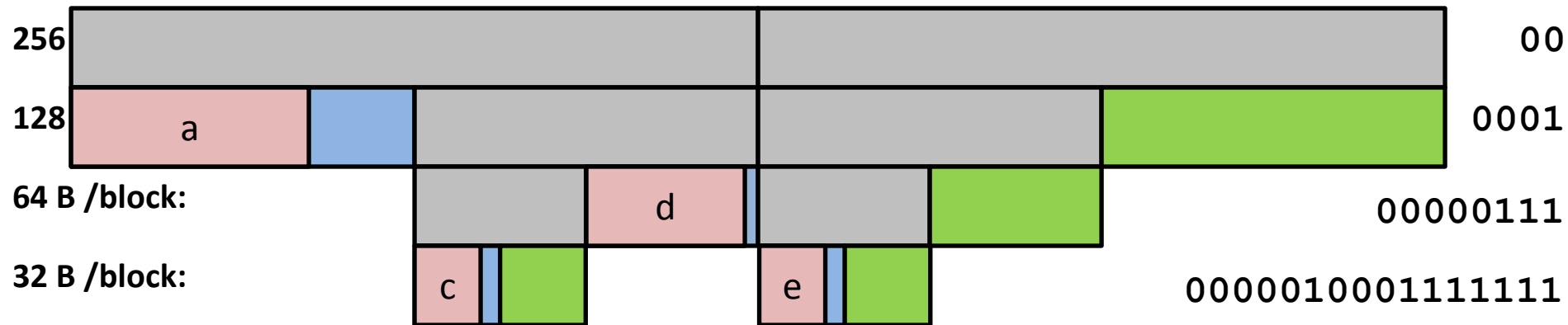


# Buddy System and Segmentation

CS 241

# More Buddy System

- Last Lecture:

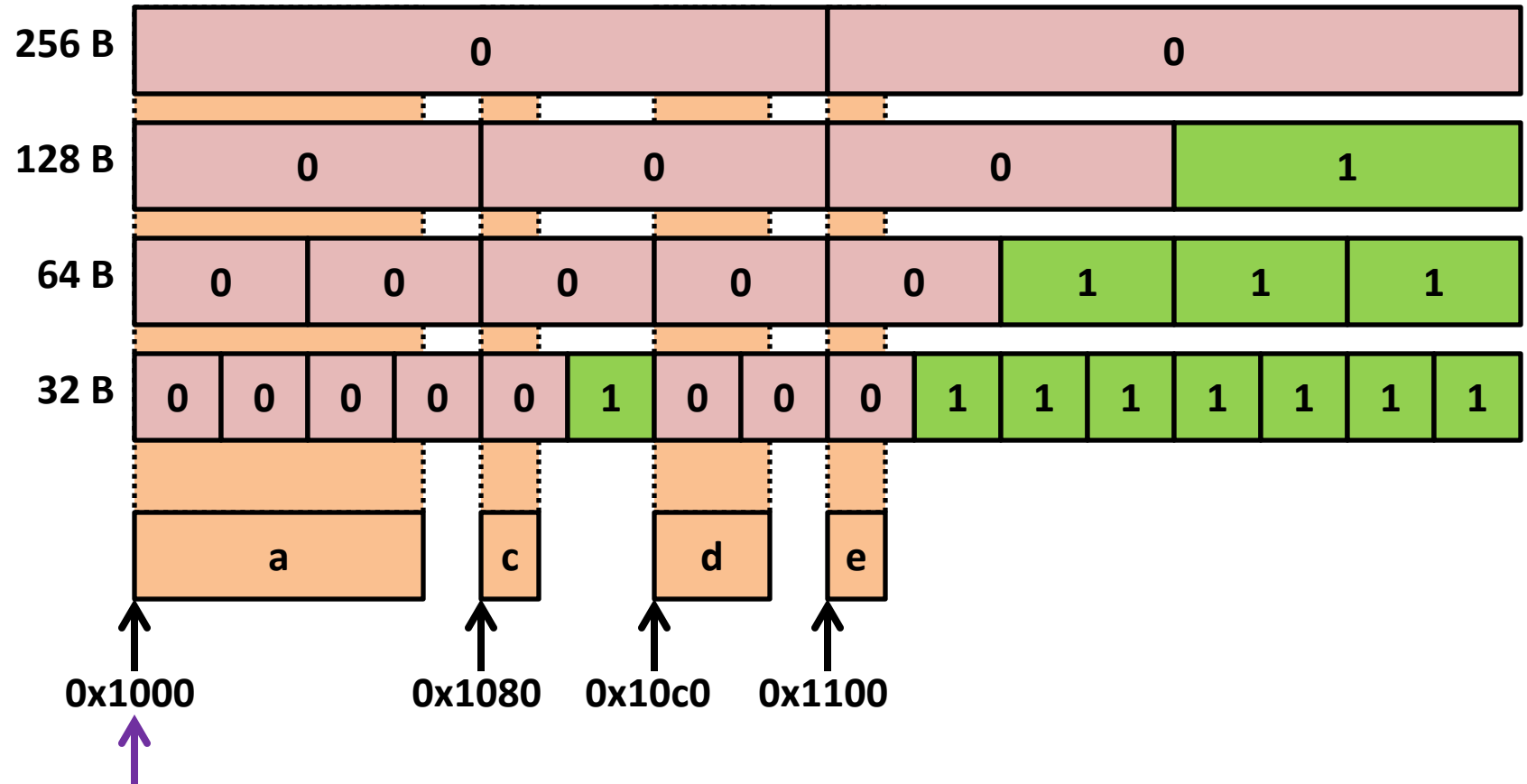


- Optimization:

