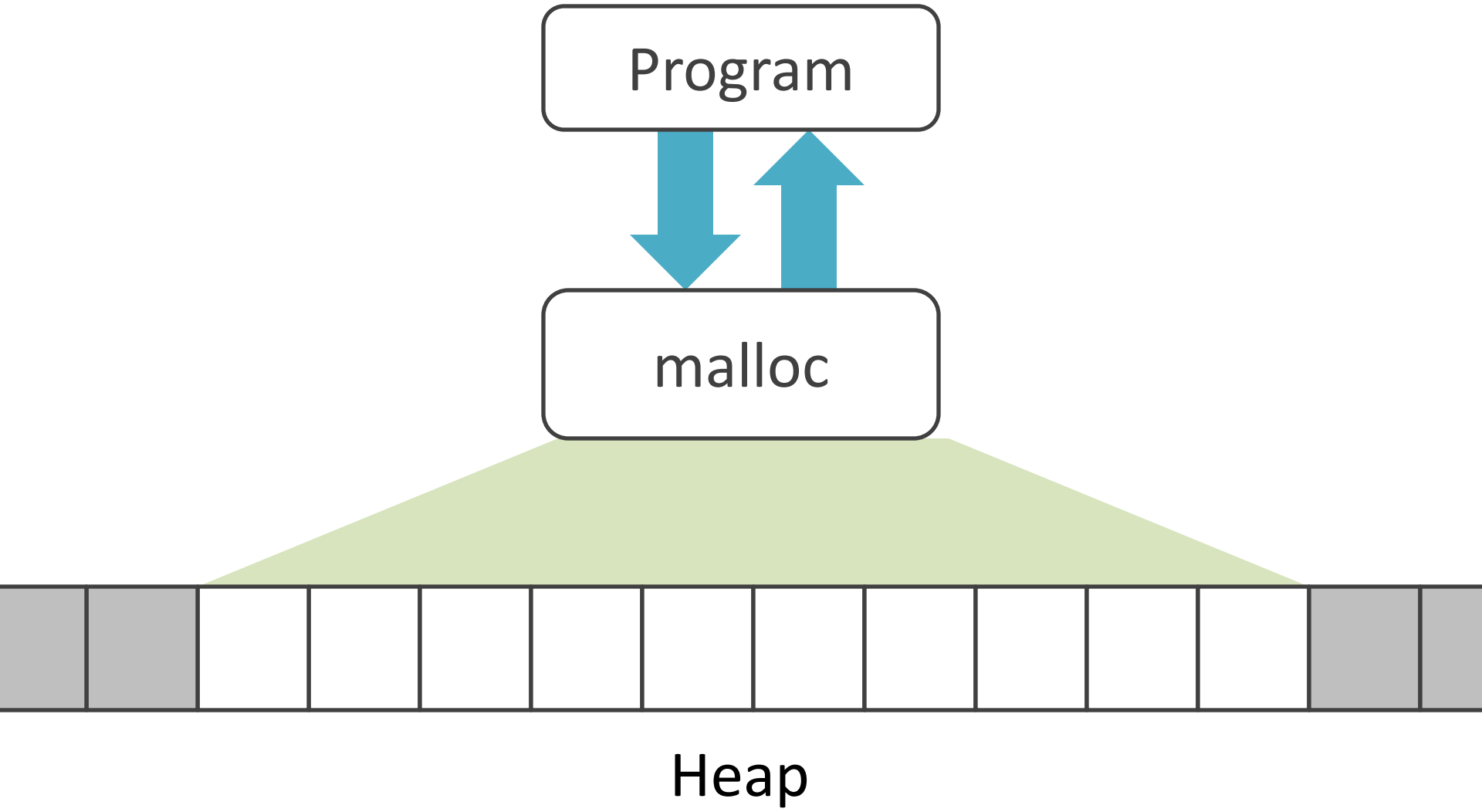
"All problems in computer science can be solved by another level of indirection"

-David Wheeler

WTF is level of indirection?!?

Abstraction…
Virtualization…
Interfaces…
Layering…

Remember this?



