Introducing Java Methods

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Objectives

- To define methods with formal parameters (§6.2).
- To invoke methods with actual parameters (i.e., arguments) (§6.2).
- To define methods with a return value (§6.3).
- To define methods without a return value (§6.4).
- To pass arguments by value (§6.5).

Outline

- Motivating example
- Defining and invoking value-returning methods
- Defining and invoking void methods
- Parameter passing and passing by value
- Pitfalls and errors

Motivating Problem. Compute the sum of integers

- Find the sum of integers from 1 to 10, from 20 to 30, and from 35 to 45, respectively.

Solution 1. Compute the sum of integers. Your thoughts?

```
int sum = 0;
for (int i = 1; i <= 10; i++)
  sum += i;
System.out.println("Sum from 1 to 10 is " + sum);

sum = 0;
for (int i = 20; i <= 30; i++)
  sum += i;
System.out.println("Sum from 20 to 30 is " + sum);

sum = 0;
for (int i = 35; i <= 45; i++)
  sum += i;
System.out.println("Sum from 35 to 45 is " + sum);
```

Critique on Solution 1. Compute the sum of integers.

```
int sum = 0;
for (int i = 1; i <= 10; i++)
  sum += i;
System.out.println("Sum from 1 to 10 is " + sum);

sum = 0;
for (int i = 20; i <= 30; i++)
  sum += i;
System.out.println("Sum from 20 to 30 is " + sum);

sum = 0;
for (int i = 35; i <= 45; i++)
  sum += i;
System.out.println("Sum from 35 to 45 is " + sum);
```

Solution 2. Introducing a Method

```
public static int sum(int i1, int i2) {
  int sum = 0;
  for (int i = i1; i <= i2; i++)
    sum += i;
  return sum;
}
```

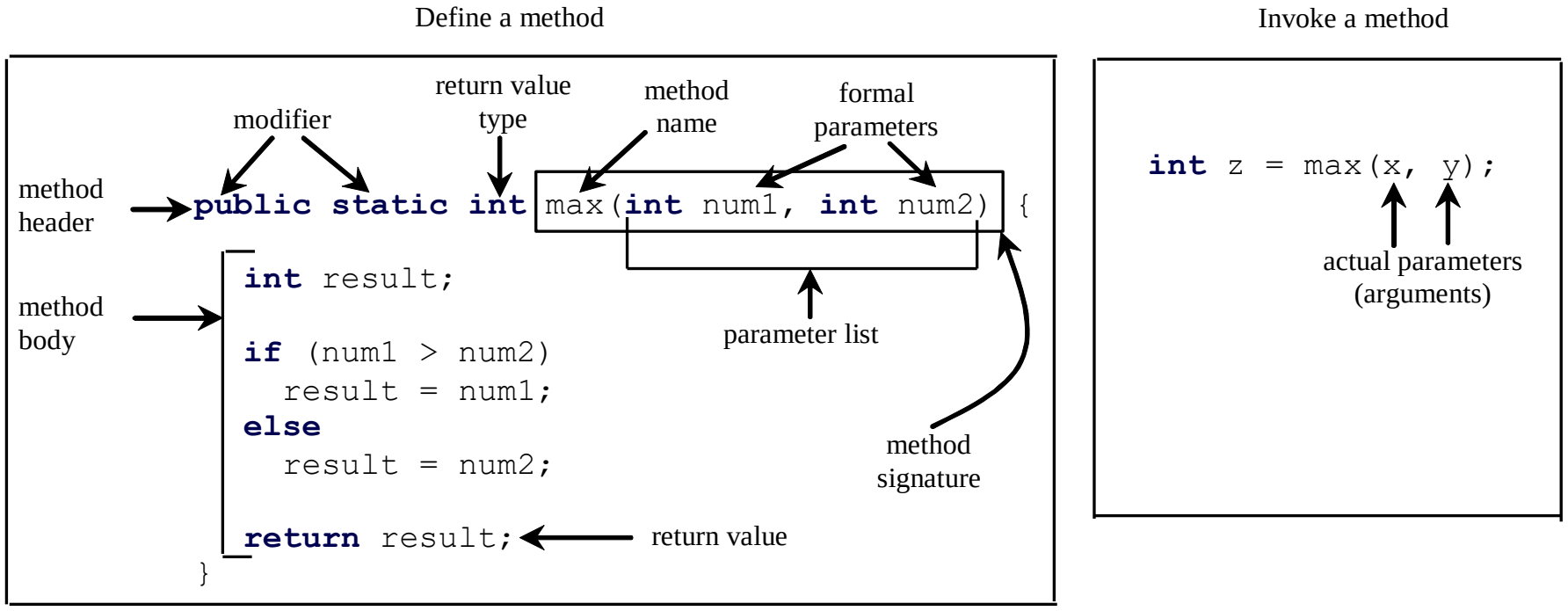
```
public static void main(String[] args) {
  System.out.println("Sum from 1 to 10 is " + sum(1, 10));
  System.out.println("Sum from 20 to 30 is " + sum(20, 30));
  System.out.println("Sum from 35 to 45 is " + sum(35, 45));
}
```

