

1. Paging

2. Virtual memory

- a. Demand paging

- b. Alternative based on locality

3. The page table and address translation

- a. Assume our processor generates 12-bit addresses
- b. However, we only have 2 KB of memory

4. Address layout example
 - a. 12-bit virtual addresses
 - b. Page size of 256 bytes

c. Physical memory size = 2 KB = 2^{11} B

- d. Layout of address below

Virtual Page Number (VPN)	Offset into Virtual Page	=	Virtual Address Size
Physical Frame Number (PFN)	Offset into Physical Frame	=	Physical Address Size

5. Page table access example – page fault
 - a. Using same parameters as last problem, let's look at a memory and a page table

Memory

Physical Frame Number	Size	Address Range	Status
000	256 B	0x000 – 0x0FF	
001	256 B	0x100 – 0x1FF	
010	256 B	0x200 – 0x2FF	
011	256 B	0x300 – 0x3FF	
100	256 B	0x400 – 0x4FF	
101	256 B	0x500 – 0x5FF	
110	256 B	0x600 – 0x6FF	
111	256 B	0x700 – 0x7FF	

- b. Processor generates the following virtual address for process A
 - i. 0x716
- c. First, need to translate this virtual address into the physical address

Page Table

Virtual Page Number	Status
0000	
0001	
0010	
0011	
0100	
0101	
0110	
0111	
1000	
1001	
1010	
1011	
1100	
1101	
1110	
1111	

d. Update page table and list of frames

Memory

Physical Frame Number	Size	Address Range	Status
000	256 B	0x000 – 0x0FF	
001	256 B	0x100 – 0x1FF	
010	256 B	0x200 – 0x2FF	
011	256 B	0x300 – 0x3FF	
100	256 B	0x400 – 0x4FF	
101	256 B	0x500 – 0x5FF	
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Page Table

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1110	
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- e. Now our memory has the page we requested
- f. Use page table to convert address

- g. Now that we have the physical address

6. Page table access example – hit

- a. Now assume we're given the next virtual address
 - i. 0x15F

7. Translation lookaside buffer (TLB)

8. Virtual memory summary

9. Scheduling (if time)

a. Types of scheduling

10. Short-term scheduler (if time)

- a. Also known as the dispatcher
- b. Each process is placed in a process state

c. Process states

- d. Need enough information to be able to restart given process after done executing