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# CMES Exam

## a) Model Checking - promela implementation

### toyFactory.pml

```
/*
Actors: ProductionDepartment (PD), RequestDepartment (RD)
Signals: PD to RD ( stop ), RD to PD ( car, doll, musicalInstrument )
*/

mtype = {sigPDtoRD, sigRDtoPD};
chan signal = [0] of {mtype};
byte toysToProduce=12;
byte toysProduced=0;

bool production_ended = false;
bool requests_ended = false;

active proctype PD() {
    waiting:
        signal?sigRDtoPD -> atomic {
        if
        :: toysProduced == toysToProduce -> atomic {
                signal!sigPDtoRD;
                goto ready;
            }
        :: else -> atomic {toysProduced++; goto waiting;};
        fi;
        };

    ready: {
        production_ended = true;
    };
}

active proctype RD() {

    sending: atomic {
        if
        :: signal?sigPDtoRD -> atomic {printf("Stop \n"); goto ready;};
        :: toysProduced <= toysToProduce -> atomic {printf("Make Car \n"); signal!sigRDtoPD; goto
sending;}
        :: toysProduced <= toysToProduce -> atomic {printf("Make Doll \n"); signal!sigRDtoPD; goto
sending;}
        :: toysProduced <= toysToProduce -> atomic {printf("Make Musical Instrument \n");
signal!sigRDtoPD; goto sending;}
```

```
                        fi;
                };
                ready: {
                        requests_ended = true;
                };
}

/*
LTL formulas

[](toysProduced<=toysToProduce)
<>(toysProduced==toysToProduce)
*/
```

