OBJECT ORIENTED PROGRAMMING

User-Defined Class

by
Dr. Nor Saradatul Akmar Zulkifli
Faculty of Computer Systems & Software Engineering
saradatulakmar@ump.edu.my

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Content Overview

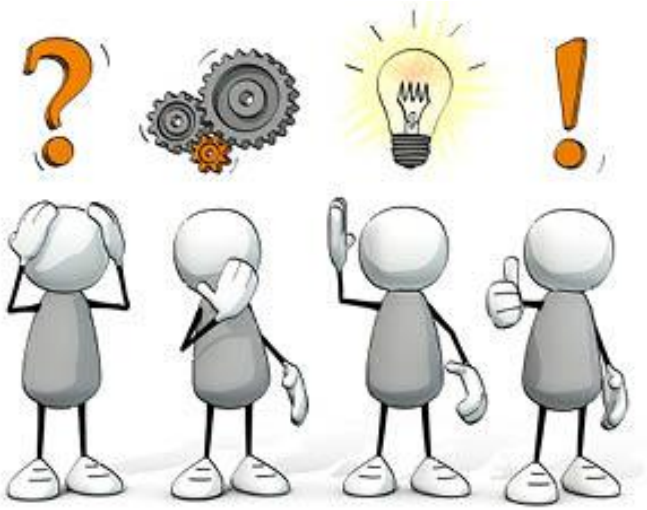
You will learn about:

- Create Classes & Objects
- Anatomy of Class Definition
- Variables in OOP (data member, argument, parameter & local variable)
  - Private and public (Accessibility modifiers)
  - General syntax for data member and method declarations
  - Arguments and parameters

Learning Objectives

Student should be able to:

- Define objects and classes
- Declare a class, data field/instance variable and methods
- Define a class with multiple methods and data members
- Create an object and invoke methods of a class
- Differentiate the local and instance variables



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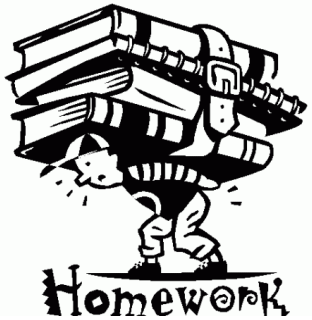
PROCEDURAL VS. OBJECT-ORIENTED

ABSTRACTION VS. ENCAPSULATION

What Are The Differences??



ReVISION

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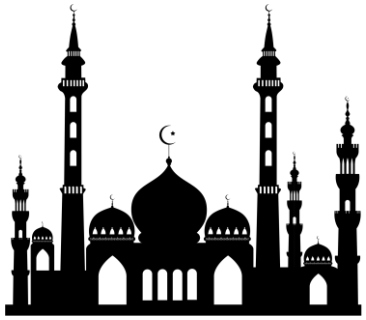
Class
Definition of objects that share structure, properties and behaviors

Skyscrapers
Class



Mosques
Class

Berries
Class

Instance
Concrete Object, Created from a certain class

KL Tower
Instance of ***Skyscraper***

Beth Mosque
Instance of ***Mosque***

Strawberry
Instance of ***Berry***

CLASS VS. OBJECT

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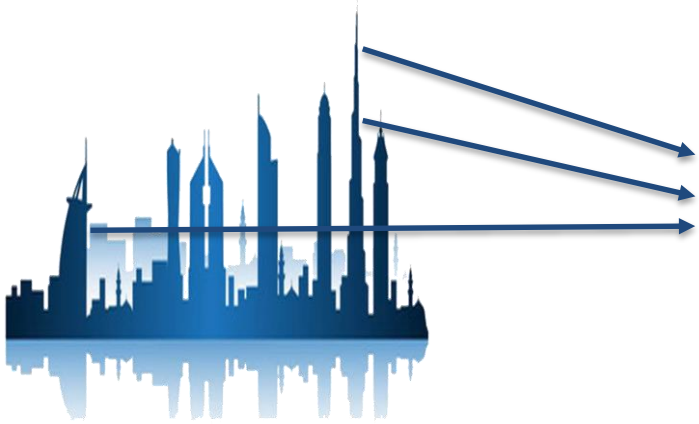
Class Skyscraper



