Java Fundamentals

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Course Objectives

- At the end of the course, you will have acquired sufficient knowledge to:
- Use Java technology data types and expressions
- Use Java technology flow control constructs
- Use arrays and other data collections
- Implement error-handling techniques using exception handling

Agenda

Audience and Prerequisite

- The course is for any one who wants to learn Java
- The following are beneficial if you already have knowledge and experiences as:
  - Created and compiled programs with C/C++/Java

Assessment Disciplines

- Class Participation: at least 80% of course time
- Assignment: get al least 70/100 score for final exercise

Java Basics

Overview

- Java programming language was originally developed by Sun Microsystems which was initiated by James Gosling and released in 1995 as core component of Sun Microsystems' Java platform (Java 1.0 [J2SE]).
- Java is:
  - Object Oriented
  - Platform independent
  - Simple
  - Multithreaded
  - Distributed

Basic Syntax

- Classes
- Methods
- Constructors
- Instance variables
- Local variables
- Class variables
- Objects

Basic Syntax

- Identifiers:
  - All identifiers should begin with a letter (A to Z or a to z), currency character ($) or an underscore (_).
  - After the first character identifiers can have any combination of characters.
  - A key word cannot be used as an identifier.
  - Most importantly identifiers are case sensitive.
  - Examples of legal identifiers: age, $salary, _value, __1_value
  - Examples of illegal identifiers: 123abc, -salary
- Modifiers
  - Access Modifiers: default, public, protected, private
  - Non-access Modifiers: static, final, abstract, synchronized

Demo 1: Greeting

- Points to remember:
  - Java coding convention
  - Review: class, constructors, methods, variables, constants …

Basic Operators

- Arithmetic Operators: +, -, *, /, %, ++, --
- Relational Operators: ==, !=, >, <, >=, <=
- Bitwise Operators: &, |, ^…
- Logical Operators: &&, ||, !
- Assignment Operators: =, +=, -=, *=, /=, %=, <<=, >>=, &=, ^=, |=
- Misc Operators:
  - Conditional operator (?:)

  variable x = (expression) ? value if true : value if false
  - Instance of

  (Object reference variable) instanceof (class/interface type)

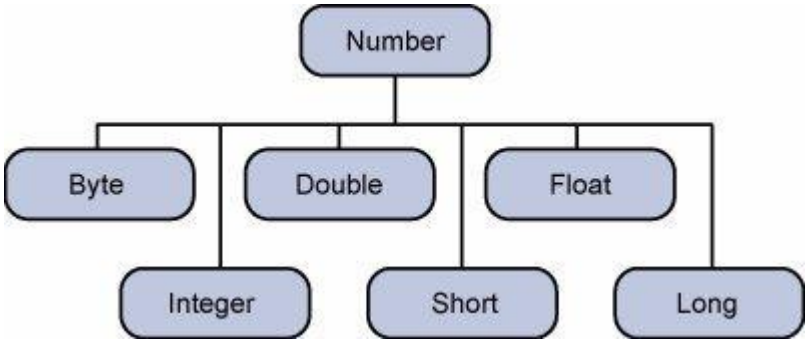
Flow Control

- Loops:
  - while Loop
  - do...while Loop
  - for Loop
- Decision making:
  - if … else if ….else
  - switch
- continue, break:

Primitive Types and Wrapper Classes

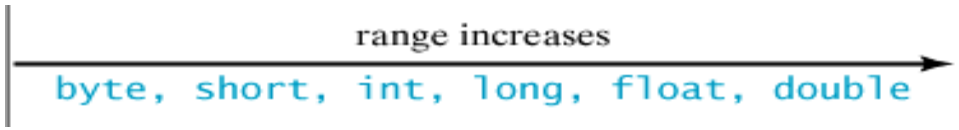
- Logical – `boolean`
- Textual – `char`
- Integral – `byte`, `short`, `int`, and `long`
- Floating – `double` and `float`

- Wrapping Classes:



Primitive Types and Wrapper Classes

Name	Range	Storage Size
byte	-2^7 (-128) to 2^7 - 1(127)	8-bit signed
short	-2^{15} (-32768) to 2^{15} - 1(32767)	16-bit signed
int	-2^{31} (-2147483648) to 2^{31} - 1(2147483647)	32-bit signed
long	-2^{63} to 2^{63} - 1	64-bit signed
	(i.e., -9223372036854775808 to 9223372036854775807)	
float	Negative range: -3.4028235E + 38 to -1.4E-45	32-bit IEEE 754
	Positive range: 1.4E-45 to 3.4028235E + 38	
double	Negative range: -1.7976931348623157E+308 to -4.9E-324	64-bit IEEE 754
	Positive range: 4.9E-324 to 1.7976931348623157E+308	



Range increases

Primitive Types and Wrapper Classes

Variable	Value
byte	0
short	0
int	0
long	0L
float	0.0F
double	0.0
char	‘’
boolean	false
All reference types	null

Default Value of Variables

String

- String: String greeting = "Hello world!";
- StringBuilder
- StringBuffer

```
StringBuffer s1 = new StringBuffer("Java");
StringBuffer s2 = new StringBuffer("HTML");
```

Show the results of the following expressions of `s1` after each statement. Assume that the expressions are independent.

```
(1) s1.append(" is fun");    (7)  s1.deleteCharAt(3);
(2) s1.append(s2);           (8)  s1.delete(1, 3);
(3) s1.insert(2, "is fun"); (9)  s1.reverse();
(4) s1.insert(1, s2);        (10) s1.replace(1, 3, "Computer");
(5) s1.charAt(2);            (11) s1.substring(1, 3);
(6) s1.length();             (12) s1.substring(2);
```

