

**saqarTvel os teqnikuri universiteti**  
**informatikisa da marTvis sistemebis**  
**instituti**

**gia surgul aZe, mzia kiksaZe**

**daprogramebis meTodebi**  
**internetisTvis**

**( JAVA-2 da XML enebis bazaze )**



**dantkicebul ia**  
**danxmare**  
**saxel mZRvanel od stu-s**  
**saswavi o-meToduri**  
**sabWos mier**

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## sar Cevi

### I Tavi. JAVA daprogramebi s ena

- 1.1. JAVA-ena C da C++ enis memkvidre
- 1.2. JAVA-programebis ageba LINUX pl atformaze
- 1.3. apl etebi da HTML kodebi Internet-isTvis
- 1.4. monacemebi da operaciebi
- 1.5. ganStoebebi da cikl ebi
- 1.6. Case-teqno logia da Uml-ena
- 1.7. kl asebi da obieqtebi
- 1.8. interfeisebis damuSaveba
- 1.9. savarj iSo programebi

### I Tavis kiTxvebi da savarj iSoebi

### II Tavi. XML - monacemTa aRwerisa da InternetSi gadacemi s ena

- 2.1. XML enis Seqmna da misi daniSnul eba
- 2.2. XML enis struqtura
- 2.3. enis el ementebi
- 2.4. enis attributebi
- 2.5. arsebi (obieqtebi)

### II Tavis kiTxvebi da savarj iSoebi

### I i t e r a t u r a

## I Tavi: JAVA daprogramebis ena

### 1.1. JAVA-ena C&C++ enis memkvidre

platformebisagan damoukidebeli, obieqt-orientirebuli daprogramebis ena Java damuSavda Sun Microsystems kompaniis mier C, C++ da SmallTalk enebis safuZvel ze. misi mTavari daniSnul eba internetSi daprogramebaa.

popularulia Java enis ramdenime interpretatori. maT Soris MicroSoft-firmis Visual-J++ da Sun Microsystems kompaniisa Java 2 SDK (Software Development Kit). gamoyenebis komfortis Tval sazrisiT araprofesional momxmareblisTvis Visual-J++ ukeTesia. aq advilia kl asebis biblioTekebis wvdoma (magal iTad, internetidan). Sun-is Java, romelic ZiriTadad Unix da Linux sistemebisaTvis gamoiyeneba (mas aqvs Windows-Tan muSaobis SesaZlebl obac), Visual-J+++-isgan gansxvavebit, met`xel iT Sromas- moitXovs (gansakuTrebit kl asTa biblioTekebis dasafiqsirebl ad). samagierod, agebuli programuli paketebi metad mdgradi da saimedoa kompiuteruli virusebis mimarT.

C&C++ enis mcodne programistebisaTvis Java-kodi ucxo ar iqneba, vinaidan rogorc arvniSneT, am enebis sintaqsi erTmaneTis msgavsia maTi memkvidreobiti kavSiris gamo. Java-enaze programuli sistemis damuSaveba (CASE-teqnologiada UML-ena) xut etaps moicavs:

1. **obieqt-orientirebuli analizi**. ganisazRvreba momxmareblis moTxovnebi, formirdeba urTierTdakavSirebuli kl asebis erTobl ioba;

2. **obieqt-orientirebuli daproeqteba**. gadawyvetil ebis gamomuSavebis procesi, romelic akmayofil ebs momxmareblis moTxovnebs. zustdeba kl asebi, obieqtebi, metodebi da Tvisebebi;

3. **real izacia**. wina etapze miRebuli modelis Cawera programuli kodSi (Java-enaze);

4. **testireba**. programuli modul ebis Semowmebis procesi;

5. **Tanxl eba**. programis muSaobis dros gamovl enil i defeqtebis armoF xvra, axali Tvisebebis Camateba, obieqtebis cvlil ebit gamowveuli Sesabamisi programebis modifikacia.

## 1.2. JAVA-programmebi saSageba LINUX platformaze

java-programmebi sawyisi teqsti, mag., Myfirst.java SeiZl eba momzaddes programul i platformis Sesabamis teqstur redaqtorSi (Windows-is NotePad, Unix-Linux-is vi da emacs, MsDos-Si NortonCommander-is redaqtori-F4). bol o varianti gamodgeba Linux-sTvisac, radgan igi teqstis Caweris dros feradi-vizual uri kontrol is saSual ebas izl eva.

Java-programmebi momzadebisa da amuSavebis sail ustraci od ganvixil ot misi ZiriTadi sami etapi:

1. **sawyisi teqstis momzadeba.** redaqtorSi SevitanoT 1.1 naxazze naCvenebi teqsti. damTavrebi Semdeg SevinaxoT saxel iT Myfirst.java. sayuradRebo momentia, rom programis fail isa da kl asis saxel i unda iyos erTnairi !

```
public class Myfirst
{
    public static void main(String[] args)
    {
        System.out.println("HELLO !\n");
    }
}
```

nax.1.1. martivi Java-programmebi kodi

2. **obleqturi kodis Seqmna** javac-kompil atoris saSual ebiT. kompil irebisTvis brZanebi striqonSi Caiwereba

**javac Myfirst.java**

Tu sawyis teqstSi araa sintaksuri Secdomebi, maSin miiReba Myfirst.class fail i, romelic gamoCndeba katal ogSi;

3. **Sesrul ebadi fail is miReba** java-interpretatoris saSual ebiT. brZanebi striqonSi Caiwereba

**java Myfirst**

Tu teqstSi araa logikur-Sinaarsobrivi Secdomebi, maSin miiReba programmebi Sedegebi (Cvens SemTxvevaSi ekranze gamodis striqoni **HELLO!**).

axl a gavukeToT mcire komentari mocemul magal iTs.

public class \_ Ria kl asia, romel Tanac mimarTva SeuZl ia programis nebismier obieqts. Java-garemoSi muSaobisas interpretatori miagnebs mas saxel iT Myfirst, romel ic gamocxadebul ia rogorc public class da aamuSavebs main()-meTods. meTodebi da Tvissebebi, roml ebic kl ass ekuTvnis, ganixil eba statikurad (static).

String[] args aris parametrebi, roml ebic mniSvnel obebs Rebul obs garedan, brZanebis striqonidan.

System.out.println() - aris meTodis gamoZaxebis operatori, romel ic ekranze gamoitans frCxil ebSi moxsenebul teqsts da daamTavrebs main() meTods.

### **1.3. apl etebi da HTML kodebi Internet-TviS**

rogorc cnobilia, internetis Web-gverdebis Seqmna xorciel deba HTML (Hypertext Markup Language) eniT. am enas ar gaaCnia daprogramebis SesaZl ebl obebi. Netscape Communicator da Internet Explorer brauzerebs am mizniT aqvs scenarebis ena \_ JavaScript. am ukanasknel s SeuZl ia HTML-enis marTvis standartul i funqciuri SesaZl ebl obebis gafarToeba, magram igi uZl uria momxmarebel Ta interfeisebis Sesacvl el ad da kl ient/serveris tipis gamoyenebiTi sistemebis (apl ikaciebis) asagebad. JavaScript - scenarebis enis simZl avre arasakmarisia aRniSnul i probl emebis gadasawyvetad.

aseT SemTxvevaSi ideal urad iTvl eba Java enis apl etebi (mcire zomis programebi), roml ebic Web-gverdebSi moTavsdeba HTML-enis <APPLET> deskriptoris saSual ebiT.

garda apl etebisa Java enaze SeiZl eba daiweros gamoyenebiTi programul i paketebi (Applications), roml ebic orientirebul ia internetSi samuSaod.

1.2 naxazze mocemul ia apl etis magal iTi Java-enis kodis saSual ebiT. pirvel i ori striqoni kompil ators miuTiTebis, rom Applet da Graphics obieqtebi aiRos Sesabamisad java.applet da

```

import java.applet.Applet;
import java.awt.Graphics;
public class HelloApplet extends Applet
{
    public void paint (Graphics theGraphics)
    {
        theGraphics.drawString("hello world!", 0,50);
    }
}

```

### max.1.2. Java aplet i (HelloApplet.java)

java.awt kl asebis pakete bidan da mi abas ZiriTad programas. angvarad import \_kl asebis import irebis operatoria. Tu paketidan sxvadasxva kl asebis gamoyenebaa aucil ebel i, maSin Caweren ase:

```

import java.applet.*;
import java.awt.*.

```

unda aRiniSnos, rom 1.1 da 1.2 magal iTebSi erTi da igive teqsti gamoitaneba. aplet-programaSi aucil ebel ia paint() xatvis meTodis gamoyeneba da ara println()-isa.

