MINISTERUL EDUCAȚIEI

UNIVERSITATEA TEHNICĂ
DIN CLUJ-NAPOCA

FACULTATEA DE AUTOMATICĂ ȘI CALCULATOARE

PROJECT REPORT

Distributed Control Systems

Authors: **Dafinoiu Andreea-Raluca (30342)**
Apetrei Andrei-Octavian (30343)

Instructor: **As. Dr. Ing. Dahlia AL-JANABI**

2024

1. Introduction:

This project purposes to model and control two intersections with the use of OETPN which communicate via network.

The intersections modelled in this project are:

- https://www.google.com/maps/place/47°04'15.9"N+21°55'12.2"E/@47.071094,21.920067,17z/data=!3m1!4b1!4m4!3m3!8m2!3d47.071094!4d21.920067?entry=ttu
- https://www.google.com/maps/search/47.069259,+21.924812?entry=tts

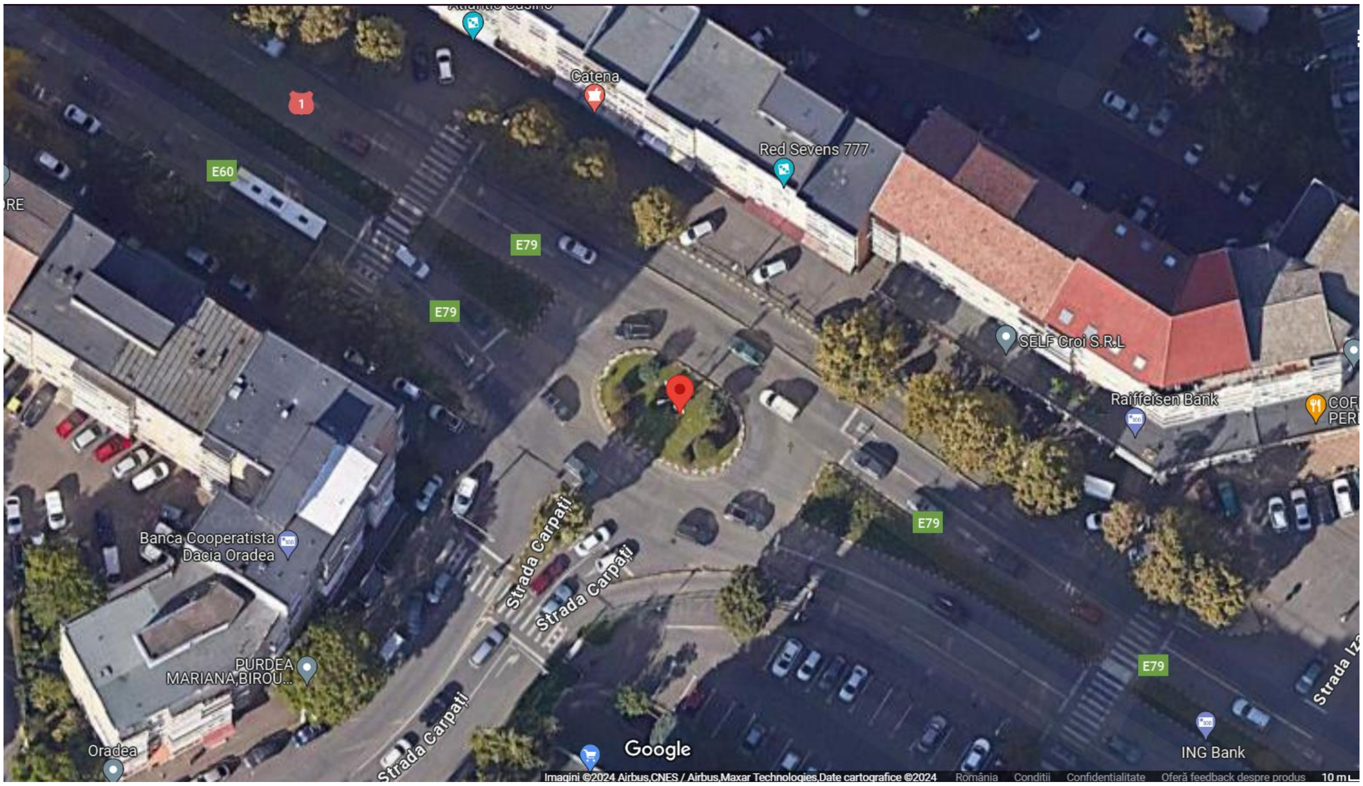


Figure 1: First Intersection

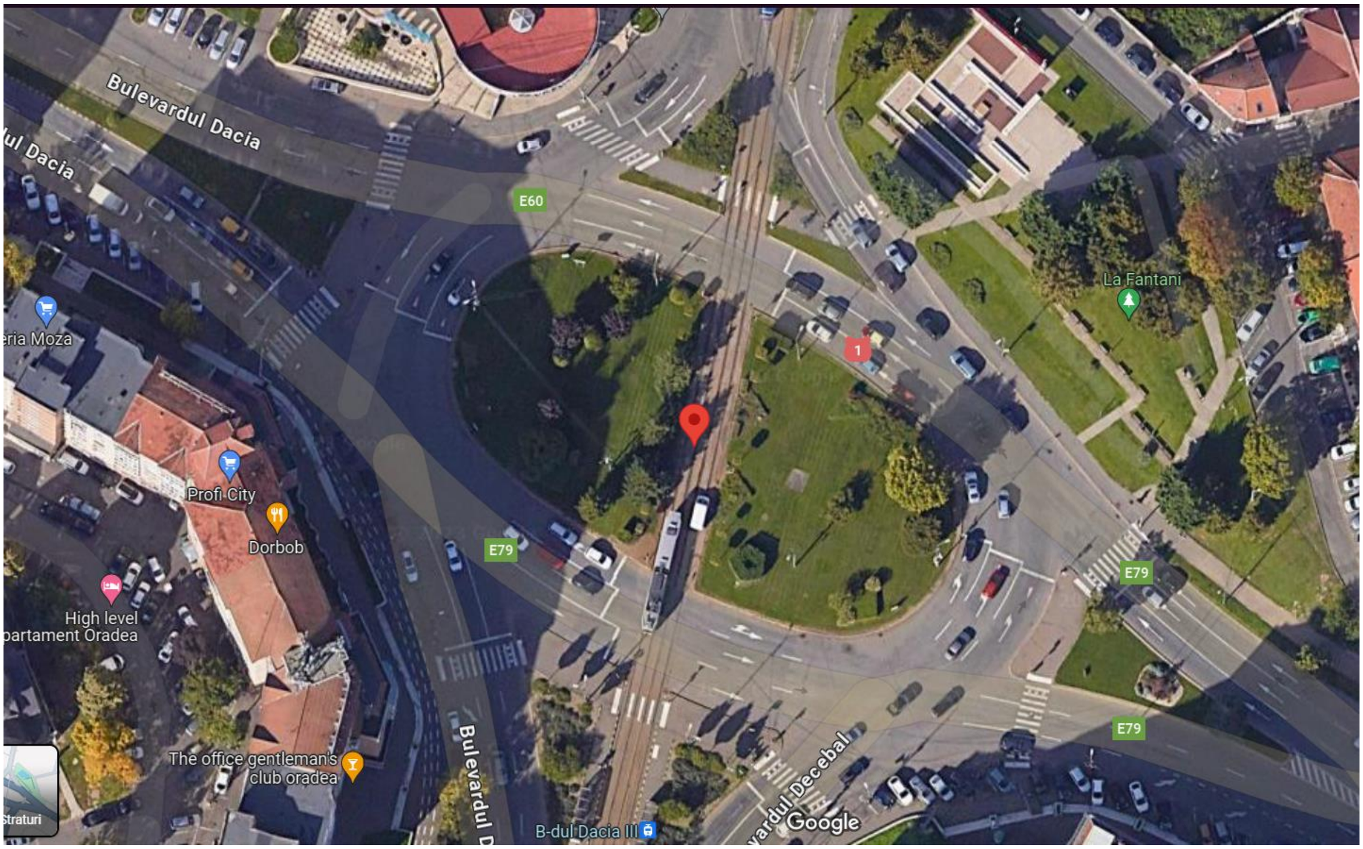


Figure 2: Second Intersection

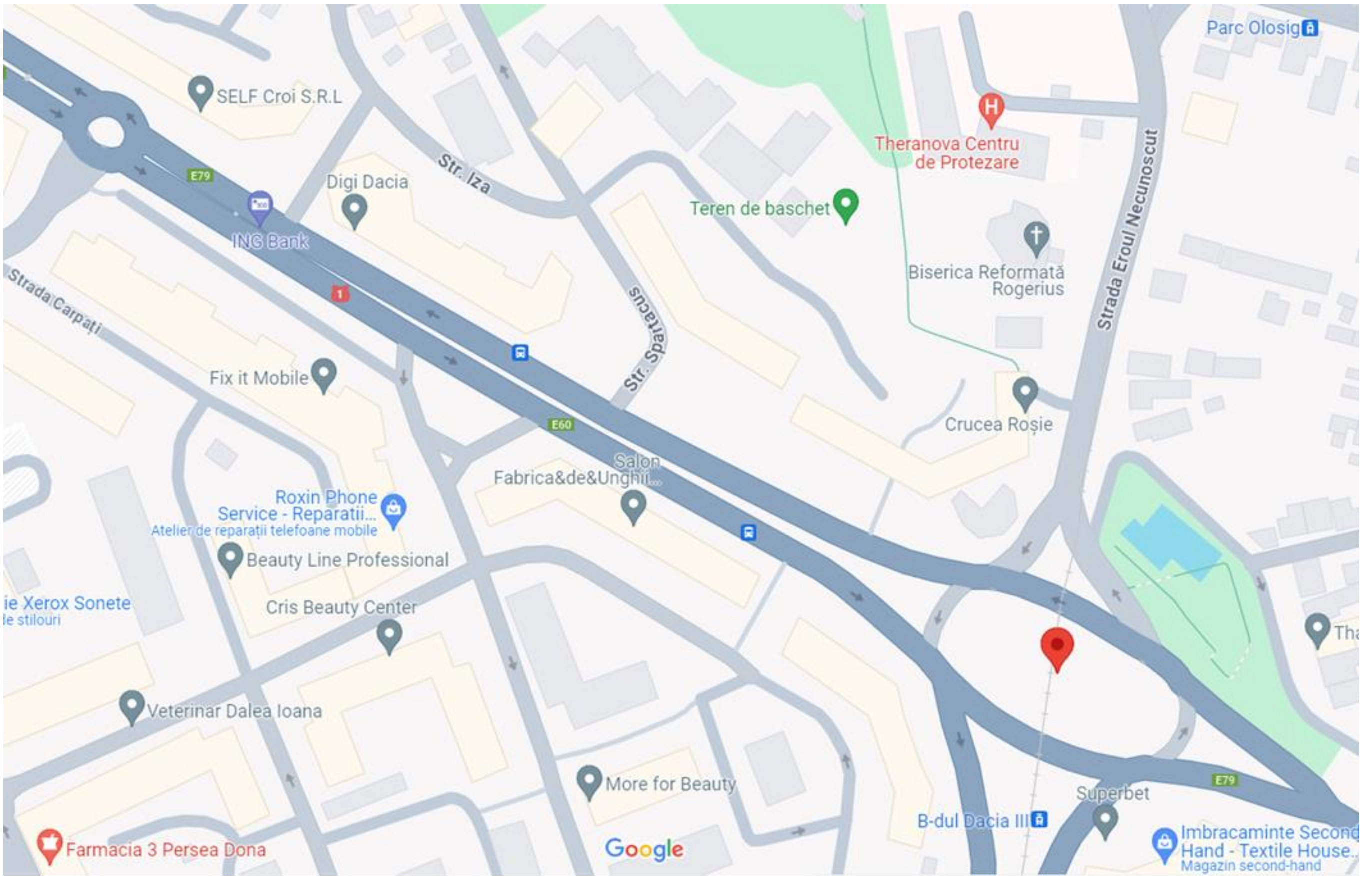


Figure 3: Both intersection with the middle street

2. Petri Nets:

The Petri Nets for both intersection, middle street and the controller are presented bellow.

