MEMORY MANAGEMENT

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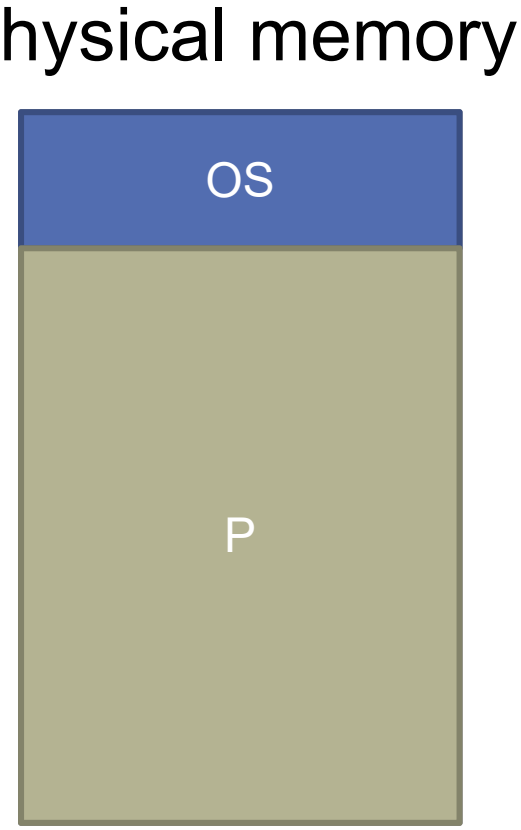
OUTLINE

- **Contiguous Memory Allocation**
  - Uniprogramming
  - Multiprogramming
- **Non-Contiguous Memory Allocation**
  - Segmentation
  - Paging