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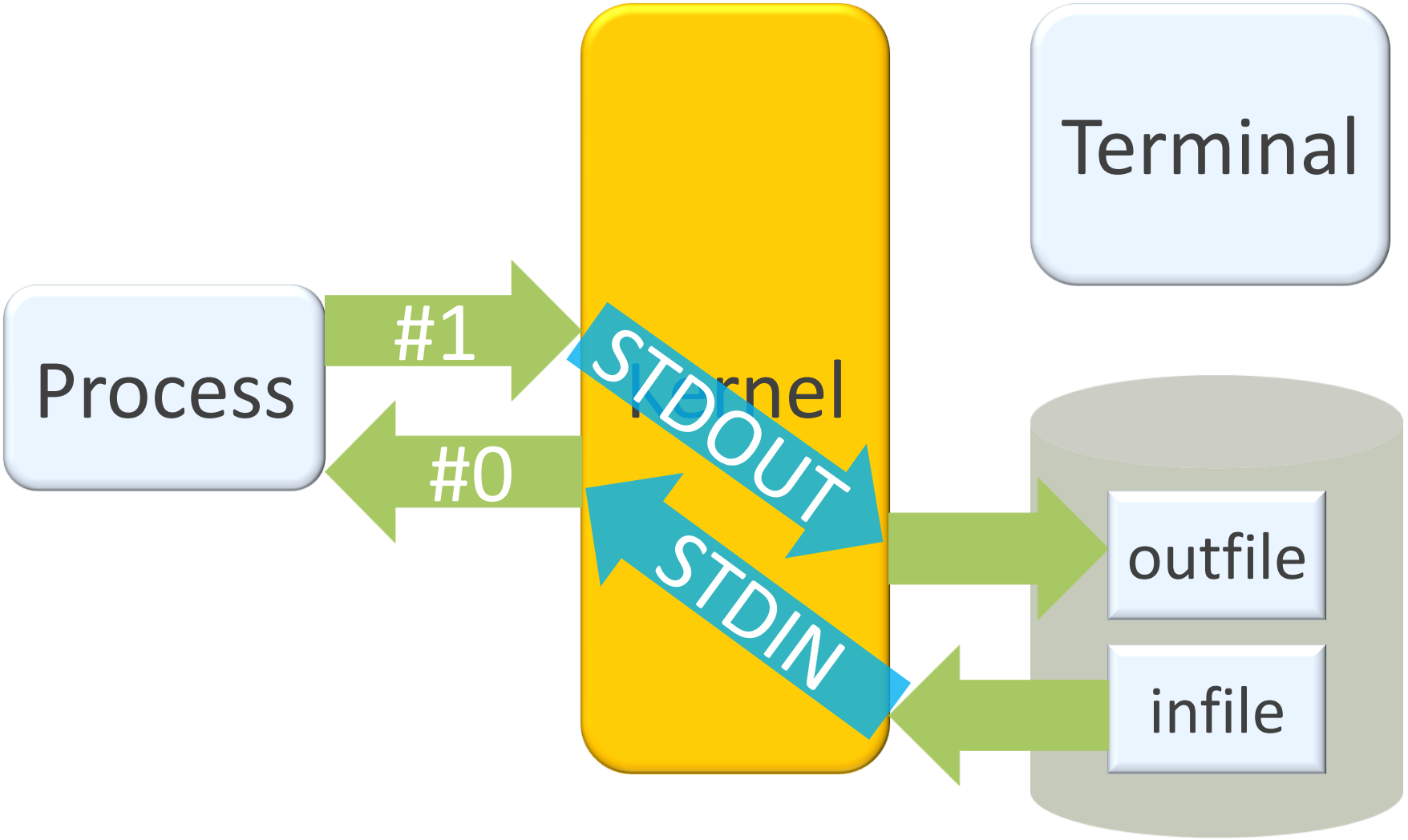
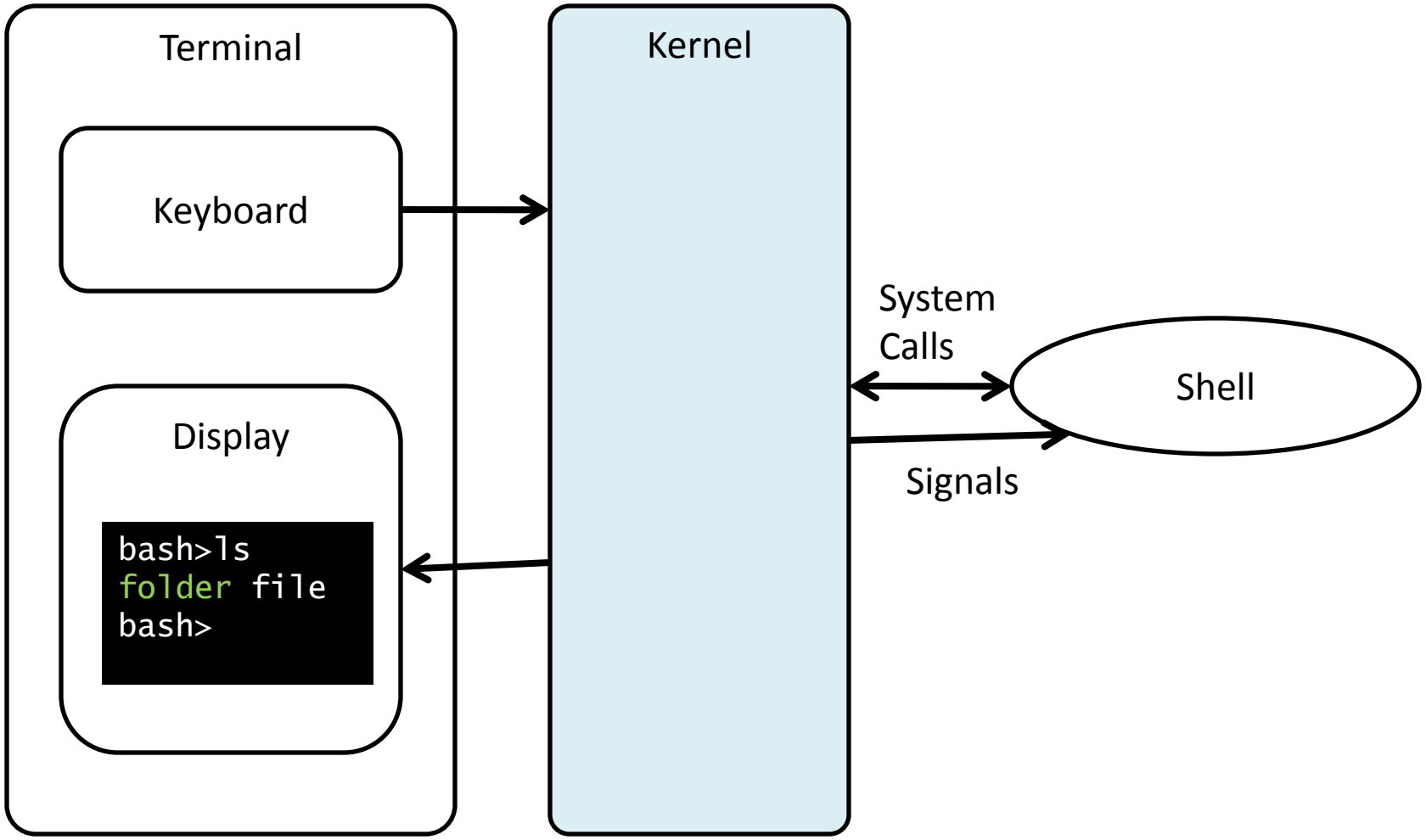


Remember this?