- Multiple levels may each have their own bit masks.
  - **Advantage:** Speeds up finding open space
  - **Disadvantage:** Increased overhead

# Buddy System

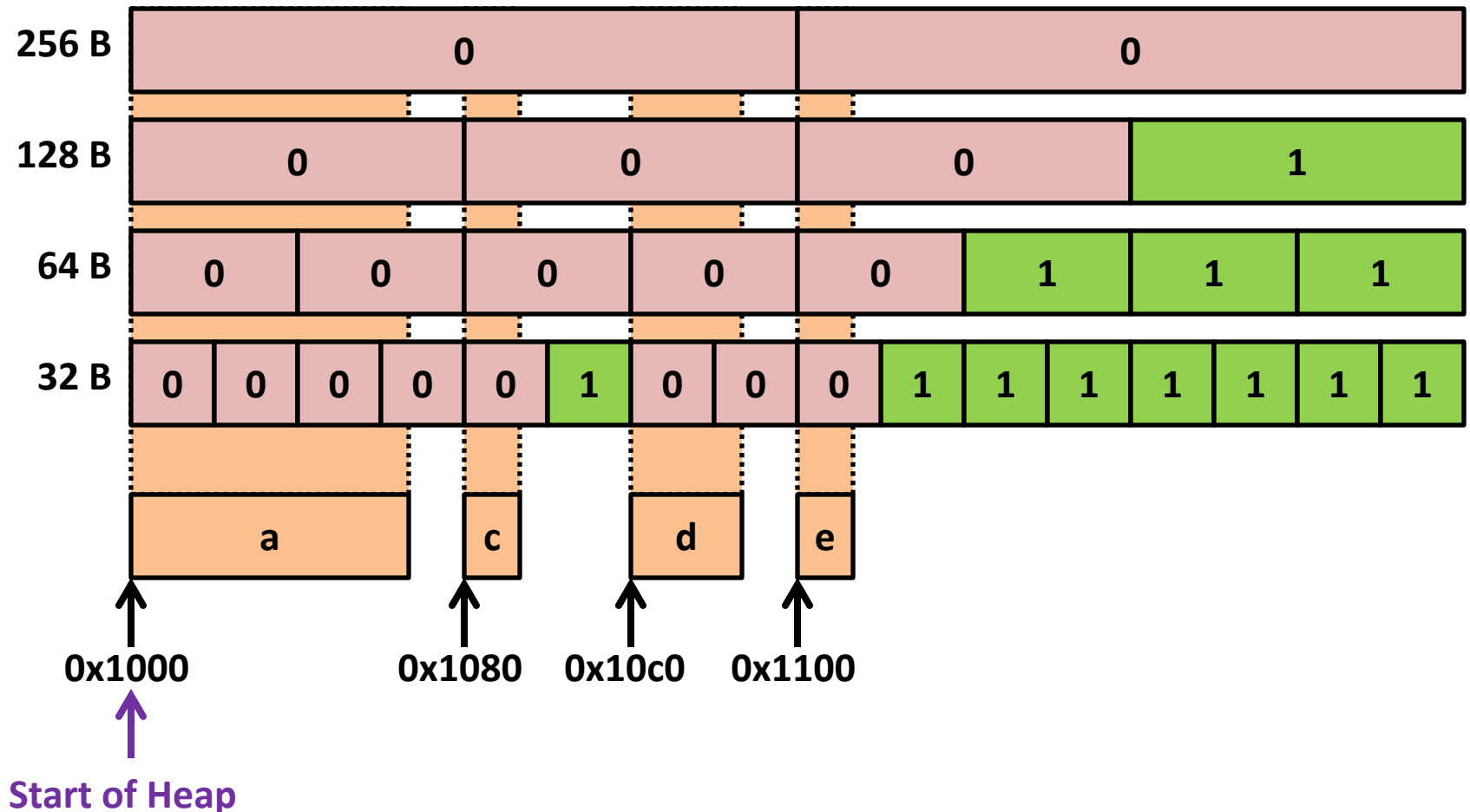
- Represented as bitmaps:



Start of Heap

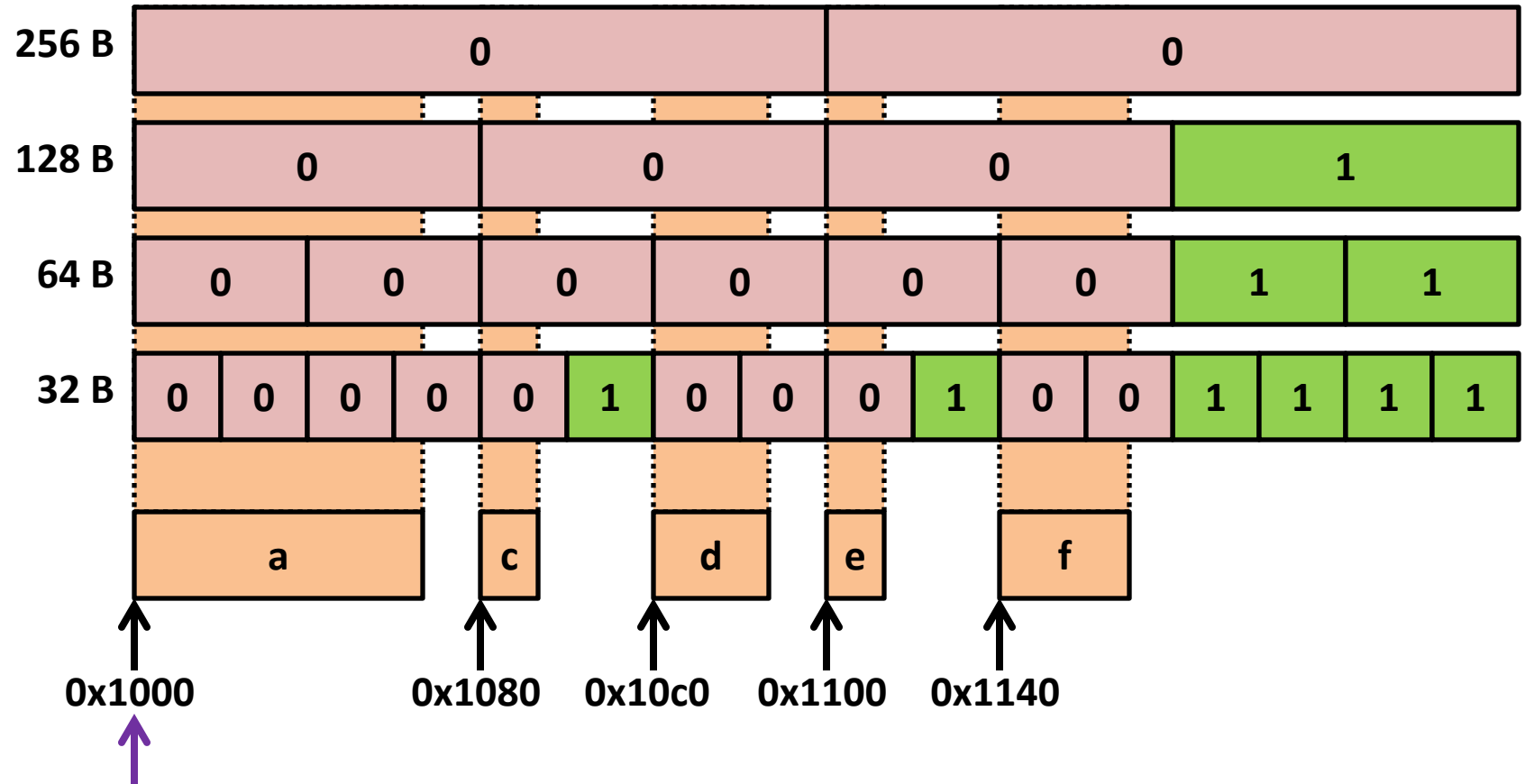
# Buddy System

- Request:  $f = \text{malloc}(56) \rightarrow 00111000$



# Buddy System

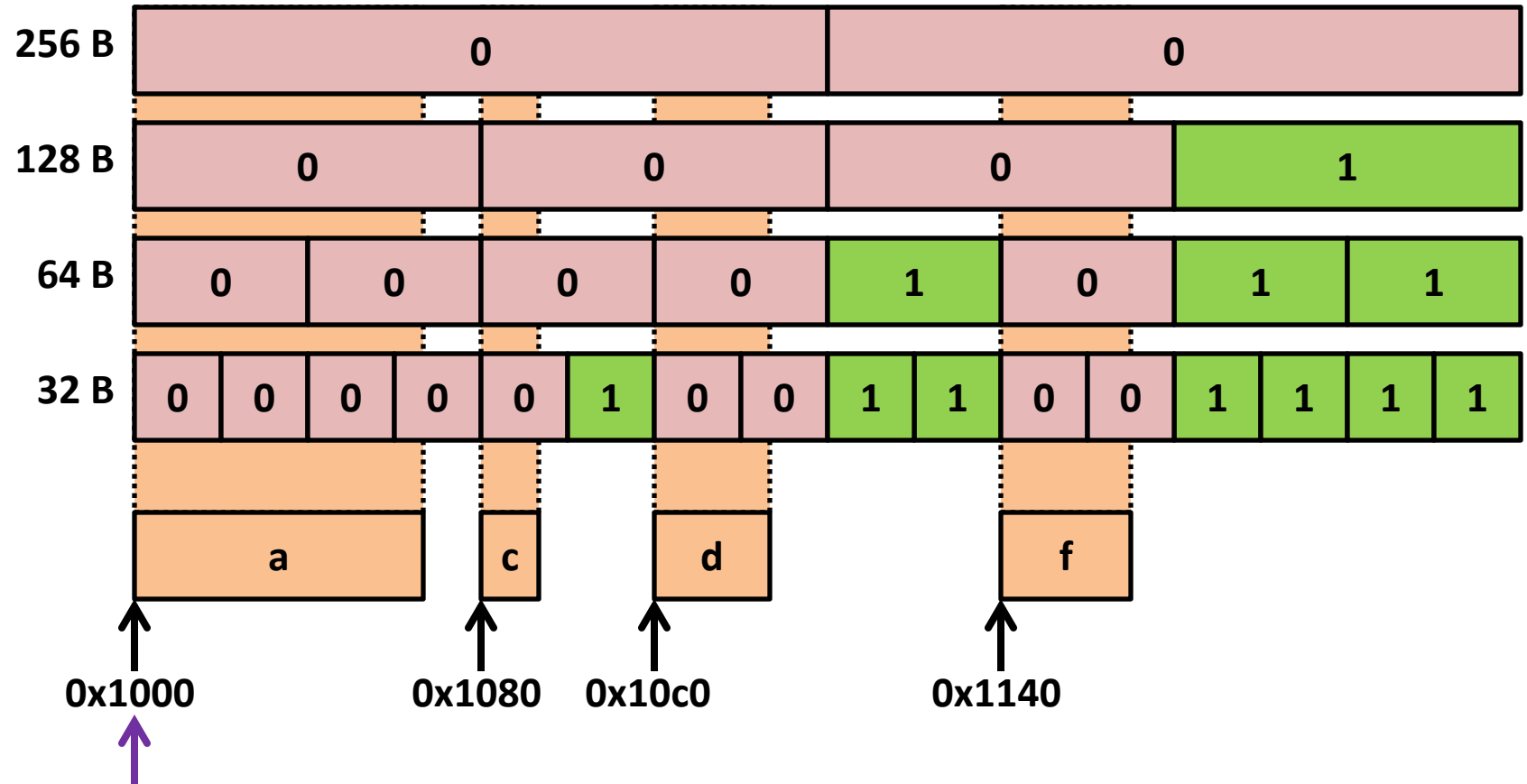
- Request: **free (e)**



Start of Heap

