OBJEKTNO PROGRAMIRANJE 2

Oznaka predmeta:	OP2
Predavanje broj:	10
Nastavna jedinica:	JAVA

Nastavne teme:

Slanje fajla sa servera na klijent. FileDialog. DatagramPacket. DatagramSocket. URL. URLConnection. Generici.

Predavač: prof. dr Perica S. Štrbac, dipl. ing.

Literatura:

Eckel B., *Thinking in Java*, 2nd edition, Prentice-Hall, New Jersey 2000.

Cay S. Horstmann and Gary Cornell*: "Core Java, Advanced Features", Vol. 2, Prantice Hall, 2013.*

The Java Tutorial, Sun Microsystems 2001. *http://java.sun.com*

Branko Milosavljević, Vidaković M, *Java i Internet programiranje*, GInT, Novi Sad 2002.

Odabiranje i slanje fajla: server

- U sledećem primeru koristi se klasa FileDialog za odabiranje fajla koji server šalje klijentima. Unapredite dati primer.

```
import java.util.*; import java.io.*; import java.net.*;
import java.text.SimpleDateFormat; import java.awt.*;
import java.awt.event.*; import javax.swing.*;
public class TrivialFileServer extends JFrame implements ActionListener {
  public final static int SOCKET_PORT = 12345;
  private JButton odaberifajl;
  private FileDialog filedialog;
  private volatile String strfajl;
  private JTextArea jta;
  public TrivialFileServer() {
    setTitle("T_F_S");     setSize(500, 300);
    this.setDefaultCloseOperation(JFrame.EXIT_ON_CLOSE);
    Container c = this.getContentPane();
    odaberifajl = new JButton("ODABERI FAJL");
    odaberifajl.setBackground(Color.YELLOW);
    odaberifajl.addActionListener(this);
    filedialog = new FileDialog(this, "Odaberite fajl !");
    strfajl= null;
    jta = new JTextArea(30,20);
    Ispisi("ODABERITE FAJL ZA KLIJENTE!");
```

Odabiranje i slanje fajla: server

```
    c.setLayout(new GridLayout(2,1));
    c.add(odaberifajl);     c.add(jta);
    setVisible(true);
  }
  public String Ok(){ return strfajl; }
  public void Ispisi(String str){
    Date dt = new Date();
    SimpleDateFormat sdf = new SimpleDateFormat("hh:mm:ss");
    String time1 = sdf.format(dt);
    jta.insert(time1+" -> " +str+"\n", 0);
  }
  public void actionPerformed(ActionEvent ae) {
    if(ae.getActionCommand().equals("ODABERI FAJL")){
      filedialog.setVisible(true);
      strfajl = filedialog.getFile();
      if(strfajl!= null){
        Ispisi("ODABRAN: "+strfajl);
        this.getContentPane().remove(odaberifajl);
        this.getContentPane().setLayout(new GridLayout(1,1));
        revalidate();
      }
    }
  }
```

