CSE 3214: Computer Network Protocols and Applications –Socket Programming

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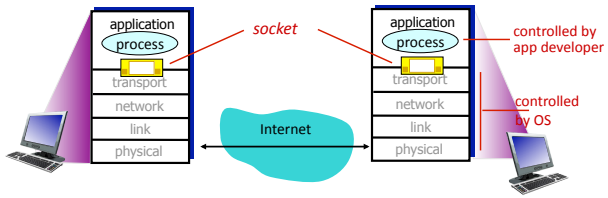
Socket programming

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

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

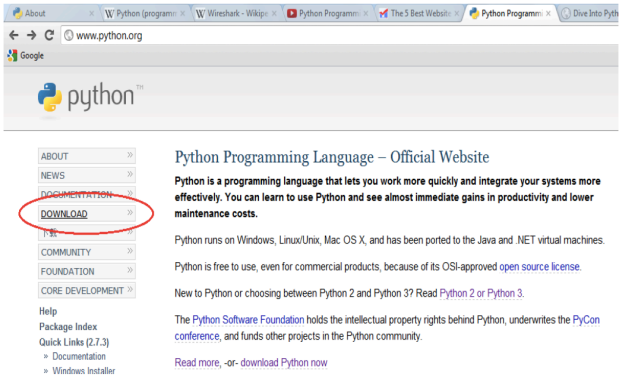


Socket programming using Python

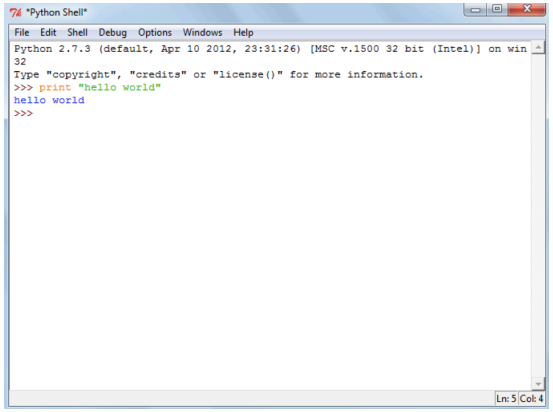
- Python is a general purpose, high level programming language
- Clear and expressive syntax
- Large and comprehensive library
- Used as scripting language as well as in a wide range of non-scripting contexts
- Available to Windows, Mac, Linux/Unix
- Official Website: http://www.python.org

Socket programming using Python

Download Python



Socket programming using Python



Socket programming using Python

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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

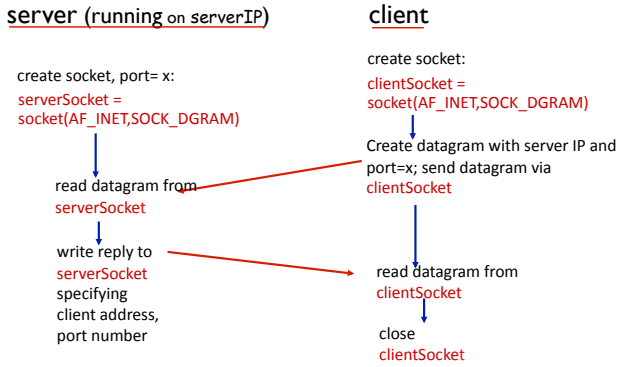
- no handshaking before sending data
- sender explicitly attaches IP destination address and port # to each packet
- rcvr extracts sender IP address and port# from received packet

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



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
serverSocket = socket(AF_INET, SOCK_DGRAM)
serverSocket.bind(('', serverPort))
print "The server is ready to receive"
while 1:
    message, clientAddress = serverSocket.recvfrom(2048)
    print message
    modifiedMessage = message.upper()
    serverSocket.sendto(modifiedMessage, clientAddress)
```

create UDP socket
bind socket to local port number 12000
loop forever
Read from UDP socket into message, getting client's address (client IP and port)
send upper case string back to this client

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:

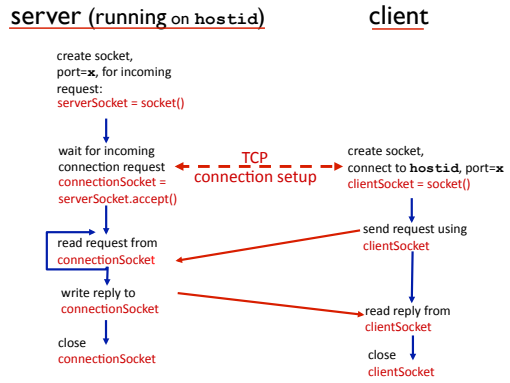
- Creating TCP socket, specifying IP address, port number of server process
- *when client creates socket:* client TCP establishes connection to server TCP

- 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



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)