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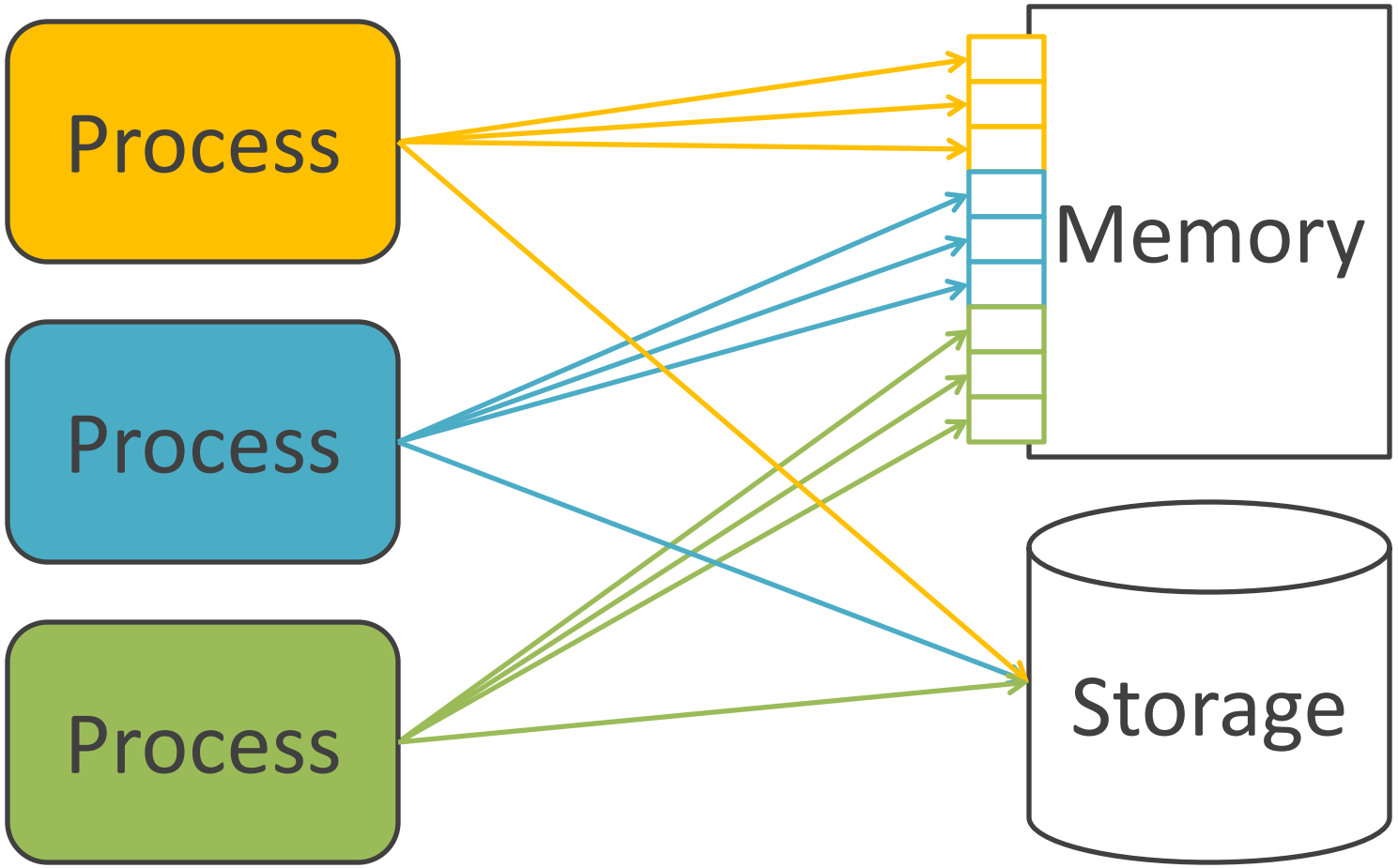