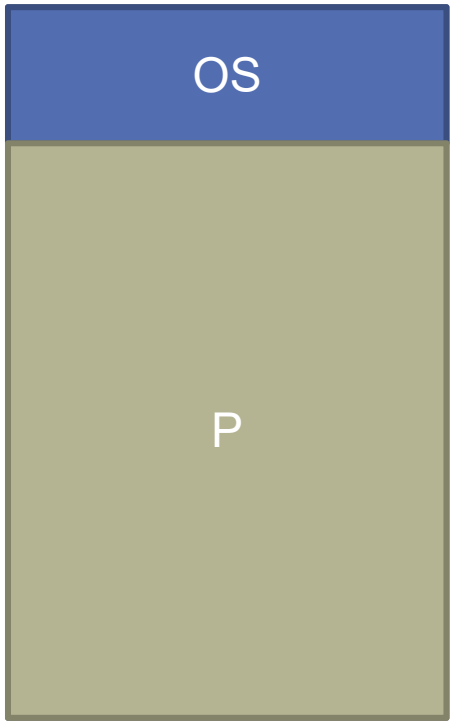
UNIPROGRAMMING



UNIPROGRAMMING

Pros

1. No translation & protection
2. App can access larger physical address
3. Simple

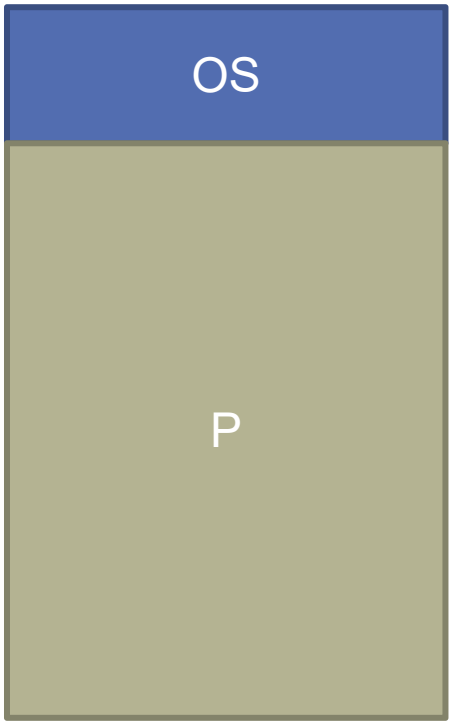


UNIPROGRAMMING

Cons

1. Not efficient
2. Not powerful

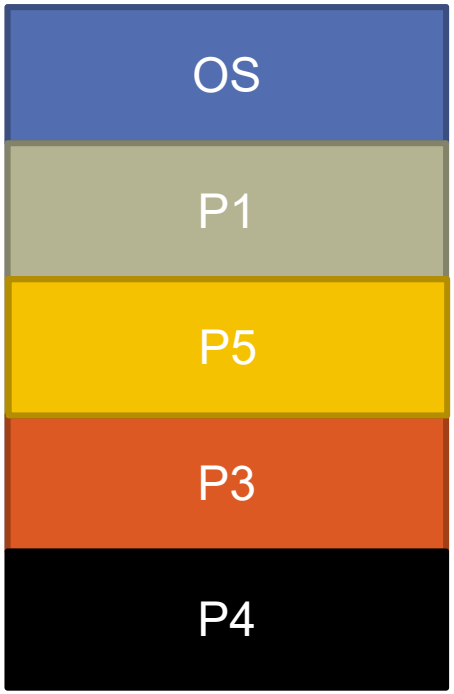
Physical memory



MULTIPROGRAMMING

What if we want to run multiple processes?

Each process has the same memory size



fixed-sized partitions

How to manage each block?

MULTIPROGRAMMING

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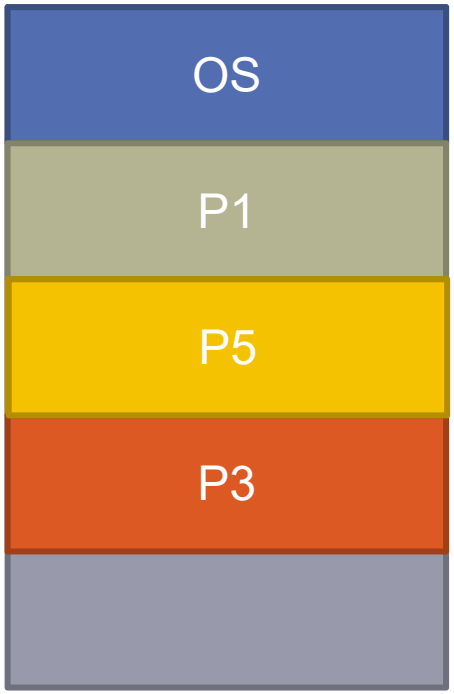
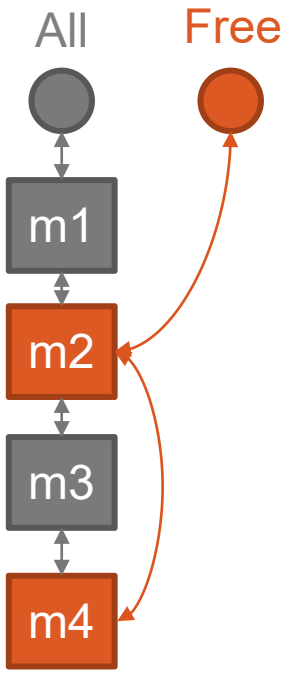
fixed-sized partitions

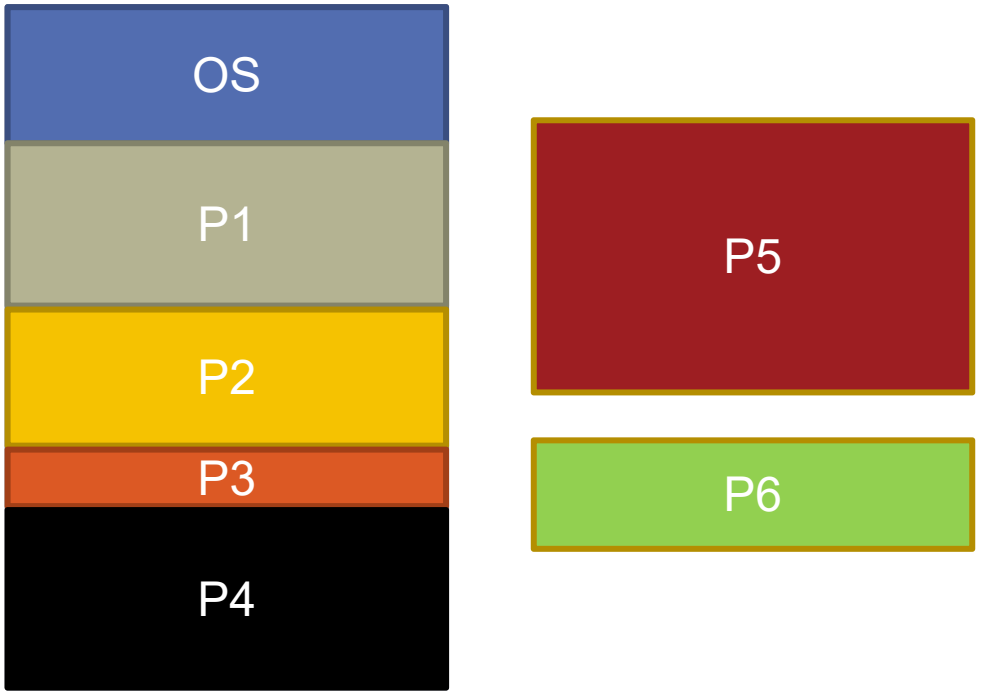




MULTIPROGRAMMING

What if we want to run multiple processes?

