Programming Foundations FIT9131

Documentation, identity, equality, more collections

Week 6

Lecture outline

- Class documentation
  - javadoc
- Object identity vs. object equality
  - Java Strings
- Iterators
- Conditional operator

Review : Class documentation

- The Java standard library documentation shows details about all classes in the library.
- This is called the *Java API* (*Application Programming Interface*) documentation.
- The documentation is readable in a Web browser.
- Provides an *interface* description for all library classes

Interface vs. Implementation

The documentation includes:

- **the *name* of the class;**
- **a general *description* of the class;**
- **a list of *constructors* and *methods*;**
- ***return value types* and *parameters* for constructors and methods;**
- **a description of the *purpose* of each constructor and method.**

describes the *interface* of the class

Interface vs. Implementation

The documentation *does not* include :

- **private fields (fields are typically private)**
- **private methods**
- **the bodies (source code) for each method**

does ***not*** describe the ***implementation*** of the class

Writing class documentation

- It is important to document your code.
- Your own classes should be documented in the same way as the Java library classes.
- *Important* : other people should be able to use your class without reading/knowing the implementation.
- Make your class to be just like a 'library class'! The aim is to *make your class as re-usable as possible* – and not just for use in the current program you are writing.

Elements of documentation

Documentation for a class should include at least:

- **the class name**
- **a comment describing the overall purpose and characteristics of the class**
- **a version number**
- **the authors' names**
- **documentation for each constructor and each method**

Elements of documentation

The documentation for each method (and also each constructor) should include:

- **the name of the method**
- **the return type**
- **the parameter names and types**
- **a description of the purpose and function of the method**
- **a description of each parameter**
- **a description of the value returned**

Javadoc

Javadoc is a tool (a document generator) to *automate* the generation of Java documentation.

Documentation comments are enclosed by / … */**

These consist of a main description followed by a "tag" section. Eg :

Start of comment

Example of a Class comment

```
/**
 * The Responder class represents a response
 * generator object. It is used to generate an
 * automatic response.
 *
 * @author     Michael Kölling and David J. Barnes
 * @version    1.0   (30.Mar.2006)
 */
```

End of comment

Tags

Tags' values

Javadoc (contd.)

Method comment:

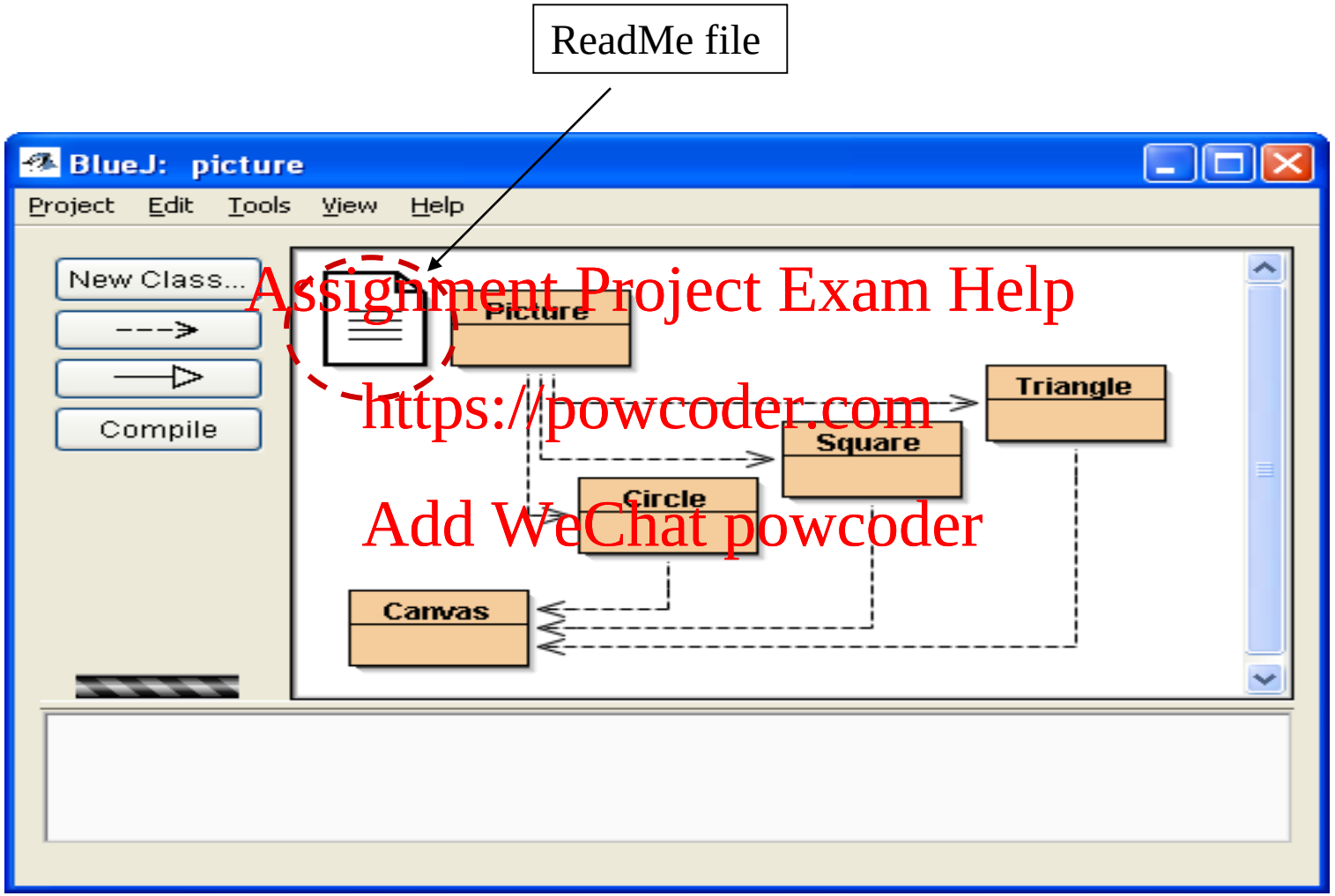
Main description

Example of a Method comment

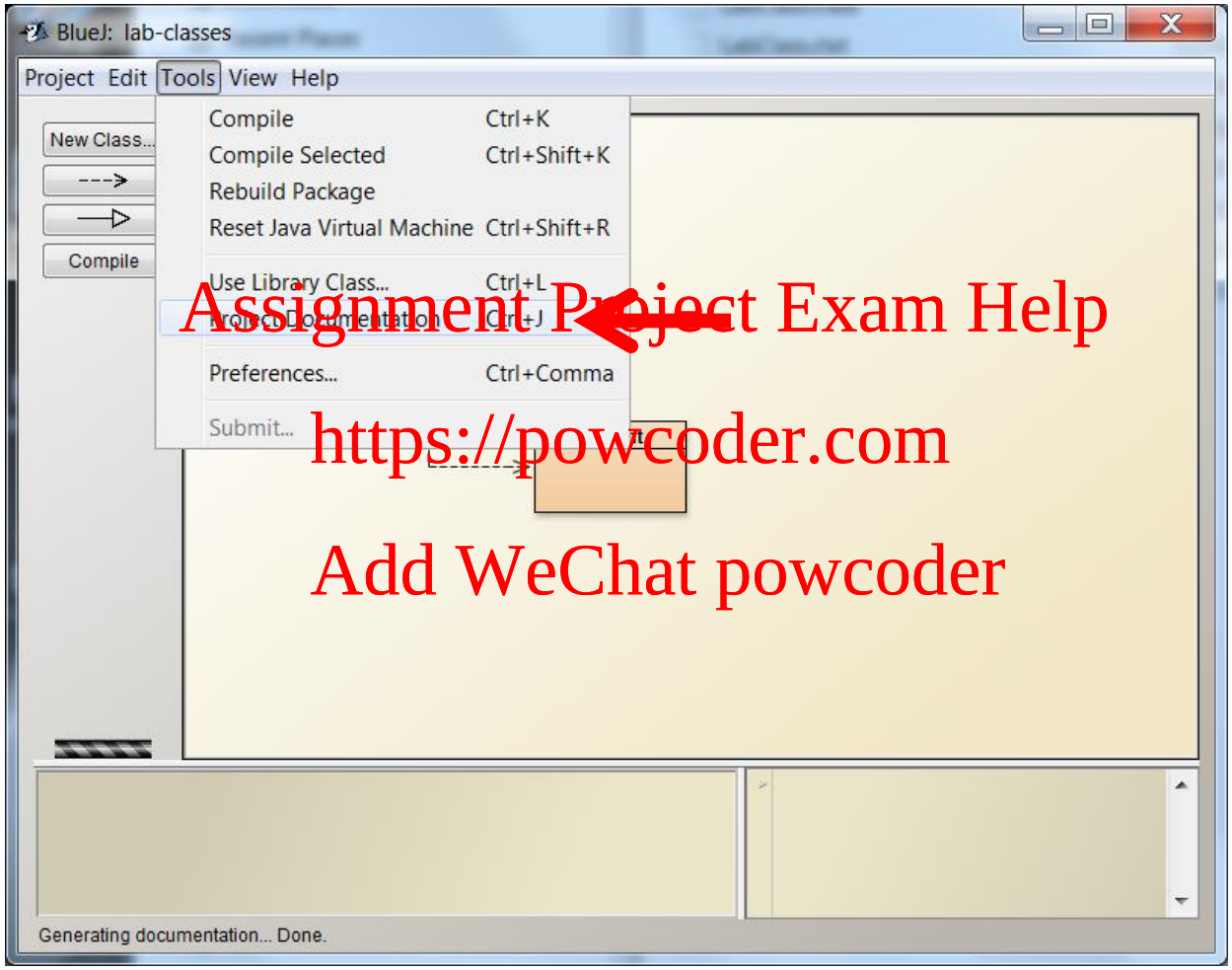
```
/**
 * Read a line of text from standard input (the text
 * terminal), and return it as a set of words.
 *
 * @param  prompt  A prompt to print to screen.
 * @return An ArrayList set of Strings, where each
 *    String is one of the words typed by the user
 */
public ArrayList<String> getInput(String prompt)
{
   ...
}
```