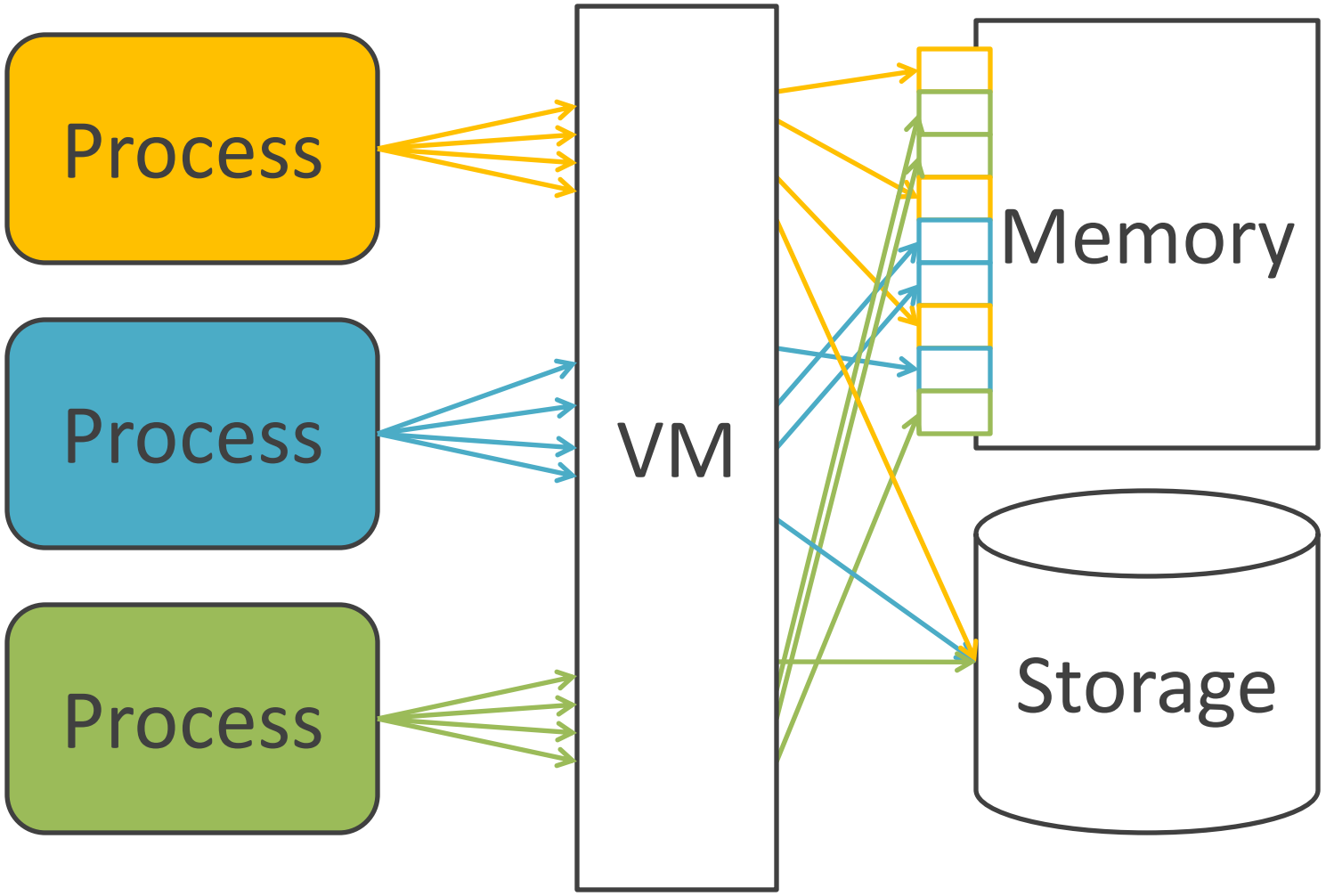
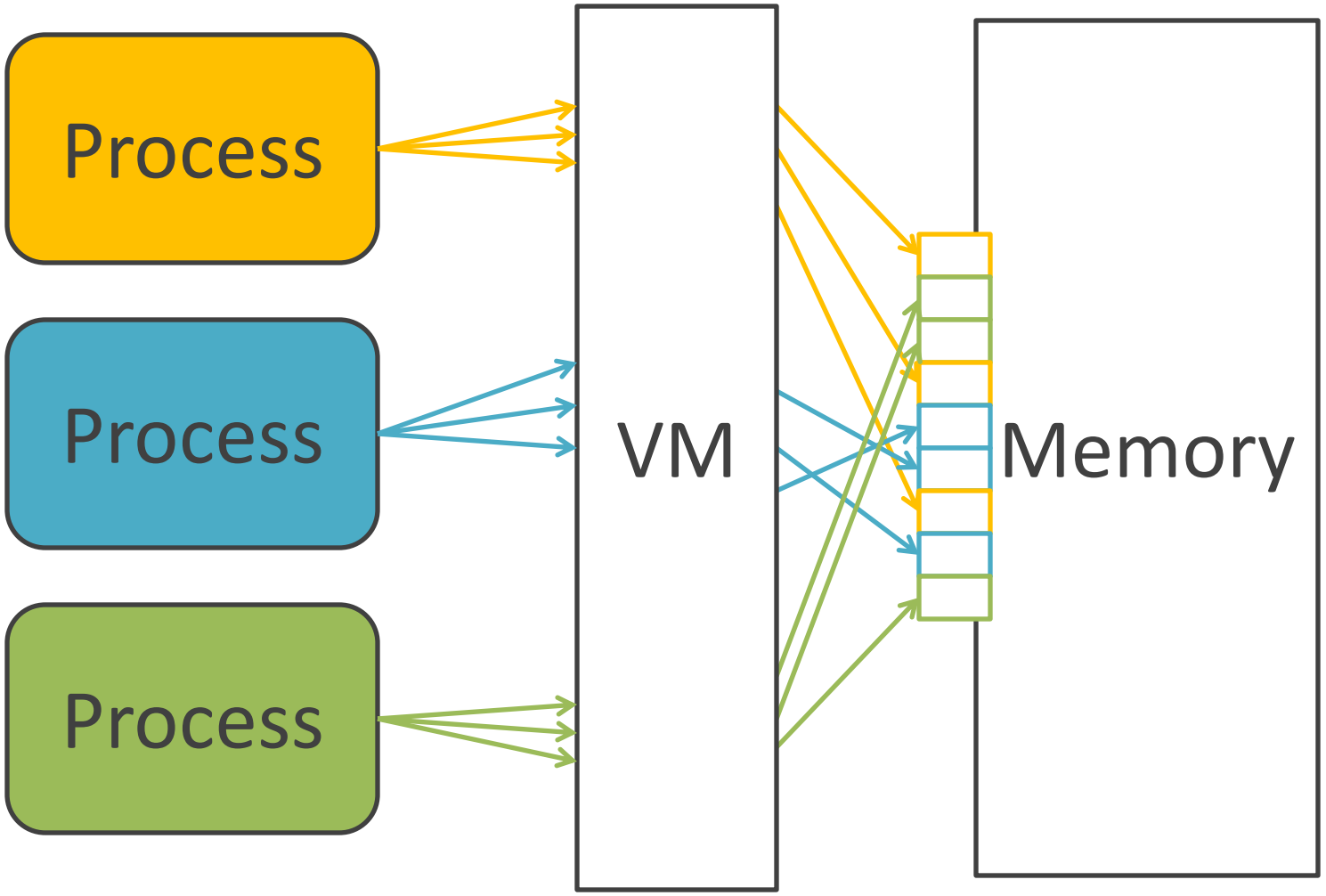


