CS202 Java Object Oriented Programming

Review of Language Basics

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Overview

- ◈Programming environments
- ◈Basic program structure
- ◈Variables and types
- ◈Operators
- ◈Methods and recursion
- ◈Arrays

JDK

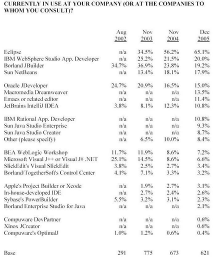
- ◈http://java.sun.com
- ◈`javac` Welcome.java
- ◈`java` Welcome

Java IDEs

- ◈ JBuilder
  - Commercial with a scaled-down free version (`JBuilder Foundation`)
- ◈ Eclipse
  - http://www.eclipse.org
  - High quality and free
  - Many tools and plug-ins have to be installed separately
- ◈ Netbeans
  - http://www.netbeans.org
  - All-in-one package
  - Slow on older computers

IDE Usage Statistics

- ◈Survey by *BZ Research* in December 2005
  - Eclipse: 65.1%
  - JBuilder: 19.2%
  - Netbeans: 17.9%



Java Use and Awareness Study
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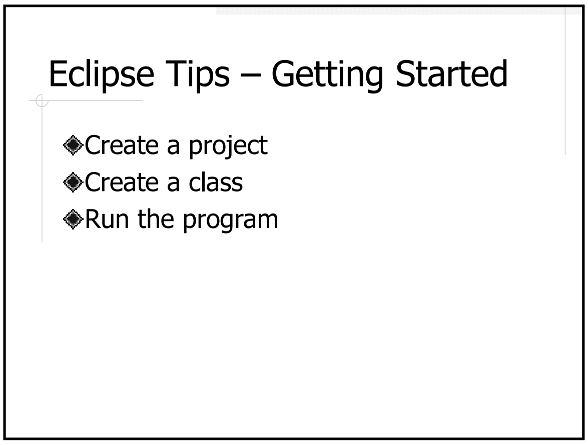
QUESTION 8. WHICH JAVA DEVELOPMENT ENVIRONMENTS ARE CURRENTLY IN USE AT YOUR COMPANY (OR AT THE COMPANIES TO WHOM YOU CONSULT)?

	Aug 2002	Nov 2003	Nov 2004	Dec 2005
Eclipse	n/a	34.5%	56.2%	65.1%
IBM WebSphere Studio App. Developer	n/a	25.2%	21.5%	20.0%
Borland JBuilder	34.7%	36.9%	23.8%	19.2%
Sun NetBeans	n/a	13.4%	18.1%	17.9%
Oracle JDeveloper	24.7%	20.9%	16.5%	15.0%
Macromedia Dreamweaver	n/a	n/a	n/a	13.5%
Emacs or related editor	n/a	n/a	n/a	11.4%
JetBrains IntelliJ IDEA	3.8%	8.1%	12.3%	10.8%
IBM Rational App. Developer	n/a	n/a	n/a	10.8%
Sun Java Studio Enterprise	n/a	n/a	n/a	9.3%
Sun Java Studio Creator	n/a	n/a	n/a	8.7%
Other (please specify)	n/a	6.5%	10.0%	8.4%
BEA WebLogic Workshop	11.7%	11.9%	8.6%	7.2%
Microsoft Visual J++ or Visual J# .NET	25.1%	14.5%	8.6%	6.6%
SlickEdit's Visual SlickEdit	3.8%	2.5%	2.7%	3.4%
Borland/TogetherSoft's Control Center	4.1%	7.1%	3.3%	3.2%
Apple's Project Builder or Xcode	n/a	1.9%	2.7%	3.1%
In-house-developed IDE	n/a	2.7%	2.4%	2.6%
Sybase's PowerBuilder	5.5%	3.2%	3.1%	2.3%
Borland Enterprise Studio for Java	n/a	n/a	n/a	2.1%
Compuware DevPartner	n/a	n/a	n/a	0.6%
Xinox JCreator	n/a	n/a	n/a	0.6%
Compuware's OptimalJ	1.0%	1.2%	0.6%	0.4%
Base	291	775	673	621

