1. Operating systems (OSes)
    a. What's the objective of an operating system?

2. History of operating systems
    a. Two dimensions determine how the OS runs things

    b. Original OSes didn't do much

    c. Batch idea introduced

    d. Finally, multiprogrammed machines

        i. Need some more components for this

3. Memory management

    a. Swapping

    b. Partitioning

    c. Fixed size partitioning

    d. Variable size (dynamic) partitioning

Fixed size partitioning	Variable size partitioning with a memory fragment in the middle

e. Idea of virtual versus physical addresses

4. Paging

5. Virtual memory

    a. When a process references data that is in a page not in RAM, have a page fault

    b. Demand paging

    c. Alternative based on locality

6. The page table and address translation
    a. Assume our processor generates 12-bit addresses
    b. However, we only have 2 KB of memory

7. 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**