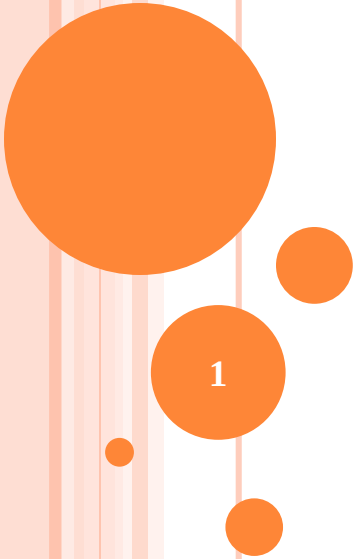
CHAPTER 3 SELECTIONS



OBJECTIVES

- To declare **boolean** variables and write Boolean expressions using comparison operators (§3.2).
- To implement selection control using one-way **if** statements (§3.3).
- To program using one-way **if** statements (**GuessBirthday**) (§3.4).
- To implement selection control using two-way **if-else** statements (§3.5).
- To implement selection control using nested **if** and multi-way **if** statements (§3.6).
- To avoid common errors in **if** statements (§3.7).
- To generate random numbers using the **Math.random()** method (§3.8).
- To program using selection statements for a variety of examples (**SubtractionQuiz**, **BMI**, **ComputeTax**) (§§3.8–3.10).
- To combine conditions using logical operators (**&&**, ||, and **!**) (§3.11).
- To program using selection statements with combined conditions (**LeapYear**, **Lottery**) (§§3.12–3.13).
- To implement selection control using **switch** statements (§3.14).
- To write expressions using the conditional operator (§3.15).
- To format output using the **System.out.printf** method (§3.16).
- To examine the rules governing operator precedence and associativity (§3.17).
- To get user confirmation using confirmation dialogs (§3.18).
- To apply common techniques to debug errors (§3.19).

The boolean Type and Operators

Often in a program you need to compare two values, such as whether i is greater than j. Java provides six comparison operators (also known as relational operators) that can be used to compare two values. The result of the comparison is a Boolean value: true or false.

```
boolean b = (1 > 2);
```

Comparison Operators

Java Operator	Mathematics Symbol	Name	Example (radius is 5)	Result
`<`	<	less than	`radius < 0`	`false`
`<=`	≤	less than or equal to	`radius <= 0`	`false`
`>`	>	greater than	`radius > 0`	`true`
`>=`	≥	greater than or equal to	`radius >= 0`	`true`
`==`	=	equal to	`radius == 0`	`false`
`!=`	≠	not equal to	`radius != 0`	`true`

Problem: A Simple Math Learning Tool

Write a program the reads from user an integer number and print on screen *true* if it is an odd number *false* otherwise

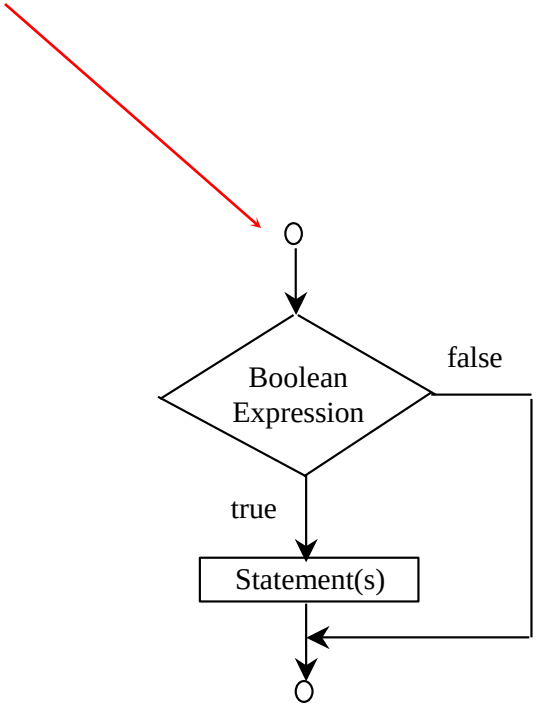
```
import javax.swing.*;

class Test{
      public static void main(String a[]){

         n=Integer.parseInt(JOptionPane.showInputDialog("enter
                  number"));
           boolean b=n%2==1;
            System.out.println(b);    }//main
}//class
```

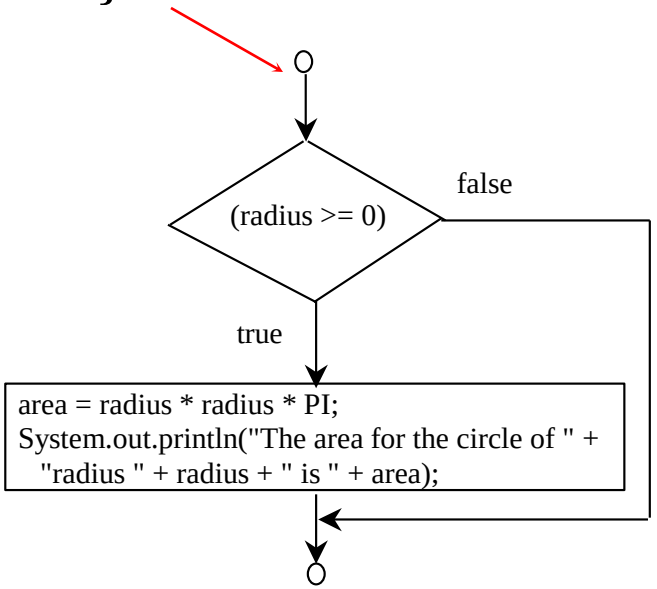
One-way if Statements

```
if (boolean-expression) {
  statement(s);
}
```



(A)

```
if (radius >= 0) {
  area = radius * radius * PI;
  System.out.println("The area"
    + " for the circle of radius "
    + radius + " is " + area);
}
```



(B)

NOTE

When your if statement has only one statement then there is no need for the braces

```
if (i > 0) {
  System.out.println("i is positive");
}
```

(a)

Equivalent

```
if (i > 0)
  System.out.println("i is positive");
```

(b)

Note that both of the following is correct

```
if (even == true)
  System.out.println(
    "It is even.");
```

(a)

Equivalent

```
if (even)
  System.out.println(
    "It is even.");
```

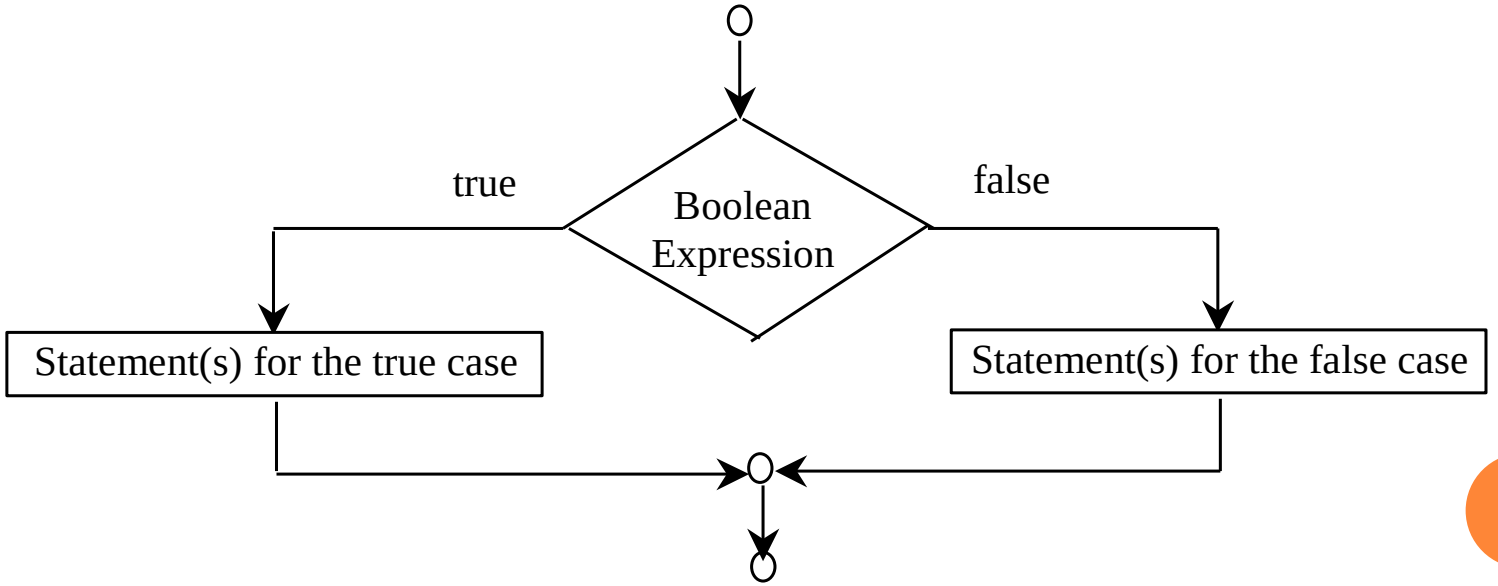
(b)

PROBLEM: SIMPLE IF

Write a program the reads from user an integer number and print on screen *Even* if it is an even number or *Odd* otherwise.