# Buddy System

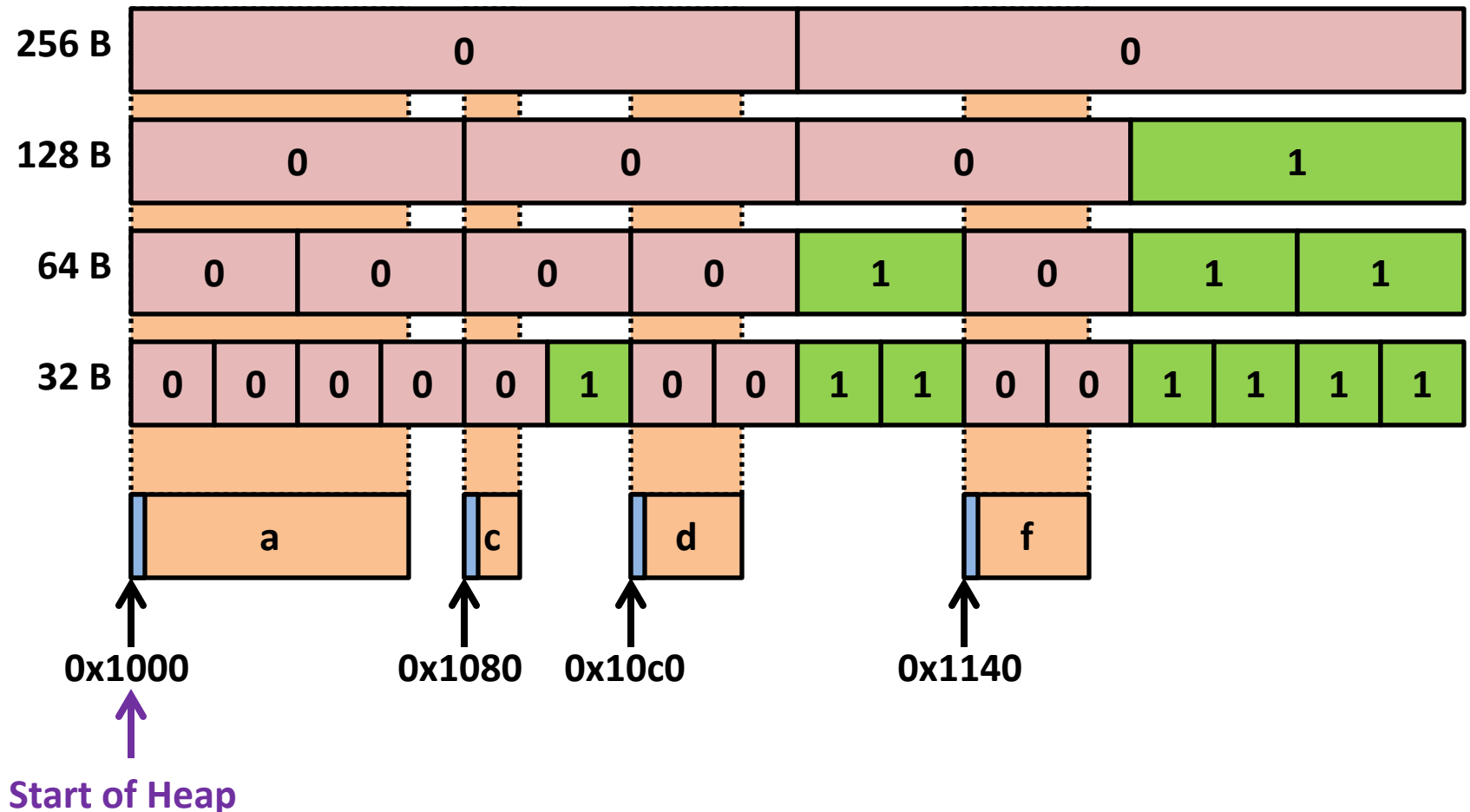
- Request: **free (f)**



Start of Heap

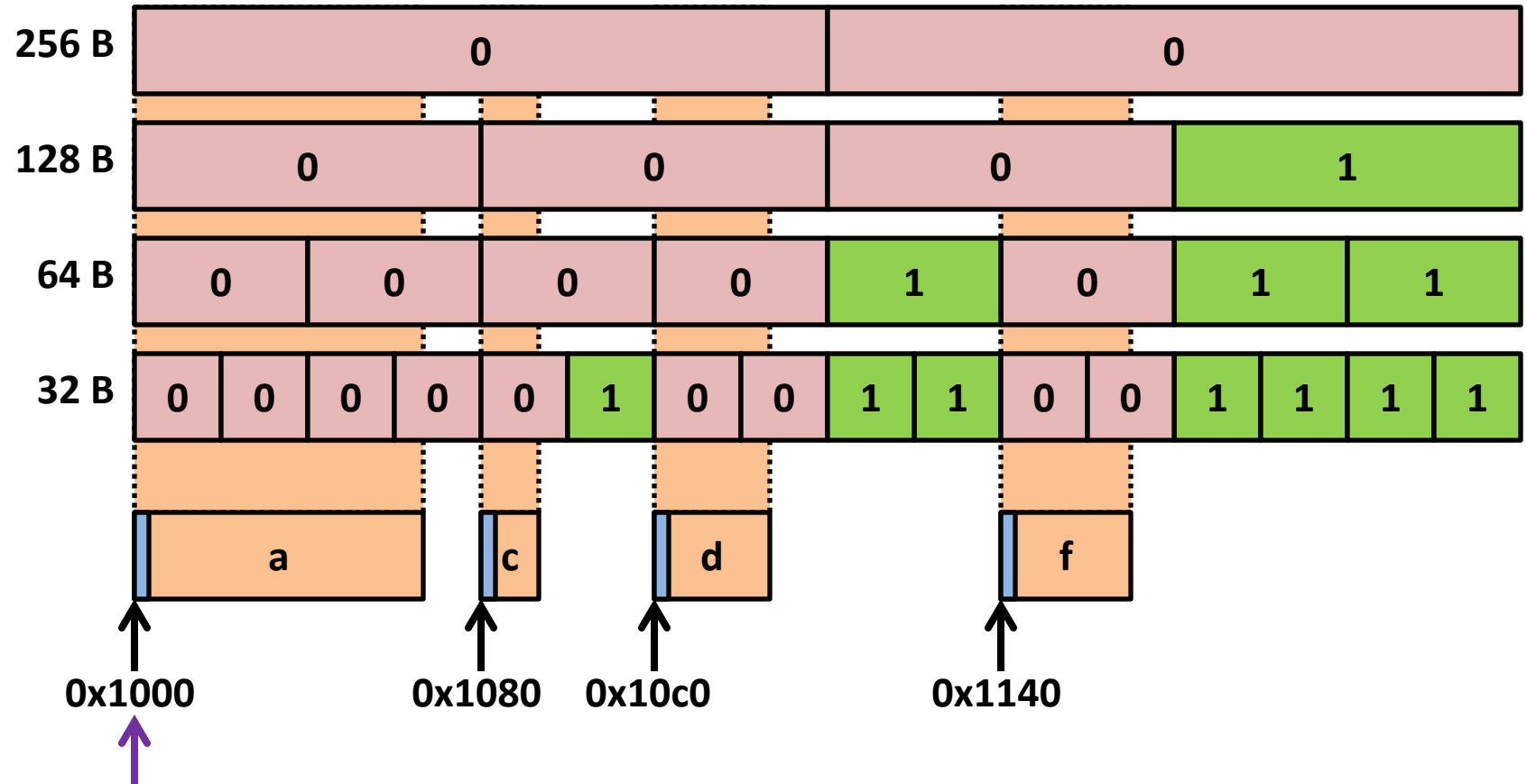
# Buddy System

- Buddy System requires knowledge of level/size of allocation.



