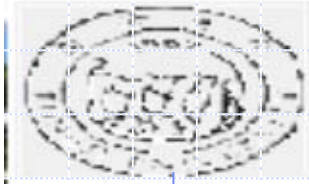

CISS

Transform Dual Transition Timed Petri Net to Time Automaton

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Mar.12,2007

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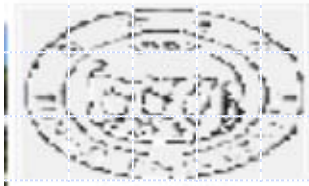
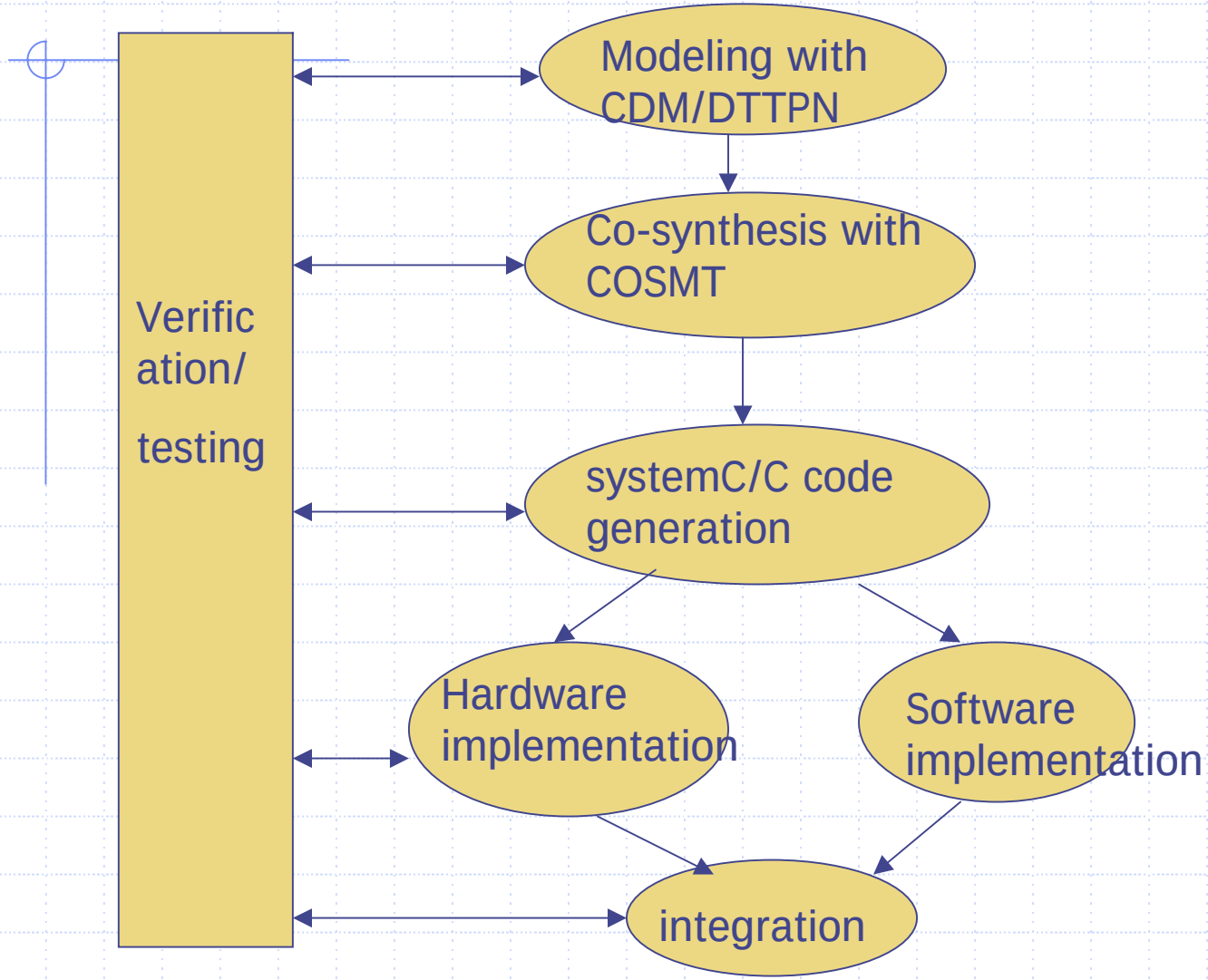


agenda

- What is Dual Transition Timed Petri Net(DTTPN)
- How to transform DTTPN to Time Automaton ?
- Some experiments and application discussion .