THE TWO-WAY IF STATEMENT

```
if (boolean-expression) {
  statement(s)-for-the-true-case;
}
else {
  statement(s)-for-the-false-case;
}
```



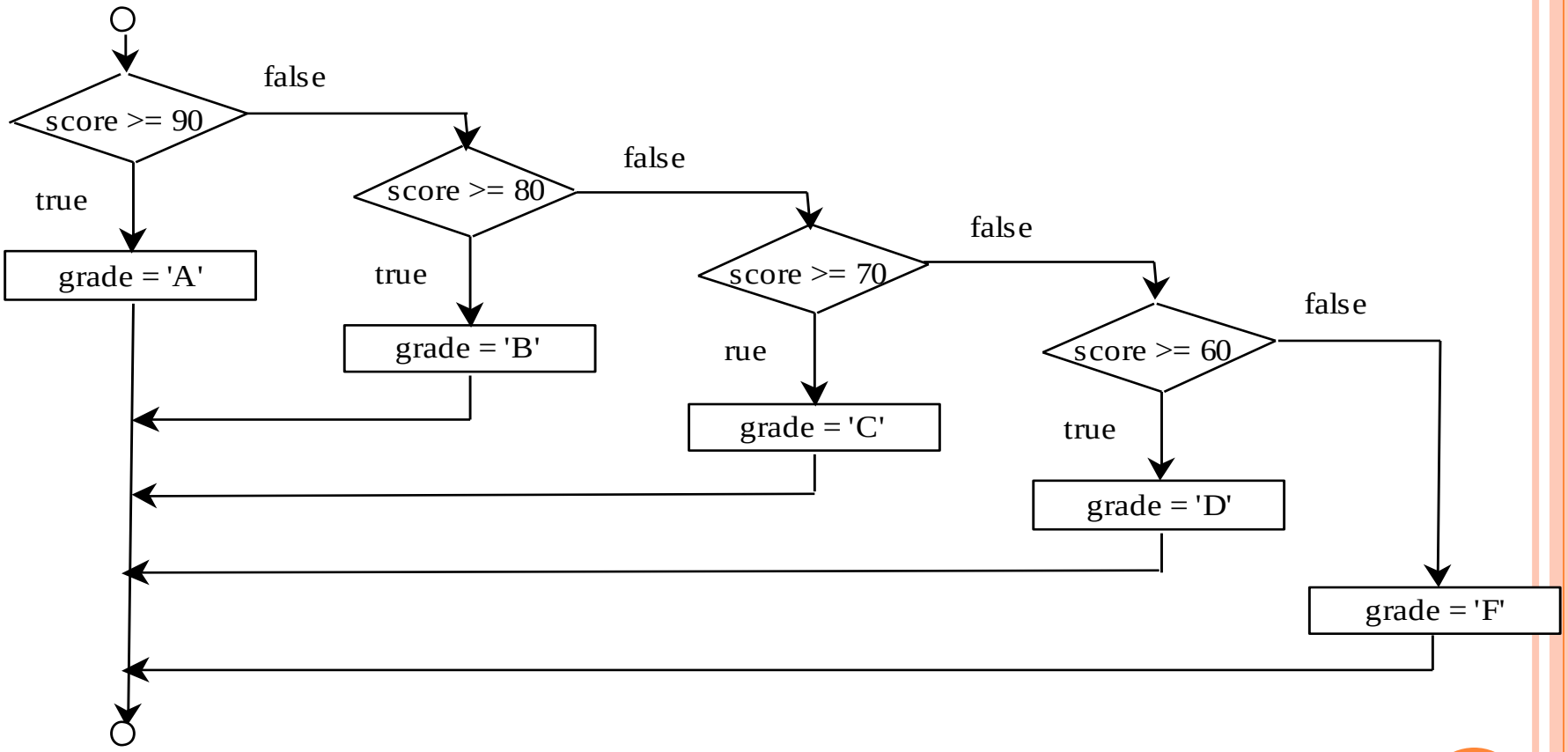
IF–ELSE EXAMPLE

```
if (radius >= 0) {
  area = radius * radius * 3.14159;

  System.out.println("The area for the "
    + "circle of radius " + radius +
    " is " + area);
}
else {
  System.out.println("Negative input");
}
```