# Buddy System

- Request: **free (f)**

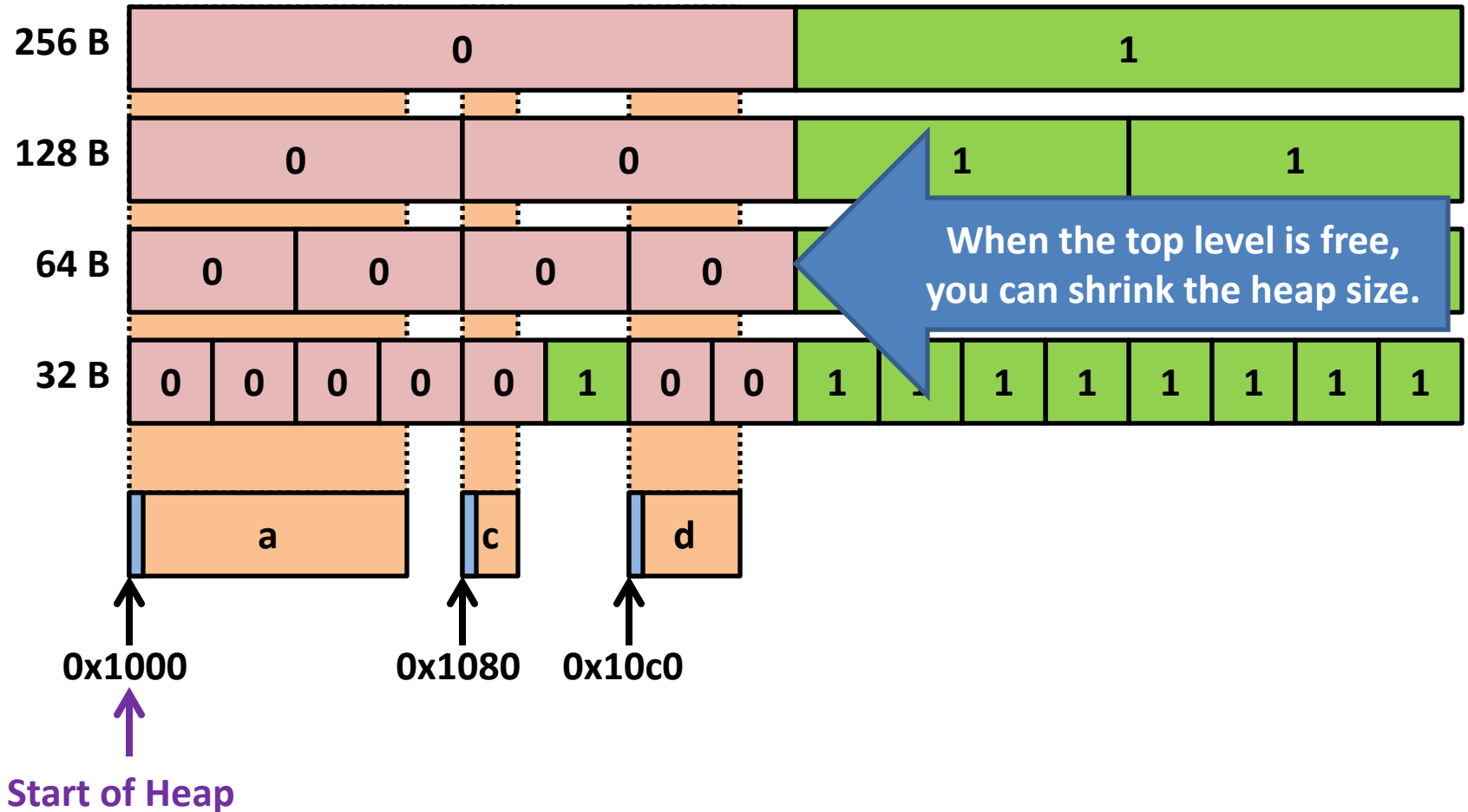


Start of Heap

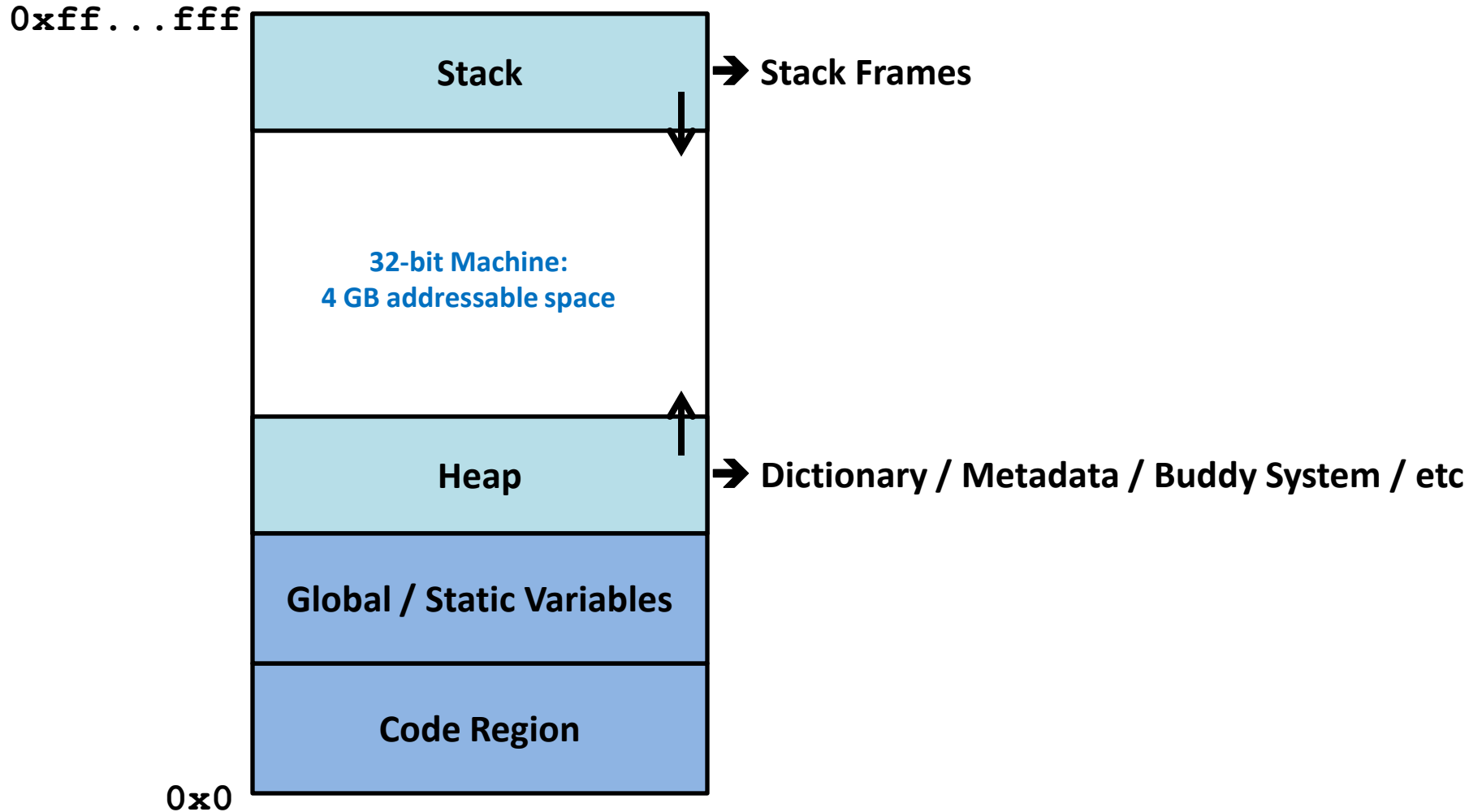


# Buddy System

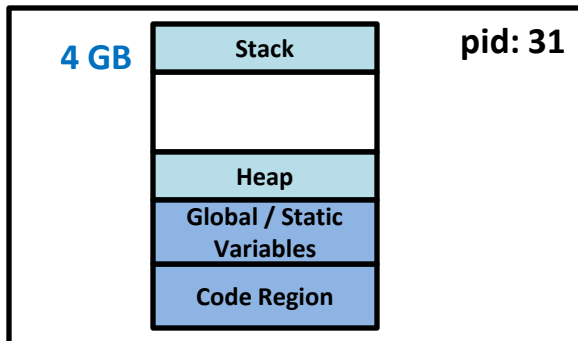
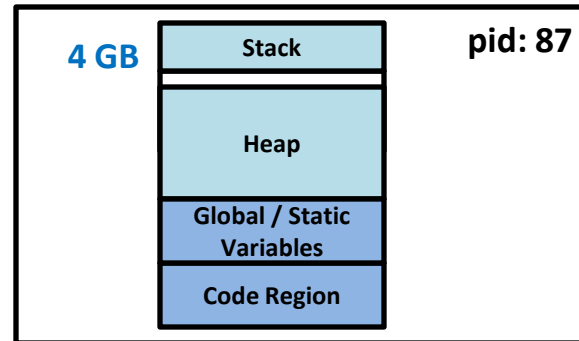
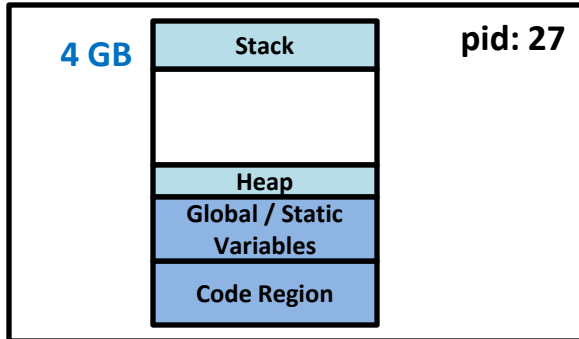