A. First Intersection:

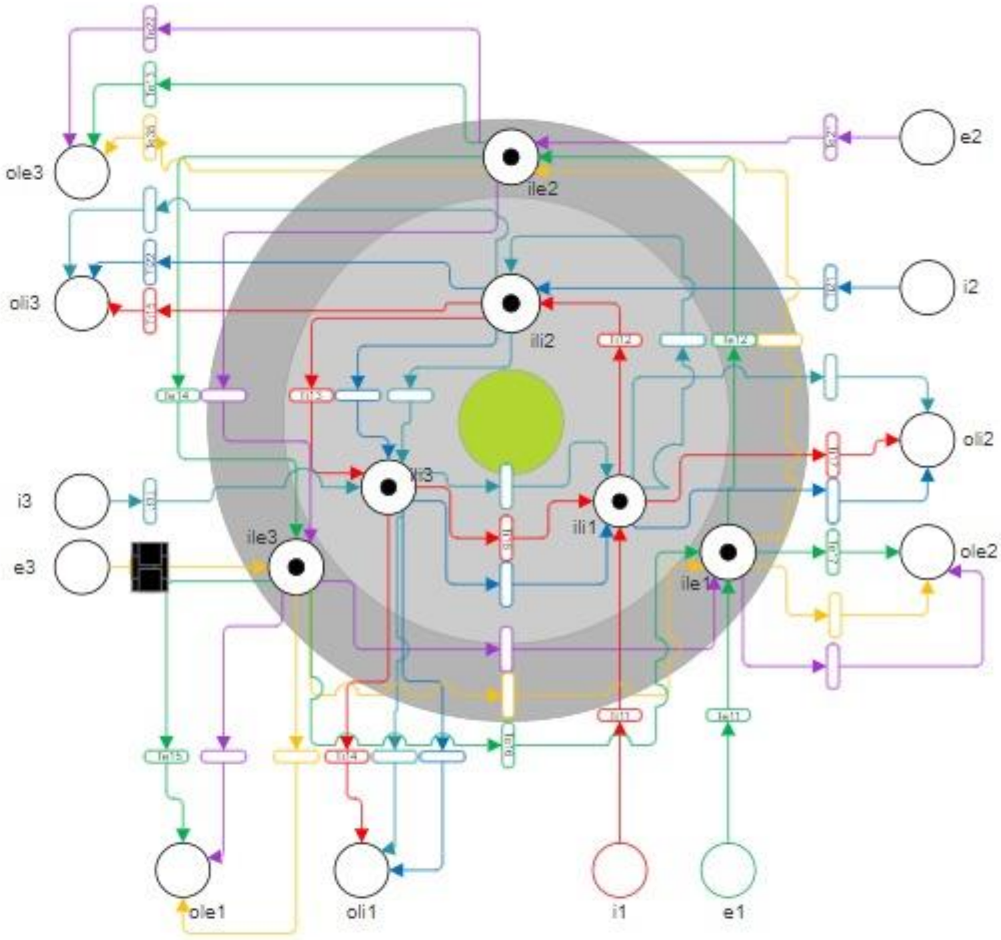
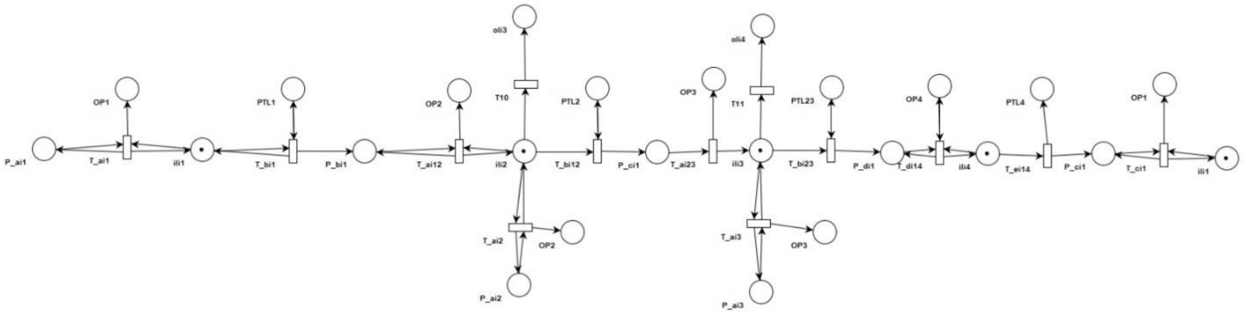
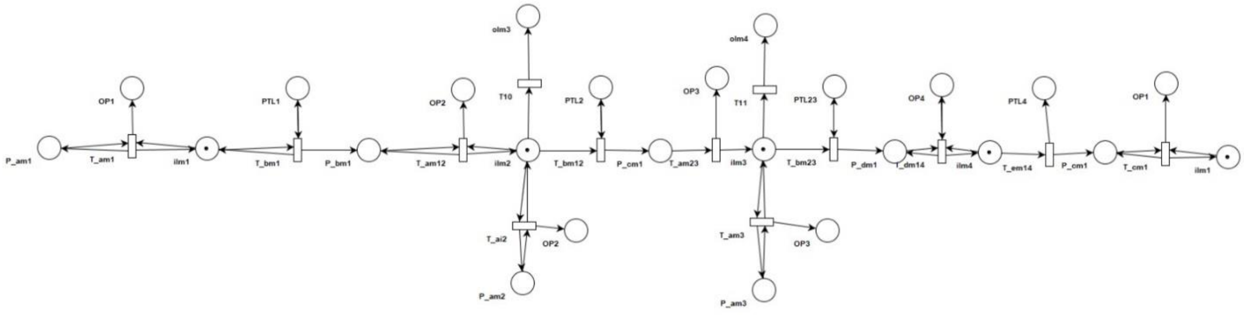
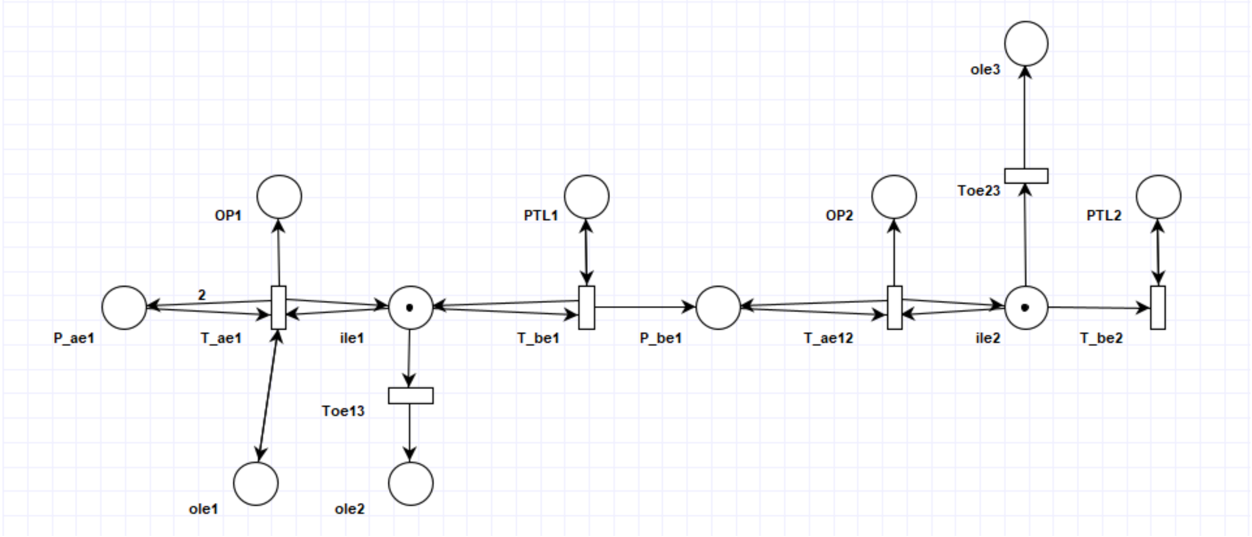


Figure 4: Petri Net of the First Intersection

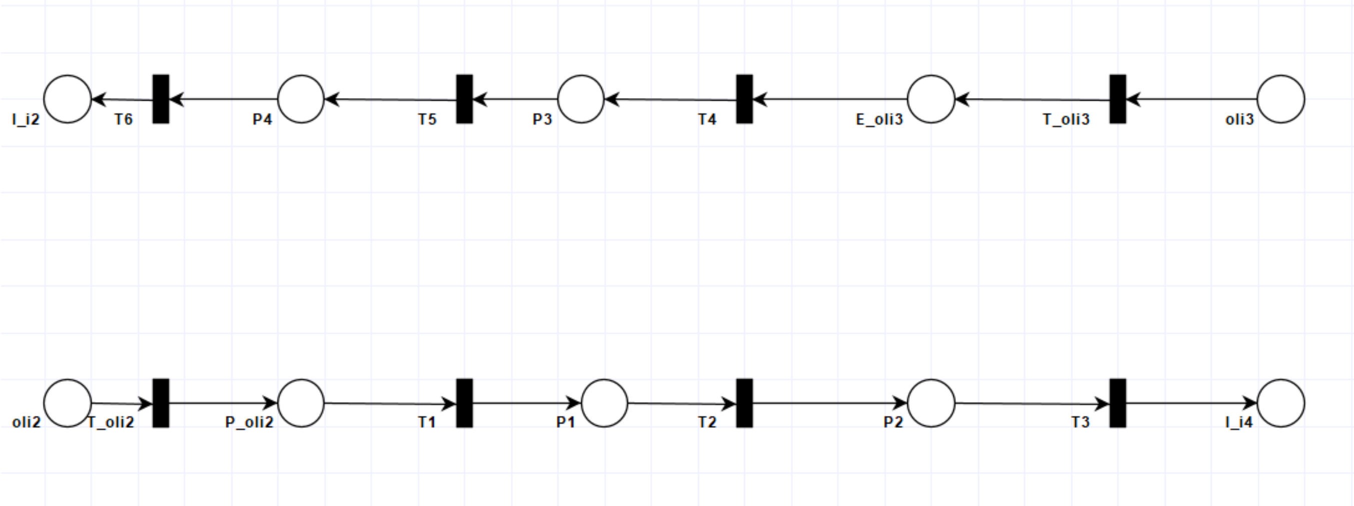
B. Second Intersection:



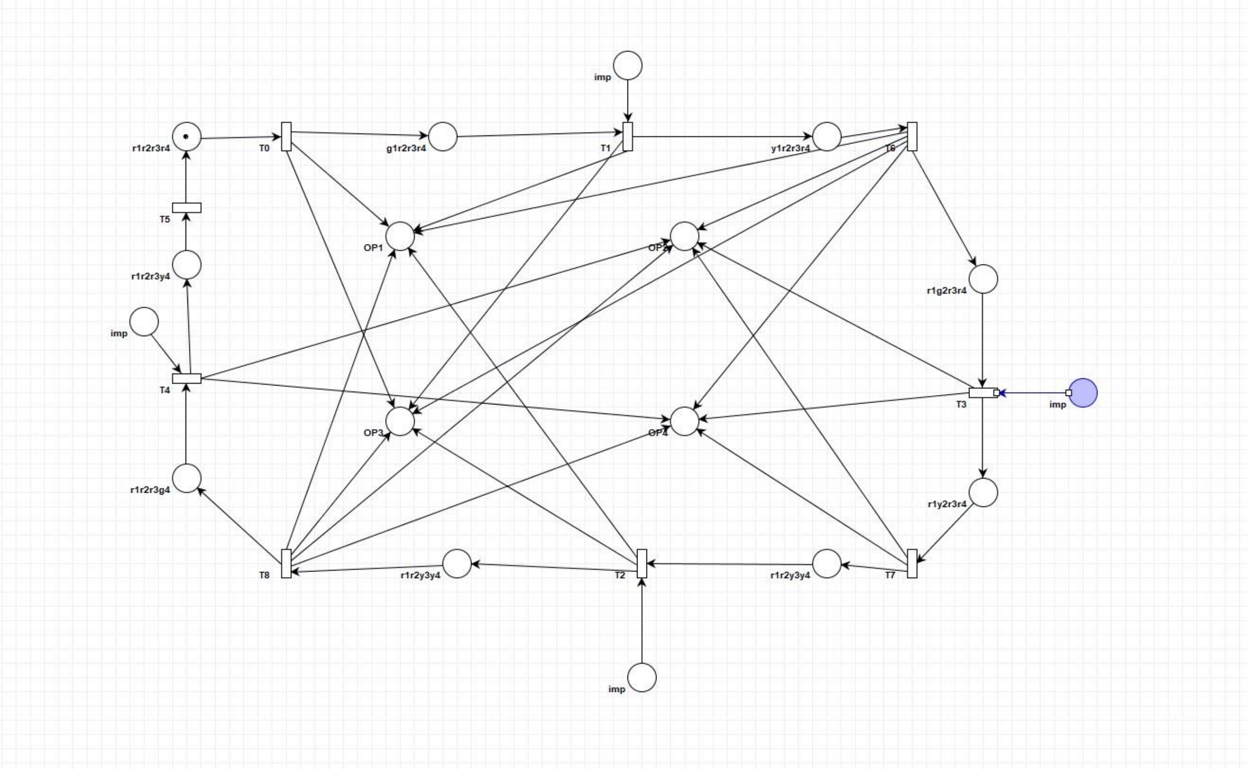




C. Middle Street:



D. Controller:



3. Guards & maps:

A. First Intersection:

Place types:

- **DataCar:** i1, e1, i2, e2, i3, e3, oli1, ole1, oli2, ole2, oli3, ole3
- **DataCarQueue:** ili1, ile1, ili2, ile2, ili3, ile3
- **DataTransfer:** P_oli2

Guard & Map:

- **Ti11**
  (i1 != null) & (ili1.CanAddCars)
  ili1.AddElement(i1)
- **Ti12**
  (ili1.HaveCarForMe) & (ili2.CanAddCars)
  Ili2.PopElementWithTargetToQueue(ili1)
- **Ti13**
  (ili2.HaveCarForMe) & (ili3.CanAddCars)
  Ili3. PopElementWithTargetToQueue (ili2)
- **Ti14**
  (ili3.HaveCarForMe)
  Ili3.PopElementWithTarget(oli1)
- **Ti15**

(ili2.HaveCarForMe)
Ili2.PopElementWithTarget(oli3)

- **Ti16**
  (ili3.HaveCarForMe) & (ili1.CanAddCars)
  Ili1. PopElementWithTargetToQueue (ili3)
- **Ti17**
  (ili1.HaveCarForMe)
  Ili1.PopElementWithTarget(oli2)
- **Te11**
  (e1 != null) & (ile1.CanAddCars)
  Ile1.AddElement(e1)
- **Te12**
  (ile1.HaveCarForMe) & (ile2.CanAddCars)
  Ile2. PopElementWithTargetToQueue (ile1)
- **Te13**
  (ile2.HaveCarForMe)
  Ile2.PopElementWithTarget(ole3)
- **Te14**
  (ile2.HaveCarForMe) & (ile3.CanAddCars)
  Ile3. PopElementWithTargetToQueue (ile2)
- **Te15**
  (ile3.HaveCarForMe)
  Ile3.PopElementWithTarget(ole1)

- **Te16**
  (ile3.HaveCarForMe) & (ile1.CanAddCars)
  Ile1. PopElementWithTargetToQueue (ile3)
- **Te17**
  (ile1.HaveCarForMe)
  Ile1.PopElementWithTarget(ole2)
- **Ti21**
  (i2 != null) & (ili2.CanAddCars)
  Ili2.AddElement(i2)
- **Ti22**
  (ili2.HaveCarForMe)
  Ili2.PopElementWithTarget(oli3)
- **Te21**
  (e2 != null) & (ile2.CanAddCars)
  Ile2.AddElement(e2)
- **Te22**
  (ile2.HaveCarForMe)
  Ile2.PopElementWithTarget(ole3)
- **Ti31**
  (i3 != null) & (ili3.CanAddCars)
  Ili3.AddElement(i3)
- **Te31**
  (e3 != null) & (ile3.CanAddCars)
  Ile3.AddElement(i3)

B. Second Intersection:

Place Types:

- **DataCar:**
  - P_ai1, P_bi1, P_am1, P_bm1, P_ae1, P_be1
  - P_ai2, P_am2, P_ae2
  - P_ai3, P_am3, P_ae3
  - P_ai4, P_am4, P_ae4
  - oli1, olm1, ole1
  - oli2, olm2, ole2
  - oli3, olm3, ole3
  - oli4, olm4, ole4
  - P_ci1
  - P_di1, P_dm1, P_de1
  - P_ei1, P_em1, P_ee1
- **DataCarQueue:**
  - ili1, ilm1, ile1
  - ili2, ilm2, ile2
  - ili3, ilm3, ile3
  - ili4, ilm4, ile4
- **DataString:** green, full, P_TL1, P_TL2, P_TL3, P_TL4
- **DataTransfer:** OP1, OP2, OP3, OP4, E_oli3

Guards & maps:

- **T_ai1**
  (P_ai1 != null) & (ili1.CanAddCars)
    Ili1.AddElement(P_ai1)
  (P_ai1 != null) & (ili1.CanNotAddCars)
    OP1.SendOverNetwork(full)
    P_ai1.Copy(P_ai1)
- **T_bi1**
  (P_TL1 == green) & (ili1.HaveCar)
    P_bi1.PopElementWithoutTarget(ili1)
    P_TL1.Move(P_TL1)
- **T_ai2**
  (P_ai2 != null) & (ili2.CanAddCars)
    Ili2.AddElement(P_ai2)
  (P_ai2 != null) & (ili2.CanNotAddCars)
    OP2.SendOverNetwork(full)
    P_ai2.Copy(P_ai2)
- **T_ai3**
  (P_ai3 != null) & (ili3.CanAddCars)
    Ili3.AddElement(P_ai3)
  (P_ai3 != null) & (ili3.CanNotAddCars)
    OP3.SendOverNetwork(full)
    P_ai3.Copy(P_ai3)

- **T_ai4**

  ```
  (P_ai4 != null) & (ili4.CanAddCars)
          Ili4.AddElement(P_ai4)
  (P_ai4 != null) & (ili4.CanNotAddCars)
          OP4.SendOverNetwork(full)
          P_ai4.Copy(P_ai4)
  ```

- **T_am1**

  ```
  (P_am1 != null) & (ilm1.CanAddCars)
          Ilm1.AddElement(P_am1)
  (P_am1 != null) & (ilm1.CanNotAddCars)
          OP1.SendOverNetwork(full)
          P_am1.Copy(P_am1)
  ```

- **T_bm1**

  ```
  (P_TL1 == green) & (ilm1.HaveCar)
          P_bm1.PopElementWithoutTarget(ilm1)
          P_TL1.Move(P_TL1)
  ```