Tags

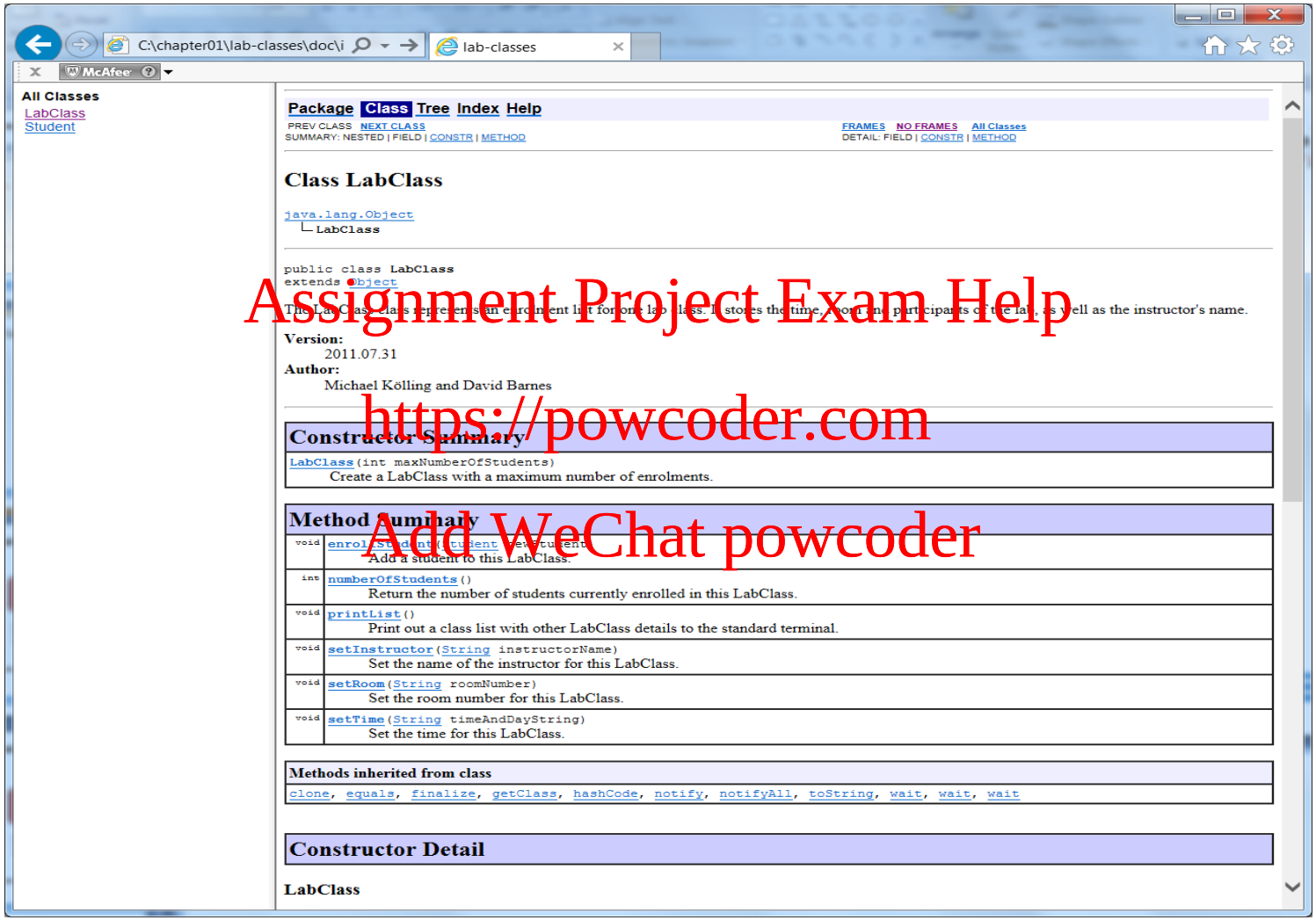
Overall project details (BlueJ)