Instances

Attributes / Properties

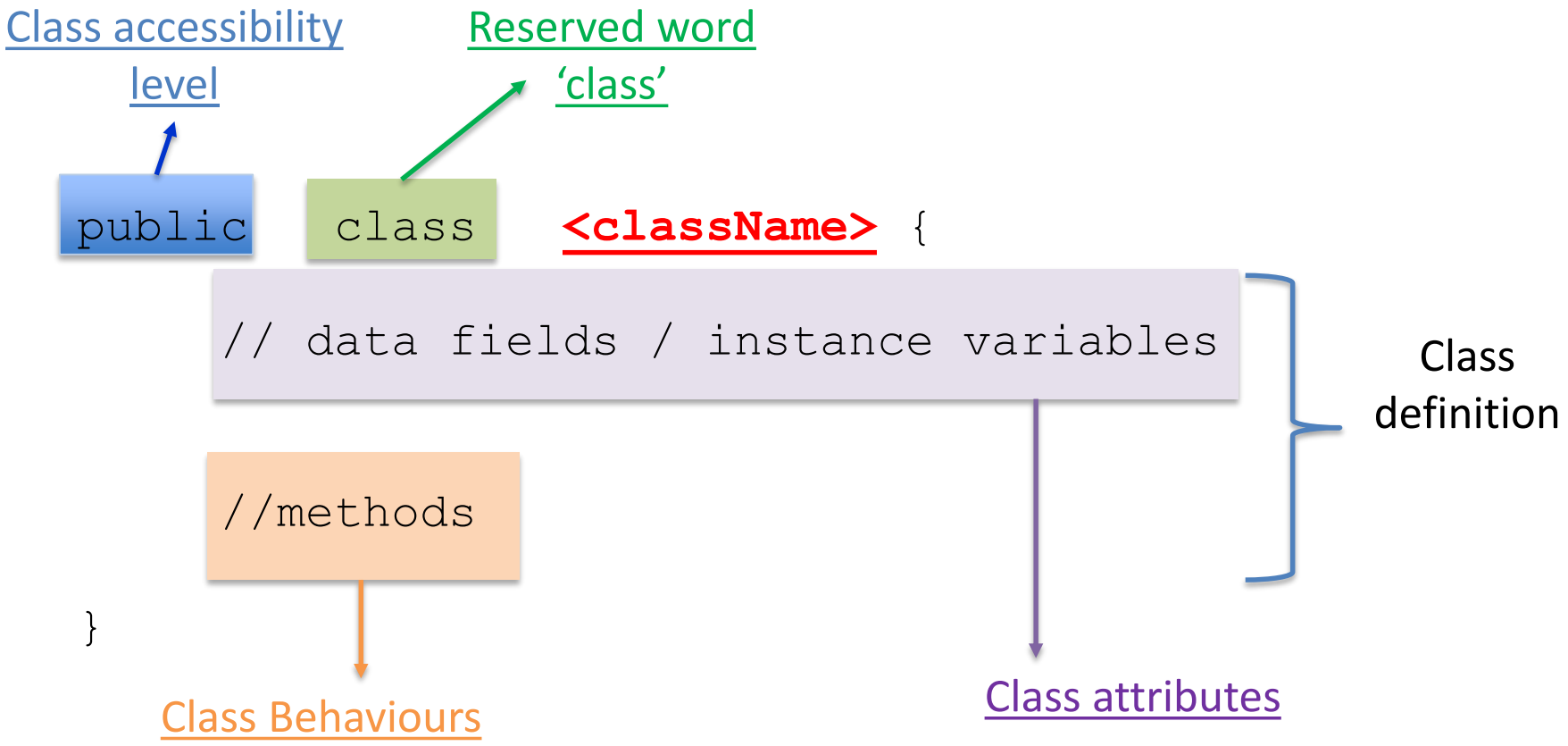
- name
- built
- country

Behaviours

- set ticket
- update ticket
- print ticket
- register visitor

Skycraper1	skycraper2	skycraper3
name = “Burj Khalifa” built = 2010 country = “UAE” set ticket update ticket print ticket register visitor	name = “Taipei 101” built = 2004 country = “China” set ticket update ticket print ticket register visitor	Name = “Petronas Twin Tower” built = 1996 country = “Malaysia” set ticket update ticket print ticket register visitor