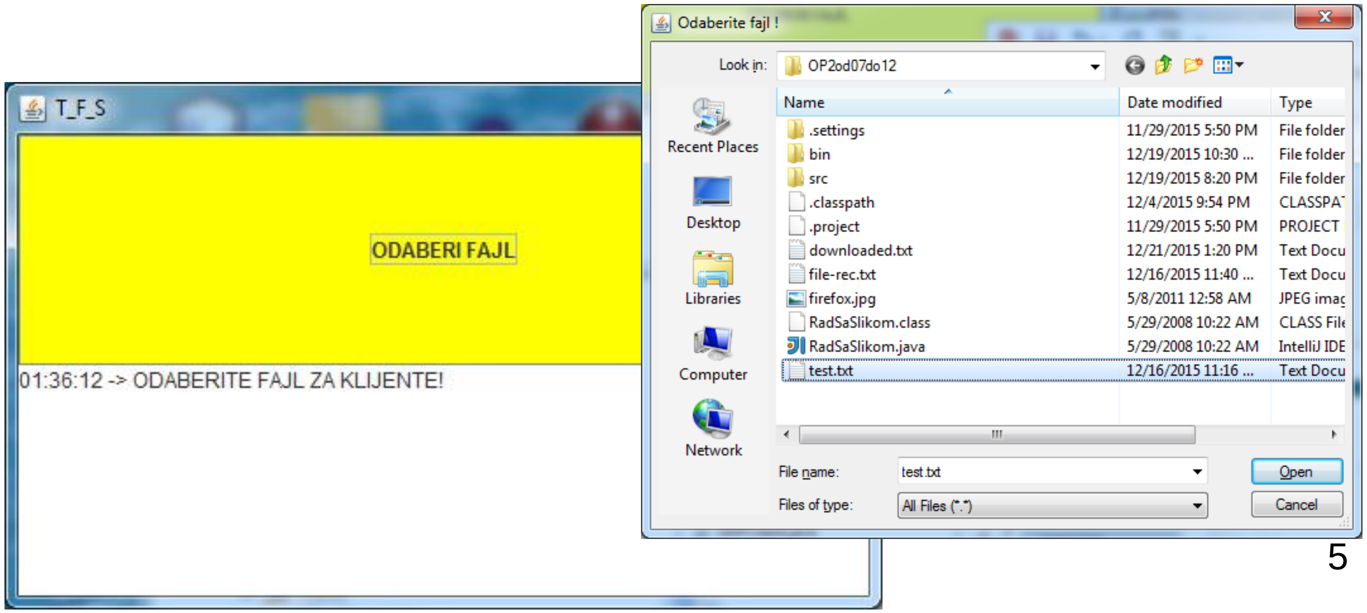
Odabiranje i slanje fajla: server

```
public static void main(String[] args) throws IOException {
  TrivialFileServer tfs = new TrivialFileServer();
  FileInputStream fis = null;
  BufferedInputStream bis = null;
  OutputStream os = null;
  ServerSocket servsock = null;
  Socket sock = null;
  while(tfs.Ok()== null);
  try {
    servsock = new ServerSocket(SOCKET_PORT);
    File myFile = new File(tfs.Ok());
    byte[] mybytearray = new byte[(int) myFile.length()];
    fis = new FileInputStream(myFile);
    bis = new BufferedInputStream(fis);
    bis.read(mybytearray, 0, mybytearray.length);
    while (true) {
      tfs.Ispisi("CEKAM POZIV KLIJENTA ...");
      try {
        sock = servsock.accept();
        tfs.Ispisi("Prihvacen poziv: " + sock);
        // send file
        os = sock.getOutputStream();
```

Odabiranje i slanje fajla: server

```
          tfs.Ispisi("Saljem " + tfs.Ok() + " (" + mybytearray.length +
                                                            " bytes)");
          os.write(mybytearray, 0, mybytearray.length);
          os.flush();
          tfs.Ispisi("Poslato.");
        } finally {
            if (fis != null) fis.close(); if (bis != null)  bis.close();
            if (os != null)  os.close();
            if (sock != null)sock.close();
        }
      }
    } finally {
        if (servsock != null) servsock.close();
    }
  }
}
```

- Sledi kod za klijente. Unapredite primer.



01:36:12 -> ODABERITE FAJL ZA KLIJENTE!

Name	Date modified	Type
.settings	11/29/2015 5:50 PM	File folder
bin	12/19/2015 10:30 ...	File folder
src	12/19/2015 8:20 PM	File folder
.classpath	12/4/2015 9:54 PM	CLASSPAT
.project	11/29/2015 5:50 PM	PROJECT
downloaded.txt	12/21/2015 1:20 PM	Text Docu
file-rec.txt	12/16/2015 11:40 ...	Text Docu
firefox.jpg	5/8/2011 12:58 AM	JPEG imag
RadSaSlikom.class	5/29/2008 10:22 AM	CLASS File
RadSaSlikom.java	5/29/2008 10:22 AM	IntelliJ IDE
test.txt	12/16/2015 11:16 ...	Text Docu

