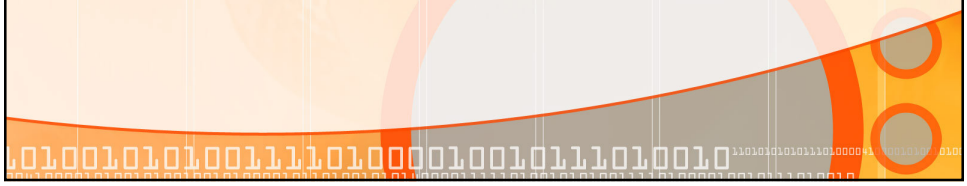
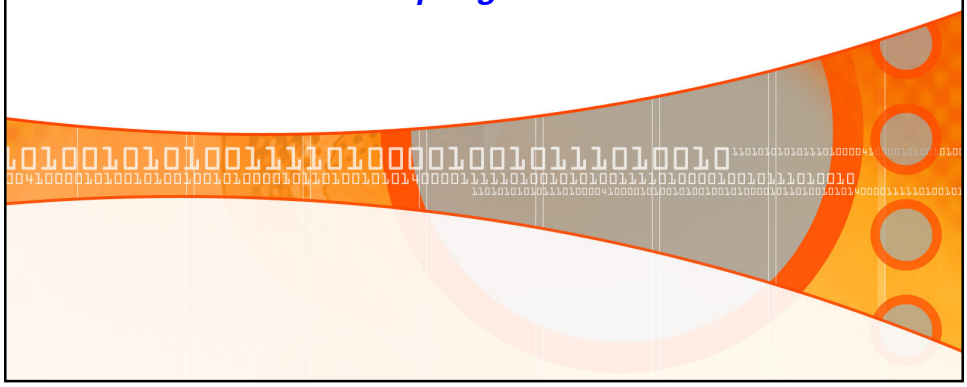
Announcement

- *Lectures moved to*
  - *150 GSPP, public policy building, right opposite Cory Hall on Hearst.*
  - *Effective Jan 31 i.e. next Tuesday*



Socket Programming

Nikhil Shetty
GSI, EECS122
Spring 2006



Outline

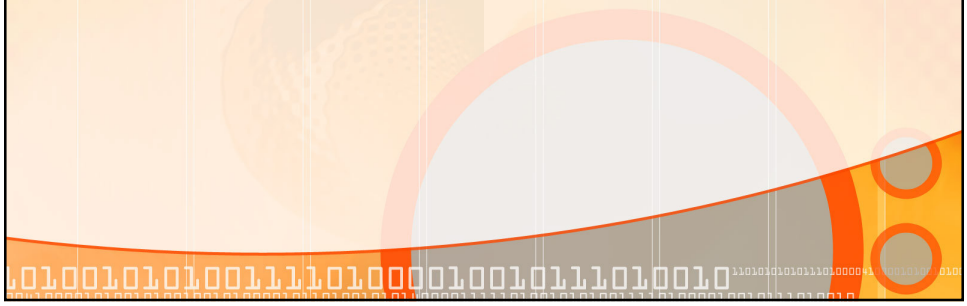
- *APIs – Motivation*
- *Sockets*
- *Java Socket classes*
- *Tips for programming*

What is an API?

- *API – stands for Application Programming Interface*

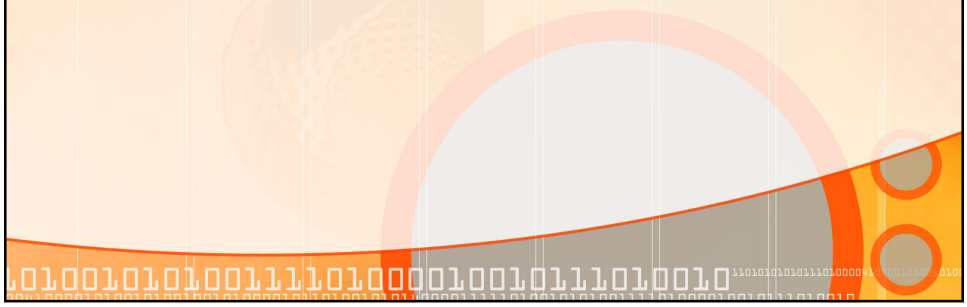
What is an API?

- *API – stands for Application Programming Interface.*
- *Interface to what? – In our case, it is an interface to use the network.*



What is an API?