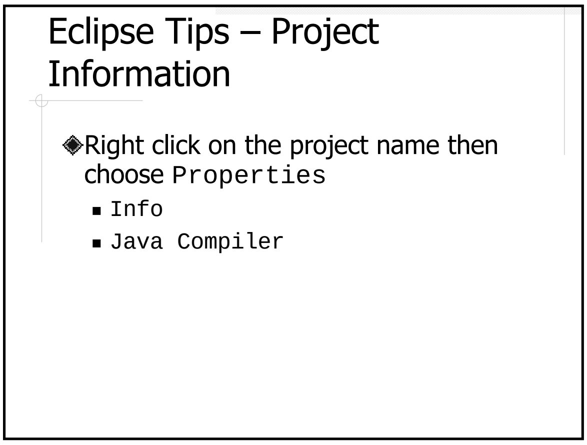
Eclipse Tips – Views and Perspective

- ◈Each block is called a View
  - `Window -> Show View`
  - `Package Explorer` view
- ◈A number of views constitute a Perspective
  - `Window -> Open Perspective`
  - `Java` perspective



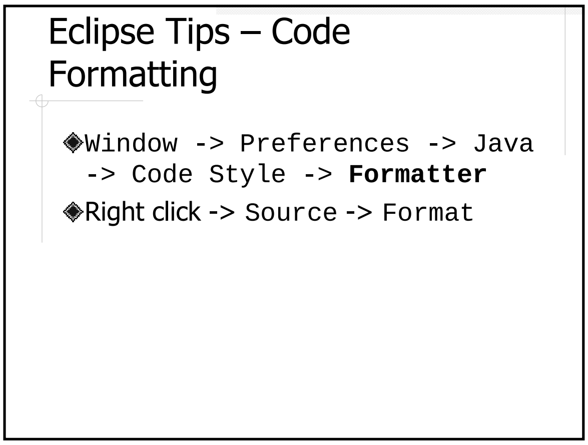
Eclipse Tips – Getting Started

- Create a project
- Create a class
- Run the program



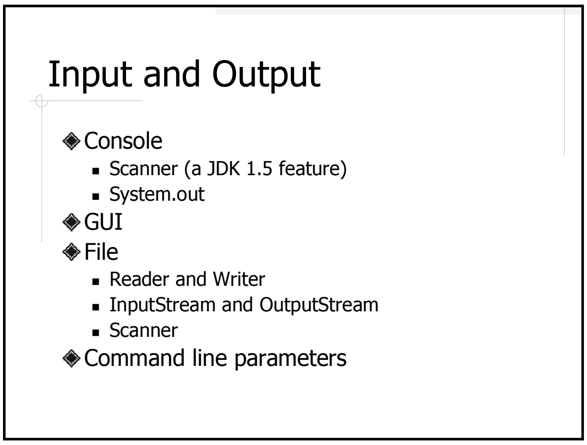
Eclipse Tips – Project Information

- Right click on the project name then choose `Properties`
  - `Info`
  - `Java Compiler`



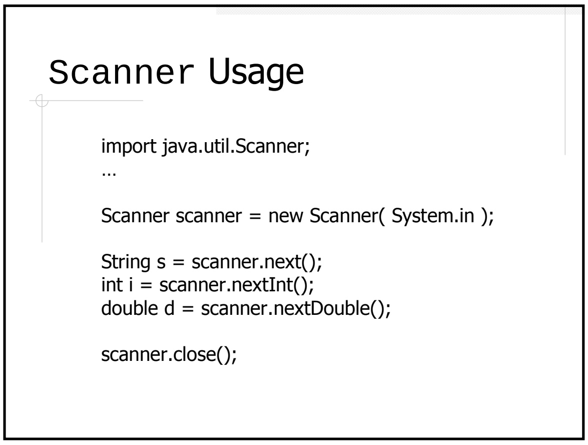
Eclipse Tips – Code Formatting

- `Window -> Preferences -> Java -> Code Style ->` **`Formatter`**
- Right click -> `Source -> Format`



