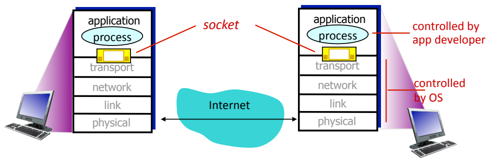
CSE 3214: Computer Network Protocols and Applications –Socket Programming

Dr. Peter Lian, Professor
Department of Computer Science and Engineering
York University
Email: peterlian@cse.yorku.ca
Office: 1012C Lassonde Building
Course website: http://wiki.cse.yorku.ca/course_archive/2012-13/W/3214

Socket programming

goal: learn how to build client/server applications that communicate using sockets

socket: door between application process and end-end-transport protocol

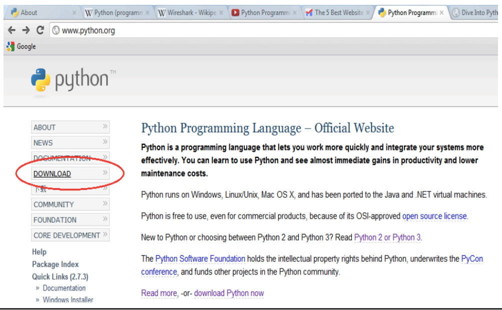


Socket programming using Python

- Python is a general purpose, high level programming language
- Clear and expressive syntax
- Large and comprehensive library
- Used as scripting language as well as in a wide range of non-scripting contexts
- Available to Windows, Mac, Linux/Unix
- Official Website: http://www.python.org

Socket programming using Python

Download Python



Python Programming Language – Official Website

Python is a programming language that lets you work more quickly and integrate your systems more effectively. You can learn to use Python and see almost immediate gains in productivity and lower maintenance costs.

Python runs on Windows, Linux/Unix, Mac OS X, and has been ported to the Java and .NET virtual machines.

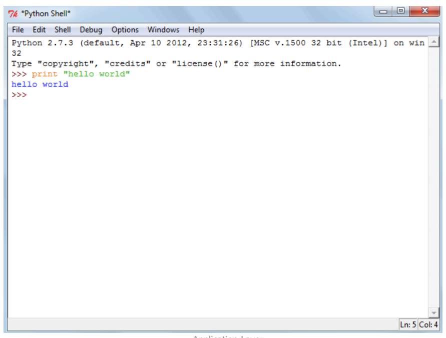
Python is free to use, even for commercial products, because of its OSI-approved open source license.

New to Python or choosing between Python 2 and Python 3? Read Python 2 or Python 3.

The Python Software Foundation holds the intellectual property rights behind Python, underwrites the PyCon conference, and funds other projects in the Python community.

Read more, -or- download Python now

Socket programming using Python



```
Python 2.7.3 (default, Apr 10 2012, 23:31:26) [MSC v.1500 32 bit (Intel)] on win
32
Type "copyright", "credits" or "license()" for more information.
>>> print "hello world"
hello world
>>>
```

Socket programming using Python

goal: learn how to build client/server applications that communicate using sockets

socket: door between application process and end-end-transport protocol

Socket programming

Two socket types for two transport services:
- *UDP:* unreliable datagram
- *TCP:* reliable, byte stream-oriented

Application Example:
1. Client reads a line of characters (data) from its keyboard and sends the data to the server.
2. The server receives the data and converts characters to uppercase.
3. The server sends the modified data to the client.
4. The client receives the modified data and displays the line on its screen.

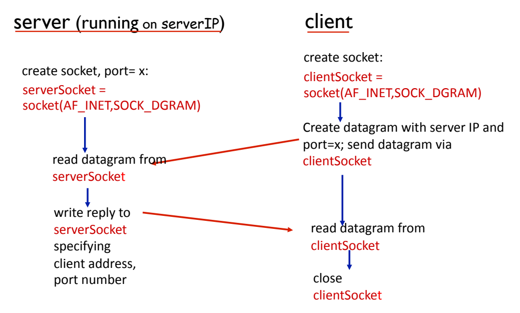
Socket programming *with UDP*

UDP: no "connection" between client & server
- no handshaking before sending data
- sender explicitly attaches IP destination address and port # to each packet
- rcvr extracts sender IP address and port# from received packet

UDP: transmitted data may be lost or received out-of-order

Application viewpoint:
- UDP provides *unreliable* transfer of groups of bytes ("datagrams") between client and server

Client/server socket interaction: UDP



server (running on serverIP)
client
create socket, port= x:
serverSocket = socket(AF_INET,SOCK_DGRAM)
create socket:
clientSocket = socket(AF_INET,SOCK_DGRAM)
Create datagram with server IP and port=x; send datagram via clientSocket
read datagram from serverSocket
write reply to serverSocket specifying client address, port number
read datagram from clientSocket
close clientSocket

Example app: UDP client

Python UDPClient

include Python's socket library	`from socket import *`
	`serverName = 'hostname'`
	`serverPort = 12000`
create UDP socket for server	`clientSocket = socket(AF_INET, SOCK_DGRAM)`
get user keyboard input	`message = raw_input('Input lowercase sentence:')`
Attach server name, port to message; send into socket	`clientSocket.sendto(message,(serverName, serverPort))`
read reply characters from socket into string	`modifiedMessage, serverAddress = clientSocket.recvfrom(2048)`
print out received string and close socket	`print modifiedMessage` `clientSocket.close()`