- **T_am2**

  ```
  (P_am2 != null) & (ilm2.CanAddCars)
          Ilm2.AddElement(P_am2)
  (P_am2 != null) & (ilm2.CanNotAddCars)
          OP2.SendOverNetwork(full)
          P_am2.Copy(P_am2)
  ```

- **T_bm2**

  ```
  (P_TL2 == green) & (ilm2.HaveCar)
          P_cm1.PopElementWithoutTarget(ilm2)
          P_TL2.Move(P_TL2)
  ```

- **T_am3**

  ```
  (P_am3 != null) & (ilm3.CanAddCars)
          Ilm3.AddElement(P_am3)
  (P_am3 != null) & (ilm3.CanNotAddCars)
          OP3.SendOverNetwork(full)
          P_am3.Copy(P_am3)
  ```

- **T_am4**

  ```
  (P_am4 != null) & (ilm4.CanAddCars)
          Ilm4.AddElement(P_am4)
  (P_am4 != null) & (ilm4.CanNotAddCars)
          OP4.SendOverNetwork(full)
          P_am4.Copy(P_am4)
  ```

- **T_ae1**

  ```
  (P_ae1 != null) & (ile1.CanAddCars)
          Ile1.AddElement(P_ae1)
  (P_ae1 != null) & (ile1.CanNotAddCars)
          OP1.SendOverNetwork(full)
          P_ae1.Copy(P_ae1)
  ```

- **T_be1**

  ```
  (P_TL1 == green) & (ile1.HaveCar)
          P_be1.PopElementWithoutTarget(ile1)
  ```

```
        P_TL1.Move(P_TL1)
```

- **T_ae2**
  ```
  (P_ae2 != null) & (ile2.CanAddCars)
          Ile2.AddElement(P_ae2)
  (P_ae2 != null) & (ile2.CanNotAddCars)
          OP2.SendOverNetwork(full)
          P_ae2.Copy(P_ae2)
  ```
- **T_be2**
  ```
  (P_TL2 == green) & (ile2.HaveCar)
          P_ce1.PopElementWithoutTarget(ile2)
          P_TL2.Move(P_TL2)
  ```
- **T_ae3**
  ```
  (P_ae3 != null) & (ile3.CanAddCars)
          Ile3.AddElement(P_ae3)
  (P_ae3 != null) & (ile3.CanNotAddCars)
          OP3.SendOverNetwork(full)
          P_ae3.Copy(P_ae3)
  ```
- **T_ae4**
  ```
  (P_ae4 != null) & (ile4.CanAddCars)
          Ile4.AddElement(P_ae3)
  (P_ae4 != null) & (ile4.CanNotAddCars)
          OP4.SendOverNetwork(full)
          P_ae4.Copy(P_ae4)
  ```

- **T_ai12:**
  ```
  (P_bi1 != null) & (ili2.CanAddCars)
          Ile2.AddElement(P_ bi1)
  (P_ bi1!= null) & (ili2.CanNotAddCars)
          OP2.SendOverNetwork(full)
          P_ bi1.Copy(P_ bi1)
  ```
- **T_bi12:**
  ```
  (P_TL2 == green) & (ili2. HaveCarForMe)
          P_ci1.PopElementWithoutTarget(ili2)
          P_TL2.Move(P_TL2)
  ```
- **T_ai23**
  ```
  (P_ci1 != null) & (ili3.CanAddCars)
          Ili3.AddElement(P_ ci1)
  (P_ ci1!= null) & (ili3.CanNotAddCars)
          OP3.SendOverNetwork(full)
          P_ ci1.Copy(P_ ci1)
  ```
- **T_bi23**
  ```
  (P_TL3 == green) & (ili3. HaveCarForMe)
          P_di1.PopElementWithoutTarget(ili3)
          P_TL3.Move(P_TL3)
  ```
- **T_di14**
  ```
  (P_di1 != null) & (ili4.CanAddCars)
          Ili4.AddElement(P_ di1)
  (P_ di1!= null) & (ili4.CanNotAddCars)
          OP4.SendOverNetwork(full)
  ```

```
            P_ di1.Copy(P_ di1)
•   T_ei14
    (P_TL4 == green) & (ili4. HaveCarForMe)
            P_ei1.PopElementWithoutTarget(ili3)
            P_TL4.Move(P_TL4)
•   T_ei1
    (P_ei1 != null) & (ili1.CanAddCars)
            Ili1.AddElement(P_ ei1)
    (P_ ei1!= null) & (ili1.CanNotAddCars)
            OP3.SendOverNetwork(full)
            P_ ei1.Copy(P_ ei1)
•   T_am12
    (P_bm1 != null) & (ilm2.CanAddCars)
            Ilm2.AddElement(P_ bm1)
    (P_ bm1!= null) & (ilm2.CanNotAddCars)
            OP2.SendOverNetwork(full)
            P_ bm1.Copy(P_ bm1)
•   T_bm23
    (P_TL3 == green) & (ilm3.HaveCarForMe)
            P_dm1.PopElementWithoutTarget(ilm3)
            P_TL3.Move(P_TL3)
•   T_dm14
    (P_dm1 != null) & (ilm4.CanAddCars)
            Ilm4.AddElement(P_ dm1)
    (P_ dm1!= null) & (ilm4.CanNotAddCars)
            OP4.SendOverNetwork(full)
            P_ dm1.Copy(P_ dm1)
•   T_em14
    (P_TL4 == green) & (ilm4.HaveCarForMe)
            P_em1.PopElementWithoutTarget(ilm4)
            P_TL4.Move(P_TL4)
•   T_ae12
    (P_be1 != null) & (ile2.CanAddCars)
            Ile2.AddElement(P_ be 1)
    (P_ be 1!= null) & (ile2.CanNotAddCars)
            OP2.SendOverNetwork(full)
            P_ be 1.Copy(P_ be 1)
•   T_be23
    (P_TL3 == green) & (ile3.HaveCarForMe)
            P_de1.PopElementWithoutTarget(ile3)
            P_TL3.Move(P_TL3)
•   T_de14
    (P_de1 != null) & (ile4.CanAddCars)
            Ile4.AddElement(P_de1)
    (P_ de1!= null) & (ile4.CanNotAddCars)
            OP4.SendOverNetwork(full)
            P_de1.Copy(P_de1)
•   T_ee14
    (P_TL4 == green) & (ile4.HaveCarForMe)
```

P_ee1.PopElementWithoutTarget(ile4)
P_TL4.Move(P_TL4)

- **Toe42**
  (P_TL1 == green) & (ile1.HaveCarForMe)
  Ole1.PopElementWithoutTarget(ile1)
  P_TL1.Move(P_TL1)
- **Toe13**
  (P_TL1 == green) & (ile1.HaveCarForMe)
  Ole2.PopElementWithoutTarget(ile1)
  P_TL1.Move(P_TL1)
- **Toi23**
  (P_TL2 == green) & (ili2.HaveCarForMe)
  Oli3.PopElementWithoutTarget(ili2)
  P_TL2.Move(P_TL2)
- **Tom23**
  (P_TL2 == green) & (ilm2.HaveCarForMe)
  Olm3.PopElementWithoutTarget(ilm2)
  P_TL2.Move(P_TL2)
- **Toe22**
  (P_TL2 == green) & (ile2.HaveCarForMe)
  Oli2.PopElementWithoutTarget(ile2)
  P_TL2.Move(P_TL2)
- **Toe33**
  (P_TL3 == green) & (ile3.HaveCar)
  Ole2.PopElementWithTarget(ile3)
  P_TL3.Move(P_TL3)
- **Toe44**
  (P_TL4 == green) & (ile4.HaveCarForMe)
  Ole4.PopElementWithoutTarget(ile4)
  P_TL4.Move(P_TL4)
- **Toi34**
  (P_TL3 == green) & (ili3.HaveCarForMe)
  Oli4.PopElementWithoutTarget(ili3)
  P_TL3.Move(P_TL3)
- **Tom34**
  (P_TL3 == green) & (ilm3.HaveCarForMe)
  Oli4.PopElementWithoutTarget(ilm3)
  P_TL3.Move(P_TL3)
- **Toe34**
  (P_TL3 == green) & (ile3.HaveCarForMe)
  Ole4.PopElementWithoutTarget(ile3)
  P_TL3.Move(P_TL3)
- **Toi41**
  (P_TL4 == green) & (ili4.HaveCarForMe)
  Oli1.PopElementWithoutTarget(ili4)
  P_TL4.Move(P_TL4)
- **Tom41**
  (P_TL4 == green) & (ilm4.HaveCarForMe)
  Olm1.PopElementWithoutTarget(ilm4)

```
        P_TL4.Move(P_TL4)
```