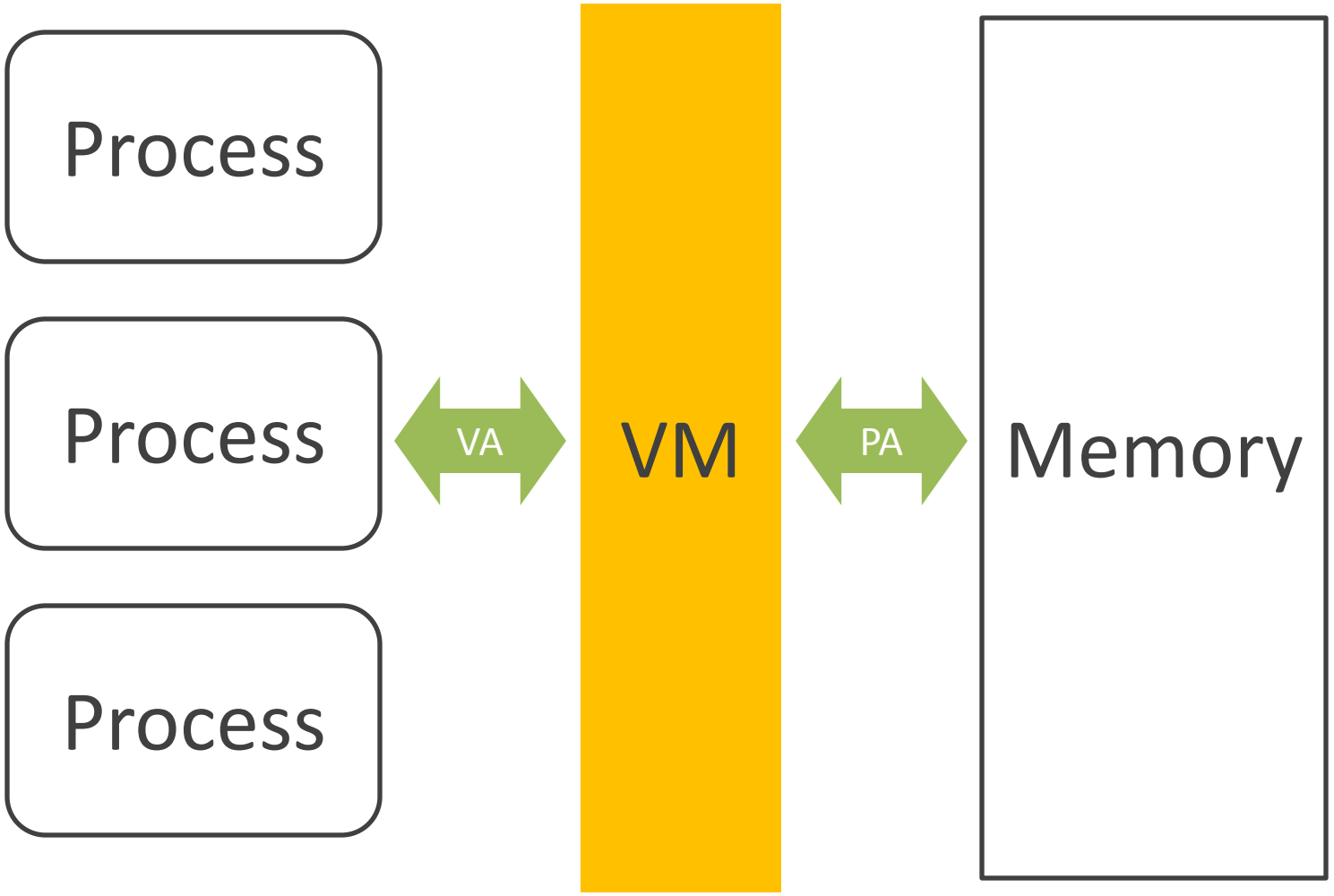
Virtual Memory



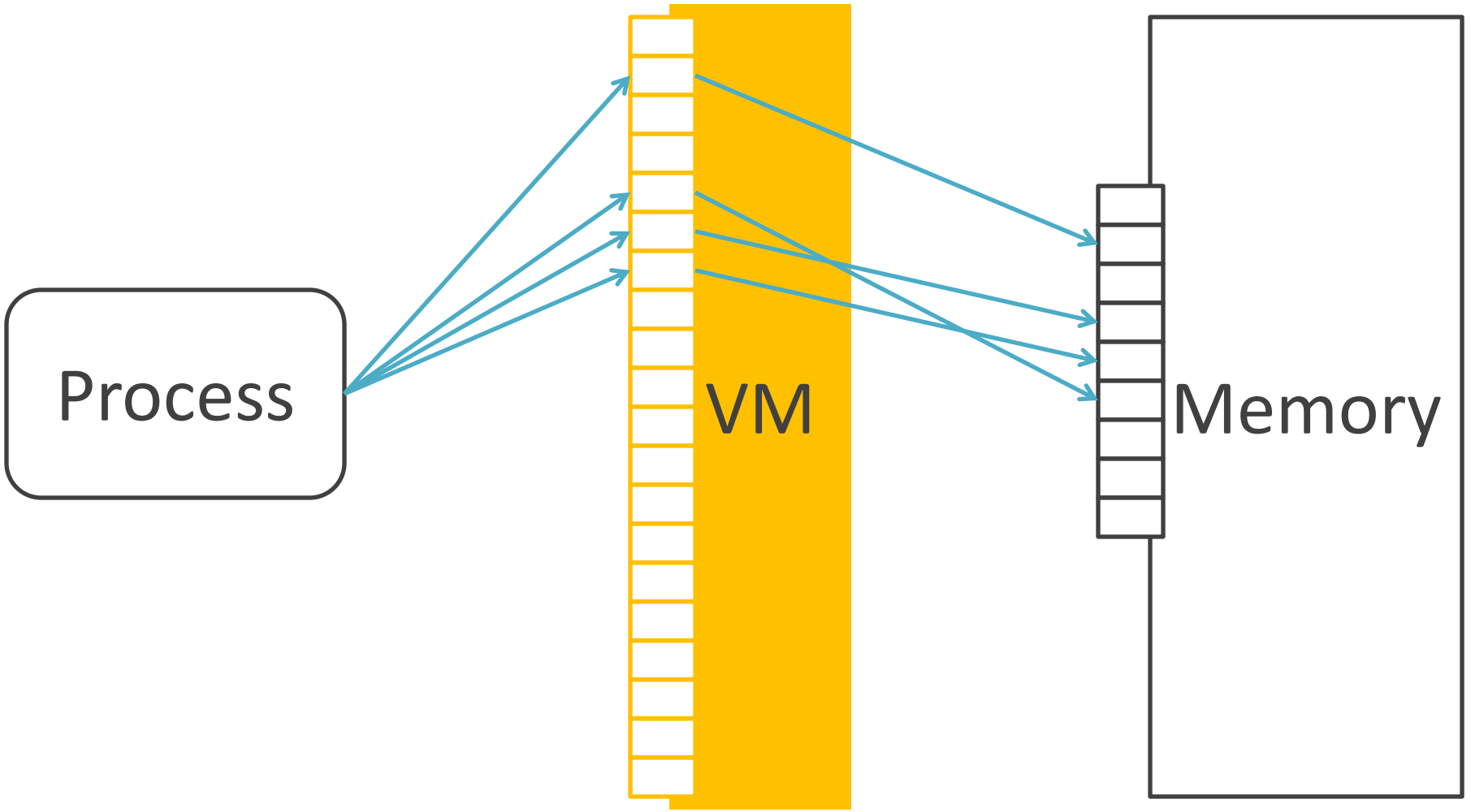
