BCS2213 – Formal methods

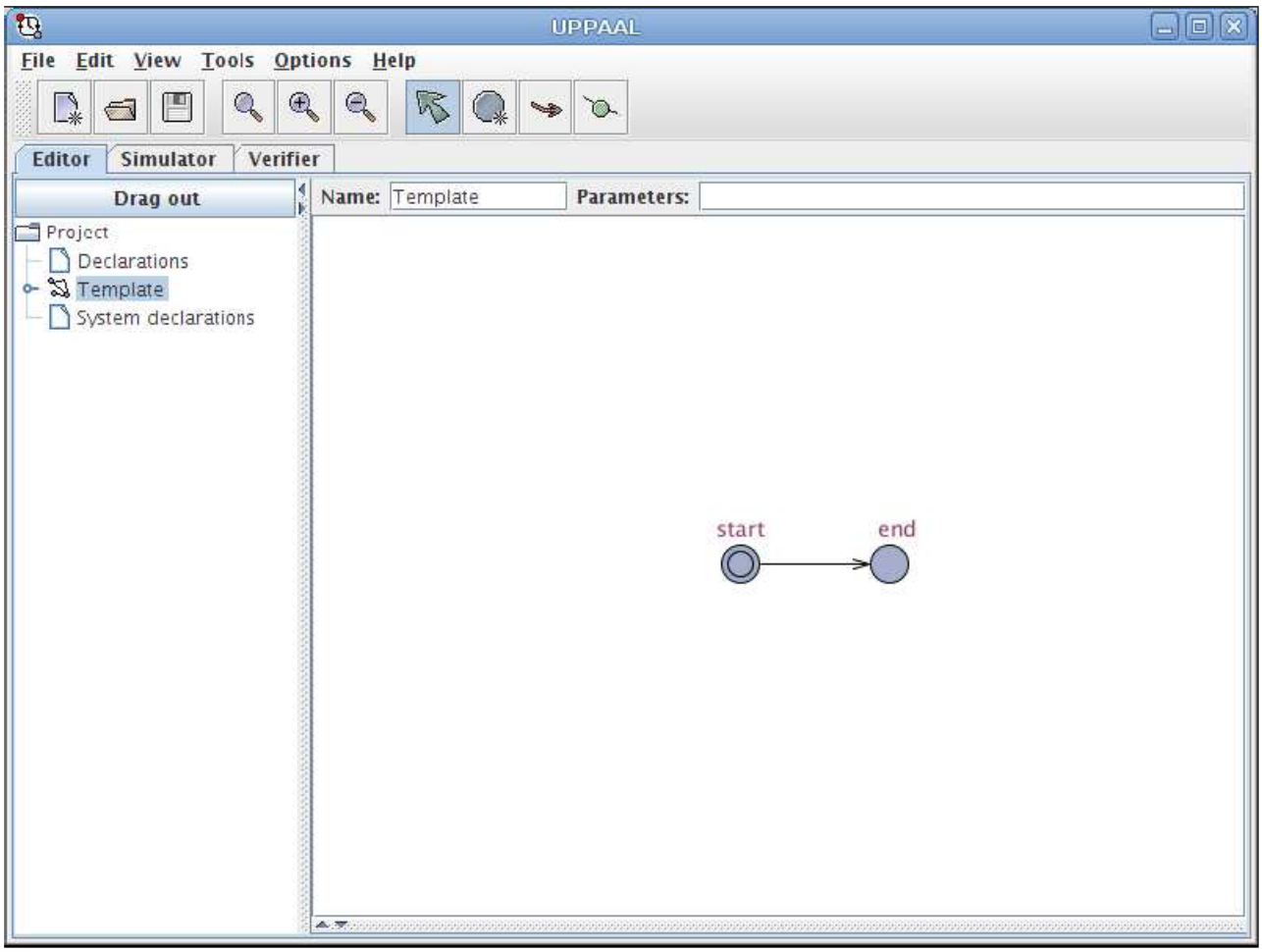
Teaching assignment 7. Learning UPPAAL. Modelling systems using timed automata.

1. Run UPPAAL Toolbox.

UPPAAL is a Toolbox for validation (via graphical simulation) and verification (via automatic model-checking) of real-time systems. It consists of two main parts: a graphical user interface and a model-checker engine.

The UPPAAL main window has two main parts: the menu and the tabs - the **editor**, the **simulator** and the **verifier**.