- *API – stands for Application Programming Interface.*
- *Interface to what? – In our case, it is an interface to use the network.*
- *A connection to the transport layer.*

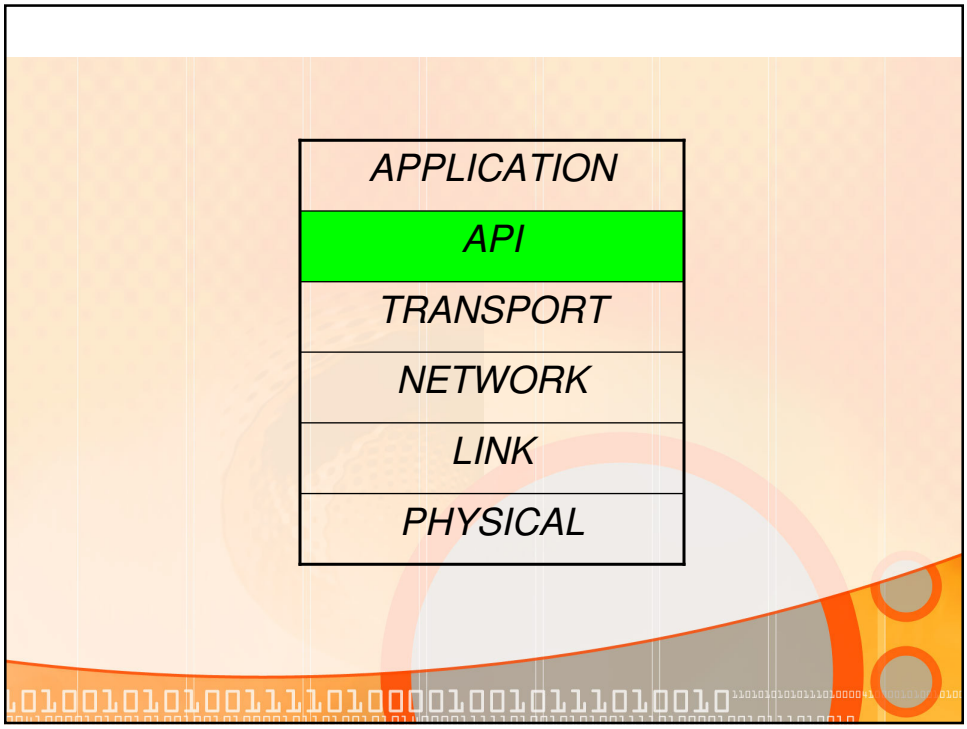


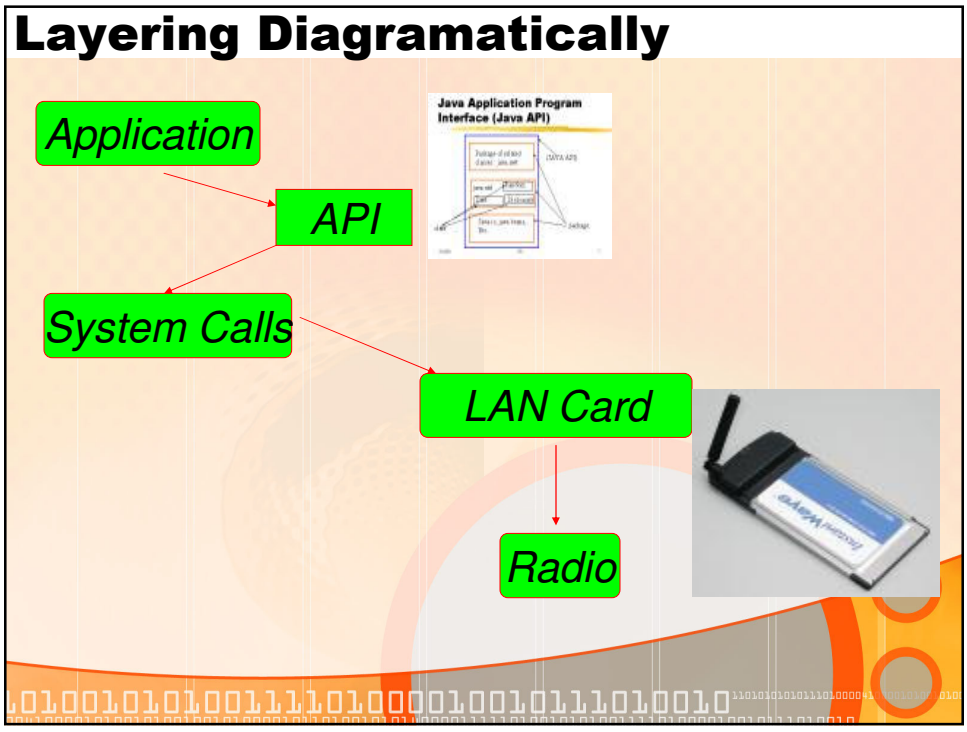
What is an API?