- **Toe41**
  ```
  (P_TL4 == green) & (ile4.HaveCarForMe)
          Ole1.PopElementWithoutTarget(ile4)
          P_TL4.Move(P_TL4)
  ```
- **T_oli3**
  ```
  (oli3 != null)
          E_oli3.SendOverNetwork(oli3)
  ```

C. Middle Street:

Place Types:

- **DataCar:** P_oli2, P1, E_oli3, P4
- **DataCarQueue:** P1, P3
- **DataTransfer:** I_i4, I_i2

Guards & maps:

- **T1**
  ```
  (P_oli2 != null) & (P1.CanAddCars)
          P1.AddElement(P_oli2)
  ```

- **T2**
  ```
  (P1.HaveCar)
          P2.PopElementWithoutTarget(P1)
  ```
- **T3**
  ```
  (P2 != null)
          I_i4.SendOverNetwork(P2)
  ```
- **T4**
  ```
  (E_oli3 != null) & (P3.CanAddCars)
          P3.AddElement(E_oli3)
  ```
- **T5**
  ```
  (P3.HaveCar)
          P4.PopElementWithoutTarget(P3)
  ```
- **T6**
  ```
  (P4 != null)
          I_i2.SendOverNetwork(P4)
  ```

D. Controller:

Place Types:

- **DataString:** ini, in1, in2, red, green, yellow, r1r2r3r4, g1r2r3r4, y1r2r3r4, r1g2r3r4, r1y2r3r4, r1r2g3r4, r1r2y3r4, r1r2r3g4, r1r2r3y4
- **DataTransfer:** op1, op2, op3, op4
- **DataInteger:** Two

Guards & maps:

- **Init:**
  ```
  (init != null)
          Ini.SendOverNetwork(OP1)
          Ini.SendOverNetwork(OP2)
          Ini.SendOverNetwork(OP3)
          Ini.SendOverNetwork(OP4)
          Ini.MakeNull(ini)
  ```
- **T1**
  ```
  (r1r2r3r4 != null)
          g1r2r3r4.Move(r1r2r3r4)
          OP1.SendOverNetwork(green)
          OP3. SendOverNetwork(green)
  ```
- **T2**
  ```
  (g1r2r3r4 != null) & (in1 == null)
          r1r2r3r4.Move(g1r2r3r4)
          OP1.SendOverNetwork(yellow)
          OP3. SendOverNetwork(yellow)
          T2 = DynamicDelay(Two)
  ```
- **T3**
  ```
  (y1r2r3r4 != null)
          r1g2r3r4.Move(y1r2r3r4)
          OP1.SendOverNetwork(red)
          OP3. SendOverNetwork(red)
          OP2. SendOverNetwork(green)
          OP4. SendOverNetwork(green)
  ```
- **T4**
  ```
  (r1g2r3r4 != null) & (in2 == null)
          r1y2r3r4.Move(r1g2r3r4)
          OP2. SendOverNetwork(yellow)
          OP4. SendOverNetwork(yellow)
          T4 = DynamicDelay(Two)
  ```
- **T5**
  ```
  (r1y2r3r4 != null)
          r1r2g3r4.Move(r1y2r3r4)
          OP2. SendOverNetwork(red)
          OP4. SendOverNetwork(red)
          OP1. SendOverNetwork(green)
          OP3. SendOverNetwork(green)
  ```
- **T6**
  ```
  (r1r2g3r4 != null) & (in1 == null)
          r1r2y3r4.Move(r1r2g3r4)
          OP1. SendOverNetwork(yellow)
          OP3. SendOverNetwork(yellow)
          T6 = DynamicDelay(Two)
  ```
- **T7**
  ```
  (r1r2y3r4 != null)
  ```

```
        r1r2r3g4.Move(r1r2y3r4)
        OP1. SendOverNetwork(red)
        OP3. SendOverNetwork(red)
        OP2. SendOverNetwork(green)
        OP4. SendOverNetwork(green)
```

- **T8**

```
(r1r2r3g4 != null) & (in2 == null)
        r1r2r3y4.Move(r1r2r3g4)
        OP2. SendOverNetwork(yellow)
        OP4. SendOverNetwork(yellow)
        T8 = DynamicDelay(Two)
```

- **T9**

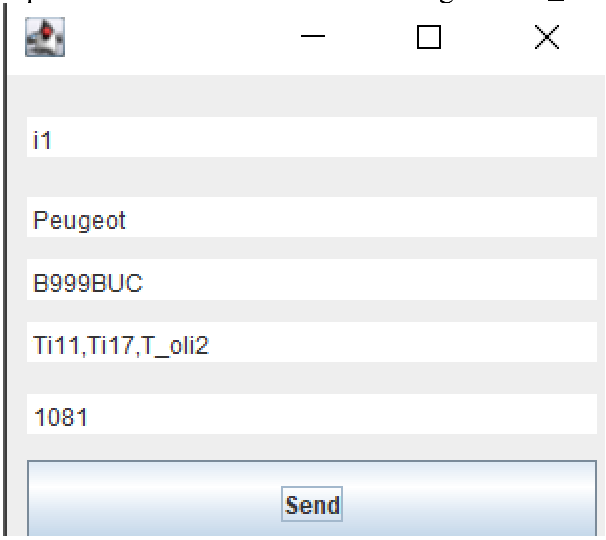
```
(r1r2r3y4 != null)
        r1r2r3r4.Move(r1r2r3y4)
        OP2. SendOverNetwork(red)
        OP4. SendOverNetwork(red)
```

4. Component Diagram

5. Testing

- **First Test:**

The first intersection (the Round About), got an input in “i1” place, that exit the round about in “oli2”. From here, it goes through the middle street and enters as an input in the second intersection through the “P_ai4” input.



i1

Peugeot

B999BUC

Ti11,Ti17,T_oli2

1081

```
PlaceList [i1(Null)  e1(Null)  i2(Null)  e2(Null)  i3(Null)  e3(Null)  oli1(Null)  ole1(Null)  oli2(Null)
ole2(Null)  oli3(Null)  ole3(Null)  ili1|(NULL)|  ile1|()|  ili2|()|  ile2|()|  ili3|()|  ile3|()|  P_oli2(localhost-
1084-P_oli2)]
 ExecutionList [T_oli2 Temp Marking [oli2(Peugeot-B999BUC)]]
PlaceList [i1(Null)  e1(Null)  i2(Null)  e2(Null)  i3(Null)  e3(Null)  oli1(Null)  ole1(Null)  oli2(Peugeot-
B999BUC)  ole2(Null)  oli3(Null)  ole3(Null)  ili1|(NULL)|  ile1|()|  ili2|()|  ile2|()|  ili3|()|  ile3|()|
P_oli2(localhost-1084-P_oli2)]
```