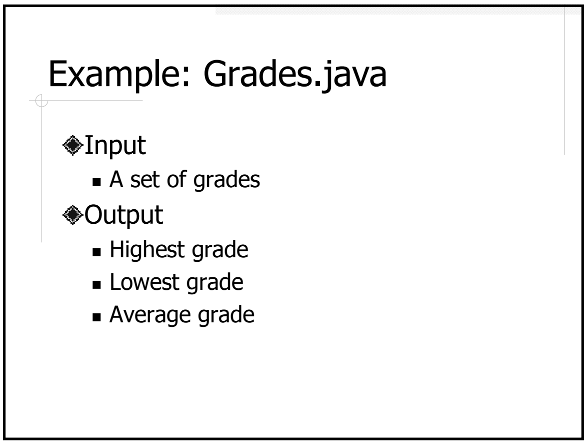
Input and Output

- Console
  - Scanner (a JDK 1.5 feature)
  - System.out
- GUI
- File
  - Reader and Writer
  - InputStream and OutputStream
  - Scanner
- Command line parameters



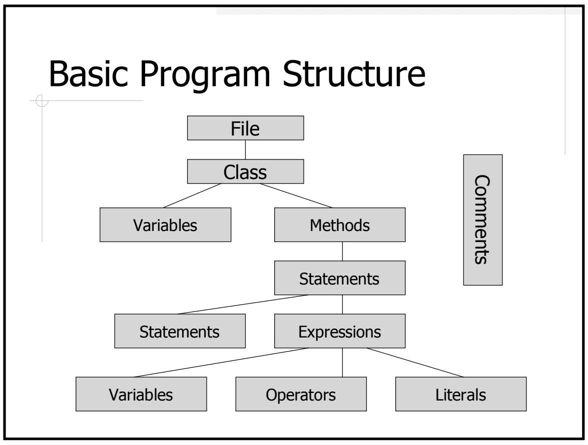
`Scanner` Usage

```
import java.util.Scanner;
…

Scanner scanner = new Scanner( System.in );

String s = scanner.next();
int i = scanner.nextInt();
double d = scanner.nextDouble();

scanner.close();
```



Example: Grades.java

- Input
  - A set of grades
- Output
  - Highest grade
  - Lowest grade
  - Average grade



