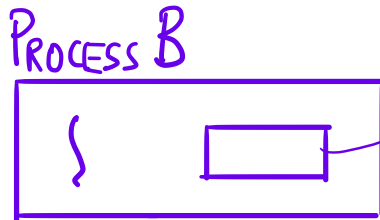
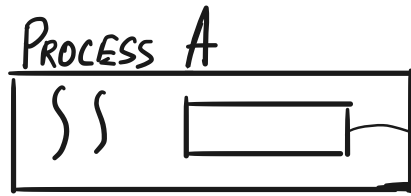


# CS202: VIRTUAL MEMORY

## o UNDERSTANDING THE PROBLEM

PROCESSOR



char [ ]

PHYSICAL MEMORY

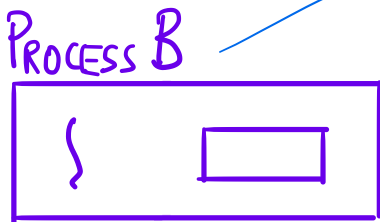
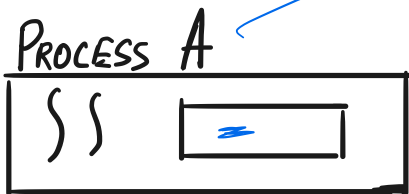


(RAM)