Aplet-programa kompil irdeba javac util itiT da miiReba HelloApplet.class, romel ic SeiZl eba amuSavdes, magal iTad, Netscape Browser-is garemoSi HTML kodis saSual ebiT:

```

<HTML>
  <BODY>
    <APPLET CODE = "HelloApplet.class" WIDTH = "200" HEIGHT = "200">
  </APPLET>
</BODY>
</HTML>

```

### max.1.3. HelloApplet.html fail i

## 1.4. monacemebi da operaciebi

### 1.4.1. martivi tipebi da operaciebi

Java enaSi, C&C++ enebis msgavsad gamoiyeneba monacemTa rva martivi tipi: **byte (1 baiti)**, **char (2b)**, **short (2b)**, **int (4)**, **long (8)**, **float (4)**, **double (8)**, **boolean (1 baiti)** (ix. §3.1). Tavis winaprebisgan- gansxvavebiT **Java** enis es martivi tipis monacemebi, maTi programaSi gamocxadebisTanave, iRebs O-ovan mniSvnel obas.

**mTel ricxva monacemTa tipebze** srul deba Semdegi saxis operaciebi:

- miniWebis (=, +=, -=, \*=, /=);
- Sedarebis (==, !=, <, <=, >, >=);
- unarul i + da - ;
- aritmetikuli (+, -, \*, /, % );
- inkrementisa (++) da dekrementis (--);
- Tanrigobrivi Zvris (orobitistvis >> , 16-vis >>>) ;
- Tanrigobrivi unarul i uaryofis (NOT, ~);
- Tanrigobrivi AND (&), OR (|) da XOR (gamomricxavi OR).

**namdvil ricxva monacemTa tipebze** (float, double) srul deba Semdegi saxis operaciebi:

- miniWebis (=, +=, -=, \*=, /=);
- Sedarebis (==, !=, <, <=, >, >=);
- unarul i + da - ;
- +, -, \*, /;
- inkrementisa (++) da dekrementis (--);

**simbol oebis tipis** (byte, char) monacemebi C/C++ gansxvavebiT ikavebs Sesabamisad 1 da 2 baits.

**logikuri tipis** (boolean) monacemistvis gamoiyofa erTi biti, romelic gamocxadebl ad Rebul obs false mniSvnel obas. am tipis monacemebTan gamoiyeneba Semdegi operaciebi:

- miniWebis (=);
- Sedarebis (==, !=);
- unarul i NOT operacia, true-s Sesacvl el ad false-Ti da piriqit;

- l ogikuri AND (& an &&);
- l ogikuri OR (| an ||);
- l ogikuri gamoricxva OR (^);
- if-then-else (?:).

\* \* \*

### **C & C++ enebisgan gansxvavebiT Java-enaSi araa:**

- maCvenebl ebi;
- tipebis gansazRvreba (typedef);
- CamoTvl iTi tipi (enum);
- CanawerTa tipebi (struct, union);
- uniSno tipi (unsigned);
- winaprocesori da misi directivebi (#include, #define, #ifdef).

\* \* \*

**konstantebis** gamocxadeba Java enaSi xdeba ase:

**final static** kABC;

static-is gamoyenebiT kABC konstanta xdeba programis kl asis yvel a egzempl arisTvis misawvdomi, magram misi Secvl is mcdel oba iZl eva Secdomas.

**cvl adebi** iseTi monacemebia, romel Ta Secvl a dasaSvebia. maTi daniSnul ebaa programis monacemTa operatiul mexsierebaSi ganl ageba, misgan wakiTxva an damuSaveba. Java-enaSi sami tipis cvl adi arsebobs:

- l okal uri, romel ic gansazRvrul ia erTi meTodis an bl okis SigniT da aq arsebobs;

- kl asis cvl adi, romel ic ganisazRvreba erTi kl asis SigniT, magram arsebobs konkretul i obieqtis gareSe;

- konkretul i egzempl aris cvl adi, romel ic ganisazRvreba erTi kl asis SigniT da arsebobs konkretul i obieqtTan erTad.

cvl adebis gamocxadeba Java enaSi Sesazl ebel ia programul i kodis nebismier adgil as. qvemoT motanil ia programul i fragmenti martivi tipis cvl adebisaTvis:



```

/*Pr5.java simple datetypes */
public class Variable
{
    public static void main(String[] args)
    { final static PI=3.14;
      int a=1;
      char b='s';
      System.out.println(a);    // 1
      double Money=350.75;
      System.out.println(b);    // s
      System.out.println(PI);   // 3.14
      System.out.println(Money); // 350.75
      boolean t=false;
      System.out.println(t);    // false
    }
}

```

### 1.4.2. monacemTa martivi Setana-gamotani s operacIebi

Java-enaSi gamoiyeneba monacemTa gamotaniS Semdegi martivi konstruqcia:

System.out.println( ); sadac frCxil ebSi TavSdeba ekranze gamosatani argumentebi da strigonebi. + operatoriT Sesazl ebel ia argumentebis konkatenacia (gadabma). ganvixil oT konkretul i programa.

```

/*Pr6.java simple date-output */
public class dateOut {
    public static void main(String[] args) {
        System.out.println("55-33=" + (55-33)); }
}

```

SedegSi mi iReba: 55 - 33 = 22.

monacemTa Sesatanad Java-enaSi gamoiyeneba System.in martivi konstruqcia, magram igi damatebiT moiTxovs dazustebas. monacemebis Setanisas gamoiyeneba nakadebze bazirebul i Setana-gamotanis operaciebi. is rom gardaiqmnas martivi tipis monacemebad, saWiroa BufferedReader da InputStreamReader kl asis gamoyeneba. ganvixil oT programis teqsti.

```
/*Pr7.java simple date-in */
```

```
import java.io.*;
```

```
public class dateIn
```

```
{
```

```
    public static void main(String[] args)
```

```
        throws IOException    // throws - gansakuTrebul i (gamosaricxi)
```

```
    { int a, b, c;            // SemTxvevis generirebis operatori
```

```
                                // new - mexsierebis gamoyofa
```

```
        BufferedReader din=new BufferedReader(
```

```
                                new InputStreamReader(System.in) );
```

```
        System.out.println("a = ");
```

```
        a=Integer.parseInt(din.readLine());
```

```
        System.out.println("b = ");
```

```
        b=Integer.parseInt(din.readLine());
```

```
        c = a + b;
```

```
        System.out.println("a+b = " + c);
```

```
    }
```

```
}
```

Sedegs SeiZl eba hqondes aseTi saxe:

```
a = 150
```

```
b = 400
```

```
a + b = 550
```

Sedegi, romelic miReba din.readLine-iT, aris String (striqonul i). vinaidan Cven aq ricxvebs viyenebT, amitom saWiroa maTi gardaqmna.

ganvixil oT programa, romel Sic gamoyenebul ia monacemTa  
sxvadasxva martivi tipebi da axal i konstruqciebi.

```
/*Pr8.java simple date-in-2 */
```

```
import java.io.*;  
class Keyboard {  
// Primitive Keyboard input of integers, reals, strings and characters.  
static boolean iseof = false;  
static char c;  
static int i;  
static double d;  
static String s;
```

```
static BufferedReader input  
    = new BufferedReader (  
        new InputStreamReader(System.in), 1); // buferSi 1 monacemi
```

```
public static int readInt () {  
    if (iseof) return 0;  
    System.out.flush();  
    try { s = input.readLine(); }  
    catch (IOException e) { System.exit(-1); }  
    if (s==null) {  
        iseof=true;  
        return 0;  
    }  
    i = new Integer(s.trim()).intValue();  
    return i;  
}
```

```
public static char readChar () {  
    if (iseof) return (char)0;  
    System.out.flush();  
    try { i = input.read(); }  
    catch (IOException e) { System.exit(-1); }
```

```

    if (i == -1) {
        iseof=true;
        return (char)0;
    }
    return (char)i;
}

public static double readDouble () {
    if (iseof) return 0.0;
    System.out.flush();
    try { s = input.readLine(); }
    catch (IOException e) { System.exit(-1); }
    if (s==null) {
        iseof=true;
        return 0.0;
    }
    d = new Double(s.trim()).doubleValue();
    return d;
}

public static String readString () {
    if (iseof) return null;
    System.out.flush();
    try { s=input.readLine(); }
    catch (IOException e) { System.exit(-1); }
    if (s==null) {
        iseof=true;
        return null;
    }
    return s;
}
public static boolean eof () {
    return iseof;
}
} // zogierT komentars $6.5.1-Si gavakeTebT (if...else, try, catch-Sesaxeb).

```

### 1.4.3. monacemTa rTul i tipebi da operaciebi

Java-enaSi xSirad gamoiyeneba ufro rTul i konstruqciis (tipis) monacemebi, vidre martivi. C&C++ enis msgavsad, masivi aris erTgvarovan (erT-tipur) monacemTa erTobl ioba, roml is el ementebi SeiZl eba iyos: martivi tipis monacemebi, obieqtebi an sxva masivebi.