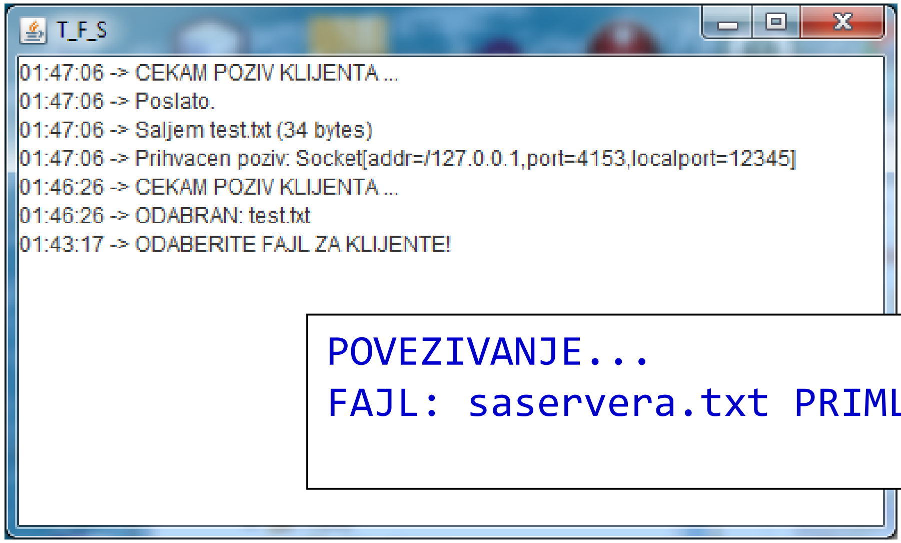
File name: test.txt
Files of type: All Files (*.*)

Odabiranje i slanje fajla: klijent

```java
import java.io.*; import java.net.*;
public class TrivialFileClient {
  public final static int SOCKET_PORT = 12345;
  public final static String SERVER = "127.0.0.1";
  public final static String FILE_TO_RECEIVED = "saservera.txt";
  public final static int FILE_SIZE = 1000000; //uradite bez ovoga
  public static void main(String[] args) throws IOException {
    int bytesRead;
    int current = 0;
    FileOutputStream fos = null;
    BufferedOutputStream bos = null;
    Socket sock = null;
    try {
      sock = new Socket(SERVER, SOCKET_PORT);
      System.out.println("POVEZIVANJE...");
      // receive file
      byte[] mybytearray = new byte[FILE_SIZE];
      InputStream is = sock.getInputStream();
      fos = new FileOutputStream(FILE_TO_RECEIVED);
      bos = new BufferedOutputStream(fos);
      bytesRead = is.read(mybytearray, 0, mybytearray.length);
      current = bytesRead;
```

Odabiranje i slanje fajla: klijent

```
        do {
          bytesRead = is.read(mybytearray, current, (mybytearray.length -
                                                                current));
          if (bytesRead > 0) current += bytesRead;
        } while (bytesRead > -1);
        bos.write(mybytearray, 0, current);
        bos.flush();
        System.out.println("FAJL: " + FILE_TO_RECEIVED + " PRIMLJENO (" +
                                                   current + " BAJTOVA)");
      } finally {
          if (fos != null)  fos.close();
          if (bos != null)  bos.close(); if (is != null) is.close();
          if (sock != null) sock.close();
      }
    }
}
```



```
01:47:06 -> CEKAM POZIV KLIJENTA ...
01:47:06 -> Poslato.
01:47:06 -> Saljem test.txt (34 bytes)
01:47:06 -> Prihvacen poziv: Socket[addr=/127.0.0.1,port=4153,localport=12345]
01:46:26 -> CEKAM POZIV KLIJENTA ...
01:46:26 -> ODABRAN: test.txt
01:43:17 -> ODABERITE FAJL ZA KLIJENTE!
```

```
POVEZIVANJE...
FAJL: saservera.txt PRIMLJENO (34 BAJTOVA)
```

Datagram

- TCP garantuje isporuku paketa i čuvanje njihovog redosleda kojim pristižu na odredište.
  - Ova osobina ima i svoju cenu u smislu efikasnosti prenosa.
- Kada navedene osobine nisu potrebne može se koristiti UDP protokol.
  - Ovaj protokol prenosi datagram pakete.
  - Datagram paketi se koriste za realizaciju beskonekcionih (connection-less) paketa.
  - Svaka poruka se prenosi od izvora do odredišta na osnovu podataka sadržanih unutar tog paketa.
  - Svaki paket mora imati adresu odredišta i svaki paket može biti preusmeren drugačije, a može stići i u bilo kom redosledu.
  - Dostava ovakvih paketa nije garantovana.
- Dat je format datagram paketa koji sadrži poruku, (offset), dužinu poruke, odredišni host i odredišni port.

Message	Length	Host	Server Port

DatagramPacket

- Konstruktori klase DatagramPacket (za predajnu stranu):

```
DatagramPacket(byte[] buf,
                       int length, InetAddress address, int port);
```

  ovaj konstruktor se koristi za kreiranje datagram paketa koji šalje poruku (smeštenu u prvi argument) date dužine na IP adresu i dati broj porta.