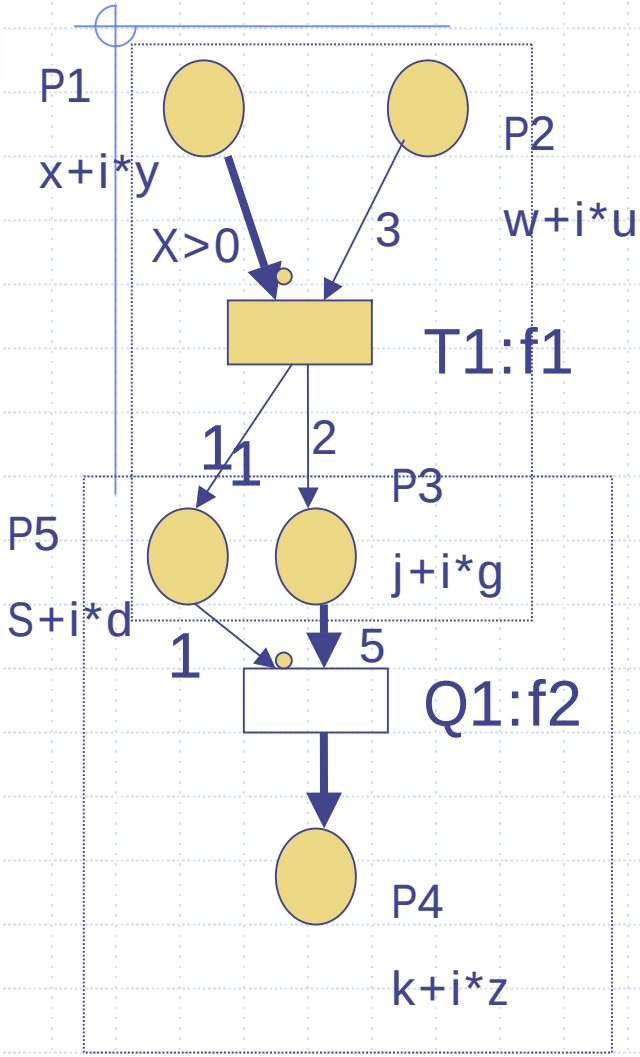
a co-design methodology

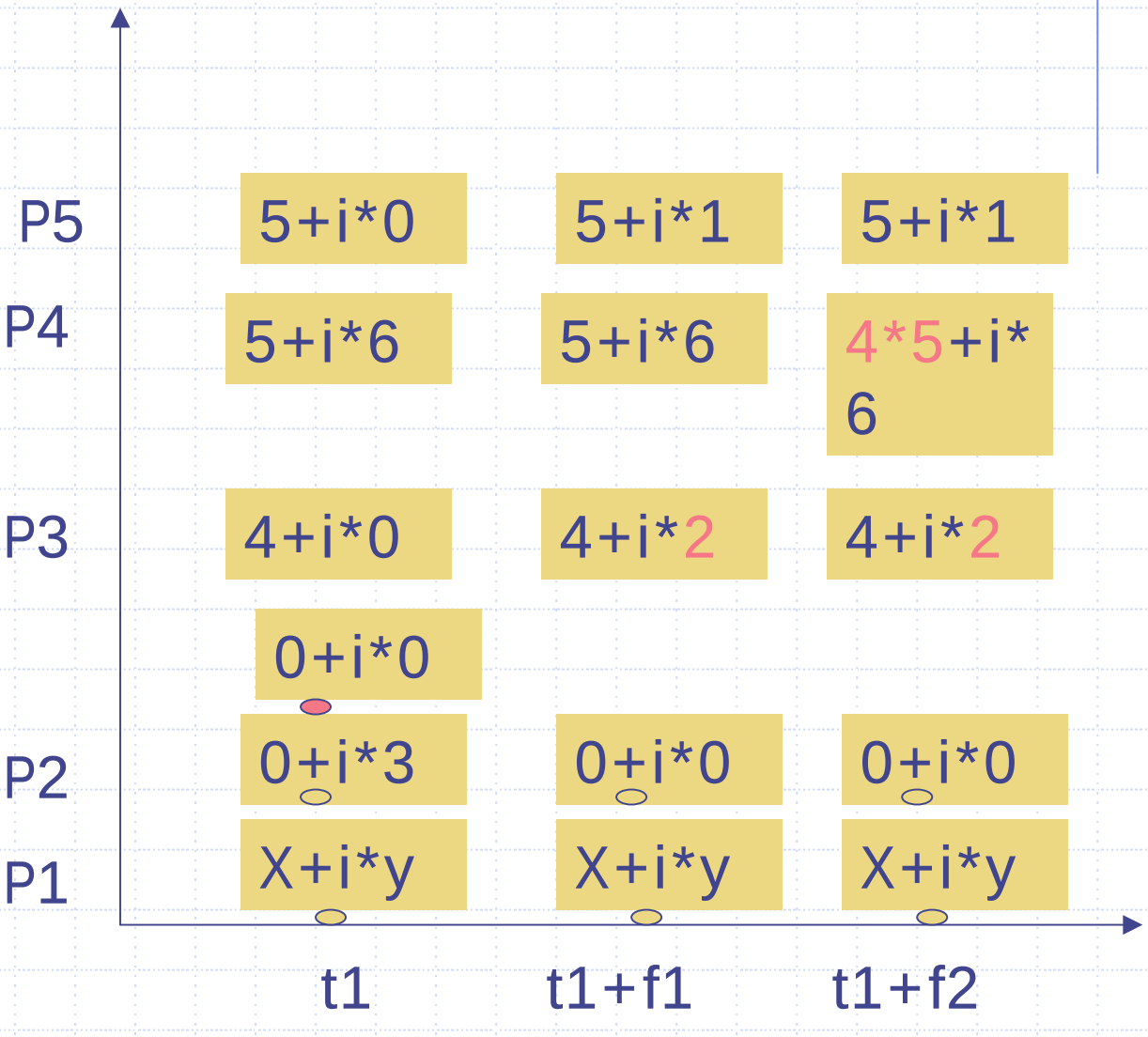


DTTPN

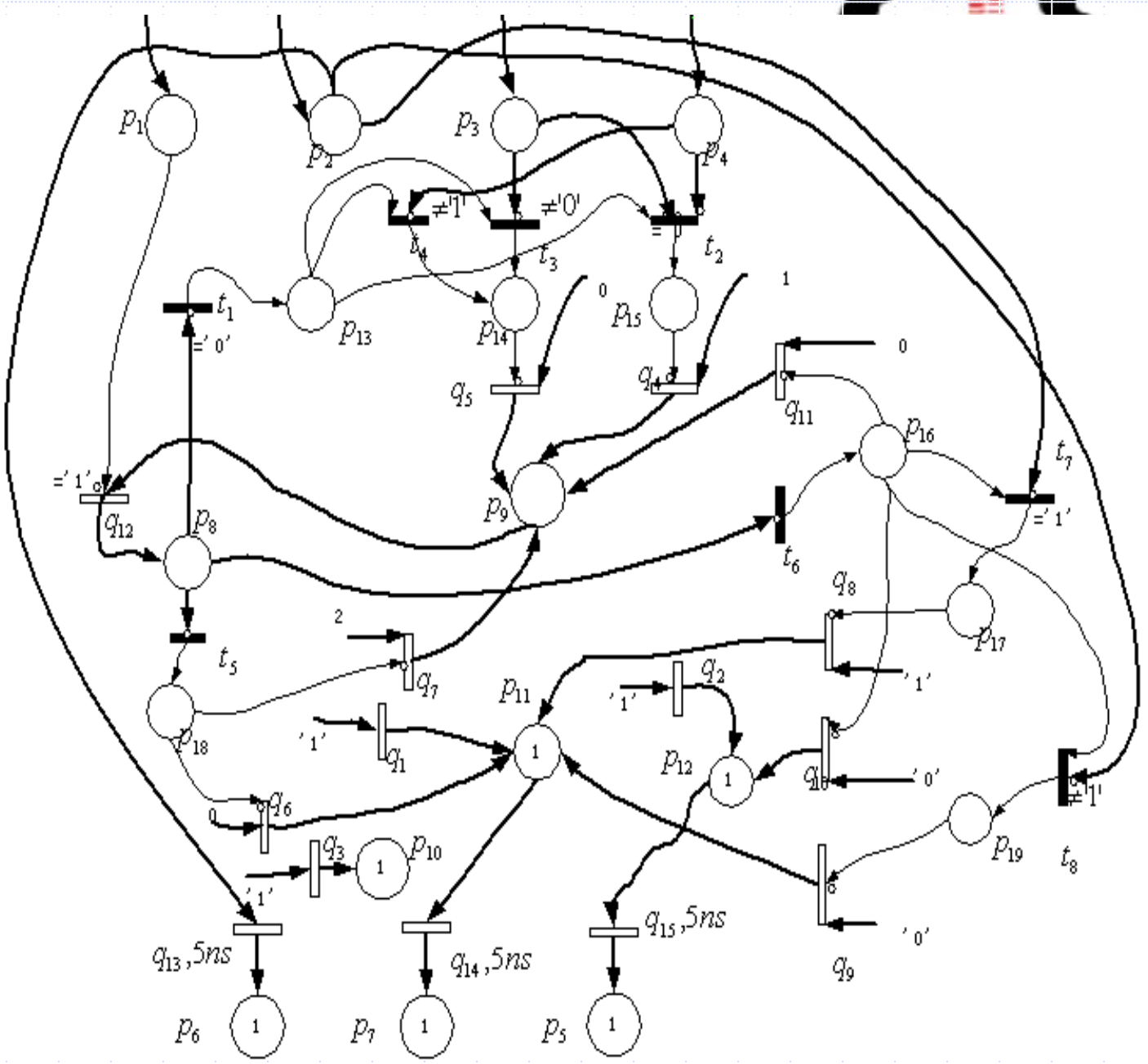
- DTPN (Dual Transition Petri Net) which proposed by Mauricio Verea ,Bashir Al-Hashimi of Southampton,UK
- DTTPN:an evolve of DTPN.
- Time is used to describe the transition time.