2. Editor mode. When you start UPPAAL, there is one location pre-created in the drawing area. It is the *initial* location of the automaton, so it has an additional circle inside. To add a second location, click on the "Add Location" button in the tool bar (tool tips will help you) and then click in the drawing area, a bit next to the initial location. To exit from the location creation mode click the "Selection Tool" button. Double click on location nodes to give them the names **start** and **end**. Then choose the Add Edge button, click on the **start** location and on the **end** location (see figure below).

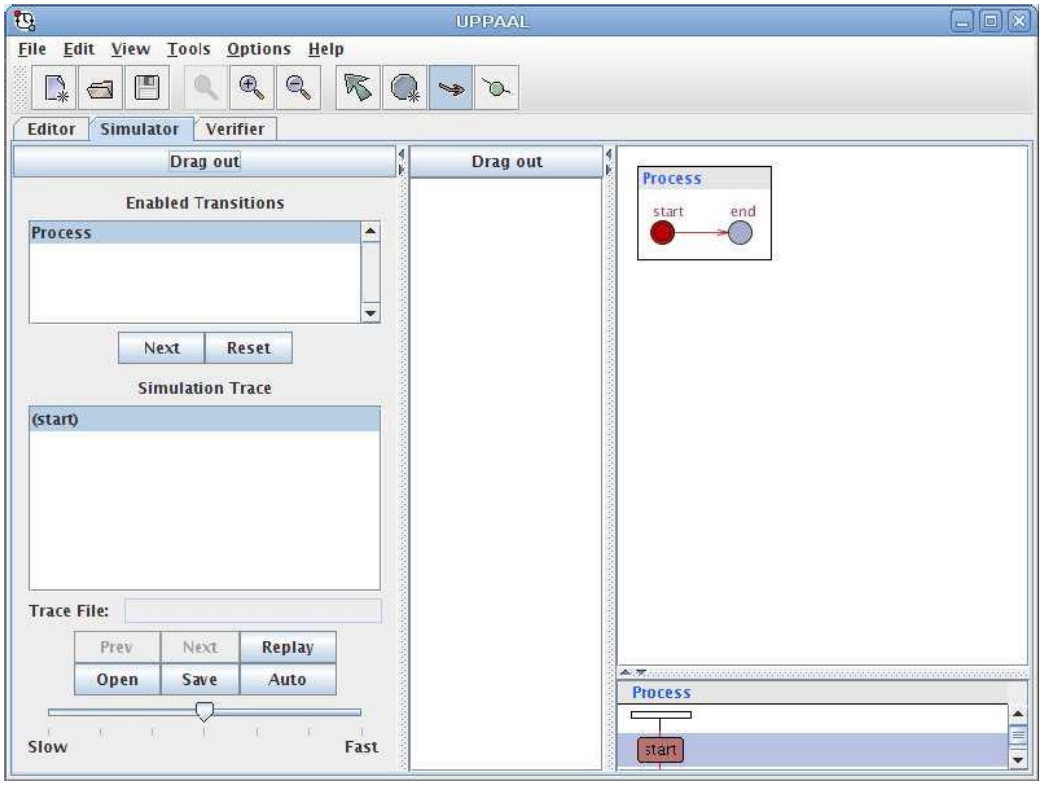


3. Simulator mode

Now, click on the Simulator tab to start the simulator, click on the yes button that will pop up and you are ready to run your first system.

Figure below shows the simulator view. On the left you will find the control part where you can choose the **enabled transitions** (upper part) and work on an existing **simulation trace** (lower part). In the middle are the **drag out** widget for the variables (we have no for the moment) and on the right you see the simulating system itself. Below the system, you will see simulation trace of **process** shown as message sequence diagram.