## Output:

```
  0:        proc  - (:root:) creates proc  0 (PD)
  0:        proc  - (:root:) creates proc  1 (RD)
1 RD    33  toysProduced<=
Make Car
1 RD    36  printf('Make C
1 RD    36  signal!sigRDto
0 PD    16  signal?sigRDto
1 RD    36  values: 1!sigR
0 PD    16  values: 1?sigR
0 PD    17  else
0 PD    22  toysProduced =
Process Statement          toysProduc
1 RD    33  toysProduced<= 1
Make Musical Instrument
1 RD    38  printf('Make M 1
1 RD    38  signal!sigRDto 1
0 PD    16  signal?sigRDto 1
1 RD    38  values: 1!sigR 1
0 PD    16  values: 1?sigR 1
0 PD    17  else           1
0 PD    22  toysProduced = 1
1 RD    33  toysProduced<= 2
Make Car
1 RD    36  printf('Make C 2
1 RD    36  signal!sigRDto 2
0 PD    16  signal?sigRDto 2
1 RD    36  values: 1!sigR 2
0 PD    16  values: 1?sigR 2
0 PD    17  else           2
0 PD    22  toysProduced = 2
1 RD    33  toysProduced<= 3
Make Doll
1 RD    37  printf('Make D 3
1 RD    37  signal!sigRDto 3
0 PD    16  signal?sigRDto 3
Process Statement          toysProduc
1 RD    37  values: 1!sigR 3
```

```
0 PD    16  values: 1?sigR 3
0 PD    17  else          3
0 PD    22  toysProduced = 3
1 RD    33  toysProduced<= 4
Make Doll
1 RD    37  printf('Make D 4
1 RD    37  signal!sigRDto 4
0 PD    16  signal?sigRDto 4
1 RD    37  values: 1!sigR 4
0 PD    16  values: 1?sigR 4
0 PD    17  else          4
0 PD    22  toysProduced = 4
1 RD    33  toysProduced<= 5
Make Car
1 RD    36  printf('Make C 5
1 RD    36  signal!sigRDto 5
0 PD    16  signal?sigRDto 5
1 RD    36  values: 1!sigR 5
0 PD    16  values: 1?sigR 5
0 PD    17  else          5
0 PD    22  toysProduced = 5
Process Statement         toysProduc
1 RD    33  toysProduced<= 6
Make Doll
1 RD    37  printf('Make D 6
1 RD    37  signal!sigRDto 6
0 PD    16  signal?sigRDto 6
1 RD    37  values: 1!sigR 6
0 PD    16  values: 1?sigR 6
0 PD    17  else          6
0 PD    22  toysProduced = 6
1 RD    33  toysProduced<= 7
Make Car
1 RD    36  printf('Make C 7
1 RD    36  signal!sigRDto 7
0 PD    16  signal?sigRDto 7
1 RD    36  values: 1!sigR 7
0 PD    16  values: 1?sigR 7
0 PD    17  else          7
0 PD    22  toysProduced = 7
1 RD    33  toysProduced<= 8
Make Car
1 RD    36  printf('Make C 8
1 RD    36  signal!sigRDto 8
0 PD    16  signal?sigRDto 8
Process Statement         toysProduc
1 RD    36  values: 1!sigR 8
0 PD    16  values: 1?sigR 8
0 PD    17  else          8
0 PD    22  toysProduced = 8
1 RD    33  toysProduced<= 9
Make Doll
1 RD    37  printf('Make D 9
1 RD    37  signal!sigRDto 9
0 PD    16  signal?sigRDto 9
1 RD    37  values: 1!sigR 9
0 PD    16  values: 1?sigR 9
0 PD    17  else           9
0 PD    22  toysProduced = 9
1 RD    33  toysProduced<= 10
Make Car
1 RD    36  printf('Make C 10
1 RD    36  signal!sigRDto 10
0 PD    16  signal?sigRDto 10
1 RD    36  values: 1!sigR 10
0 PD    16  values: 1?sigR 10
0 PD    17  else           10
0 PD    22  toysProduced = 10
Process Statement          toysProduc
1 RD    33  toysProduced<= 11
Make Doll
1 RD    37  printf('Make D 11
1 RD    37  signal!sigRDto 11
0 PD    16  signal?sigRDto 11
1 RD    37  values: 1!sigR 11
0 PD    16  values: 1?sigR 11
0 PD    17  else           11
0 PD    22  toysProduced = 11
1 RD    33  toysProduced<= 12
Make Musical Instrument
1 RD    38  printf('Make M 12
1 RD    38  signal!sigRDto 12
0 PD    16  signal?sigRDto 12
1 RD    38  values: 1!sigR 12
0 PD    16  values: 1?sigR 12
0 PD    17  toysProduced== 12
0 PD    19  signal!sigPDto 12
1 RD    35  signal?sigPDto 12
0 PD    19  values: 1!sigP 12
1 RD    35  values: 1?sigP 12
Stop
1 RD    35  printf('Stop \ 12
Process Statement          toysProduc
0 PD    28  production_end 12
Process Statement          production toysProduc
1 RD    43  requests_ended 1          12
 68:        proc  1 (RD) terminates
 68:        proc  0 (PD) terminates
2 processes created
```

