
Formal Methods

Assignment #3

Mehmoona Bibi
#111299
BESE 5B

Q1: Prepare and Enhance in the example of Light with various levels of brightness.

Light model:

Light model has three levels (light, medium, bright). I have also included mutual exclusion principle in that is defined below.

Mutual exclusion:

Mutual exclusion model is a process which prevents two processes to access shared resources. The concept is used in concurrent programming which has a critical section in which there are shared resources.

Locations of Light1, Light2:

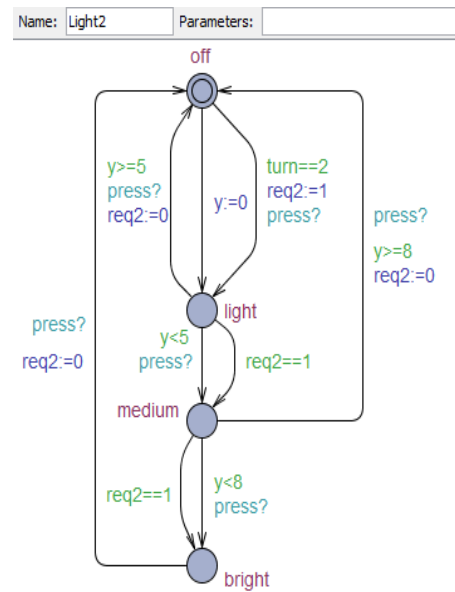
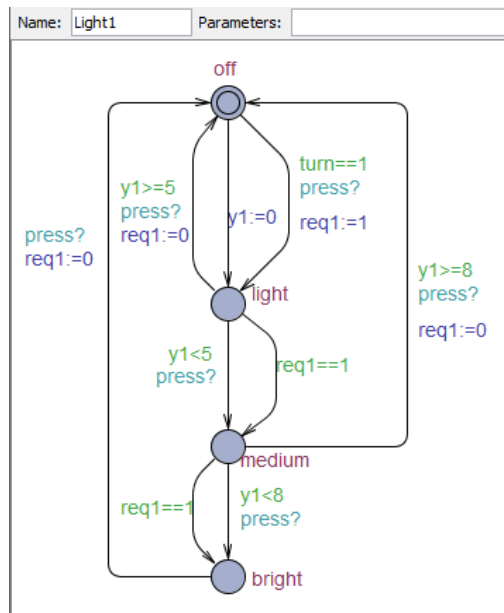
Off, light, medium, bright

Locations of User:

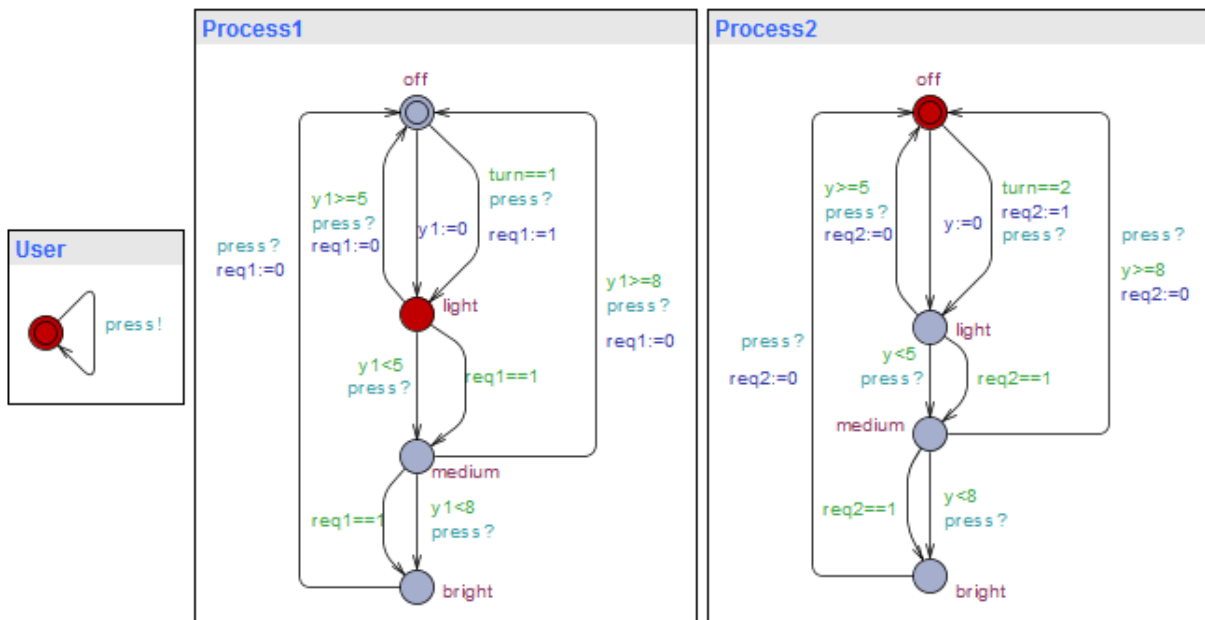
idle

| Process 1: | Process 2: | User: |
|--|---|------------------------|
| off: req1=1; while(turn!=1); press? Y1==0; light: while(req1!=1 && y1<5); press? medium: while(req1!=1 && y1<8); press? bright: press? req1=0; //and return to off | off: req2=1; while(turn!=2); press? y==0; light: while(req2!=1 && y<5); press? medium: while(req2!=1 && y<8); press? bright: press? req2=0; //and return to off and return to idle | Idle: press! |

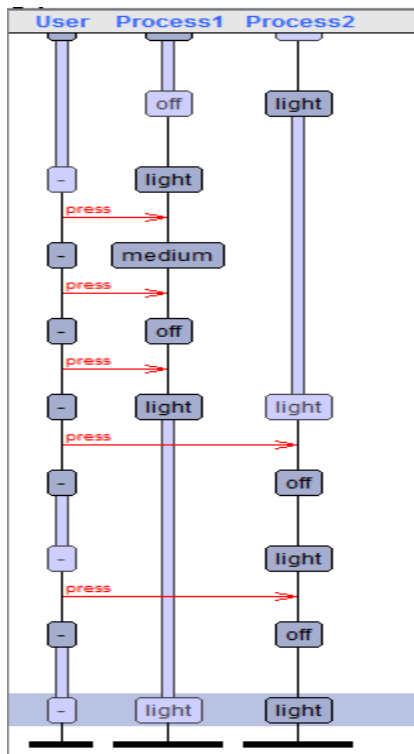
Automaton:



Simulation:



Simulation Trace:



Simulation Trace

```

(-, bright, off)
press: User → Process1
(-, off, off)
Process2
(-, off, light)
press: User → Process2
(-, off, off)
Process2
(-, off, light)
press: User → Process2
(-, off, off)
press: User → Process1
(-, light, off)

```

System declarations:

```

// Place template instantiations here.
User = user();
Process1 = Light1();
Process2 = Light2();
// List one or more processes to be composed into a system.
system User, Process1, Process2;

```

Declarations:

```

// Place global declarations here.
chan press;
int [1,2] turn;
int [0,1] req1, req2;

```

| | |
|--------------|--------------|
| Name: Light1 | Name: Light2 |
| clock y1; | clock y; |

Verification:

| | |
|---|--|
| Overview | |
| E<> (Process2.bright and Process2.y<8) | |
| E<> (Process1.bright and Process1.y1<8) | |
| E<> deadlock | |
| A[] not deadlock | |

| | |
|---|--|
| Query | Query |
| E<> (Process2.bright and Process2.y<8) | E<> (Process1.bright and Process1.y1<8) |
| Comment | Comment |
| when process2 is at bright y is less than 8 | when process1 is at bright y1 is less than 8 |