MULTI-WAY IF-ELSE STATEMENTS

Write Java code for the following flowchart



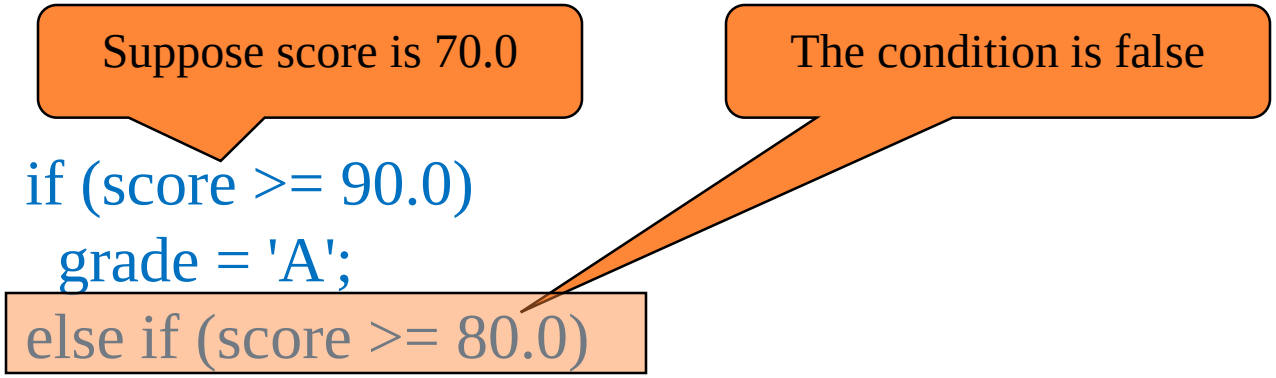
TRACE IF-ELSE STATEMENT

Suppose score is 70.0

The condition is false

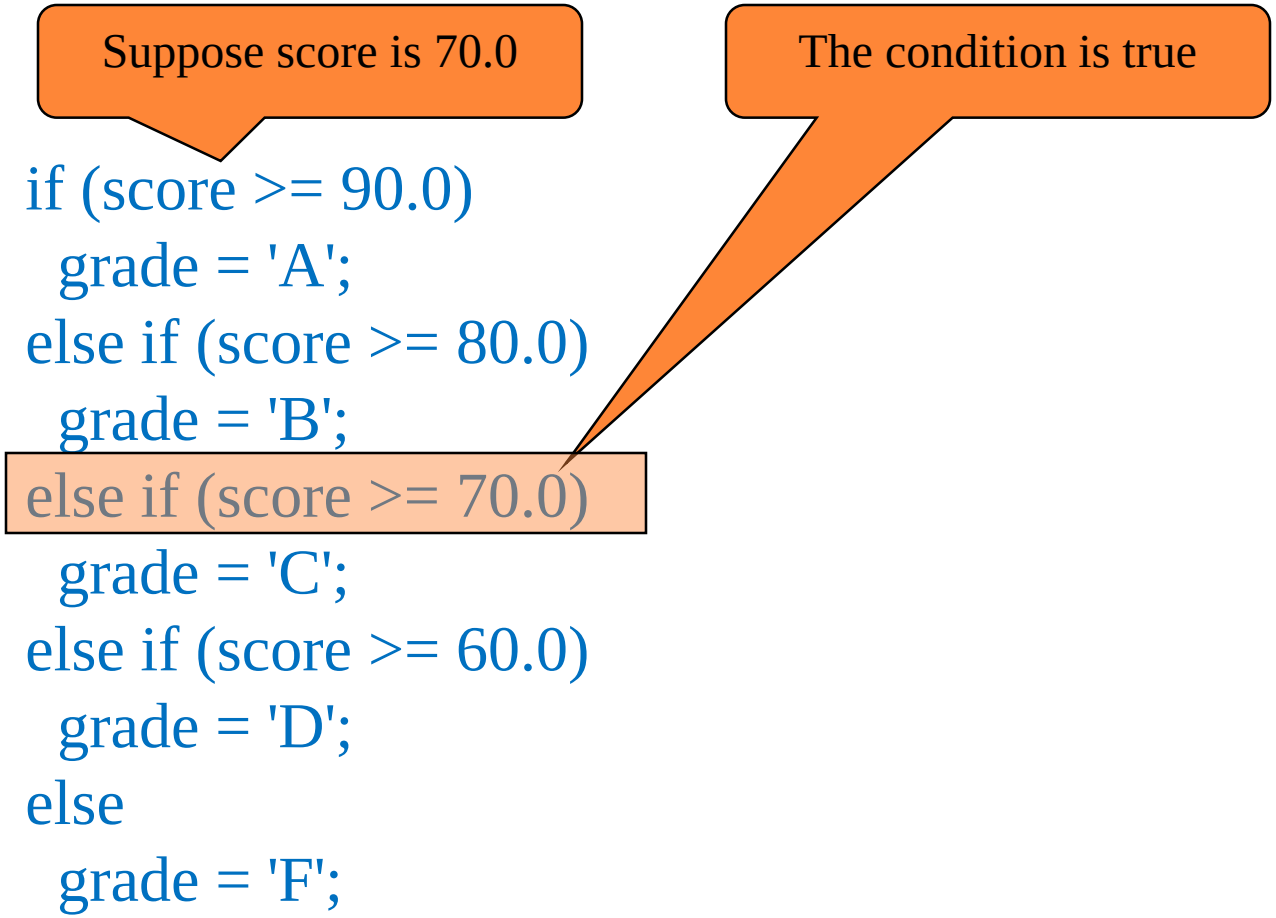
```
if (score >= 90.0)
  grade = 'A';
else if (score >= 80.0)
  grade = 'B';
else if (score >= 70.0)
  grade = 'C';
else if (score >= 60.0)
  grade = 'D';
else
  grade = 'F';
```

TRACE IF-ELSE STATEMENT

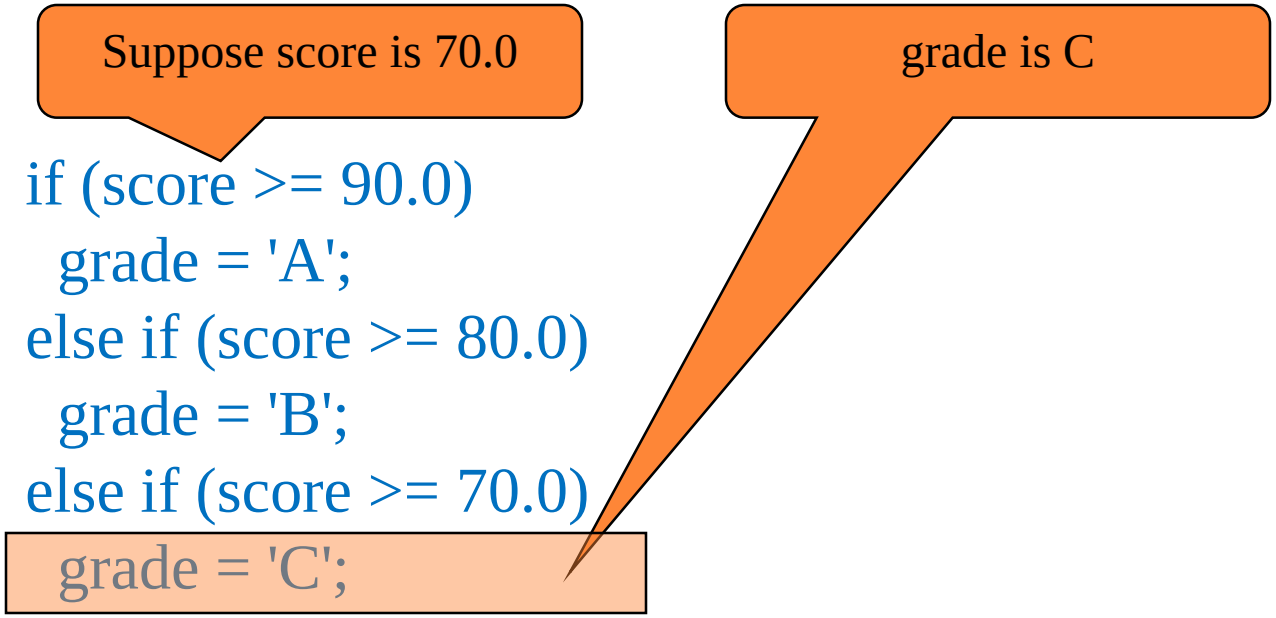



```
if (score >= 90.0)
  grade = 'A';
else if (score >= 80.0)
  grade = 'B';
else if (score >= 70.0)
  grade = 'C';
else if (score >= 60.0)
  grade = 'D';
else
  grade = 'F';
```

