Exercise : Getting started with CPN-AMI

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First, you must get all the information (models for this exercise and formalisms) to be operational. To do so, please type first (when logged under Unix) the following commands :

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>cd
>cp -r /export/home/profesores/kordon/MACAO .
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Then, typing "ls", you notice a MACAO folder in your home directory. All required information is there. When you run Macao under your Home Directory and open models, You will get into this MACAO that contains two folders :

- FORMALISMS that contains the AMI-Net description (you go there when you create a new model),

- MODELS in which we will insert (if required) directories containing models for exercises.
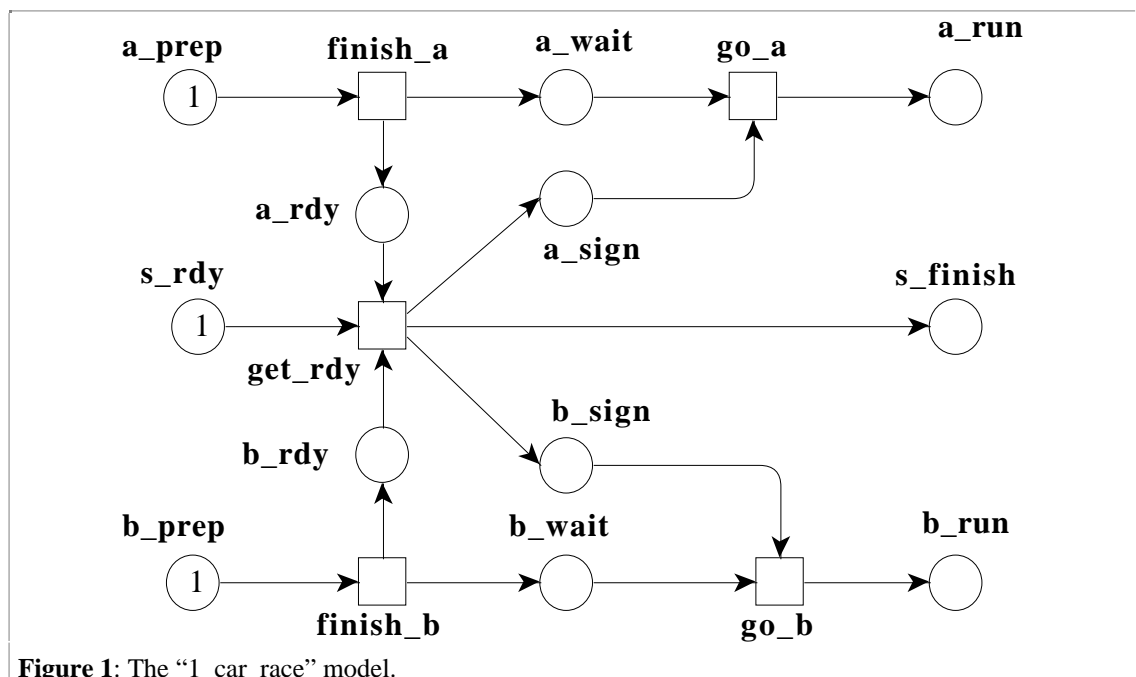
1. First Net

Figure 1: The "1_car_race" model.

Getting connected and setting the model :

1) Run Macao and open the model
2) Get connected to CPN-AMI
3) Connect the model and get the AMI-Net menu
4) Run "Petri Net Verification" (if required)

Using the simulator:

5) Run "Simulation/Start Session"
6) Run "Simulation/Execution/Step by step..."
   How many firings do you find before the models blocks?
7) Run "Simulation/Intermediate Marking/Load..." and then, select "initial marking" from the dialog box.
8) Set the flag "Simulation/Execution mode/Animation" and then run "Simulation/Execution/Automatic..." (set it for 100 firings). You should see the model being animated by the simulator. ***Important***: *before starting the*

simulation, please be sure the model window is in front otherwise you will not be able to observe anything.

9) Run "Simulation/Execution/backward execution", can you get such a result with a C debugger (even the excellent xxgdb;-)?

10) Run "Simulation/End Session"

Using PROD to generate the reachability graph :

11) Run "RG[1] analysis with PROD/Start Continue the RG construction"

12) Run "RG analysis with PROD/Statistics about the RG", How many terminal state do you observe?