Physical Memory for now



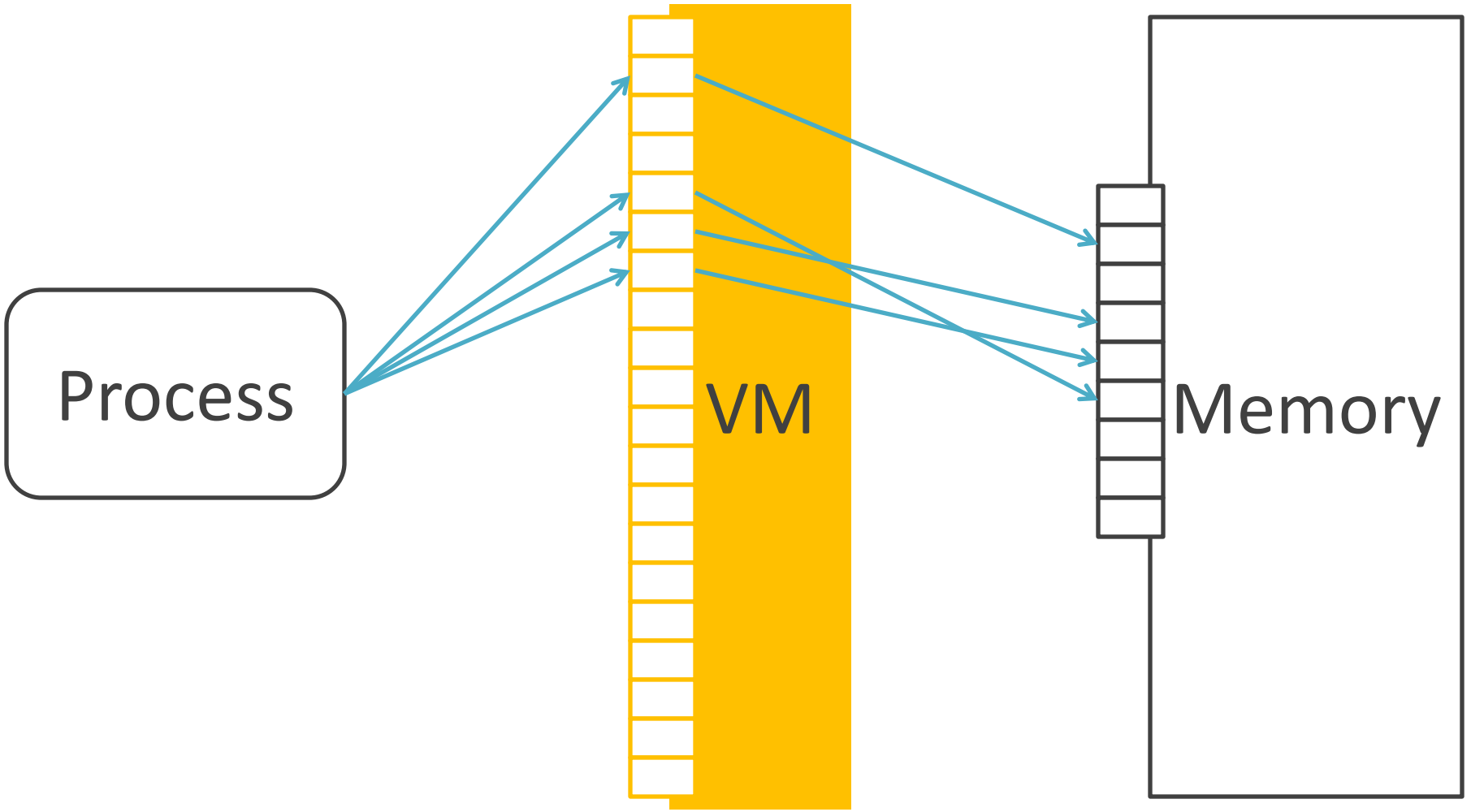
VA -> PA