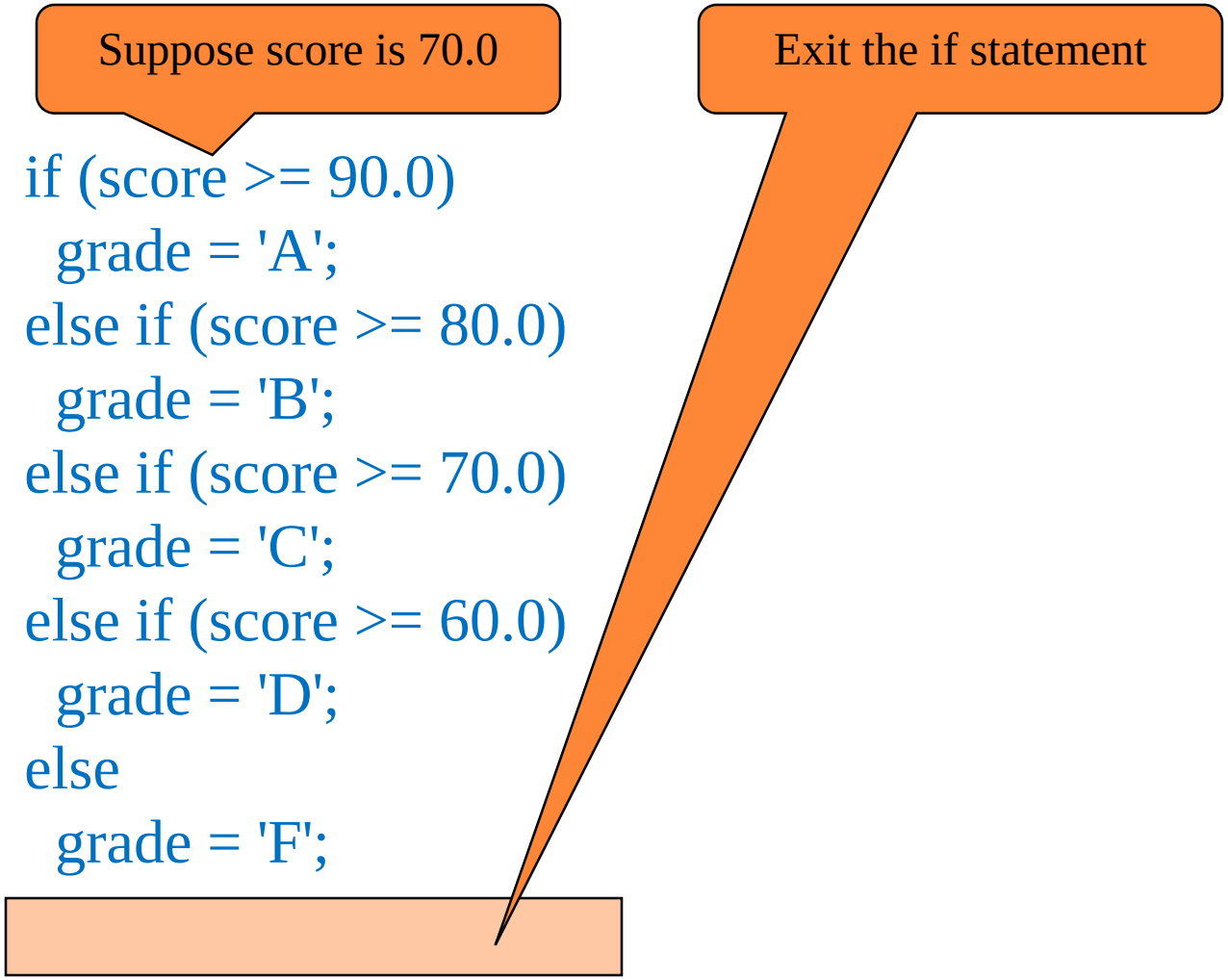
TRACE IF-ELSE STATEMENT



TRACE IF-ELSE STATEMENT



TRACE IF-ELSE STATEMENT



NOTE

The else clause matches the most recent if clause in the same block.

```
int i = 1;
int j = 2;
int k = 3;

if (i > j)
  if (i > k)
    System.out.println("A");
else
    System.out.println("B");
```

(a)

Equivalent

```
int i = 1;
int j = 2;
int k = 3;

if (i > j)
  if (i > k)
    System.out.println("A");
  else
    System.out.println("B");
```

(b)

NOTE, CONT.

Nothing is printed from the preceding statement. To force the else clause to match the first if clause, you must add a pair of braces:

```
int i = 1;
int j = 2;
int k = 3;
if (i > j) {
  if (i > k)
    System.out.println("A");
}
else
  System.out.println("B");
```

This output is: B

Common Errors

Adding a semicolon at the end of an if clause is a common mistake.

```
if (radius >= 0);
{
  area = radius*radius*PI;
  System.out.println(
    "The area for the circle of radius " +
    radius + " is " + area);
}
```

Wrong

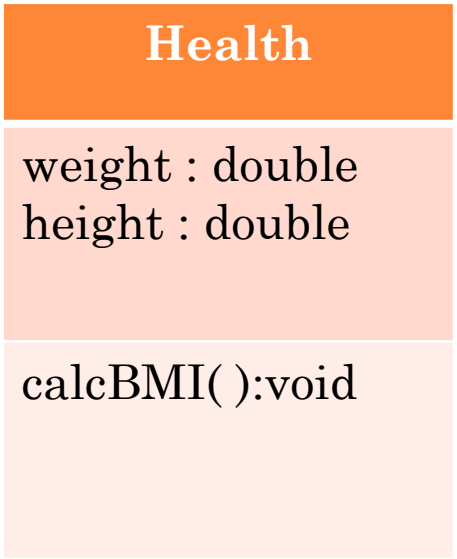
This mistake is hard to find, because it is not a compilation error or a runtime error, it is a logic error.

This error often occurs when you use the next-line block style.

EX. BODY MASS INDEX

Body Mass Index (BMI) is a measure of health on weight. It can be calculated by taking your weight in kilograms and dividing by the square of your height in meters. The interpretation of BMI for people 16 years or older is as follows:

BMI	Interpretation
Below 18.5	Underweight
18.5-24.9	Normal
25.0-29.9	Overweight
Above 30.0	Obese



Problem: (bonus) Computing Taxes

The US federal personal income tax is calculated based on the filing status and taxable income. There are four filing statuses: single filers, married filing jointly, married filing separately, and head of household. The tax rates for 2009 are shown below.

Marginal Tax Rate	Single	Married Filing Jointly or Qualifying Widow(er)	Married Filing Separately	Head of Household
10%	$0 – $8,350	$0 – $16,700	$0 – $8,350	$0 – $11,950
15%	$8,351– $33,950	$16,701 – $67,900	$8,351 – $33,950	$11,951 – $45,500
25%	$33,951 – $82,250	$67,901 – $137,050	$33,951 – $68,525	$45,501 – $117,450
28%	$82,251 – $171,550	$137,051 – $208,850	$68,525 – $104,425	$117,451 – $190,200
33%	$171,551 – $372,950	$208,851 – $372,950	$104,426 – $186,475	$190,201 - $372,950
35%	$372,951+	$372,951+	$186,476+	$372,951+

LOGICAL OPERATORS

Operator	*Name*
!	not
&&	and
||	or
^	exclusive or

TRUTH TABLE FOR OPERATOR ! , &&

p	!p	Example (assume age = 24, gender = 'M')
true	false	!(age > 18) is false, because (age > 18) is true.
false	true	!(gender != 'M') is true, because (grade != 'M') is false.

p1	p2	p1 && p2	Example (assume age = 24, gender = 'F')
false	false	false	(age > 18) && (gender == 'F') is true, because (age > 18) and (gender == 'F') are both true.
false	true	false	
true	false	false	(age > 18) && (gender != 'F') is false, because (gender != 'F') is false.
true	true	true	

Truth Table for Operator ||, ^

p1	p2	p1 || p2	Example (assume age = 24, gender = 'F')
false	false	false	(age > 34) || (gender == 'F') is true, because (gender == 'F') is true.
false	true	true	
true	false	true	(age > 34) || (gender == 'M') is false, because (age > 34) and (gender == 'M') are both false.
true	true	true	

p1	p2	p1 ^ p2	Example (assume age = 24, gender = 'F')
false	false	false	(age > 34) ^ (gender == 'F') is true, because (age > 34) is false but (gender == 'F') is true.
false	true	true	
true	false	true	(age > 34) || (gender == 'M') is false, because (age > 34) and (gender == 'M') are both false.
true	true	false	

EXAMPLES

Here is a program that checks whether a number is divisible by 2 and 3, whether a number is divisible by 2 or 3, and whether a number is divisible by 2 or 3 but not both:

EXAMPLES

```
System.out.println("Is " + number + " divisible by 2 and 3? " +
  ((number % 2 == 0) && (number % 3 == 0)));

System.out.println("Is " + number + " divisible by 2 or 3? " +
  ((number % 2 == 0) || (number % 3 == 0)));

 System.out.println("Is " + number +
   " divisible by 2 or 3, but not both? " +
   ((number % 2 == 0) ^ (number % 3 == 0)));
```

THE & AND | OPERATORS

- Both Operators are used to check both conditions, Meanwhile &&, || are both checks only one condition unless they need to check both conditions.
- For example discuss the following with your teacher

```
If x is 1, what is x after this expression?
(x > 1) & (x++ < 10)

If x is 1, what is x after this expression?
(1 > x) && ( 1 > x++)

How about (1 == x) | (10 > x++)?
(1 == x) || (10 > x++)?
```

PROBLEM: DETERMINING LEAP YEAR?

This program first prompts the user to enter a year as an int value and checks if it is a leap year.

A year is a leap year if it is divisible by 4 but not by 100, or it is divisible by 400.

```
(year % 4 == 0 && year % 100 != 0) || (year % 400 == 0)
```