13) Run "RG analysis with PROD/List of dead markings". How many dead markings do you observe? Do they correspond to what you observed by simulation.

14) Run "RG analysis with PROD/Get the RG - arc routing". What can you observe in the Graph? How many nodes does it contains ?
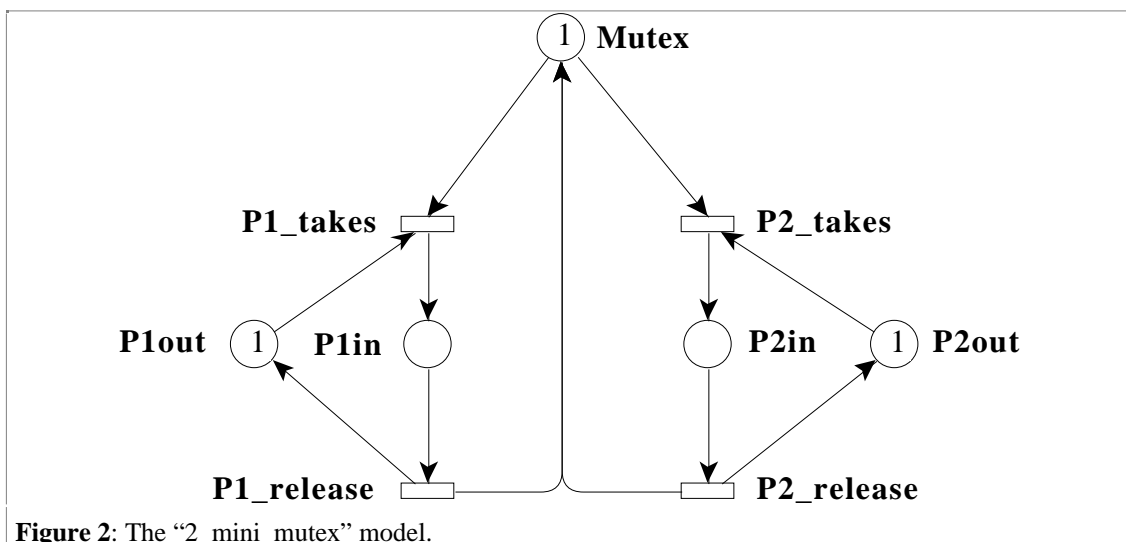
You can now quit Macao.

2. Second Net

Figure 2: The "2_mini_mutex" model.

Getting connected and setting the model :

1) Run Macao and open the model

2) Get connected to CPN-AMI

3) Connect the model and get the AMI-Net menu

4) Run "Petri Net Verification" (if required)

Playing with the simulator:

5) Run "Simulation/Start Session"

6) Run "Simulation/Execution/Automatic..." (set it for 10000 firings). If the model does not block, you can start again until it blocks or until you get tired of it (it should not block;-)

7) Run "Simulation/End Session"

Getting the reachability graph :

8) Run "RG analysis with PROD/Start Continue the RG construction"