ANATOMY OF JAVA CLASS



ANATOMY OF JAVA CLASS

Class accessibility level

Reserved word 'class'

```
public class <className> {

    <AccessLevel> <DataType> <variableName>

    <AccessLevel> <ReturnType> <methodName> (<parameters>)

    //code
}
```

Where;

- Access Level – public, private, default and protected
- DataType – data type of variable e.g. int, double, String etc
- ReturnType – data type returned by the method

CLASSES

Pre-Defined Classes

Classes defined in JAVA standard class library

Most commonly used :

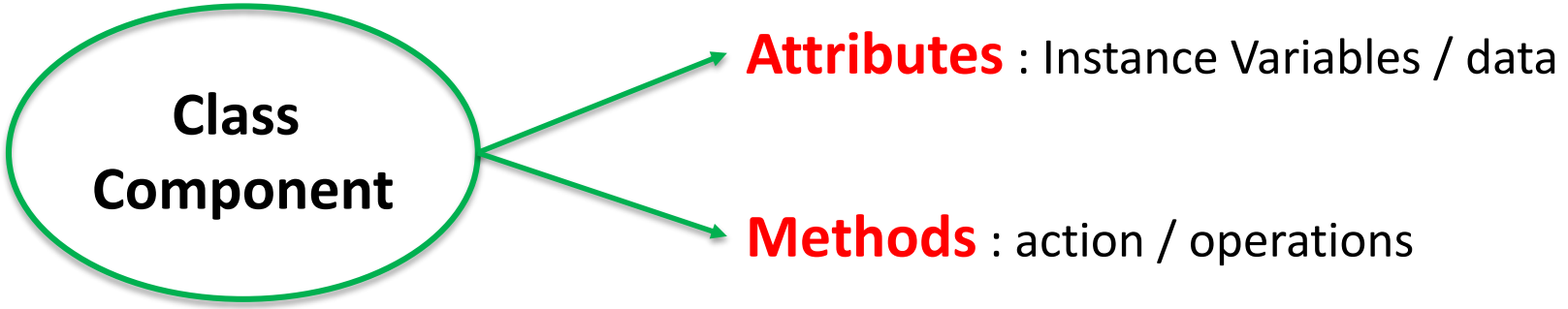
- ❑ String
- ❑ Math
- ❑ Random
- ❑ Scanner
- ❑ Primitive type wrapper

User-Defined Classes

Classes that defined by the programmer

Define own classes is the first step towards mastering the skill necessary in building large programs.