DTTPN(Cont.)

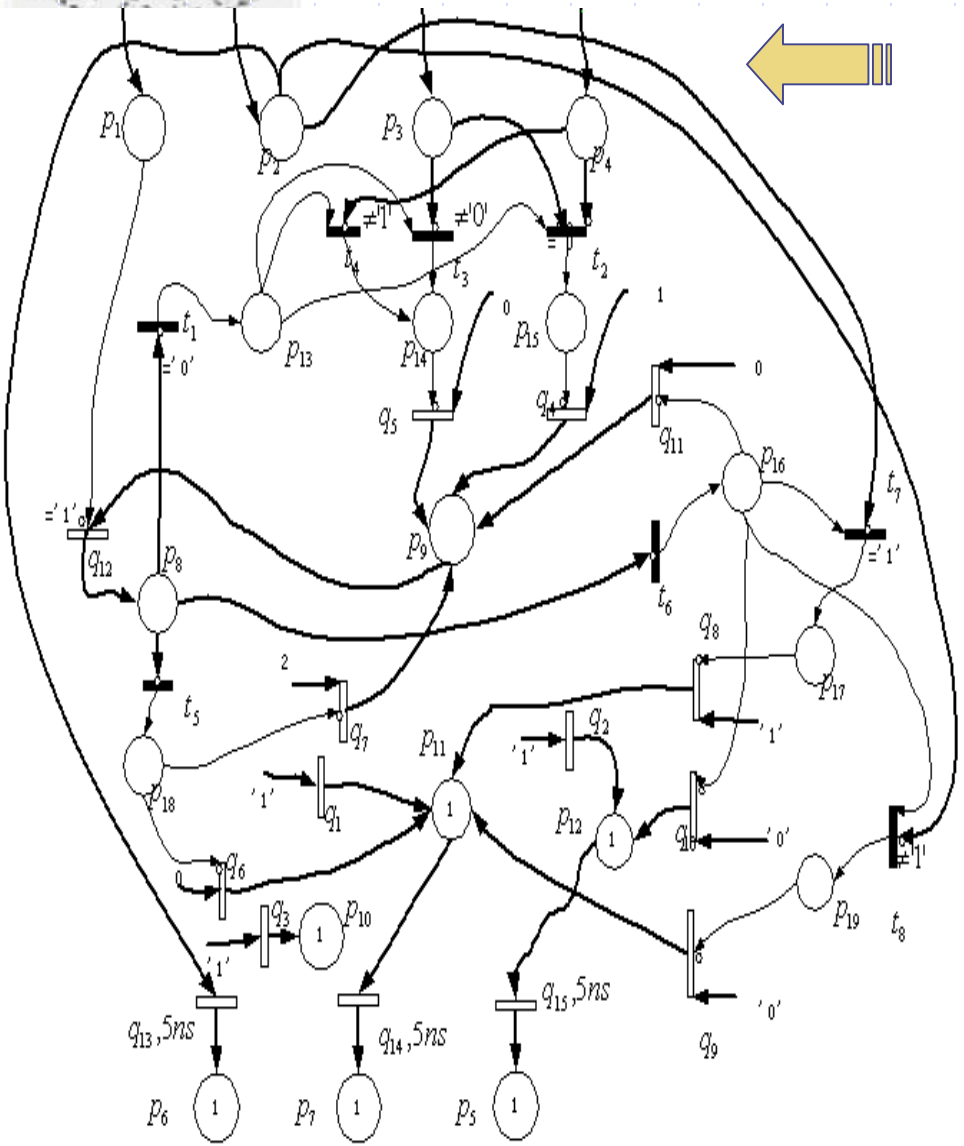

P1
x+i*y
P2
w+i*u
X>0
3
T1:f1
1
1
2
P3
j+i*g
P5
S+i*d
1
5
Q1:f2
P4
k+i*z


P5
P4
P3
P2
P1
5+i*0
5+i*1
5+i*1
5+i*6
5+i*6
4*5+i*6
4+i*0
4+i*2
4+i*2
0+i*0
0+i*3
0+i*0
0+i*0
X+i*y
X+i*y
X+i*y
t1
t1+f1
t1+f2

DTTPN ex. Cont.



DTTPN ex. Cont.




```
port( clk,w_rb,ads_b,csl:in bit;
rdy_b,we_b,cs_b:out bit :='1');
end mm_control;
 architectre behaval_mm of mm_control is
  constant delay:time :=5ns;
 signal state,nextstate:integar range 0 to 2;
 signal
new_we_b,new_cs_b,new_rdy_b:bit:='1';
begin
        process(state,ads_b,w_rb,csl)
            begin
                new_cs_b<='1';
new_rdy_b<='1';
new_we_b<='1';
                .......
 we_b<=nor w_rb after delay;
cs_b<=new_cs_b after delay;
rdy_b<=new_rdy_b after delay;
```

How to transform ?

- The inadequate of Extended state class :cannot state the non-determination of DTTPN and unbound of data domain so as it can be checked .

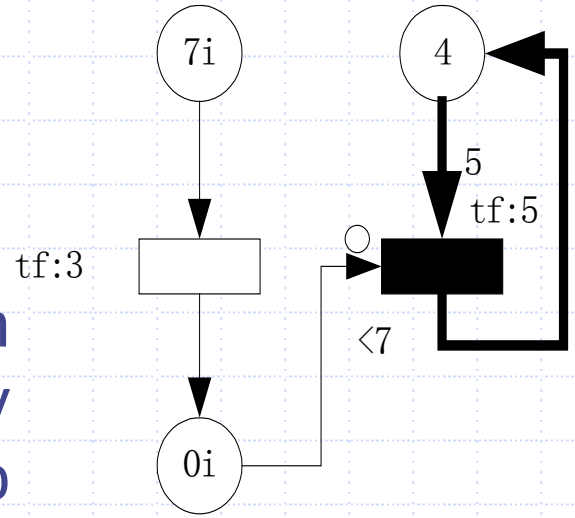
Example:

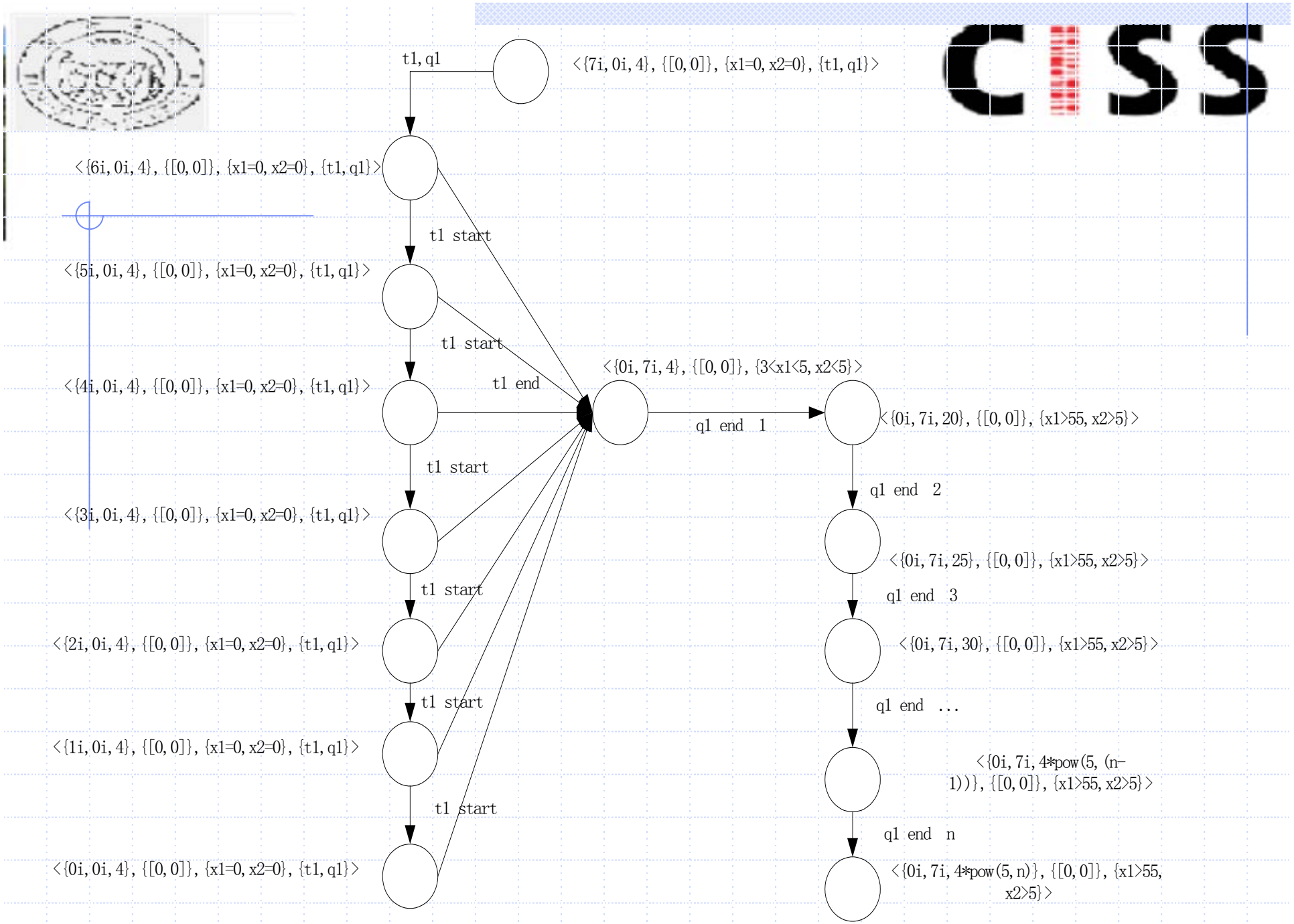
P1=7;p2=0;p3=4

For(;p2<7;p1--,p2++)

P3=5*p3;

If we want to implemented it with hardware or hardware/software by assign a processing time 3 time units to t1,and 5 time units to q1,and one guy got out the model as the right figure. What will happen ?

