

Sisteme Concurente și Distribuite

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Titlu: *Problema podului*

Profesor universitar: Dr. Ing. Costin Bădică

Student: Voiculescu Ioan-Valentin

Facultate: Automatică, Calculatoare și Electronică

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1 Declarația problemei

1.1 Titlu

Problema podului

1.2 Enunțul

Se considera o mulțime de mașini care încearcă în mod repetat să treacă un pod în lucru ce are o singură bandă de traversare. Fiecare mașină se deplasează într-un singur sens, fie de la stânga la dreapta, fie de la dreapta la stânga. Mașinile care se deplasează de la stânga la dreapta formează convoiul din stânga, iar celelalte mașini care se deplasează de la dreapta la stânga formează convoiul din dreapta. Capacitatea de traversare a podului este limitată, în sensul că la orice moment de timp pot să existe pe pod maximum mașini. În plus, mașinile se pot deplasa pe pod doar într-o singură direcție, nefiind posibil ca două mașini să mergă în direcții opuse să se întâlnească pe pod. Se cunoaște că există mașini în convoiul din stânga și mașini în convoiul din dreapta. Să se dezvolte un program concurent care simulează modul în care mașinile traversează podul în mod repetat. Fiecare mașină intră pe pod, traversează podul, și iese de pe pod, iar acest proces se repetă pentru fiecare mașină în parte de un număr prestabilit de ori. Fiecare mașină se va implementa printr-un fir de execuție separat. Fiecare dintre activitățile de deplasare a unei mașini în afara podului, respectiv pe pod, durează un interval de timp nenul. Mașinile nu se pot depăși pe pod, în schimb există posibilitatea depășirii în afara podului.

2 Proiectarea Aplicației

2.1 Corectitudinea rezultatului

Corectitudinea unui program concurrent presupune verificarea unor proprietati ale tuturor scenariilor posibile rezultate prin intreteserea arbitrara:

- Proprietatea de siguranta (engl. safety). O proprietate de siguranta P este satisfacuta daca si numai daca pentru orice scenariu posibil si pentru orice stare ea este adevarata.

In problema noastra aceasta proprietate este satisfacuta intrucat nicio masina nu se ciocneste (masinile circula intr-u singur sens la un moment dat).

- Proprietatea de vivacitate (engl. liveness). O proprietate de vivacitate P este satisfacuta daca si numai daca pentru orice scenariu posibil exista o stare in care ea este adevarata.

In *Problema podului* aceasta proprietate este satisfacuta, deoarece fiecare masina obtine la un moment dat sansa de a trece peste pod.

2.2 Clasa Main

Clasament Main este clasa principală în care creez Threadul principal `thread[0]`.

2.3 Clasa Masina

In această clasă voi avea proprietățile despre o mașină producator, model, an, număr înmatriculare.

2.4 Clasa Read

Această clasă se va ocupa de citirea datelor din fișier.

2.5 Clasa Write

Această clasă se va ocupa de scrierea datelor în consolă. Functia `console()` va afișa starea actuală a podului.

2.6 Clasa MainThread

Această clasă conține implementarea pentru trenul principal. Va conține doi vectori de Threaduri *S.Th* si *D.Th* și 3 vectori de mașini *bridge*, *S* si *D*, dar mai conține 3 semafoare *semaphore_bridge_0*, *semaphore_bridge_n* si *Sectiune_critica*, două din semafoare fiind responsabile pentru intrarea și respectiv ieșirea de pe pod iar unul pentru secțiunea critică. Tot în această clasă initializez vectorii de threaduri și de mașini și semafoarele. In funcția `run()` voi nu porni executia threadurilor atât pentru mașinile din stanga cat si pentru cele din dreapta.

2.7 Clasa SThread

Această clasă va fi responsabilă pentru gestionarea Mașinilor din coloana din stânga. Ea va putea introduce muta sau scoate mașini de pe pod.

2.8 Clasa DThread

Această clasă va fi responsabilă pentru gestionarea Mașinilor din coloana din dreapta. Ea va putea introduce muta sau scoate mașini de pe pod.