Example for StringBuffer

Java Advance

Collection Framework

Java Collections Framework

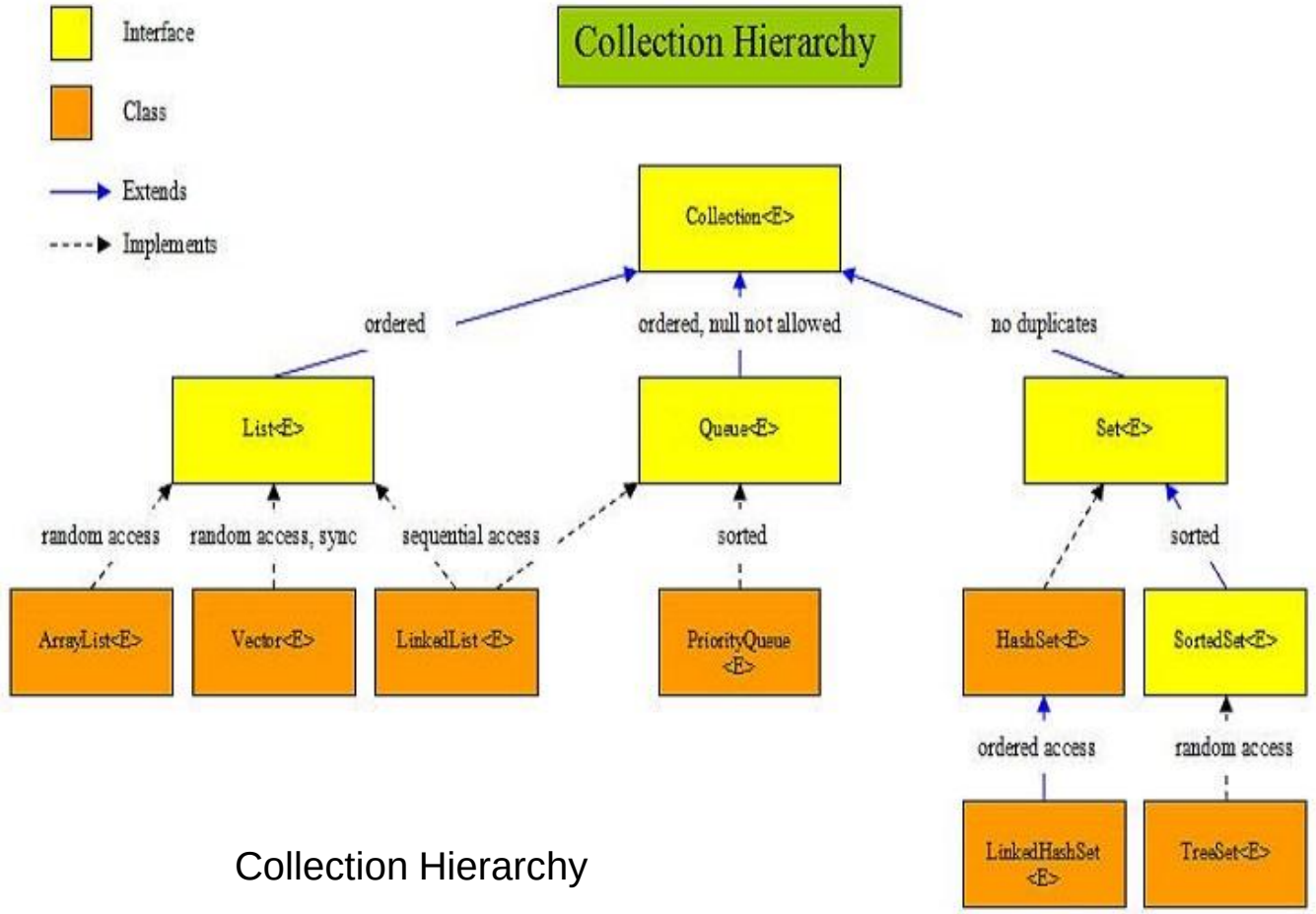
- A collections framework is a unified architecture for representing and manipulating collections. All collections frameworks contain the following:
  - Interfaces: Collection, List, Map
  - Implementations, i.e., Classes: ArrayList, HashSet, HashMap
  - Algorithms: These are the methods that perform useful computations, such as searching and sorting, on objects that implement collection interfaces

Java Collections Framework

SN	Interfaces with Description
1	The Collection Interface This enables you to work with groups of objects; it is at the top of the collections hierarchy.
2	The List Interface This extends **Collection** and an instance of List stores an ordered collection of elements.
3	The Set This extends Collection to handle sets, which must contain unique elements
4	The SortedSet This extends Set to handle sorted sets
5	The Map This maps unique keys to values.
6	The Map.Entry This describes an element (a key/value pair) in a map. This is an inner class of Map.
7	The SortedMap This extends Map so that the keys are maintained in ascending order.
8	The Enumeration This is legacy interface and defines the methods by which you can enumerate (obtain one at a time) the elements in a collection of objects. This legacy interface has been superceded by Iterator.