m (e.g.,  $32 \cdot 2^{30}$ )  
32GB

## WHAT IS DESIRABLE?

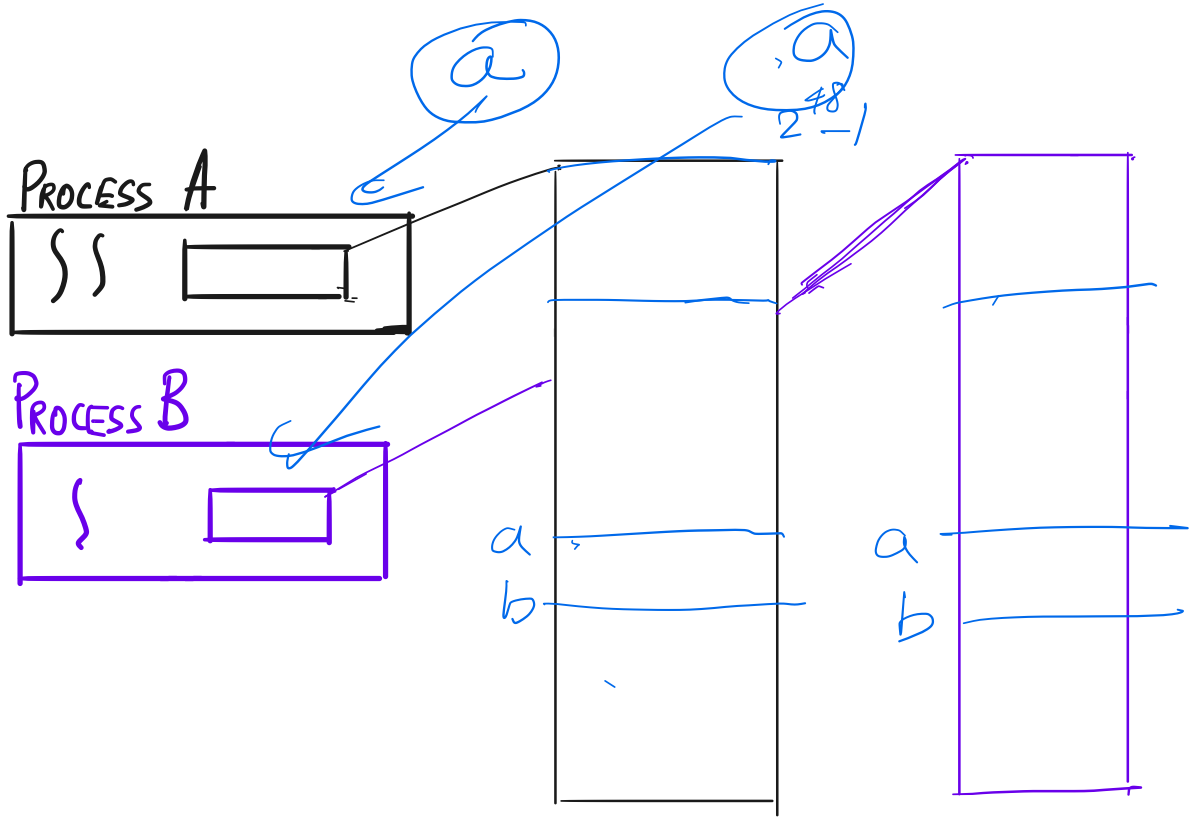
### ① ISOLATION



WHY? ① Reasoning

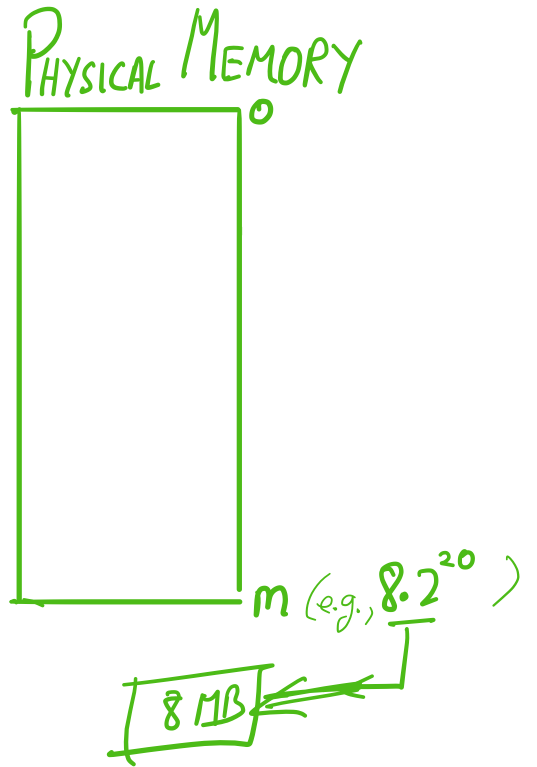
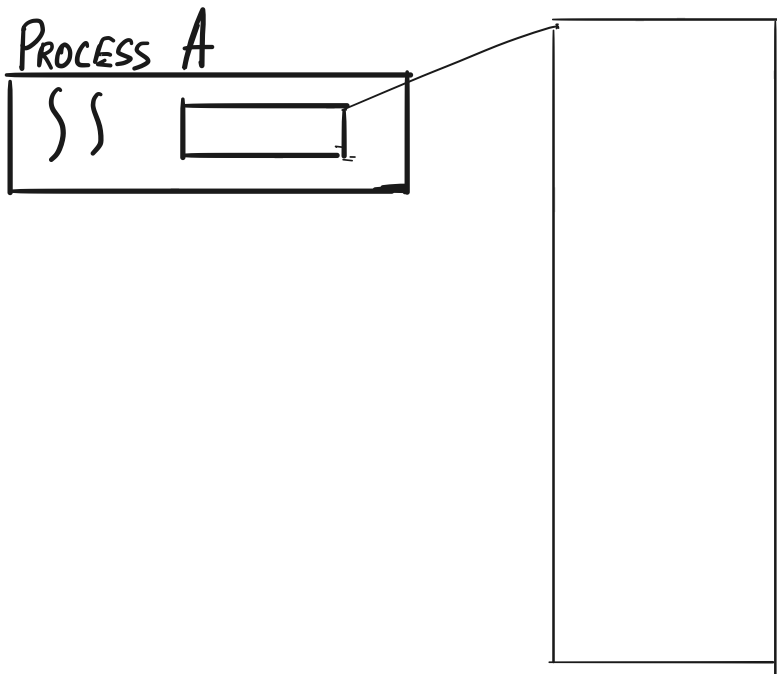
② ... 27