PROGRAMMER-DEFINED CLASS

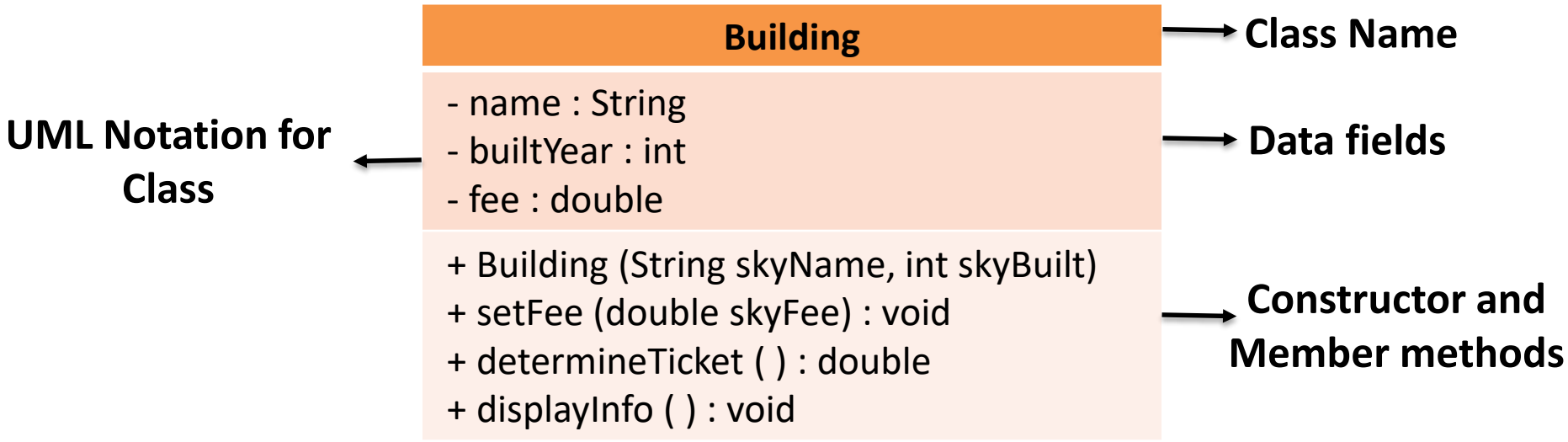


Example:

1. `Building` Class
   a. Attributes : `name`, `country`, `built`
   b. Methods : `setFee ( )`, `determineNationality ( )`, `displayInfo ( )`

2. `Skyscrapper` Class
   a. `name = "Petronas Twin Tower", country = "Malaysia", built = 1996`

PROGRAMMER-DEFINED CLASS : UML CLASS DIAGRAM




```
SkyScraper : Building
name = "Petronas Twin Towers"
builtYear = 1996
fee = 50.0
```

```
Mosque : Building
name = "Masjid Zahir"
builtYear = 1912
fee = 0.0
```

UML Notation for Objects

EXAMPLE : Class Bicycle

```
class Bicycle {
    // Data member
    private String ownerName;

    //Constructor: Initializes the data member
    public Bicycle(){
        ownerName = "Unknown";
    }
    //Returns the name of this bicycle's owner
public String getOwnerName(){
    return ownerName;
}
//Assigns the name of this bicyle's owner
public void setOwnerName(String name){
    ownerName = name;
    }
}
```

Class Name

Data fields

Constructor and Member methods

EXAMPLE : MAIN CLASS

```
class BicycleRegistration {

    public static void main(String[] args) {
        Bicycle bike1, bike2; //Create instances of class Bicycle
        String owner1, owner2;

        bike1 = new Bicycle(); //Create and assign values to bike1
        bike1.setOwnerName ("Sara Zulkifli");

        bike2 = new Bicycle(); //Create and assign values to bike2
        bike2.setOwnerName ("Ben Jones");

        owner1 = bike1.getOwnerName ( );  //Output the information
        owner2 = bike2.getOwnerName ( );
        boolean owner;

        System.out.println(owner1 + " owns a bicycle.");
        System.out.println(owner2 + " also owns a bicycle.");
    }
```

EXAMPLE : CLASS BICYCLE

- The dependency diagram between both programming

- The key differences : The use of bicycle class instead of standard classes
- Two classes created : BicycleRegistration (main class) and Bicycle