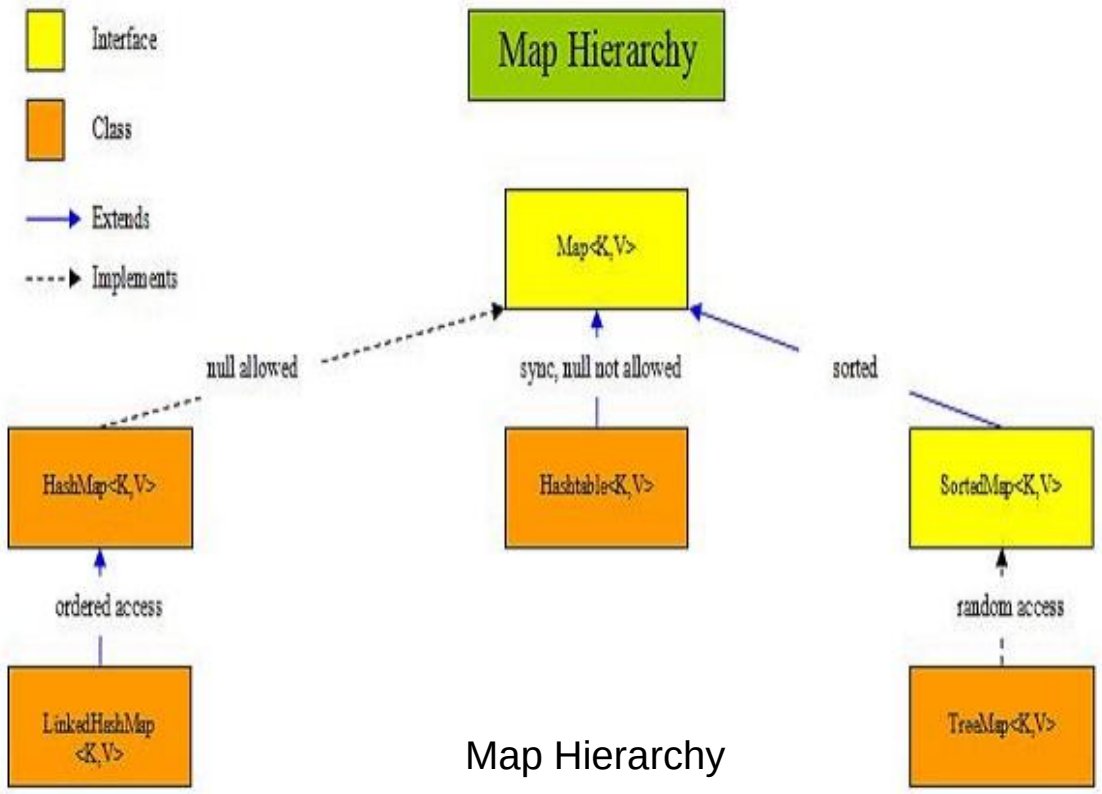
Interface of Collection

Java Collections Framework



Collection Hierarchy

Java Collections Framework



Map Hierarchy

Java Collections Framework

- Iterator: In general, to use an iterator to cycle through the contents of a collection, follow these steps:
  - Obtain an iterator to the start of the collection by calling the collection's iterator() method.
  - Set up a loop that makes a call to hasNext( ). Have the loop iterate as long as hasNext() returns true.
  - Within the loop, obtain each element by calling next().

Java Collections Framework

- The Methods Declared by Iterator:

SN	Methods with Description
1	**boolean hasNext( )** Returns true if there are more elements. Otherwise, returns false.
2	**Object next( )** Returns the next element. Throws NoSuchElementException if there is not a next element.
3	**void remove( )** Removes the current element. Throws IllegalStateException if an attempt is made to call remove ( ) that is not preceded by a call to next( ).

Java Collections Framework

- The Methods Declared by ListIterator:

SN	Methods with Description
1	**void add(Object obj)** Inserts obj into the list in front of the element that will be returned by the next call to next( ).
2	**boolean hasNext( )** Returns true if there is a next element. Otherwise, returns false.
3	**boolean hasPrevious( )** Returns true if there is a previous element. Otherwise, returns false.
4	**Object next( )** Returns the next element. A NoSuchElementException is thrown if there is not a next element.
5	**int nextIndex( )** Returns the index of the next element. If there is not a next element, returns the size of the list.
6	**Object previous( )** Returns the previous element. A NoSuchElementException is thrown if there is not a previous element.
7	**int previousIndex( )** Returns the index of the previous element. If there is not a previous element, returns -1.
8	**void remove( )** Removes the current element from the list. An IllegalStateException is thrown if remove( ) is called before next( ) or previous( ) is invoked.
9	**void set(Object obj)** Assigns obj to the current element. This is the element last returned by a call to either next( ) or previous( ).

Methods Declared by ListIterator

Comparator	Comparable
A comparator object is capable of comparing two different objects. The class is not comparing its instances, but some other class's instances. This comparator class must implement the java.util.Comparator interface	A comparable object is capable of comparing itself with another object. The class itself must implements the java.lang.Comparable interface in order to be able to compare its instances.
int compare(Object o1, Objecto2)	int compareTo(Object o1)
TreeSet(Comparator) java.util.Collections.sort(List, Comparator)	TreeSet() java.util.Collections.sort(List)