Basic Program Structure

File

Class

Variables

Methods

Statements

Statements

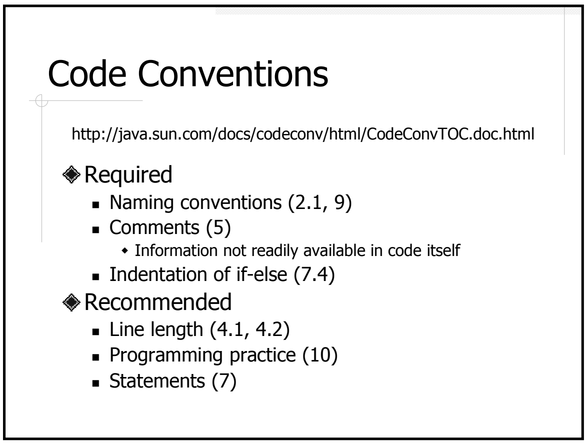
Expressions

Variables

Operators

Literals

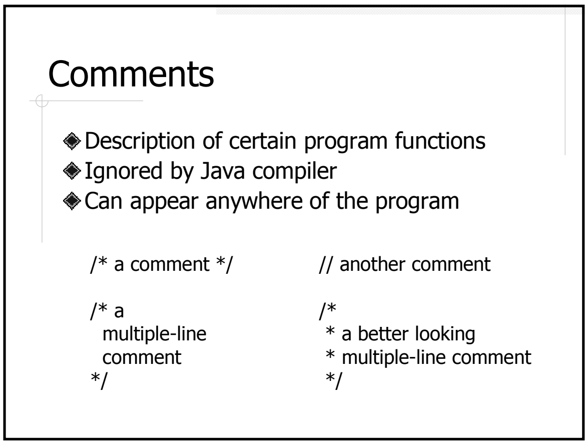
Comments



Code Conventions

http://java.sun.com/docs/codeconv/html/CodeConvTOC.doc.html

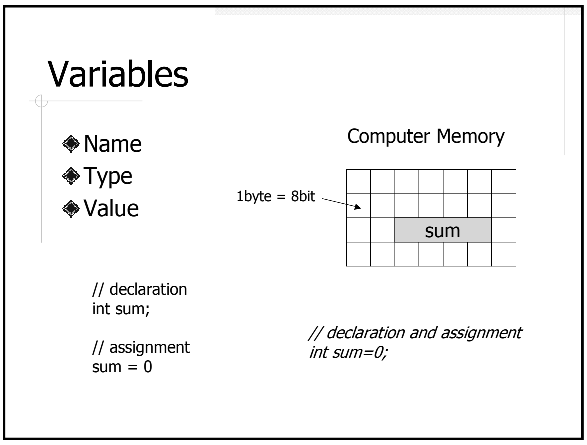
- Required
  - Naming conventions (2.1, 9)
  - Comments (5)
    - Information not readily available in code itself
  - Indentation of if-else (7.4)
- Recommended
  - Line length (4.1, 4.2)
  - Programming practice (10)
  - Statements (7)



Comments

- Description of certain program functions
- Ignored by Java compiler
- Can appear anywhere of the program

```
/* a comment */              // another comment

/* a                         /*
  multiple-line               * a better looking
  comment                     * multiple-line comment
*/                            */
```



Variables

- Name
- Type
- Value

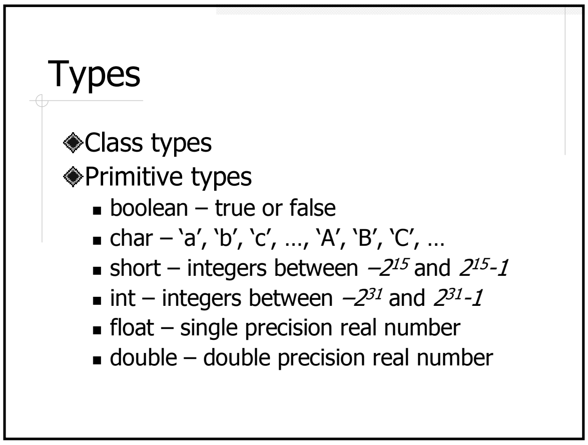
Computer Memory

1byte = 8bit

sum

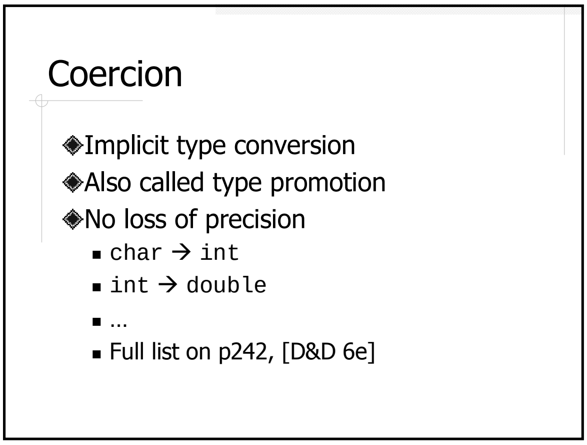
```
// declaration
int sum;

// assignment
sum = 0
```

// declaration and assignment
int sum=0;