  – zadaje pomak u baferu gde će se smeštati podaci.

```
DatagramPacket (byte[] buf, int offset,
                       int length, InetAddress ipAdresa, int port)
```

  Za prijemnu stranu:

```
     DatagramPacket (byte[] buf, int length)
     DatagramPacket (byte[] buf, int offset, int length)
```

- Značajne metode klase DatagramPacket su:

`byte[]`	`getData()`	vraća bafer podataka.
`int`	`getOffset()`	vraća offset.
`int`	`getLength()`	vraća dužinu podataka koji se šalju ili dužinu prispelih podataka.
`InetAddress`	`getAddress()`	vraća odredišnu adresu.
`int`	`getPort()`	vraća broj priključka odredišta.
`void setData(byte[] buf)`		postavlja podatke za tekući paket.
`void setLength(int length)`		postavlja dužinu tekućeg paketa.

DatagramSocket

- Konstruktor klase Datagram**Socket**:

  `DatagramSocket(int port);`

  – Navedeni konstruktor kreira datagram socket koji koristi dati port .

- Ključne metode klase Datagram**Socket** su:

`void send    (DatagramPacket dp)`	šalje datagram paket na socket.
`void receive(DatagramPacket dp)`	prihvata datagram paket sa socket-a.
`InetAddress getInetAddress()`	vraća odredišnu adresu.
`InetAddress getLocalAddress()`	vraća lokalnu adresu.
`int getPort()`	vraća broj priključka odredišta.
`int getLocalPort()`	vraća broj lokalnog priključka.

- Sledi komunikacioni program koji koristi slanje datagrama.
  – Jednostavan UDP eho serverski program čeka zahtev klijenta.
  – Po prijemu zahteva server klijentu vraća prihvaćenu poruku (datagram).

Primer 1/4

```
//serverska strana
import java.net.*; import java.io.*;
public class UDPServer {
  public static void main(String args[]) {
      DatagramSocket aSocket = null;
      if (args.length < 1) {
          System.out.println("Usage: java UDPServer <Port Number>");
          System.exit(1);
      }
      try {
         int socket_no = Integer.valueOf(args[0]).intValue();
         aSocket = new DatagramSocket(socket_no);
         byte[] buffer = new byte[1000];
         while (true) {
            System.out.println("cekam klijenta ...");
            DatagramPacket request =
            new DatagramPacket(buffer, buffer.length);
            aSocket.receive(request);
            DatagramPacket reply =
               new DatagramPacket(
                         request.getData(),    request.getLength(),
                         request.getAddress(), request.getPort());
```

Primer 2/4

```
                System.out.println("saljem klijentu ...");
                aSocket.send(reply);
                System.out.println("POSLAO !");
            }
        } catch (SocketException e) {
            System.out.println("Socket: " + e.getMessage());
        } catch (IOException e) {
            System.out.println("IO: " + e.getMessage());
        } finally {
            if (aSocket != null) {  aSocket.close(); }
        }
    }
}
//---------------------------------- klijentska strana ----------------
import java.net.*; import java.io.*;
public class UDPClient {
  public static void main(String args[]) {
    DatagramSocket aSocket = null;
    if (args.length < 3) {
      System.out.println(
        "Usage: java UDPClient <message > <Host name > <Port number >");
          System.exit(1);
    }
```

Primer 3/4

```
try {
    aSocket = new DatagramSocket();
    byte[] m             = args[0].getBytes();
    InetAddress aHost = InetAddress.getByName(args[1]);
    int serverPort     = Integer.valueOf(args[2]).intValue();
    DatagramPacket request =
       new DatagramPacket(m, args[0].length(), aHost, serverPort);
    aSocket.send(request);
    System.out.println("poslao !");
    byte[] buffer = new byte[1000];
    DatagramPacket reply = new
                DatagramPacket(buffer, buffer.length);
    aSocket.receive(reply);
    System.out.println("Server vraca: " +
                      new String(reply.getData()));
}
catch (SocketException e) {
      System.out.println("Socket: " + e.getMessage());
}
  catch (IOException e) {
      System.out.println("IO: " + e.getMessage());
}
```

Primer 4/4

```
      finally {
         if (aSocket != null) {
                aSocket.close();
         }
      }
    }
}
```

- Izlaz:

serverska strana java UDPServer 12345	klijentska strana java UDPClient "Pozdrav od klijenta!" 127.0.0.1 12345
cekam klijenta ...	
	poslao !
saljem klijentu ...	
POSLAO ! cekam na klijenta ...	Server vraca: Pozdrav od klijenta !