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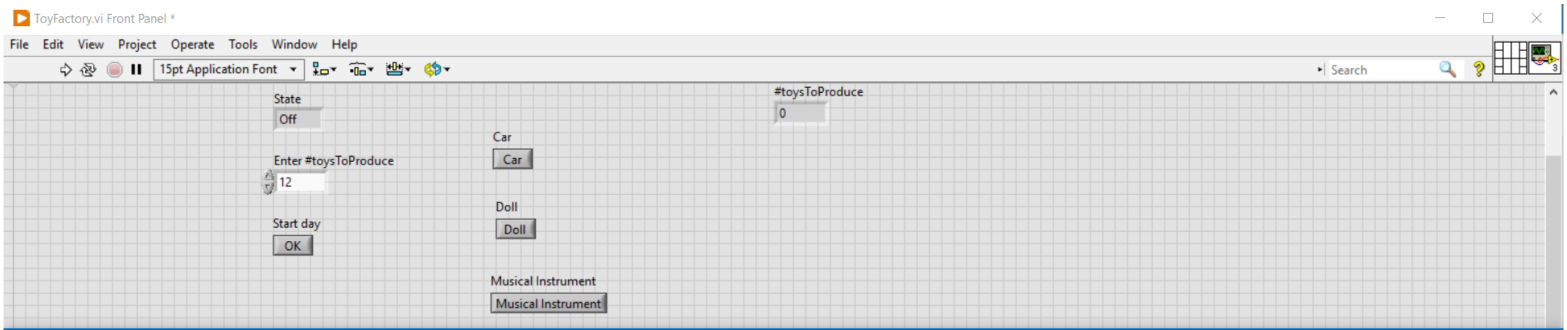
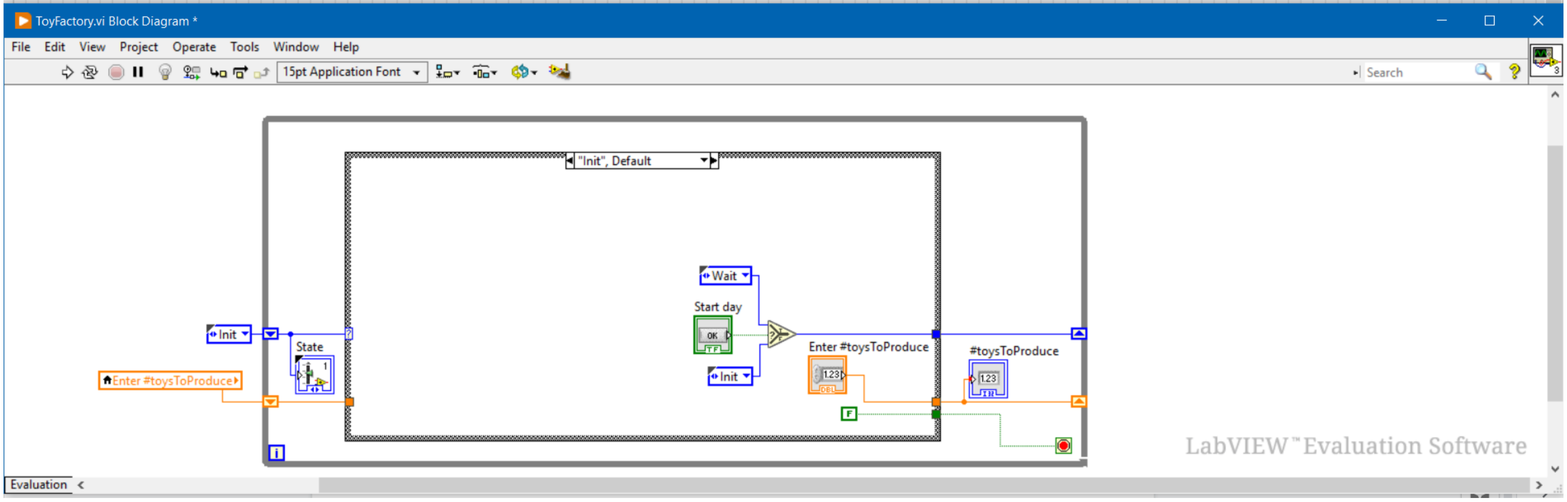
## b) LabView implementation