Questions?

Methods

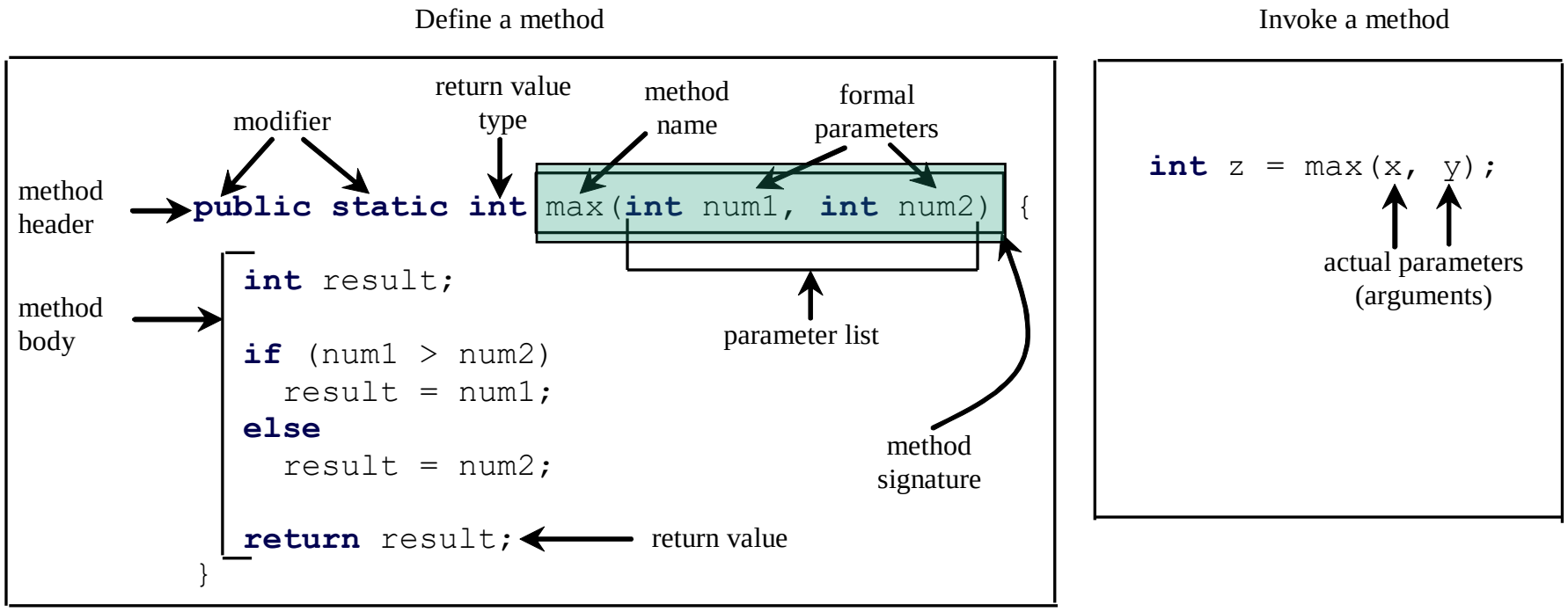
- A method (functions, subroutines) is a collection of statements that are grouped together to perform an operation.

