Computer Networks Advanced Course

Lesson 2 – Sockets

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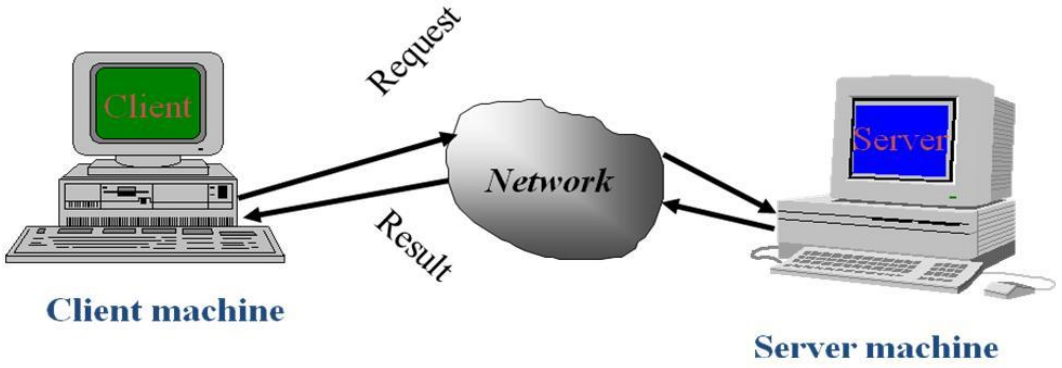
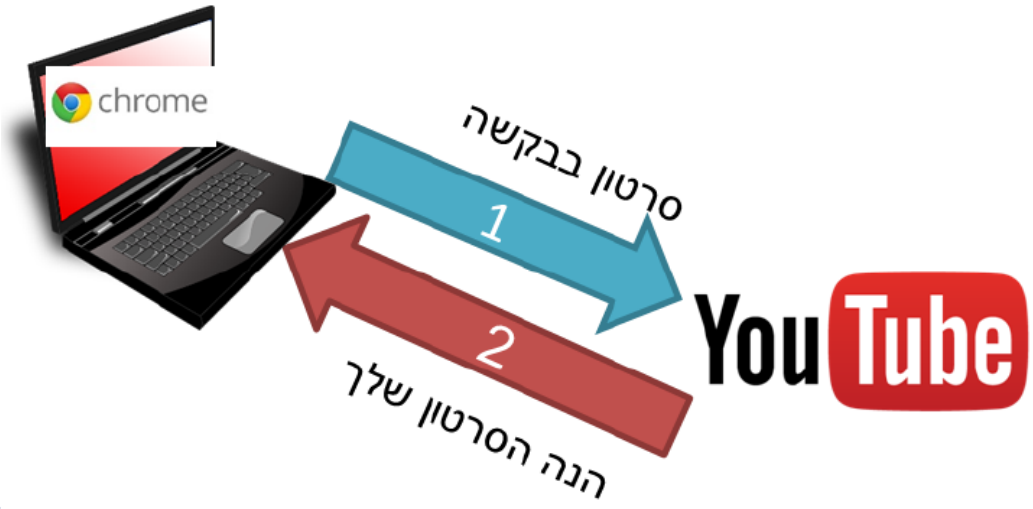
Lesson Topics