9) Run "RG analysis with PROD/Statistics about the RG", How many terminal state do you observe? Can you relate this information to what you observed with simulation?
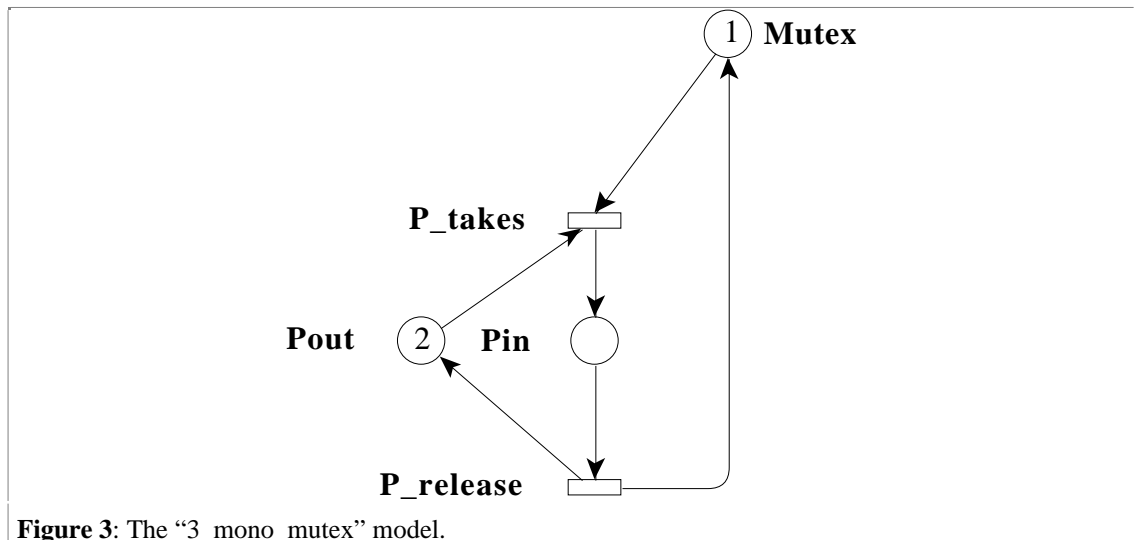
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[1] Here, RG means Reachability Graph (shorter to write;-)

10) Run "RG analysis with PROD/Get the RG - arc routing". How many nodes do you get ?

11) Save the reachability Graph for later (file menu)

You can now quit Macao.

3. Third Net

Figure 3: The "3_mono_mutex" model.

Getting connected and setting the model :

1) Run Macao and open the model
2) Get connected to CPN-AMI
3) Connect the model and get the AMI-Net menu
4) Run "Petri Net Verification" (if required)

Getting the reachability graph :

5) Run "RG analysis with PROD/Start Continue the RG construction"
6) Run "RG analysis with PROD/Get the RG - arc routing". How many nodes do you get ? Can you compare it to the one you get wit the previous model? What do you observe...

Observing the size of the RG regarding the initial marking :

7) In place *Pout*, change the number of tokens and set it to six[2].
8) Reprocess the model (steps 1 to 6) and display its RG. What do you observe compared to the previous RG?
9) In place *Mutex*, change the number of tokens and set it to three. What do you observe now compared to the previous RG? Can you explain the new structure of the RG compared to the modification you have done?

You can now quit Macao.

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[2] If Macao tells you that you cannot change the model (regression to fix:-(, just close the model and reopen it. You can also quit Macao and restart it.