Klasa URL

- URL (Uniform Resource Locator) predstavlja jedinstveno ime dodeljeno svakom resursu na Internetu. Java ima podršku za URL adresni pristup resursima Interneta.
- Delovi URL adrese (http://www.viser.edu.rs:80/index.html) su kao što sledi:

– protokol	odvojen je dvotačkom od ostatka URL adrese.
– računar	IP adresa računara, levi graničnik je dvostruka kosa crta, a desni graničnik je kosa crta ili dvotačka ako se navodi port.
– port	neobavezan parametar. Levi graničnik je dvotačka a desni graničnik je kosa crta.
– navigacija do fajla	u datom primeru index.htm

- URL klasa može izazvati izuzetak MalformedURLException.
- Konstruktori URL klase su kao što sledi:

```
URL(String urlString)
URL(String protokol, String racunar, int port, String putanja)
URL(String protokol, String racunar,           String putanja)
```

Klasa URL

- Sledi primer koji ispisuje svojstva stranice Osborne (http://www.osborne/download) :

```
import java.net.*;
class URLDemo {
  public static void main(String args[])
                     throws MalformedURLException {
    URL hp = new URL("http://www.osborne/download");
    System.out.println("Protokol:\t"   + hp.getProtocol());
    System.out.println("Racunar:\t"    + hp.getHost());
    System.out.println("Prikljucak:\t" + hp.getPort());
    System.out.println("Datoteka:\t"   + hp.getFile());
    System.out.println("URL:\t"        + hp.toExternalForm());
  }
}
```

- Izlaz:

```
Protokol:        http
Racunar:         www.osborne
Prikljucak:      -1
Datoteka:        /download
URL:             http://www.osborne/download
```

Klasa URLConnection

- Klasa `URLConnection` (u java.net paketu) koristi se za pristup sadržaju udaljenih resursa. Ovim se mogu proveriti svojstva udaljenih resursa.
- Sledi primer koji koristi metodu openConnection klase URL da bi se kreirao objekat URLConnection. Program uspostavlja HTTP vezu sa lokacijom `http://www.w3.org/`, lista vrednosti zaglavlja i učitava sadržaj.

```
import java.net.*;
import java.io.*;
import java.util.Date;

class URLConnectionPrimer {
  public static void main(String args[]) throws Exception {
    int c;
    URL hp = new URL("http://www.w3.org/");
    URLConnection hpCon = hp.openConnection();
    System.out.println("Datum: "+new Date(hpCon.getDate()));
    System.out.println("Vrsta sadržaja: " +
                              hpCon.getContentType());
    System.out.println("Rok trajanja: " +
                              hpCon.getExpiration());
    System.out.println("Vreme poslednje izmene: " +
                       new Date(hpCon.getLastModified()));
    int len = hpCon.getContentLength();
    System.out.println("Dužina sadržaja: " + len);
```

Klasa URLConnection

```
      if (len > 0) {
        System.out.println("Sadržaj:");
        InputStream input = hpCon.getInputStream();
        int i = len; //ako bi trebalo za nesto drugo
        while (((c = input.read()) != -1) && (--i > 0)) {
          System.out.print((char) c);
        }
        input.close();
      }
      else {
         System.out.println("Nema dostupnih podataka"); }
    }
  }
```

```
Datum: Sun Dec 20 14:16:29 CET 2015
Vrsta sadržaja: text/html; charset=utf-8
Rok trajanja: 1450617989000
Vreme poslednje izmene: Sat Dec 19 10:20:13 CET 2015
Dužina sadržaja: 37845
Sadržaj:
<!DOCTYPE html PUBLIC "-//W3C//DTD XHTML 1.0 Strict//EN"
"http://www.w3.org/TR/xhtml1/DTD/xhtml1-strict.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" xml:lang="en" lang="en">
<!-- Generated from data/head-home.php, ../../smarty/{head.tpl} -->
<head> ...
```