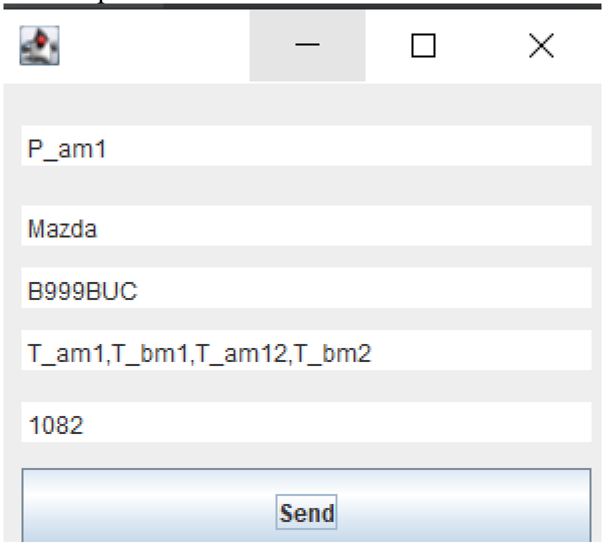
```
 ExecutionList [Ti17 Temp Marking []]
PlaceList [i1(Null)  e1(Null)  i2(Null)  e2(Null)  i3(Null)  e3(Null)  oli1(Null)  ole1(Null)  oli2(Null)
ole2(Null)  oli3(Null)  ole3(Null)  ili1|(ili1(Peugeot-B999BUC))|  ile1|()|  ili2|()|  ile2|()|  ili3|()|  ile3|()|
P_oli2(localhost-1084-P_oli2)]
 ExecutionList [Ti17 Temp Marking []]
PlaceList [i1(Null)  e1(Null)  i2(Null)  e2(Null)  i3(Null)  e3(Null)  oli1(Null)  ole1(Null)  oli2(Null)
ole2(Null)  oli3(Null)  ole3(Null)  ili1|(ili1(Peugeot-B999BUC))|  ile1|()|  ili2|()|  ile2|()|  ili3|()|  ile3|()|
P_oli2(localhost-1084-P_oli2)]
 ExecutionList [Ti11 Temp Marking [i1(Peugeot-B999BUC)]]
PlaceList [i1(Peugeot-B999BUC)  e1(Null)  i2(Null)  e2(Null)  i3(Null)  e3(Null)  oli1(Null)  ole1(Null)
oli2(Null)  ole2(Null)  oli3(Null)  ole3(Null)  ili1|()|  ile1|()|  ili2|()|  ile2|()|  ili3|()|  ile3|()|
P_oli2(localhost-1084-P_oli2)]
$$$$$$$$$$$$$$$ I got an Input From NetWork for i1
```

```
PlaceList [P_oli2(Null)  P1|(NULL)|  P2(Null)  I_i4(localhost-1082-P_ai4)  E_oli3(Null)  P3|()|  P4(Null)
I_i2(localhost-1081-i2)]
 ExecutionList [T3 Temp Marking [P2(Peugeot-B999BUC)]]
PlaceList [P_oli2(Null)  P1|(NULL)|  P2(Peugeot-B999BUC)  I_i4(localhost-1082-P_ai4)  E_oli3(Null)
P3|()|  P4(Null)  I_i2(localhost-1081-i2)]
 ExecutionList [T2 Temp Marking []]
PlaceList [P_oli2(Null)  P1|(P1(Peugeot-B999BUC))|  P2(Null)  I_i4(localhost-1082-P_ai4)  E_oli3(Null)
P3|()|  P4(Null)  I_i2(localhost-1081-i2)]
 ExecutionList [T1 Temp Marking [P_oli2(Peugeot-B999BUC)]]
PlaceList [P_oli2(Peugeot-B999BUC)  P1|()|  P2(Null)  I_i4(localhost-1082-P_ai4)  E_oli3(Null)  P3|()|
P4(Null)  I_i2(localhost-1081-i2)]
$$$$$$$$$$$$$$$ I got an Input From NetWork for P_oli2
```

```
ConstantPlaceList [full(full)]
 PlaceList [P_ai1(Null)  ili1|()|  P_bi1(Null)  P_am1(Null)  ilm1|()|  P_bm1(Null)  P_ae1(Null)  ile1|()|
P_be1(Null)  OP1(localhost-1082-in1)  P_TL1(Null)  P_ai2(Null)  ili2|()|  P_am2(Null)  ilm2|()|
P_ae2(Null)  ile2|()|  OP2(localhost-1082-in2)  P_TL2(Null)  P_ai3(Null)  ili3|()|  P_am3(Null)  ilm3|()|
P_ae3(Null)  ile3|()|  P_TL3(Null)  OP3(localhost-1082-in1)  P_ai4(Null)  ili4|(ili4(Peugeot-B999BUC))|
P_am4(Null)  ilm4|()|  P_ae4(Null)  ile4|()|  OP4(localhost-1082-in2)  P_TL4(Null)  oli1(Null)
olm1(Null)  ole1(Null)  oli2(Null)  ole2(Null)  oli3(Null)  olm3(Null)  ole3(Null)  oli4(Null)  olm4(Null)
ole4(Null)  P_ci1(Null)  P_di1(Null)  P_dm1(Null)  P_de1(Null)  P_ei1(Null)  P_em1(Null)  P_ee1(Null)
E_oli3(localhost-1084-E_oli3)]
 ExecutionList [T_ai4 Temp Marking [P_ai4(Peugeot-B999BUC)]]
PlaceList [P_ai1(Null)  ili1|()|  P_bi1(Null)  P_am1(Null)  ilm1|()|  P_bm1(Null)  P_ae1(Null)  ile1|()|
P_be1(Null)  OP1(localhost-1082-in1)  P_TL1(Null)  P_ai2(Null)  ili2|()|  P_am2(Null)  ilm2|()|
P_ae2(Null)  ile2|()|  OP2(localhost-1082-in2)  P_TL2(Null)  P_ai3(Null)  ili3|()|  P_am3(Null)  ilm3|()|
P_ae3(Null)  ile3|()|  P_TL3(Null)  OP3(localhost-1082-in1)  P_ai4(Peugeot-B999BUC)  ili4|()|
P_am4(Null)  ilm4|()|  P_ae4(Null)  ile4|()|  OP4(localhost-1082-in2)  P_TL4(Null)  oli1(Null)
olm1(Null)  ole1(Null)  oli2(Null)  ole2(Null)  oli3(Null)  olm3(Null)  ole3(Null)  oli4(Null)  olm4(Null)
ole4(Null)  P_ci1(Null)  P_di1(Null)  P_dm1(Null)  P_de1(Null)  P_ei1(Null)  P_em1(Null)  P_ee1(Null)
E_oli3(localhost-1084-E_oli3)]
$$$$$$$$$$$$$$$ I got an Input From NetWork for P_ai4
```

- **Second Test:**

The second test was performed to test how the second intersection works with the controller. It receives an input from "P_am1", enters the queue in "ilm1" and waits for the green light at the traffic light. Then, it enters the "ilm2" queue and waits for the second traffic light to turn green. After, it exists the intersection through the "olm3" place.