- Client – Server
- Sockets
- Programming TCP Sockets



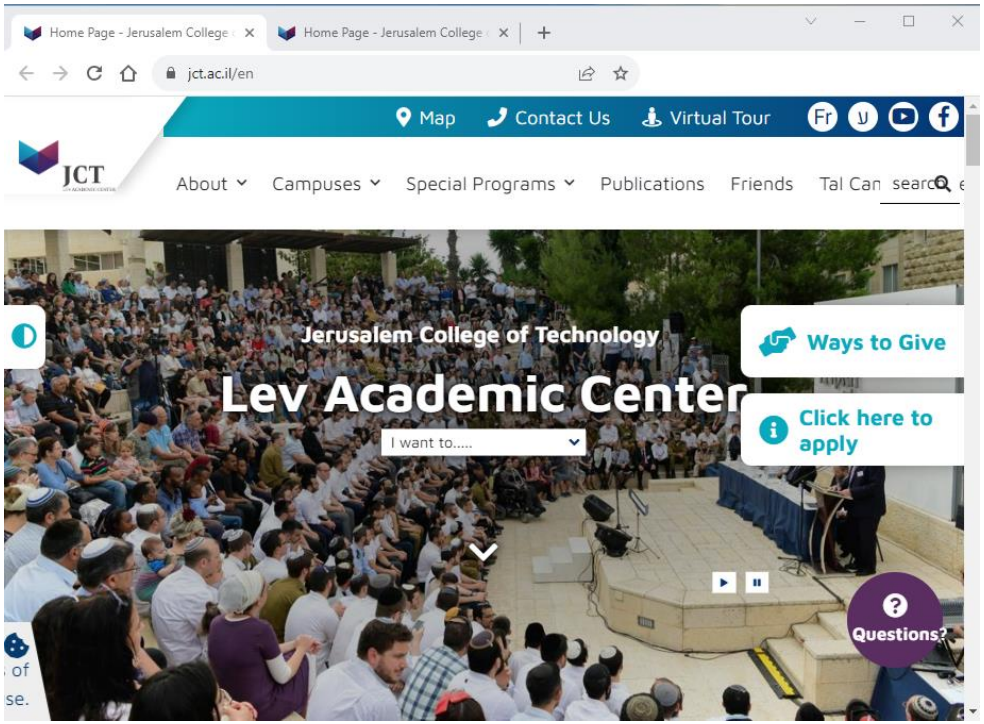
Client – Server Communication

- Server provides a service
- Client contacts server
- Communication through sockets



Experiment

- How can the computer separate between two browser tabs, pointing to the same website?



Socket

- A socket is the set of connection endpoints between two devices
- Think of it a pipe
  - Flow of bytes
  - Bi-directional
  - Two endpoints

Socket Addresses

- The endpoints of a socket should be defined
- Two identifiers are used:
  - Device identifier – with which PC the communication is done?
  - Application identifier –several applications are running on the target device, with which one the communication is done?
- Device identifier – IP address
- Application identifier – Port number, 0-65535
- Socket is a combination of
  - Src IP
  - Dst IP
  - Src port
  - Dst port

"IP" –
Herzl 1 Tel Aviv
"Port" –
apartment 5

Quick Questions

- Server A, HTTP and HTTPS
  - IP 1.2.3.4
- Server B, FTP, DNS, Emails
  - IP 5.6.7.8
- Which combination of IP and Port should use a client that has a DNS request? HTTPS browsing?

Applications:
1. HTTP – port 80
2. HTTPS – port 443

Server 1.2.3.4

Applications:
1. FTP – port 20
2. DNS – port 53
3. SMTP – port 25

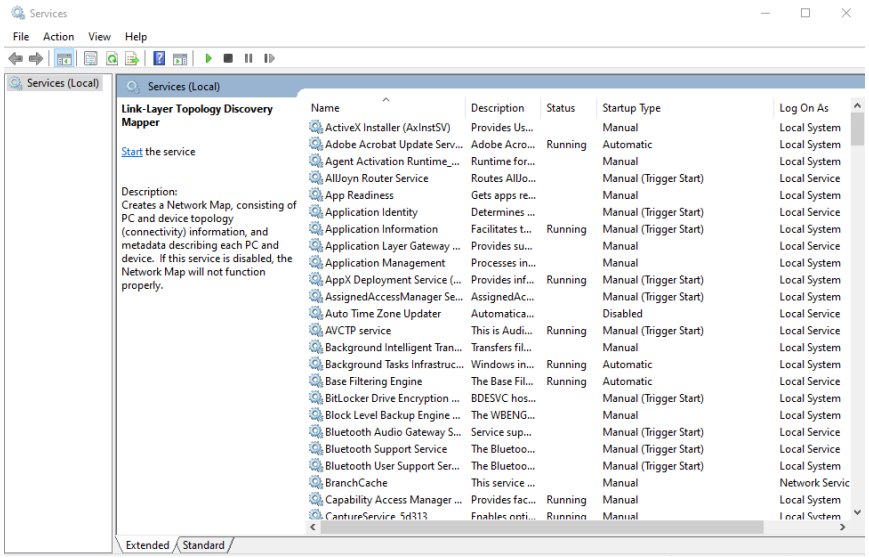
Server 5.6.7.8

Food for thought

- Can a server use one port number for more than one application?
- Can a client use one port number for communicating with more than one server?
- Should the destination port be identical to the source port?
- What is the max number of applications a server can host?

Special IP Address

- Assume an application has both its client and server running on the same machine
- Actually, quite common
  - Run services.msc



- Which destination IP should the client use?

Special IP Address – cont.