Each process has different memory size



variable partitions

MULTIPROGRAMMING

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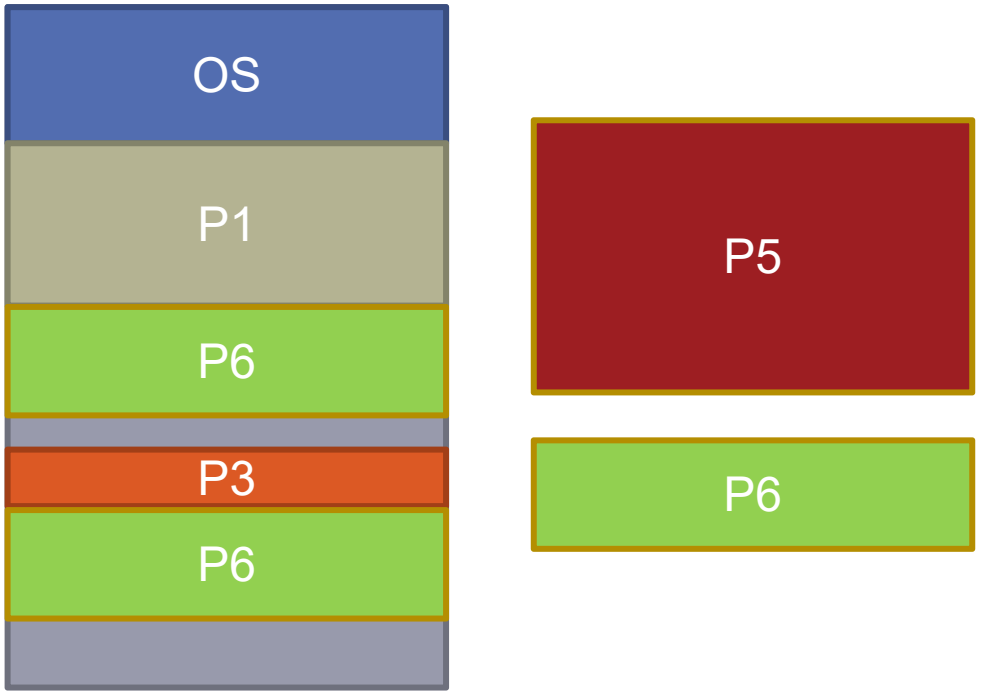
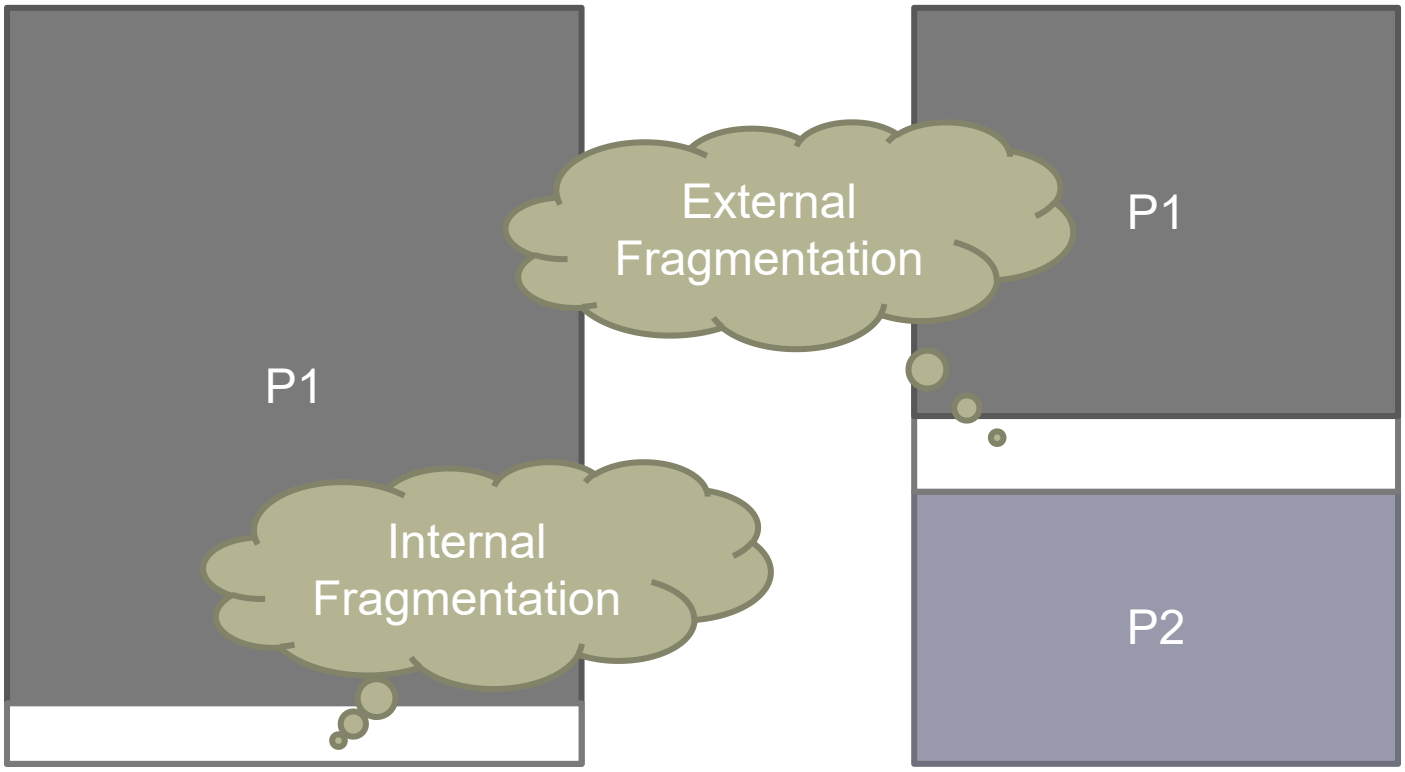