Java-enis instruments aqvs Cadgmul i kl asi String, romel ic masivebis dros xSirad gamoiyeneba. Sesazl ebel ia agreTve axal i kl asebis Seqmnac.

masivebis gamosayenebl ad Java-enaSi sami proceduraa Sesasrul ebel i: masivis gamocxadeba (saxel iT, tipiT da el ementebiT), misTvis mexsierebis gamoyofa (el ementTa raodenobis miTiTebiT) da inicial izeba (el ementebze sawyisi mniSvel obebis miniWeba). ganvixil oT programebi.

```
/*Pr9.java Array - 1 */
```

```
public class ArrayElem {
    public static void main(String[] args) {
        int Mas[] = new int[5];
        boolean bulbul[] = {true, false};
        Mas[0]=1; Mas[1]=8; Mas[2]=0; Mas[3]=2; Mas[4]=15;
        System.out.println("Mas has "+Mas.length+" Elements");
        System.out.println("bulbul has "+bulbul.length+" Elements");
        System.out.println(Mas[0]); System.out.println(Mas[1]);
        System.out.println(Mas[2]); System.out.println(Mas[3]);
        System.out.println(Mas[4]);
        System.out.println(bulbul[0]); System.out.println(bulbul[1]);
    }
} Sedegs eqneba aseTi saxe:
Mas has 5 Elements
bulbul has 2 Elements
1 8 0 2 15
true false
```

```
// Pr10.java ArrayYear -----
class Monate {
    public final static String[] // konstante bia
        MONTH_NAME = { "",
            „Januar“, „Februar“, „Maerz“, „April“,
            „Mai“, „Juni“, „Juli“, „August“,
            „September“, „Oktober“, „November“, „Dezember“ };
    public final static int[]
        DAYS_OF_MONTH = { 0,
            31, 28, 31, 30,
            31, 30, 31, 31,
            30, 31, 30, 31 };
    public final static int
        JANUAR=1, FEBRUAR=2, MAERZ=3, APRIL=4, MAI=5,
        JUNI=6, JULI=7, AUGUST=8, SEPTEMBER=9,
        OKTOBER=10, NOVEMBER=11, DEZEMBER=12;
    static int M = MAI;

    public static void main (String[] args) {
        System.out.println("Monat " + MONTH_NAME[M]
            + " hat " + DAYS_OF_MONTH[M] + " Tage !");
    }
}
    Sedegi: Monat Mai hat 31 Tage !
```

## 1.5. ganSt oebebi da ci kl ebi

### 1.5.1. if ...else... da switch operatorebi

Java ena strukturul i daprogramebis el ementebi T mdidaria. masSi gamoiyeneba ganStoebis martivi if, if...else... da Cal agebul i if...else...if else... da a.S. konstruqciebi. Tu gvaqvs Cal agebis ramdenime done, maSin umj obesia switch() funqciis gamoyeneba. qvemoT mocemul ia am konstruqciebis Caweris sintaksi da sail ustracio programebi.

- 1) **if** (l ogikuri piroba)  
    **operatori**;
- 2) **if** (l ogikuri piroba) // Tu l og-piroba sworia  
    **operatori-1**; // srul deba op-1  
    **else** //Tu ara  
    **operatori-2**; // srul deba op-2

aseTi ganStoebis al ternatiul i, efeqturi konstruqciaa:  
    **cvl adi = (l og.pir.)? gamosax-1 : gamosax-2;**

magal iTad,  $y = (x > a)? 500 : (a+100)/x$ , aq  $x \neq 0$ .

- 3) **if** (l og-piroba-1)  
    **operatori-1**;  
    **else**  
        **if** (l og-piroba-2)  
            **operatori-2**;  
        **else**  
            **if** (l og-piroba-3)  
                **operatori-3**;  
    **da a.S.**
- 4) **switch** (gamosaxul eba)  
    {  
        **case** konstanta-1: // mag.: 1 an 49 an '1'  
            **operatori-1**;  
            **break**; // switch-dan gamosvl a  
        **case** konstanta-2: // mag.: 27 esaa Esc-ASCII  
            **operatori-2**;  
        . . . **break**;  
        **case** konstanta-7: // aq araa **break**; amitom  
            **operatori-22**; // op-22 Semdeg default:-is  
        **default** : // sxva-op. Sesrul deba  
            **sxva-operatori**;  
            **break**;  
    }

switch() funqcia gamoiyeneba mraval punqtiani meniuebis  
(dial ogebis) dasaprogramebl ad.

```

    ganvixil oT sail ustracio programebi.
// Pr10.java if...else...
class ZeitPlan {
    private static int hour, minute; // aqtual uri dro !
    private static void addMinutes (int m)
    { // aqtual ur dros zrdis m wuTiT
        int totalMinutes = (60*hour + minute + m) % (24*60);
        if (totalMinutes < 0)
            totalMinutes = totalMinutes + 24*60;
        hour = totalMinutes/60;
        minute = totalMinutes%60;
    }
    private static int timeInMinutes ()
    {
        // iTvl is wuTebis 0:00 saaTidan aqtual uri droisTvis
        int totalMinutes = (60*hour + minute) % (24*60);
        if (totalMinutes < 0)
            totalMinutes = totalMinutes + 24*60;
        return totalMinutes;
    }
    private static void printTime ()
    {
        // beWdavs aqtual ur dros AM, PM -iT
        if ((hour == 0) && (minute == 0))
            System.out.print("SuaRame");
        else
            if ((hour == 12) && (minute == 0))
                System.out.print("SuadRe");
            else {
                if (hour == 0) System.out.print(12);
                else
                    if (hour > 12) System.out.print(hour-12);
                    else
                        System.out.print(hour);
            }
    }
}

```



```

    if (minute < 10)
        System.out.print(":0" + minute);
    else
        System.out.print(": " + minute);
    if (hour < 12)
        System.out.print("AM");
    else
        System.out.print("PM");
}
}
private static void printTimeInMinutes ()
{ // beWdavs aqTual ur dros wuTebSi
    printTime ();
    System.out.println(„ = „ + timeInMinutes() +
                        „, Minute des Tages „);
}
private static void includeNewEntry (int intervalInMinutes)
{ // beWdavs striqons: dros da , _____ ;
    // zrdis dros interval ebis Sesabamisad
    printTime();
    System.out.println(„ _____”);
    addMinutes(intervalInMinutes);
}
//-----
public static void main (String[] args)
{
    hour = 8; minute = 30;
    // beWdavs droiT monacemebs cxril is saxiT
    System.out.println(„Sexvedrebis kal endari : dro + teqsti“);
    System.out.println(„_____“);
    printTime();
    System.out.println(„ _____”);
    addMinutes(30);
    printTime();
    System.out.println(„ _____”);
}

```

```

addMinutes(30);
printTime();
    System.out.println(" _____");
addMinutes(150);
printTime();
    System.out.println(" _____");
addMinutes(100);
printTime();
    System.out.println(" _____");
addMinutes(10);
printTime();
    System.out.println(" _____");
addMinutes(30);
includeNewEntry(100);
System.out.println("");
System.out.println("dRis bol o (aqtual uri) dro wuTebSi :");
printTimeInMinutes ();
}
}

```

Sedegebis cxril i mocemul ia qvemoT.

| შეხვედრების<br>კალენდარი : დრო     | ტექსტი |
|------------------------------------|--------|
| 8:30 PM                            | -----  |
| 9:30 PM                            | -----  |
| შუაღამე                            | -----  |
| 1:40 AM                            | -----  |
| 1:50 AM                            | -----  |
| 2:20 AM                            | -----  |
| დღის ძალი (აქტუალური) დრო წუთებში: |        |
| 4:00 AM = 240 min                  |        |

ganStoebis if...else konstruqcia Cven gamoviyleneT Pr8.java-programaSi (\$ 6.4.2). axl a SeiZI eba ganmarTEba mivceT zogierT operatorebs am programidan, kerZod try, catch, exit, flush.

rogorc cnobil ia, programiis muSaobis dros SeiZI eba iseTi situacia dafiqsirdes, roca manqana `gaiWedeba~ (programul i Secdomis gamo). magal iTad, 0-ze gayofisas an sxva. amas specifikur **gansakuTrebul (gamosaricx) SemTxvevebs** uwodeben. winaswar iTval iswineben da weren maT damuSavebis funqciebs, raTa ar moxdes aseTi movl ena.