BicycleRegistration.java

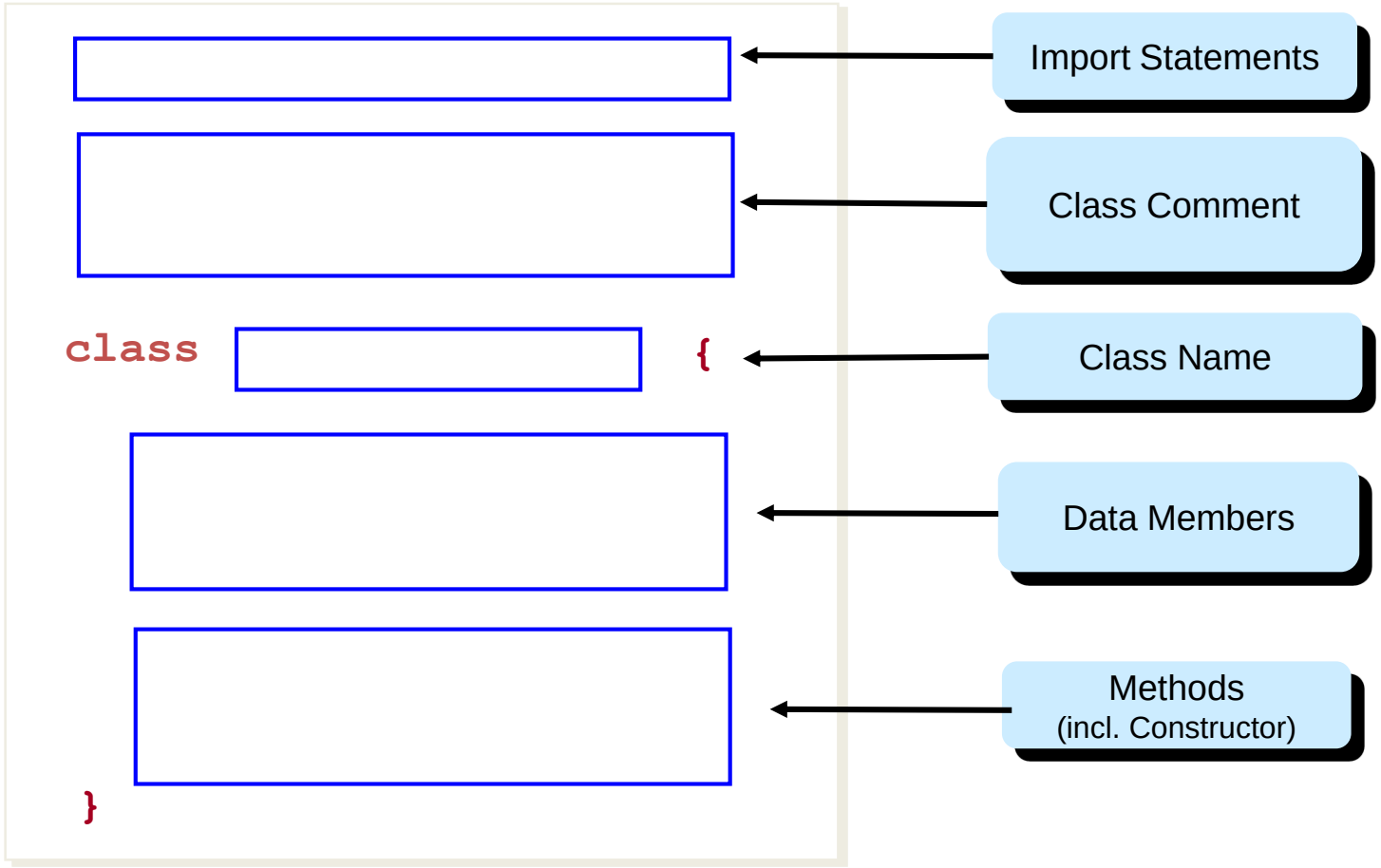

Bicycle.java

There are two source files. Each **class definition** is stored in a separate file.

To run the program: 1. javac Bicycle.java (compile)
2. javac BicycleRegistration.java (compile)
3. java BicycleRegistration (run)

REMEMBER!
Place all source files for a program in the same folder (directory)

ANATOMY OF CLASS DEFINITION



CLASS DEFINITION

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✓ To define a class, use `class` keyword and put the class members inside curly braces { }

1 Define Class Header

- Use a noun for the class name
- Begin the class name with a capital letter
- `final` keyword indicates a class cannot have subclasses and it's optional

2 Define Instance Variables

- `final` keyword indicates the value for the instance variable is permanent and it's optional
- `static` keyword indicates the variable is a class variable
- Define before it can be used.