4. Fourth Net
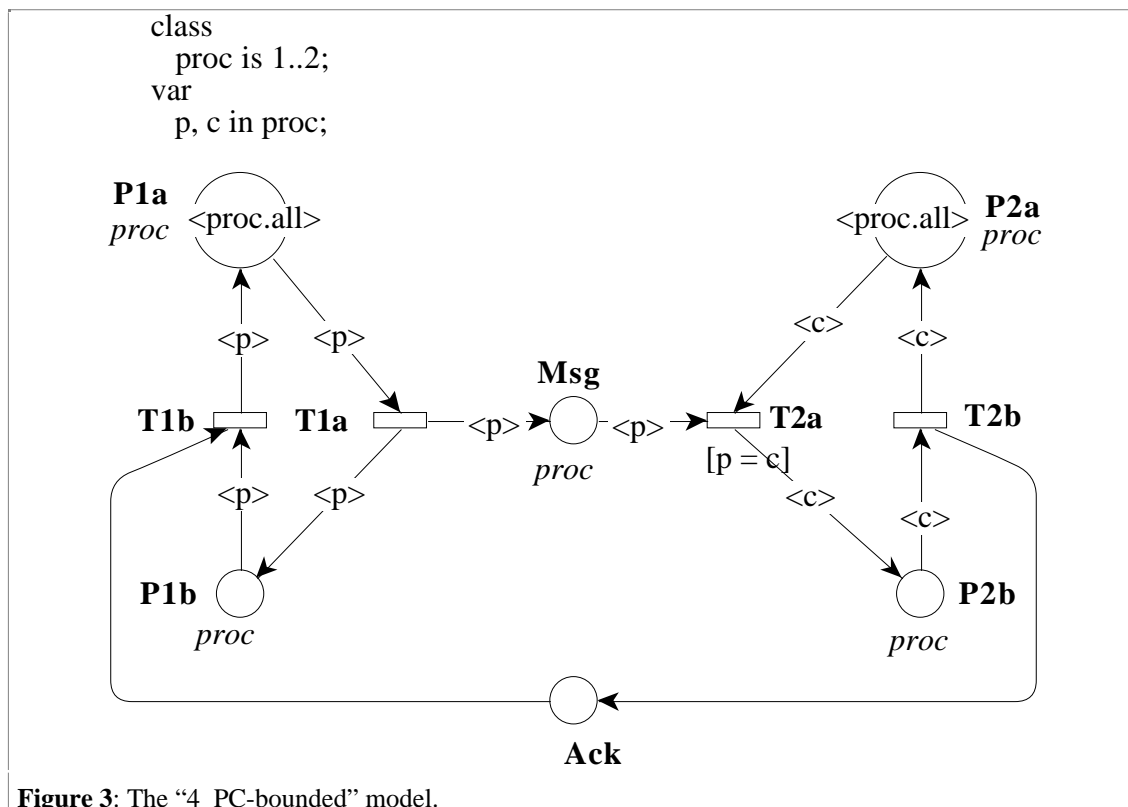
Figure 3: The "4_PC-bounded" model.

Getting connected and setting the model :

1) Run Macao and open the model
2) Get connected to CPN-AMI
3) Connect the model and get the AMI-Net menu
4) Run "Petri Net Verification" (if required)

Using the simulator:

5) Run "Simulation/Start Session"
6) Run "Simulation/Execution/Step by step..."

   What is now the difference between the step by step execution of Colored nets and the step by step execution of P/T nets?

7) Run "Simulation/Intermediate Marking/Load..." and then, select "initial marking" from the dialog box.
8) Set the flag "Simulation/Execution mode/Animation" and then run "Simulation/Execution/Automatic..." (set it for 15 firings). You should see the model being animated by the simulator
9) Run "Simulation/Execution/backward execution", and play with it.
10) You can also save an intermediate marking by using the "Simulation/Intermediate Marking/Save..." option and answering questions. You can later retrieve these intermediate markings.
11) Run "Simulation/End Session"

Playing with the reachability graph :

12) Run "RG analysis with PROD/Start Continue the RG construction"
13) Run "RG analysis with PROD/Statistics about the RG", how many states do you get, how many arcs do you get?
14) Run "RG analysis with PROD/Get the RG - arc routing". Watch the graph and then save it.

Observing the Graph without guard :

15) Delete the guard in transition *T2a*[3]. If you want to save this model, please change its name, the model will be reused later on

16) Reprocess the model (steps 1 to 6) and display its RG. What do you observe compared to the previous RG? Can you relate the difference with your modification (i.e. provide a semantic meaning to it).

Observing equivalencies between P/T nets and Colored nets :

18) Exit Macao, run Macao again and open the original Run the service "CPN unfolder" and then observe the resulting net.

19) Save the net, close the previous one and open the P/T nets obtained from unfolding

20) Run the service "Bounds of places". How many places are not 1-bounded. For which places should this not be normal?

21) Propose a modification of the original Colored net and then, reprocess steps (18 to 20). Observe the changes.

You can now quit Macao.

5. Design Your Own Nets

Problem 1 : car manufacturing

Let us now design a new Petri net "from scratch". It has to model a car construction. We assume that a car is made of four wheels, four doors (front right and left, back right and left), one body and an engine. Parts stocks will be modeled by places (let us imagine that there are sufficient elements to build 10 cars) and assembling by transitions. Store complete cars in a place.

Problem 2 : A Railway Crossing with Gates

Imagine there is a pedestrian path crossing two train lines. For safety, there are gates (ain't one Bill enough? ;-)) which can be opened and closed. Construct a P/T-net model of the railway crossing that ensures that the gates are down whenever one or both lines are occupied by trains. It should be possible for more than one train to pass with the gates staying closed. Does using Colored Nets simplify the model?

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[3] If Macao tells you that you cannot change the model (regression to fix:-(, just close the model and reopen it. You can also quit Macao and restart it.