variable partitions

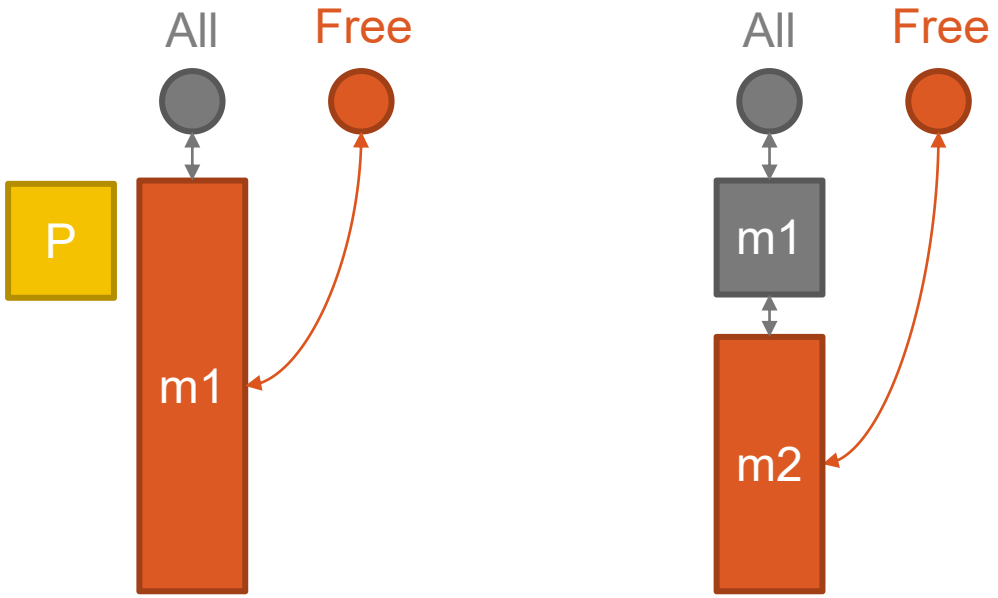
FRAGMENTATION



MULTIPROGRAMMING

For Multiprogramming, we need to consider fragmentation problem.