3 Codul Sursă

3.1 Main.java

```
1 public class Main
2 {
3     protected static int tempn,tempnS,tempnD;
4     private static Thread[] thread=new Thread[1];
5
6     public static void main(String[] args)
7     {
8         try {
9             Read.init0();
10            thread[0] = new MainThread(tempnS,tempnD,tempn);
11            thread[0].start();
12            thread[0].join();
13        } catch (Exception e) {
14            System.err.println(e);
15        }
16    }
17 }
```

3.2 Masina.java

```
1  /**
2   * Created by ioan on 12/2/17.
3   */
4  public class Masina
5  {
6      private String producator,model,anul,numarinmatriculare;
7      Masina(String valueofproducator, String valueofmodel, String
8          valueofanul, String valueofnumarinmatriculare)
9      {
10         this.producator=valueofproducator;
11         this.model=valueofmodel;
12         this.anul=valueofanul;
13         this.numarinmatriculare=valueofnumarinmatriculare;
14     }
15     protected String Get_producator()
16     {
17         return this.producator;
18     }
19     protected String Get_model()
20     {
21         return this.model;
22     }
23     protected String Get_anul()
24     {
25         return this.anul;
26     }
27     protected String Get_numarinmatriculare()
28     {
29         return this.numarinmatriculare;
30     }
31 }
```

3.3 Read.java

```
1 import java.io.BufferedReader;
2 import java.io.FileReader;
3
4 /**
5  * Created by ioan on 12/16/17.
6  */
7 public class Read
8 {
9     static private FileReader in;
10    static private BufferedReader br;
11    static void init()
12    {
13        try {
14            String temp1,temp2,temp3,temp4;
15            in = new FileReader("Input.txt");
16            br = new BufferedReader(in);
17            Masina tempMasina;
18            for(int i=0;i<3;i++) {
19                temp1 = br.readLine();
20            }
21
22            for(int i=0;i<MainThread.nS;i++){
23                temp1 = "";
24                temp1.replaceAll("[^a-zA-Z0-9]", "");
25                temp2 = "";
26                temp2.replaceAll("[^a-zA-Z0-9]", "");
27                temp3 = "";
28                temp3.replaceAll("[^a-zA-Z0-9]", "");
29                temp4 = "";
30                temp4.replaceAll("[^a-zA-Z0-9]", "");
31                temp1=br.readLine();
32                temp2=br.readLine();
33                temp3=br.readLine();
34                temp4=br.readLine();
35                tempMasina = new Masina(temp1,temp2,temp3,temp4);
36                MainThread.S[i]=tempMasina;
37            }
38            for(int i=0;i<MainThread.nD;i++){
39                temp1 = "";
40                temp1.replaceAll("[^a-zA-Z0-9]", "");
41                temp2 = "";
42                temp2.replaceAll("[^a-zA-Z0-9]", "");
43                temp3 = "";
44                temp3.replaceAll("[^a-zA-Z0-9]", "");
45                temp4 = "";
46                temp4.replaceAll("[^a-zA-Z0-9]", "");
47                temp1=br.readLine();
48                temp2=br.readLine();
49                temp3=br.readLine();
50                temp4=br.readLine();
51                tempMasina = new Masina(temp1,temp2,temp3,temp4);
52                MainThread.D[i]=tempMasina;
53            }
54            in.close();
55            br.close();
```



```

56         }catch (Exception e) {
57             System.err.println(e);
58         }
59     }
60     static void init0()
61     {
62         try {
63             String temp;
64             in = new FileReader("Input.txt");
65             br = new BufferedReader(in);
66             temp = br.readLine();
67             Main.tempnS=Integer.parseInt(temp);
68             temp = br.readLine();
69             Main.tempnD=Integer.parseInt(temp);
70             temp = br.readLine();
71             Main.tempn=Integer.parseInt(temp);
72         }catch (Exception e) {
73             System.err.println(e);
74         }
75     }
76 }
77 }