Comparator and Comparable

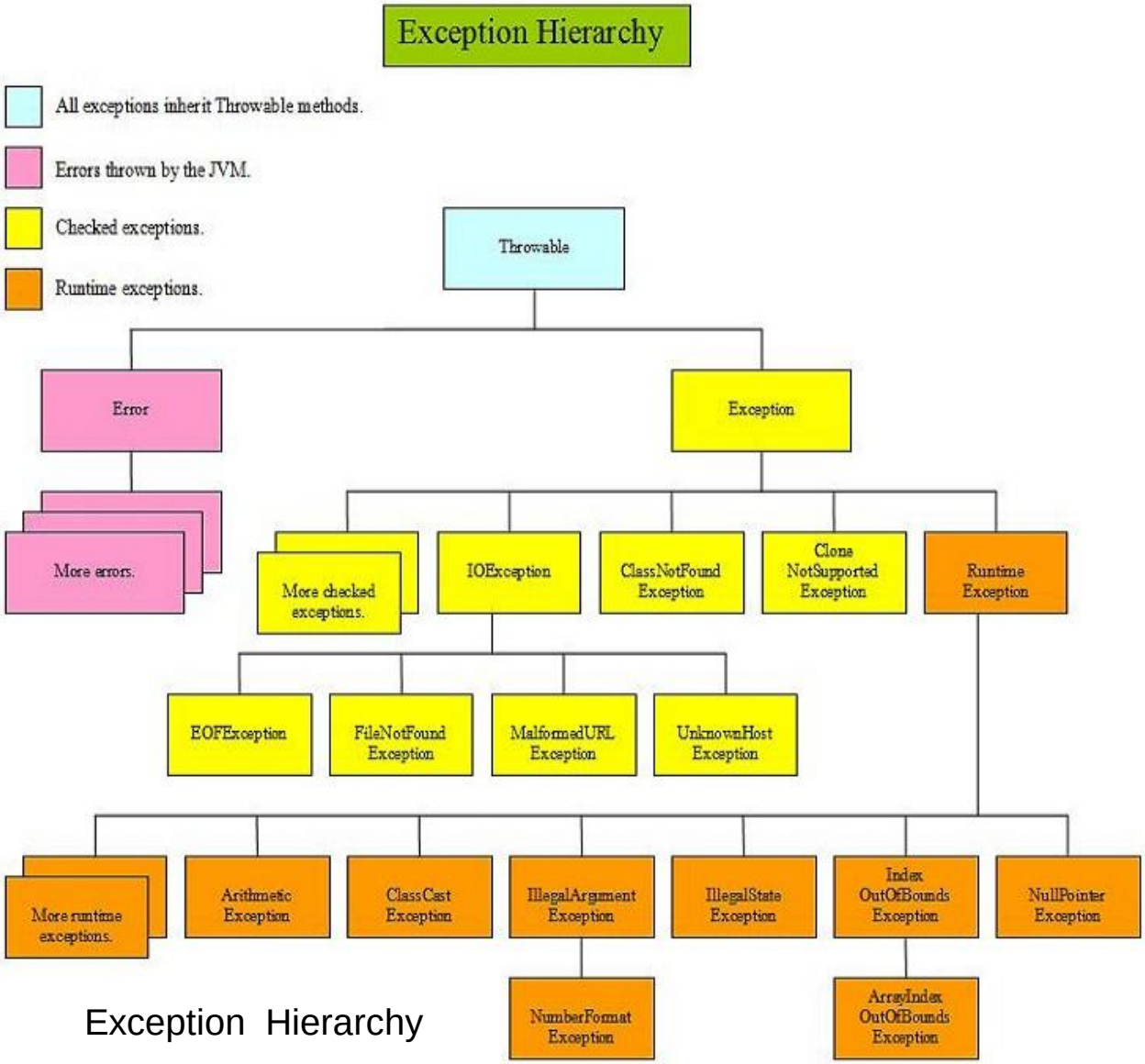
Demo 3: Collection Framework

- Exercise:
  - Add Customer class which has: name, memberType (VIP, MEMBER, OTHERS) and list of orders
  - Sort orders in demo 2 by date, desc.
  - Display orders in console
- Points to remember:
  - Initialize collections
  - Manage collections
  - Order collections
  - Generic, advanced loop