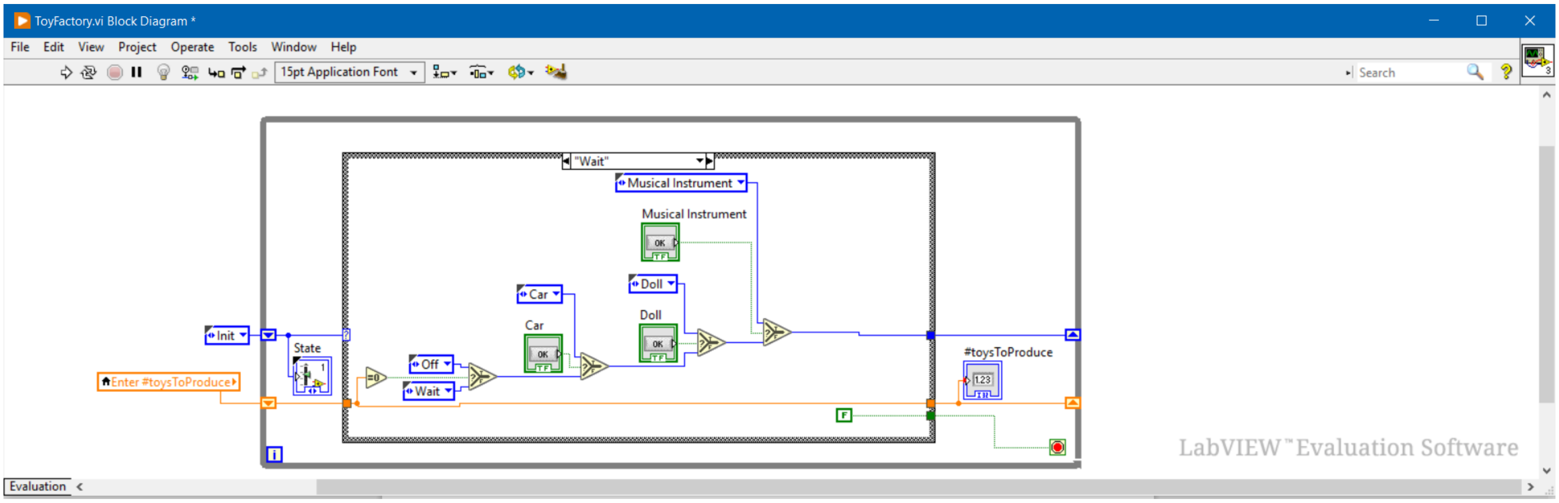


State: Off

Enter #toysToProduce: 12

#toysToProduce: 0





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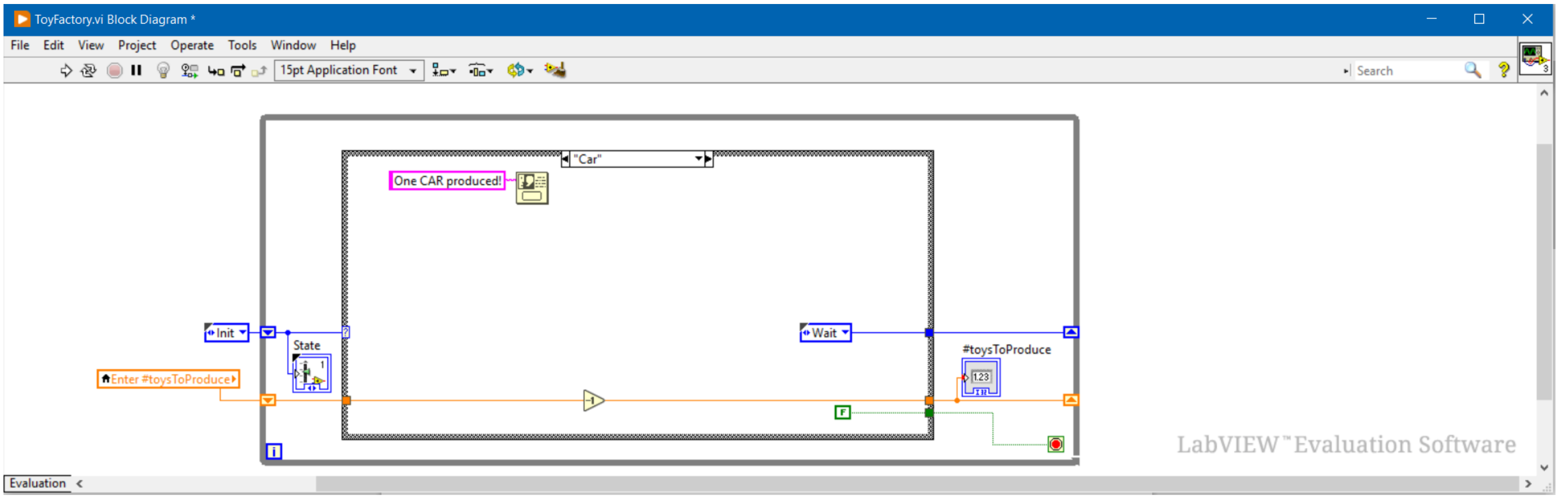