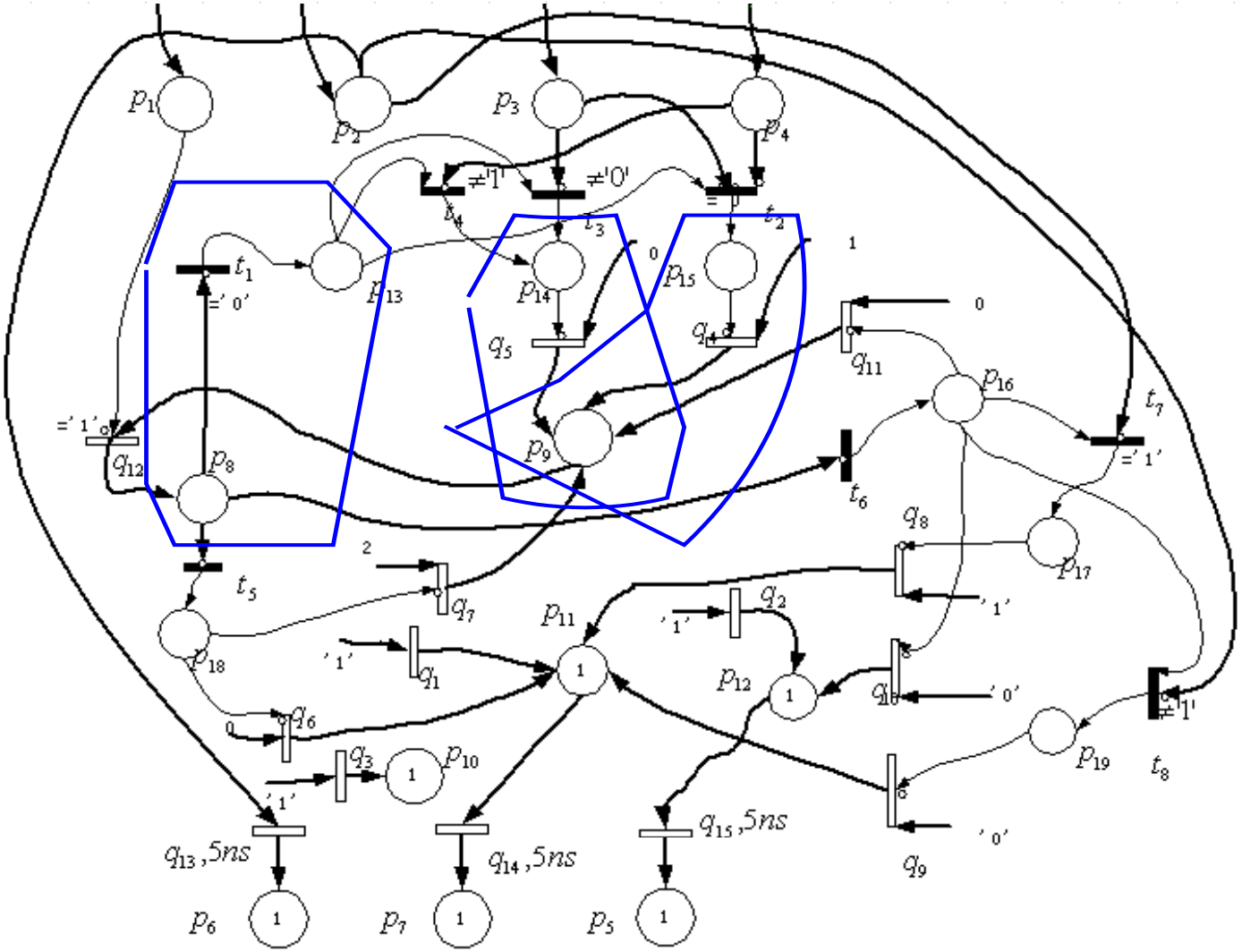



t1, q1
<{7i, 0i, 4}, {[0, 0]}, {x1=0, x2=0}, {t1, q1}>
<{6i, 0i, 4}, {[0, 0]}, {x1=0, x2=0}, {t1, q1}>
t1 start
<{5i, 0i, 4}, {[0, 0]}, {x1=0, x2=0}, {t1, q1}>
t1 start
<{4i, 0i, 4}, {[0, 0]}, {x1=0, x2=0}, {t1, q1}>
t1 end
<{0i, 7i, 4}, {[0, 0]}, {3<x1<5, x2<5}>
q1 end 1
<{0i, 7i, 20}, {[0, 0]}, {x1>55, x2>5}>
t1 start
<{3i, 0i, 4}, {[0, 0]}, {x1=0, x2=0}, {t1, q1}>
q1 end 2
<{0i, 7i, 25}, {[0, 0]}, {x1>55, x2>5}>
t1 start
<{2i, 0i, 4}, {[0, 0]}, {x1=0, x2=0}, {t1, q1}>
q1 end 3
<{0i, 7i, 30}, {[0, 0]}, {x1>55, x2>5}>
t1 start
<{1i, 0i, 4}, {[0, 0]}, {x1=0, x2=0}, {t1, q1}>
q1 end ...
<{0i, 7i, 4*pow(5, (n-1))}, {[0, 0]}, {x1>55, x2>5}>
t1 start
<{0i, 0i, 4}, {[0, 0]}, {x1=0, x2=0}, {t1, q1}>
q1 end n
<{0i, 7i, 4*pow(5, n)}, {[0, 0]}, {x1>55, x2>5}>

How,Our method:

- Get the active state set graph of the petri net,and transform this active state set graph into time automaton so called active set automaton.

the core of active set:



the core of active set:

$$\phi^a = (\Theta, \Omega, X, \Xi, \Psi),$$

$$\Theta \subseteq P, \Omega \subseteq TF, \psi \subseteq T \cup Q,$$

$$X = \{x_{ij} \mid x_{ij} \in R^+ \cup \{0\}, t_i \in \psi, i, j \in N\}$$

$$\Xi = \{Con \mid Con = (\mathrm{Im}(p_i) >= W_C(p_i, \xi)) \mid p_i \in {}^\bullet\xi, \xi \in \psi\} \cup \{G_q^C(\xi) \mid \xi \in \psi\} \cup \{G_t^D(\xi) \mid \xi \in \psi\}$$

$$\forall t_i \in \Psi, \forall p \in \Theta, \forall tf_i \in \Omega, \begin{cases} if\ t_i \in T, ([\mathrm{Im}(p \in {}^\bullet t_i) >= W_c(p, t_i)] \wedge [G_t^D == 0]), and(\exists x_{ij} \in X, s.t. x_{ij} < tf_i) \\ else \\ ([G_q^C == 1] \vee [{}^\bullet q = \phi]), and(\exists x_{ij} \in X, s.t. x_{ij} < tf_i) \end{cases}$$

active state set of DTTPN

Six types of active state set :

Initial state: the set of mark and clocks of transition

Not ready not firing: the mark of place not meet the conditions and the transition not be firing

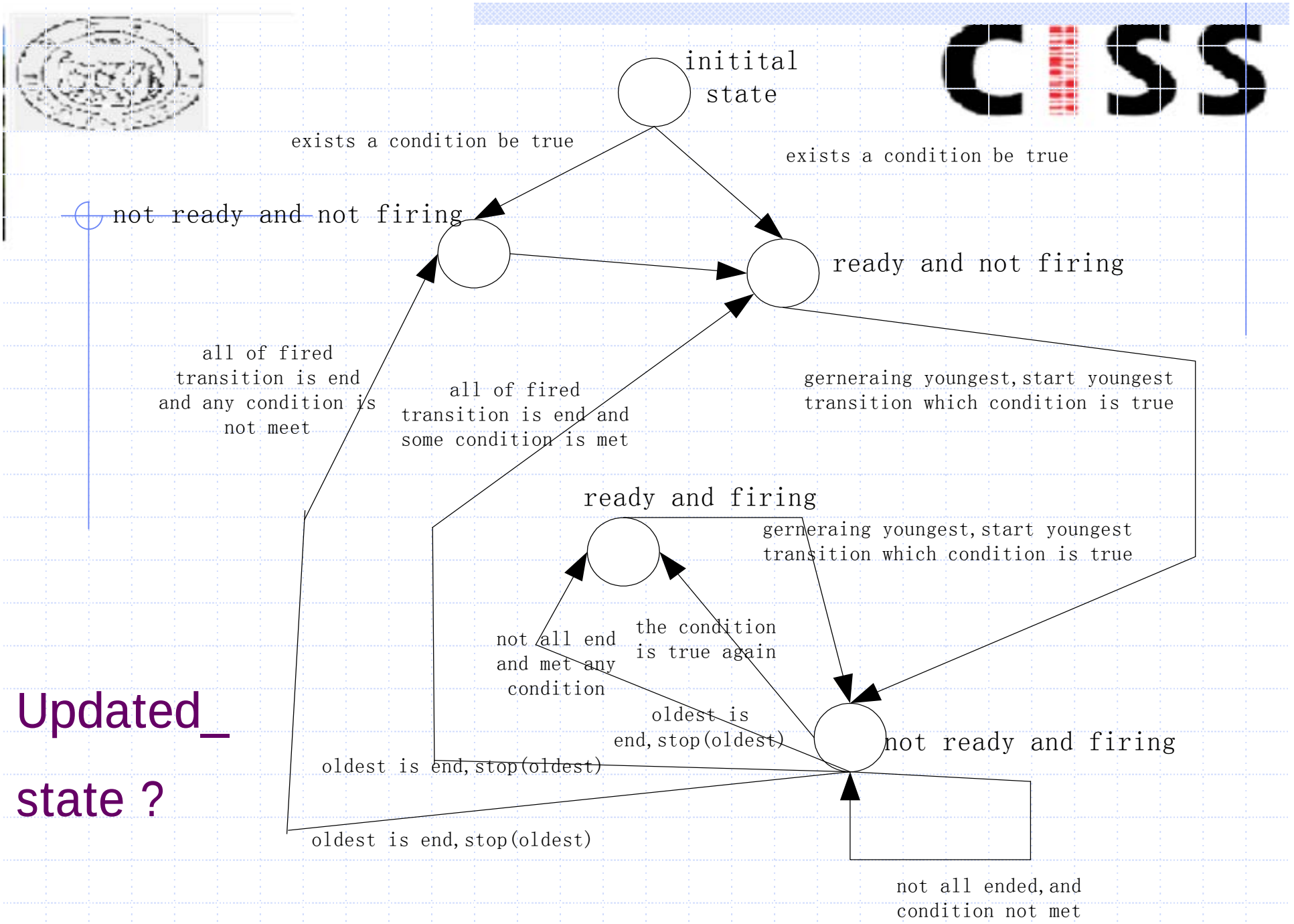
Ready and not firing: the mark of place meet the conditions but the transition not be firing,instant

active state set of DTTPN

Not ready and not firing: the mark of place not meet the conditions and the transition not be firing

