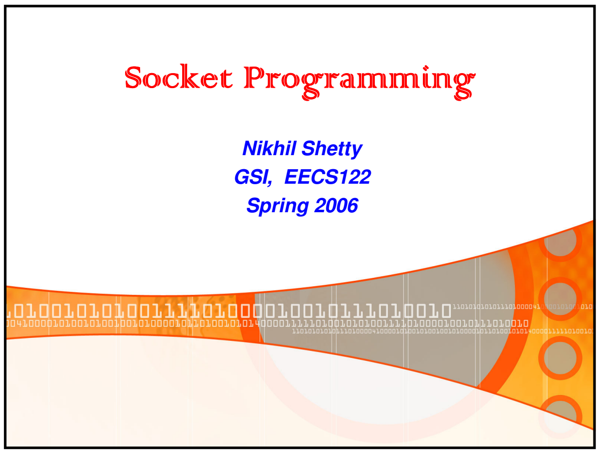
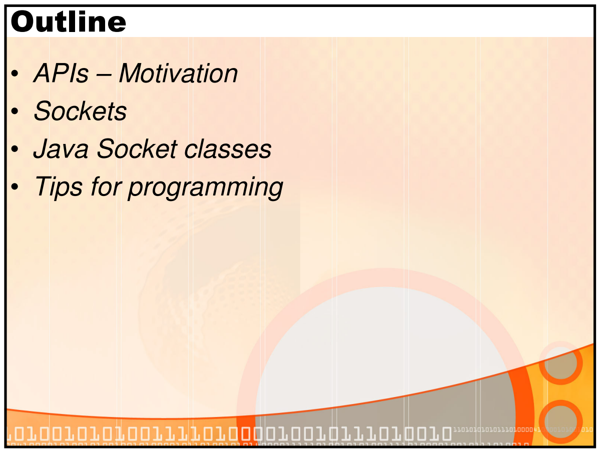
Announcement

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



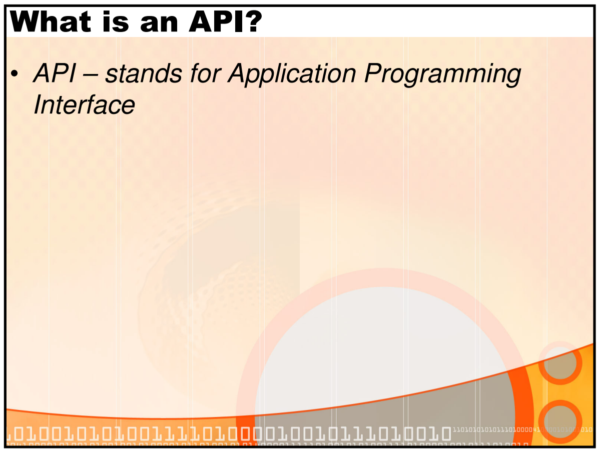
Socket Programming

Nikhil Shetty
GSI, EECS122
Spring 2006



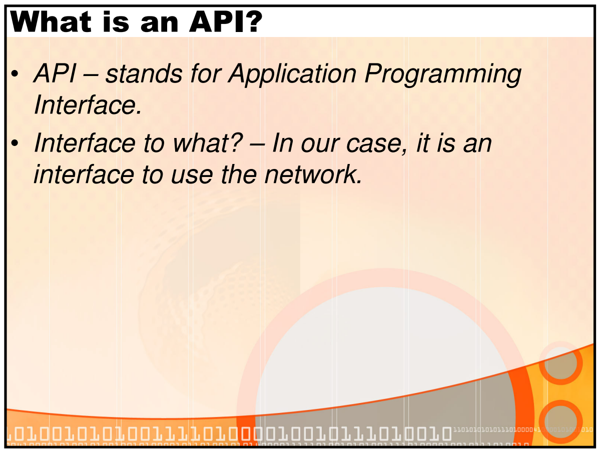
Outline

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



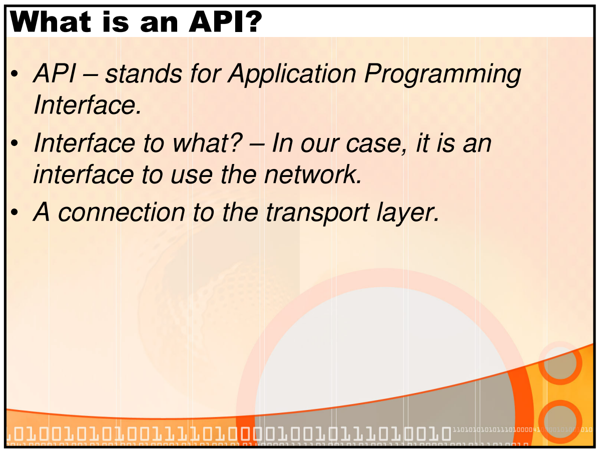
What is an API?