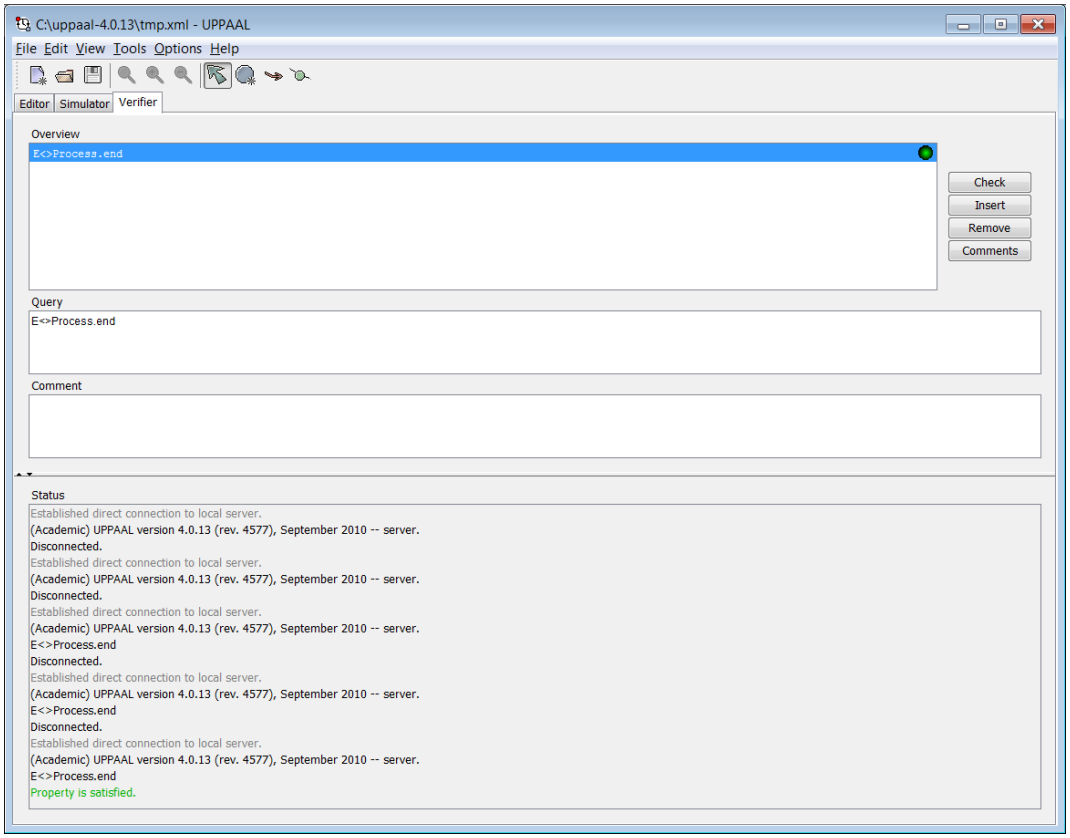
To simulate our trivial system pick one of the **enabled transitions** in the list in the upper left part of the screen (there is only one transition in our example). Click Next. The process view to the right will change (the red dot indicating the current location will move) and the simulation trace will grow. You will note that more transitions are not possible, i.e. the system is deadlocked.



4. Verification mode

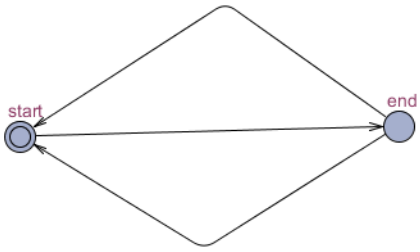
Click on the **Verifier** tab (see figure below). The upper section allows you to specify *queries* to the system. The lower part **Comments** the communication with the model-checking engine.

Enter the text E<>Process.end in the *Query* field below the Overview. This is the UPPAAL notation for the temporal logic formula ∃◊Process.end and should be understood as "it is possible to reach the location **end** in the automaton **Process**". Click Check to let the engine verify this. The green bullet in the overview will turn green indicating that the property indeed is satisfied.



5. Modelling more complex transitions.

Modify your model in order it has two possible transitions from the **end** to the **start** location (see figure below).



Declare Boolean variable x (bool x; in the Project Declarations), and allow the first transition if x is true, and second – if x is false (so you need define *guards* for transitions, correspondingly, x==true, x==false). *Update* of the state transitions will be correspondent assignments (x=false, x=true).

Track your model in simulation mode.

Make screenshot from this first UPPAAL model and put into Word file with possible comments. Save the file with name lab_7_<your_ID>.doc

6. Develop the model of Intelligent Light Control system.

Requirements:

- If a user presses the light control, then it lights;
- If a user quickly presses the light control, then the light should get brighter;
- if the user slowly presses the light control, the light should turn off.

7. Track your model in simulation mode.

8. Check the property of the Light Control system**: A[](x>=0)**
Explain this property by making comment in Word file.

9. Define own temporal property of the Light Control system and check it with UPAALL.
Explain this property by making comment in Word file.

10. Make screenshots of your model of Intelligent Light Control system (basically, *Simulator* page of UPPAAL is needed) and update your Word file, adding possible comments.

11. Upload lab_7_<your_ID>.doc into Kalam for evaluation. This assignment will be evaluated in maximum 2.5% of your general marks.