Tu gansakuTrebul i SemTxveva `amotivtivda~, maSin try-catch operatorebma iniciativa unda aiRon da `ganmuxton- mdgomareoba. qvemoT motanil ia es fragmenti:

```
...
System.out.flush(); // buferis nakaduri monacemebis iZul ebiTi
                    // gadmotvirTva gare mexsierebaSi
try                // gansakuTrebul i SemTxvevis daWera
{
    s = input.readLine();
}
catch (IOException e) // Setyobinebis gamotana gansak.SemTxvevaze
{
    System.exit(-1); // programis muSaobis damTavreba
}
...
```

java.io - paketSi yvel a kl asis meTods SeuZI ia gansakuTrebul i situaciis IOException generireba. amitom daprogramebis stil is gasaumj obesebl ad yovel Tvis ukeTesia Setana-gamotanis operaciebis gamoZaxeba moTavsdes try da catch bl okebSi.

### 1.5.2. cikl is operorebi: **while, for da do..while**

Java enaSi gamoiyeneba sami tipis cikl uri operatori. maTi zogadi konstruqcia aseTia:

1) **while (gamosaxul eba) // logikuri piroba  
operatori;**

Tu **gamosaxul eba** `WeSmaritia~ (anu 1), maSin srul deba **operatori**, Tu `mcdari~ (anu 0), gamodis cikl is gareT.

Tu ramdenime operatoria cikli Si Sesasrul ebel i, isini Tavsdeba figurul frCxil ebSi. cikli idan gamosvl a xdeba agreTve operatoriT **break**.

2) **do**

```

    operatori; // an ramdenime { operatori }
    while (gamosaxul eba) // l ogikuri piroba
aseTi cikli i erTxel mainc Sesrul deba, sanam Semowmdeba
l ogikuri piroba. Tu es gamosaxul eba gaxda `mcdari~, maSin
cikli i dasrul deba.

```

3) **for (init; test; update)**

**operatori;**

sadac **init** aris cikli Si mTvl el is (cvl adis) sastarto mniSvnel oba. aqve Sesazl ebel ia iyos pirvel isgan mZimiT gamoyofil i sxva cvl adebic. **test** aris l ogikuri piroba cikli is Sesasrul ebl ad (Tu `WeSmaritia~). **update** mTvl el is mniSvnel obas cvl is, raTa gamovricxoT `usasrul o cikli i-. magal iTad: **for (short i=1, int j=106; i < 10; i++, -- j).**

cikli idan gamosvl a vadaze adre (roca **test** `WeSmaritia~) SeiZl eba **break** operatoriT. **C&C++** enisgan gansxvavebiT **Java**-s aqvs **break Label;** saSual ebac (cikli idan gamosvl a `Wdis-miT iTebiT). magal iTad:

```

A1: for (short i=100; i > 0; i-- ) //1-el i cikli i
    { for(int j=0; j<100; j++) //me-2 cikli i
        { if (Matric[i][j] > 55) { break; } //gamosvl a me-2 cikli idan
            { if Matric[i][j] == null ) { break A1; } } } } // A1 - Wdea

```

**break**-saviT gamoiyeneba **continue** operatori, oRondac igi ar tovebs cikli s, mxol od vadaze adre amTavrebs mocemul bijs da ubrundeba cikli s mTvl el is Semdegi iteraciIT. axl a ganvixil oT programa do {...} while cikli iT.

// Pr11.java Zebnisa da mowesrigebis meTodi masivebiT -----

```

public class Quicksort {
    public static void quicksort (int[] a, int links, int rechts) {
        int help; int i = links; int j = rechts;
        int x = a[(links+rechts) / 2]; // Sedarebis el ementi

```

```

do {
    while (a[i] < x) i++;
    while (a[j] > x) j--;
    if ( i <= j )    {
        help = a[i];
        a[i] = a[j];
        a[j] = help;
        i++; j--;   }
    } while ( i <= j);
// marcxena nawil Si el ementebi nakl ebia marj venaze.
// marcxena-marj vena nawil ebis mowesrigeba
if (links < j) quicksort(a, links, j);
if (i < rechts ) quicksort(a, i, rechts );
} // --- end class -----
public static void main (String argv[])
{ int[] a; int n;
  System.out.print(" vel is sgrZe :");
  n = Keyboard.readInt(); a = new int[n];
  System.out.println(n + " vel is mniSvnel oba: ");
  for (int i = 0; i < n; i++)
    { System.out.print(" Semdegi ricxvi :");
      a[i] = Keyboard.readInt(); }
  quicksort(a, 0, n-1); // saSedego vel is dal ageba---
  System.out.println("mowesrigebul i vel i:"); // Sedegi
  for (int i=0; i<a.length; i++)
    System.out.print("“ “ + a[i]);
  System.out.println();
}
}

```

## 1.6. Case-teqno logi a da Uml-ena

dasawyisSi aRniSnul iqna, rom yvel a Tanamedrove daprogramebis enas safuZvl ad aqvs obieqt-orientirebul i daprogramebis meTodi, romel zec CASE-teqno logi a da UML-enis konstruqciebia real izebul i. \$6.1-Si am Tval sazrisiT ganvixil eT Java-proeqtis agebis etapebi da zigierTi cnebebi.

programul i enebisa da sistemebis paketebis Semqmmel i firmebi swored am teqnoL ogiebs iyenebs. ra kavSiri aqvs Java-enas am sakiTxTan ? magal iTad, iseTi cnobil i programul i paketebi, rogoricaa Rational Rose, Paradigm Plus, Together, ObjectiveF da mraVal i sxva, fl obs dapogramebis avtomatizaciis saSual ebebs.

es niSnavs imas, rom momxmarebel i agebs proeqts vizual uri komponentebis saSual ebiT, Semdeg ki Case-paketi TviTon qmnis Java-programis kods. aseT `reversul --teqnoL ogias (proeqti-programa-proeqti) dRes msOfL ioSi didi gamoyeneba aqvs, vinaidan sagrZnobl ad Cqardeba proeqtebis real izacia da maRI deba programul i produqtis standartizaciis done.

momdevno paragrafidan ganvixil avT obieqt-orientirebul i dapogramebis Sesazl ebl obebs Java-enisaTvis.

## 1.7. kl asebi , obieqtebi da meTodebi

Java-enaSi ar gamoiyeneba struct el ementi, romel ic C&C++ enis erT-erTi mTavari konstruqciaa. mis funqcias aq asrul ebs termini class. rogorc cnobil ia, kl asi monacemebisa (attributebis) da maTi damuSavebis meTodebis (funqciebis) inkafsul irebiTaa miRebul i (\$ 1.4). ganvixil oT programis magal iTi Java-enaze kl asebis da obieqtebis wamosadgenad.

```
// Pr12.java class, object, methods -----
class Schedule { private static void includeNewEntry
    (Time t, String s, int intervalInMinutes) {
    // beWdavs striqons: dro, RonisZiebis dasaxel eba s;
    // umatebs dros RonisZiebis xangrZl iobas
    t.printTime(); System.out.println(" "+ s);
    t.addMinutes(intervalInMinutes);
}
public static void main (String[] args) {
    Time t1 = new Time(8,30); Time t2 = new Time(); Time t3, t4;
    // beWdavs Sexvedrebis gegmas
    System.out.println("pi rvel i gegma:");
    includeNewEntry(t1,"PI1",90);

```

```

includeNewEntry(t1,"Sesveneba",15);
includeNewEntry(t1,"TI1",90);
includeNewEntry(t1,"Sesveneba",15);
t3 = t1;           // mimaTva igive obieqtze
t4 = t1.copy();   // mTel i obieqtis dubl ireba
includeNewEntry(t1,"Ma1",100);
includeNewEntry(t1,"Sesveneba",15);
includeNewEntry(t1,"Ma2",20);
System.out.println("dRis bol o (aqtual uri) dro wuTebSi: ");
t1.printTimeInMinutes ();
System.out.println(" ");
System.out.println("meore gegma:");
includeNewEntry(t2,"meoradi sagani",100);
includeNewEntry(t2,"seminari",90);
System.out.println("dRis bol o (aqtual uri) dro wuTebSi: ");
t2.printTimeInMinutes ();
System.out.println(" ");
System.out.println("mesame gegma:"); // t1, t3 -> erTi obieqtia
includeNewEntry(t3,"sporti",100); // t3: aqtual uri t1-dro
includeNewEntry(t3,"dasveneba",200);
System.out.println("dRis bol o (aqtual uri) dro wuTebSi: ");
t3.printTimeInMinutes ();
System.out.println(" ");
if (t4.before(t1)) {
    System.out.println("meoTxe gegma:"); // t1 <> t4
includeNewEntry(t4,"meore damat.sagani",100); //t4: Zvel i t1-dro
includeNewEntry(t4,"Tavisufali",200);
    System.out.println("dRis bol o (aqtual uri) dro wuTebSi: ");
    t4.printTimeInMinutes ();
}
}
}
}
am programaSi gamoyenebul ia kl asi Time, roml iTac ganisazRvreba
t1, t2, t3 Ra t4 obieqtebi. misi aRwera $6.8-Sia mocemul i.