3 Define member methods

- Use verb for the method name
- Begin the method name with lowercase letter and capitalize internal words.
- `static` keyword indicates the method is a static or class method

CLASS DEFINITION : SYNTAX

Class Header

```
<accessModifier> final class <className> {

        < instance variable(s) >
        < member method(s) >
}
```

Instance Variable(s)

```
<accessModifier> final/static <datatype> <identifierList>;
```

CLASS DEFINITION : SYNTAX

Member Method(s)

```
<accessModifier> static <returnType> <methodName>
(<parameter(s)>)
{
        <method Body>
}
```

Where ;

<accessModifier>	- determine **access right** for the class and its members
<className>	- class name that a programmer want to declare
<dataType>	- can be **primitive data type** or a class type
<identifierList>	- contain one or more variables names
<returnType>	- either primitive data type, a class type or void
<parameter(s)>	- a comma separated list of data types and variable names.

CLASS DEFINITION : ACCESS MODIFIERS

Access Modifier	Class or member can be referenced by;
`public`	Methods of the same class and methods of other classes
`Private`	Methods of the same class only
`Protected`	Methods of the same class, methods of subclasses and methods of classes in the same package
`No access Modifier (package access)`	Methods in the same package only

Additional:
The implementation of Access Modifiers for attributes and methods will be discuss in Lecture 7: Class Member Accessibility

CLASS DEFINITION : DATA TYPES

A **variable** can be either a primitive type or an object reference

PRIMITIVE DATA TYPES

- Numerical data
- A primitive variable contains **the value itself**

REFERENCE DATA TYPES

- Known as object reference variable
- An object reference variable holds **the address of an object**
- The contents are addresses that refer to memory location where the objects are actually stored
- Or thought of as a pointer to the location of the object

CLASS DEFINITION : RETURN TYPES

```
public void setOwnerName(String name){
    ownerName = name;
    }
```

Void Method

- A method that does not return a value
- Declare as void

```
public String getOwnerName(){
    return ownerName;
}
```

Value-returning Method

- When it is called, its return a value to the caller
- For this sample, since getOwnerName( ) method returns a string value – the value of instance variable ownerName – so it's return type is declare as string
- MUST include a return statement

return <expression> ;

EXAMPLE :
THE DEFINITION OF THE CLASS

```
class Bicycle {
    // Data member
    private String ownerName;

    //Constructor: Initializes the data member
    public Bicycle(){
        ownerName = "Unknown";
    }
    //Returns the name of this bicycle's owner
public String getOwnerName(){
    return ownerName;
}
//Assigns the name of this bicyle's owner
public void setOwnerName(String name){
    ownerName = name;
    }
}
```

Template:

```
class Bicycle {
    //data members
    //methods
}
```

We define the data member ownerName of the Bicycle Class

EXAMPLE :
THE DEFINITION OF THE CLASS

```
class Bicycle {
    // Data member
    private String ownerName;

    //Constructor: Initializes the data member
    public Bicycle(){
        ownerName = "Unknown";
    }
    //Returns the name of this bicycle's owner
public String getOwnerName(){
    return ownerName;
}
//Assigns the name of this bicyle's owner
public void setOwnerName(String name){
    ownerName = name;
    }
}
```