EX. LOTTERY

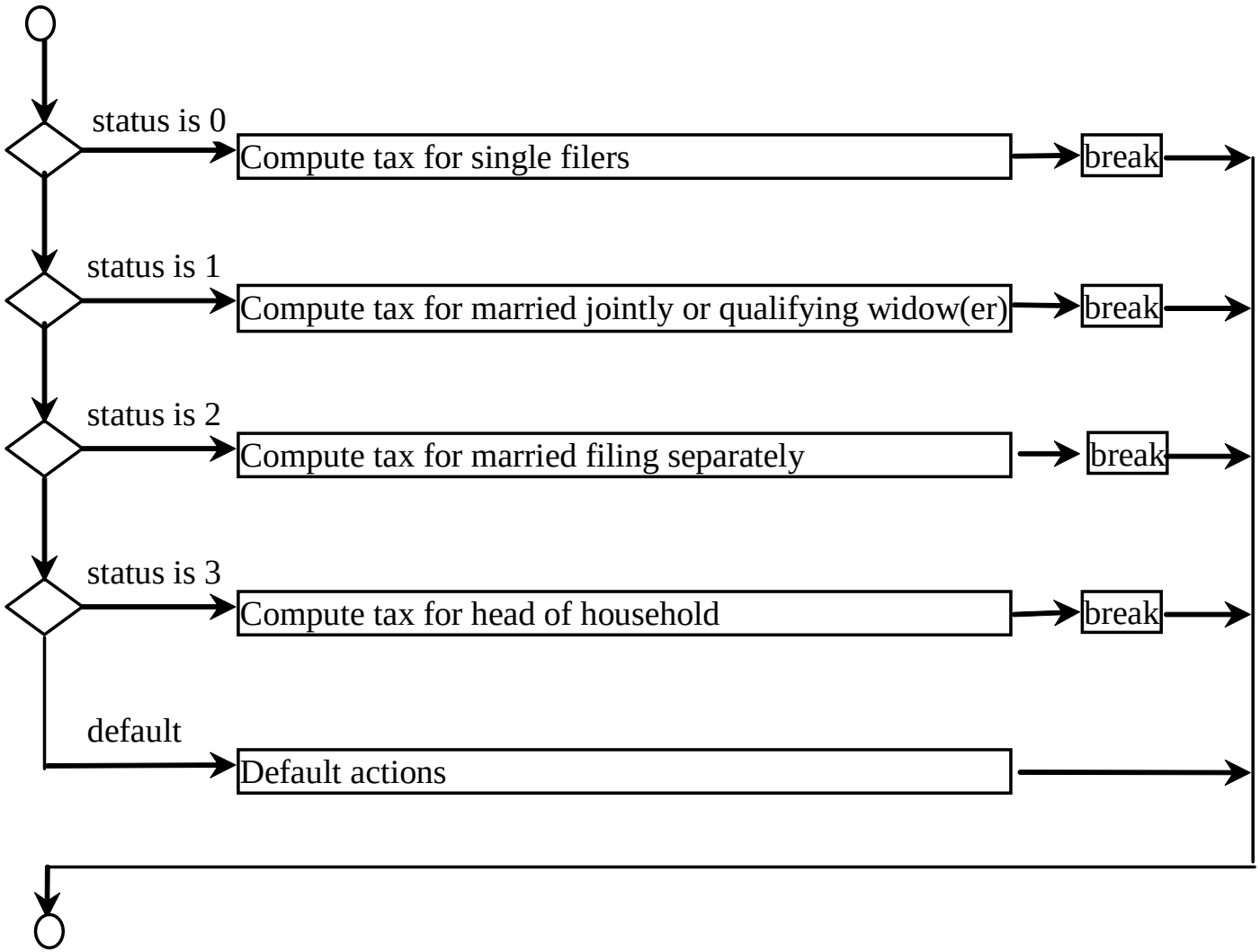
Write a program that randomly generates a lottery of a two-digit number, prompts the user to enter a two-digit number, and determines whether the user wins according to the following rule:

- If the user input matches the lottery in exact order, the award is $10,000.
- If the user input matches the lottery, the award is $3,000.
- If one digit in the user input matches a digit in the lottery, the award is $1,000.

SWITCH STATEMENTS

```
switch (status) {
  case 0:  compute taxes for single filers;
           break;
  case 1:  compute taxes for married file jointly;
           break;
  case 2:  compute taxes for married file separately;
           break;
  case 3:  compute taxes for head of household;
           break;
  default: System.out.println("Errors: invalid status");
           System.exit(1);
}
```

SWITCH STATEMENT FLOW CHART



SWITCH STATEMENT RULES

The switch-expression must yield a value of char, byte, short, or int type and must always be enclosed in parentheses.

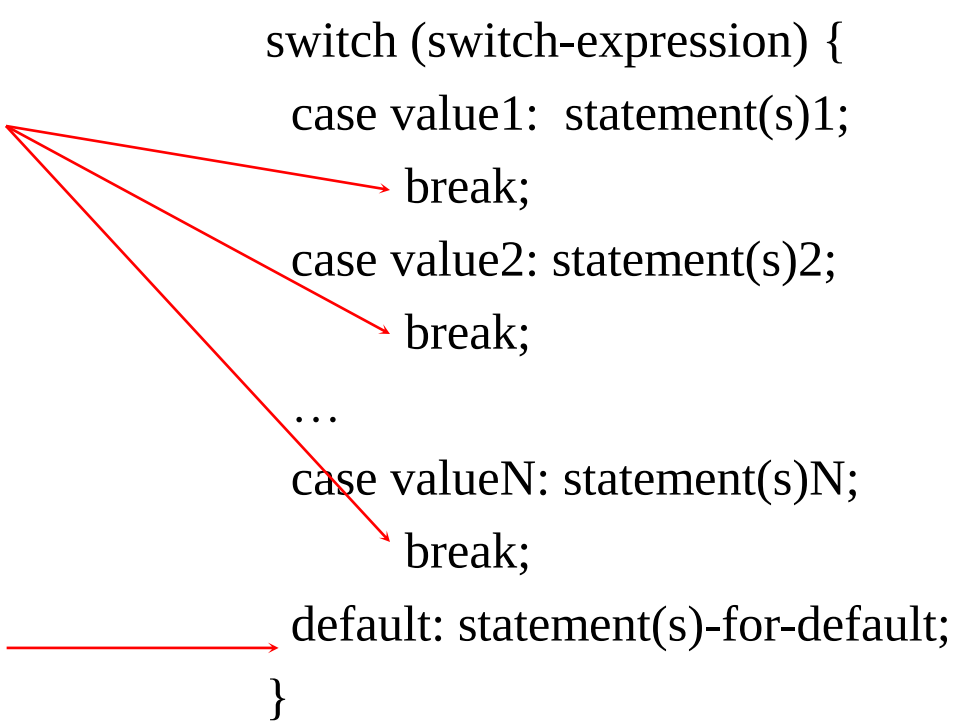
The value1, ..., and valueN must have the same data type as the value of the switch-expression. The resulting statements in the case statement are executed when the value in the case statement matches the value of the switch-expression. Note that value1, ..., and valueN are constant expressions, meaning that they cannot contain variables in the expression, such as 1 + x.

```
switch (switch-expression) {
  case value1:  statement(s)1;
                break;
  case value2: statement(s)2;
                break;
  …
  case valueN: statement(s)N;
                break;
  default: statement(s)-for-default;
}
```

SWITCH STATEMENT RULES

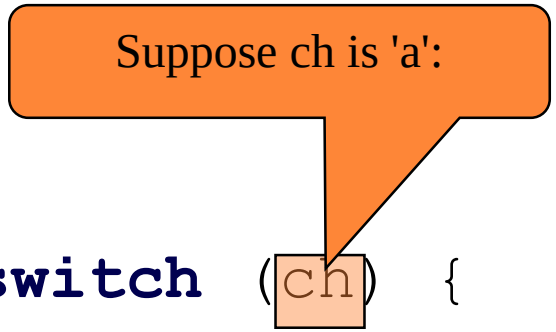
The keyword break is optional, but it should be used at the end of each case in order to terminate the remainder of the switch statement. If the break statement is not present, the next case statement will be executed.

The default case, which is optional, can be used to perform actions when none of the specified cases matches the switch-expression.



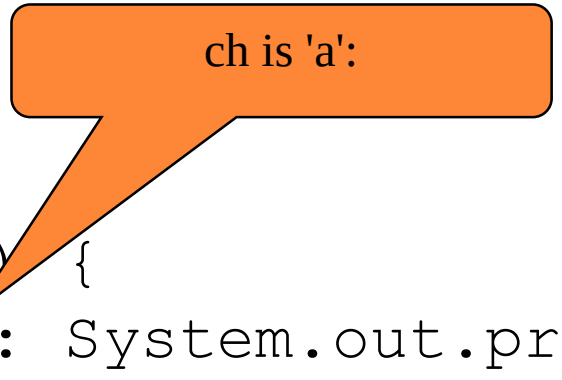
The case statements are executed in sequential order, but the order of the cases (including the default case) does not matter. However, it is good programming style to follow the logical sequence of the cases and place the default case at the end.