```

3.4 Write.java

```
1 /**
2  * Created by ioan on 12/16/17.
3  */
4 public class Write
5 {
6     protected static void console()
7     {
8         for (int i = 0; i < MainThread.n; i++) {
9             if (MainThread.bridge[i] != null) {
10                 System.out.print(MainThread.bridge[i].
11                 Get_numarinmatriculare() + " ");
12             } else {
13                 System.out.print("null ");
14             }
15             System.out.println("");
16         }
17     }
```

3.5 MainThread.java

```
1 import java.util.concurrent.Semaphore;
2
3 /**
4  * Created by ioan on 12/2/17.
5  */
6 public class MainThread extends Thread
7 {
8     protected static Thread[] S_Th,D_Th;
9     protected static Masina[] bridge,S,D;
10    protected static int nS,nD,n;
11    protected static Semaphore semaphore_bridge_0;
12    protected static Semaphore semaphore_bridge_n;
13    protected static Semaphore Sectiune_critica;
14
15    MainThread(int valueofnS,int valueofnD, int valueofn)
16    {
17        nS=valueofnS;
18        nD=valueofnD;
19        n=valueofn;
20        S_Th = new SThread[nS];
21        D_Th = new DThread[nD];
22        bridge = new Masina[n];
23        S= new Masina[nS];
24        D = new Masina[nD];
25        semaphore_bridge_0 = new Semaphore(1);
26        semaphore_bridge_n = new Semaphore(1);
27        Sectiune_critica = new Semaphore(1);
28        Read.init();
29        for (int i=0;i<nS;i++) {
30            S_Th[i] = new SThread(S[i],i);
31        }
32        for (int i=0;i<nD;i++) {
33            D_Th[i] = new DThread(D[i],i);
34        }
35        for(int i=0;i<n;i++){
36            bridge[i]=null;
37        }
38        semaphore_bridge_n.acquireUninterruptibly(1);
39    }
40    public void run()
41    {
42        for (int i = 0; i < nS; i++) {
43            S_Th[i].start();
44        }
45        for (int i = 0; i < nD; i++) {
46            D_Th[i].start();
47        }
48    }
49 }
```

3.6 SThread.java

```
1 import java.util.concurrent.Semaphore;
2
3 /**
4  * Created by ioan on 12/2/17.
5  */
6 public class SThread extends Thread
7 {
8     private Masina masina;
9     private int id;
10    protected static int cnt;
11
12    SThread(Masina valueofmasina, int valueofid)
13    {
14        masina = valueofmasina;
15        id = valueofid;
16        cnt = 0;
17    }
18
19    public void run()
20    {
21        while (true) {
22
23            try {
24                boolean sw = false;
25                if ((MainThread.bridge[0] == null) && (MainThread.
26                    semaphore_bridge_n.availablePermits() == 0) && (MainThread.
27                    semaphore_bridge_0.availablePermits() == 1)) {
28                    MainThread.Sectiune_critica.
29                    acquireUninterruptibly(1);
30                    //BEGIN - Sectiune critica
31                    int x = -1;
32                    for (int i = 0; i < MainThread.n; i++) {
33                        if (MainThread.bridge[i] == masina)
34                            x = i;
35                    }
36                    if (x == -1) {
37                        MainThread.bridge[0] = masina;
38                        MainThread.S[id] = null;
39                        sw = true;
40                        cnt++;
41                    }
42                    //END - Sectiune critica
43                    MainThread.Sectiune_critica.release(1);
44                }
45
46                if (sw == false) {
47                    if (masina == MainThread.bridge[MainThread.n -
48                        1]) {
49                            MainThread.Sectiune_critica.
50                            acquireUninterruptibly(1);
51                            //BEGIN - Sectiune critica
52                            MainThread.S[id] = masina;
53                            MainThread.bridge[MainThread.n - 1] = null;
54                            //END - Sectiune critica
55                            MainThread.Sectiune_critica.release(1);
```

```

51         sw = true;
52     }
53 }
54 if (sw == false) {
55     int x = -1;
56     MainThread.Sectiune_critica.
acquireUninterruptibly(1);
57     //BEGIN - Sectiune critica
58     for (int i = 0; i < (MainThread.n - 1) && (x ==
-1); i++) {
59         if (MainThread.bridge[i] == masina) {
60             x = i;
61         }
62     }
63     if (x != -1) {
64         if (MainThread.bridge[x + 1] == null) {
65             MainThread.bridge[x + 1] = MainThread.
bridge[x];
66             MainThread.bridge[x] = null;
67         }
68         sw = true;
69     }
70     //END - Sectiune critica
71     MainThread.Sectiune_critica.release(1);
72 }
73
74 if (sw == true) {
75     MainThread.Sectiune_critica.
acquireUninterruptibly(1);
76     //BEGIN - Sectiune critica
77     if (cnt >= 20) {
78         MainThread.semaphore_bridge_n.release(1);
79         boolean sw2 = false;
80         for (int i = 0; i < (MainThread.n) && (sw2
== false); i++) {
81             if (MainThread.bridge[i] != null) {
82                 sw2 = true;
83             }
84         }
85         if (sw2 == false) {
86             MainThread.semaphore_bridge_0.
acquireUninterruptibly(1);
87             cnt = 0;
88             Write.console();
89             synchronized (MainThread.S_Th) {
90                 MainThread.S_Th.wait();
91             }
92             Write.console();
93             MainThread.Sectiune_critica.release(1);
94         }
95     }
96     Write.console();
97     //END - Sectiune critica
98     MainThread.Sectiune_critica.release(1);
99 }
100 } catch (Exception e) {
101     System.err.println(e);