| | |
|--|--|
| Status | Status |
| E<> (Process2.bright and Process2.y<8) Verification/kernel/elapsed time used: 0.016s / 0s / 0.016s. Resident/virtual memory usage peaks: 6,448KB / 25,180KB. Property is satisfied. | E<> (Process2.bright and Process2.y<8) Verification/kernel/elapsed time used: 0.016s / 0s / 0.016s. Resident/virtual memory usage peaks: 6,448KB / 25,180KB. Property is satisfied. |

| | |
|------------------------|---------------------------------|
| Query | Query |
| E<> deadlock | A[] not deadlock |
| Comment | Comment |
| there exist a deadlock | system does not have a deadlock |

| | |
|--|--|
| Status | Status |
| E<> deadlock Verification/kernel/elapsed time used: 0s / 0s / 0.016s. Resident/virtual memory usage peaks: 6,516KB / 25,540KB. Property is not satisfied. | A[] not deadlock Verification/kernel/elapsed time used: 0.016s / 0s / 0.016s. Resident/virtual memory usage peaks: 6,436KB / 25,156KB. Property is satisfied. |

Q2: Write an example of your own.

AC example:

Air conditioner is on and automatically adjusts its temperature at 20C. one the user pressed the on button AC adjusts the temperature itself. The temperature is not increased or decreased from 20C.

| AC | User |
|---|------------------------|
| off: press? on:=1 running: while(on==1 && temp>20); while(on==1 && temp<20); while(temp==20); lessen_temp: temp:=20 increase_temp: temp:=20 | idle: press! |

There are two templates:

1. AC :

a. Locations:

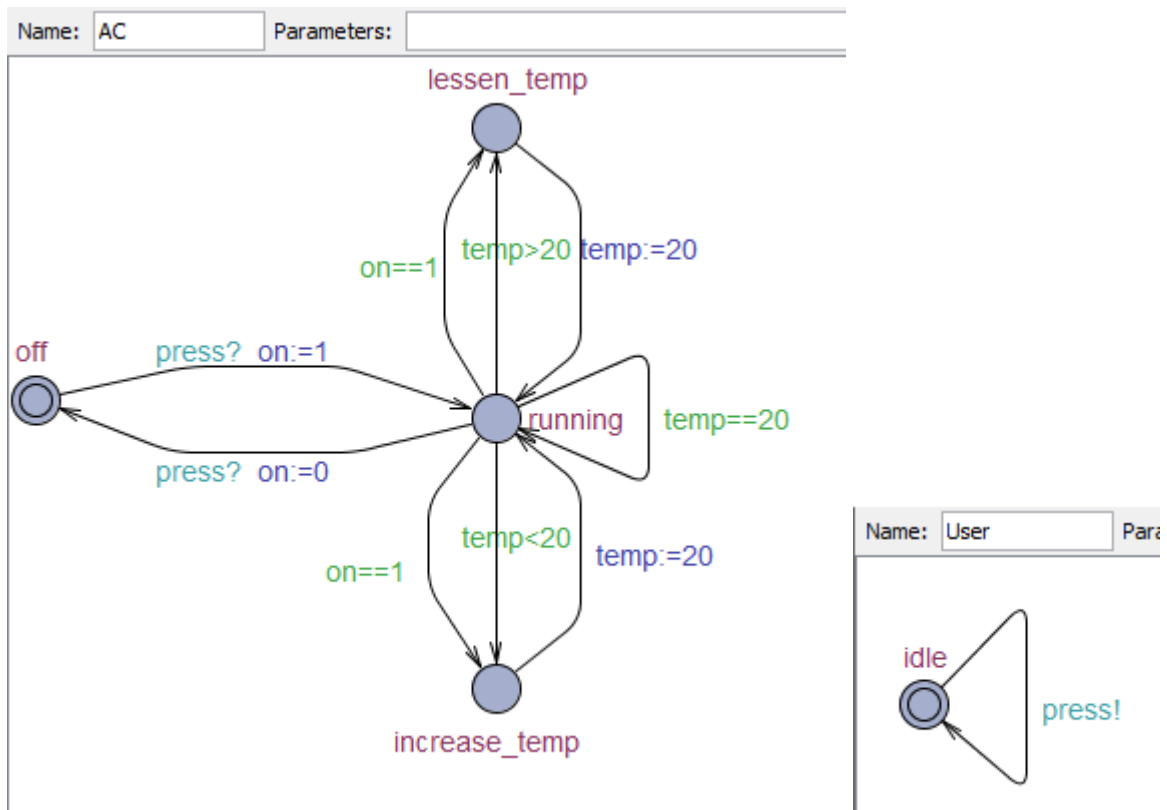
- i. Off
- ii. Running
- iii. Lessen_temp
- iv. Increase_temp