- **There are several strategies:**
  - First fit
  - Best fit
  - Worst fit



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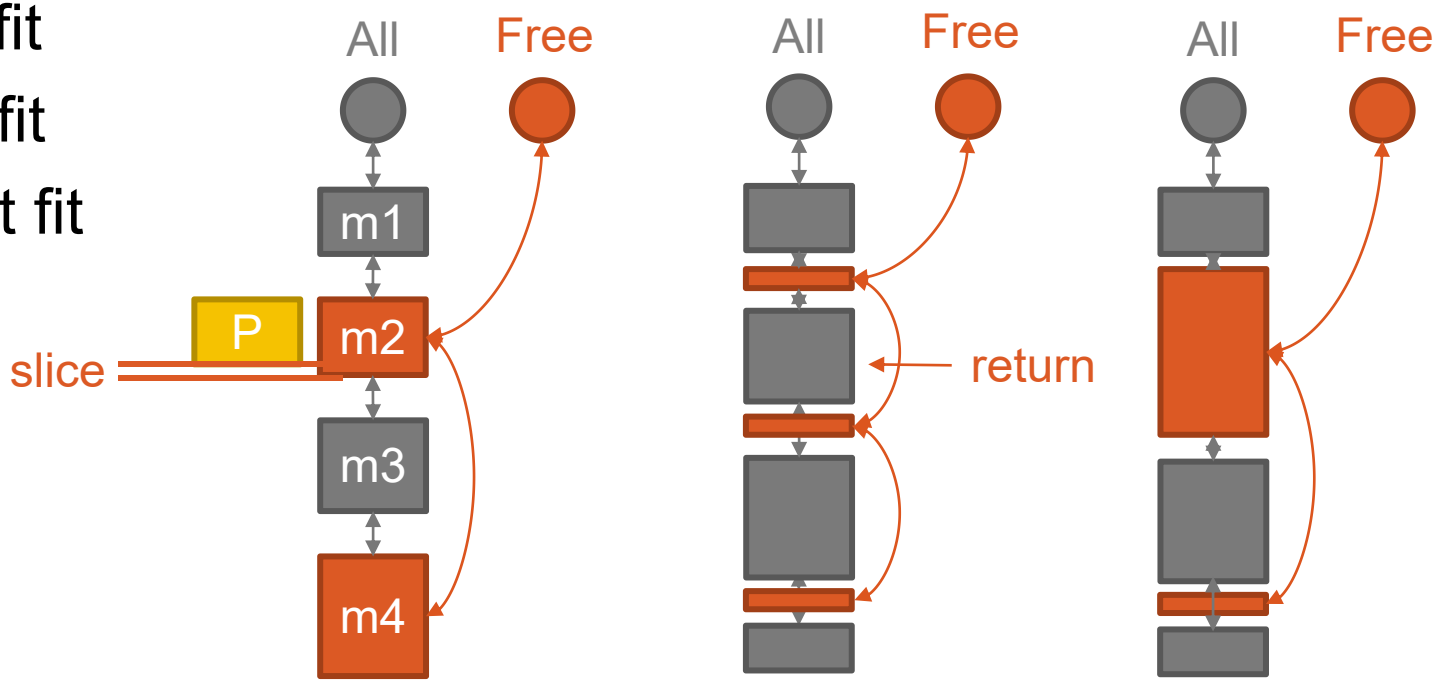
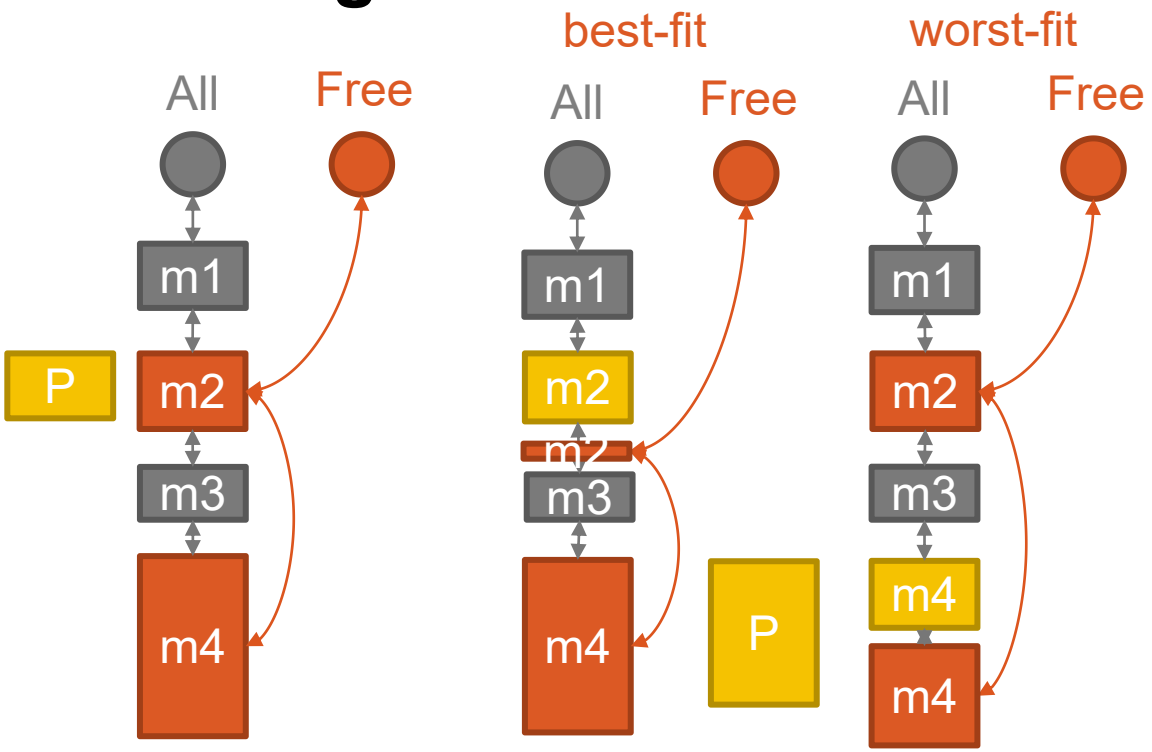