- *API – stands for Application Programming Interface.*
- *Interface to what? – In our case, it is an interface to use the network.*
- *A connection to the transport layer.*
- *WHY DO WE NEED IT?*

Need for API

- *One Word - Layering*
- *Functions at transport layer and below very complex.*
- *E.g. Imagine having to worry about errors on the wireless link and signals to be sent on the radio.*


APPLICATION
API
TRANSPORT
NETWORK
LINK
PHYSICAL


Layering Diagramatically
Application
API
System Calls
LAN Card
Radio
Java Application Program Interface (Java API)

What is a socket then?

- *What is a socket?*

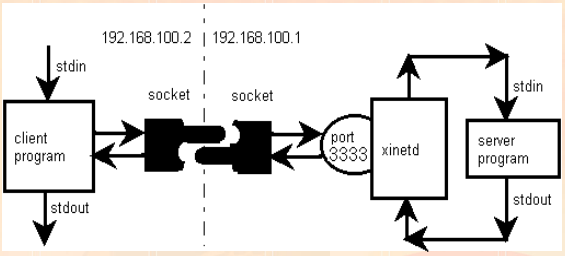
Introduction

- *What is a socket?*
- *It is an abstraction that is provided to an application programmer to send or receive data to another process.*

Introduction

- *What is a socket?*
- *It is an abstraction that is provided to an application programmer to send or receive data to another process.*
- *Data can be sent to or received from another process running on the same machine or a different machine.*

Socket – An Abstraction



Adapted from http://www.troubleshooters.com/codecorn/sockets/

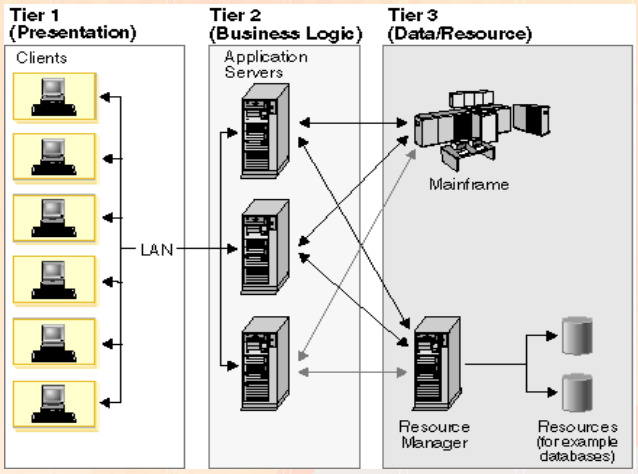
Sockets

- *It is like an endpoint of a connection*
- *Exists on either side of connection*
- *Identified by IP Address and Port number*
- *E.g. Berkeley Sockets in C*
  - *Released in 1983*
  - *Similar implementations in other languages*

Engineers working on Sockets!!!

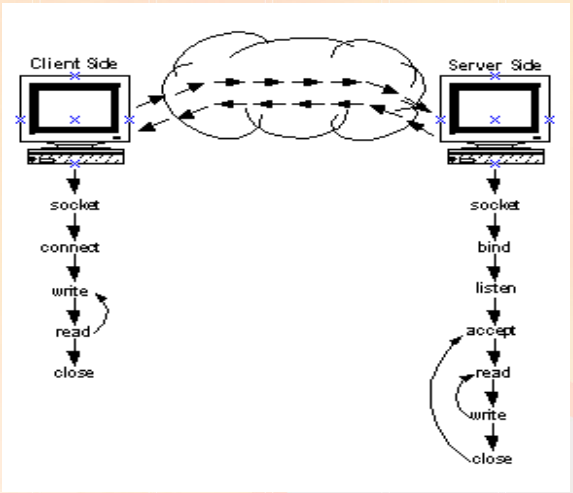
http://www.fotosearch.com/MDG238/frd1404/

Client – Server Architecture



From http://publib.boulder.ibm.com/infocenter/txen/topic/com.ibm.txseries510.doc/atshak0011.htm