```

## 1.8. Interfeisis damuSaveba

C++ enaSi real izebul ia mraVal j eradi memkvidreobiToba (\$5.13), roca ori an meti sabazo kl asidan (superkl asi) miRebul ia erTi warmoebul i kl asi (subkl asi). aseTi instrumentis arseboba enis did simZl avreze metyvel ebs, magram, misi gamoyenebisas programistebs xSirad Secdomebic mosdiT. amitomac Sun-firmam Java enidan igi amoRo.

imisaTvis, rom Sesazl ebel i iyos real urad arsebul i mraVal j eradi memkvidreobiTi kavSirebis real izacia Java-enaSi, gamoiyeneba kl asis gansakuTrebul i forma, romel sac interfeiss (Interfaces) uwodeben. igi Sedgeba mxol od abstraqtul i meTodebisa da konstantebisagan da SeiZl eba ar hqondes konstruqtori. magal iTad,

```
public interface ClassName //interfeisis da TviT fail is saxel i
{
    //unda iyos erTi da igive
    public int method1();
    public double method2();
}
```

interfeisi aris ufro moqnili struqtura, vidre abstraqtul i kl asi, vinaidan misi saSual ebiT Sesal ebel ia kl asi gamdidrdes axali funqcional uri Sesazl ebl obebiT.

kl asTa memkvidreobiTobis ganxil visas moixsenieben termins "warmoebul i" (sabazo A-kl asidan warmoebul i B-qvekl asi). interfeisis SemTxvevaSi am cnebis anal ogiuria `real izacia, Sesrul eba~ (Implementation). interfeisis realizaciis saSual ebiT kl asi val debul ia masSi gamocxadebul i yvel a meTodi aRweros. erTi meTodic rom akl des, miviRebT Secdomas. ganvixil oT magal iTi:

```
public class Person
implements ClassName
{
    public String name;
    public int Atr1;
    public int Atr2;    //mag., dabadebis wel i
}
```



```

public int Atr3;    // asaki
private double Atr4; // mag., Tviuri xel fasi
private double Atr5; // xel ze asaRebi Tanxa

```

```

public int method1()

```

```

    { return 2003-Atr2; }

```

```

public double method2()

```

```

    { return Atr4 - Atr4*KP; } // KP dasabegri-% (mag.,12%)

```

```

}

```

programaSi gasaReburi sityva **implements** gamoiyeneba imisaTvis, rom kompil ators gadaeces Setyobineba kl asSi real izebul i interfeisis Sesaxeb. kompilatori sintaksurad amowmebs interfeisis teqsts da gamoscems informacias arsebul i Secdomebis Sesaxeb (Tu aseTi arsebobs). magal iTad, Tu interfeisi gamocxadebul i ramdenime meTodidan romel ime maTgani araa aRweril i.

erTi interfeisidan SeiZl eba sxva interfeisebis warmoeba, rogorc es kl asisTvis iyo damaxasiaTebel i. maT gadaecemaT memkvidreobiT pirvel i interfeisis yvel a Tviseba. mas Semdeg, rac interfeisi real izebul i iqneba programaSi, Sesazl ebel ia misi gamoyeneba rogorc axal i tipisa (kl asis magvarad).

gansxvaveba kl assa da interfeiss Soris am SemTxvevaSi isaa, rom kl asi (rogorc tipi) gadascems obieqts Tavis yvel a Tvisebas, interfeisi ki - mxol od nawil s (rac xSirad ufro mosaxerxebel i da moqnilia).

interfeisebs SeuZl iaT static da final attributebiT konstantebis gamoyeneba. SeiZl eba interfeisi mxol od konstantebidan Sedgebodes:

```

//interfeisis tanSi meTodis gamocxadeba

```

```

public void aDarizxTanxa();

```

```

//konstantis gamocxadeba

```

```

public static final long kMinute=11520;

```

Tu interfeisi gamocxadebul ia rogorc public, maSin nebismier kl ass SeuZl ia masSi gamocxadebul i konstantebis wakiTxva.

ganvixil oT programis teqsti interfeisiT.

```
// Pr13.java    interface -----
interface TimeI {
    public void addMinutes (int m);
    public void subtractMinutes (int m);
    public void printTime ();
    public void printTimeInMinutes ();
}
class Time implements TimeI
{ private int hour, minute; // aqTual uri dro
    public Time (int h, int m) { hour = h; minute = m; }
    public Time () {hour = 0; minute = 0; }
    public void addMinutes (int m) {
        // aqTual ur dros zrdis m wuTiT
        int totalMinutes = (60*hour + minute + m) % (24*60);
        if (totalMinutes < 0)
            totalMinutes = totalMinutes + 24*60;
        hour = totalMinutes/60;
        minute = totalMinutes%60;
    }
    public void subtractMinutes (int m) { addMinutes(-m); }
    public void printTime () {
        // beWdavs aqTual ur dros AM, PM -iT
        if ((hour == 0) && (minute == 0))
            System.out.print("SuaRame");
        else
            if ((hour == 12) && (minute == 0))
                System.out.print("SuadRe");
            else {
                if (hour == 0)
                    System.out.print(12);
                else
                    if (hour > 12)
                        System.out.print(hour-12);
            }
    }
}
```

```

        else
            System.out.print(hour);

    if (minute < 10)
        System.out.print(":0" + minute);
    else
        System.out.print(": " + minute);

    if (hour < 12)
        System.out.print("AM");
    else
        System.out.print("PM");
    }
}

public void printTimeInMinutes ()
{ // beWdavs aqtual ur dros wuTebSi
    printTime ();
    System.out.println(., = ,, + timeInMinutes() +
        " Minute des Tages ");
}

private int timeInMinutes ()
{ // private: damxmare funqcia
    // iTvl is wuTebS 0:00 saaTidan aqtual uri droisTvis
    int totalMinutes = (60*hour + minute) % (24*60);
    if (totalMinutes < 0)
        totalMinutes = totalMinutes + 24*60;
    return totalMinutes;
}
}

class ScheduleInt {
    private static void includeNewEntry
        (TimeI t, String s, int intervalInMinutes) {

        // beWdavs striqons: dros, s-RonisZioebis dasaxel ebas;

```

```

// zrdis t-dros RonisZioebis interval is Sesabamisad
t.printTime();
System.out.println("  "+ s);
t.addMinutes(intervalInMinutes);
}

public static void main (String[] args) {
    TimeI t1 = new Time(8,30);
// beWdavs SexvedraTa gegmebs:
    System.out.println("erster Plan:");
    includeNewEntry(t1,"PI1",90);
    includeNewEntry(t1,"Sesveneba",15);
    System.out.println("bol o (aqtual uri) dro wuTebSi: ");
    t1.printTimeInMinutes ();
    System.out.println(" ");
}
}

```

## 1.9. savarj i So programebi

obieqt-orientirebul i daprogramebis el ementebis ganxil visas Cven gavecaniT kl asebis, obieqtebis da meTodebis Java-enaze realizaciis sakiTxebs (\$1.7). qvemoT moyvanilia memkvidreobiTobis daprogramebis Sesabamisi kodis fragmenti.

```

// Pr14.java Inheritance -----
class Time
{
    protected int hour, minute;
    public Time (int h, int m) { hour = h; minute = m; }
    public void addMinutes (int m)
    {
        int totalMinutes = (60*hour + minute + m) % (24*60);
        if (totalMinutes < 0)
            totalMinutes = totalMinutes + 24*60;
        hour = totalMinutes/60;
    }
}

```

```

    minute = totalMinutes%60;
}
public void printTime ()
{ if ((hour == 0) && (minute == 0))
    System.out.print("SuaRame");
  else if ((hour == 12) && (minute == 0))
    System.out.print("SuadRe");
  else { if (hour == 0)
        System.out.print(12);
        else if (hour > 12)
            System.out.print(hour-12);
        else System.out.print(hour);
    if (minute < 10)
        System.out.print(":0" + minute);
    else System.out.print(": " + minute);
    if (hour < 12)
        System.out.print("AM");
    else System.out.print("PM");
} } }
class PreciseTime extends Time
{ private int second;
  public PreciseTime (int h, int m, int s)
    { super(h, m); second = s; }
public void addSeconds (int s)
{ int advMinutes = s / 60;
  second += s % 60;
  if (second < 0)
    { advMinutes--;
      second += 60; }
  else
    if (second >= 60)
      { advMinutes++;
        second -= 60; }
  addMinutes(advMinutes);
}