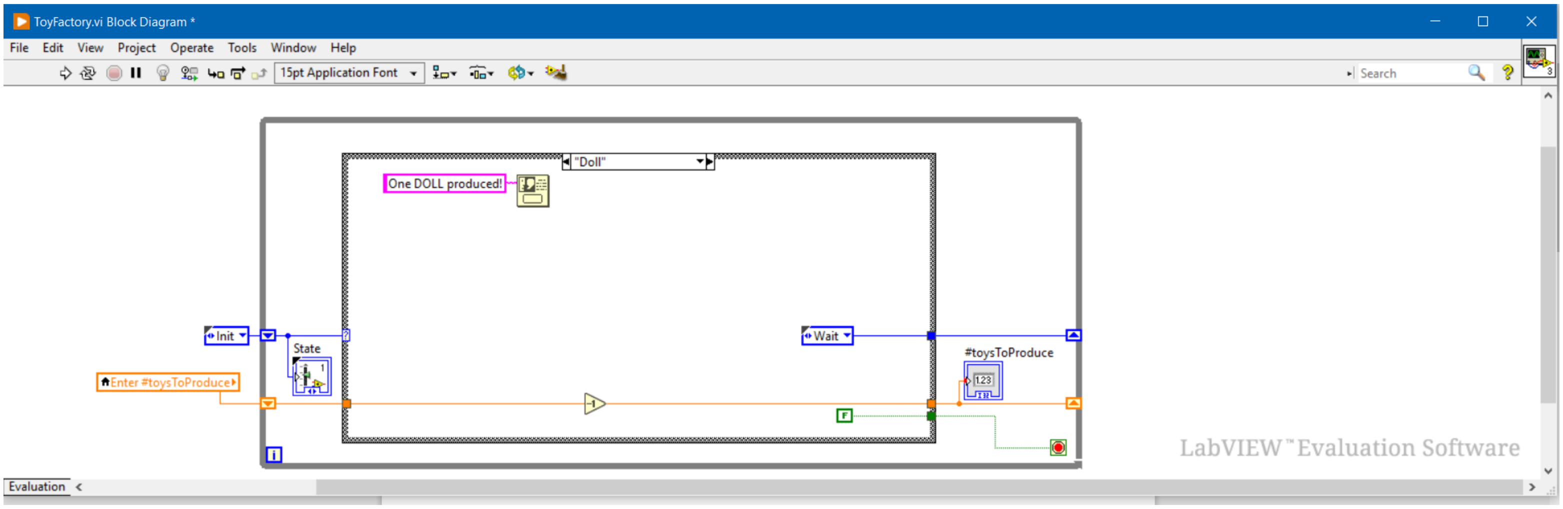

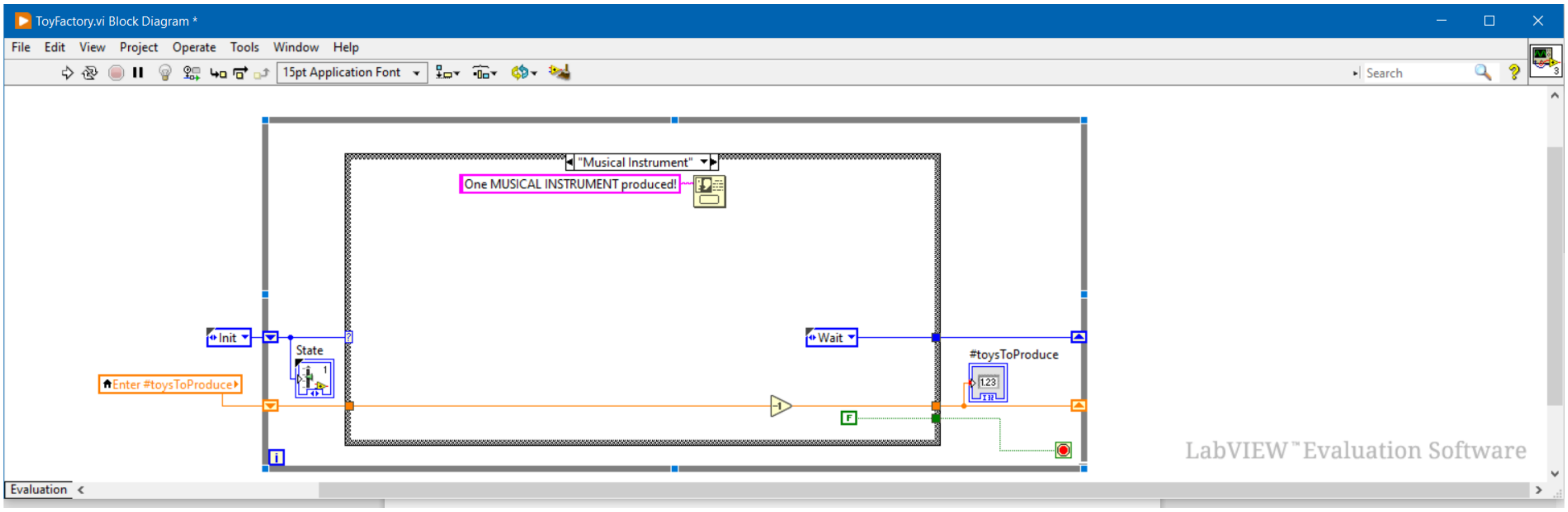
ToyFactory.vi Block Diagram *
File Edit View Project Operate Tools Window Help
15pt Application Font
Search
"Musical Instrument"
One MUSICAL INSTRUMENT produced!
Init
State
Enter #toysToProduce
Wait
#toysToProduce
123
F
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LabVIEW™ Evaluation Software
Evaluation