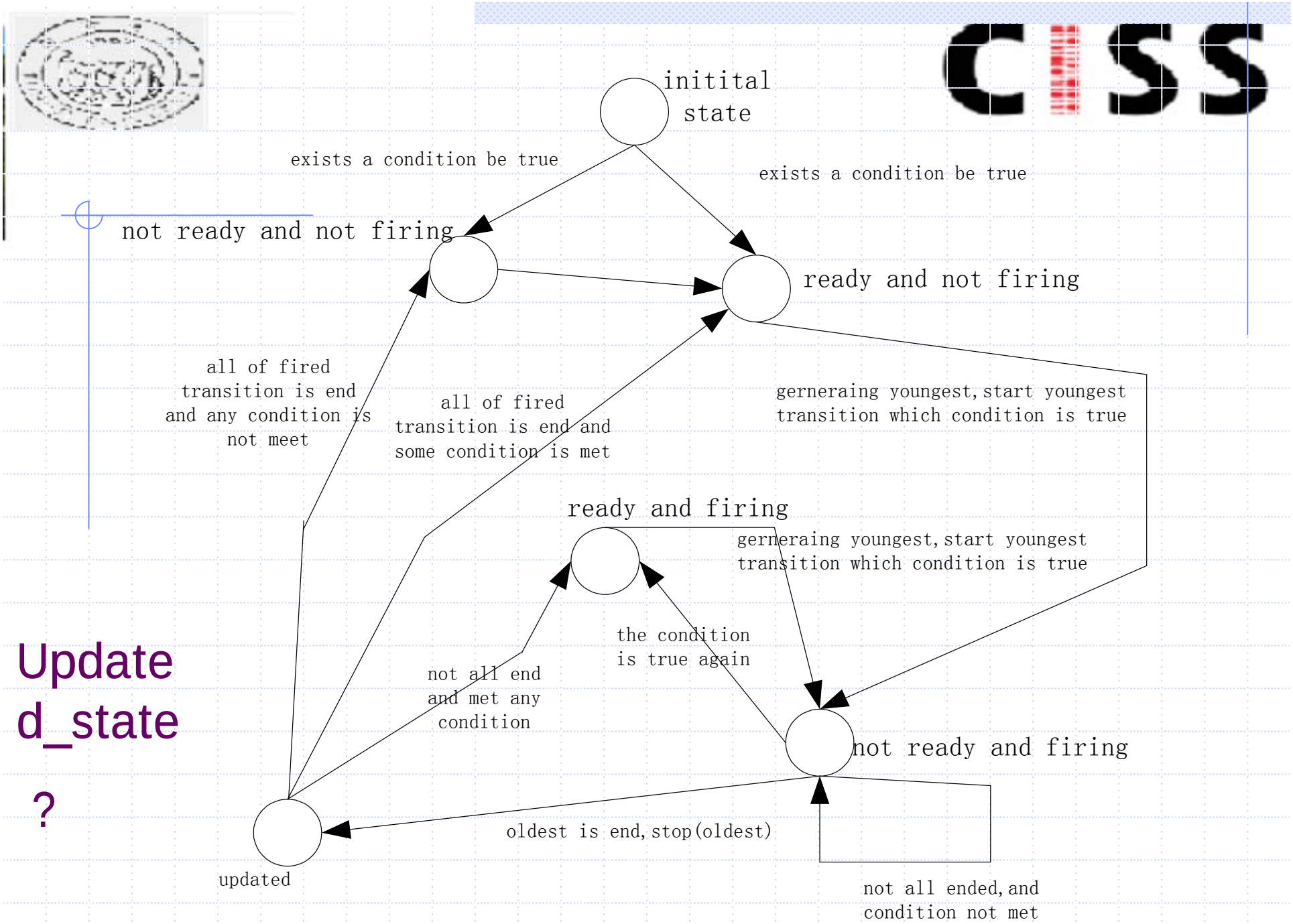
Ready and firing: the mark of place meet the conditions and the transition be firing,instant

Updated result:justify the mark of successor places has been updated ,instant



Updated_

state ?



Update d_state ?

Active Set Time Automaton

$$\Delta^a(DTTPN) = (L, l_0, X, A, E, Inv)$$

$$L = SE^a, l_0 = se_0^a \qquad X = \cup_{X_i}, \Phi(se^a) = (\Theta_i, \Omega_i, X_i, \Xi_i, \Psi_i)$$

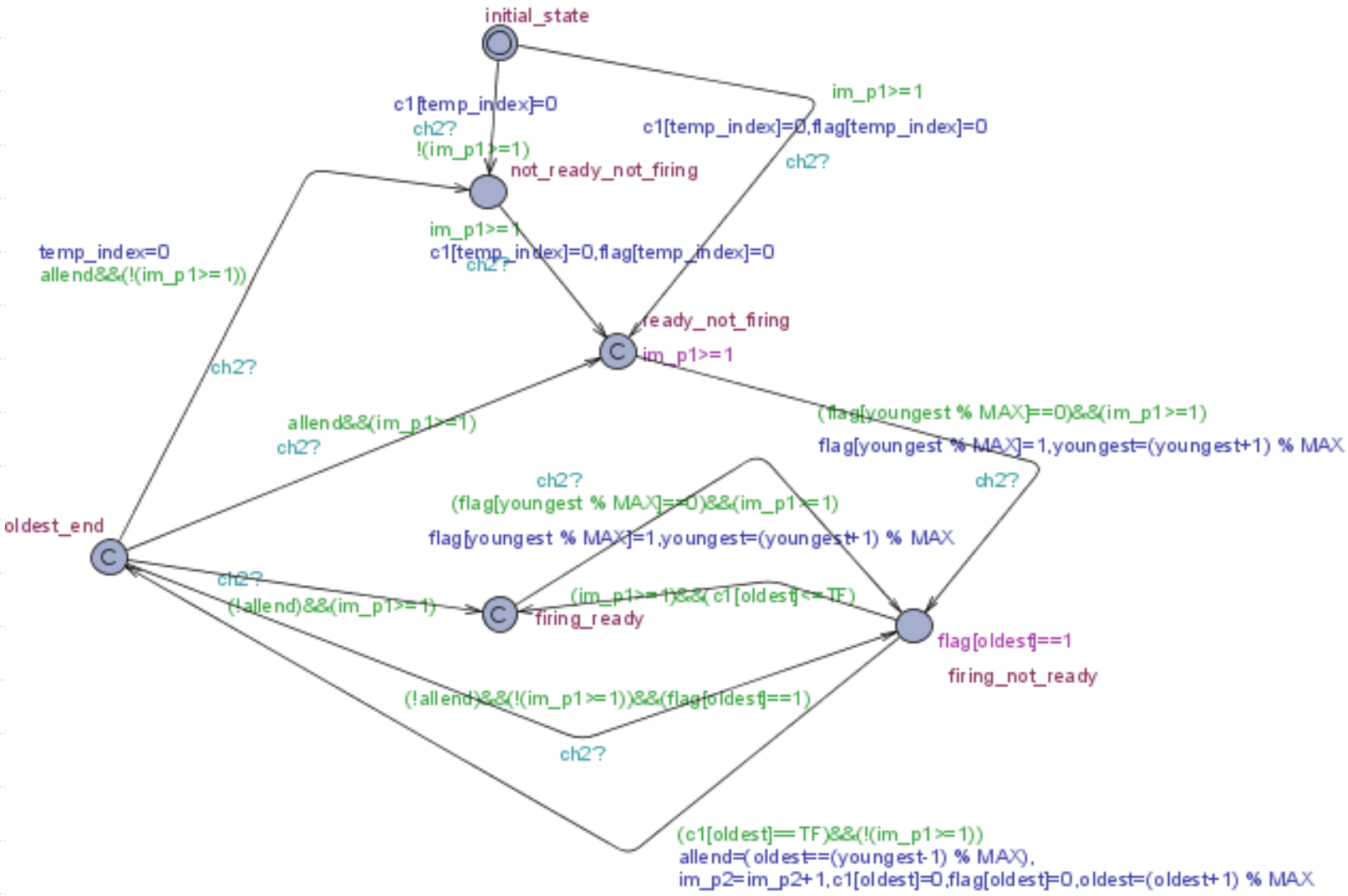
$$\exists se^a \xrightarrow{action(t)} se^{a'}, t \in \psi$$