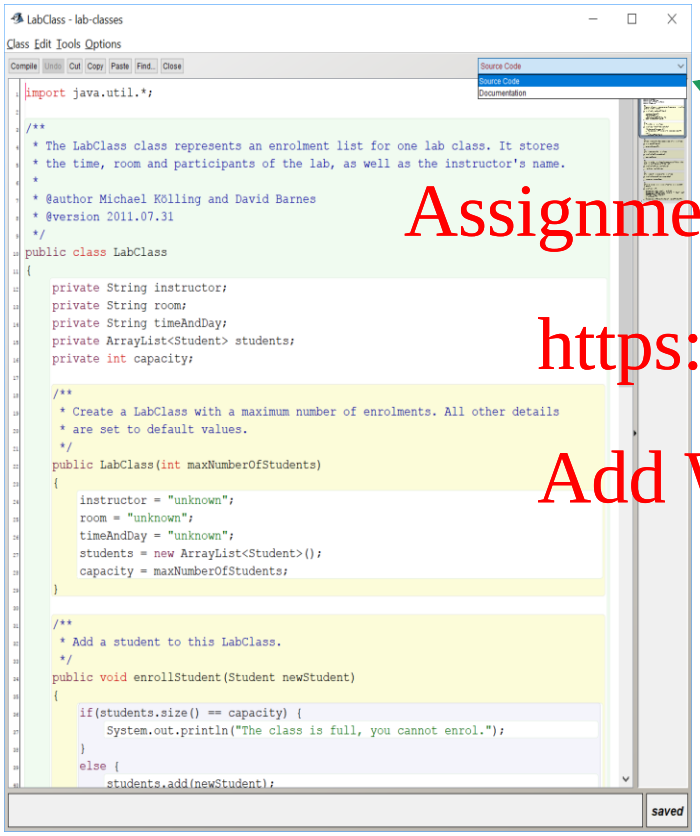
Using BlueJ to generate documentation

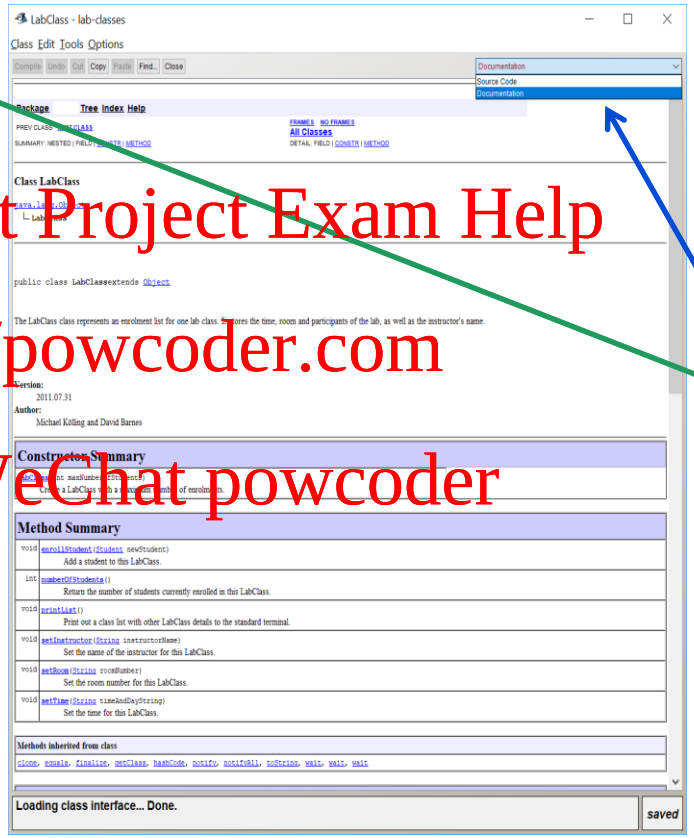


Sample Javadoc output from BlueJ



Toggling between Document/SourceCode view



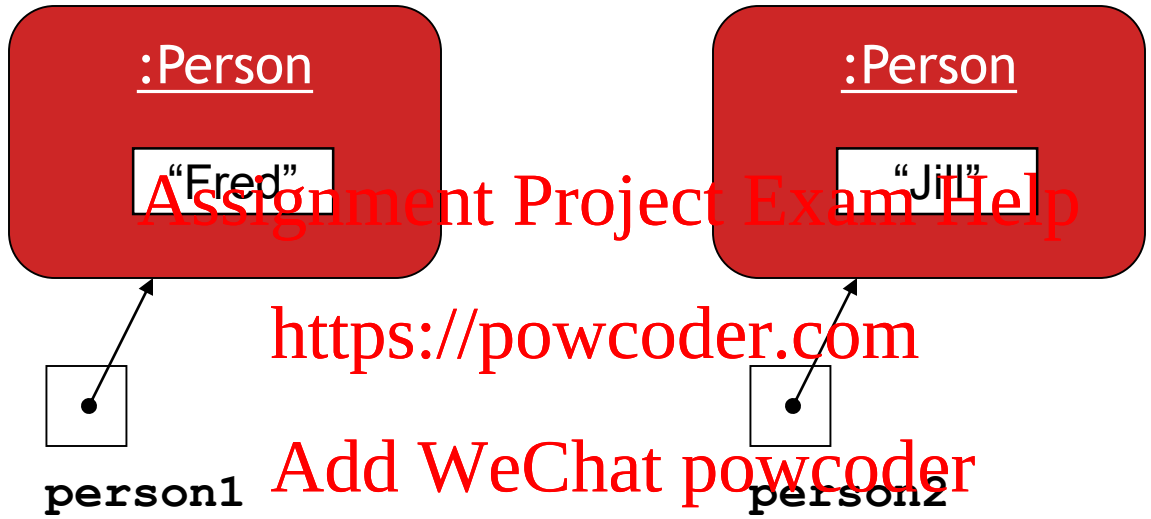


In the BlueJ code editor, you can easily toggle between the **Document view** and the **Source Code view**