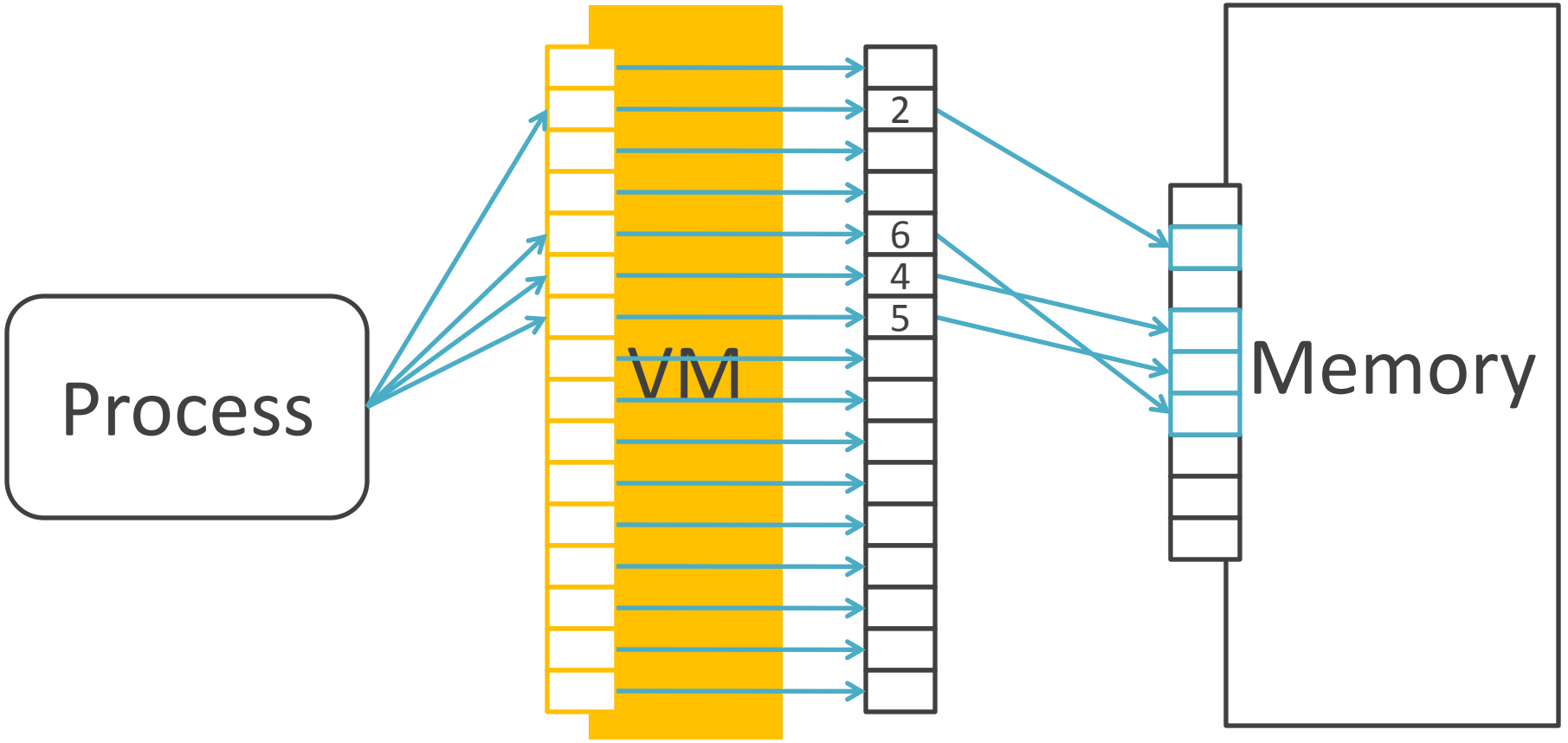
Process sees entire VM space



How do we map VA->PA?