## ② POSITION INDEPENDENCE



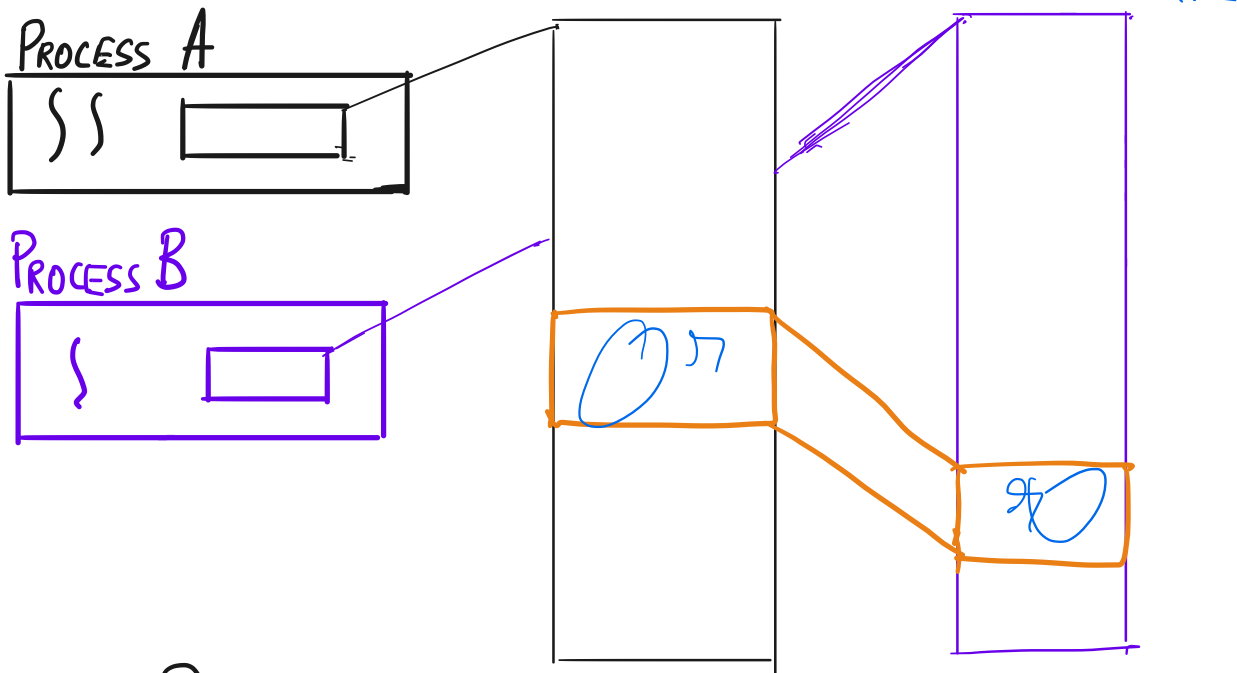
WHY?

③ "OVERCOMMIT" - ALLOW PROCESSES TO ACCESS MORE MEMORY THAN PHYSICALLY AVAILABLE



WHY?