Java Advance

Exceptions handling

Exception Hierarchy



Exception Hierarchy

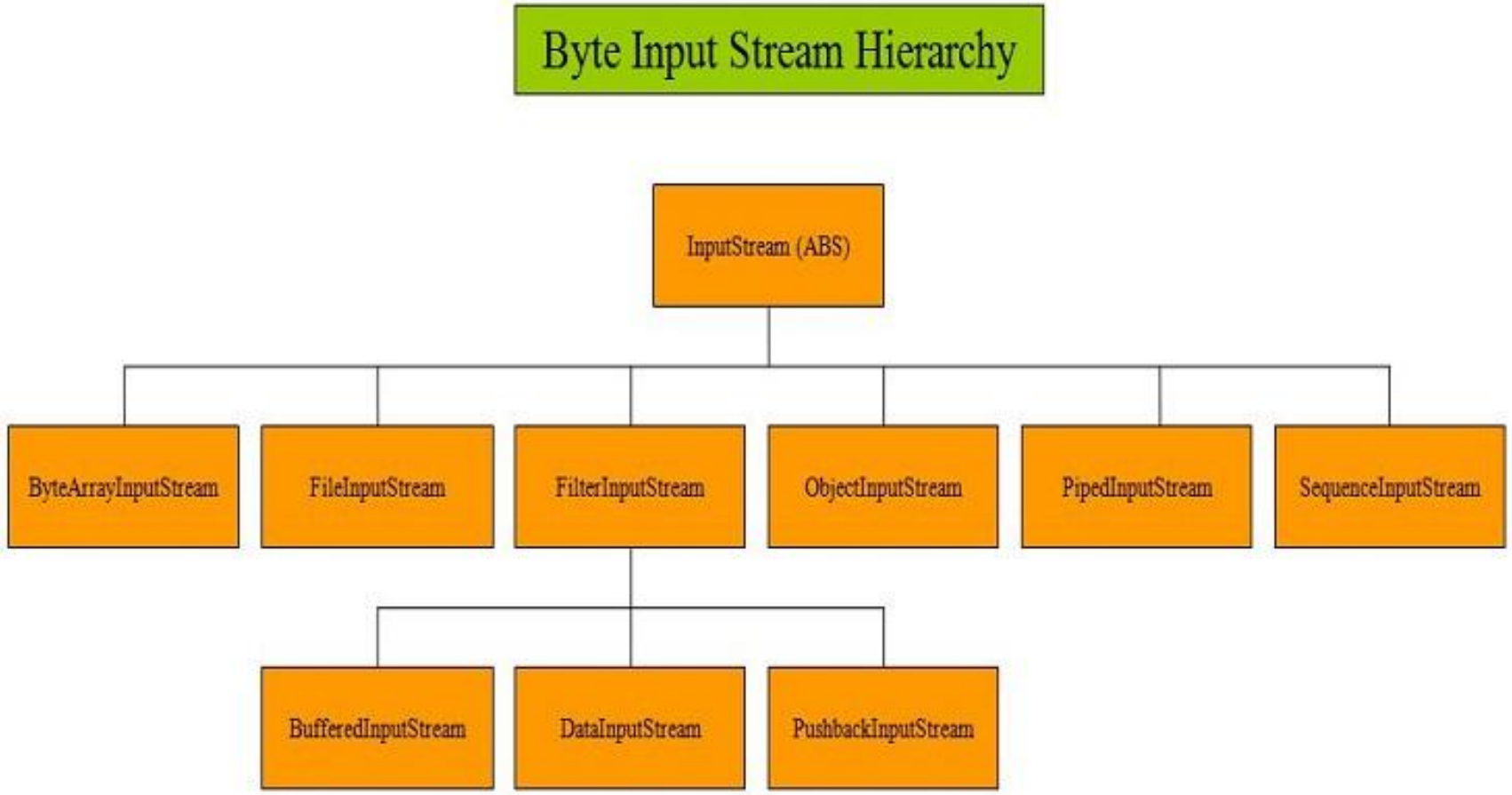
Java Advance

Basic I/O

Basic I/O

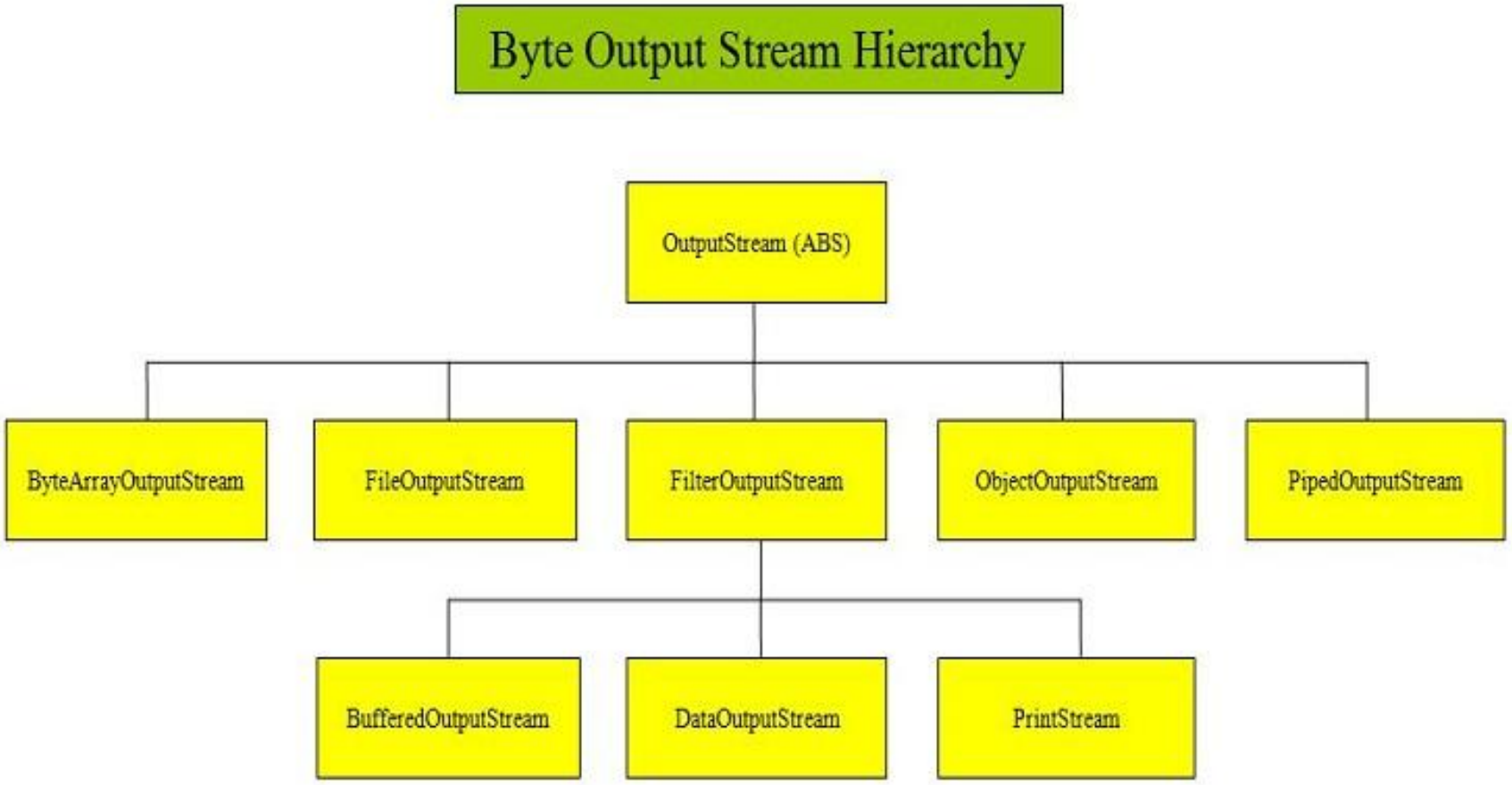
- A *stream* can be thought of as a flow of data from a source or to a sink.
- A *source* stream initiates the flow of data, also called an input stream.
- A *sink* stream terminates the flow of data, also called an output stream.
- Sources and sinks are both *node streams*.
- Types of node streams:
  - Byte streams
  - Character streams
  - Buffered streams
  - Data streams
  - Object streams