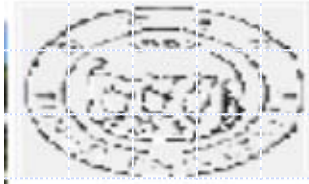
$$\Leftrightarrow \exists e = (l, \sigma, \alpha, R, \rho, l'),$$

$$s.t. \begin{cases} \sigma = Con(se^{a'}), \\ \alpha = action(t), \\ R = \{x_{ij} \mid x_{ij} = tf_i, t_i \in \psi\} \\ \forall x_{i,j}, x_{i,k} \in X_i, k > j, x_{i,j} = x_{i,k}, \rho(x_{i,k}) = x_{i,j} \\ \forall x_{i,j}, x_{i,k} \in X_i, K > j, x_{i,j} > 0, x_{i,(j+1) \bmod |X_i|} = 0, \rho(x_{i,k}) = x_{i,(j+1) \bmod |X_i|} \end{cases}$$

$$\forall se^a \in SE^a, Inv(l) = \wedge_{\forall x_{ij} \in X_i} (x_{ij} < tf_i) \wedge \overline{con(next(se^a))}$$

An example of active set TA

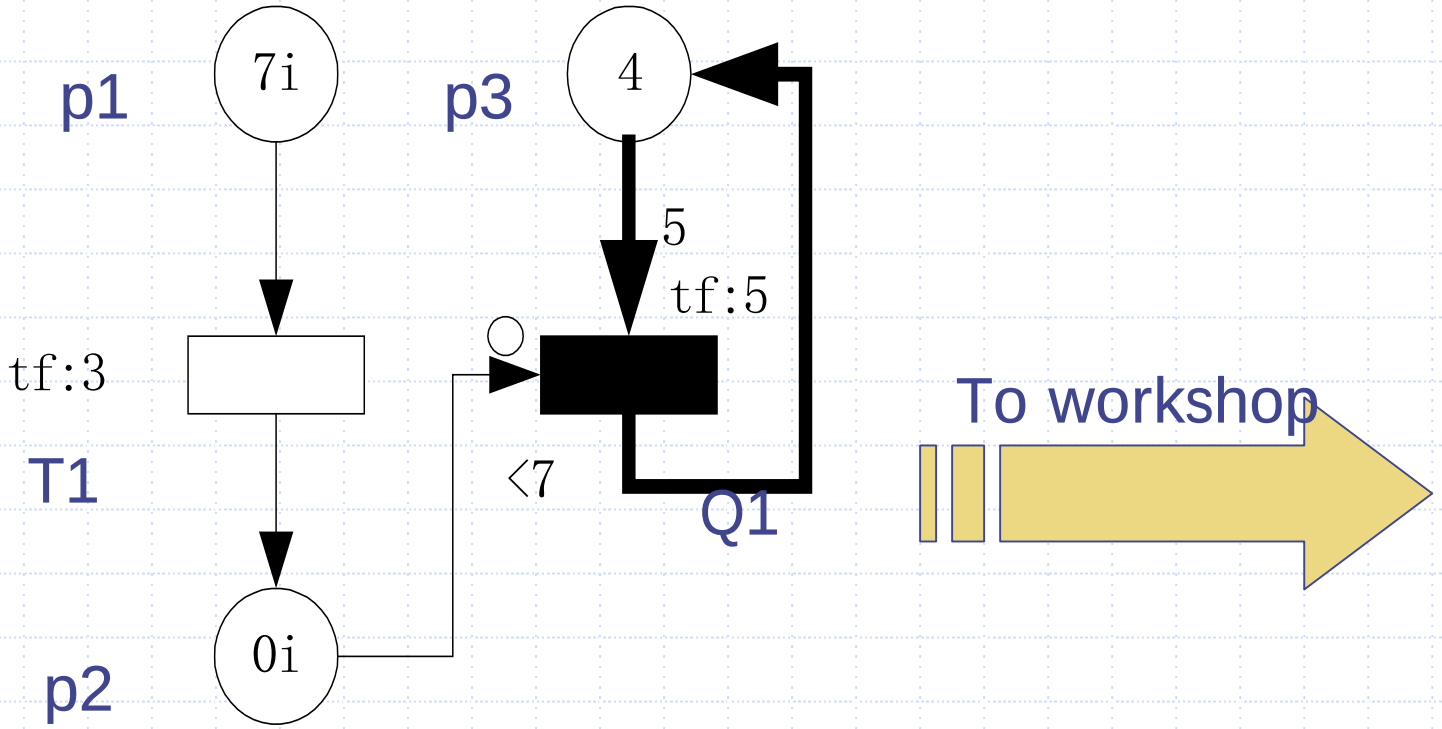




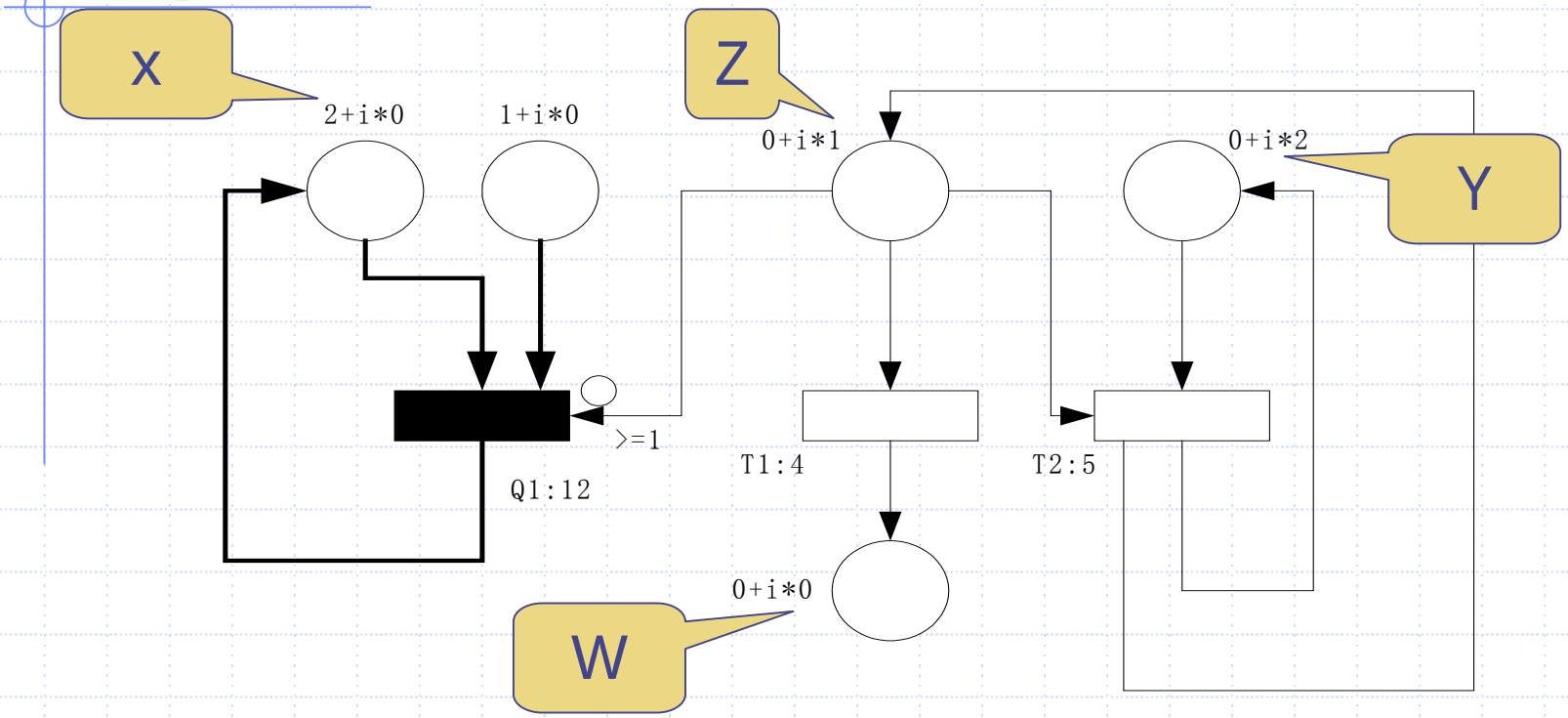
Experiments and discussions

- Transition resource constraints
- Model check the collision

Experiments and discussions

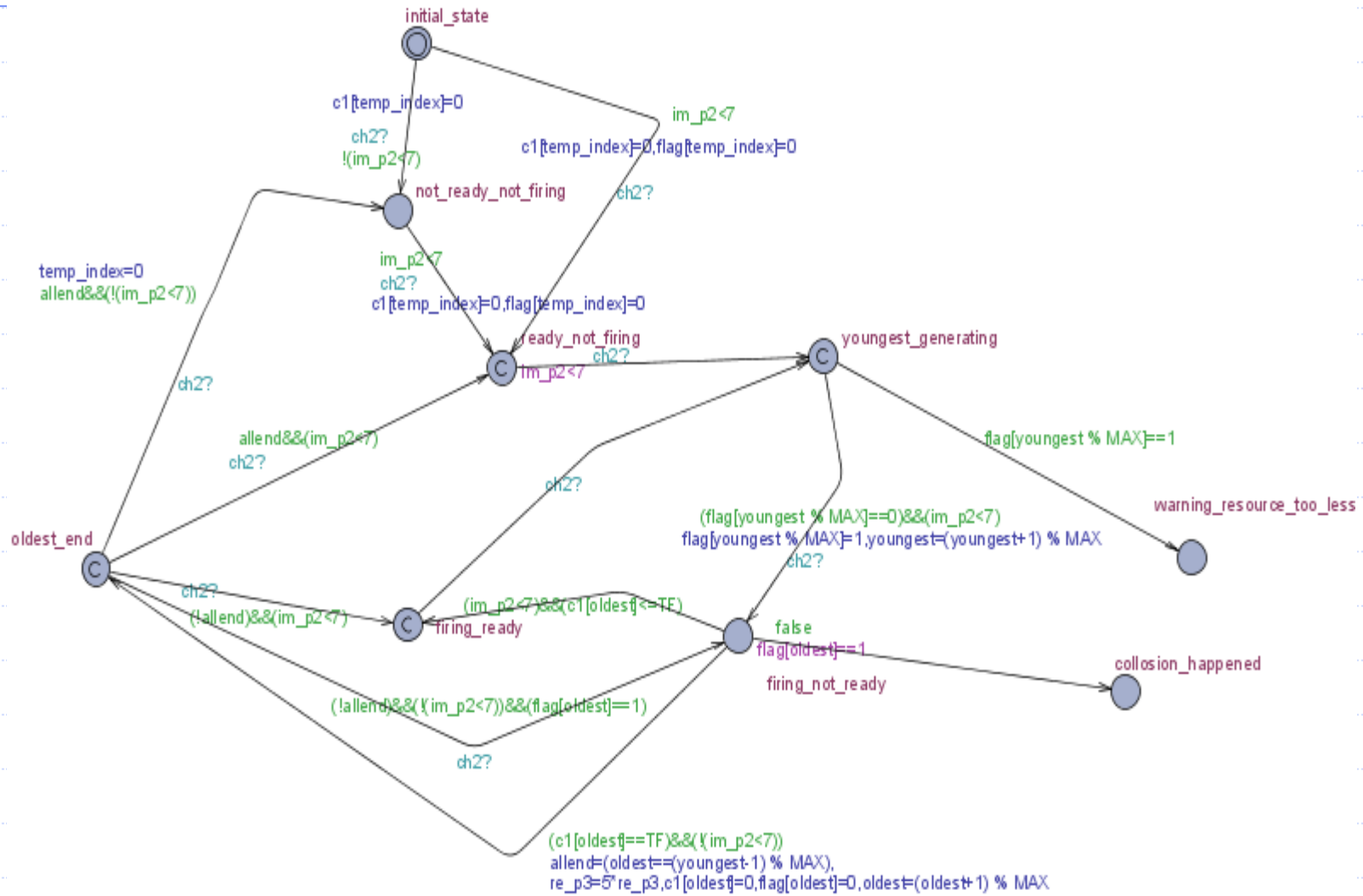


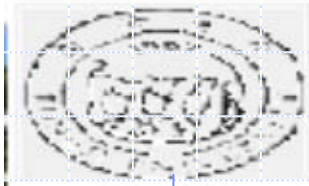
Experiments and discussions



To workshop

Experiments and discussions





Thank you!

My e_mail address:

tongji_luoyigui@yahoo.com