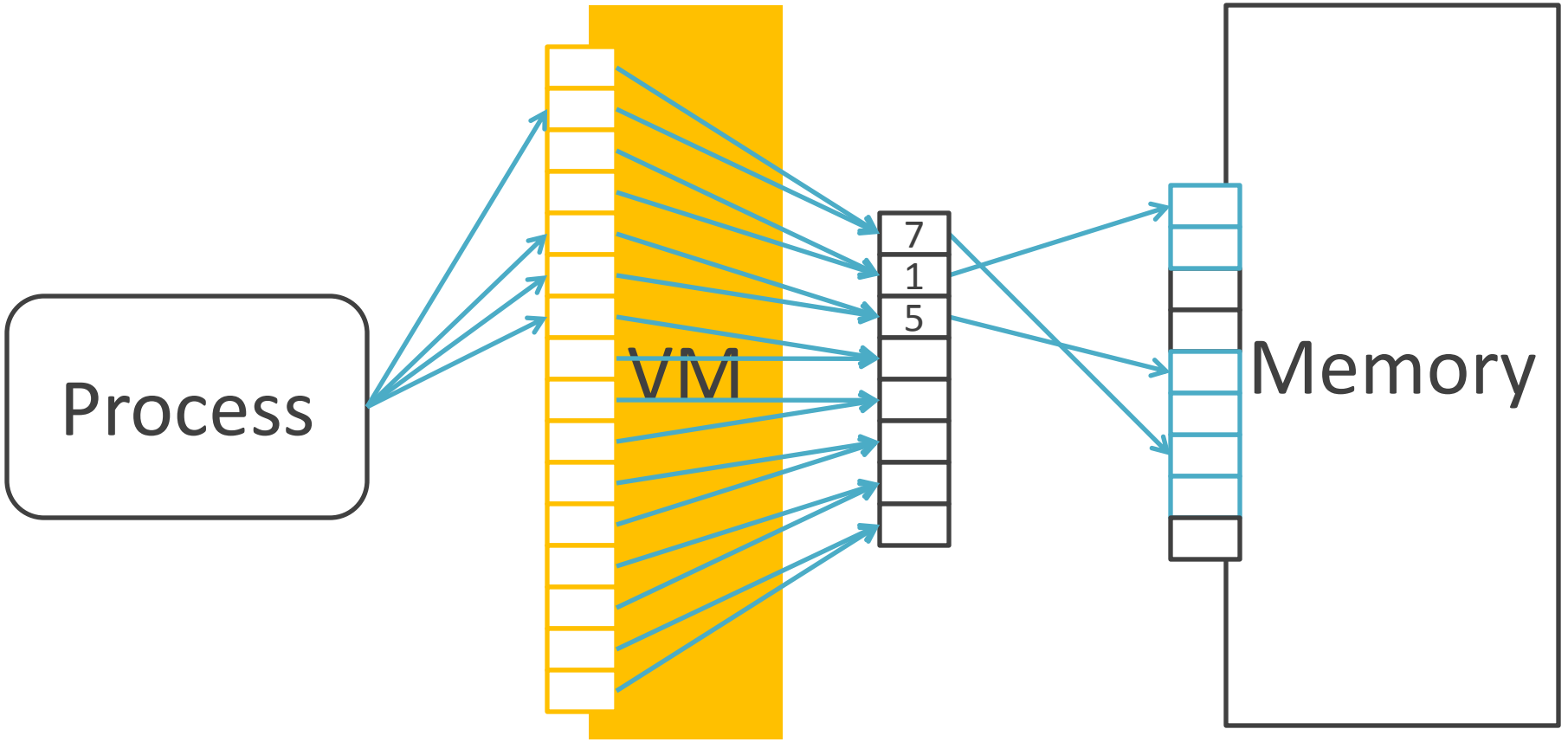


Keep an Address Map Table

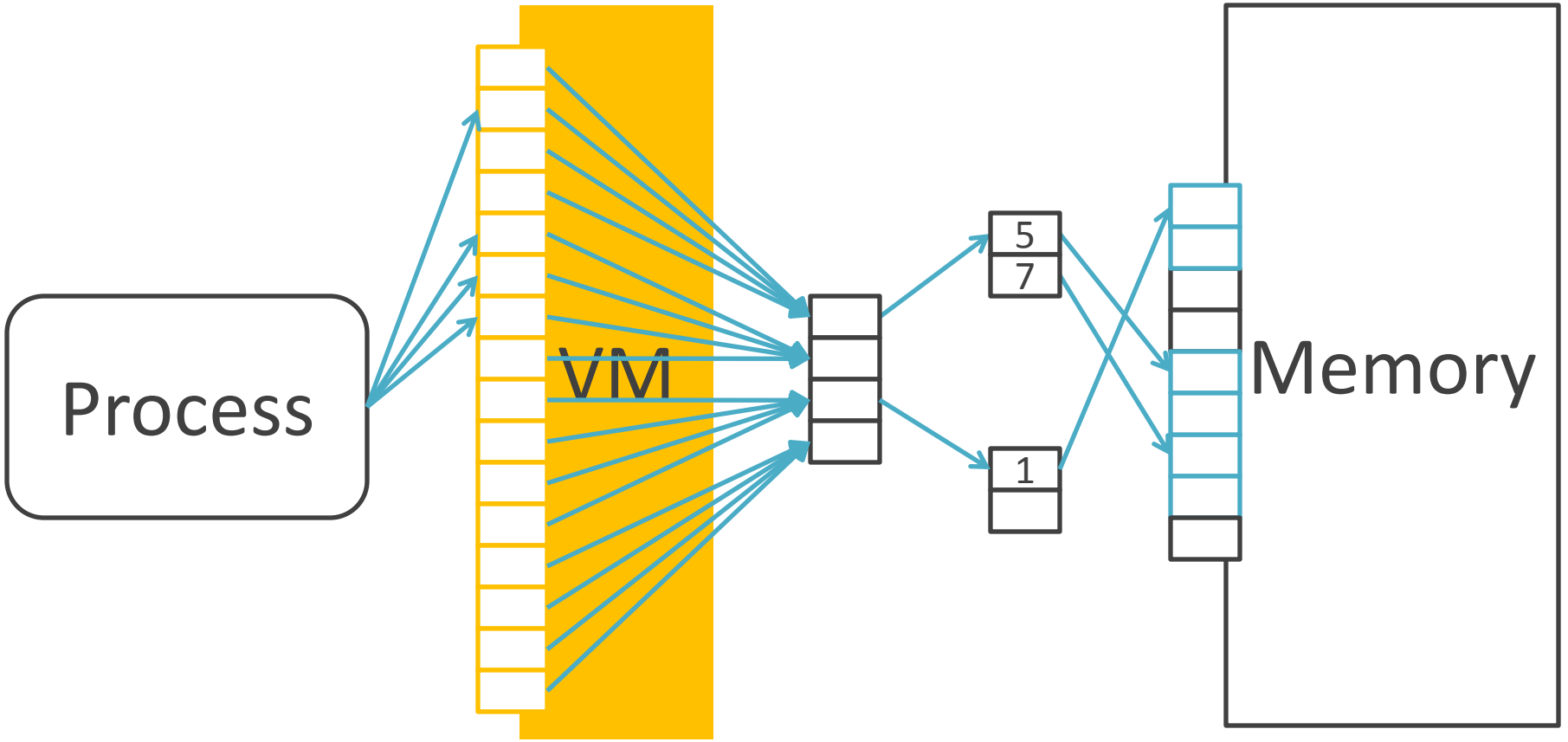


Problems?

Keep a Page Map Table



2-level page tables



Common Interview Question

What is Virtual Memory?

Extremely useful level of indirection

- Protect processes from each other
- Seamlessly use secondary storage when physical memory runs out
- Allows processes to use 32/64 bit address space no matter how much physical memory there actually is
- Cool use for memory saving optimizations: COW, zeroed page

START STUDYING!