Miscellaneous Applications

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Using the URLConnection class

- A simple way of accessing a server is to use the $URLConnection$ class.
- This class represents a connection between an application and a URL instance.
    - A URL instance represents a resource on the Internet.
- Create an application to read HTML page of a website

```
public class URLConnect {
    public static void main(String[] args) {
        Scanner scanner = new Scanner(System.in);
        System.out.print("Enter a url: ");
        String url = scanner.nextLine();
        accessWebsite(url);
    }

    private static void accessWebsite(String url) {
        BufferedReader br = null;
        try {
            URL my_url = new URL(url);
            URLConnection urlConnection = my_url.openConnection();

            InputStreamReader isr = new
InputStreamReader(urlConnection.getInputStream());
            br = new BufferedReader(isr);

            String line;
            while ((line = br.readLine()) != null) {
                System.out.println(line);
            }
        } catch (IOException exception) {
            System.out.println("\n  Cannot access URL");
            System.exit(1);
        } finally {
            System.out.println("\n  Closing the connection");
            try {
                br.close();
                System.exit(1);
            } catch (IOException e) {
                e.printStackTrace();
            }
        }
    }
```

- Create a class and the $main$ method and a static function $accessWebsite$ with $String$ parameter.

```
public class URLConnection {
    public static void main(String[] args) {

    }
}

private static void accessWebsite(String url){

}
```

- In the main method, read URL string from user and call $accessServer$ mehtod.

```
public static void main(String[] args) {
    Scanner scanner = new Scanner(System.in);
    System.out.print("Enter a url: ");
    String url = scanner.nextLine();
    accessWebsite(url);
}
```

- In $accessServer$, set up $try - catch - finally$ block.
- Create a $BufferedReader$ variable to read incoming data.

```
private static void accessWebsite(String url){
        BufferedReader br = null;
        try {

            } catch () {

        }finally {

    }
}
```

- Inside try block, define an object of class URL that represents a pointer to a resource on the World Wide Web.
- Define an object of the abstract class $URLConnection$, that will handle the communication link between the application and a URL resource.
- Open the connection to the website using $openConnection$ method in the URL class.

```
try {
    URL my_url = new URL(url);
    URLConnection urlConnection =
my_url.openConnection();
```

- Define an object of $InputStreamReader$, which is a bridge that reads a stream of bytes and decodes them into characters.
    - This gets the input stream from $URLConnection$ object.
- Initialize the $BufferedReader$ object with $InputStreamReader$ as a parameter to the constructor.

```
InputStreamReader isr = new InputStreamReader(
urlConnection.getInputStream());
br = new BufferedReader(isr);
```

- In the try block, create a $while$ loop to read the data line by line and print the data to the console.

```
String line;
while ((line = br.readLine()) != null) {
    System.out.println(line);
}
```

- In the $catch$ block, catch the exception and print appropriate message.

```
catch (IOException exception) {
    System.out.println("Cannot access URL");
    System.exit(1);
```

- In the *finally* block, close the connection.

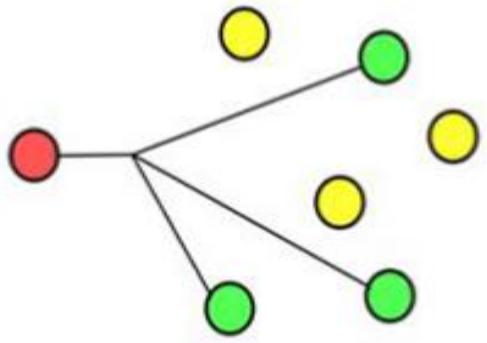
```
finally {
    System.out.println("Closing connection");
    try {
        br.close();
        System.exit(1);
    } catch (IOException e) {
        e.printStackTrace();
    }
}
```

Task

- Rewrite the same program above but print the output to an HTML file instead of displaying it on the console.

UDP and multicasting

- Multicasting is a technique for sending messages to a group of receivers on a periodic basis.
    - Multicasting is a type of one-to-many and many-to-many communication as it allows sender or senders to send data packets to multiple receivers at once across LANs or WANs.
    - It uses a UDP server and one or more UDP clients.



- Multicasting will send an identical message to every member of a group.
- A group is identified by a multicast address.
    - A multicast address must use the following IP address range: 224.0.0.0 through 239.255.255.255.
- Clients must join the group before they can receive any multicast messages.

Address Class	RANGE	Default Subnet Mask
A	1.0.0.0 to 126.255.255.255	255.0.0.0
B	128.0.0.0 to 191.255.255.255	255.255.0.0
C	192.0.0.0 to 223.255.255.255	255.255.255.0
D	224.0.0.0 to 239.255.255.255	Reserved for Multicasting
E	240.0.0.0 to 254.255.255.255	Experimental
Note: Class A addresses 127.0.0.0 to 127.255.255.255 cannot be used and is reserved for loopback testing.		