Source Code view

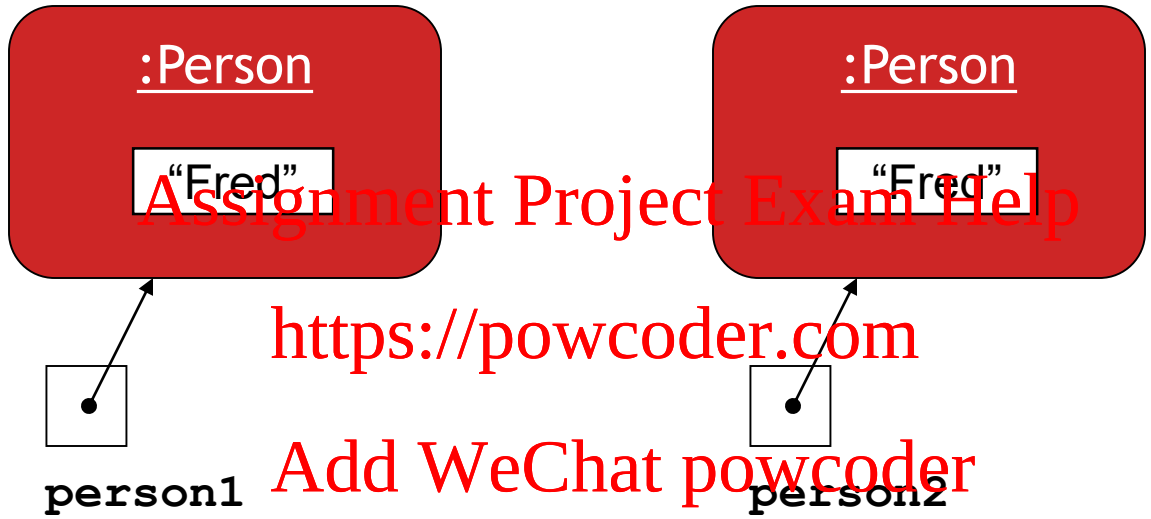
Document view

Object : Identity vs. Equality



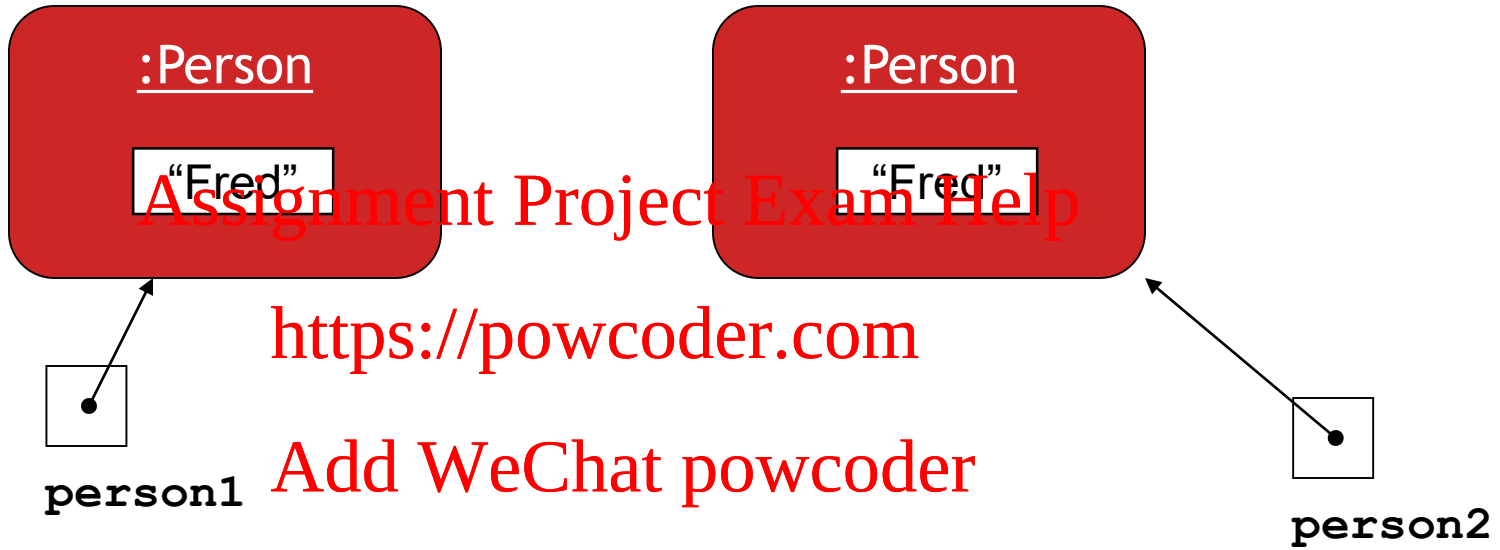

```
person1 == person2 ?
```

Object : Identity vs. Equality




```
person1 == person2 ?
```

Object : Identity vs. Equality

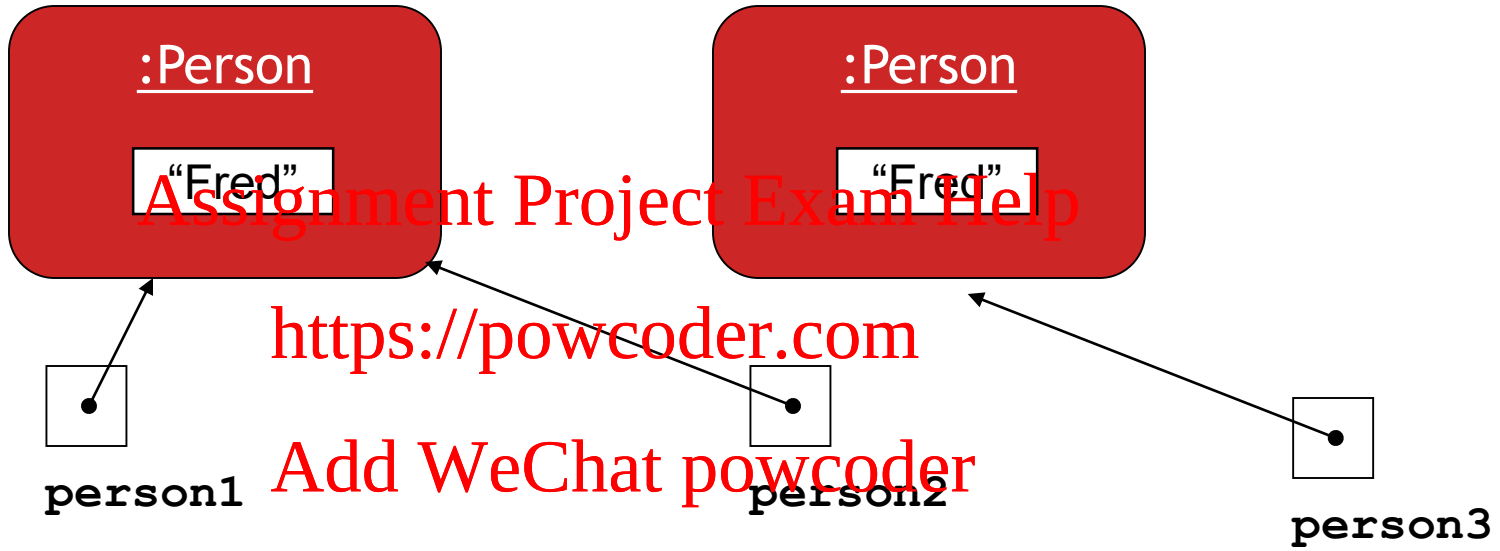


This is really *NOT* the correct way to compare 2 strings!!!

```
person1.getName() == person2.getName() ?
```

(assuming **`Person`** class has a **`getName()`** accessor method)

Object : Identity vs. Equality




```
person1 == person2 ?

person1 == person3 ?
```

Comparing two `Strings`

A java `String` is an object. Comparing two `Strings` for equality using the `==` operator compares the reference variables, i.e. the memory locations, for equality. The only way they will be equal is if they are the same location in memory, i.e. the same object.

If you want to compare the *content* of two `Strings` to see if they are the same, you should use the `equals` method of the `String` class.

The same rule applies to any two objects. If you write a class, and you want to compare the state (eg. the `name` attribute of a `Person` class) of the two objects of that class, you need to write an `equals` method for the class.

String equality

```
if(input == "bye")
{
    ...
}
```

✘ tests identity


```
if(input.equals("bye"))
{
    ...
}
```


✓ tests equality

Strings should always be compared using the `equals` method.

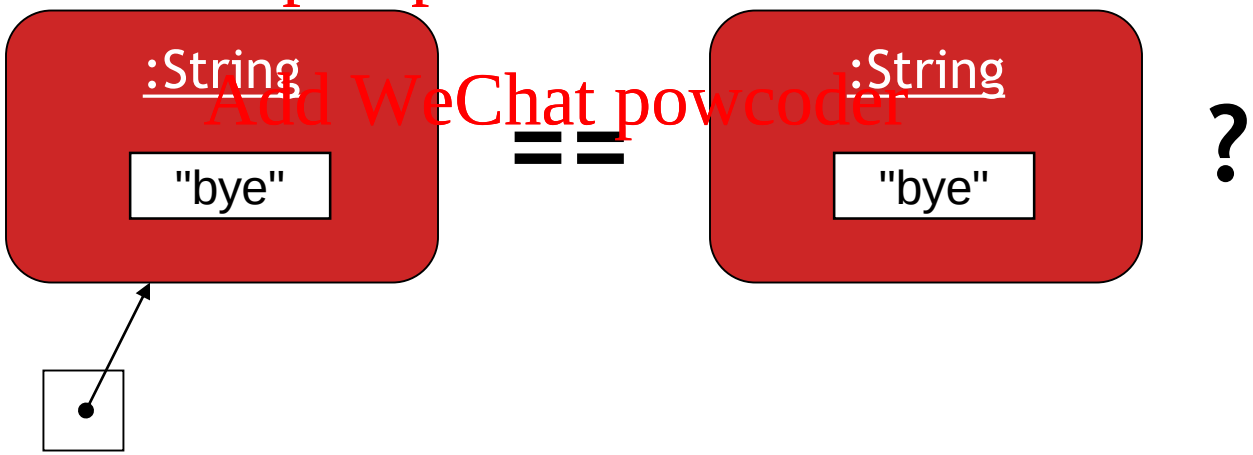
The `String` class also has an `equalsIgnoreCase` method.

