Introduction to Memory

CS 241

Sept. 6, 2013

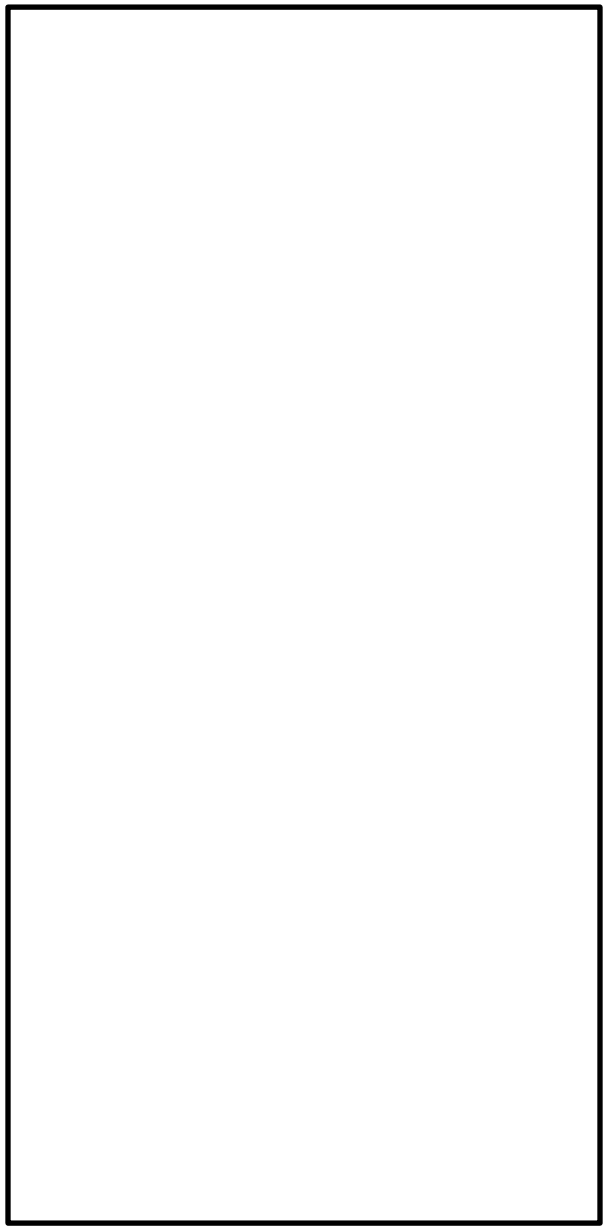
MP1

Program #1

```
void main() {
   int i, j;
   void *s1 = &i,
        *s2 = &j;
   void *h1 = malloc(sizeof(int)),
        *h2 = malloc(sizeof(int));

   printf("s1: %p\ns2: %p\n", s1, s2);
   printf("h1: %p\nh2: %p\n", h1, h2);
}
```

Program #1



Address Space

Observation:

Implication:

Virtual Memory

- You have discovered a result of **virtual memory**.
  - All modern OSs provide a level of indirection between processes and the underlying RAM.
  - What if we didn't have virtual memory?