MULTIPROGRAMMING

For Multiprogramming, we need to solve fragmentation problem.

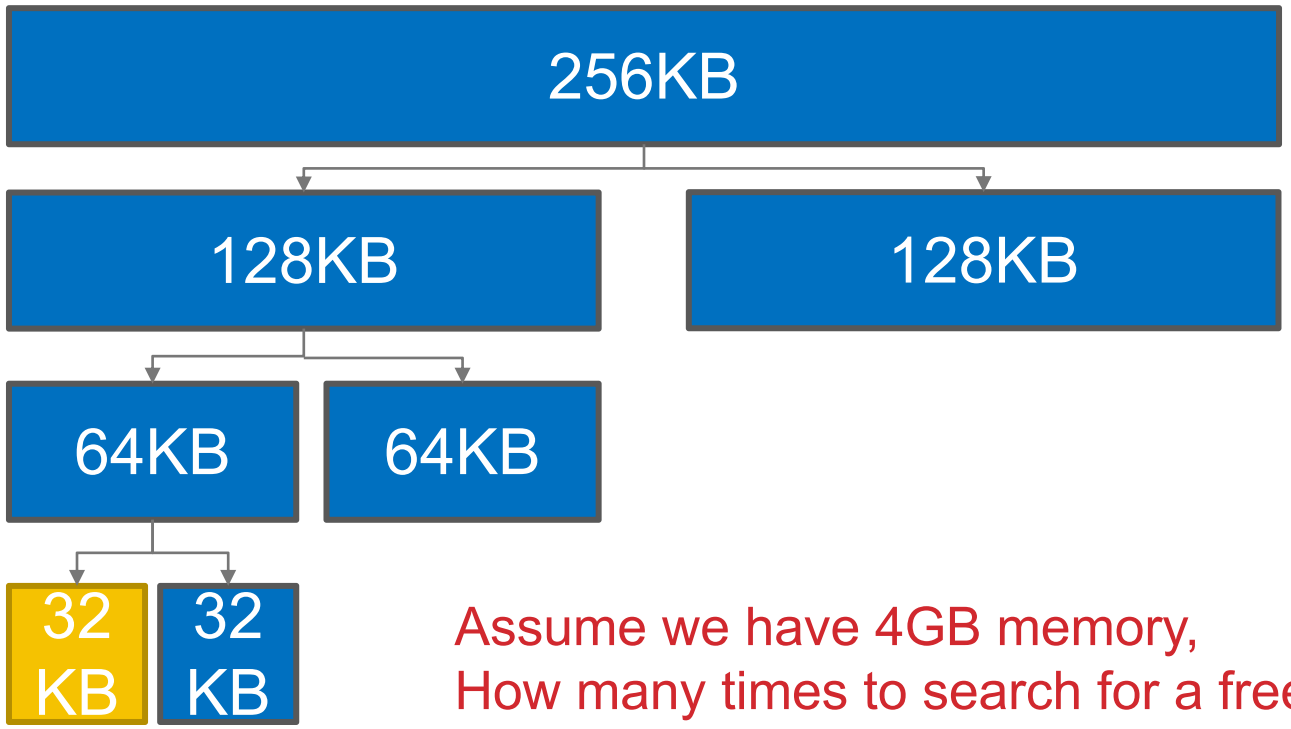
- **There are several strategies :**
  - First fit
  - Best fit
  - Worst fit

Which is better?