2. User

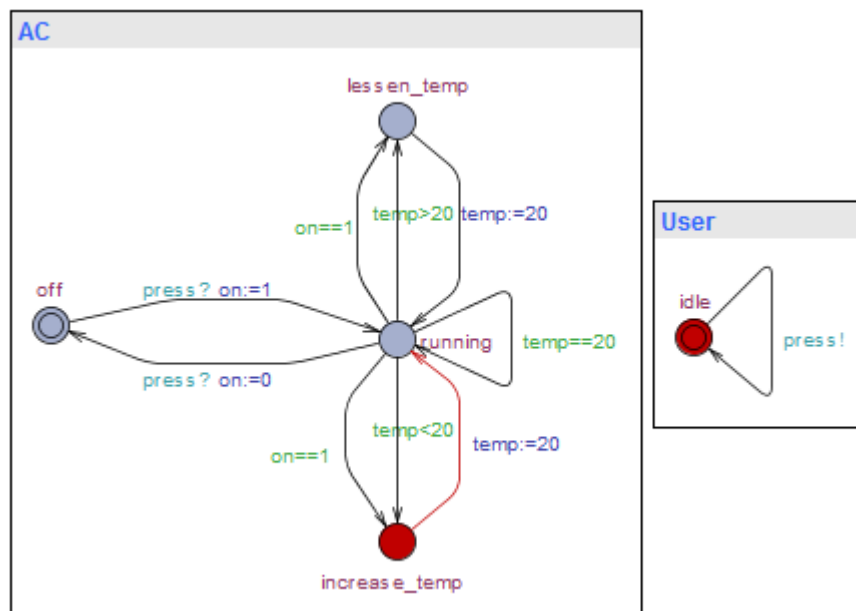
a. Locations:

- i. idle

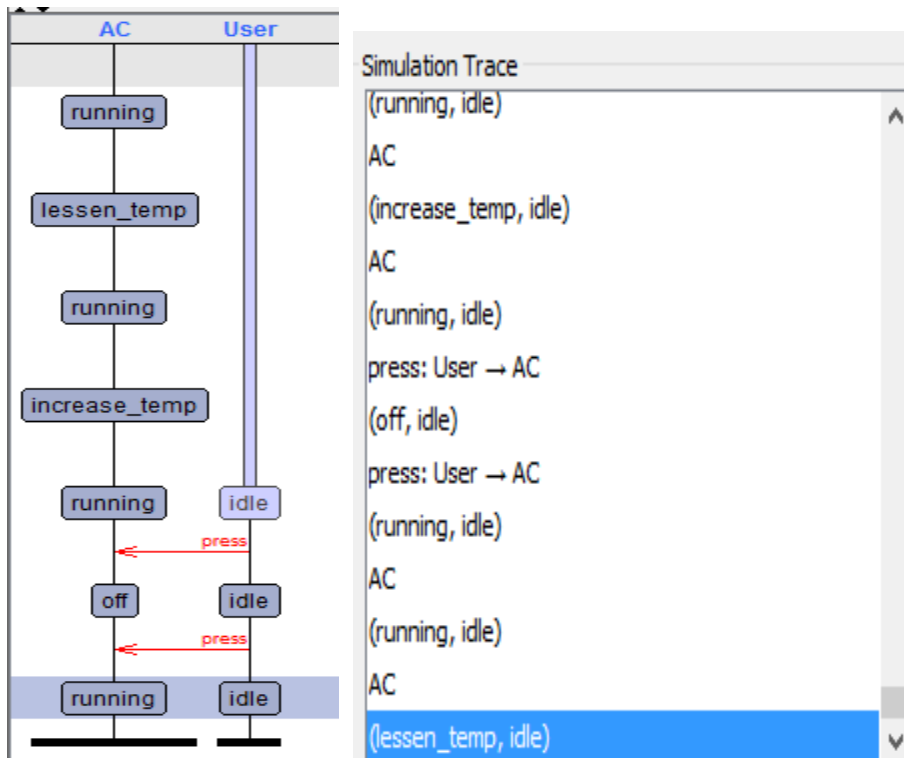
Automaton:



Simulation:



Simulation trace:



System declarations:

```
// Place template instantiations here.  
// List one or more processes to be composed into a system.  
system AC, User;
```

Declarations:

```
// Place global declarations here.  
chan press;
```

Name: Parameters:

```
// Place local declarations here.  
clock temp;  
int [0,1] on;
```


Verification:

| Overview | |
|----------------------------------|--|
| E<> deadlock | |
| E<> (AC.running and AC.on==0) | |
| E<> (AC.running and AC.on==1) | |
| E<> (AC.running and AC.temp<20) | |
| E<> (AC.running and AC.temp>20) | |
| E<> (AC.running and AC.temp==20) | |
| A[] not deadlock | |

| Query | Query |
|--|---|
| E<> deadlock | E<> (AC.running and AC.on==0) |
| Comment | Comment |
| there exist a deadlock | AC is running and AC is off |
| Status | Status |
| E<> deadlock Verification/kernel/elapsed time used: 0s / 0s / 0s. Resident/virtual memory usage peaks: 7,072KB / 26,516KB. Property is not satisfied. | E<> (AC.running and AC.on==0) Verification/kernel/elapsed time used: 0s / 0s / 0s. Resident/virtual memory usage peaks: 7,076KB / 26,520KB. Property is not satisfied. |

| Query | Query |
|---|---|
| E<> (AC.running and AC.on==1) | E<> (AC.running and AC.temp<20) |
| Comment | Comment |
| AC is running and AC is on | AC is running and temprature is less than 20 |
| Status | Status |
| E<> (AC.running and AC.on==1) Verification/kernel/elapsed time used: 0s / 0s / 0s. Resident/virtual memory usage peaks: 7,084KB / 26,528KB. Property is satisfied. | E<> (AC.running and AC.temp<20) Verification/kernel/elapsed time used: 0s / 0s / 0.015s. Resident/virtual memory usage peaks: 7,084KB / 26,528KB. Property is satisfied. |

| | |
|---|---|
| <div>Query</div> <div>E<> (AC.running and AC.temp>20)</div> | <div>Query</div> <div>E<> (AC.running and AC.temp==20)</div> |
| <div>Comment</div> <div>AC is running and temprature is greater than 20</div> | <div>Comment</div> <div>AC is running and temprature is equal to 20</div> |
| <div>Status</div> <div> E<> (AC.running and AC.temp>20) Verification/kernel/elapsed time used: 0s / 0s / 0.016s. Resident/virtual memory usage peaks: 7,080KB / 26,512KB. Property is satisfied. </div> | <div>Status</div> <div> E<> (AC.running and AC.temp==20) Verification/kernel/elapsed time used: 0s / 0s / 0s. Resident/virtual memory usage peaks: 7,080KB / 26,512KB. Property is satisfied. </div> |
| <div>Query</div> <div>A[] not deadlock</div> | |
| <div>Comment</div> <div>there does not exist a deadlock</div> | |
| <div>Status</div> <div> A[] not deadlock Verification/kernel/elapsed time used: 0s / 0s / 0s. Resident/virtual memory usage peaks: 7,092KB / 26,532KB. Property is satisfied. </div> | |

Github Link:

<https://github.com/Mehmoona-bibi/Automaton/>