TRACE SWITCH STATEMENT



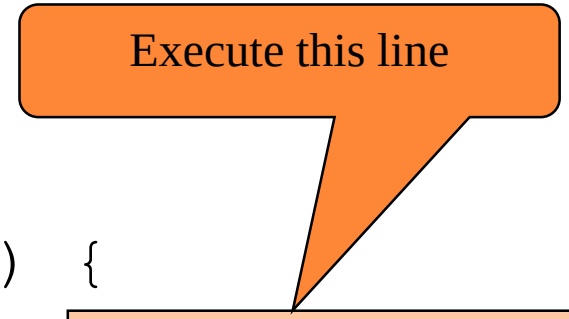

```
switch (ch) {
  case 'a': System.out.println(ch);
  case 'b': System.out.println(ch);
  case 'c': System.out.println(ch);
}
```

TRACE SWITCH STATEMENT




```
switch (ch) {
  case 'a': System.out.println(ch);
  case 'b': System.out.println(ch);
  case 'c': System.out.println(ch);
}
```

TRACE SWITCH STATEMENT




```
switch (ch) {
  case 'a': System.out.println(ch);
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  case 'c': System.out.println(ch);
}
```
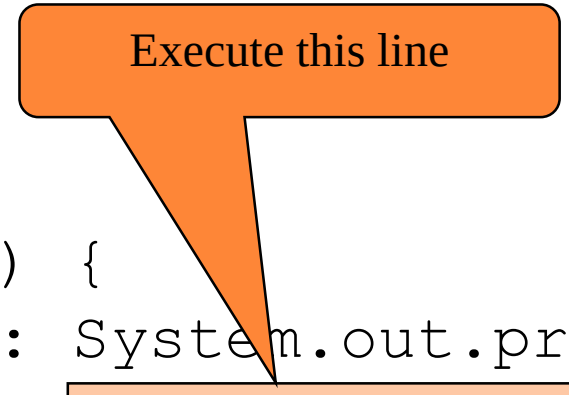

TRACE SWITCH STATEMENT




```
switch (ch) {
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  case 'c': System.out.println(ch);
}
```
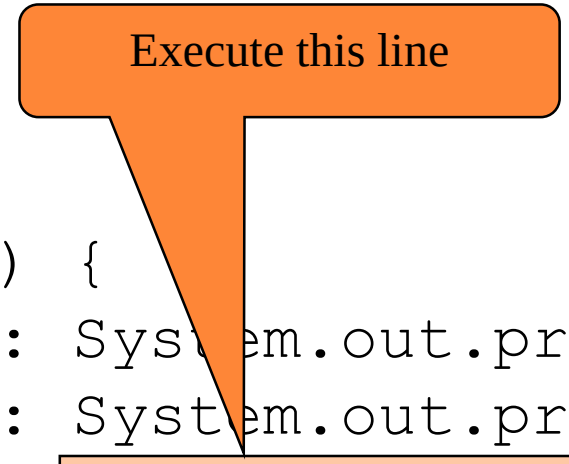
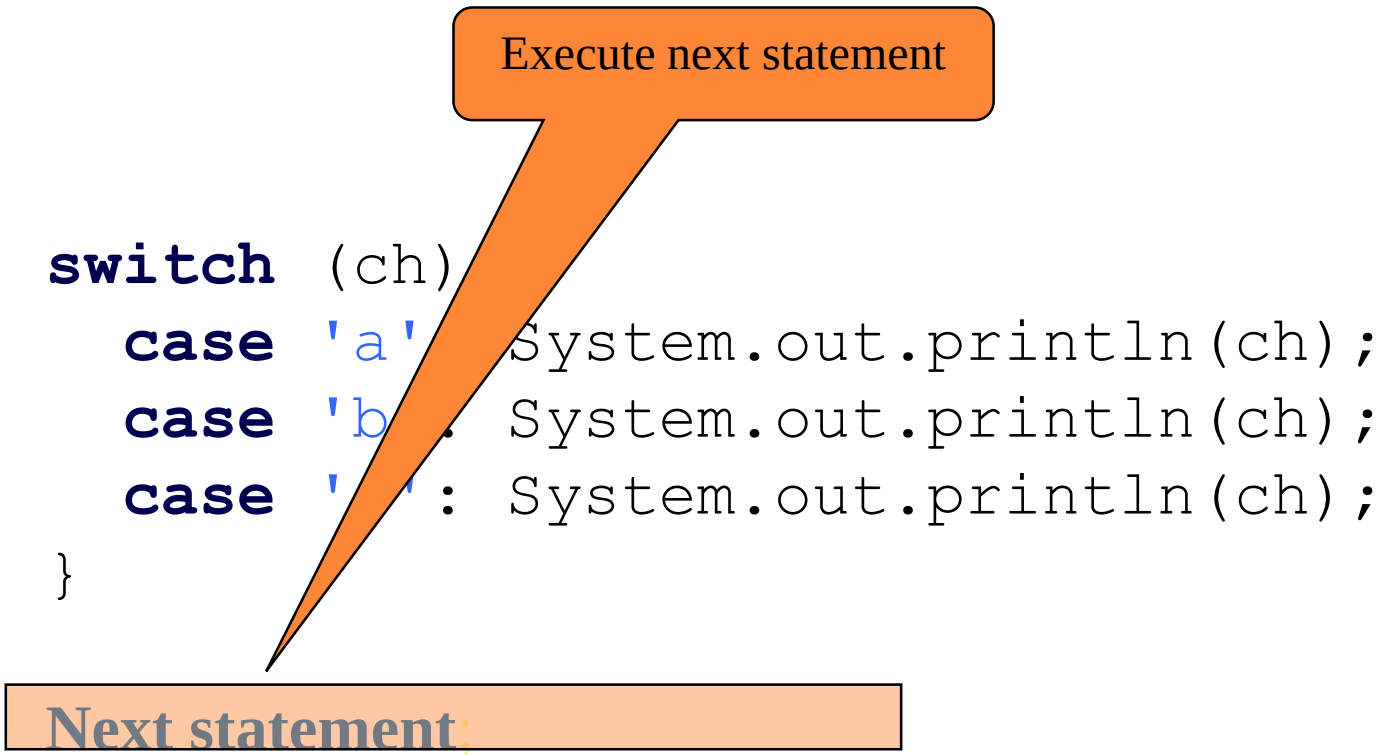

TRACE SWITCH STATEMENT

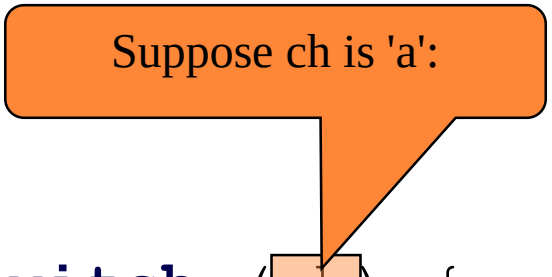



```
switch (ch) {
  case 'a': System.out.println(ch);
  case 'b': System.out.println(ch);
  case 'c': System.out.println(ch);
}
```