- The client should connect to 127.0.0.1
- This IP means “home” address

Programming Sockets

- Client attempts to connect to server
- If the server listens to port and accepts the request, a connection is established

AF_INET: Internet protocol (IP)

SOCK_STREAM: Connection type (TCP)

first_client.py

```
1   import socket
2
3   my_socket = socket.socket(socket.AF_INET, socket.SOCK_STREAM)
4   my_socket.connect(("127.0.0.1", 8820))
5
6   my_socket.send("Hello".encode())
7   data = my_socket.recv(1024).decode()
8   print("The server sent " + data)
9
10  my_socket.close()
```

Server Side

first_server.py

```
1   import socket
2
3   server_socket = socket.socket()
4   server_socket.bind(("0.0.0.0", 8820))
5   server_socket.listen()
6   print("Server is up and running")
7
8   (client_socket, client_address) = server_socket.accept()
9   print("Client connected")
10
11  data = client_socket.recv(1024).decode()
12  print("Client sent: " + data)
13
14  reply = "Hello " + data
15  client_socket.send(reply.encode())
16
17  client_socket.close()
18  server_socket.close()
```

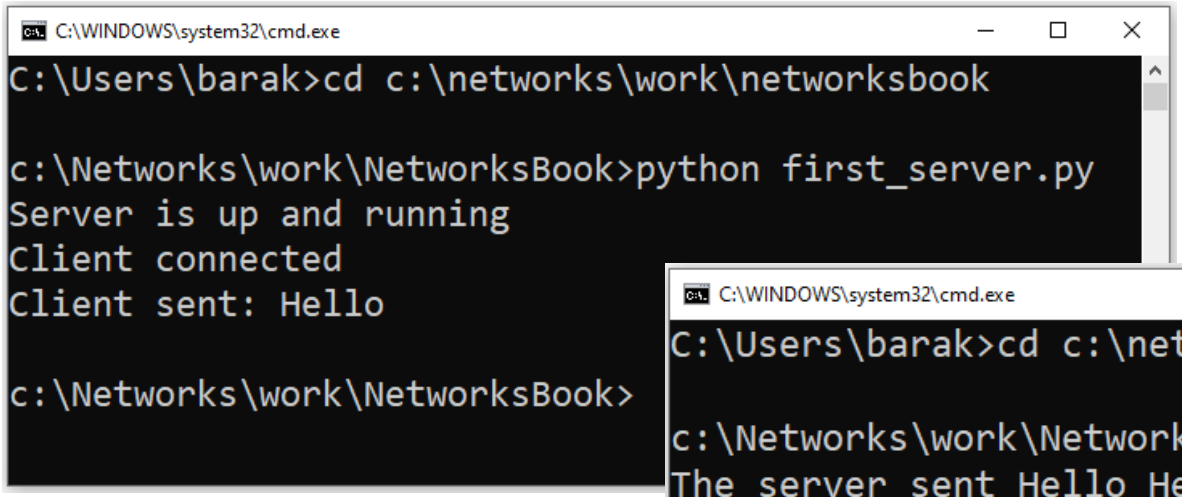
0.0.0.0: Listen to all IP's on this computer

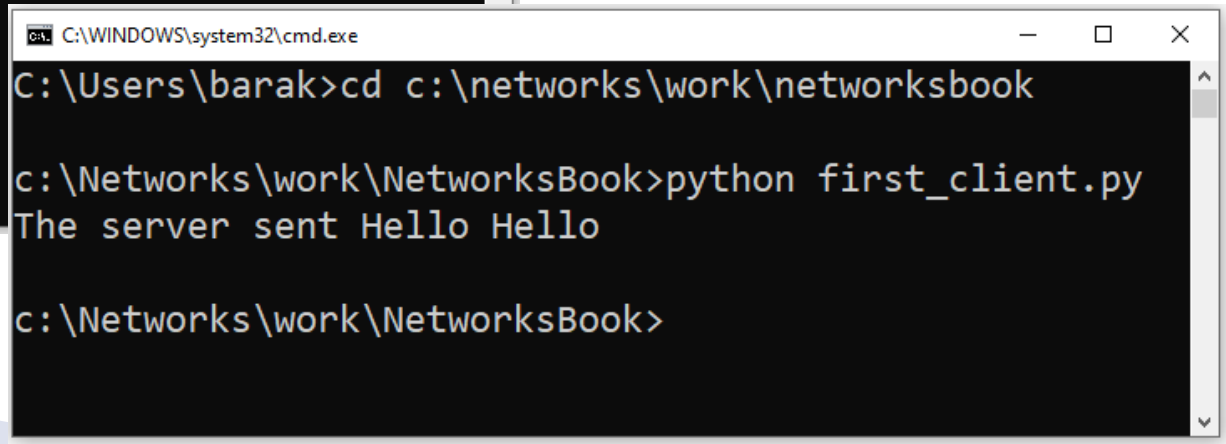
Wait for client connection

- To do:
  - Write client + server
  - Client should send username, server responds "Hello username"
  - Ex 2.3 in book