Identity vs. equality (Strings)

This example is from the **InputReader** class in the **tech-support** project from the textbook (Chapter05)

```
String input = reader.getInput();
if (input == "bye")
{
    ...
}
```

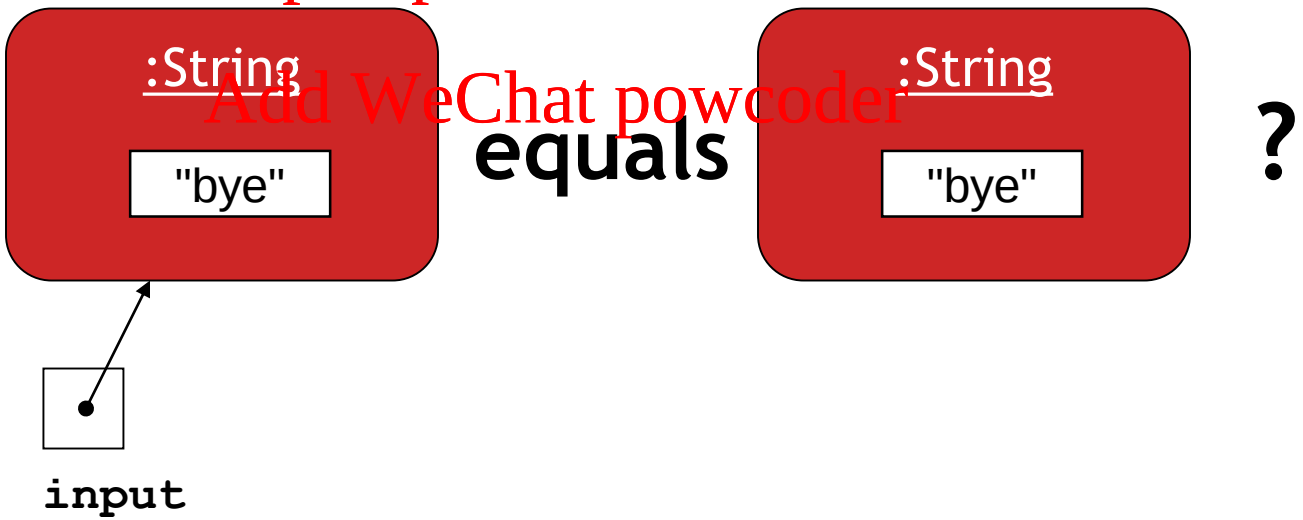
== tests identity



Identity vs. equality (Strings)

```
String input = reader.getInput();
if (input.equals("bye"))
{
    ...
}
```

equals tests equality



Strings *are immutable*

Java Strings are *immutable*. A String never changes its value. A method that appears to change a String (e.g. toUpperCase) actually creates a new temporary String that looks like the original in upper case, but the original is unchanged.

Eg :

```
public void changingString()
{
    String greeting = "Hello there";
    System.out.println(greeting.toUpperCase());
    System.out.println(greeting);
}
```

What will be displayed on the screen?

Example: Building a string using a loop

```
// this works, but is rather inefficient
public void showLine(int numberOfStars)
{
    String line = "";
    for (int counter = 0; counter < numberOfStars;
         counter++)
        line = line + "*";
    System.out.println(line);
}
```


How many temporary `String`s are created here?

Example : Changing a string (more efficient way)

```
public String changingString(String aString)
{
    StringBuffer buffer = new StringBuffer(aString);

    // modify the StringBuffer object here...
    ...

    return buffer.toString();
}
```


Strings can be converted to StringBuffers and vice versa. It is often more efficient to use a StringBuffer, especially when you are going to append things to it.

Example: Building a string (more efficient way) again

```
public void showLineWithStringBuffer(int numberOfStars)
{
    String line = "";
    StringBuffer buffer = new StringBuffer(line);
    for (int counter = 0; counter < numberOfStars;
         counter++)
       buffer.append("*");
    System.out.println(buffer);
}
```


This is more efficient than the previous example. Why?

Removing spaces from a string

This is from the **InputReader** class in the **tech-support** project from the textbook (Chapter05)

The leading and trailing spaces can be easily removed from a string:


```
String input = console.getInput();
input = input.trim();
```


These can be merged into a single line of code :


```
String input = console.getInput().trim();
```

Test : Changing the case of characters in a string

Write a line of code that will *get a line of input from the user, removes the leading and trailing spaces and also changes it to lower case*. Hint : use the line of code on the previous slide as a starting point.


```
String input =
```

Examples : Validating a `String`

- If a `String` is supposed to be numeric (e.g. a phone number or a postcode), you need to check that each character is a numeric character (i.e. between '0' and '9').

- If a `String` is not supposed to be blank (where a blank `String` is either empty or full of space characters), you could check each character to see if they are all spaces.

- Unfortunately the `String` class does not provide methods to do these checks.

Example: `stringNumeric` *method*

```
public boolean stringNumeric(String aString)
{
    if (aString.length() == 0)
        return false;
    int position = 0;
    while (position < aString.length())
    {
        char thisCharacter = aString.charAt(position);
        if (thisCharacter < '0' || thisCharacter > '9')
            return false;
        position++;
    }
    return true;
}
```

Revision : loops and collections

Loop statements allow a block of statements to be repeated.