Basic I/O



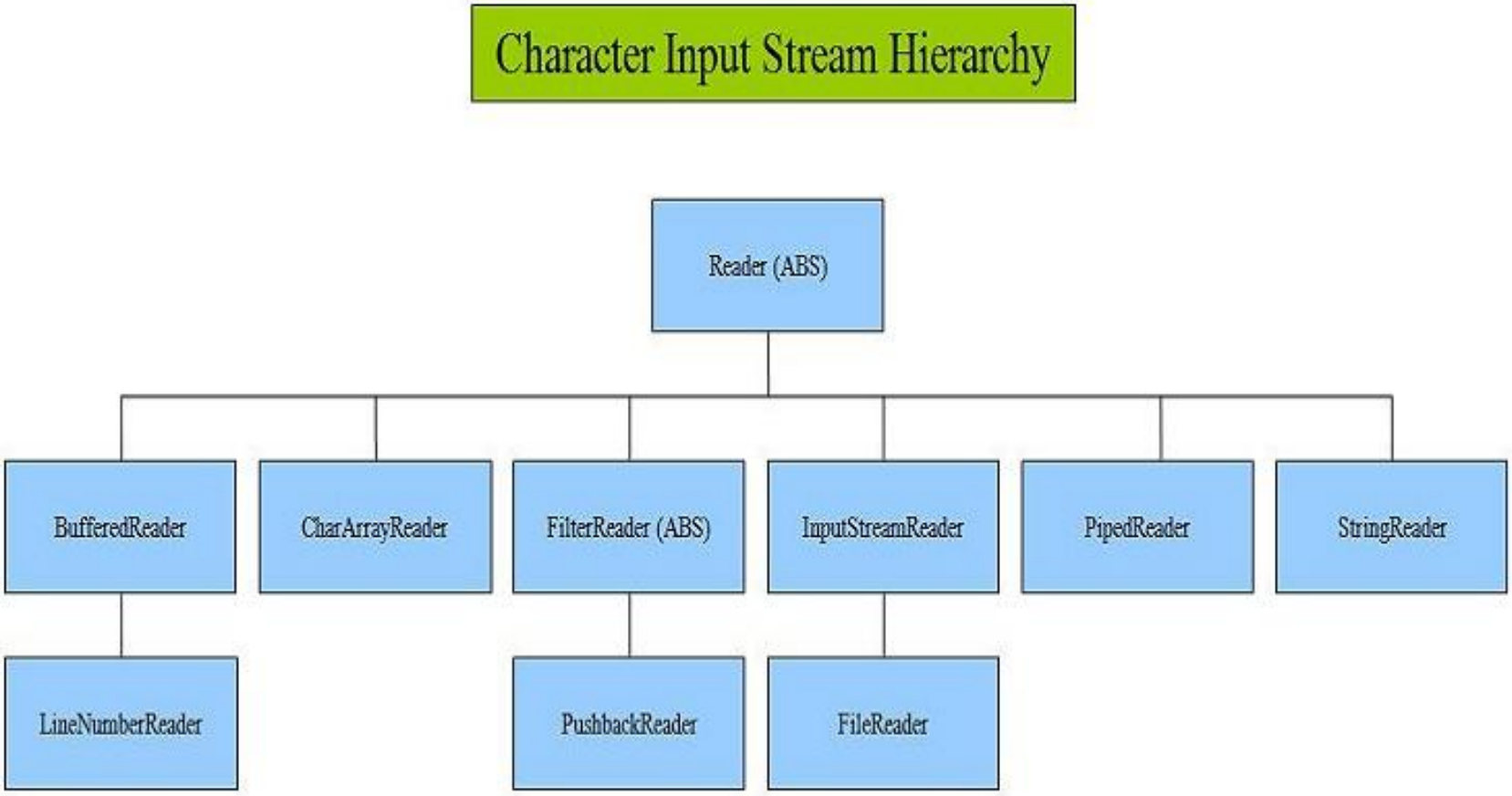
Byte Input Stream Hierarchy

Basic I/O



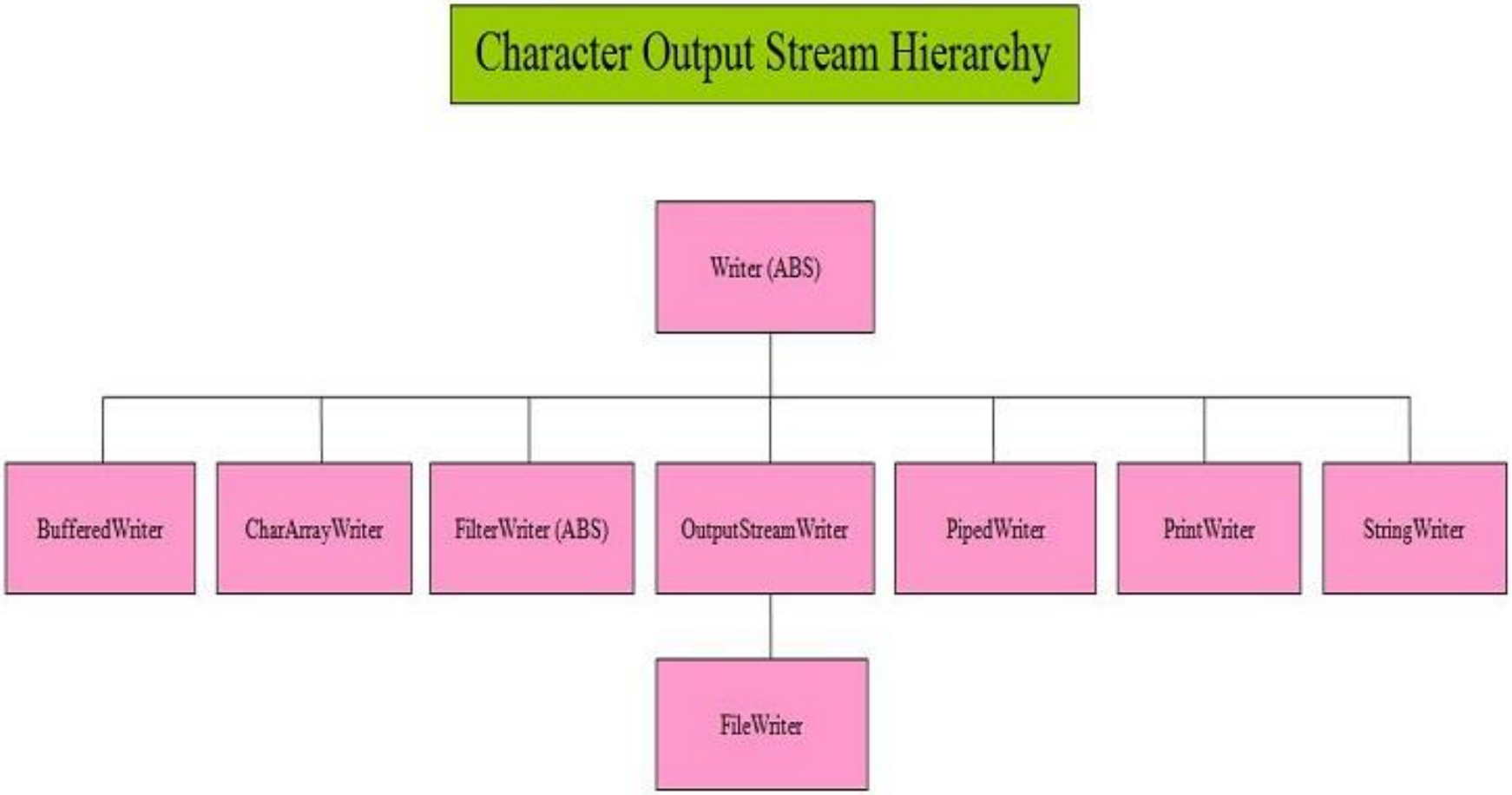
Byte Output Stream Hierarchy

Basic I/O



Character Input Stream Hierarchy

Basic I/O



Character Output Stream Hierarchy

Demo 4: Basic I/O

- Exercise: Save customer with orders to file
- Points to remember:
  - Use classes provided in I/O package to read and write from/to a file
  - Handle exception

Java Advance

Serialization

Serialization

- Interface Serializable:
  - A marker interface, when implementing it, it enables classes to serialize/deserialize their state
  - Use ObjectOutputStream/ObjectInputStream to write/read an object to/from a stream (or file)

Demo 5: Serialization

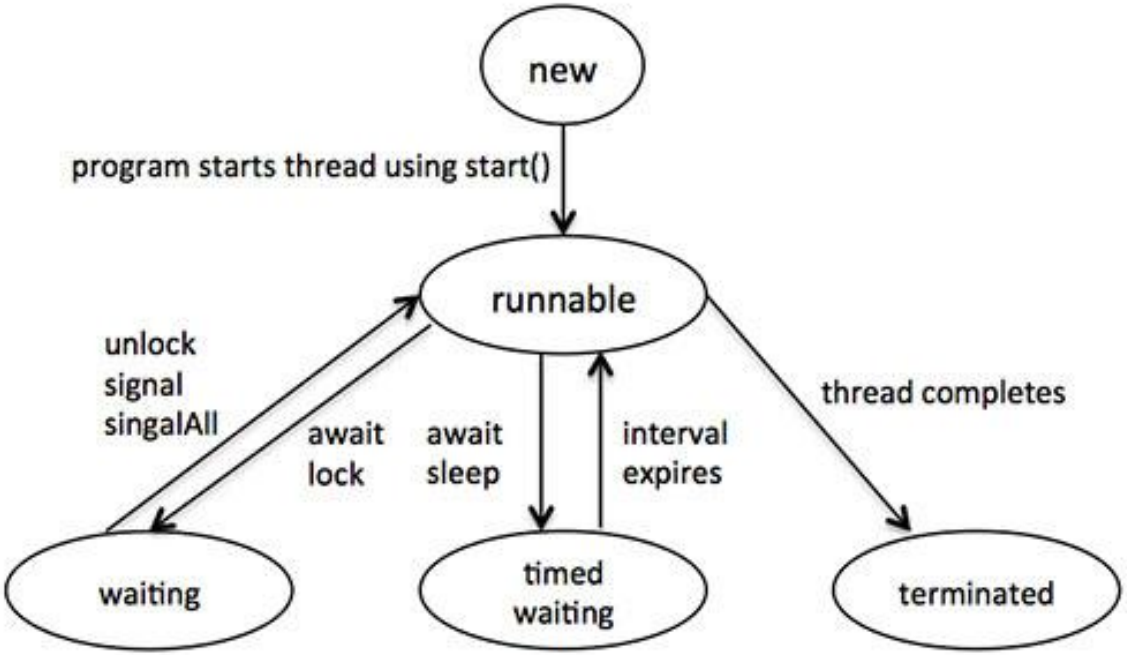
- Exercise:
  - Serialize customer with orders to a file
  - Deserialize customer from the file, print out to console and compare
- Points to remember:
  - Usage of Serializable interface and Object Input/Output Stream

Java Advance

Multithreading

Multithreading – Thread definition

- A *thread* is a thread of execution in a program. The Java Virtual Machine allows an application to have multiple threads of execution running concurrently.
- States:



Thread states

Multithreading – Creating thread

- Two ways to create a thread:
  - Implement Runnable interface
  - Extend Thread class

Multithreading - Concurrency

- Thread Interference
- Memory Consistency Errors
- Synchronization: synchronized methods, statements
- Deadlock
- Thread Communication: wait, notify, notifyAll

Demo 6: Thread

- Exercise:
  - Create two threads accessing and modifying one customer.
  - Each thread prints the order to console.
  - Investigate the result
- Points to remember:
  - Create thread
  - Experience multithreading issues.