```

```

public void printTime ()
{ if ((hour == 0) && (minute == 0))
    System.out.print("SuaRame");
  else
    if ((hour == 12) && (minute == 0))
        System.out.print("SuadRe");
    else
        { if (hour == 0)
            System.out.print(12);
          else
            if (hour > 12)
                System.out.print(hour-12);
            else
                System.out.print(hour);
          if (minute < 10)
              System.out.print(":0" + minute);
          else
              System.out.print(":." + minute);
        }
    if (second < 10)
        System.out.print(":0" + second);
    else
        System.out.print(":." + second);
    if (hour < 12)
        System.out.print("AM");
    else
        System.out.print("PM");
  }
}
}
class Time2 { public static void main(String[] args)
{
    PreciseTime lunchtime = new PreciseTime(12, 1, 0);
    lunchtime.addMinutes(1);
    lunchtime.printTime();
}
}

```

```

        System.out.println();
        lunchtime.addSeconds(-61);
        lunchtime.printTime();
        System.out.println();
        lunchtime.addSeconds(1);
        lunchtime.printTime();
        System.out.println();
    }
}

```

axl a ganvixil oT apl etebis sail ustracio programebi.

```

// Pr15.java Applets ----
import java.awt.*;
import java.applet.*;
import java.awt.event.*;
public class TempApplet extends Applet
    implements ActionListener {
    // Convert from Fahrenheit to Centigrade
    TextField tFahr;
    Label lCent;
    public void init() {
        // Create the TextField and the Label
        tFahr = new TextField(10);
        lCent = new Label(
            "I'll tell you what that is in degrees C");
        // Lay out the three Components
        add(new Label("Please type the temperature (deg F): "));
        add(tFahr);
        add(lCent);
        // Register the Component Listener
        tFahr.addActionListener(this);
    }
    // Respond to Action Event: typing in the tFahr TextField
    public void actionPerformed (ActionEvent e) {
        double fahr=0.0, cent=0.0;

```

```

    fahr = Integer.parseInt(tFahr.getText());
    cent = 5.0 * (fahr - 32) / 9.0;
    lCent.setText(fahr + « deg F is « + cent + « deg C»);
}
}

```

```

// Pr16.java  Ereignisse (Events): Eyes Applet
// *** (ein Beispiel zu Applets, Events, Graphics)
import java.awt.*;
import java.awt.event.*;
import java.applet.*;
public class EyesApplet extends Applet
    implements MouseMotionListener {
    Point cursor;
    Eyes e1, e2;
    public void init () {
        // Register the Listener.
        addMouseMotionListener(this);
        setSize(500,400);
        e1 = new Eyes(new Point (63,30)); // center of one eye
        e2 = new Eyes(new Point (437,30)); // center of the other
        cursor = new Point(250, 2000); // initial cursor
    }
    public void paint(Graphics g) {
        e1.stare(g, cursor);
        e2.stare(g, cursor);    }

    public void mouseMoved (MouseEvent e) {
        cursor = e.getPoint();
        repaint();    }

    // not necessary:
    public void mouseDragged (MouseEvent e) {}
}
// Pr17.java  Events: Eyes Applet, Graphics)

```



```

import java.awt.*;
import java.awt.event.*;
import java.applet.*;
public class Eyes {
    private Point left, right, leftPupil, rightPupil;
    private final int EYE_RADIUS = 30, PUPIL_RADIUS = 10;
    public Eyes(Point c) {
        left = new Point(c.x-EYE_RADIUS-3, c.y);
        right = new Point(c.x+EYE_RADIUS+3, c.y);
    }
    private void fillCircle (Graphics g , Point center, int radius) {
        // Utility method "fillOval": abbreviated way to draw a filled circle.
        g.fillOval(center.x-radius, center.y-radius, 2*radius, 2*radius);
    }
    public void stare (Graphics g, Point cursor) {
        g.setColor(Color.white); // Draw the white eyes
        fillCircle(g, left, EYE_RADIUS);
        fillCircle(g, right, EYE_RADIUS);
        g.setColor(Color.black); // Draw the pupils
        leftPupil = compute (cursor, left);
        fillCircle(g, leftPupil, PUPIL_RADIUS);
        rightPupil = compute (cursor, right);
        fillCircle(g, rightPupil, PUPIL_RADIUS);
    }
    private Point compute (Point cursor, Point eye) {
        // Compute the location of the pupil, given the
        // locations of the eye and the cursor.
        double d = Math.sqrt((cursor.x-eye.x)*(cursor.x-eye.x)
            + (cursor.y-eye.y)*(cursor.y-eye.y));
        int r = EYE_RADIUS - PUPIL_RADIUS;
        return new Point (eye.x + (int)((cursor.x-eye.x)*r/d),
            eye.y + (int)((cursor.y-eye.y)*r/d));
    }
}

```

## klTxvebi da savarjI Soebi

1. Java enaze programul i sistemis daproeqtების 5 etapi.
2. Java programis kompil irebisa da linkirebis etapebi.
3. ra aris apl etis da aplikacia ?
4. ra kavSiria Java da HTML enebSoris ?
5. monacemTa tipebi da operaciebi.
6. ra gansxvavebaa Java da C&C++ enebSoris ?
7. rogor xdeba cvl adebisa da konstantebis gamocxadeba ?
8. cvl adebis romel tipebs icnobT ?
9. monacemTa martivi Setana-gamotanis operaciebis sintaksi.
10. ra aris gansakuTrebul i (gamosaricxi) SemTxveva ?
11. SeadgineT Java-programa studentis 5-monacemis Sesatanad.
12. ra aris masivi da rogor xdeba masTan muSaoba Java enaSi?
13. axseniT if, if...else, if..else..if... konstrukciebis muSaoba.
14. rogor muSaobs konstrukcia "= ( ) ? : " Java enaSi ?
15. ras warmoadgens switch funqcia da misi sintaksi ?
16. daaxasiaTeT while da do...while cikl is operatorebi.
17. rogor muSaobs for() cikl i ? moitaneT magal iTebi.
18. kl asebis da obieqtების daprogameba Java enaSi.
19. meTodebis gamocxadeba da aRwera Java enaSi.
20. ra aris interface da implements ?
21. rogor xdeba memkvidreobiTi kavSirebis daprogameba ?
22. mraval jeradi memkvidreobiTobis real izacia C++ da Java enebSi.
23. aageT programa sami kl asiT: I eqtori, studentTa jgufi da studentebi. daakavSireT isini erTmaneTTan I eqciebis mixedviT.
24. aageT programa fexburTis Cempionatis aRricxvisaTvis `evrol igis~ magal iTze.
25. aageT programa `biblioTeka-: mkiTxvel Ta momsaxureba da wignebis aRricxva.
26. aageT programa sawarmoo firmaSi rentabel uri produqciis SesarCevad. mocemul ia 20 produqti TviTRirebul ebebiTa da sareal izacio-sabazro fasebiT.

## II Tavi

### XML - monacemTa aRwerisa da internetSi gadacemisa

#### 2.1. XML enis Seqmna da misi dani Snul eba

eXtensible Markup Language (monacemTa formatirebis gafarToebuli ena) aris platformebisagan damoukidebeli metaena dokumentTa tipebis aRwerisaTvis. misi pirveli standartuli versia 1998 wels warmoadgina W3C-konsorciumma ([www.w3.org](http://www.w3.org)). misive produqciaa HTML (Hyper Text Markup Language).

amgvarad, XML da HTML monaTesave enebia, roml ebic SGML (Standard Generalized Markup Language) standartiT damusavda. esaa dokumentebis formatirebis standartuli ena, romel Ta daniSnul ebaa maTi Seqmna, wakiTxva (daTvaliereba) da beWdva. es enebi, rogorc cnobil ia, gamoiyeneba pirvel rigSi internetis Web-gverdebisaTvis. kerZod, HTML - dokumentirebuli informaciis aRsawerad da gamosatanad Web-gverdebze, xolo XML - aseTi informaciis aRwerisa da gadacemisaTvis (monacemebis gacvli svadasxva sistemebis Soris).

XML enis popul arobas ganapirobebs is faqti, rom mas aqvs monacemTa aRweris moxerxebuli formati, vidre sxva teqstur fail ebs, roml ebic gamoiyeneba informaciis gacvli iTvis biznesis sferoSi. aseT teqstur fail ebs ar gaaCniat struqtura, maTSi mxolod monacemebia. formatis mcire cvlilebac ki iwvevs gamoyenebit paketebSi problemebs, rasac maTi xelaxali gadaprogrameba swirdeba.

aseTi problemebisgan Tavisufal ia XML enaze dawerili dokumentTa fail ebi, vinaidan maTSi aris rogorc monacemebi (teqsti), aseve misi aRweris struqtura standartizebuli tegebis (tags) saxiT. amgvarad, XML formatis gamoyenebit monacemebisa da gamoyenebit paketebis Soris xorciel deba sruli damoukidebili obis koncepcia.