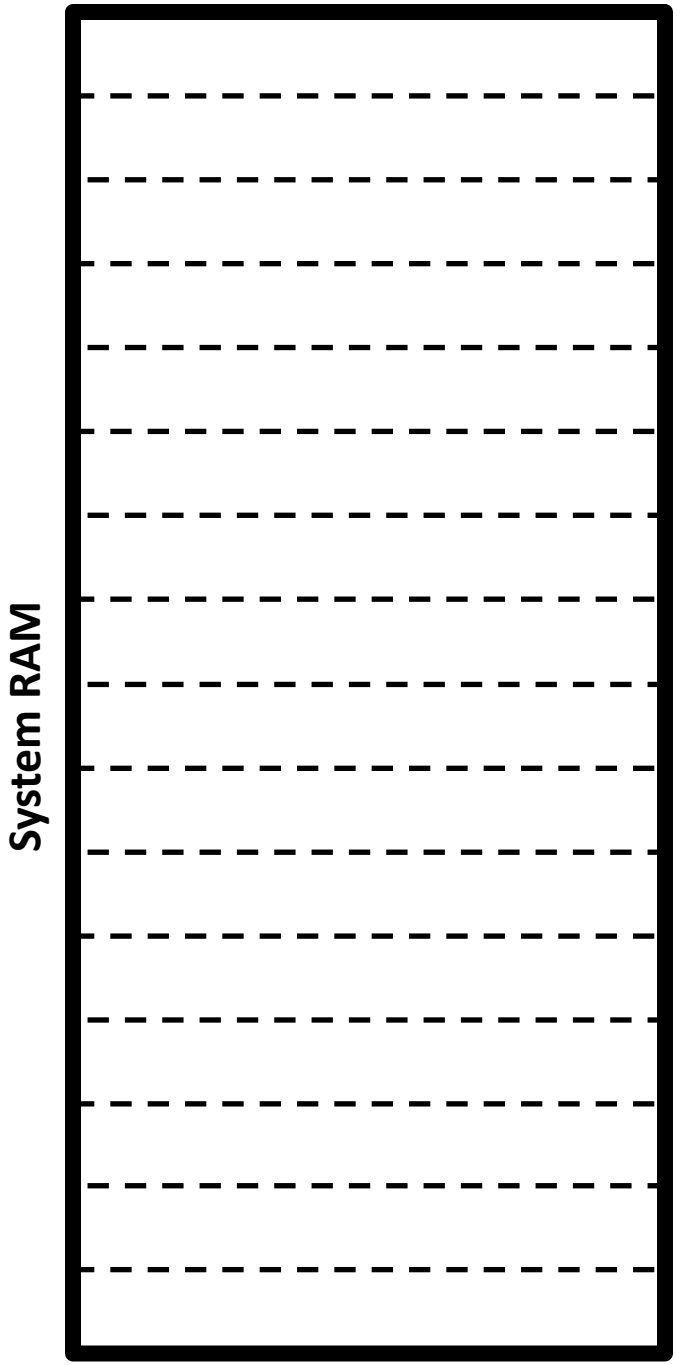
Alternative Option

Segmentation

- **Each process owns a segment of the system's RAM.**

Example Allocations:

1. **P1: 3 MB**
2. **P2: 5 MB**
3. **P3: 2 MB**
4. **P2 is free'd**
5. **P4: 4 MB**
6. **P5: 5 MB**
7. **P1: Increase to 5 MB**



Segmentation

- Problems:
  1.
  2.
- Advantages?

Virtual Memory

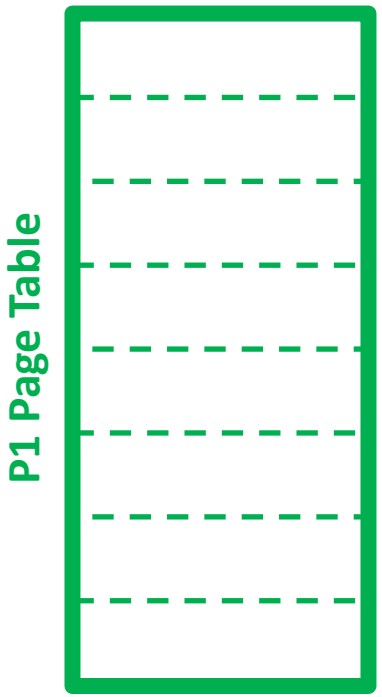
- **Virtual memory** is derived from segmentation, with two major differences:
  - The entire memory space is divided up into **fixed sized segments** called **pages**.
  - Each and **every process** on an OS has its own **page table** to translate between **"virtual addresses"** (used in user-space) and **"physical addresses"** (used in kernel-space, the address on the physical RAM).

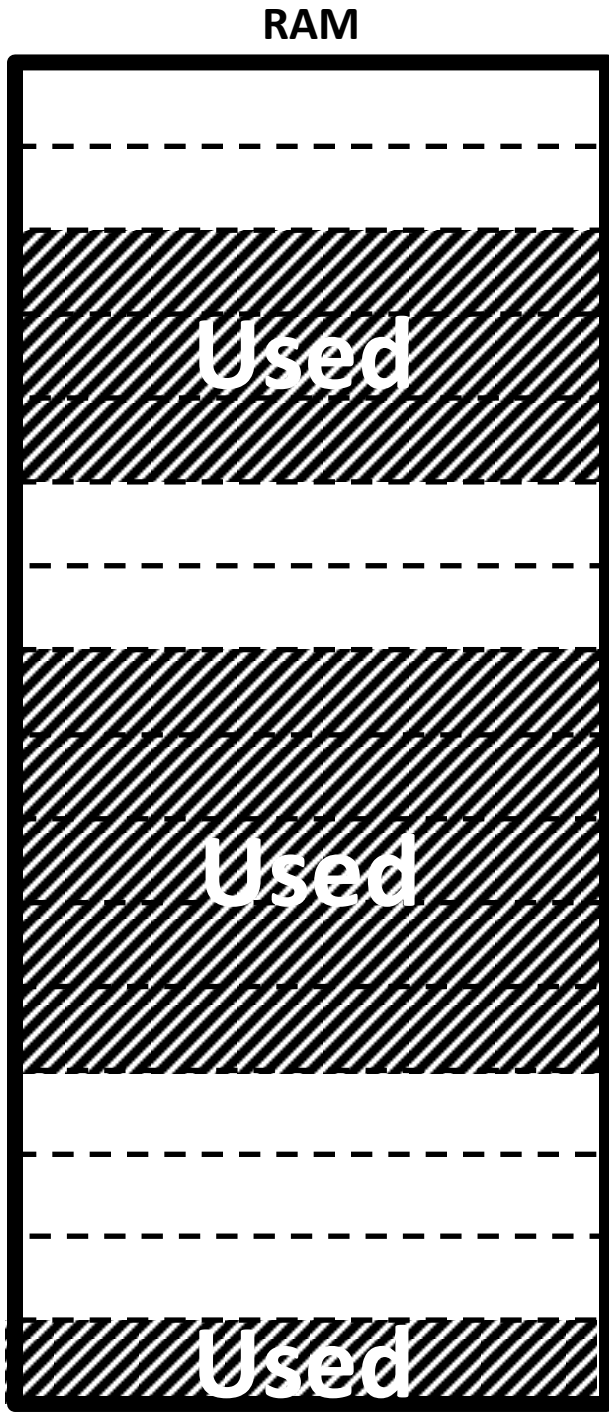
```
p = malloc(1 MB);

q = malloc(2.1 MB);

free(p);

r = malloc(2 MB);
```





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