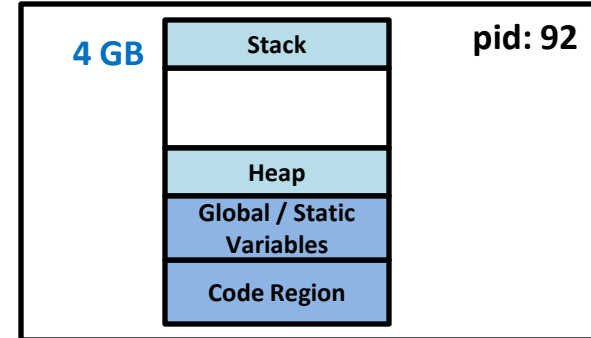
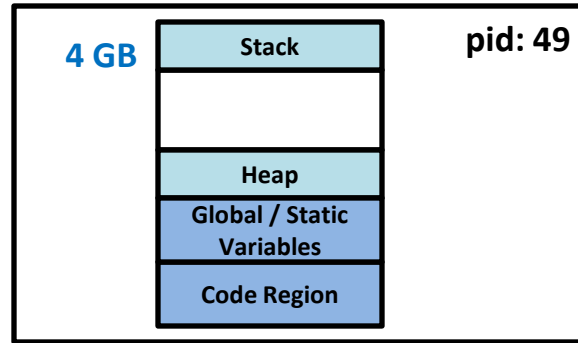
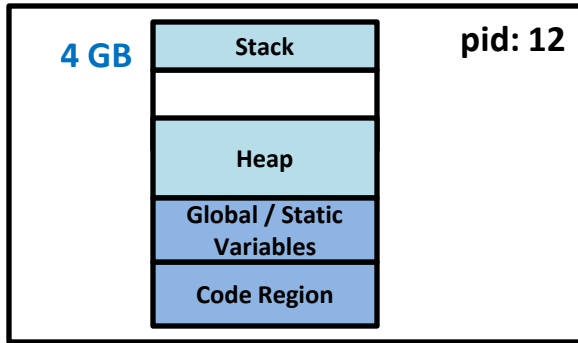
- Result:



# Up to now...



# Every process has their own virtual memory space..



# Virtual Memory Translation

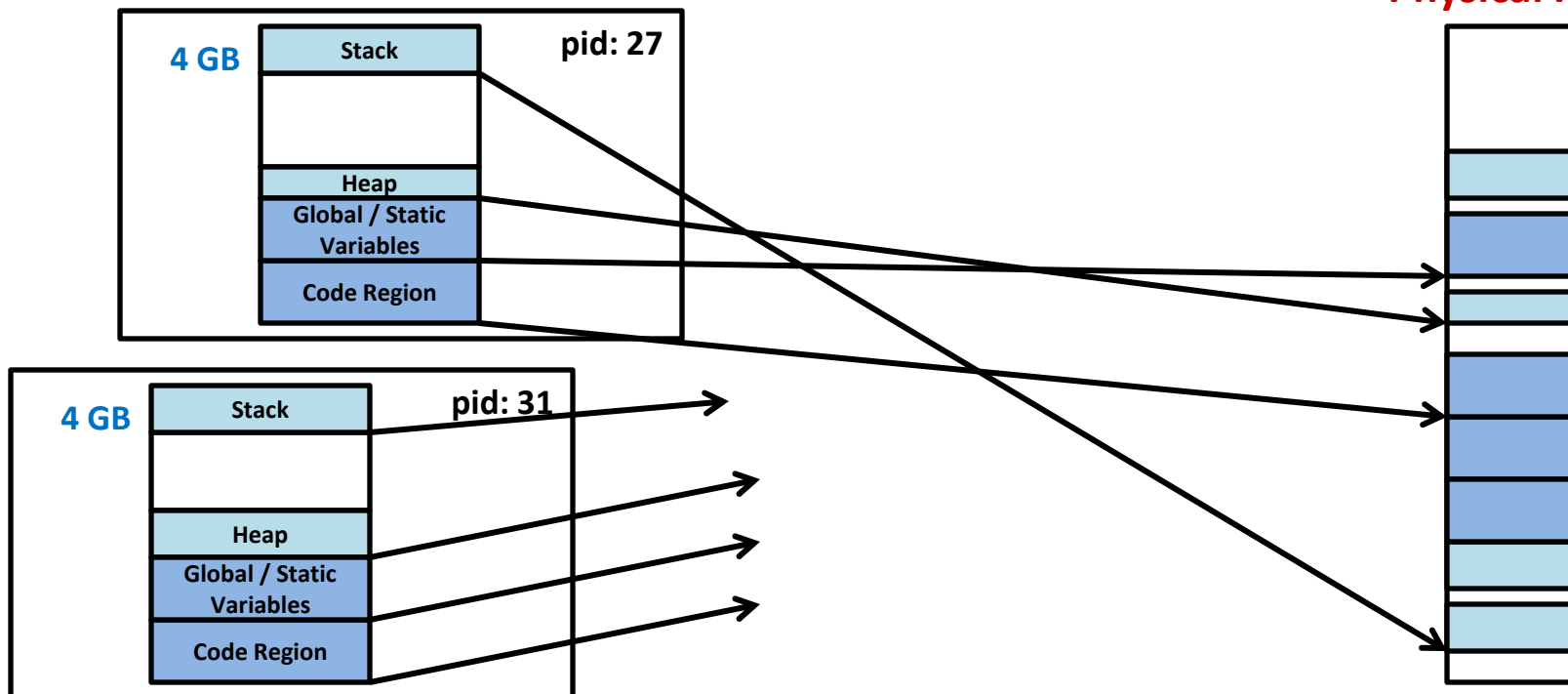
- Every virtual address **must** to be translated into a physical address before data is accessed.
- **int k = j + 3;**
  - To look up the data stored in virtual address **&j**...
    - Translate virtual address **&j** into a physical address
    - Fetch that data from the location in RAM
    - Return the data to the process