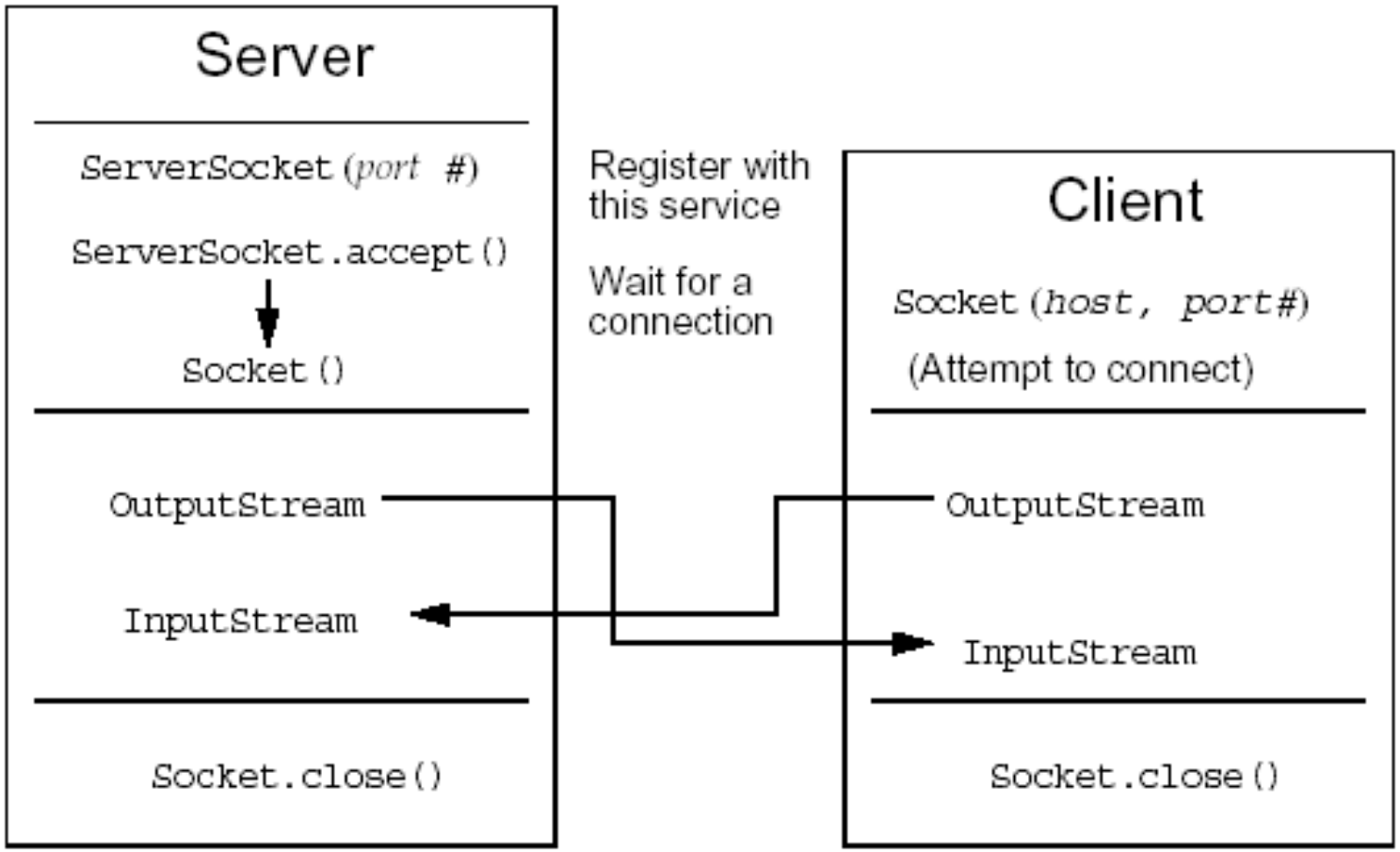
Java Advance

Sockets

Sockets

- A socket is one end-point of a two-way communication link between two programs running on the network. Socket classes are used to represent the connection between a client program and a server program
- The java.net package provides Socket that implements the client side of the connection
- The java.net package provides ServerSocket that implement the server side of the connection

Sockets



Socket server and client

Sockets

- Open a socket.
- Open an input stream and output stream to the socket.
- Read from and write to the stream according to the server's protocol.
- Close the streams.
- Close the socket.

Demo 7: Socket

- Exercise:
  - Create socket client and server.
  - Server hold an Order object.
  - When a client connecting, server sends client that order
  - Client shows order to console
- Points to remember:
  - Create socket
  - Communication between to sockets.

Final Project

- This is a client – server application
- Client asks for a customer with a name
- If server doesn't have a customer with that name, it creates new one, otherwise it returns the existing one.
- Client can:
  - add order(s) to customer
  - print orders to console
  - send customer back to server to save
- Server saves (serializes) customer to file
- One customer has a list of orders, sorting by date (desc)
- Depending on customer type (VIP, MEMBER, OTHERS) customer receives different discount percentage

Thank You

Revision History

Date	Version	Description	Updated by	Reviewed and Approved By
01/01/2015	1.0	Initialize	Nam Vu	
01/12/2015	2.0	Update Image and template	Khoa Le	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