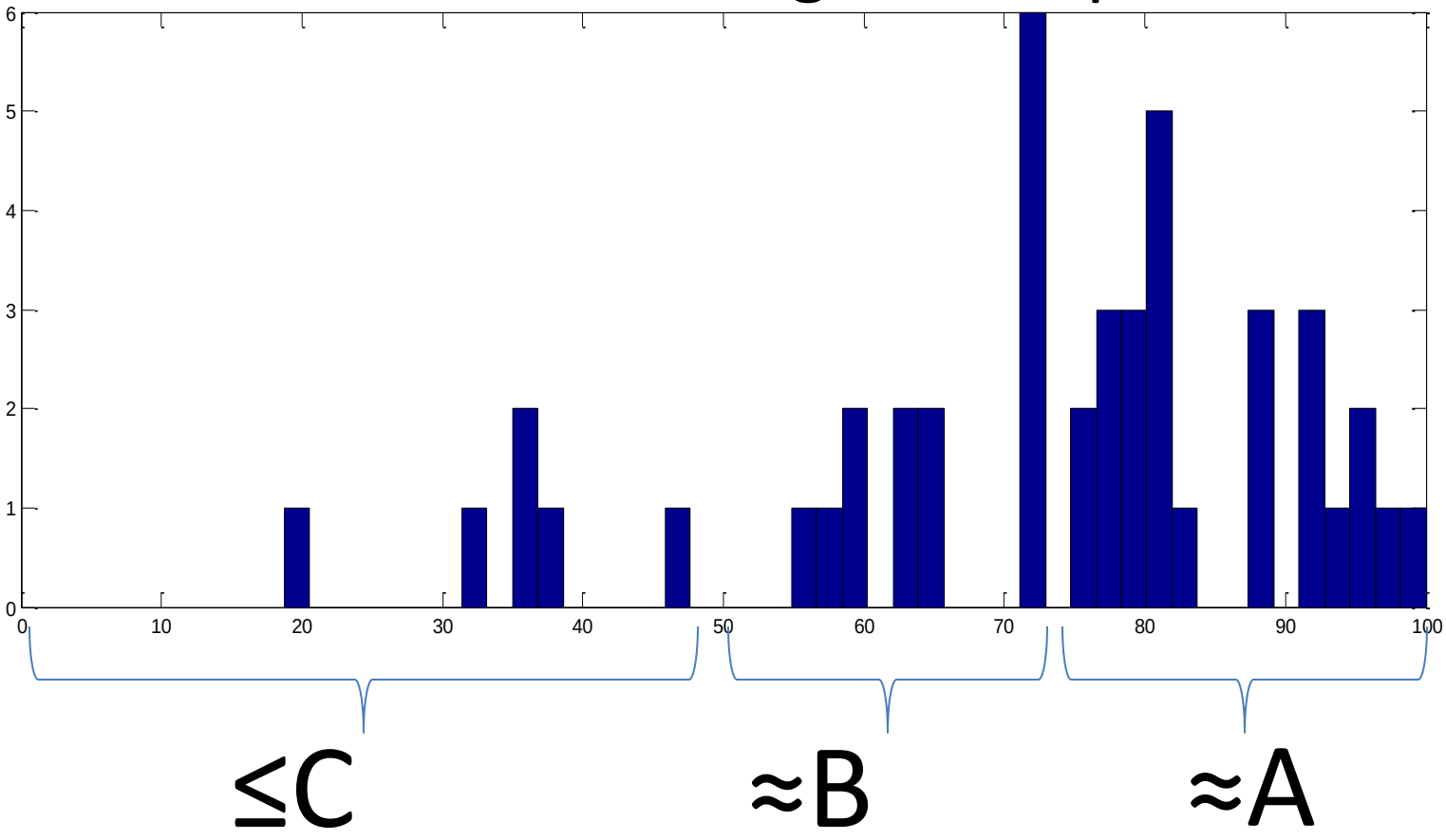
Announcements

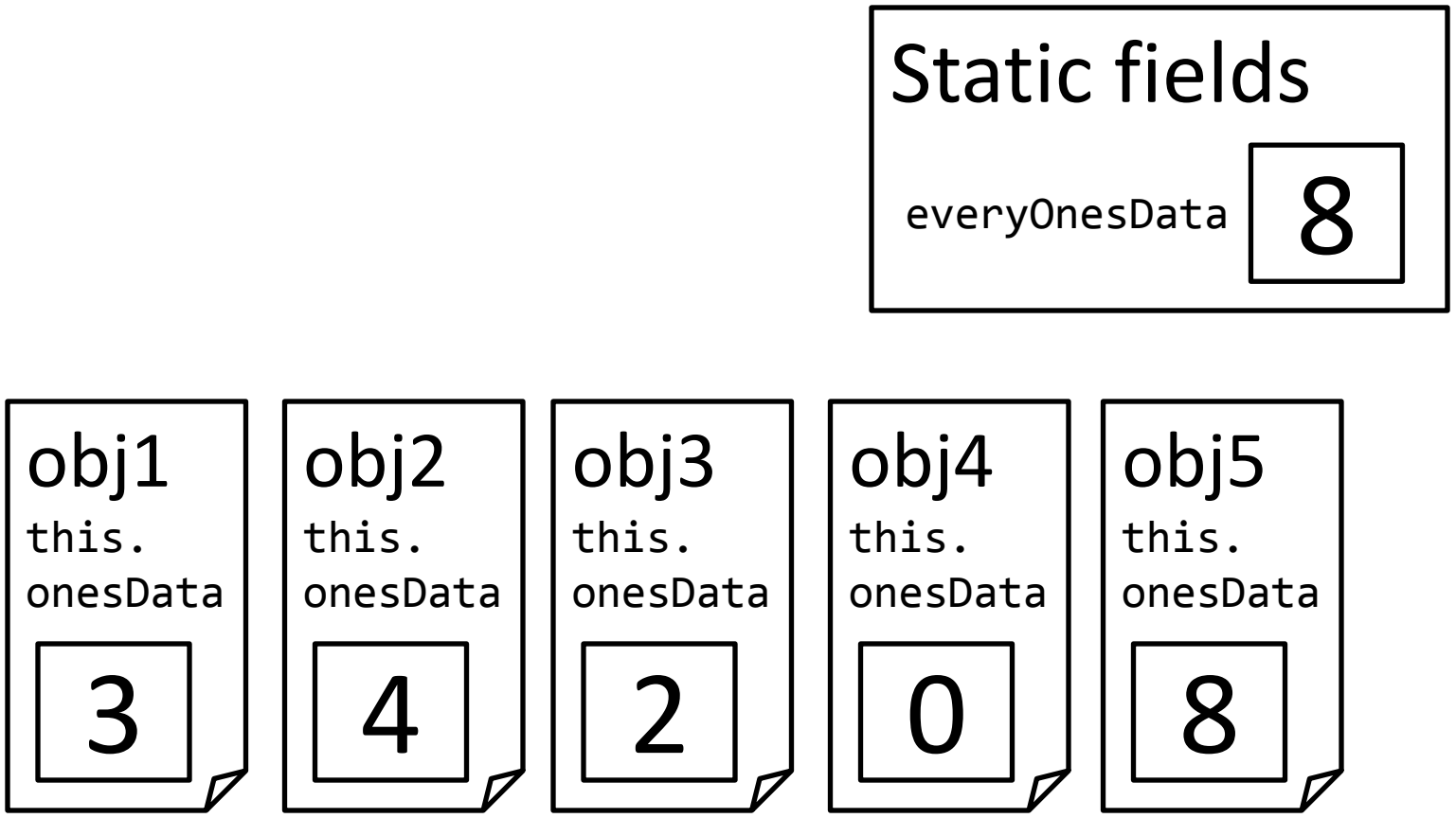
- Lecture examples on CVS
- Quiz Thursday
  - OOP concepts (last Monday through this Wednesday)
  - Study questions up tonight
- Lab tomorrow
  - Grading policy + “challenge question”
- P3 on Wednesday
- Midterm 1