```

```
102     }
103     }
104
105     }
106 }
```

3.7 DThread.java

```
1 import java.util.concurrent.Semaphore;
2
3 /**
4  * Created by ioan on 12/2/17.
5  */
6 public class DThread extends Thread
7 {
8     private Masina masina;
9     private int id;
10    protected static int cnt;
11
12    DThread(Masina valueofmasina, int valueofid)
13    {
14        masina=valueofmasina;
15        id=valueofid;
16        cnt=0;
17    }
18    public void run()
19    {
20        while (true) {
21
22            try {
23                boolean sw = false;
24                if ((MainThread.bridge[MainThread.n-1] == null)&&(
25                    MainThread.semaphore_bridge.n.availablePermits() == 1)&&(
26                    MainThread.semaphore_bridge_0.availablePermits() == 0)) {
27                    MainThread.Sectiune_critica.
28                    acquireUninterruptibly(1);
29                    //BEGIN - Sectiune critica
30                    int x = -1;
31                    for (int i = 0; i < MainThread.n; i++) {
32                        if (MainThread.bridge[i] == masina)
33                            x = i;
34                    }
35                    if (x == -1) {
36                        MainThread.bridge[MainThread.n-1] = masina;
37                        MainThread.D[id]=null;
38                        sw = true;
39                        cnt++;
40                    }
41                    //END - Sectiune critica
42                    MainThread.Sectiune_critica.release(1);
43                }
44                if (sw == false) {
45                    if (masina == MainThread.bridge[0]) {
46                        MainThread.Sectiune_critica.
47                        acquireUninterruptibly(1);
48                        //BEGIN - Sectiune critica
49                        MainThread.D[id]=masina;
50                        MainThread.bridge[0] = null;
51                        //END - Sectiune critica
52                        MainThread.Sectiune_critica.release(1);
53                        sw = true;
54                    }
55                }
56            }
57        }
58    }
59 }
```

```

52         if (sw == false) {
53             int x = -1;
54             MainThread.Sectiune_critica.
acquireUninterruptibly(1);
55             //BEGIN - Sectiune critica
56             for (int i = 1; i < (MainThread.n) && (x == -1)
; i++) {
57                 if (MainThread.bridge[i] == masina) {
58                     x = i;
59                 }
60             }
61             if (x != -1) {
62                 if (MainThread.bridge[x - 1] == null) {
63                     MainThread.bridge[x - 1] = MainThread.
bridge[x];
64                     MainThread.bridge[x] = null;
65                 }
66                 sw = true;
67             }
68             //END - Sectiune critica
69             MainThread.Sectiune_critica.release(1);
70         }
71
72         if (sw == true) {
73             MainThread.Sectiune_critica.
acquireUninterruptibly(1);
74             //BEGIN - Sectiune critica
75             if (cnt >= 20) {
76                 MainThread.semaphore_bridge_0.release(1);
77                 boolean sw2 = false;
78                 for (int i = 0; i < (MainThread.n) && (sw2 == false);
i++){
79                     if (MainThread.bridge[i] != null) {
80                         sw2 = true;
81                     }
82                 }
83                 if (sw2 == false) {
84                     MainThread.semaphore_bridge_n.
acquireUninterruptibly(1);
85                     cnt = 0;
86                     synchronized (MainThread.S_Th) {
87                         MainThread.S_Th.notifyAll();
88                     }
89                     Write.console();
90                     MainThread.Sectiune_critica.release(1);
91                 }
92             }
93             Write.console();
94             //END - Sectiune critica
95             MainThread.Sectiune_critica.release(1);
96         }
97     } catch (Exception e) {
98         System.err.println(e);
99     }
100 }
101 }
102