Defining and Invoking Methods



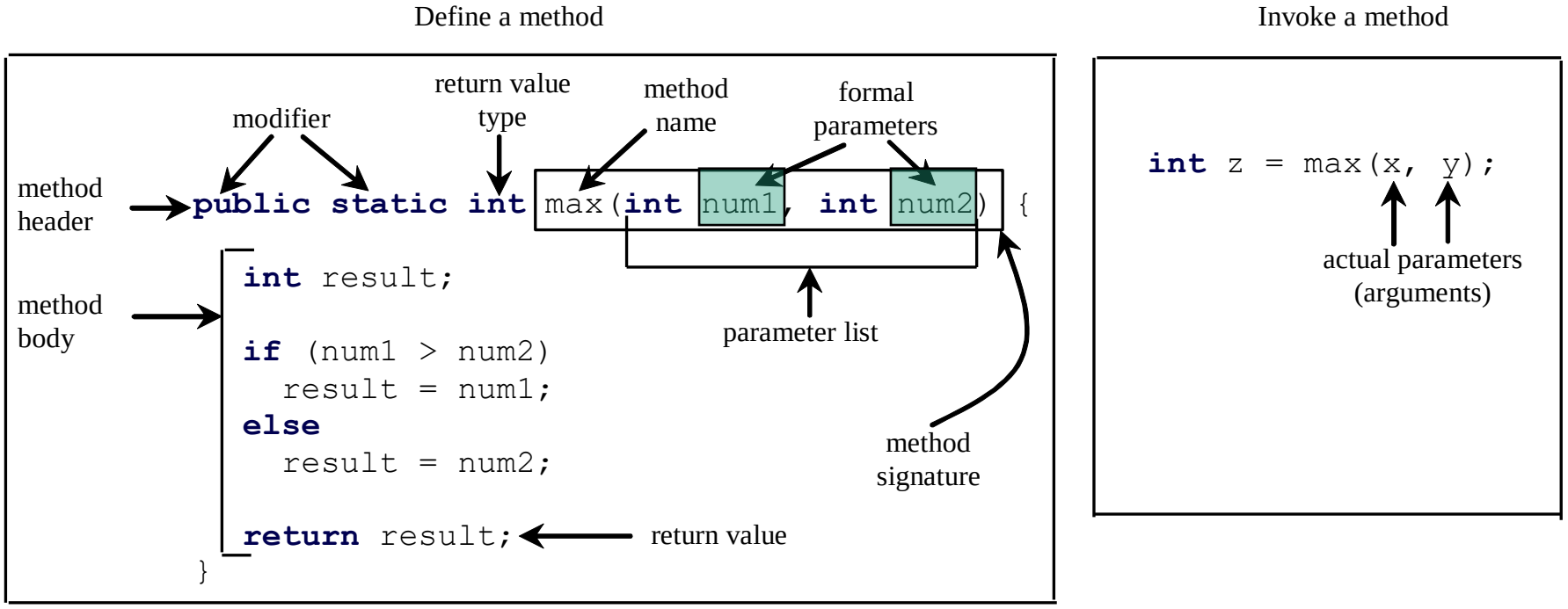
Method Signature

- *Method signature* is the combination of the method name and the parameter list.