How to Run Client and Server

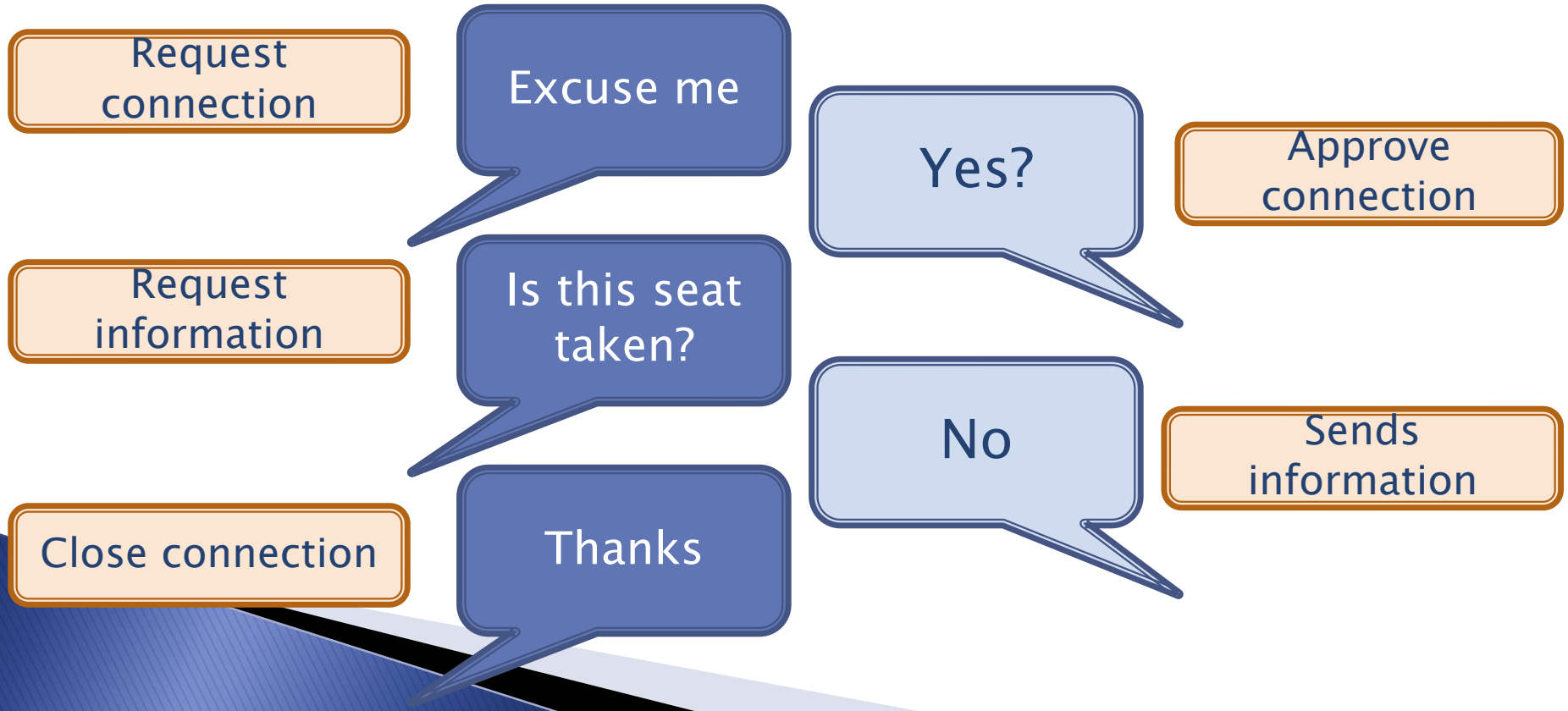
- Option 1: PyCharm
  - Recommended if debugging required
- Option 2: Command line windows
- Who should run first, client or server?





Communication Protocol

- Protocol – a set of rules for communications
  - Network devices must follow strictly
- Example



Length Field

- How can each side know how many bytes to extract from the socket?
- Length field, with predetermined size
  - Predetermined where? Protocol!

```
LENGTH_FIELD_SIZE = 2

length = str(len(message))
length_field_value = length.zfill(LENGTH_FIELD_SIZE)
message = length_field_value + message
```

Class Work – Simple Application

- Client requests user to enter input
- Client sends the user input to the server
- This is repeated until user input is “EXIT”
- When server receives “EXIT”, it will reply with a string which is a combination of the first letter of the input
  - Ex: cat, yoyo, batman, error, rabbit, india, sea, code, one, olive, loop, EXIT
  - Server reply: cyberiscool
- Design a proper length field

Lessons Learned

- Client-server model operation
- Using socket module
- Programming client and server apps
- Basic communication protocol