```




4 Input si Output

4.1 Input

Datele de intrare se gasesc in fiserul *Input.txt*.

```
1 6
2 8
3 4
4 BMW
5 S3
6 2008
7 0T-22-TTB
8 BMW
9 C8
10 2012
11 0T-45-VIV
12 Dacia
13 Logan
14 2000
15 B-08-POL
16 Dacia
17 Logan
18 2000
19 B-09-TOR
20 Mercedes
21 QClass
22 2015
23 DJ-66-DFW
24 Nisan
25 Juke
26 2017
27 B-45-ASD
28 Opel
29 Zafira
30 2006
31 DJ-58-GAI
32 Opel
33 Astra G
34 1999
35 B-66-JEG
36 Mercedes
37 E250
38 2010
39 CS-57-SFN
40 Hyundai
41 galloper
42 2002
43 CJ-68-ALF
44 Nissan
45 Terrano 2
46 2000
47 TM-23-FAL
48 Audi
49 A4
50 2003
51 OT-68-SFJ
```

```

52 Opel
53 Astra H
54 2007
55 AG-68-AKS
56 BMW
57 318
58 2001
59 CJ-32-UOE

```

4.2 Output

Datele de iesire se afiseaza in consola.

```

1 0T-45-VIV null null null
2 null 0T-45-VIV null null
3 0T-22-TTB 0T-45-VIV null null
4 0T-22-TTB 0T-45-VIV null null
5 0T-22-TTB null 0T-45-VIV null
6 0T-22-TTB null null 0T-45-VIV
7 0T-22-TTB null null null
8 B-08-POL 0T-22-TTB null null
9 B-08-POL 0T-22-TTB null null
10 B-08-POL null 0T-22-TTB null
11 null B-08-POL 0T-22-TTB null
12 B-09-TOR B-08-POL 0T-22-TTB null
13 B-09-TOR B-08-POL 0T-22-TTB null
14 B-09-TOR B-08-POL null 0T-22-TTB
15 B-09-TOR B-08-POL null null
16 B-09-TOR B-08-POL null null
17 B-09-TOR null B-08-POL null
18 null B-09-TOR B-08-POL null
19 B-45-ASD B-09-TOR B-08-POL null
20 B-45-ASD B-09-TOR B-08-POL null
21 B-45-ASD null B-09-TOR B-08-POL
22 B-45-ASD null B-09-TOR B-08-POL
23 B-45-ASD null B-09-TOR B-08-POL
24 B-45-ASD null B-09-TOR B-08-POL
25 B-45-ASD null B-09-TOR B-08-POL
26 B-45-ASD null B-09-TOR B-08-POL
27 B-45-ASD null B-09-TOR B-08-POL
28 B-45-ASD null B-09-TOR B-08-POL
29 B-45-ASD null B-09-TOR B-08-POL
30 B-45-ASD null B-09-TOR B-08-POL
31 B-45-ASD null B-09-TOR B-08-POL
32 B-45-ASD null B-09-TOR B-08-POL
33 B-45-ASD null B-09-TOR B-08-POL
34 B-45-ASD null B-09-TOR B-08-POL
35 B-45-ASD null B-09-TOR B-08-POL
36 null B-45-ASD B-09-TOR B-08-POL
37 DJ-66-DFW B-45-ASD B-09-TOR B-08-POL
38 DJ-66-DFW B-45-ASD B-09-TOR B-08-POL
39 DJ-66-DFW B-45-ASD B-09-TOR null
40 DJ-66-DFW B-45-ASD B-09-TOR null
41 DJ-66-DFW B-45-ASD null B-09-TOR
42 DJ-66-DFW B-45-ASD null null
43 DJ-66-DFW B-45-ASD null null