Klasa URLConnection

- Klasa URLConnection poseduje getInputStream i getOutputStream metode slične metodama getInputStream i getOutputStream klase Socket.
- Sledeći primer demonstrira korišćenje klase URLConnetion i URLEncoder za slanje upita na pretraživač Yahoo. Program kreira kodirani upit koji će koristiti web aplikacija a onda šalje i prima podatke u sprezi sa Yahoo pretraživačem.
- Potrebna je klasa za URL kodiranje ne-ASCII karaktera.

```
import java.io.UnsupportedEncodingException;
import java.net.URLEncoder;
public class QueryStringFormatter {
  private String queryEngine;
  private StringBuilder query = new StringBuilder();
  public QueryStringFormatter(String queryEngine) {
     this.queryEngine = queryEngine;
  }
  public String getEngine() { return this.queryEngine;  }
  public void addQuery(String queryKey, String queryValue)
        throws Exception {
     query.append(queryKey + "="
             + URLEncoder.encode(queryValue, "UTF-8") + "&");
 }
 public String getQueryString() { return "?" + query.toString();  } }
```

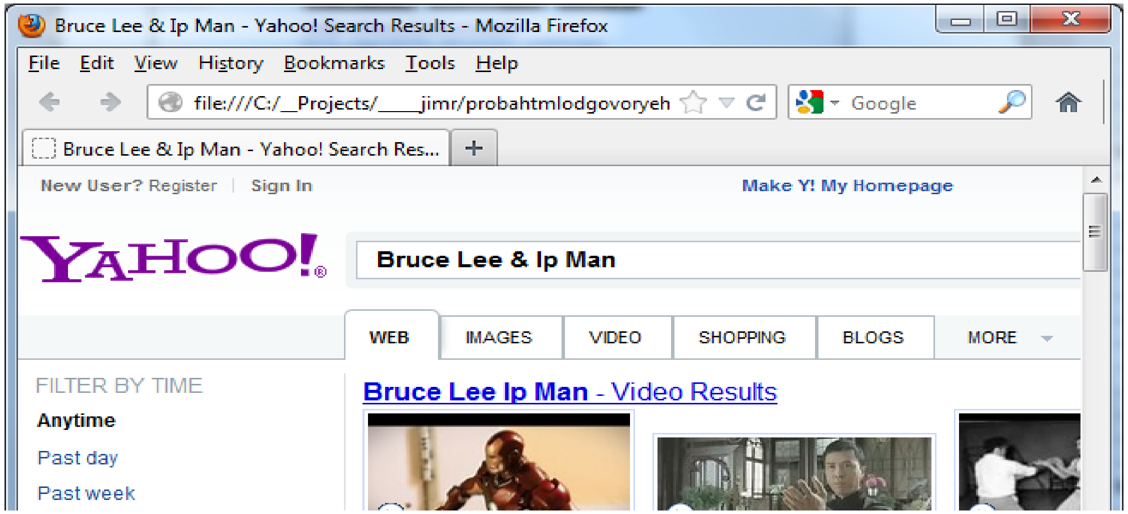
Klasa URLConnection

```
import java.io.*; import java.net.*;
public class UpitZaYahoo {
  private String searchEngine;
  public UpitZaYahoo(String searchEngine) {this.searchEngine = searchEngine;}
  public void doSearch(String queryString) {
    try {
      // otvaranje url konekcije
      URL url = new URL(searchEngine);
      URLConnection connection = url.openConnection();
      connection.setDoOutput(true);
      // slanje upita pretrazivacu
      PrintStream ps = new PrintStream(connection.getOutputStream());
      ps.println(queryString);
      ps.close();
      // citanje i ispisivanje rezultata
      DataInputStream input =
                   new DataInputStream(connection.getInputStream());
      BufferedReader lines = new BufferedReader(new InputStreamReader(input,
                                                                     "UTF-8"));
      String inputLine = null;
      while ((inputLine = lines.readLine()) != null) {
                System.out.println(inputLine);
            }    } catch (Exception e) {      e.printStackTrace();     } }
```

Klasa URLConnection

```
  public static void main(String[] args) throws Exception {
    QueryStringFormatter formatter =
      new QueryStringFormatter("http://search.yahoo.com/search");
    formatter.addQuery("newwindow", "1");
    formatter.addQuery("q", "Bruce Lee & Ip Man");
    // pretrazivanje pomocu yahoo-a
    UpitZaYahoo search = new UpitZaYahoo(formatter.getEngine());
    search.doSearch(formatter.getQueryString());
  }
}
```

•Odgovor sadrži kompletnu html stranicu. Ako se snimi kao html i startuje dobija se:


Bruce Lee & Ip Man - Yahoo! Search Results - Mozilla Firefox
File Edit View History Bookmarks Tools Help
file:///C:/__Projects/____jimr/probahtmlodgovoryeh
Google
Bruce Lee & Ip Man - Yahoo! Search Res...
New User? Register | Sign In
Make Y! My Homepage
YAHOO!
Bruce Lee & Ip Man
WEB IMAGES VIDEO SHOPPING BLOGS MORE
FILTER BY TIME
Anytime
Past day
Past week
Bruce Lee Ip Man - Video Results

Generici

- Posmatra se primer:

```
List list = new ArrayList();
list.add(new Integer(2));
list.add("a String");
```

sada je uzimanje podataka sa kastovanjem:

```
Integer integer = (Integer) list.get(0);
String  string  = (String)  list.get(1);
```

- Java generici omogućuju da se postavi tip koji kolekcija prihvata čime dalje nije potrebno kastovanje uzete vrednosti iz kolekcije:

```
List<String> strings = new ArrayList<String>();
//ili diamond operator List<String> strings = new ArrayList<>();
strings.add("a String"); ...
//nema kastovanja
String aString = strings.get(0);
for(String aString : strings){
  System.out.println(aString);
}
Iterator<String> iterator = strings.iterator();
while(iterator.hasNext()){
  String aString = iterator.next();
}
```

Generički skupovi, generičke mape

- Generički skupovi:

```
Set<String> set = new HashSet<String>();
String string1 = "a string";
set.add(string1);...
Iterator<String> iterator = set.iterator();
while(iterator.hasNext()){  String aString = iterator.next(); }
for(String aString : set){  System.out.println(aString);      }
```

- Generičke mape:

```
Map<Integer, String> map = new HashMap<Integer, String>();
Integer key1   = new Integer(123);
String  value1 = "value 1";
map.put(key1, value1);
...
String value1_1 = map.get(key1);
Iterator<Integer> keyIterator   = map.keySet().iterator();
while(keyIterator.hasNext()){
  Integer aKey   = keyIterator.next();
  String  aValue = map.get(aKey);
}
Iterator<String>  valueIterator = map.values().iterator();
while(valueIterator.hasNext()){
  String aString = valueIterator.next();
}
```

Generičke mape, generičke klase

- Generičke mape:

```
Map<Integer, String> map = new HashMap<Integer, String>();
//... add key, value pairs to the Map
for(Integer aKey : map.keySet()) {
    String aValue = map.get(aKey);
    System.out.println("" + aKey + ":" + aValue);
}
for(String aValue : map.values()) {
    System.out.println(aValue);
}
```

- Generičke klase:

```
public class GenericFactory<T> {
  Class theClass = null;
  public GenericFactory(Class theClass) {
     this.theClass = theClass;
  }
  public T createInstance()
    throws IllegalAccessException, InstantiationException {
      return (T) this.theClass.newInstance();
  }
}
```

Generički metodi

- Poziv bi bio:

```
GenericFactory<MyClass> factory =
    new GenericFactory<MyClass>(MyClass.class);
MyClass myClassInstance = factory.createInstance();
```

- Generički metodi:

```
public static <T> T addAndReturn(T element, Collection<T> collection){
    collection.add(element);
    return element;
}

String stringElement = "stringElement";
List<String> stringList = new ArrayList<String>();
String theElement = addAndReturn(stringElement, stringList);

Integer integerElement = new Integer(123);
List<Integer> integerList = new ArrayList<Integer>();
Integer theElement = addAndReturn(integerElement, integerList);

String stringElement = "stringElement";
List<Object> objectList = new ArrayList<Object>();
Object theElement = addAndReturn(stringElement, objectList);
```

Generički metodi

- Kreiranje instance klase preko metode:

```
public static <T> T getInstance(Class<T> theClass)
    throws IllegalAccessException, InstantiationException {
      return theClass.newInstance();
}...
String string   = getInstance(String.class);
MyClass myClass = getInstance(MyClass.class);
```

- Korišćenje npr. kod komunikacije sa bazom podataka:

```
public static <T> T read(Class<T> theClass, String sql)
    throws IllegalAccessException, InstantiationException {
      //execute SQL.
      T obj = theClass.newInstance();
      //set properties via reflection.
      return obj;
}
```

pozivi bi bili npr:

```
Driver employee= read(Driver.class, "select * from drivers where id=1");
Vehicle vehicle= read(Vehicle.class,"select * from vehicles where id=1");
```