Example app: UDP server

Python UDPServer

	`from socket import *`
	`serverPort = 12000`
create UDP socket	`serverSocket = socket(AF_INET, SOCK_DGRAM)`
bind socket to local port number 12000	`serverSocket.bind(('', serverPort))`
	`print "The server is ready to receive"`
	`while 1:`
loop forever	`message, clientAddress = serverSocket.recvfrom(2048)`
	`print message`
Read from UDP socket into message, getting client's address (client IP and port)	`modifiedMessage = message.upper()`
send upper case string back to this client	`serverSocket.sendto(modifiedMessage, clientAddress)`

Socket programming *with TCP*

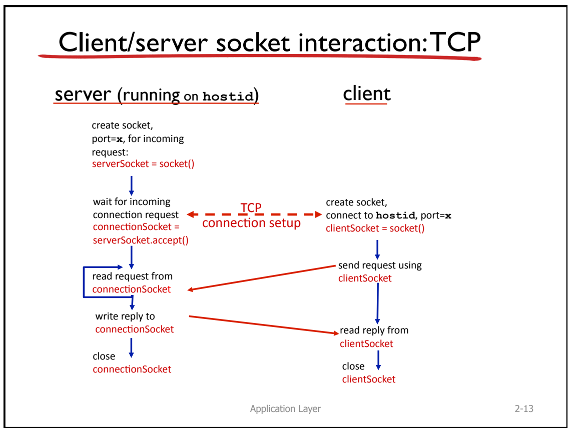
client must contact server
- server process must first be running
- server must have created socket (door) that welcomes client's contact

client contacts server by:
- Creating TCP socket, specifying IP address, port number of server process
- *when client creates socket:* client TCP establishes connection to server TCP

- when contacted by client, *server TCP creates new socket* for server process to communicate with that particular client
  - allows server to talk with multiple clients
  - source port numbers used to distinguish clients (more in Chap 3)

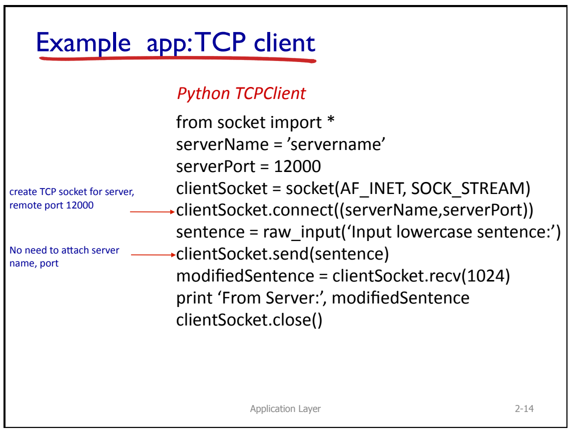
application viewpoint:

TCP provides reliable, in-order byte-stream transfer ("pipe") between client and server



Client/server socket interaction: TCP

server (running on hostid)
client
create socket, port=x, for incoming request:
serverSocket = socket()
wait for incoming connection request
connectionSocket = serverSocket.accept()
TCP connection setup
create socket, connect to hostid, port=x
clientSocket = socket()
send request using clientSocket
read request from connectionSocket
write reply to connectionSocket
read reply from clientSocket
close connectionSocket
close clientSocket



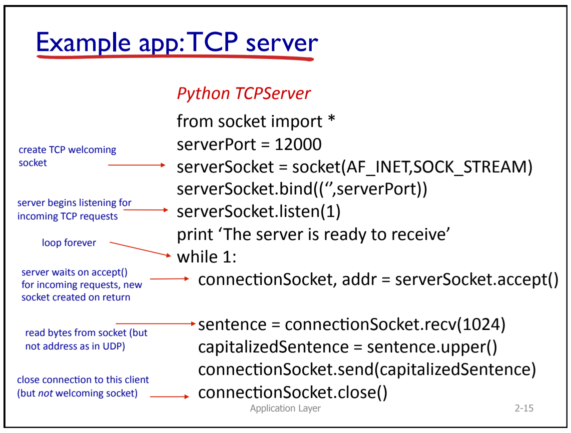
Example app: TCP client

Python TCPClient

```
from socket import *
serverName = 'servername'
serverPort = 12000
clientSocket = socket(AF_INET, SOCK_STREAM)
clientSocket.connect((serverName,serverPort))
sentence = raw_input('Input lowercase sentence:')
clientSocket.send(sentence)
modifiedSentence = clientSocket.recv(1024)
print 'From Server:', modifiedSentence
clientSocket.close()
```

create TCP socket for server, remote port 12000

No need to attach server name, port



Example app: TCP server

Python TCPServer

```
from socket import *
serverPort = 12000
serverSocket = socket(AF_INET,SOCK_STREAM)
serverSocket.bind(('',serverPort))
serverSocket.listen(1)
print 'The server is ready to receive'
while 1:
   connectionSocket, addr = serverSocket.accept()

   sentence = connectionSocket.recv(1024)
   capitalizedSentence = sentence.upper()
   connectionSocket.send(capitalizedSentence)
   connectionSocket.close()
```

create TCP welcoming socket

server begins listening for incoming TCP requests

loop forever

server waits on accept() for incoming requests, new socket created on return

read bytes from socket (but not address as in UDP)

close connection to this client (but *not* welcoming socket)