① Simple Page tables.

Frame = block for below

① start with mem size (127 rows or 7 bits)
② decide block size below we have 8 blocks
③ # bits to address each block $\log_2(\text{block\_size}) = 3$ bits
for left we need $\log_2 16 = 4$ bits
4 bits to get to every cell in a block

0 / 16	05
32	X
64	3
	0
	X
	2
	X
128	1

④ Now how about your process?
say it takes 4 blocks
⑤ each block is 16 bytes long

Page#	
0	16
1	32
2	48
3	64

bits to address it all = $\log_2 64 = 6$

B_5 B_4 B_3 B_2 B_1 B_0
V. page # | offset in block

⇓
Address trans
⇓
P_6 P_5 P_4 P_3 P_2 P_1 P_0
Physical F# | offset

Pagetable

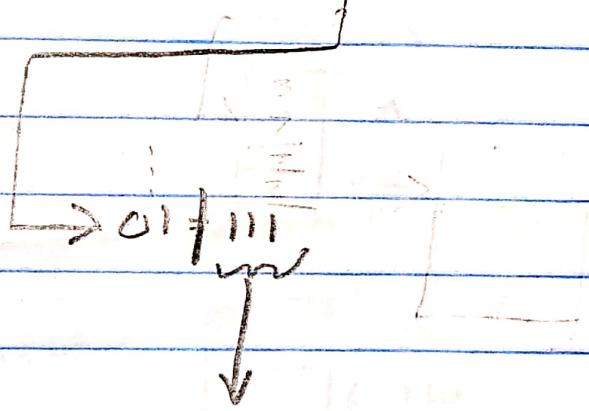
Index	VP	PF
→	0	3
	1	7
	2	5
	3	2

⇒

00	011
01	111
10	101
11	010

Say we have `mov 21 %eax` load eax from 21

21 ⇒bin⇒ 010101

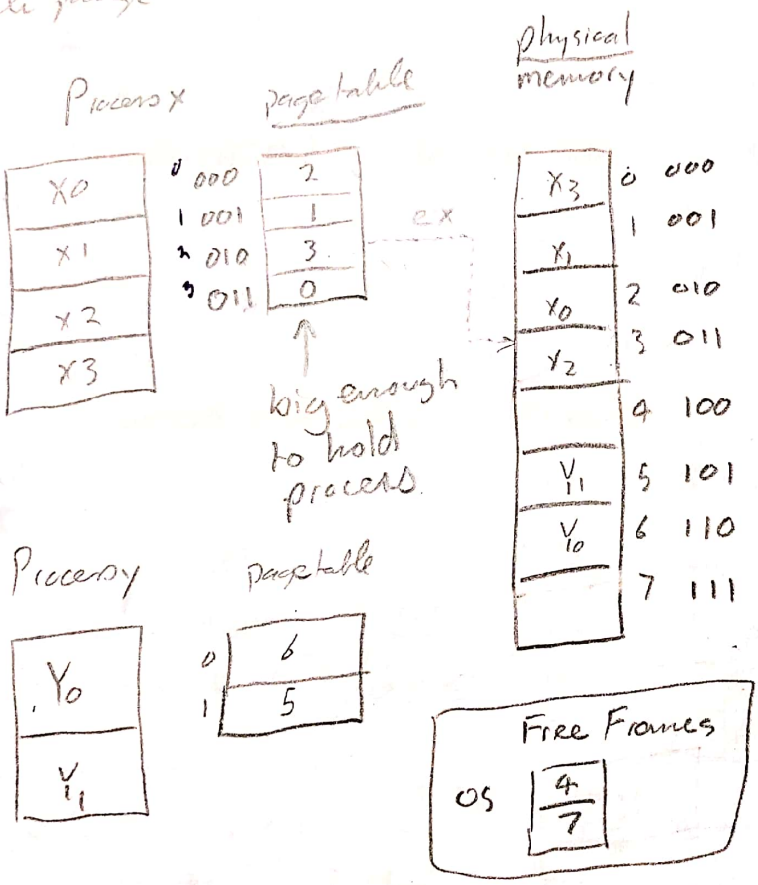


111 0101 ← physical address

* borrowed from www.cs.columbia.edu/~junfeng/10sp-w4118/lectures/...