- The *while* loop allows the repetition to be controlled by a `boolean` expression.
- The *for* loop offers an alternative to while loops when the number of repetitions is known.
- The *for-each* loop allows iteration over a whole collection.

- All collection classes provide a special object known as an *Iterator*, that provides sequential access to the whole collection.

Iterator and iterator()

- Collections (eg. `ArrayLists`) have an `iterator()` method.
  - Calling this method returns an `Iterator` *object*.
- An `Iterator<E>` object has three methods:
  - `boolean hasNext()`
  - `E next()`
  - `void remove()`

Iterating using an iterator object

An iterator object can be used to perform looping over a Collection. *Eg :*

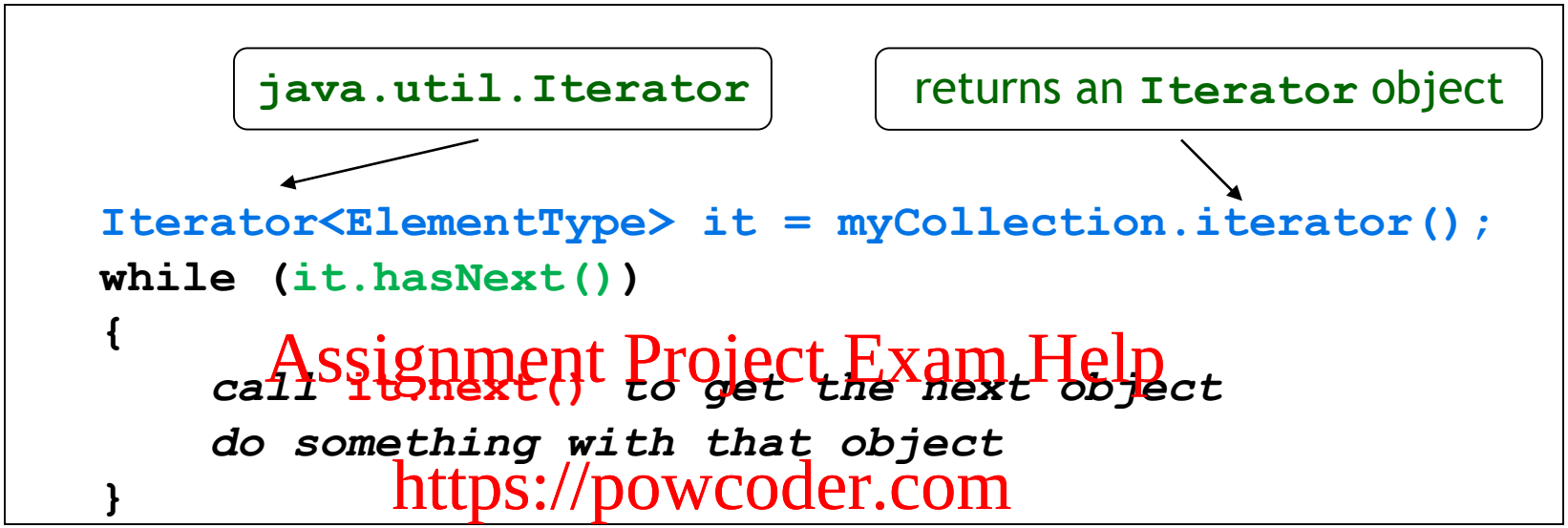
- The `iterator` method of ArrayList, like all collections, returns an *iterator* object.
- A `while` loop performs the iteration.
- The *iterator* object keeps track of the position in the list.

To use the iterator object we need to import the Iterator class:

```
import java.util.Iterator;
```

Using an Iterator object

General Syntax



Java Example

```
public void listAllFiles()
{
    Iterator<Track> it = files.iterator();
    while (it.hasNext())
    {
        Track tk = it.next();
        System.out.println(tk.getDetails());
    }
}   // MusicOrganizer example from Week 5
```

Other Collections (non-examinable topics)

- Apart from the `ArrayList` we discussed before, Java also provides other collections. Two of the more commonly used ones are :
  - `HashMaps` : collections that contain *pairs of objects*. Pairs consist of a *key* and a *value*.
  - `HashSets` : collections that store each individual element at most once (ie. no duplicates).

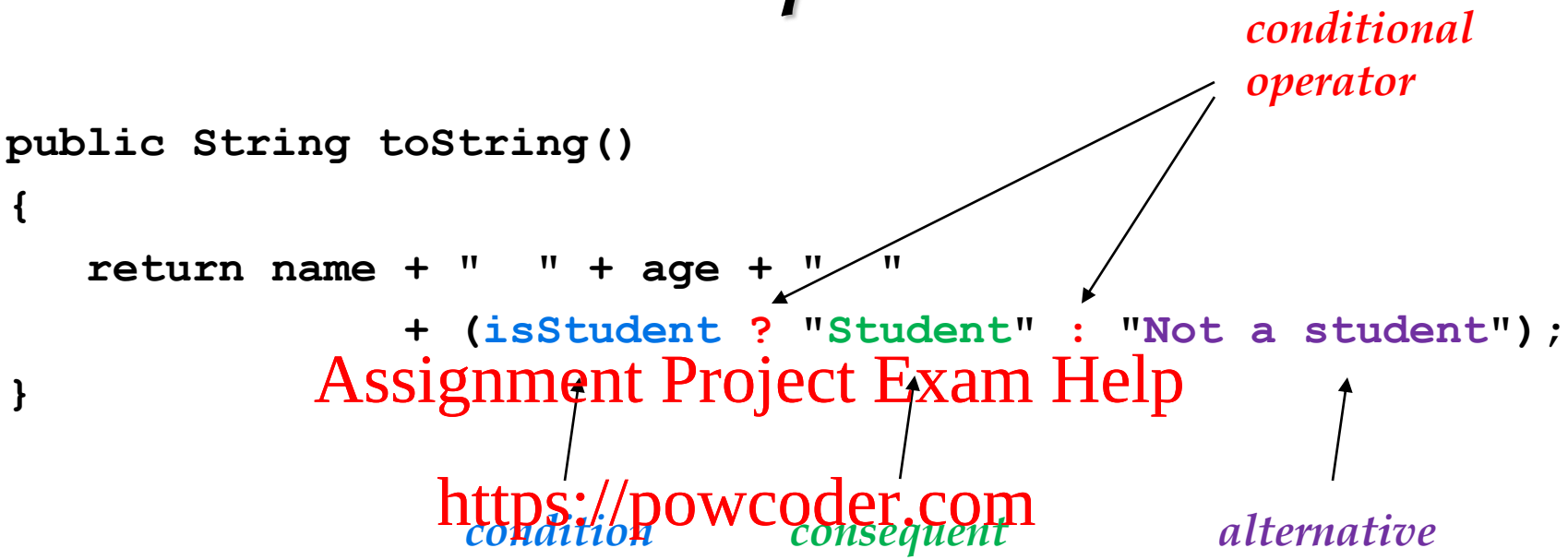
- These specialised collections are often used to implement specific types of data, Eg. A Map can be used to implement a *Telephone Book*, where each "pair" consists of a *name* and a corresponding *tel#*.