Flow in client-server model



- *http://www.process.com/tcpip/tcpware57docs/Programmer/fig1-2.gif*

Java Sockets

- *Part of the java.net package*
  - *import java.net.*;*
- *Provides two classes of sockets for TCP*
  - *Socket – client side of socket*
  - *ServerSocket – server side of socket*
- *Provides one socket type for UDP*
  - *DatagramSocket*

Java TCP Sockets

- *ServerSocket performs functions bind and listen*
  - *Bind – fix to a certain port number*
  - *Listen – wait for incoming requests on the port*
- *Socket performs function connect*
  - *Connect – begin TCP session*

TCP sockets

- *TCP as a byte-stream*
  - *During data packet. transmission, no packetization and addressing required by application.*
  - *Formatting has to be provided by application.*
  - *Two or more successive data sends on the pipe connected to socket may be combined together by TCP in a single packet.*
  - *E.g. Send "Hi" then send "Hello Nikhil" is combined by TCP to send as "HiHello Nikhil"*

UDP sockets

- *UDP is packet-oriented*
  - *Info sent in packet format as needed by app.*
  - *Every packet requires address information.*
  - *Lightweight, no connection required.*
  - *Overhead of adding destination address with each packet.*

Java Quiz

Q. A constructor is used to...

A. Free memory.
B. Initialize a newly created object.
C. Import packages.
D. Create a JVM for applets.

Java Quiz

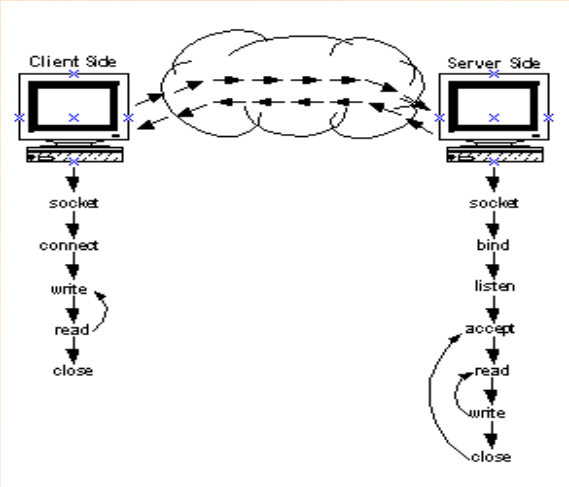
Q. A constructor is used to...

A. Free memory.
B. Initialize a newly created object.
C. Import packages.
D. Create a JVM for applets.

Socket Class

- *Socket*
  - *Socket nameSocket = null;*
  - *nameSocket = new Socket("hostname", portno);*
- *ServerSocket*
  - *ServerSocket nameSocket = new ServerSocket(portno);*
  - *Causes it to listen until there is a connection.*

Flow in client-server model



- *http://www.process.com/tcpip/tcpware57docs/Programmer/fig1-2.gif*

Accept

- *Socket connectionSocket = nameSocket.accept();*
- *Creates a new socket to connect to the client.*
- *Waits till a new connection request appears.*

Read or write from socket

- *Associated with classes DataOutputStream and BufferedReader which create input and output streams.*
- *nameSocket.getInputStream() and nameSocket.getOutputStream() return input and output streams respectively.*
- *These streams assigned to local stream classes and byte stream can be input or output.*

DatagramSocket Class

- *DatagramSocket nameSocket = new DatagramSocket();*
- *DatagramPacket sendPacket = new DatagramPacket(sendData, sendData.length, IPAddress, portno);*
- *DatagramPacket recvPacket = new DatagramPacket(recvData, recvData.length);*
- *nameSocket.send(sendPacket);*
- *nameSocket.receive(recvPacket)*

Programming Tips

- *Good programming techniques*
  - *Enclose all socket creations in try{…} and use catch() {…} to get the error conditions*
  - *e.g.*

```
try { clientSocket = serverSocket.accept(); }
catch (IOException e)
  { System.out.println("Accept failed: portno");
  System.exit(-1); }
```

- *Use tcpdump/Ethereal to see what is being transmitted on the link.*
- *Check online guides to Java and Network Programming.*

Network Programming Tips (contd)

- *How to check if particular port is listening*
  - *Windows – use netstat*
    - *netstat -an*
  - *Linux – use nmap*
    - *nmap -sT -O localhost*
- *Tip: Use port numbers greater than 1024.*
- *Tip: InetAddress IPAddress = InetAddress.getByName("hostname");*
- *Check RFCs if in doubt about protocols.*
  - *http://www.ietf.org/rfc*
- *Lots of System.out.println("present_condition");*
- *http://java.sun.com/docs/books/tutorial/networking/*