# Solution #1: Segmentation

- **Segmentation:** Place each logical piece of a program's memory into RAM at an offset.

Virtual Memory

Physical RAM

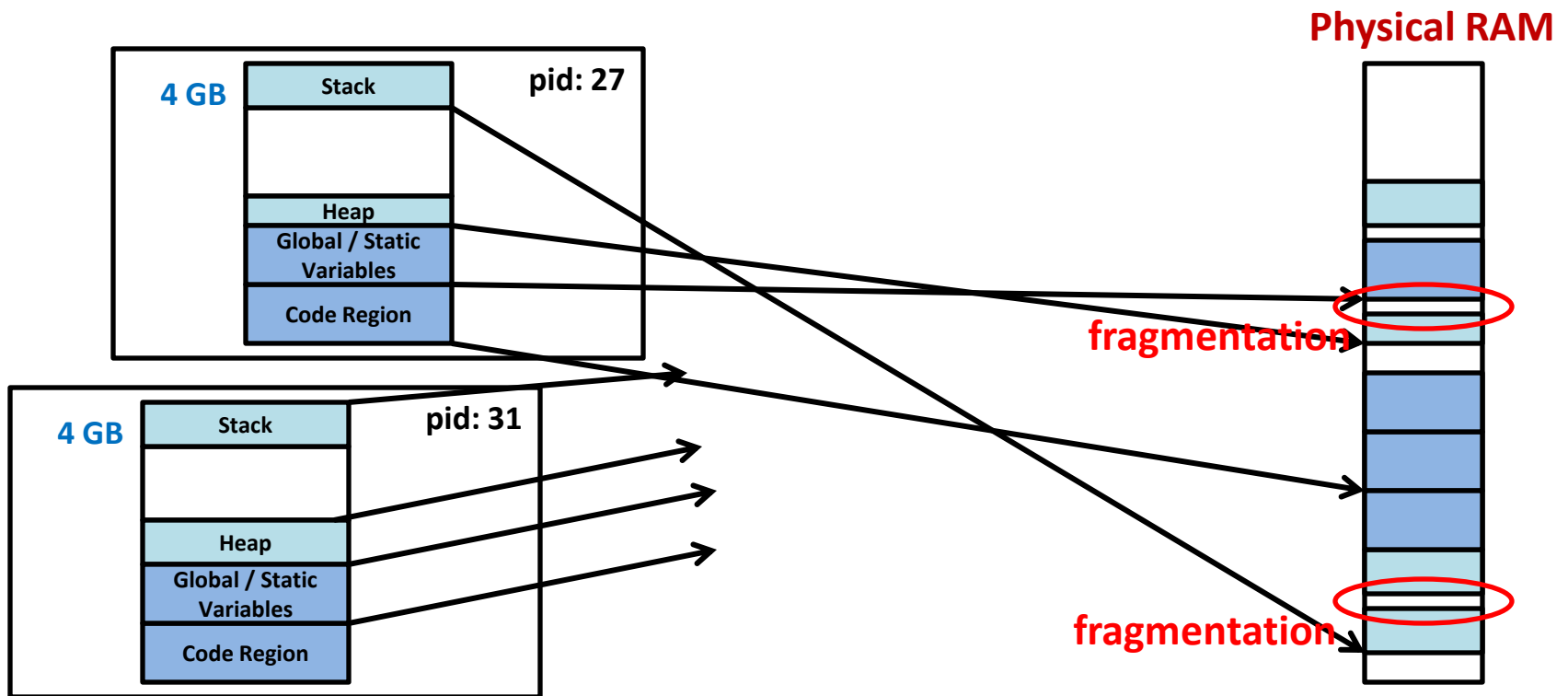


# Memory Segmentation

- **Advantages?**
- **Disadvantages?**

# Segmentation Disadvantage #1

- **External Fragmentation:** Physical RAM will develop small holes over time, unable to be allocated.



# Segmentation Disadvantage #2

- **Storage Growth:** When memory usage grows, physical RAM must be allocated. If space is not available nearby, a large copy is required.