TRACE SWITCH STATEMENT

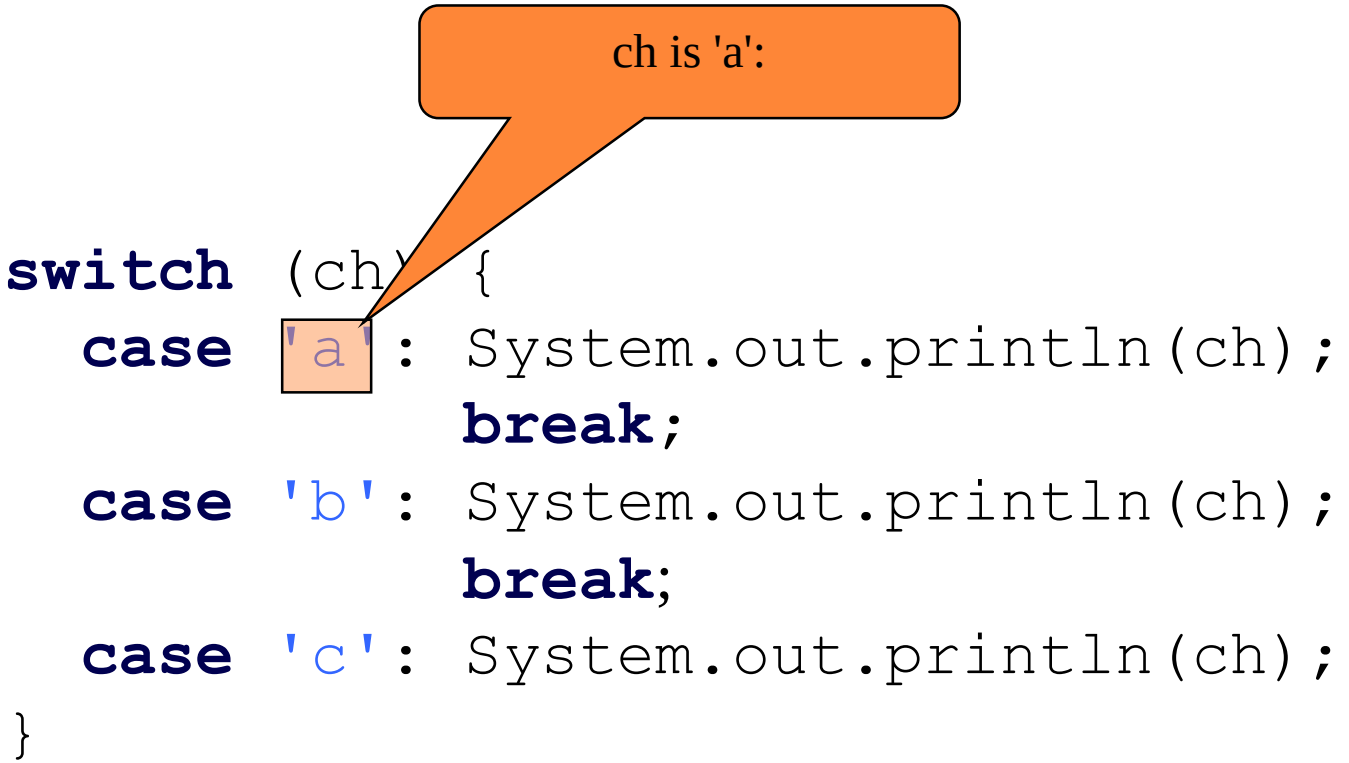


TRACE SWITCH STATEMENT

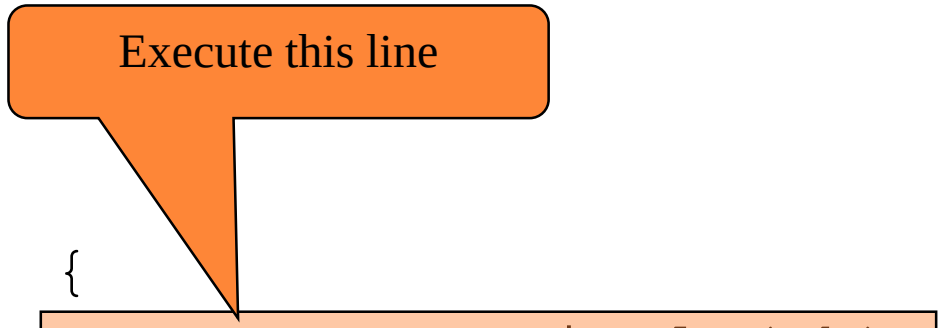



```
switch (ch) {
  case 'a': System.out.println(ch);
            break;
  case 'b': System.out.println(ch);
            break;
  case 'c': System.out.println(ch);
}
```

TRACE SWITCH STATEMENT



TRACE SWITCH STATEMENT

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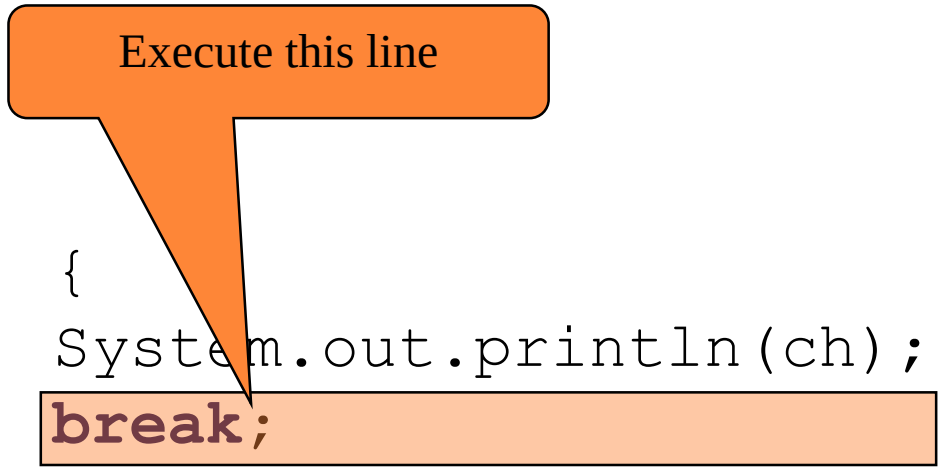
  case 'a': System.out.println(ch);
            break;
  case 'b': System.out.println(ch);
            break;
  case 'c': System.out.println(ch);
}
```

TRACE SWITCH STATEMENT

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            break;
  case 'b': System.out.println(ch);
            break;
  case 'c': System.out.println(ch);
}
```
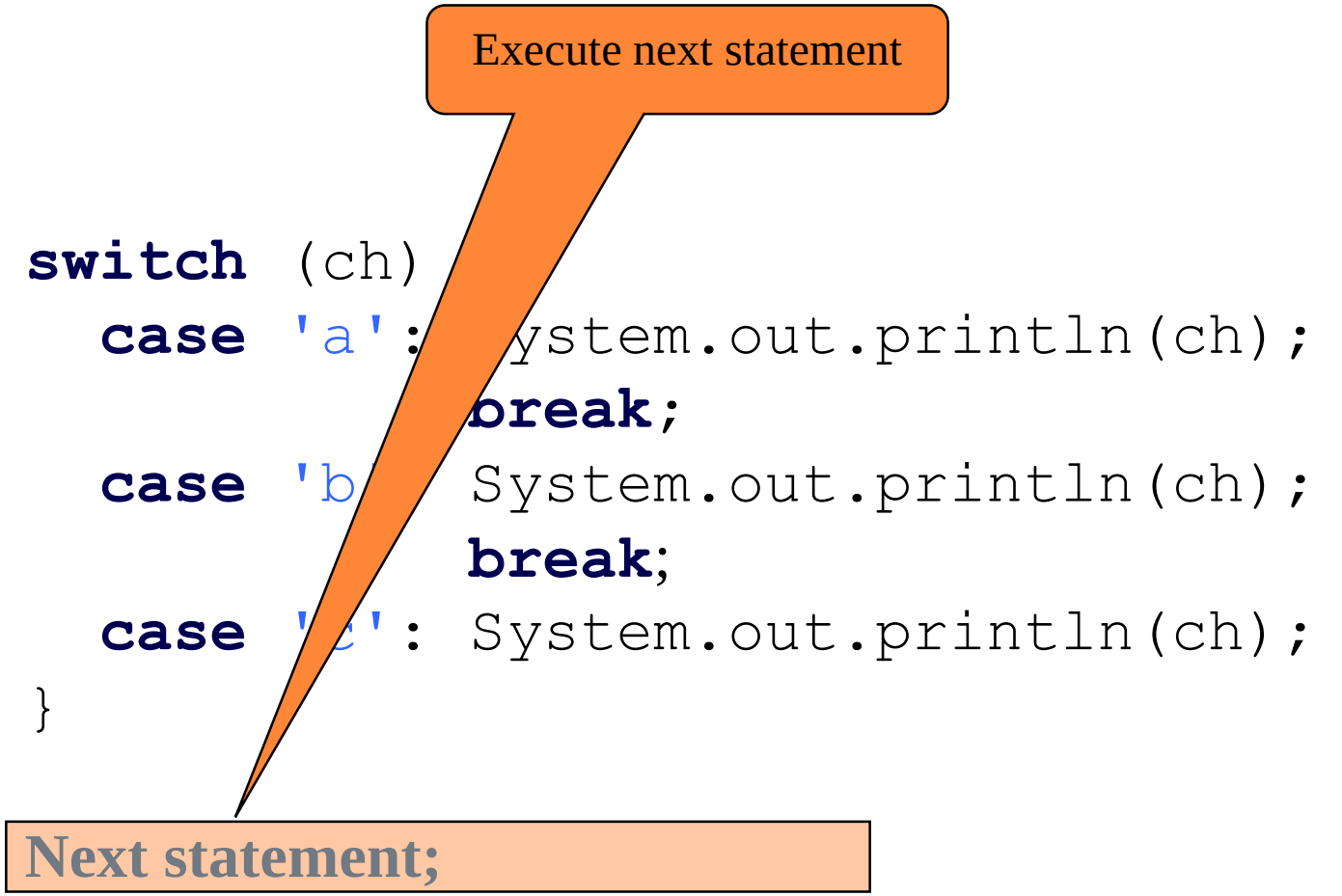
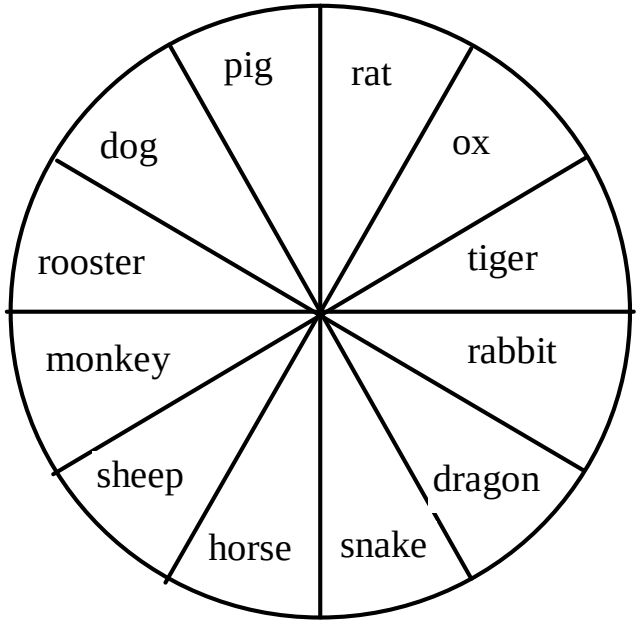