```

```

44 DJ-66-DFW null B-45-ASD null
45 DJ-66-DFW null null B-45-ASD
46 0T-45-VIV DJ-66-DFW null B-45-ASD
47 0T-45-VIV DJ-66-DFW null null
48 0T-45-VIV null DJ-66-DFW null
49 null 0T-45-VIV DJ-66-DFW null
50 0T-22-TTB 0T-45-VIV DJ-66-DFW null
51 0T-22-TTB 0T-45-VIV DJ-66-DFW null
52 0T-22-TTB 0T-45-VIV DJ-66-DFW null
53 0T-22-TTB 0T-45-VIV DJ-66-DFW null
54 0T-22-TTB 0T-45-VIV DJ-66-DFW null
55 0T-22-TTB 0T-45-VIV DJ-66-DFW null
56 0T-22-TTB 0T-45-VIV DJ-66-DFW null
57 0T-22-TTB 0T-45-VIV DJ-66-DFW null
58 0T-22-TTB 0T-45-VIV DJ-66-DFW null
59 0T-22-TTB 0T-45-VIV DJ-66-DFW null
60 0T-22-TTB 0T-45-VIV DJ-66-DFW null
61 0T-22-TTB 0T-45-VIV DJ-66-DFW null
62 0T-22-TTB 0T-45-VIV DJ-66-DFW null
63 0T-22-TTB 0T-45-VIV DJ-66-DFW null
64 0T-22-TTB 0T-45-VIV DJ-66-DFW null
65 0T-22-TTB 0T-45-VIV DJ-66-DFW null
66 0T-22-TTB 0T-45-VIV DJ-66-DFW null
67 0T-22-TTB 0T-45-VIV DJ-66-DFW null
68 0T-22-TTB 0T-45-VIV DJ-66-DFW null
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[illegible]

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984	0T-22-TTB	0T-45-VIV	null	null
985	0T-22-TTB	0T-45-VIV	null	null
986	0T-22-TTB	0T-45-VIV	null	null
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1007	0T-22-TTB	0T-45-VIV	null	null
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1010	0T-22-TTB	0T-45-VIV	null	null
1011	0T-22-TTB	0T-45-VIV	null	null
1012	0T-22-TTB	0T-45-VIV	null	null

1013	0T-22-TTB	0T-45-VIV	null	null
1014	0T-22-TTB	0T-45-VIV	null	null
1015	0T-22-TTB	0T-45-VIV	null	null
1016	0T-22-TTB	0T-45-VIV	null	null
1017	0T-22-TTB	0T-45-VIV	null	null
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1037	0T-22-TTB	0T-45-VIV	null	null
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1066	0T-22-TTB	null	0T-45-VIV	null
1067	0T-22-TTB	null	null	0T-45-VIV
1068	0T-22-TTB	null	null	null
1069	0T-22-TTB	null	null	null

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1085 null null DJ-58-GAI null
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1087 null DJ-58-GAI B-66-JEG CS-57-SFN
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1125 null null null null
1126 null null null CJ-68-ALF

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1180 null CJ-68-ALF CS-57-SFN null
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1182 null CJ-68-ALF CS-57-SFN null
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[illegible]

[illegible]

[illegible]

[illegible]

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1472 null CJ-68-ALF CS-57-SFN TM-23-FAL
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[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

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5 Compatibilitate

Proiectul a fost realizat in sitemul de operare *Linux* versiunea *Mint 18.3 Cinnamon 64-bit*. IDE-ul folosit este *IntelliJ IDEA 2017.1.5*.

JRE: *1.8.0_112 – release – 736 – b21 amd64*

JVM: *OpenJDK 64-Bit Server VM by JetBrains s.r.o*