P_am1

Mazda

B999BUC

T_am1,T_bm1,T_am12,T_bm2

1082

```
PlaceList [P_ai1(Null)  ili1|()|  P_bi1(Null)  P_am1(Null)  ilm1|(NULL)|  P_bm1(Null)  P_ae1(Null)
ile1|()|  P_be1(Null)  OP1(localhost-1082-in1)  P_TL1(red)  P_ai2(Null)  ili2|()|  P_am2(Null)
ilm2|(NULL)|  P_ae2(Null)  ile2|()|  OP2(localhost-1082-in2)  P_TL2(green)  P_ai3(Null)  ili3|()|
P_am3(Null)  ilm3|()|  P_ae3(Null)  ile3|()|  P_TL3(red)  OP3(localhost-1082-in1)  P_ai4(Null)  ili4|()|
P_am4(Null)  ilm4|()|  P_ae4(Null)  ile4|()|  OP4(localhost-1082-in2)  P_TL4(green)  oli1(Null)
olm1(Null)  ole1(Null)  oli2(Null)  ole2(Null)  oli3(Null)  olm3(Mazda-B999BUC)  ole3(Null)
oli4(Null)  olm4(Null)  ole4(Null)  P_ci1(Null)  P_di1(Null)  P_dm1(Null)  P_de1(Null)  P_ei1(Null)
P_em1(Null)  P_ee1(Null)  E_oli3(localhost-1084-E_oli3)]
ExecutionList [T_bm2 Temp Marking [P_TL2(green)]]
$$$$$$$$$$$$$$$$ I got an Input From NetWork for P_TL4
$$$$$$$$$$$$$$$$ I got an Input From NetWork for P_TL2
$$$$$$$$$$$$$$$$ I got an Input From NetWork for P_TL3
$$$$$$$$$$$$$$$$ I got an Input From NetWork for P_TL1


PlaceList [P_ai1(Null)  ili1|()|  P_bi1(Null)  P_am1(Null)  ilm1|(NULL)|  P_bm1(Null)  P_ae1(Null)
ile1|()|  P_be1(Null)  OP1(localhost-1082-in1)  P_TL1(green)  P_ai2(Null)  ili2|()|  P_am2(Null)
ilm2|(ilm2(Mazda-B999BUC))|  P_ae2(Null)  ile2|()|  OP2(localhost-1082-in2)  P_TL2(red)  P_ai3(Null)
ili3|()|  P_am3(Null)  ilm3|()|  P_ae3(Null)  ile3|()|  P_TL3(green)  OP3(localhost-1082-in1)  P_ai4(Null)
ili4|()|  P_am4(Null)  ilm4|()|  P_ae4(Null)  ile4|()|  OP4(localhost-1082-in2)  P_TL4(red)  oli1(Null)
olm1(Null)  ole1(Null)  oli2(Null)  ole2(Null)  oli3(Null)  olm3(Null)  ole3(Null)  oli4(Null)  olm4(Null)
ole4(Null)  P_ci1(Null)  P_di1(Null)  P_dm1(Null)  P_de1(Null)  P_ei1(Null)  P_em1(Null)  P_ee1(Null)
E_oli3(localhost-1084-E_oli3)]
 ExecutionList [T_am12 Temp Marking [P_bm1(Mazda-B999BUC)]]
PlaceList [P_ai1(Null)  ili1|()|  P_bi1(Null)  P_am1(Null)  ilm1|(NULL)|  P_bm1(Mazda-B999BUC)
P_ae1(Null)  ile1|()|  P_be1(Null)  OP1(localhost-1082-in1)  P_TL1(green)  P_ai2(Null)  ili2|()|
P_am2(Null)  ilm2|()|  P_ae2(Null)  ile2|()|  OP2(localhost-1082-in2)  P_TL2(red)  P_ai3(Null)  ili3|()|
P_am3(Null)  ilm3|()|  P_ae3(Null)  ile3|()|  P_TL3(green)  OP3(localhost-1082-in1)  P_ai4(Null)  ili4|()|
P_am4(Null)  ilm4|()|  P_ae4(Null)  ile4|()|  OP4(localhost-1082-in2)  P_TL4(red)  oli1(Null)  olm1(Null)
ole1(Null)  oli2(Null)  ole2(Null)  oli3(Null)  olm3(Null)  ole3(Null)  oli4(Null)  olm4(Null)  ole4(Null)
P_ci1(Null)  P_di1(Null)  P_dm1(Null)  P_de1(Null)  P_ei1(Null)  P_em1(Null)  P_ee1(Null)
E_oli3(localhost-1084-E_oli3)]
PlaceList [P_ai1(Null)  ili1|()|  P_bi1(Null)  P_am1(Null)  ilm1|(ilm1(Mazda-B999BUC))|  P_bm1(Null)
P_ae1(Null)  ile1|()|  P_be1(Null)  OP1(localhost-1082-in1)  P_TL1(Null)  P_ai2(Null)  ili2|()|
P_am2(Null)  ilm2|()|  P_ae2(Null)  ile2|()|  OP2(localhost-1082-in2)  P_TL2(red)  P_ai3(Null)  ili3|()|
P_am3(Null)  ilm3|()|  P_ae3(Null)  ile3|()|  P_TL3(green)  OP3(localhost-1082-in1)  P_ai4(Null)  ili4|()|
P_am4(Null)  ilm4|()|  P_ae4(Null)  ile4|()|  OP4(localhost-1082-in2)  P_TL4(red)  oli1(Null)  olm1(Null)
ole1(Null)  oli2(Null)  ole2(Null)  oli3(Null)  olm3(Null)  ole3(Null)  oli4(Null)  olm4(Null)  ole4(Null)
P_ci1(Null)  P_di1(Null)  P_dm1(Null)  P_de1(Null)  P_ei1(Null)  P_em1(Null)  P_ee1(Null)
E_oli3(localhost-1084-E_oli3)]
 ExecutionList [T_bm1 Temp Marking [P_TL1(green)]]

PlaceList [P_ai1(Null)  ili1|()|  P_bi1(Null)  P_am1(Null)  ilm1|(ilm1(Mazda-B999BUC))|  P_bm1(Null)
P_ae1(Null)  ile1|()|  P_be1(Null)  OP1(localhost-1082-in1)  P_TL1(red)  P_ai2(Null)  ili2|()|
P_am2(Null)  ilm2|()|  P_ae2(Null)  ile2|()|  OP2(localhost-1082-in2)  P_TL2(red)  P_ai3(Null)  ili3|()|
P_am3(Null)  ilm3|()|  P_ae3(Null)  ile3|()|  P_TL3(red)  OP3(localhost-1082-in1)  P_ai4(Null)  ili4|()|
P_am4(Null)  ilm4|()|  P_ae4(Null)  ile4|()|  OP4(localhost-1082-in2)  P_TL4(red)  oli1(Null)  olm1(Null)
ole1(Null)  oli2(Null)  ole2(Null)  oli3(Null)  olm3(Null)  ole3(Null)  oli4(Null)  olm4(Null)  ole4(Null)
P_ci1(Null)  P_di1(Null)  P_dm1(Null)  P_de1(Null)  P_ei1(Null)  P_em1(Null)  P_ee1(Null)
E_oli3(localhost-1084-E_oli3)]
ExecutionList [T_am1 Temp Marking [P_am1(Mazda-B999BUC)]]
PlaceList [P_ai1(Null)  ili1|()|  P_bi1(Null)  P_am1(Mazda-B999BUC)  ilm1|()|  P_bm1(Null)
P_ae1(Null)  ile1|()|  P_be1(Null)  OP1(localhost-1082-in1)  P_TL1(red)  P_ai2(Null)  ili2|()|
P_am2(Null)  ilm2|()|  P_ae2(Null)  ile2|()|  OP2(localhost-1082-in2)  P_TL2(red)  P_ai3(Null)  ili3|()|
P_am3(Null)  ilm3|()|  P_ae3(Null)  ile3|()|  P_TL3(red)  OP3(localhost-1082-in1)  P_ai4(Null)  ili4|()|
P_am4(Null)  ilm4|()|  P_ae4(Null)  ile4|()|  OP4(localhost-1082-in2)  P_TL4(red)  oli1(Null)  olm1(Null)
ole1(Null)  oli2(Null)  ole2(Null)  oli3(Null)  olm3(Null)  ole3(Null)  oli4(Null)  olm4(Null)  ole4(Null)
P_ci1(Null)  P_di1(Null)  P_dm1(Null)  P_de1(Null)  P_ei1(Null)  P_em1(Null)  P_ee1(Null)
E_oli3(localhost-1084-E_oli3)]
$$$$$$$$$$$$$$$ I got an Input From NetWork for P_TL4
$$$$$$$$$$$$$$$ I got an Input From NetWork for P_am1
$$$$$$$$$$$$$$$ I got an Input From NetWork for P_TL3
```