TRACE SWITCH STATEMENT



Problem: Chinese Zodiac

Write a program that prompts the user to enter a year and displays the animal for the year.



year % 12 =

0: monkey
1: rooster
2: dog
3: pig
4: rat
5: ox
6: tiger
7: rabbit
8: dragon
9: snake
10: horse
11: sheep

CONDITIONAL OPERATOR EXAMPLE

Ex1:

```
if (x > 0)
  y = 1
else
  y = -1;
```

is equivalent to

```
y = (x > 0) ? 1 : -1;
```

(boolean-expression) ? expression1 : expression2

Ex2:

```
if (num % 2 == 0)
  System.out.println(num + “is even”);
else
  System.out.println(num + “is odd”);
```

```
System.out.println(
  (num % 2 == 0)? num + “is even” :
  num + “is odd”);
```

FORMATTING OUTPUT – SELF STUDY

Group Presentation

Operator Precedence

- var++, var--
- +, - (Unary plus and minus), ++var,--var
- (type) Casting
- ! (Not)
- *, /, % (Multiplication, division, and remainder)
- +, - (Binary addition and subtraction)
- <, <=, >, >= (Comparison)
- ==, !=; (Equality)
- ^ (Exclusive OR)
- && (Conditional AND) Short-circuit AND
- || (Conditional OR) Short-circuit OR
- =, +=, -=, *=, /=, %= (Assignment operator)

Operator Precedence and Associativity Self Reading

The expression in the parentheses is evaluated first. (Parentheses can be nested, in which case the expression in the inner parentheses is executed first.) When evaluating an expression without parentheses, the operators are applied according to the precedence rule and the associativity rule.

If operators with the same precedence are next to each other, their associativity determines the order of evaluation. All binary operators except assignment operators are left-associative.

Operator Associativity

- When two operators with the same precedence are evaluated, the *associativity* of the operators determines the order of evaluation. All binary operators except assignment operators are *left-associative*.

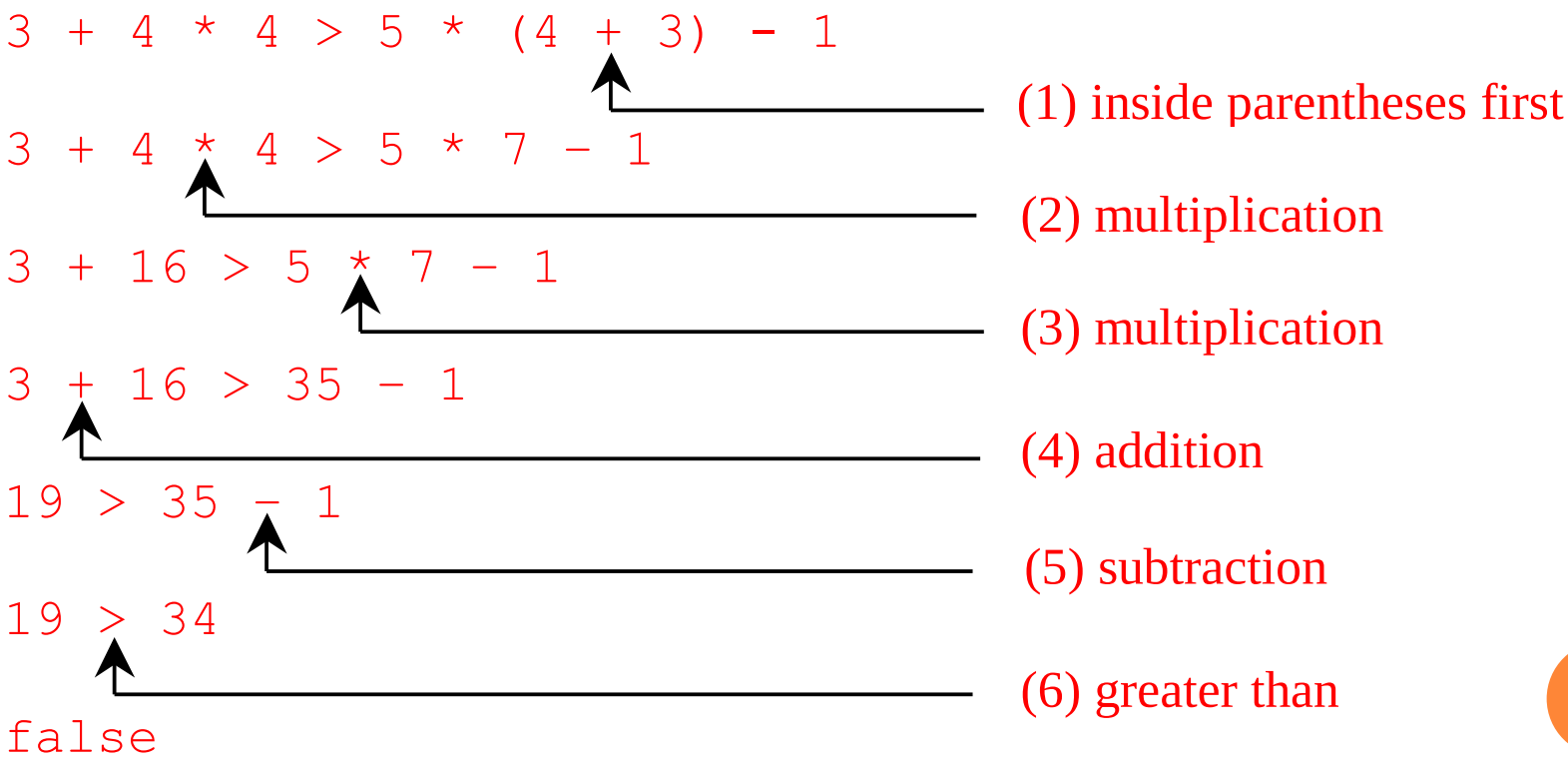
  a – b + c – d is equivalent to ((a – b) + c) – d

  Assignment operators are *right-associative*. Therefore, the expression

  a = b += c = 5 is equivalent to a = (b += (c = 5))

EXAMPLE

Applying the operator precedence and associativity rule, the expression 3 + 4 * 4 > 5 * (4 + 3) - 1 is evaluated as follows:



Evaluating Cancel button in Input dialog

```
import javax.swing.*;
class TestOp{
  public static void main(String a[]){
 //option==null incase of pressing cancel, option="" in case of pressing OK with empty input
      int x=0;
      String option = JOptionPane.showInputDialog("test");
      if(option!=null && !option.equals(""))
       {
            x=Integer.parseInt(option);
            System.out.println(x);
       }
   }
}
```

(GUI) Confirmation Dialogs – self study

int option = JOptionPane.showConfirmDialog(**null**, "Continue");

Here the option variable has values of (0,1,2) for the three buttons respectively.