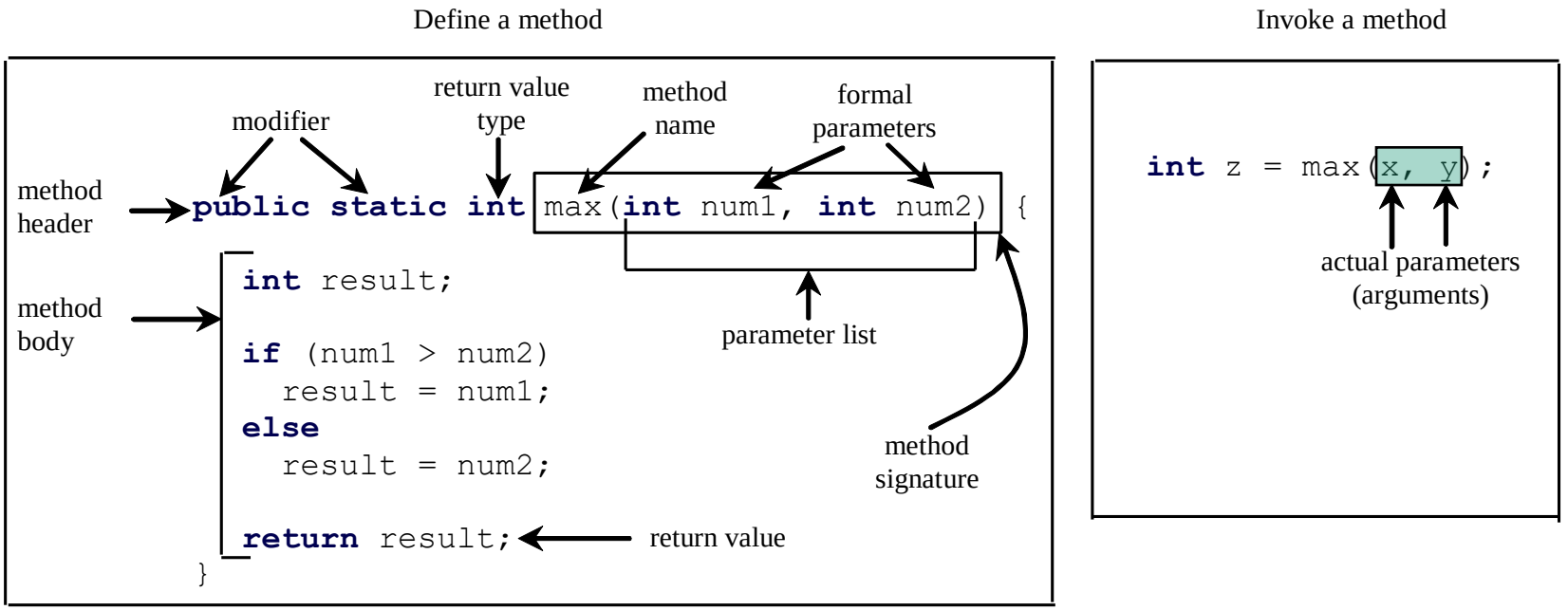
Formal Parameters

- The variables defined in the method header are known as *formal parameters*



Actual Parameter (Argument)