Midterm 1

- Handed back tomorrow in lab
- 1 week for written re-grade requests



Static fields and instance fields

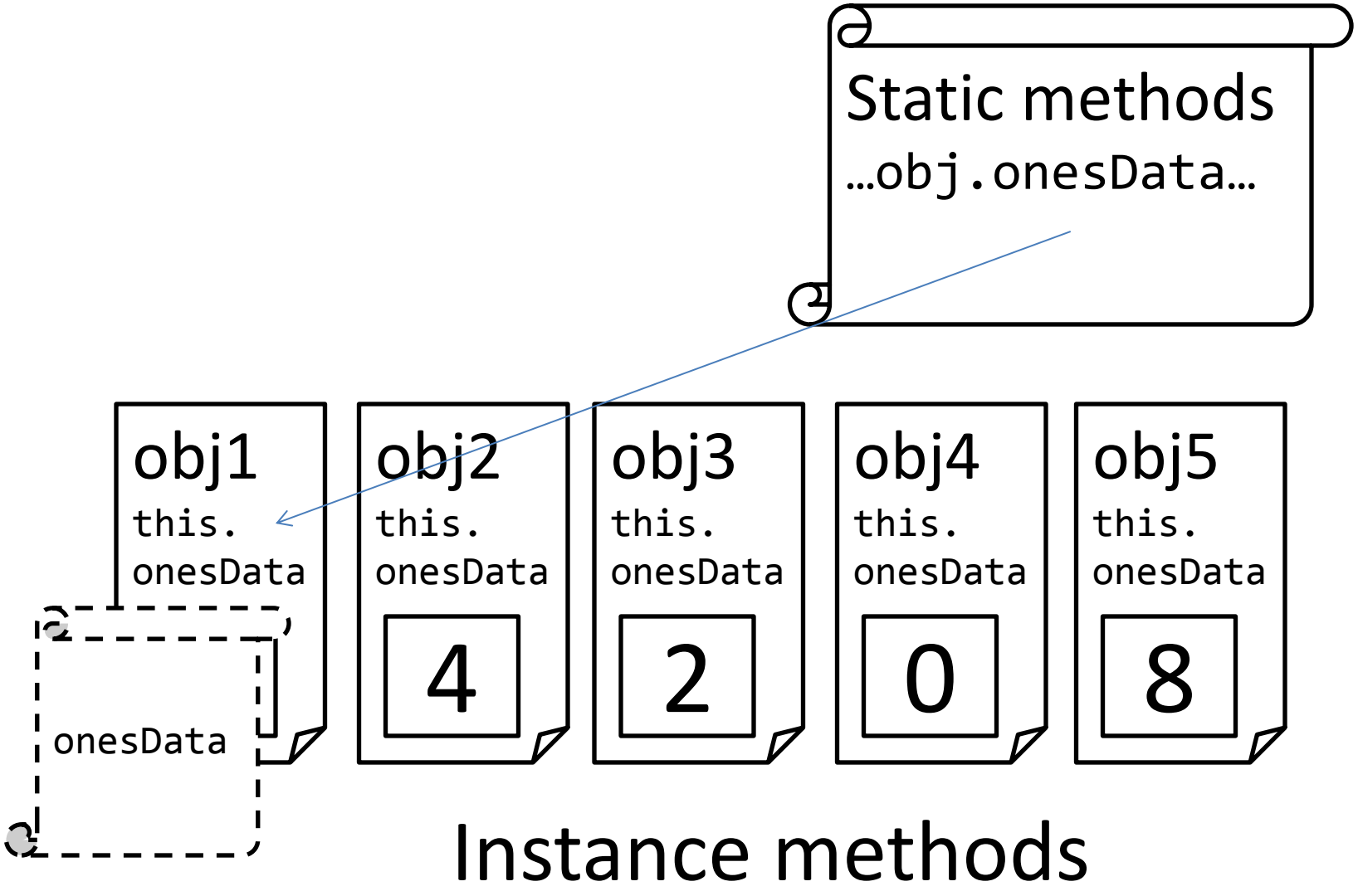


Static/instance usage

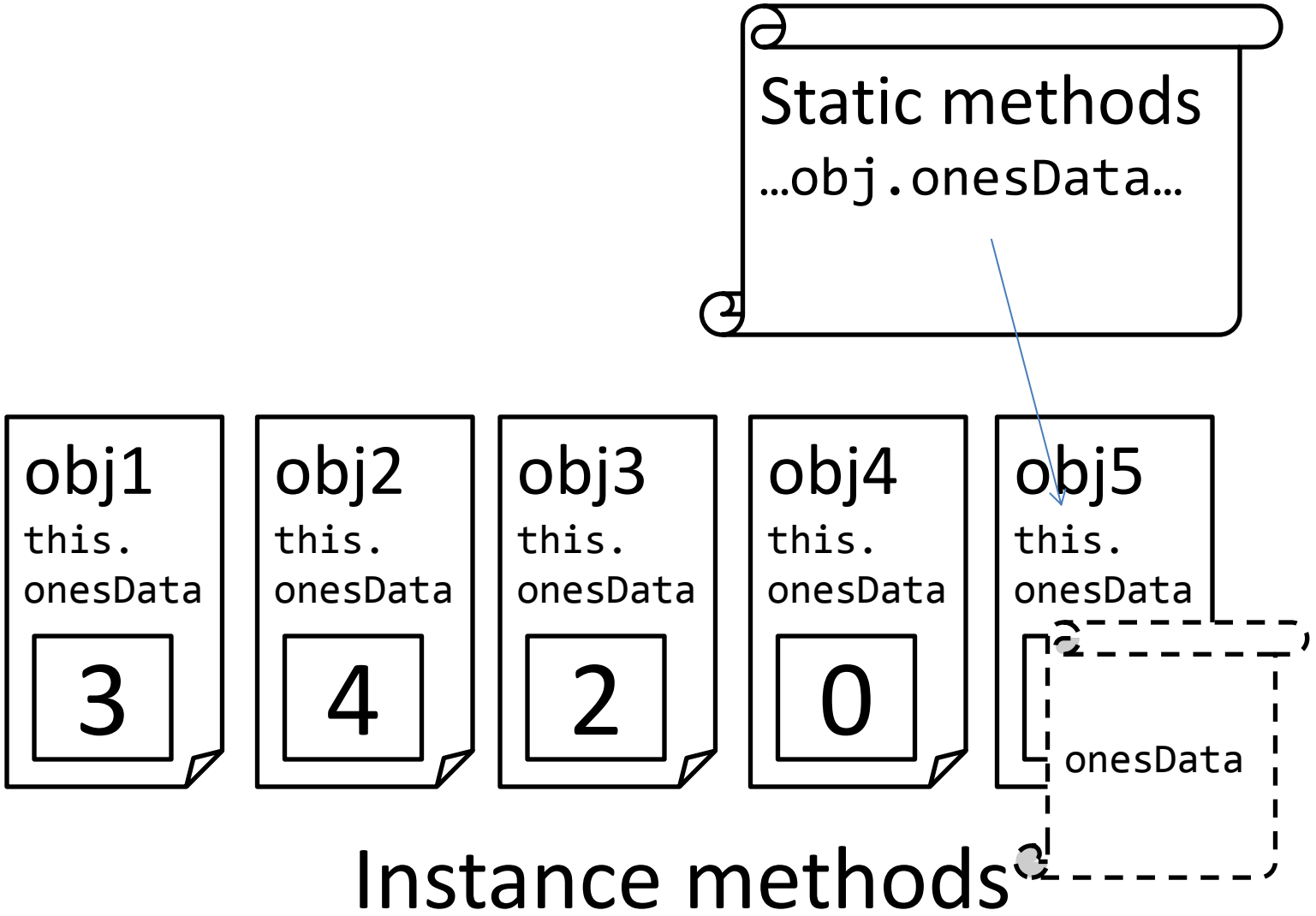
```
//Static usage
MyClassname.staticField
     e.g. Integer.MAX_VALUE
//Instance usage
myObject.instanceField
     e.g. myInt.intValue
```

Something previously constructed with the new keyword

Static methods and instance methods



Static methods and instance methods



Static methods and instance methods

```
//instance method
public void doSomething() {
        //access this.instanceField
}
//static method
public void doSomething(MyClass myObject) {
        //access myObject.instanceField
}
```

Static “Constructor”

```
//Typical constructor
public MyClass(int valueToAssign) {
	this.value = valueToAssign;
}
//Rewritten as a static method
public static MyClass makeNew(int val) {
	MyClass mc = new MyClass(); //default constructor
	mc.value = val;
	return mc;
}
```

Access modifiers - APIs

Application Programming Interface

- A set of methods available to programmers
- “Encapsulation”: The inner workings behind the method calls are treated like a black box
  - Java APIs
    - String
    - Math
    - Etc.
  - What are the trade-offs of encapsulation?

Access modifiers – member level

- "Members" of a class: fields and methods
- Modifying access to members:
  - `public` keyword: Accessible to any object of any class
  - `private` keyword: only accessible to other methods within the same class
  - More to come:
    - package-private (Wednesday)
    - protected (In a few weeks)
- "Top-level" modifiers: modify access to classes as a whole (more on Wednesday)

Memory Model

- Stack

  Contains the local variables used in each method call:

  – primitive data values
  – reference variables (memory addresses)