Paging

each page table kept with process control block



say have 8 bit address space

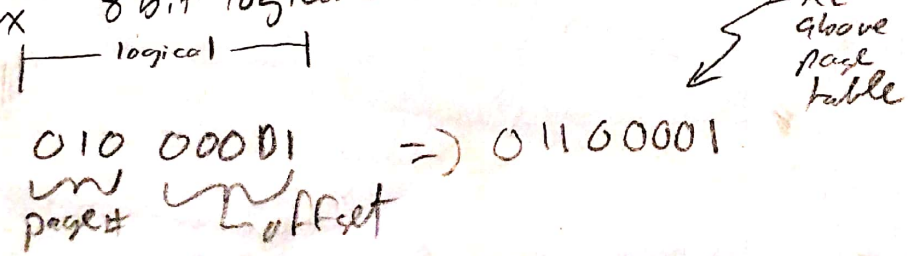
have 8 frames (3 bits)

frames have $2^5 = 32$ words

but still need all of process in mem at once!

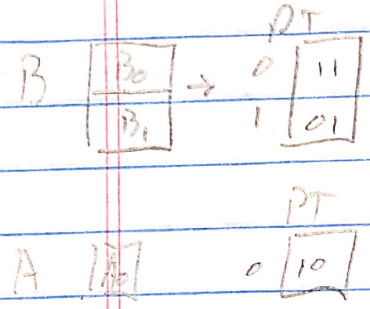
also internal frag on last block of process.

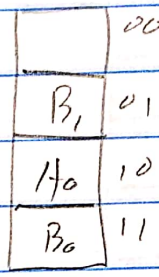
ex 8 bit logical address for process X



ex. 5 bits 2→VPN 3 offset

2^2 = 4 blocks 2^3 8 items block





free blocks
2, X, Z, B

what if A had 3 blocks? Next chapter, virtual

have a system virtual address is 00|1|11

physical address is 10|1|11

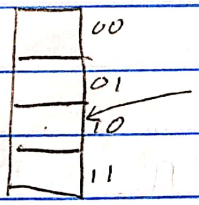
what can we tell me?

at least 2 VP bits, if know block size, know all

OK block size = 4 bits

have 2^2 = 4 blocks

each 2^4 = 16 bytes long

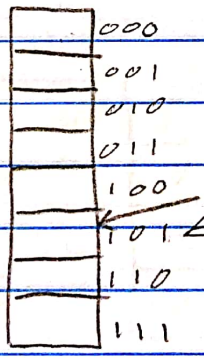


physical address is here
program has at least 1 block
(because virtual is 00)
what if 10|11|11? then prog has at least 3 blocks
so 2 other blocks occupied

block size = 3 bits

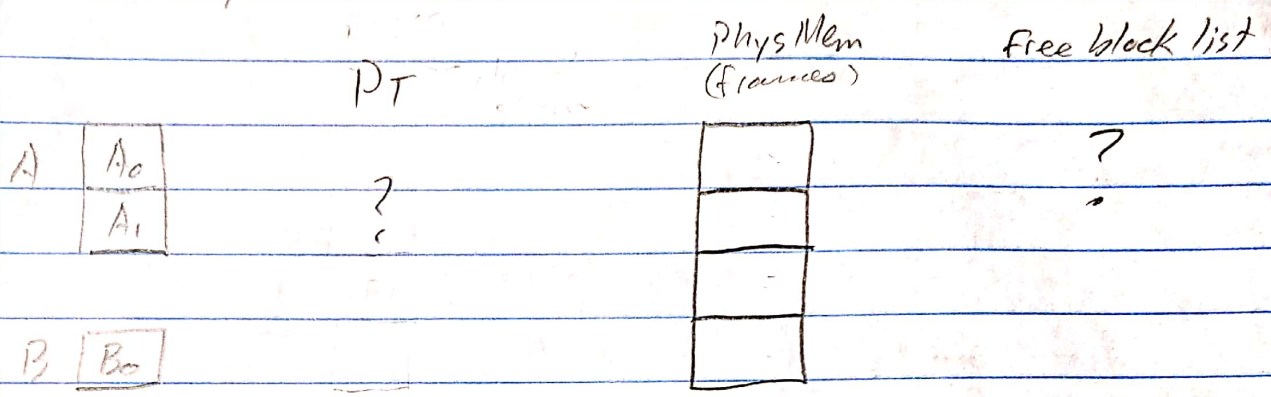
have 2^3 = 8 blocks

each block 2^3 = 8 bytes long



know our prog has at least 2 blocks
(VPN => 000 + 001)

what if you have this



Say 6 bits

	virtual address	Physical address
A	01 | 1111	00 | 1111
A	00 | 1111	11 | 1111
B	00 | 1111	10 | 1111

show where process pages are in physical mem. ← phys mem has 4 frames ⇒ 2 bits
show PT for each process — each frame 24 = 16 bits
show free block list
determine block size (# page bits) + # address bits