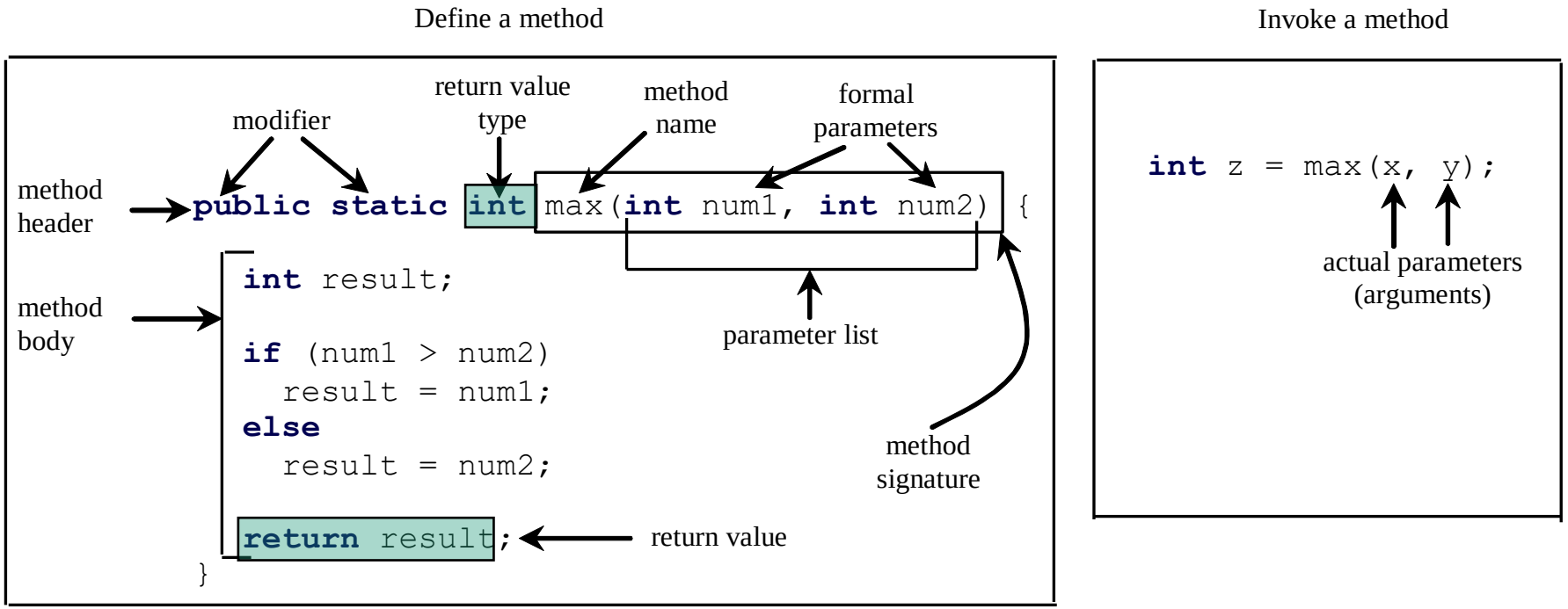
- When a method is invoked, you pass a value to the parameter. This value is referred to as *actual parameter or argument*.