④ CONTROLLED SHARING



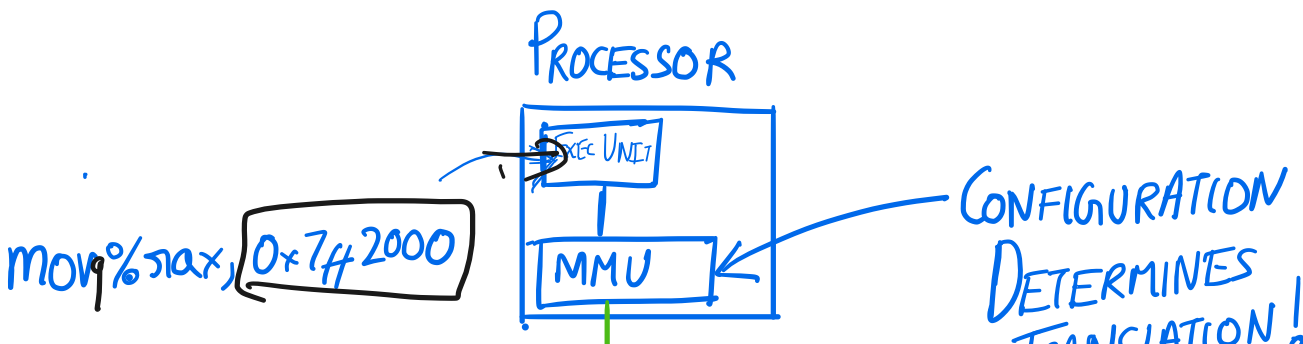
WHY?

int64x; }  
 ...  
 @ = 5;

leaq %rax, %rbp, offset-  
 movq \$5, (%rax)

address

How?



Memory Management Unit

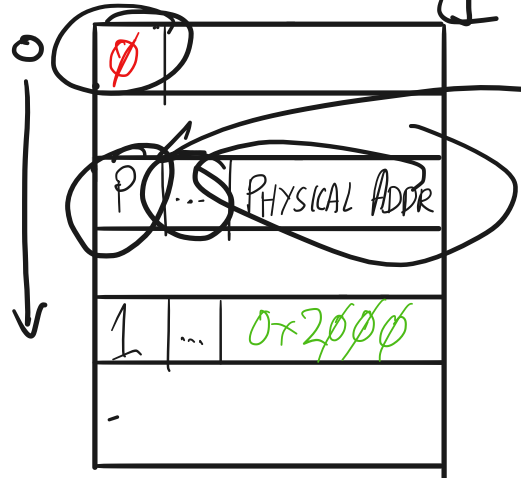


### MMU CONFIGURATION

REGISTER (%CR3) :- ADDRESS OF PAGE TABLE  
(PHYSICAL ADDRESS)

PAGE TABLE (ABSTRACT)

```
movq %rax, X
```



Present

VA. Max

### PROBLEM :- PAGE TABLE SIZE

#### SOLUTION

① MAP AT A COARSE GRANULARITY

- 4KB, ...

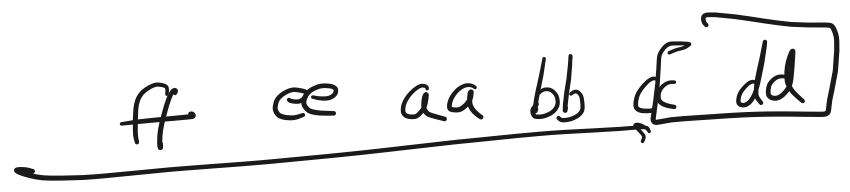
1KB 1024 Bytes - 0x1000 Bytes

4KB = 4096 bytes = 0111111111111111  
 addr/4K → aabbc → V7  
 + cdd

32-bit



48-bit



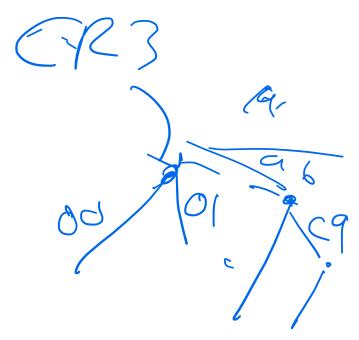
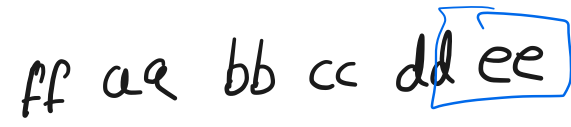
② BUILD A TREE

- ASSUMPTION: SPARSITY

32-bit



48-bit



Page