Kreiranje iterabilne klase

- Korišćenje generika za kreiranje kolekcije.

```
public class MyCollection<E> implements Iterable<E>{
    public Iterator<E> iterator() {
        return new MyIterator<E>();
    }
}
public class MyIterator <T> implements Iterator<T> {
    public boolean hasNext() {
        //implement...
    }
    public T next() {
        //implement...
    }
    public void remove() {
        //implement...
    }
}
public static void main(String[] args) {
    MyCollection<String> stringCollection = new MyCollection<String>();
    for(String string : stringCollection){ ... }
}
```

Nasleđivanje i generici

- Lista tipova nepoznatog tipa:

```
public class A { }
public class B extends A { }
public class C extends A { }
        public static void processElements(List<?> elements){
           for(Object o : elements){
              System.out.println(o);
           }
        }...
        List<A> listA = new ArrayList<A>();
        processElements(listA);
```

- Lista instanci klase ili njene podklase

```
        public static void processElements(List<? extends A> elements){
           for(A a : elements){
              System.out.println(a.getValue());
           }
        }...
        List<A> listA = new ArrayList<A>();
        processElements(listA);
        List<B> listB = new ArrayList<B>();
        processElements(listB);
        List<C> listC = new ArrayList<C>();
        processElements(listC);
```

Nasleđivanje i generici

- Lista instanci klase ili superklase:

```
public static void insertElements(List<? super A> list){
    list.add(new A());
    list.add(new B());
    list.add(new C());
}
List<A>      listA      = new ArrayList<A>();
insertElements(listA);
List<Object> listObject = new ArrayList<Object>();
insertElements(listObject);
```

sada je kastovanje na Object:

```
Object object = list.get(0);
```

Primer generičke metode

```
public class GenericMethodTest {
  public static <E> void printArray(E[] inputArray) {
    for (E element : inputArray) { System.out.printf("%s ", element); }
    System.out.println();
  }
  public static void main(String args[]) {
    Integer[] intArray = { 1, 2, 3, 4, 5 };
    Double[] doubleArray = { 1.1, 2.2, 3.3, 4.4 };
    Character[] charArray = { 'H', 'E', 'L', 'L', 'O' };
    System.out.println("Array integerArray contains:");
    printArray(intArray); // pass an Integer array
    System.out.println("\nArray doubleArray contains:");
    printArray(doubleArray); // pass a Double array
    System.out.println("\nArray characterArray contains:");
    printArray(charArray); // pass a Character array
  }
}
```

```
Array integerArray contains:
1 2 3 4 5
Array doubleArray contains:
1.1 2.2 3.3 4.4
Array characterArray contains:
H E L L O
```

Primer generičke metode

```
public class MaximumTest{
   // najveci od tri
   public static <T extends Comparable<T>> T maximum(T x, T y, T z) {
      T max = x;
      if ( y.compareTo( max ) > 0 ){ max = y; }
      if ( z.compareTo( max ) > 0 ){ max = z; }
      return max;
   }
   public static void main( String args[] ) {
      System.out.printf( "Max of %d, %d and %d is %d\n\n",
                   3, 4, 5, maximum( 3, 4, 5 ) );
      System.out.printf( "Maxm of %.1f,%.1f and %.1f is %.1f\n\n",
                   6.6, 8.8, 7.7, maximum( 6.6, 8.8, 7.7 ) );
      System.out.printf( "Max of %s, %s and %s is %s\n","pear",
         "apple", "orange", maximum( "pear", "apple", "orange" ) );
   }
}
```

```
Max of 3, 4 and 5 is 5

Maxm of 6.6,8.8 and 7.7 is 8.8

Max of pear, apple and orange is pear
```

Primer generičke klase

```
public class Box<T> {
  private T t;
  public void add(T t) {
    this.t = t;
  }
  public T get() {
    return t;
  }
  public static void main(String[] args) {
    Box<Integer> integerBox = new Box<Integer>();
    Box<String>   stringBox = new Box<String>();
    integerBox.add(new Integer(10));
    stringBox.add(new String("Hello World"));
    System.out.printf("Integer Value :%d\n\n", integerBox.get());
    System.out.printf("String Value :%s\n", stringBox.get());
  }
}
```

```
Integer Value :10

String Value :Hello World
```