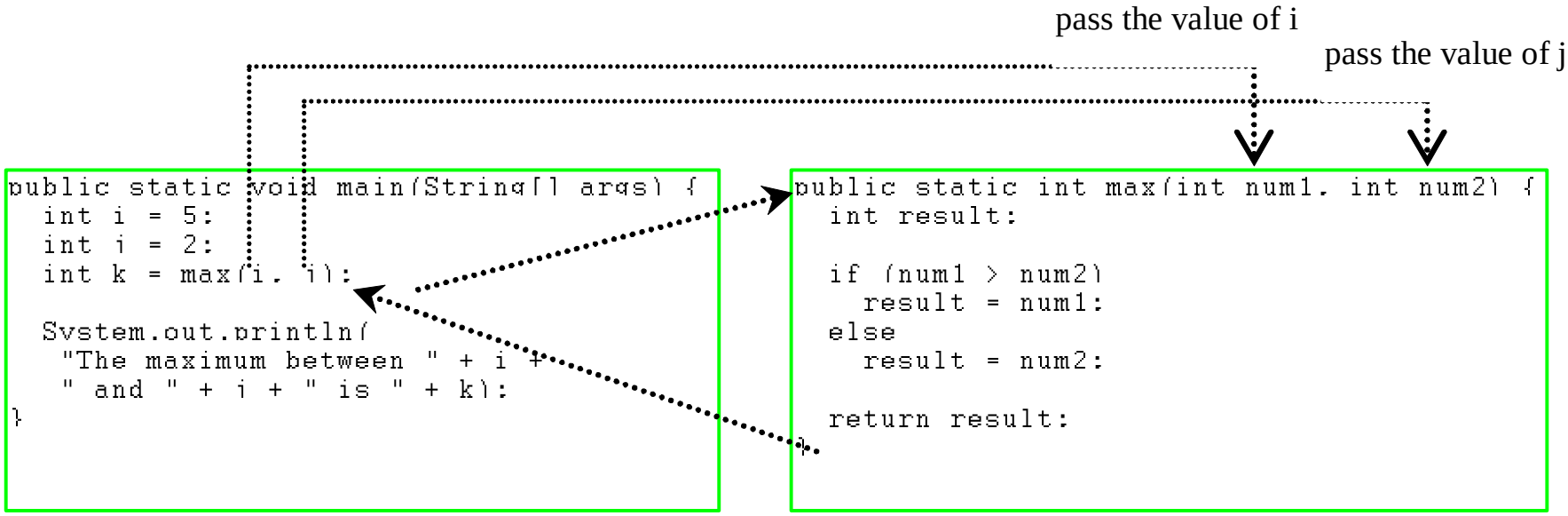
Return Value Type

- A method may return a value.
- The returnValueType is the data type of the value the method returns.
- If the method does not return a value, the returnValueType is the keyword void.
  - For example, the returnValueType in the main method is void.

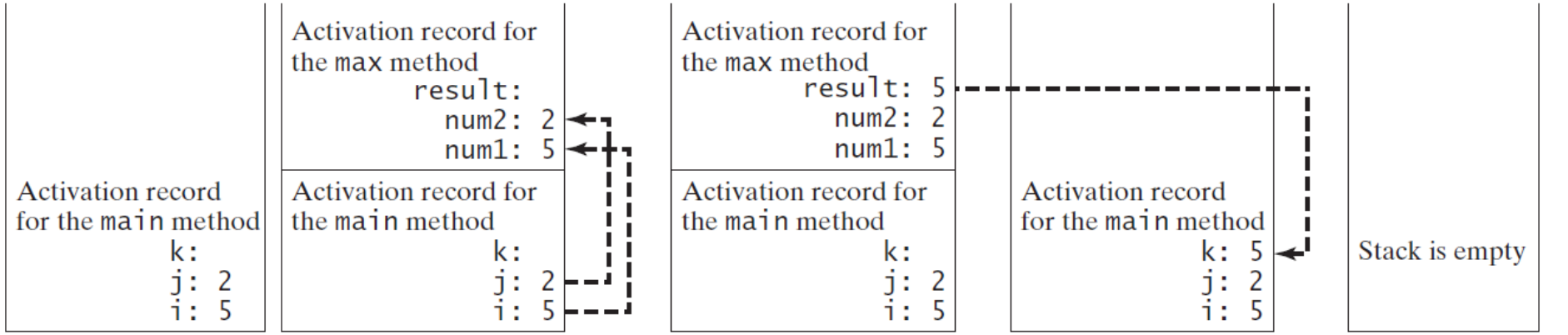
Return Value Type



Calling/Invoking Methods



Call Stacks



(a) The `main` method is invoked.

(b) The `max` method is invoked.

(c) The `max` method is being executed.

(d) The `max` method is finished and the return value is sent to `k`.

(e) The `main` method is finished.

Errors and Pitfalls

- A return statement is required for a value-returning method.

Is there an error? Where is it and Why?

```
public static int sign(int n) {
  if (n > 0)
    return 1;
  else if (n == 0)
    return 0;
  else if (n < 0)
    return -1;
}
```

A value-returning method must return a value

- The method shown below in (a) is logically correct, but it has a compilation error because the Java compiler thinks it possible that this method does not return any value

```
public static int sign(int n) {
  if (n > 0)
    return 1;
  else if (n == 0)
    return 0;
  else if (n < 0)
    return -1;
}
```

Correction

- To fix this problem, delete *if (n < 0)* in (a), so that the compiler will see a return statement to be reached regardless of how the if statement is evaluated

```
public static int sign(int n) {
  if (n > 0)
    return 1;
  else if (n == 0)
    return 0;
  else if (n < 0)
    return -1;
}
```

(a)

Should be

```
public static int sign(int n) {
  if (n > 0)
    return 1;
  else if (n == 0)
    return 0;
  else
    return -1;
}
```

(b)

Questions?

void Method

- This type of method does not return a value. The method performs some actions

Problem. Given points, print letter grade

- Write a program that prompts the user to enter a point, and print the letter grade in a method

Questions?