MULTIPROGRAMMING

Another allocation structure——Buddy System

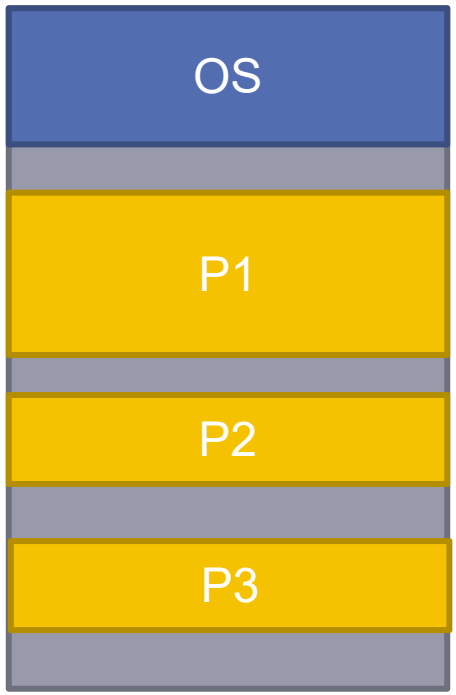


Assume we have 4GB memory,
How many times to search for a free block?

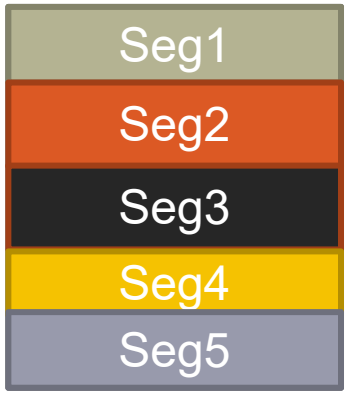
QUESTION

Q: How to avoid or reduce fragmentation?

- Defragmentation
- Noncontiguous allocation
  - Segmentation
  - Paging



SEGMENTATION



QUESTION

Q: How to know which segment is stored in which physical address?

SEGMENTATION

Pros.

1) Make data more “logical”, easy to share
2) We can do much better on “protection”
3) Reduce fragmentation

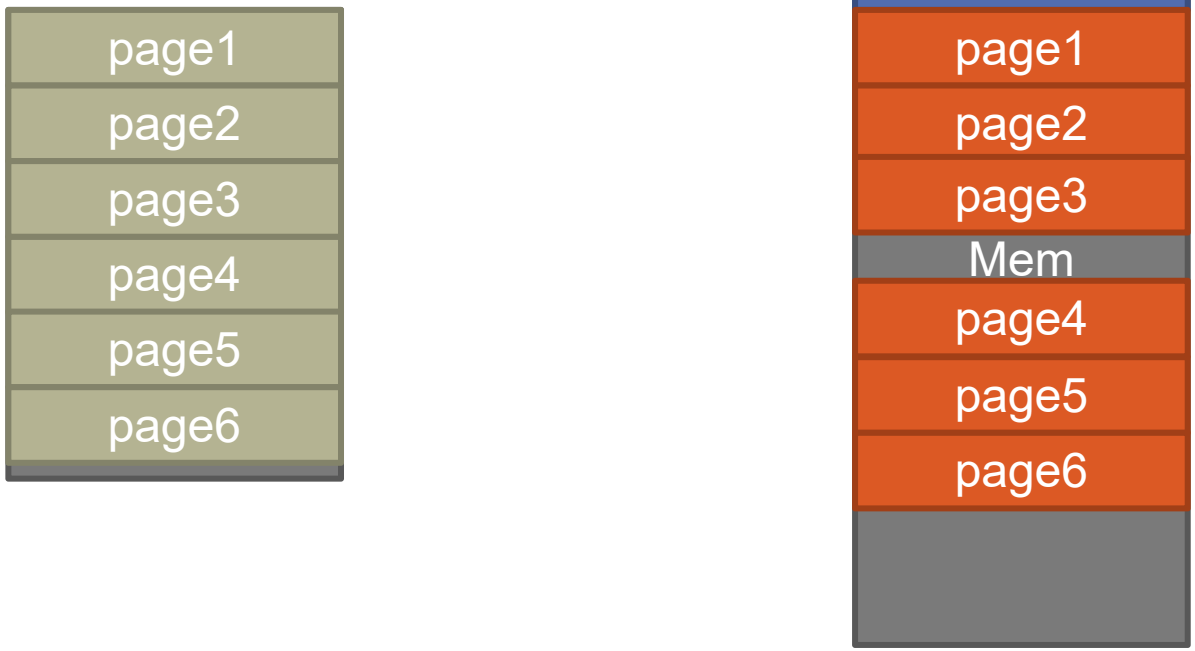
Cons.