The syntax for **Data Member Declaration**

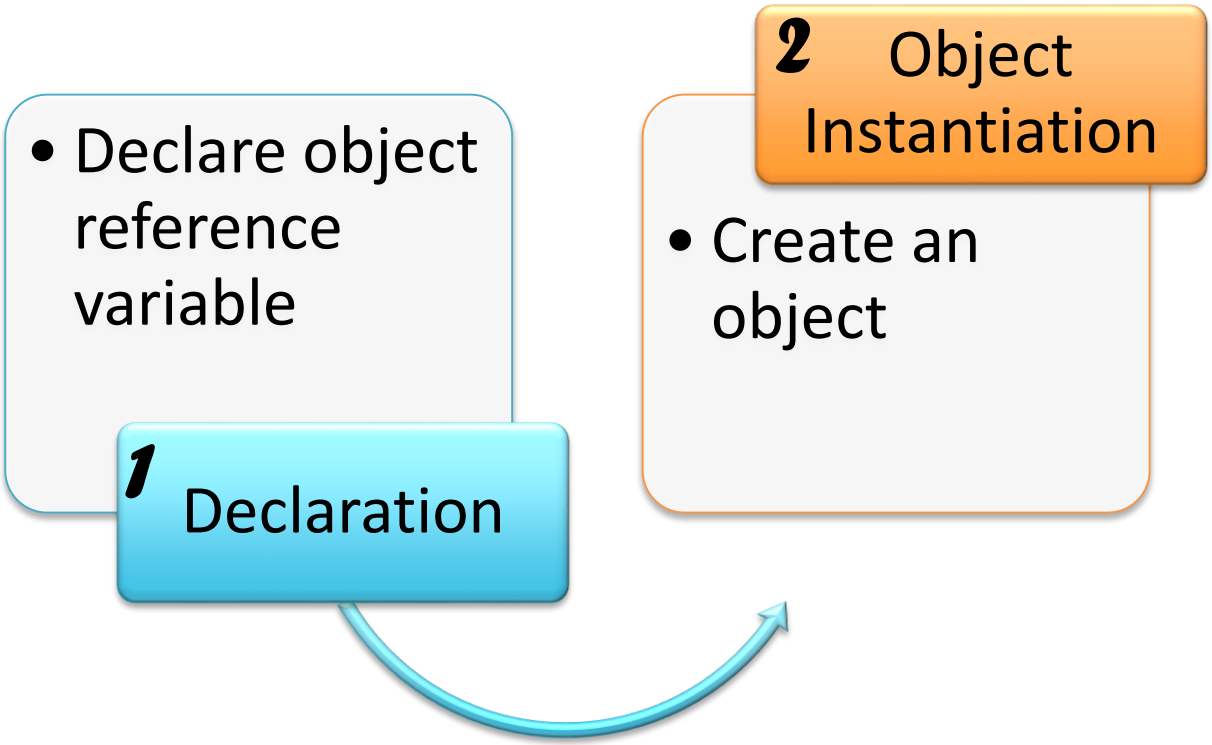
<modifiers> <data type> <name> ;

The syntax for **Method Declaration**

<modifiers> <return type>
<method name>
(<parameters>)
{
    <statements>
}

USER-DEFINED CLASS

Programmer need to create an object from the user-defined class in order to use it in a program



DECLARE AN OBJECT

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SYNTAX

```
<className>    <object reference variable>;
```

EXAMPLE:

```
Building     skyscraper1;
Person       student;
Vehicle      car;
Building     skyscraper1, skyscraper2;
```

Also known as declaring of an ***object reference***

Class Name
Must be defined before declaration can be stated

Object Reference Variable
One object is declare for 1 name

CREATE AN OBJECT

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SYNTAX

```
<object reference variable> = new <class name>
(<arguments>);
```

EXAMPLE:

Class Name
An instance of this class is created

Also known as assigning an ***object reference to the object***

```
skyscraper1 = new Building ("Burj Khalifa",2004);
Skyscraper2 = new Building ("KLCC", 1996);
Student     = new Person ("Ammar",01982);
```

Object reference variable

Arguments

DECLARE & CREATE AN OBJECT

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SYNTAX

```
<class Name> <object reference variable> = new
<class name> (<arguments>);
```

EXAMPLE:

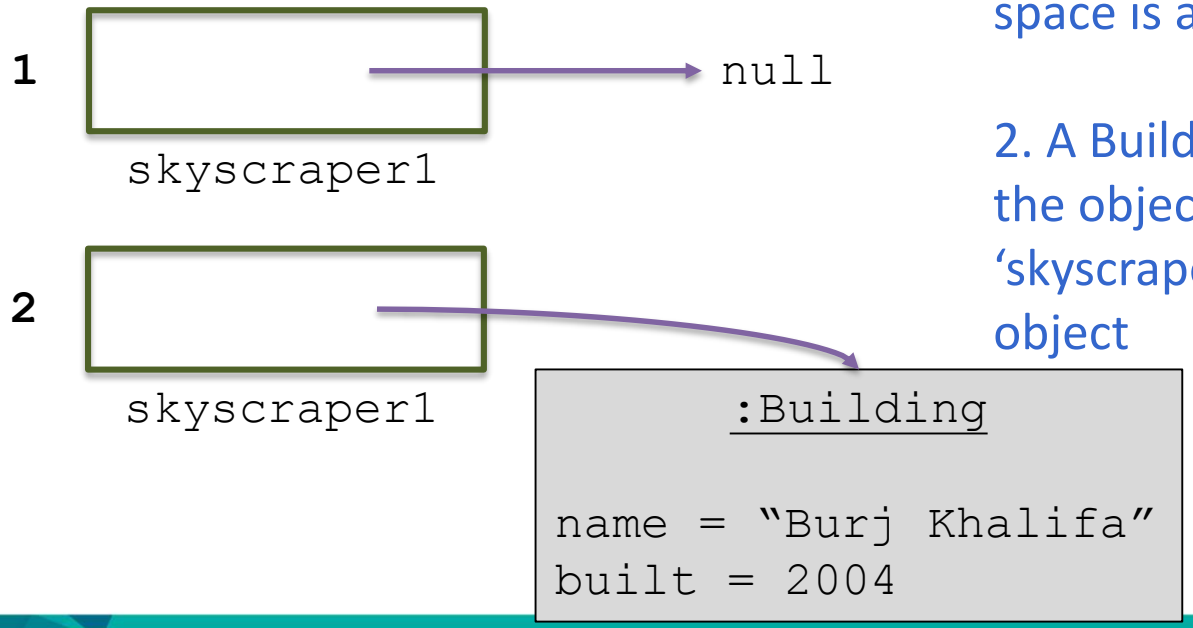
```
Building skyscraper1 = new Building ("Burj Khalifa",2004);
Building skyscraper2 = new Building ("KLCC", 1996);
Person student       = new Person ("Ammar",01982);
```

DECLARE Vs. CREATE AN OBJECT

EXAMPLE:

```
1. Building     skyscraper1;
2. skyscraper1 = new Building ("Burj Khalifa",2004);
```

MEMORY STATE



1. An object reference variable named 'skyscraper1' is declared and space is allocated in memory

2. A Building object is created and the object reference variable 'skyscraper1' is set to refer to the object

EXAMPLE : USING THE CLASS BICYCLE

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Memory State?

```
class BicycleRegistration {

    public static void main(String[] args) {
        Bicycle bike1, bike2; //Create instances of class Bicycle
        String owner1, owner2;

        bike1 = new Bicycle(); //Create and assign values to bike1
        bike1.setOwnerName ("Sara Zulkifli");

        bike2 = new Bicycle(); //Create and assign values to bike2
        bike2.setOwnerName ("Ben Jones");

        owner1 = bike1.getOwnerName ( );  //Output the information
        owner2 = bike2.getOwnerName ( );
        boolean owner;

        System.out.println(owner1 + " owns a bicycle.");
        System.out.println(owner2 + " also owns a bicycle.");
    }
```

INVOKING METHODS

```
owner1 = bike1.getOwnerName ( );
owner2 = bike2.getOwnerName ( );
```

- We send a *message* to the object to instruct an object to perform a task
- ONLY send a message that the objects can understand!
- To enable an object to handle the received message, it must posses a matching *method.* (The *behaviours* of an object implemented in classes are ***methods***)

Message `getOwnerName` is sent to a Bicycle object `bike1` → Bike1 : Bicycle

- Use dot operator (.) to invoked its method and to access a data field in the object

INVOKING METHODS

SYNTAX:

```
<objectReferenceVariable>.<methodName>(<arguments>);
```

EXAMPLE:

Method Name
The name of the message being send

```
skyscraper1.printTicket ( ) ;
Skyscraper1.editProfile ("BurjKhalifa", 2004);
```

Object reference variable

Argument(s)
Argument passing with the message

EXERCISE

> Imagine you are given the task of designing an airline reservation system that keeps track of flights for a commuter airline. Create and declare the objects involved in the system. Include the member methods and invoke the method necessarily.
>
> C.Thomas Wu
> Introduction to Object-Oriented Programming

The OBJECTIVE of this Exercise is to give you a continuous experience in building your own user-defined program.

Author Information

Dr. Nor Saradatul Akmar Binti Zulkifli

Senior Lecturer
Faculty of Computer Systems & Software Engineering
Universiti Malaysia Pahang