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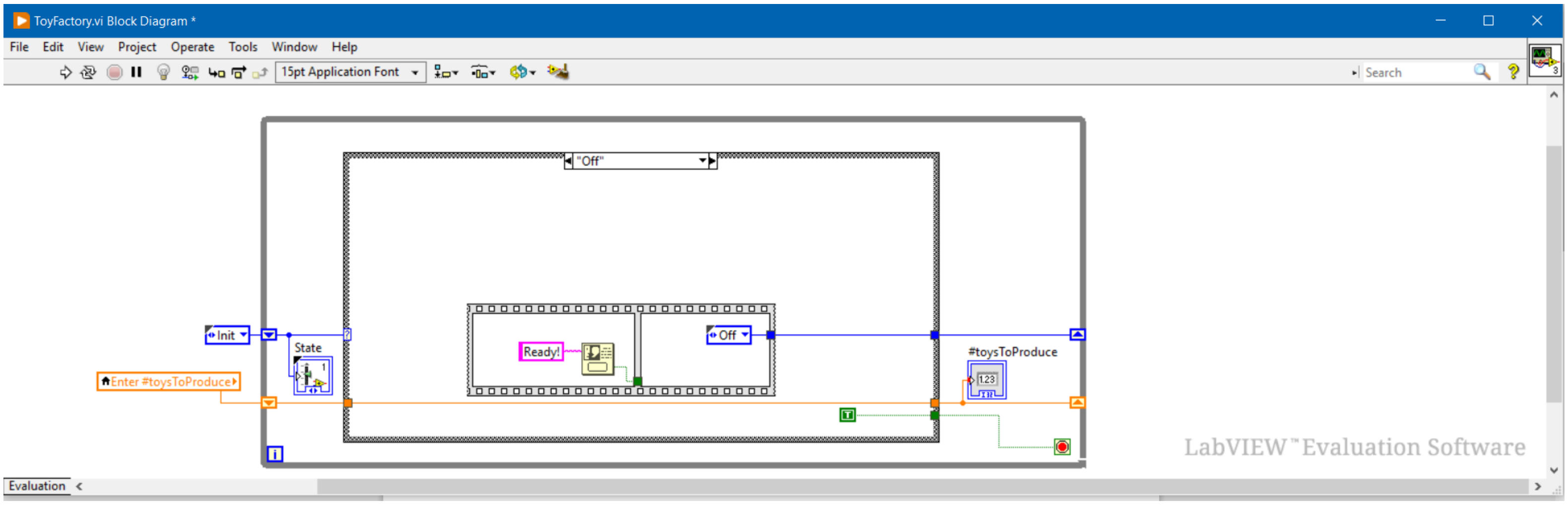
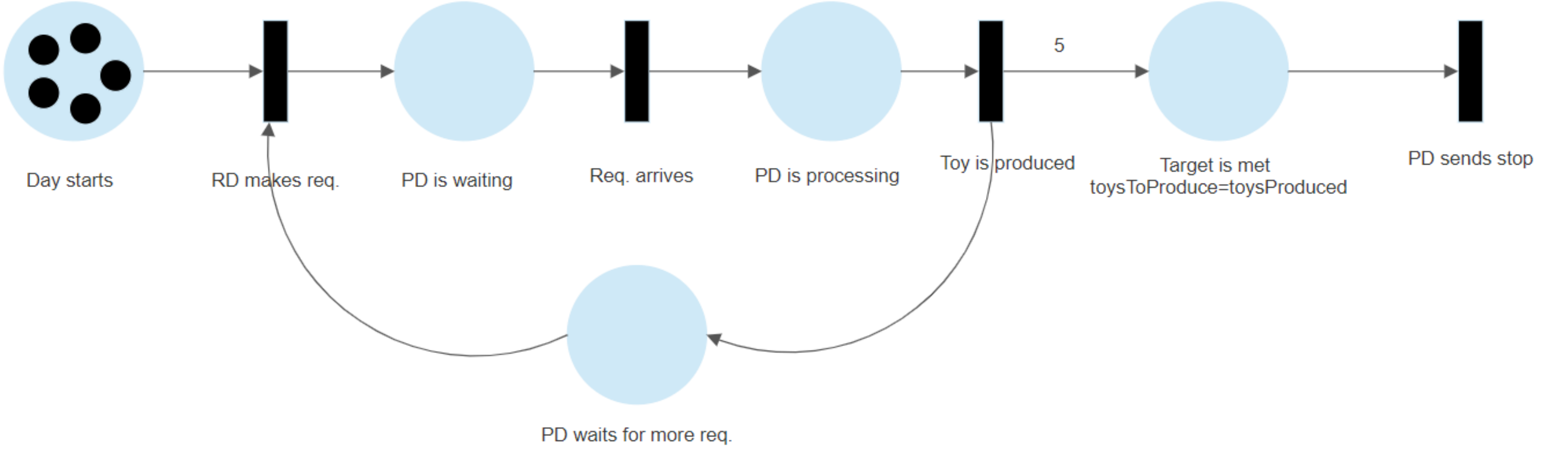

ToyFactory.vi Block Diagram *
File Edit View Project Operate Tools Window Help
15pt Application Font
Search
"Off"
Init
State
Enter #toysToProduce
Ready!
Off
#toysToProduce
123
LabVIEW™ Evaluation Software
Evaluation

## c) Petri net representation


5
Day starts
RD makes req.
PD is waiting
Req. arrives
PD is processing
Toy is produced
Target is met
toysToProduce=toysProduced
PD sends stop
PD waits for more req.