XML dokumenti aris Cveul ebrivi ASCII fail i, romel ic Tavisufi ad gadaicema internetSi. igi teqsturi tipis protokol uri fail ia, romel sac advil ad kiTxul obs adamianic da manqanac. perspeqtivaSi miaCniaT, rom XML gaxdeba monacemTa gadacemis universal uri formati, ar iqneba damokidebul i firmebsa da pl atformebsze.

amaze metyvel ebs msofli ioSi cnobili kompiuterul i teqnologi ebis firmebis Borland, MicroSoft, Sun Microsystems, Oracle da sxvaTa programul paketebSi XML enis farTo gamoyeneba. agreTve is samecniero publikaciebi, roml ebic gamoicema aRniSnul Temaze amerikis, germaniisa da sxva ganvitarebul i qveynebis sauniversiteto gamocemebsi.

## 2.2. XML enis struqtura

2.1 naxazze mocemul ia XML dokumentis fragmenti, romel ic pirvel warmodgenas mogvcems am fail is konstruqciaze.

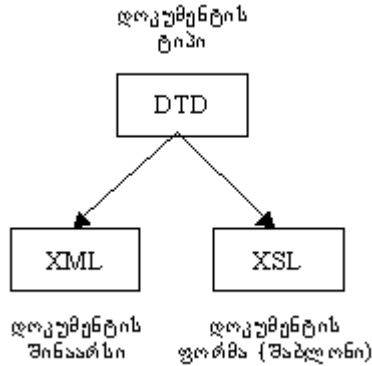
```
<? xml version="1.0" ?> <!--saTauri komentaris tegi -->
<bookstable> <!-- fesvuri el ementis dasawyisis tegi -->
  <books b_id="3-02-0025" <!-- cxril is striqonis tegebi -->
    b_autor="L. Torvalds" <!-- aris atributebi $7.4 -- >
    b_title=" Linux" />
  <books b_id="1-22-0415"
    b_autor="D. Martin"
    b_title=" Databases" /><!-- striqonebis dasasrul is tegebi-->
</bookstable> <!-- fesvuri el ementis dasasrul is tegi -->
```

### nax.2.1. XML- dokumentis fragmenti

teqstis marjvena nawil Si konstruqcia <!-- teqsti --> aris XML- enis komentari. danarCen el ementebs Cven SemdgomSi ganvixil avT, axl a ki TviT enis koncefcias SevexoT.

rogorc cnobil ia, nebismieri enis gansazRvra niSnavs misi gramatikisa da sityvaTa l eqsikonis dadgenas. aseT funqcias Cvens SemTxvevaSi DTD (Document Type Definition) asrul ebs.

ესაა დოკუმენტის ტიპის განსაზღვრის ინსტრუმენტი, რომელიც არწერს XML-სი მისი ელემენტებსა და ატრიბუტებს. DTD ფორმატი განსხვავდება XML-ფორმატიდან და შეიძლება ან ცალკე ფაილი, ან უსუალოდ XML-დოკუმენტი. 2.2 ნახაზზე ნაჩვენებია მისი სტრუქტურა.



ნახ.2.2. DTD სტრუქტურა

XSL (Extensible Style Sheet Language) სტილებს ცხრილია. იგი სპეციალურად შექმნილია XML-დოკუმენტისთვის, რომელიც განსაზღვრავს სხვა XML-დოკუმენტის ფორმატების ან მონაცემთა გარდაქმნის პრინციპს. მაგალითად, XML-დოკუმენტის კონვერტირება HTML-ფორმატში.

2.2 ნახაზიდან განსინაარსება და ფორმის მიმართების საკითხი. XML არწერს სინარსს (სემანტიკას) და იგი ყოველთვის ერთია. მისი ასახვის ფორმალური აპარატი კი მრავალფეროვანია (მაგალითად, ტექსტ-ფაილი, HTML-ფაილი, აუდიო-ვიზუალური ფაილი, მონაცემთა ბაზის ფაილი და ა.შ.), ზოგადად n-ფორმა. XSL ემსახურება სწორედ ასეთ გარდაქმნებს.

### 2.3 XML-ის ელემენტები

როგორც 2.1. ნახაზის პროგრამის ტექსტიდან დავინახეთ, XML ტექსტი <ტეგები>-ს სტრიკონებისგან შედგება. მისი პირველი სტრიკონი ყოველთვის ეწოდება სატურია - კომენტარი:

`<? xml version="1.0" ?>` an

`<? xml version="1.0" encoding="UTF-8" ?>` .

rogorc aRvniSneT, DTD da XML dokumentebi SeiZl eba SevinaxoT erTad (erT fail Si), an cal -cal ke. pirvel i SemTxveva il ustrebul ia 2.3 naxazze.

```
<? xml version="1.0" ?>
<!DOCTYPE doc[
  <!ELEMENT docElem (#PCDATA)>
]>
```

nax.2.3.

aq **doc** fesvuri el ementis saxel ia. fesvuri el ementi aris tegi, romel ic yvel a danarCen tegebs Seicavs. kvadratul frCxil ebSi " [ ] " moTavsebul ia el ementis aRwera (gansazRvra).

**PCDATA (Parsed character data)** aris teqsturi monacemebi.

meore SemTxvevaSi DTD dokumenti inaxeba XML-is gareT da xdeba masze cxadi mimarTva (ix.nax.2.4).

```
<? xml version="1.0" ?>
<!DOCTYPE doc SYSTEM "doc.dtd">
```

nax.2.4.

am SemTxvevaSi XML-anal izatori (Parser) fail ebis masivSi moZebnis "**doc.dtd**" saxel is fail s. masSi iqneba igive Sinaarsis teqsti, rac wina SemTxvevaSi " [ ] "- frCxil ebSi iyo.

SesaZl ebel ia orive wina SemTxvevis gaerTianeba.

amgvarad, XML-dokumentis prol ogi Sedgeba xml-versiis monacemebisa da DTD-misamarTisagan. fesvuri el ementi, rogorc aRvniSneT, mxol od erTia da Seicavs yvel a danarCen el ements.

```
<? xml version="1.0" ?>
<doc> avtobiografia</doc>
<person>
  <L_name> erisTavi </L_name>
  <F_name> pi pini a </F_name>
</person>
```

nax.2.5.

XML enis erT-erTi mTavari wesia is, rom yovel gaxsnil tegs aucil ebl ad unda hqondes daxurvis-tegi. SeiZl eba tegebs Soris adgil i iyos cariel i, magal iTad:

```
<F_name> </F_name>
```

XML enaSi mxedvel obaSi misaRebi simbol oebis registri, vinaidan striqonul i da mTavrul i aseobi gansxvavebul ia.

el ementebs Soris kavSirebi SeiZl eba ganxorciel des saxel ebiT, magal iTad:

```
<!ELEMENT Deprtm(#PCDATA)>  
<!ELEMENT Name(#PCDATA)>  
<!ELEMENT Head_of_Deprtm(Deprtm, Name)>
```

aq me-3 el ementis XML dokumenti erTxel Seicavs aRniSnul i mimdevrobiT 1-el da me-2 el ements.

el ementSi SesaZl ebel ia logikuri `an--is gamoyenebac, magal iTad:

```
<!ELEMENT Person(Name, Status, Phone|E-mail)>  
<!ELEMENT Name(#PCDATA)>  
<!ELEMENT Status(#PCDATA)>  
<!ELEMENT Phone(#PCDATA)>  
<!ELEMENT E-mail(#PCDATA)>
```

pirovnebas SeiZl eba ar hqondes **E-mail**, an hqondes 1, an ramdenime. aseT SemTxvevaSi Sesabamisi el ementis cvl adis bol oSi dasvamen simbol os: " ? " (esaa 0 an 1), " \* " (ramdenime) an " + " (minimum 1).

magal iTad, Tu pirovnebas tel efonis ramdenime nomeri aqvs, maSin gveqneba: " **Phone** \* ".

Tu aseTi aRniSvnebi araa gamoyenebul i, maSin igul isxmeba mxol od erTi mniSvel oba.

axl a ganvixil oT konkretul i magal iTi DTD da XML dokumentebisa `kaTedris akademiuri sagnebisaTvis-.

```
<!-- DTD -->  
<!ELEMENT Kafedra(KafSaxeli, Sagani +)>  
<!ELEMENT KafSaxeli(#PCDATA)>  
<!ELEMENT Sagani(thema, (text | resume) *)>
```

```

<!ELEMENT thema (#PCDATA)>
<!ELEMENT text (#PCDATA)>
<!ELEMENT resume (#PCDATA)>

<!-- XML -->
<? xml version="1.0" ?>
<!DOCTYPE Kaferda SYSTEM "Kafedra.dtd" >
<Kaferda>
  <KafSaxeli> marTvis avtomatizebul i sistemebi</KafSaxeli>
  <Sagani>
    <thema>dapogramebis meTodebi</thema>
    <text> teqsti, teqsti, teqsti,
      teqsti, teqsti, teqsti
    </text>
    <resume> reziume </resume>
    <text> teqsti, teqsti, teqsti
    </text>
  </Sagani>
</Kaferda>

```

#### 2.4. enis attributebi

XML enis elementis Sesaxeb damatebit informacias izi eva attributebi. Cven isini ganvixil et naxazebze 2.1 (elementi **books**) da 2.5 (elementi **person**). sadac "brWyal ebSi" da tegebSi "< >" iyo isini warmodgenili.

attributebisavis arsebobs garkveul i wesebi, romel Ta dacva aucil ebel ia mati gamoyenebisas. magal iTad,

- erT elementSi ar SeiZi eba atributis saxel is orjer gamoyeneba;

- atributis mnisvnel obas ufl eba ara aqvs mimarTos gare obieqtebs (Entity).

