

Systems for Design and Implementation

Outline

- Networking (Sockets)

Sockets

`java.net`

TCP and UDP

- UDP (User Datagram Protocol): connectionless (additional data must be sent each time), datagram size limit - 64KB, unreliable (datagram receiving order is not guaranteed)
- TCP (Transmission Control Protocol): connection oriented, no limit, reliable

`ServerSocket` - represents a server socket that runs on the server and listens for incoming TCP connections

`Socket` - the class for performing client side TCP operations

Steps that occur when establishing a TCP connection between two computers using sockets:

1. The server instantiates a *ServerSocket* object, specifying which port number communication is to occur on.
2. The server invokes the *accept()* method of the *ServerSocket* class. This method waits until a client connects to the server on the given port.
3. While the server is waiting, a client instantiates a *Socket* object, specifying the server name and port number to connect to.
4. The constructor of the *Socket* class attempts to connect the client to the specified server and port number. If communication is established, the client now has a *Socket* object capable of communicating with the server.
5. On the server side, the *accept()* method returns a reference to a new *Socket* that is connected to the client's *Socket*.
6. Communication can now occur using I/O streams. Each socket has both an *OutputStream* and an *InputStream*. The client's *OutputStream* is connected to the server's *InputStream*, and the client's *InputStream* is connected to the server's *OutputStream*.

Server

```
ServerSocket server=null;
try{
    server=new ServerSocket(1234);
    while(keepProcessing){
        Socket client=server.accept(); //blocks and
        //waits for clients

        //processing code
    }
}catch(IOException ex){
    //...
}finally{
    if(server!=null){
        try{
            server.close();
        }catch(IOException ex){...}
    }
}
```

Client

```
try (Socket connection=new Socket("localhost", 1234)){  
    //processing code  
}catch(UnknownHostException e){  
    //...  
}catch(IOException e){  
    //...  
}
```

RPC (Remote Procedure Call)

- RPC is an inter-process communication paradigm that allows a computer program to cause a subroutine or procedure to execute in another address space without the programmer explicitly coding the details for this remote interaction
- The programmer writes almost the same code whether the subroutine is local to the executing program, or remote
- When the software is written using object-oriented paradigm, RPC may be referred to as remote invocation or Remote Method Invocation (**RMI**)
- RPC is a popular paradigm for implementing the client-server model of distributed computing
- RPC is initiated by a client sending a request message to a known remote server in order to execute a specified procedure using supplied parameters. A response is returned to the client and the application continues along with its process
- While the server is processing the call, the client is, by default, blocked (it waits until the server has finished processing before resuming execution)

socket

Proxy