Collection comparisons

Collection	Strengths	Limitations	Example usages
ArrayList	A sequence of elements in order of insertion	Slow to search, slow to add/remove arbitrary elements.	List of accounts; waiting line; the lines of a file.
HashSet	A set of unique elements that is fast to search	Does not have indexes; cannot retrieve arbitrary elements from it.	Unique words in a book; lottery ticket numbers
HashMap	A group of associations between pairs of "key" and "value" objects.	Not a general-purpose collection; cannot easily map backward from a value to its key.	Word counting; phone book.

From: "Building Java Programs", by Regges & Stepp

Conditional operator



? : **is called the *conditional operator*. All three parts (condition, consequent, alternative) *must* be present. Its returned value can be used like any other returned value. How does this compare to the `if` statement?**

An equivalent IF example

```
public String toString()
{
    if (isStudent)
        return name + "  " + age + " Student";
    else
        return name + "  " + age + " Not a student");
}
```

condition

consequent

alternative

This does the same thing as the version using the *conditional operator*, but the code is longer.

Common Scanner input error

Problems may occur when using `nextLine()` in conjunction with `nextInt()` from the Scanner class.

For example, when the following code was executed:

```
int age = console.nextInt();
String name = console.nextLine();
System.out.println(age + ", " + name);
```


with the following input from the keyboard:

```
77<enter>
Helen<enter>
```

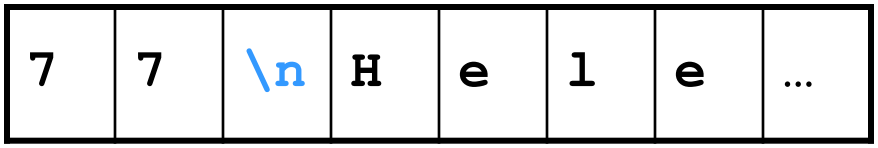
the following output will be produced:

```
77,
```

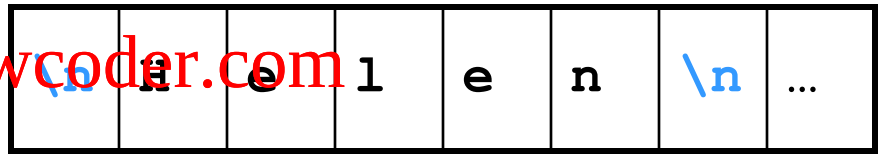
What happened to the name?

What was the problem?

To Java, the input is a long buffer of characters:

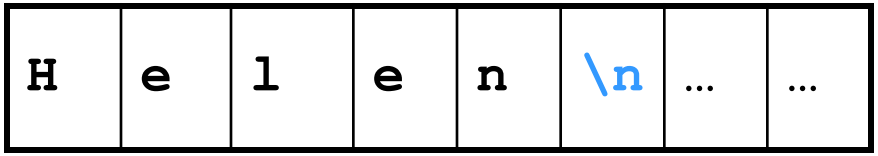


`nextInt` removes the characters corresponding to a number, and that is all. The newline character ('\n') is not removed from the buffer.




```
age = 77
```

`nextLine` looks for the next newline character ('\n'), and returns everything before the first one it finds, in this example it will return an empty string.




```
name = ""
```

Some possible solutions

- use `nextLine()` to get all input (this will remove the newline character properly)
  - for this approach, the inputs may need to be converted back to the correct format, eg. to int's if arithmetic operations are needed.
  - so the previous example would become :


```
String      nextLine()
   int age = console.nextInt();
   String name = console.nextLine();
   System.out.println(age + ", " + name);

   // obviously, this only works if we do not intend
   // to perform any calculations on the age
```

Some possible solutions

- use a dummy `nextLine()` to explicitly remove the newline character, before the next real input statement. In other words, use an extra `nextLine()` statement, but don't store the input for it.
  - so the previous example would become :


```
int age = console.nextInt();
console.nextLine();
String name = console.nextLine();
System.out.println(age + ", " + name);
```

a dummy `getLine()` (note that the result is not assigned to anything)

The auction *project*

The *auction* project (Chapter04 from textbook) provides further illustration of collections and iteration ... and some other concepts.

A field that has not explicitly been initialised will contain the special value `null` by default.

We can test if an object variable holds the `null` variable. If it does, *it is not a valid object*, and must not be used!!

Special value : `null`

- Used with object types.
- Used to indicate : *"no object"*.
- We can test if an object variable holds the `null` value, Eg :


```
if (highestBid == null) ...
```


  - if successful, this test indicates 'there is no bid yet', since the `highestBid` object does not exist.

"Anonymous" objects

- Objects are often created and handed on elsewhere immediately:

```
Lot furtherLot = new Lot(…);
lots.add(furtherLot);
```


- If we don't really need the object `furtherLot` after this, we could have achieved the same effect using an anonymous object:

```
lots.add(new Lot(…));
```

anonymous object (an object with no name)