// TV Program Example

public class Driver {
    private TV joesTV, suesTV, emasTV;
    public Driver() {
        joesTV = new TV();
        joesTV.turnSetOn();
        joesTV.press8();
        joesTV.pressEnter();
        joesTV.setToAverageVolume();
    }
}

```java
public class Driver {
    private TV joesTV, suesTV, emasTV;
    public Driver() {
        joesTV = new TV();
        joesTV.turnSetOn();
        joesTV.press8();
        joesTV.pressEnter();
        joesTV.setToAverageVolume();
    }
}
```
A variable serves to **name** an object.
- Each variable is can be **bound** to no more than one object.
- Each variable is unbound (________) initially.

**Object Diagram**

An **object diagram** is a picture of object bindings and values at some moment (run-time location).

**Example**

```
joesTV = new TV();
joesTV.turnSetOn();
joesTV.press8();
joesTV.pressEnter();
joesTV.setToAverageVolume();
joesTV.turnSetOff();
```

**run-time location**

- **joesTV**
  - channel = 8
  - volume = 10
  - isOperating = true

**Tracing**

Programmers often **trace** their code by simulating its execution and observing state changes.

**Example**

```
joesTV = new TV();
joesTV.turnSetOn();
joesTV.press1();
joesTV.press9();
joesTV.pressEnter();
joesTV.setToAverageVolume();
joesTV.turnSetOff();
emasTV = new TV();
emasTV.turnSetOn();
emasTV.setToAverageVolume();
emasTV.raiseVolume1db();
suesTV = emasTV;
suesTV.press3();
suesTV.pressEnter();
emasTV = joesTV;
joesTV = null;
```

- **joesTV**
- **suesTV**
- **emasTV**
**Example**

```java
joesTV = new TV();
joesTV.turnSetOn();
joesTV.press1();
joesTV.press9();
joesTV.pressEnter();
joesTV.setToAverageVolume();
emasTV = new TV();
emasTV.turnSetOn();
emasTV.setToAverageVolume();
emasTV.raiseVolume1db();
suesTV = emasTV;
suesTV.press3();
suesTV.pressEnter();
emasTV = joesTV;
joesTV = null;
```

---

**Two Cautions**

**Null Pointer Exception**

When a variable is `null`, it **cannot** be used as a reference to an object (e.g., in a method call).

Failure to remember the rule above results in a **null pointer exception**, the most common of all run-time errors.

**Example**

```java
joesTV = null;
joesTV.turnSetOn();
```

**Orphans**

When an object has no remaining program reference, it is said to be an **orphan**.

Orphans don’t cause run-time errors in Java. However, the programmer should be aware that assigning a value to a variable may orphan the object previously bound to the variable. Orphans become inaccessible.

**Example**

```java
joesTV = new TV();
joesTV = emasTV;
```
Example

```java
joesTV = new TV();
joesTV = null;
emasTV = new TV();
suesTV = emasTV;
suesTV = joesTV;
emasTV = new TV();
```

---

Trace for Orphans

Example

```java
joesTV = new TV();
joesTV = null;
emasTV = new TV();
suesTV = emasTV;
suesTV = joesTV;
emasTV = new TV();
```

---

```
null
```

```
null
```

```
: TV
channel = = ?
volume = = ?
isOperating = = ?
```

```
emasTV : TV
channel = = ?
volume = = ?
isOperating = = ?
```

```
: TV
channel = = ?
volume = = ?
isOperating = = ?
```
A Few Style Guidelines

1. Matching items should be aligned on the left. (e.g. public class … )
2. Indent the bodies/clauses from their enclosing brackets/braces. (e.g. instance variable declarations and Driver code.)
3. An indentation distance of three or four characters is good.
4. Place assertions (class invariants, pre- and post-conditions) immediately before their class or method. Use /** convention for pre/postconditions.
5. Pick identifiers that are meaningful (to you and others).
6. Variable names should be nouns or noun phrases.
7. Capitalize the first letter of each word in an identifier, excepting possibly the first.
8. Capitalize the first letter of the name of a class. Names of instance variables and methods should begin with a small letter.
9. Blank lines can be included to separate code, but should be used sparingly.
10. Assertions are a good use of comments. Minimize other comments.