Multicast Server

- We will create a simple time server. The server will send a date and time string to clients every second.

```
public class MulticastServer {
    public static void main(String[] args) {
        System.out.println("Multicast Time Server");
        DatagramSocket serverSocket = null;

        try {
            serverSocket = new DatagramSocket();
            while (true) {
                String dateText = new Date().toString();
                byte[] buffer = new byte[256];
                buffer = dateText.getBytes();
                InetAddress group =
InetAddress.getByName("224.0.0.0");
                DatagramPacket packet;
                packet = new DatagramPacket(buffer,
buffer.length,
                        group, 8888);
                serverSocket.send(packet);
                System.out.println("Time sent: " + dateText);
                try {
                    Thread.sleep(1000);
                } catch (InterruptedException ex) {
                    System.out.println(ex.getMessage());
                }
            }
        } catch (IOException e) {
            e.printStackTrace();
            System.exit(1);
      }
    }
}
```

- Create $MulticastServer$ class with main method
- Inside $main$ create $DatagramSocket$ object.
- Inside $main$, set up $try - catch$ block.
- Inside try, initialize $serverSocket$ object.

```
public static void main(String[] args) {
    System.out.println("Multicast Time Server");
    DatagramSocket serverSocket = null;

    try {
        serverSocket = new DatagramSocket();

    } catch (IOException e) {

    }
}
```

- Inside try, create an infinite $while$ loop.
- Inside the loop create an array of bytes to hold the current date and time.

```
while (true) {
    String dateText = new Date().toString();
    byte[] buffer = new byte[256];
    buffer = dateText.getBytes();
}
```

- Inside loop, create an $InetAddress$ object to represent the multicast group.
- Inside loop, create a $DatagramPacket$ to hold the array of bytes, the multicast IP of the group and port number.
- Inside loop, cast (send) the message to the group using $send$ method.

```
InetAddress group =
InetAddress.getByName("224.0.0.0");
DatagramPacket packet = new
DatagramPacket(buffer, buffer.length, group,
8888);
serverSocket.send(packet);
System.out.println("Time sent: " + dateText);
```

- To make the server send the message every 1 second, we pause the server for 1000 millisecond using $Thread.sleep()$ method.
    - Note that this server only sends messages. It never receives from client.

```
try {
    Thread.sleep(1000);
} catch (InterruptedException ex) {
    System.out.println(ex.getMessage());
    System.exit(1);
}
```

- Catch the IO exception.

```
catch (IOException e) {
    e.printStackTrace();
    System.exit(1);
}
```

Multicast Client

```
public class MulticastClient {
    public static void main(String args[]) {
        System.out.println("Multicast Time Client");
        try (MulticastSocket socket = new
MulticastSocket(8888)) {
            InetAddress group =
                    InetAddress.getByName("224.0.0.0");
            socket.joinGroup(group);
            System.out.println("Multicast Group Joined");
            byte[] buffer = new byte[256];
            DatagramPacket packet =
                    new DatagramPacket(buffer,
buffer.length);
            for (int i = 0; i < 5; i++) {
                socket.receive(packet);
                String received = new
String(packet.getData());
                System.out.println(received.trim());
            }
            socket.leaveGroup(group);
        } catch (IOException ex) {
            ex.printStackTrace();
        }
        System.out.println("Multicast Time Client
Terminated");
    }
}
```

- Create $MulticastClient$ class with $main$ function.
- Inside $main$, create a $try\ with\ resources - catch$ block.
    - Remember that try with resources has the form $try(\ \ )\{\ \ \}catch\{\ \ \}$. It ensures that each resource is closed at the end of the statement.

```
public class MulticastClient {
    public static void main(String args[]) {
        System.out.println("Multicast Time
Client");
        try () {

        } catch () {

        }
        System.out.println("Multicast Time
Client Terminated");
    }
}
```

- Inside ( ) of the try, we define a $MulticastSocket$ object, which is a UDP socket used for sending and receiving multicast packets and joining groups.
- Inside try block, create an $InetAddress$ object to access the group at IP 224.0.0.0. Then, use the socket to join the group.

```
try (MulticastSocket socket = new
MulticastSocket(8888)) {
    InetAddress group =
            InetAddress.getByName("224.0.0.0");
    socket.joinGroup(group);
    System.out.println("Multicast Group
Joined");

} catch () {

}
```

- Inside try, create a byte array to receive the incoming datagram packets.

```
byte[] buffer = new byte[256];
DatagramPacket packet =
      new DatagramPacket(buffer, buffer.length);
```

- We want the client to receive 5 packets, so we create a for loop to receive the packets, extract the data from the packet, and print it to the console.
- After the for loop, we leave the group using $socket.leaveGroup()$.

```
for (int i = 0; i < 5; i++) {
    socket.receive(packet);
 String received = new String(packet.getData());
    System.out.println(received.trim());
}
socket.leaveGroup(group);
```

- Catch the exception.

```
catch (IOException ex) {
    ex.printStackTrace();
    System.exit(1);
}
System.out.println("Multicast Time Client
Terminated");
```

- Now run the server then run the client.
- What happens if we run the client first?

Task

- What are unicast and broadcast? What are the differences between unicast, multicast, and broadcast?

Using the *NetworkInterface* class

- The *NetworkInterface* class provides a means of accessing the devices that act as nodes on a network.
    - This class also provides a means to get low-level device addresses.
    - This class represents a Network Interface made up of a name, and a list of IP addresses assigned to this interface.
- A network interface is the point of connection between a computer and a network (NIC).

```
public class NetInterface {
    public static void main(String[] args) {
        try {
            Enumeration<NetworkInterface> interfaceEnum =
                  NetworkInterface.getNetworkInterfaces();
            System.out.printf("Name Display name\n");
            for (NetworkInterface element :
                    Collections.list(interfaceEnum)) {
                System.out.printf("%-8s %-32s\n",
                        element.getName(),
element.getDisplayName());
            }
        } catch (SocketException ex) {
            ex.printStackTrace();

        }
    }
}
```

- The *Enumeration* interface defines the methods by which you can enumerate (obtain one at a time) the elements in a collection of objects.
- The $Collections.list(interfaceEnum)$ line returns an array list of the elements in the $interfaceEnum$.

Task

- What are java Generics and wildcards?
- What is the difference between array list and enums?