Types

- Class types
- Primitive types
  - boolean – true or false
  - char – ‘a’, ‘b’, ‘c’, …, ‘A’, ‘B’, ‘C’, …
  - short – integers between -2^{15} and $2^{15}-1$
  - int – integers between -2^{31} and $2^{31}-1$
  - float – single precision real number
  - double – double precision real number



Coercion

- Implicit type conversion
- Also called type promotion
- No loss of precision
  - `char` → `int`
  - `int` → `double`
  - …
  - Full list on p242, [D&D 6e]

Cast

- ◈Explicit type conversion
- ◈*Possible* loss of precision
- ◈Syntax: (*Type*) *Expression*

```
double    number = 3.6;

int    integer_part = (int) number; // cast
double    fraction_part = number – integer_part;
```

Values (a.k.a. Literals)

- ◈boolean: true, false
- ◈char: 'a', 'b', … , 'A', 'B', …, '1', '2', …
- ◈float, double: -0.1, 99.99, 1.1e13
- ◈short, int: -10, 203, 0x11, 011 …

Number Systems

- ◈Base-2 (Binary)
  - 0, 1
- ◈Base-8 (Octal)
  - 0, 1, … , 7
- ◈Base-10 (Decimal)
  - 0, 1, … , 9
- ◈Base-16 (Hexadecimal)
  - 0, …, 9, A, B, C, D, E

1	1	0	1
2^3	2^2	2^1	2^0

Bin: $1 \times 2^3 + 1 \times 2^2 + 0 \times 2^1 + 1 \times 2^0$

1	1	0	1
16^3	16^2	16^1	16^0

Hex: $1 \times 16^3 + 1 \times 16^2 + 0 \times 16^1 + 1 \times 16^0$

Operators

- ◈Arithmetic
  - +
  - -
  - *
  - /
  - %
- ◈Assignment
  - =
  - +=, -=, *=, /=, %=
- ◈Increment and decrement
  - ++
  - --

More Operators

- ◈Relational
  - ==, !=
  - >, <
  - >=, <=
- ◈Conditional
  - ?:
- ◈Logical
  - Negation: !
  - AND: &&
  - OR: ||

Precedence

- ◈ Determines the evaluation order of different types of operators
- ◈ Or, *parenthesis* to the rescue
- ◈ Exercise: check out the operator precedence table in the textbook (Appendix A)

↑ Increment/decrement
Arithmetic
Logical
Assignment ↑

```
a + b * c – d
a + b * c – d++
a + b * c - ++d

!a && b || c && d && a > d
!a && (b || c) && d && (a > d)
```

Associativity

- ◈Determine the evaluation order of the operators with the same precedence
- ◈Left-associative
  - Most operators are left-associate
  - E.g. *a + b + c*
- ◈Right-associative
  - E.g. ??

Control Statements

- ◈Branch
  - if
  - if … else
- ◈Switch
  - switch
- ◈Loop
  - while
  - do … while
  - for
- ◈Break and continue
  - break
  - continue

Method

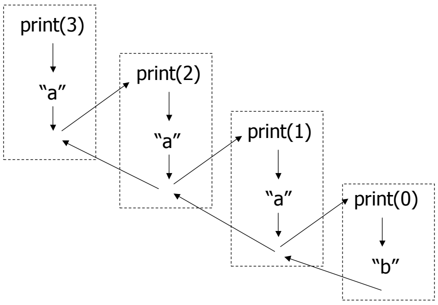
- ◈Header
  - Access modifier
  - Return type
  - Name
  - Parameter list
- ◈Body

Recursion

- ◈A method calls itself

```
void print( int n )
{
   if( n <= 0 ) System.out.println();
   else
   {
      System.out.print("a");
      print(n-1);
   }
}
```

Recursive Process



Ending Condition

- ◈When the recursion should stop
- ◈To avoid infinite recursion, make sure the ending condition
  - Exists
  - Reachable
  - Comes before the recursive call

Simple Recursion Examples

- Factorial
  - f(n) = 1*2*3*…*n
- Fibonacci series
  - 0, 1, 1, 2, 3, 5, 8, 13, 21, …
  - Definition
    - fibonacci(0) = 0
    - fibonacci(1) = 1
    - fibonacci(n) = fibonacci(n-1)+fibonacci(n-2)

When Can We Use Recursion?