- Heap

  Contains all of the object instance data

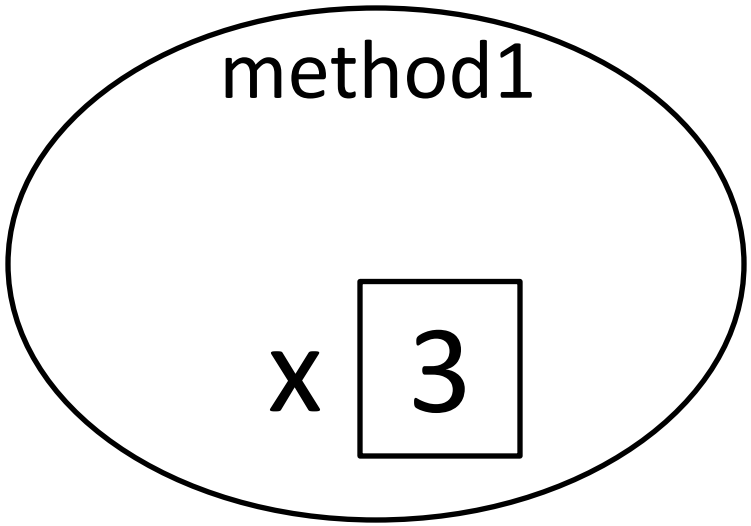
  – Where the reference variables “point to”

- Permanent generation

  – Stores class definitions (things like the instructions for each method)

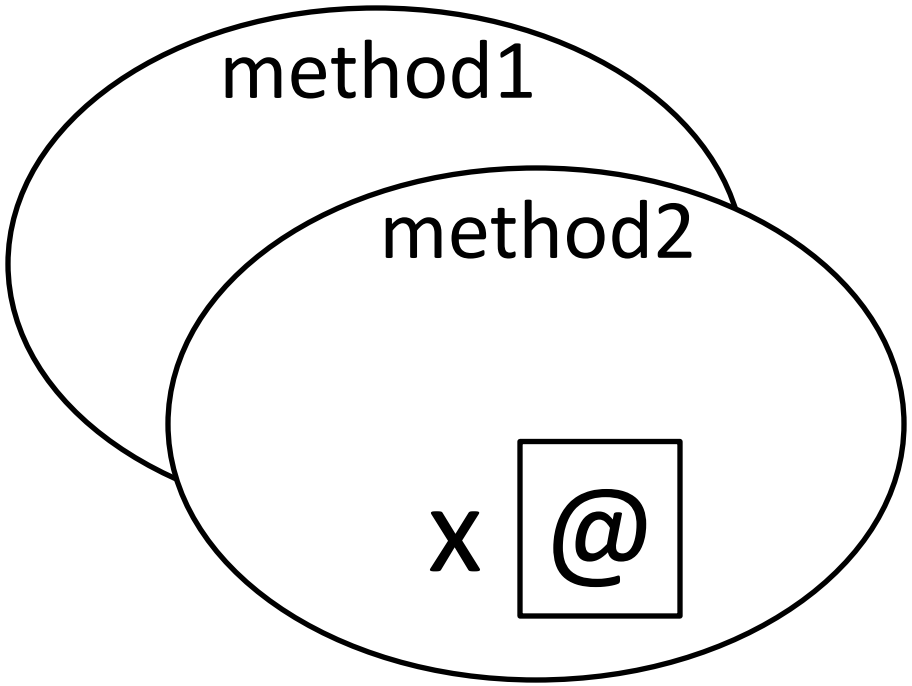
Stack

Stack frame example:



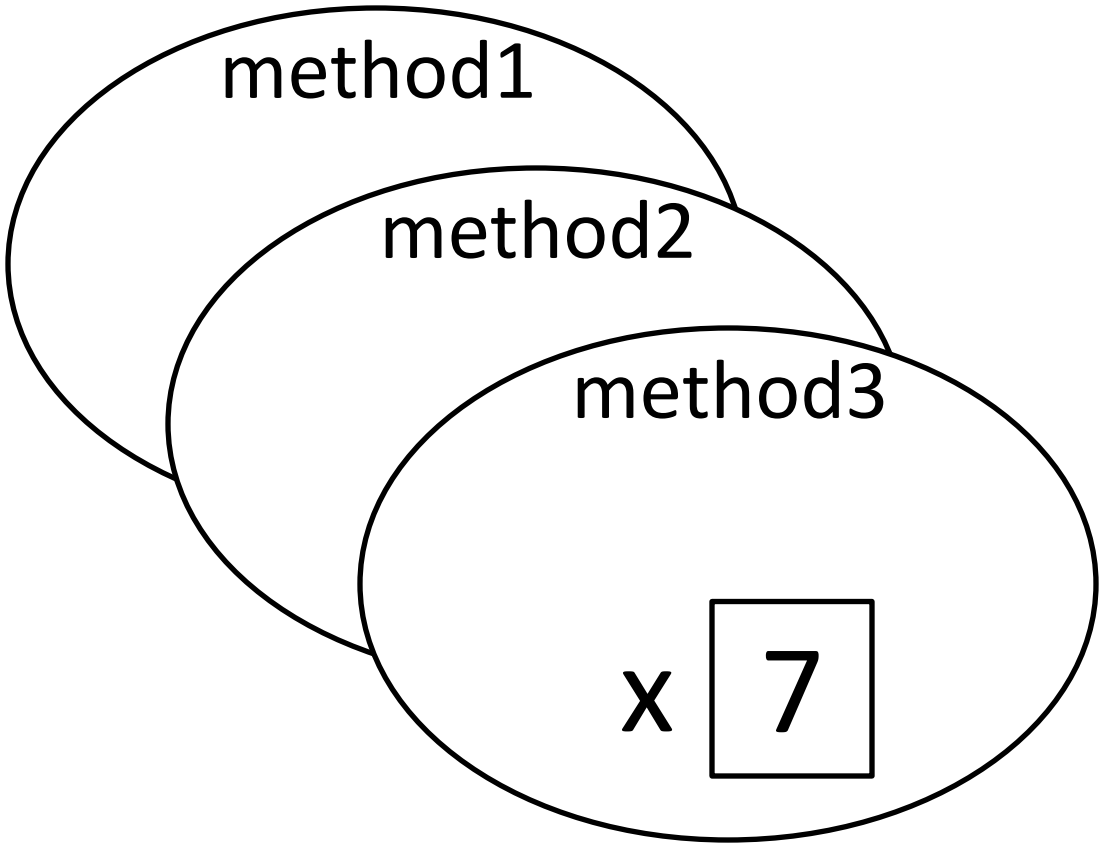
Stack

Stack frame example:



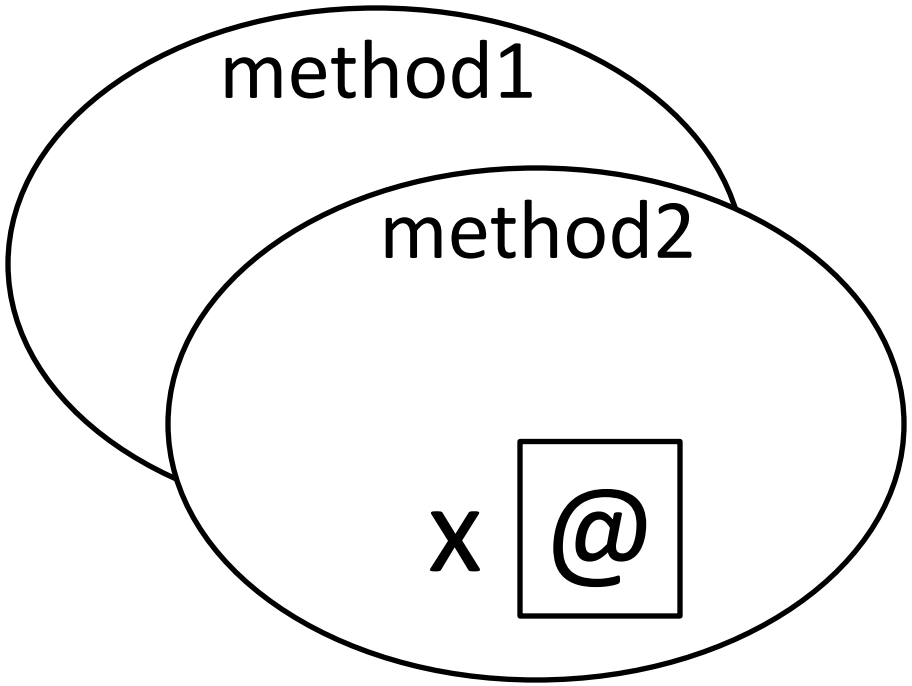
Stack

Stack frame example:



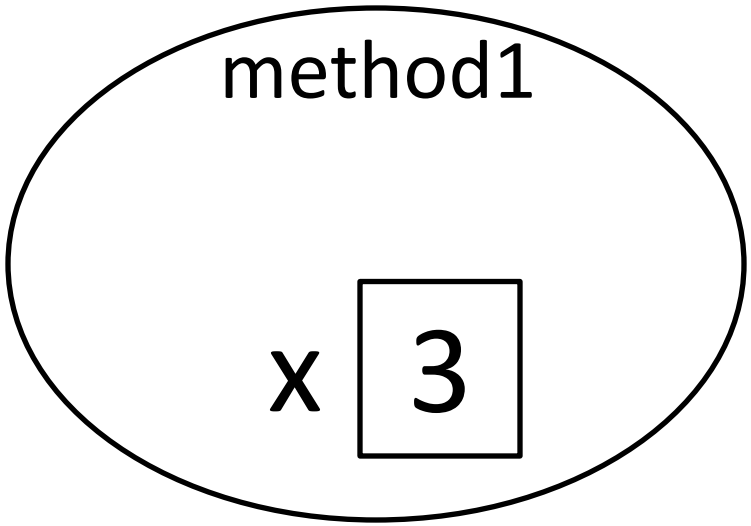
Stack

Stack frame example:

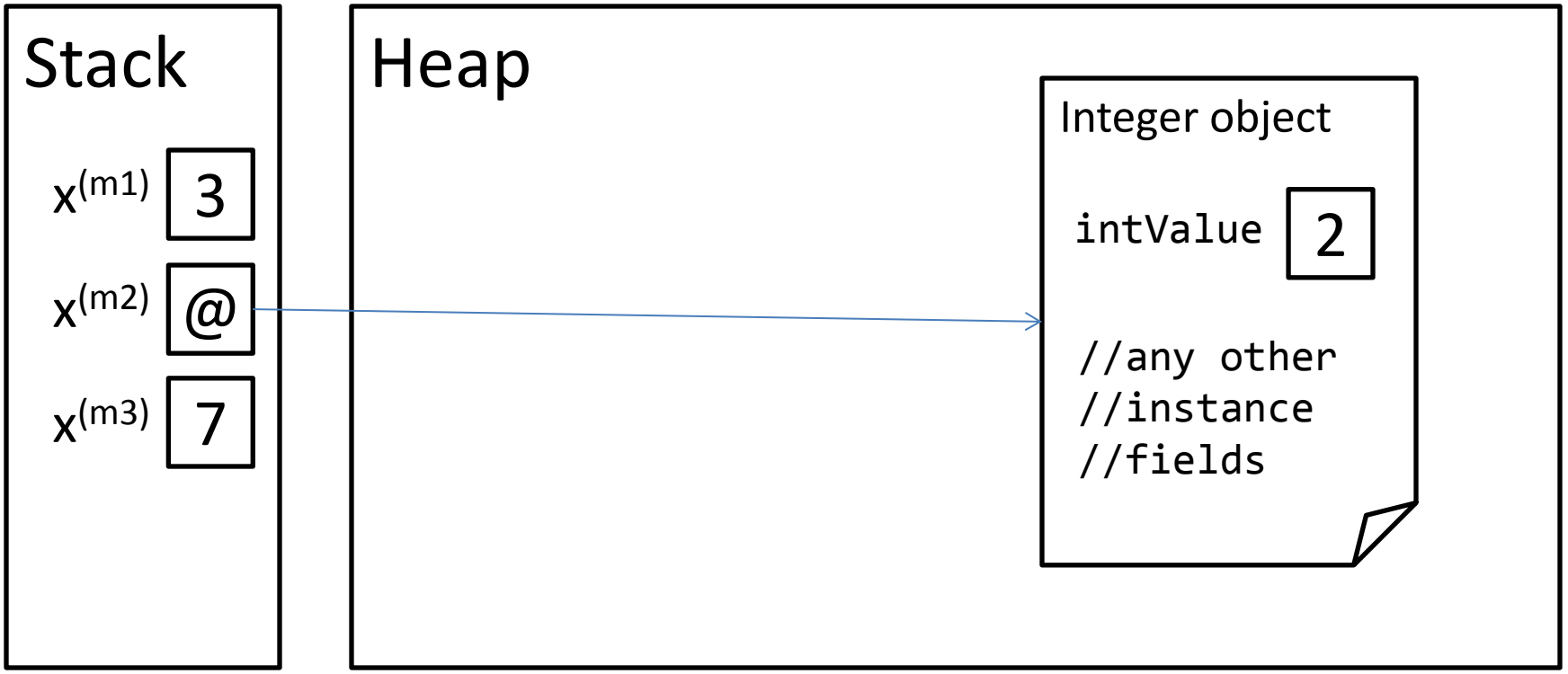


Stack

Stack frame example:

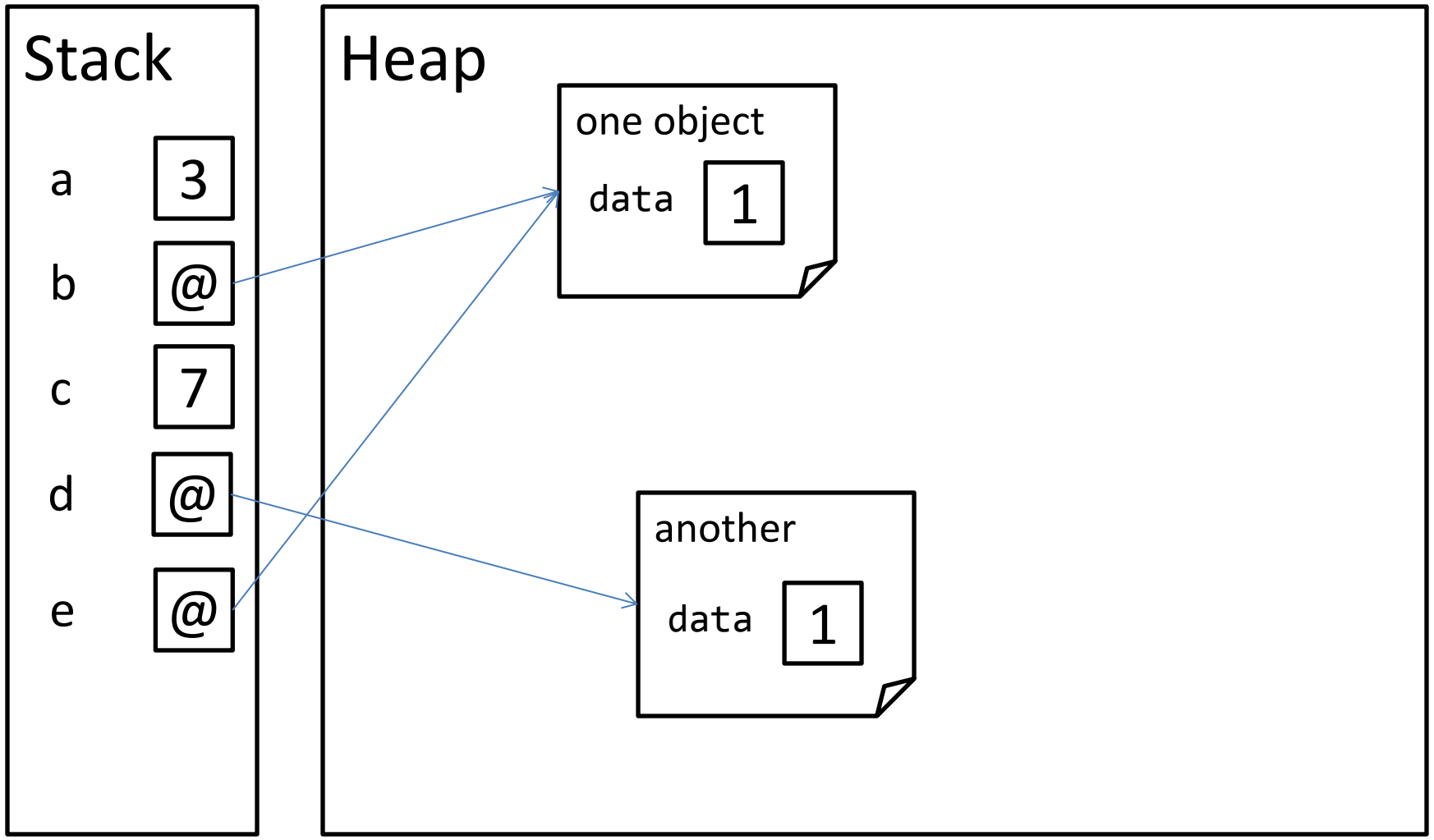


Stack vs Heap

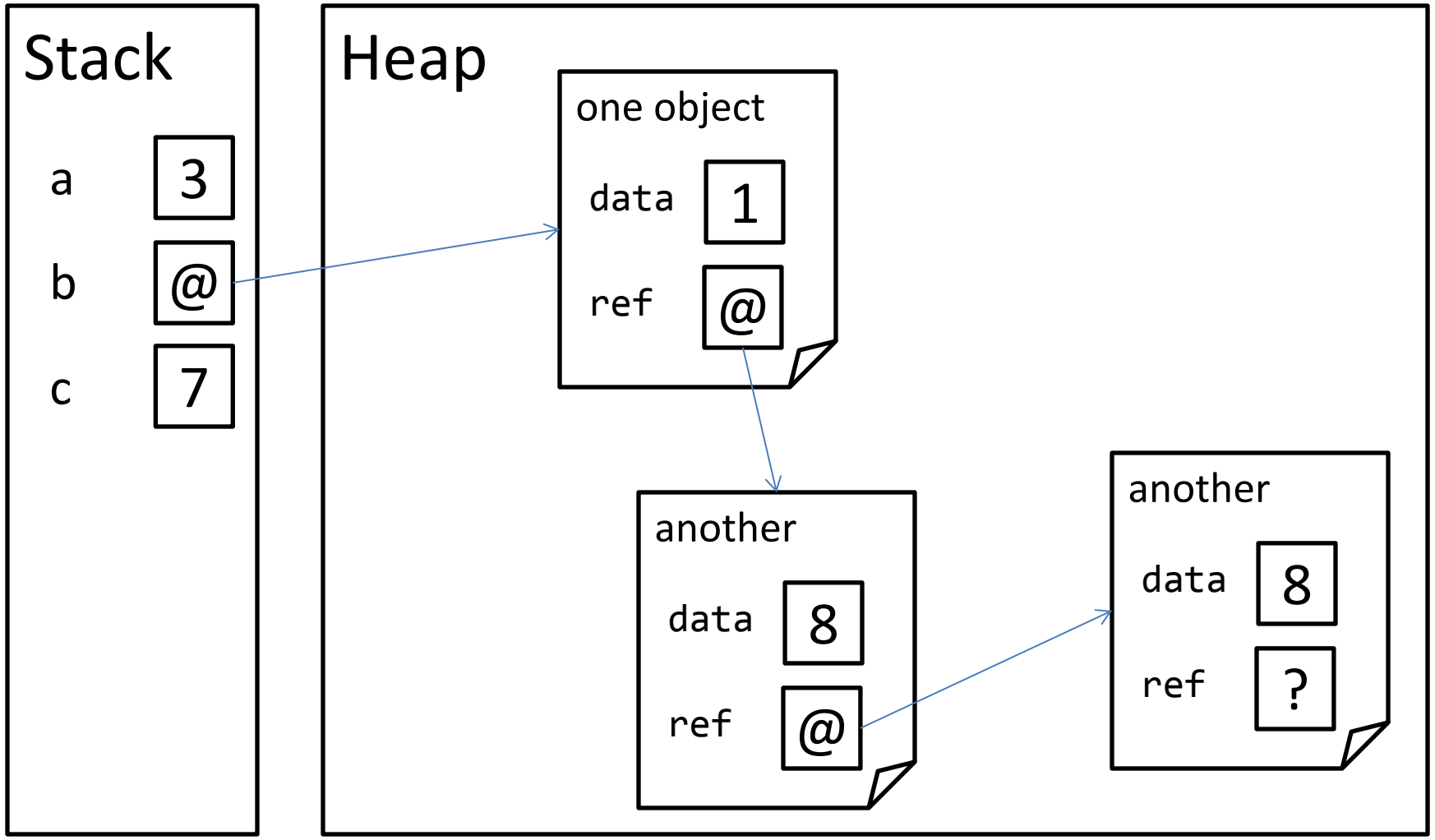


This is how you should draw the stack, heap, variables, and objects on exams

Aliasing



Deeper referencing



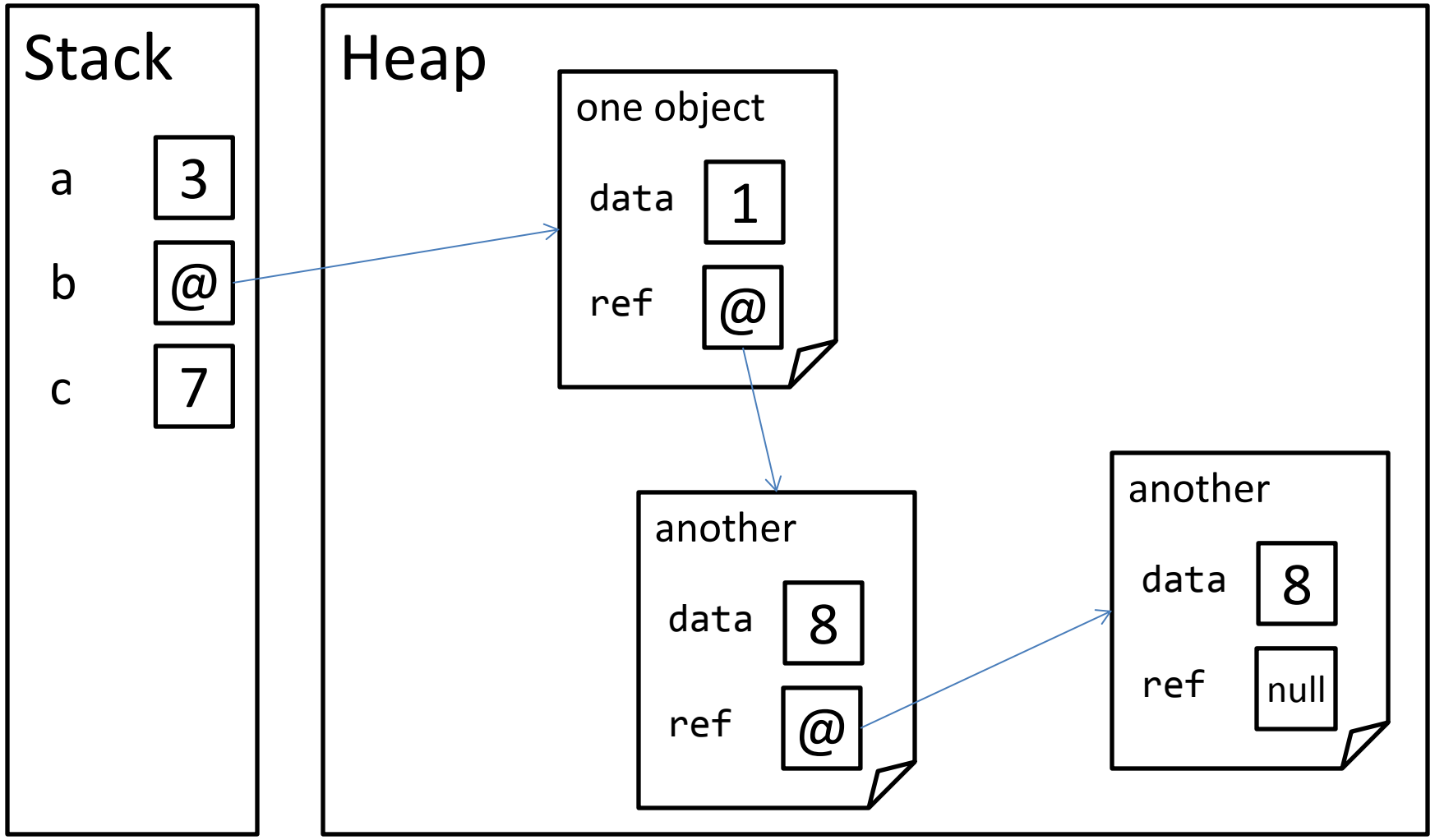
The `null` literal

- Used to indicate an empty reference variable (Doesn't point to a location in memory)
- E.g.

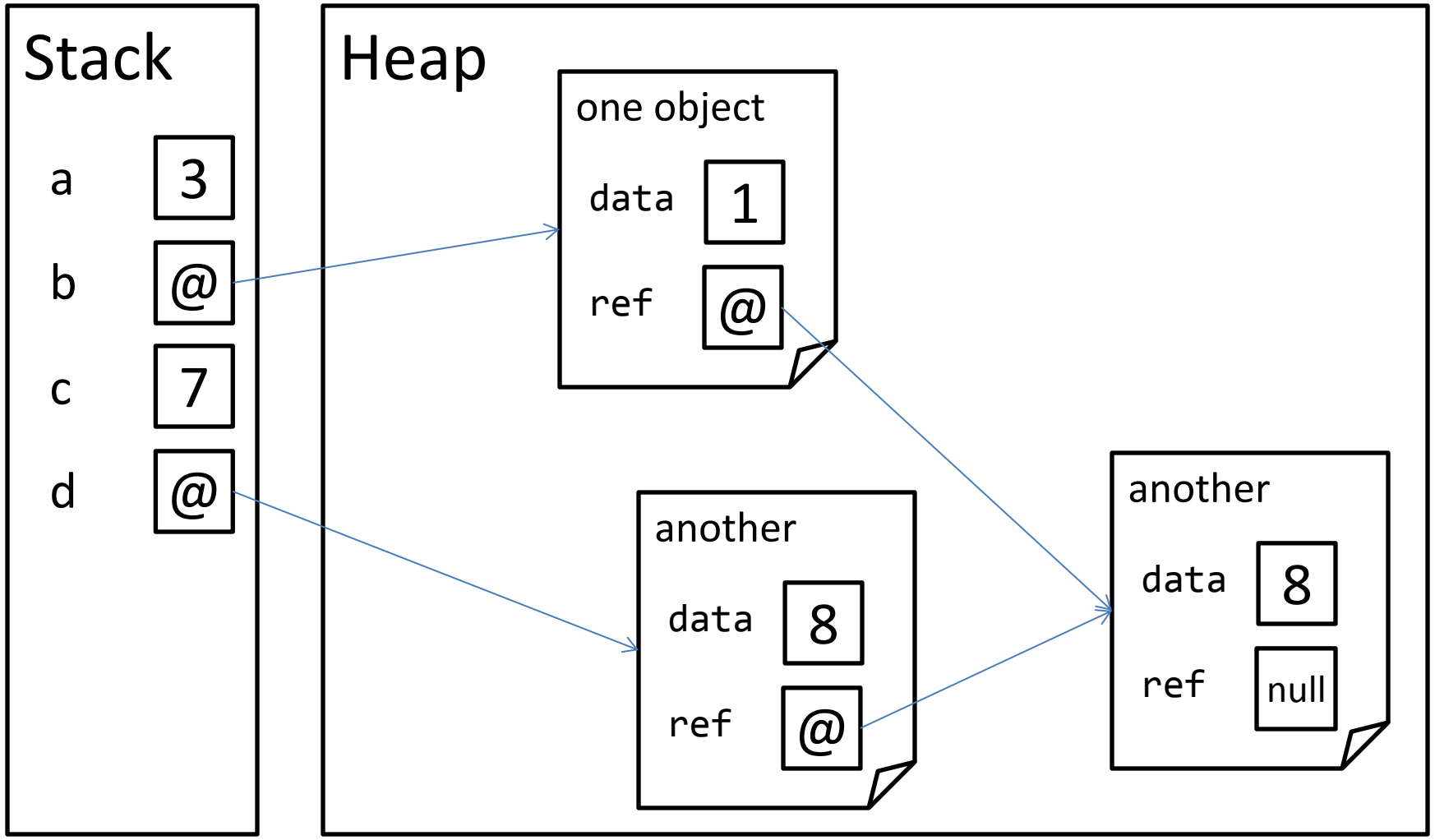
```
MyClass myObject = null;
```

- Not a keyword

Deeper referencing



Deeper aliasing



.equals method

- == compares memory addresses
- .equals can compare instance data
- Should contain a null-check:

```
public boolean equals(MyObject other) {
	if(other != null) {
		return this.data == other.data;
	} else {
		return false;
	}
	//Rewrite using a single line?
}
```

Hard coding data structure

```
//Data for student 01
String student_01_Name;
int student_01_Age;
int student_01_Year;
String student_01_Major;

//Data for student 02
String student_02_Name;
…

//Data for student 03
String student_03_Name;
…
```

(Partially) soft-coding data structure

```
//Data for student 01
Student student_01 = new Student(“Bob”, 17, 2, “CMSC”);
//Data for student 02
Student student_02 = new Student(“Bill”, 20, 4, “CMSC”);
…
//Data for student 03
Student student_02 = new Student(…);
…
```

Fully soft-coding data structure

- Arrays (more later)
  - Contiguous block of memory addresses
- Linked list
  - Non-contiguous: each entry saves the memory address of the subsequent entry
- Trade-offs?