- 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.



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- A connection to the transport layer.

What is an API?

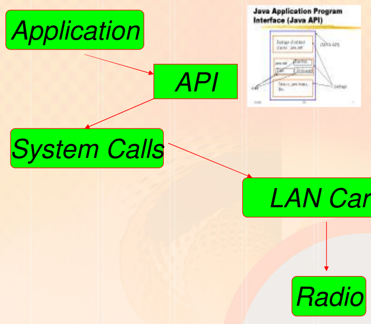
- *API – stands for Application Programming Interface.*
- *Interface to what? – In our case, it is an interface to use the network.*
- *A connection to the transport layer.*
- *WHY DO WE NEED IT?*

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



What is a socket then?

- *What is a socket?*

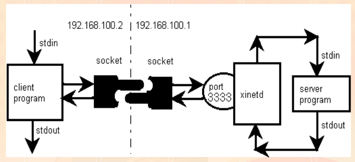
Introduction

- *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/

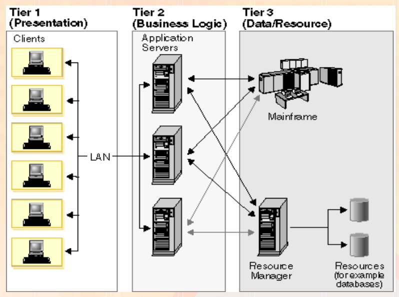
Sockets

- *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!!!

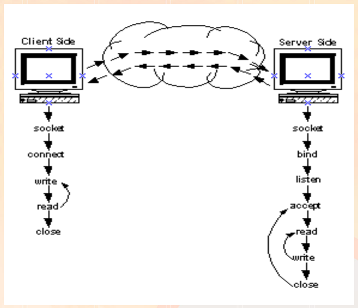
http://www.fotosearch.com/MDG238/frd1404/

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

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[✓ B. Initialize a newly created object.]
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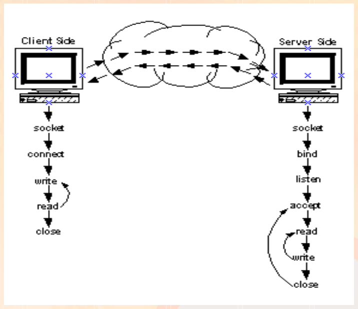
Socket Class

- *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

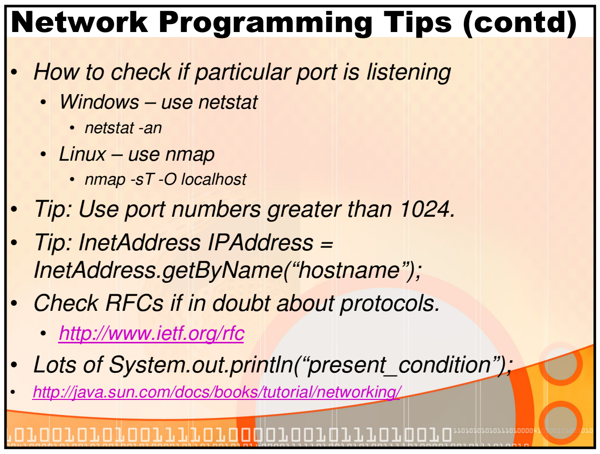
- *DatagramSocket nameSocket = new DatagramSocket();*
- *DatagramPacket sendPacket = new DatagramPacket(sendData, sendData.length, IPAddress, portno);*
- *DatagramPacket recvPacket = new DatagramPacket(recvData, recvData.length);*
- *nameSocket.send(sendPacket);*
- *nameSocket.receive(recvPacket)*

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/*