Passing Parameters

```
public static void nPrintln(String message, int n) {
  for (int i = 0; i < n; i++)
    System.out.println(message);
}
```

Suppose you invoke the method using

nPrintln("Welcome to Java", 5);

What is the output?

Suppose you invoke the method using

nPrintln("Computer Science", 15);

What is the output?

Can you invoke the method using

nPrintln(15, "Computer Science");

Pass By Value

- Java passes a parameter to a method by the value of the parameter.

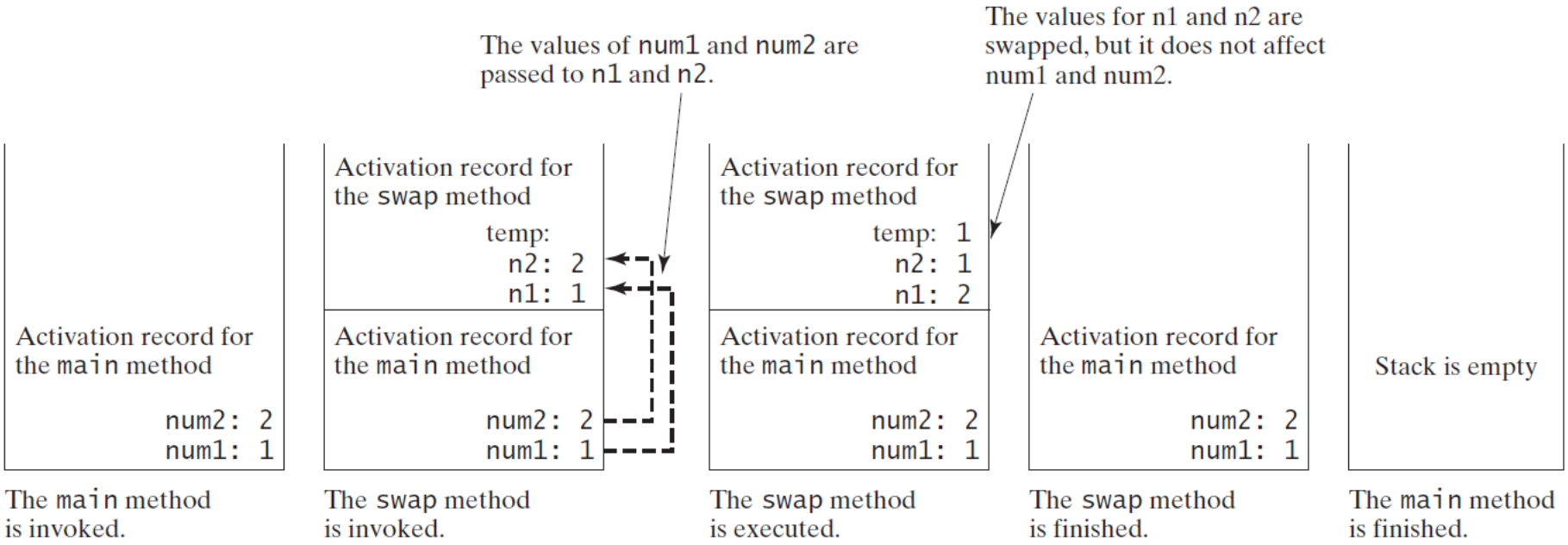
Observe Output of Following Program

```
public class Increment {
  public static void main(String[] args) {
    int x = 1;
    System.out.println("Before the call, x is " + x);
    increment(x);
    System.out.println("After the call, x is " + x);
  }

  public static void increment(int n) {
    n++;
    System.out.println("n inside the method is " + n);
  }
}
```

Why?

- Observe Call Stack



Questions