- A problem itself is recursively defined
  - Fibonacci → f(n) = f(n-1) + f(n-2)
  - Tree
    - A tree has a root
    - Each child of the root is also a tree
- A problem of size n can be reduced to a problem of size less than n
  - Factorial: n → n-1
  - Sort: n → n-1
  - Binary search: n → n/2

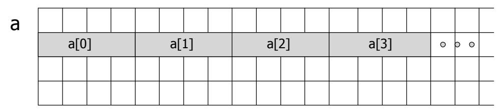
When Should We Use Recursion?

- When the homework problem says so
- When speed of code development takes precedence over code efficiency
- When the problem is naturally recursive
  - Fibonacci Series
- When the non-recursive solution is much harder
  - Hanoi tower
  - Solving maze

Arrays

- Name
- Type
- Length (or Size) – number of elements in the array
- Values

Computer Memory



Access Array Elements

- arrayname.length
- Index is from 0 to (arrayname.length-1)

```
int a[];
a = new int[10];

a[5] = 3;    // assign 3 to the 6th element

// prints out all elements
for( int i=0 ; i < a.length ; ++i )
  System.out.println( a[i] );
```

index

Array as Parameter

- Write a method sumArray() which returns the sum of the elements in a given array

```
int sumArray( ?? )
{
    int sum = 0;

    ??

    return sum;
}
```

Array as Return Type

- Write a method createArray() which returns an integer array of given size n.

```
?? createArray( int n )
{
    return ??;
}
```

Multidimensional Data

	HW0	HW1	HW2
Student1	90	80	100
Student2	80	75	85
Student3	70	90	70
Student4	50	50	80

Multidimensional Array

- Array of arrays
- Initialization??
- Allocation??

Multidimensional Array as Array-of-Arrays

```
int grades2 = { {10, 80, 100}, {10, 75, 85},
                {10, 90, 70}, {10, 50, 80} };
```

- grades2 – an array of 4 arrays
  - grades2[0] – an array of 3 integers: `10`, `80`, and `100`
  - …
  - grades2[3] – an array of 3 integers: `10`, `50`, and `80`

Arrayname.length and Friends

- arrayname.length is the length of the 1st dimension
- arrayname[i].length is the length of the 2nd dimension
- arrayname[i][j].length is the length of the 3rd dimension
- …

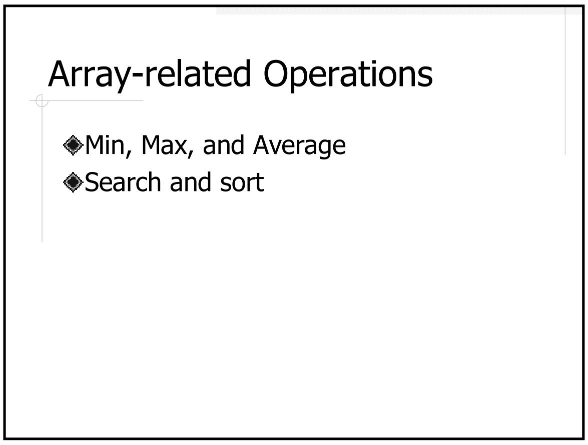
More Fun with Multidimensional Array

- Each row doesn't have to have the same number of elements

```
1
1 2
1 2 3
1 2 3 4
1 2 3 4 5
```