1) Segment size is not fixed, more complicated
2) One process need allocate memory many times
3) Fragmentation is smaller but still a problem

PAGING

Q: What’s the idea of Paging?

PAGING

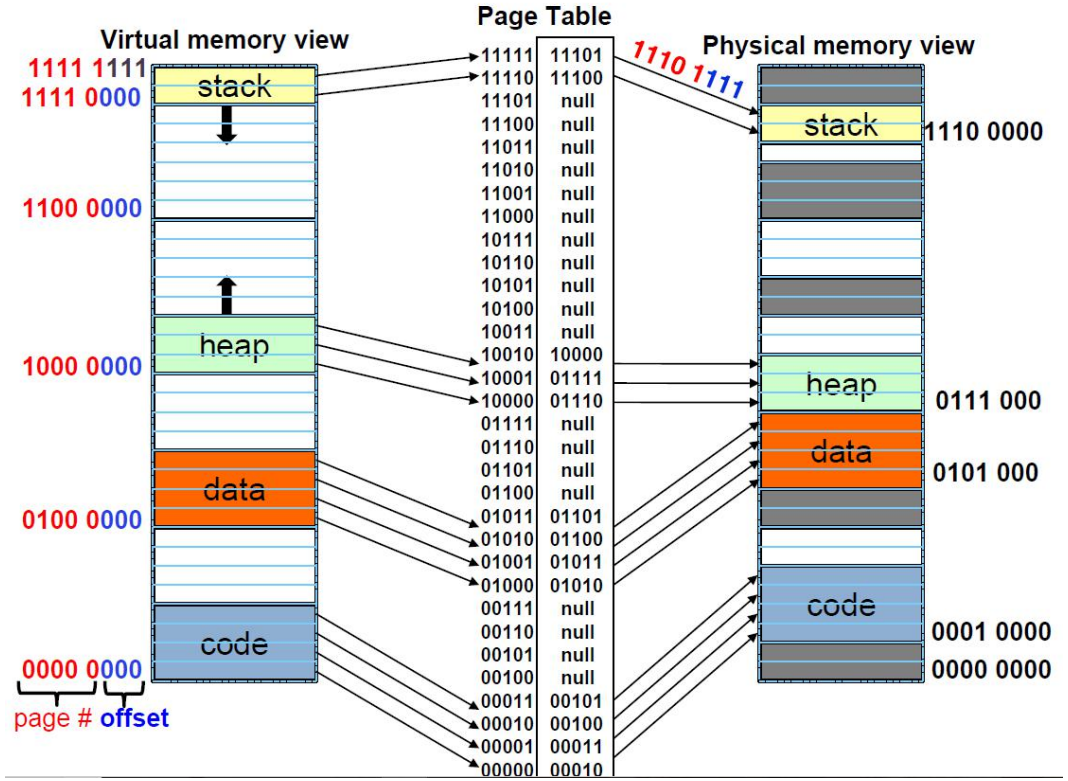

page1
page2
page3
page4
page5
page6
OS
page1
page2
page3
Mem
page4
page5
page6

QUESTION

Q: How to know which page is stored in which physical address?

PAGING

The idea like database. We need a extra space for "Page Table", and we also need a "index" to speed up the searching.



PAGING

Pros.

1) Simple to implement
2) Reduce external fragmentation
3) Demand paging technique (learn latter)

Cons.

1) Page table requires extra memory space
2) Internal fragmentation problem

LAB REQUIREMENT

1. Complete the code, so that it can realize basic memory allocation (basic). Please notice, the program may have some bugs, you are also required to fix it. (be care of input/output buffer)
2. You can try to add buddy system/ segmentation /paging to this program, which will give you 20 bonus points.
3. read OS_Lab8_Memory_Guide.pdf for detail.