- atributis mnisvnel obas ar unda hqondes win "<"M.

axl a ganvixil oT attributebis gamoyenebis sakiTxi DTD-dokumentSi. magal iTad,



```

<!ATTLIST person gvari CDATA #REQUIRED
          asaki CDATA #REQUIRED
          simagle CDATA #IMPLIED
          zona CDATA #IMPLIED

```

>

aq elements **person** aqvs attributebis sia. Semdeg Cans atributis saxel i (mag.,gvari), tipi (CDATA simbol oebis teqsti) da bol os, modifikatori (**REQUIRED** - aucil ebel i, **IMPLIED** - araucil ebel i, **FIXED** - fiqsirebul i anu konstantaa).

atributis tipi SeiZl eba iyos Semdegi:

**CDATA** - simbol ur-teqsturi

**ID** - unikal uri identifikatori

**IDREF** - meoradi simbol uri identifikatori

**IDREFS** - mimarTvebis sia

**ENTITY** - atributis mniSnel oba unda eTanadebodes gare obieqts

**ENTITIES** - sia (gamyofad gamoiyeneba cariel i simbol o)

**NMTOKEN** - msgavsia **CDATA**-si, SezRudvebiT: iwyeba A-Z,a-z,0-9 simbol oebiT, dasaSvebia " . " da " , " (cariel i simbol o ara)

**NOTACION** - miniSneba (mag., kavSiri saxel sa da programas Soris).

ganvixil oT konkretul i magal iTi DTD da XML dokumentebisa `kaTedris akademiuri sagnebisatvis~ (nax.2.6).

```

<!-- DTD -->
<!ELEMENT Kafedra (Sagani)+ >
<!ELEMENT Sagani( sagn_ dasax, lektori, thema) >
<!ATTLIST Sagani mec_saxe(Lectia |Ppraqt | Labor) "Lectia"
          auditNo CDATA #REQUIRED      "6-207a "
          Tariqi CDATA #REQUIRED      "25.05.03"
          Time-Begin CDATA #REQUIRED  "10-45"
>
<!ELEMENT mecadineoba (#PCDATA)>
<!ELEMENT lektori (#PCDATA)>
<!ATTLIST lektori status(Prof |Doz |Ass) #REQUIRED >
<!ELEMENT thema (#PCDATA)>

```

nax.2.6

```

<!-- XML -->
<? xml version="1.0" ?>
<!DOCTYPE Kaferda SYSTEM "Kafedra.dtd" >
<Kaferda>
  <Sagani mec_saxe="I eqcia" auditNo="6-207a"
    Tariqi="25/05/03 Time-Begin="10-45" >
    <sagn-dasax> daprogramebis meTodebi </sagn-dasax>
    <lektori>g. surgul aZe </lektori>
    <thema>obieqt-orientirebul i daprogrameba </thema>
  </Sagani>

  <Sagani mec_saxe="I aboratoria" auditNo="6-205a"
    Tariqi="30/05/03 Time-Begin="15-35" >
    <sagn-dasax> daprogramebis meTodebi </sagn-dasax>
    <lektori>d. gul ua </lektori>
    <thema>abstraqtul i kl asebi </thema>
  </Sagani>

  <Sagani mec_saxe="I eqcia" auditNo="6-230d"
    Tariqi="15/06/03 Time-Begin="09-50" >
    <sagn-dasax> operaciaTa kvl eva </sagn-dasax>
    <lektori>g. gogiCaiSvil i </lektori>
    <thema>maragebis marTvis amocana </thema>
  </Sagani>

```

## 2.5. ar sebi (obieqt ebi)

arsis (Entity - obieqti) aris magal iTad, teqsti, suraTi, mel odia an sxva tipis obieti, romel ic dokumentis unda miebas aRniSnul adgil as miTiTebul i saxel iT.

obieqt ebi sami saxisaa:

- zogadi / parametrul i;

zogadi arsebi (obieqtTa kavSirebi) Cndeba mxol od XML-dokumentSi, xol o parametrul i mxol od DTD-Si.

orive obieqtis gamocxadeba xorciel deba winaswar DTD-dokumentSi.

- gaanal izebil i / gauanal izebul i;

enis gramatikul i anal izatori (Parser) j er Caanacvl ebs obieqts, Semdeg gaaanal izebs mis formal ur mxares. gauanal izebl ad gamoiyeneba mag., suraTebis obieqtebi.

- gare / Sida.

gare obieqtis Sinaarsi (Canacvl ebs teqsti, suraTi an sxv.) ganisazRvreba mimarTviT (maCvenebl iT). Sida obieqti ganisazRvreba uSual od misi gamocxadebisas dokumentSi.

miRebul ia zemoaRniSnul i kl asifikaciis daj gufeba. magal iTad,

- Sida, gaanal izebul i, zogadi obieqti:

<!ENTITY gtu "Georgian Technical University">

angvarad,gtu aris obieqtis saxel i,xol o Georgian Technical University Canacvl ebs teqsti.

obieqtis gamoZaxeba SemdgomSi moxdeba konstruqciIT:  
&gtu;

ganvixil oT sail ustracio magal iTi.

<? xml version="1.0" ?>

<! DOCTYPE Kafedra [

<! ELEMENT Kafedra (uni)>

<! ELEMENT uni (#PCDATA)>

<!ENTITY gtu "Georgian Technical University">

<!ENTITY uni "<uni>&gtu;</uni>" >

] >

<Kafedra>

&uni;

</Kafedra>

- Sida, gaanal izebul i, parametrul i obieqti:  
 mag.: <!ENTITY % margins "top | bottom | left | right" > da  
 Semdgomi gamoyenebi sTvis %margins;  
 - gare, gaanal izebul i, zogadi obieqti:  
 mag.: <!ENTITY ims SYSTEM "www.gtu.edu.ge/dprtm/K94.xml"  
 - gare, gauanal izebel i, zogadi obieqti:  
 mag.: <!ENTITY bild SYSTEM "/photos/img55.gif" NDATA gg>

## 2.6. kl Txvebi da savarj i Soebi

1. ra tipis enaa XML ?
2. rogori struqtura aqvs XML enas ?
3. ra aris tegi (tag) da rogor gamoiyeneba igi ?
4. arwereT XML dokumentis fragmenti ?
5. ras warmoadgens DTD dokumenti ?
6. rogoria DTD dokumentis tipis struqtura ?
7. ra msgavseba da gansxvavebaa XML da HTML fail ebs  
 Soris ?
8. ra el ementebisgan Sedgeba XML ?
9. ra aris PCDATA ?
10. rogor iwereba DTD da XML dokumentebi ?
11. ras warmoadgens XML enis atributebi ?
12. ra aris atributis tipi da modifikatori ?
13. rogor iwereba XML dokumentis teqsti atributebis  
 gamoyenebiT ?
14. ra aris arsebi (obieqtebi) ?
15. rogoria obieqtebis kl asifikacia ?
16. dawereT XML enaze programa `biblioTeka~.
17. aageT XML dokumenti `TanamSromleba firmaSi~.
18. aageT XML programa `I eqtorebi da akademiuri j gufebi~.
19. dawereT XML programis teqsti da gadaeciT internetiT

## I i t e r a t u r a

1. k. bothe, g. surgul aZe, T dol iZe, o. Sonia, g. surgul aZe. Tanamedrove programul i pl atformebi da enebi. stu, Tbil isi, 2003.

2. g. gogiCaiSvil i, g. surgul aZe, gr. surgul aZe. internetis veb-gverdebis daproeqtebisa da agebis teqno logia Tanamedrove programul sistemebSi. stu-s Sr.kreb., #4(437), Tbil isi, 2001.

3. <http://java.sun.com/xml/>(Sun)

4. Chan M.C., Griffith S.W., Iasi A.F. 1001 Java Programmer's Tips. "Jamsa Press", 1997.

5. <http://www.xml.org>

6. <http://www.xml.com>

7. <http://www.mintert.com/xml/buch>