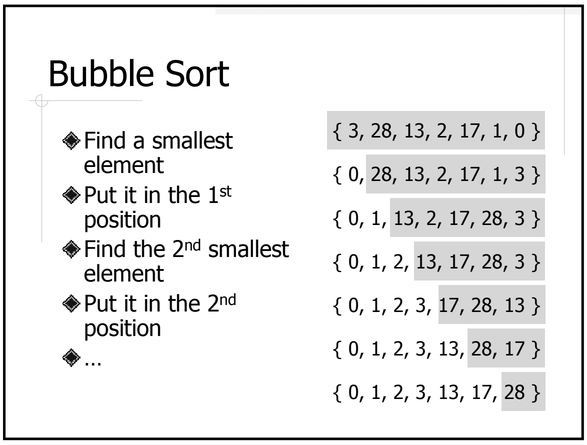
```
int a[][];

// allocation
a = new int[4][];
for( int i=0 ; i < a.length ; ++i )
  a[i] = new int[??];
```

- Exercise: add initialization to the code above



Array-related Operations

- Min, Max, and Average
- Search and sort



Bubble Sort

- Find a smallest element
- Put it in the 1st position
- Find the 2nd smallest element
- Put it in the 2nd position
- …

{ 3, 28, 13, 2, 17, 1, 0 }

{ 0, 28, 13, 2, 17, 1, 3 }

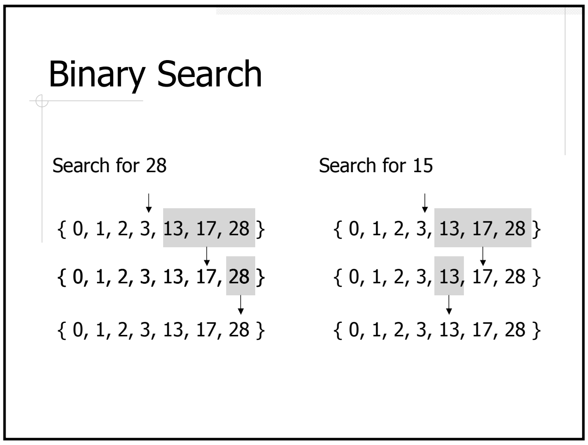
{ 0, 1, 13, 2, 17, 28, 3 }

{ 0, 1, 2, 13, 17, 28, 3 }

{ 0, 1, 2, 3, 17, 28, 13 }

{ 0, 1, 2, 3, 13, 28, 17 }

{ 0, 1, 2, 3, 13, 17, 28 }



Binary Search

Search for 28

{ 0, 1, 2, 3, 13, 17, 28 }

{ 0, 1, 2, 3, 13, 17, 28 }

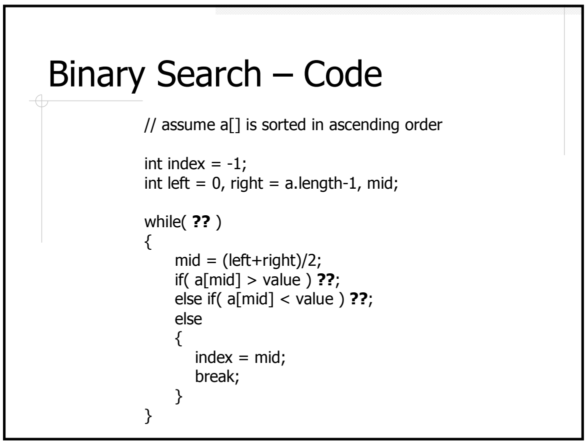
{ 0, 1, 2, 3, 13, 17, 28 }

Search for 15

{ 0, 1, 2, 3, 13, 17, 28 }

{ 0, 1, 2, 3, 13, 17, 28 }

{ 0, 1, 2, 3, 13, 17, 28 }



Binary Search – Code

```
// assume a[] is sorted in ascending order

int index = -1;
int left = 0, right = a.length-1, mid;

while( ?? )
{
    mid = (left+right)/2;
    if( a[mid] > value ) ??;
    else if( a[mid] < value ) ??;
    else
    {
        index = mid;
        break;
    }
}
```