Petri Net Modelling to ARGESIM Comparison C4 'Dining Philosophers' with Petrinetz-Tool, with Integrated Net Analyzer INA, and Peneca / CHROMOS

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Simulator: *The Petrinetz-Tool*, developed at Magdeburg University, is a graphic net editor and simulator for PT-nets. It represents the reachability graph, creates the incidence matrix and the INA file of the net. INA, a freely available tool of the HU Berlin, performs a reachability analysis here. It unfolds Colored Petri Nets (CPN) into PT-nets before analyzing. The graphic net editor/ simulator CHROMOS for CPNs is a product from Peneca, Ilmenau.

Model. The base of the investigation is the classic model. Five philosophers with five chopsticks can meditate or eat. At the beginning of the eating the chopsticks on the left and on the right next to the plate are seized and put back after the eating in pairs. With five chopsticks only two philosophers can eat simultaneously which implies conflicts.

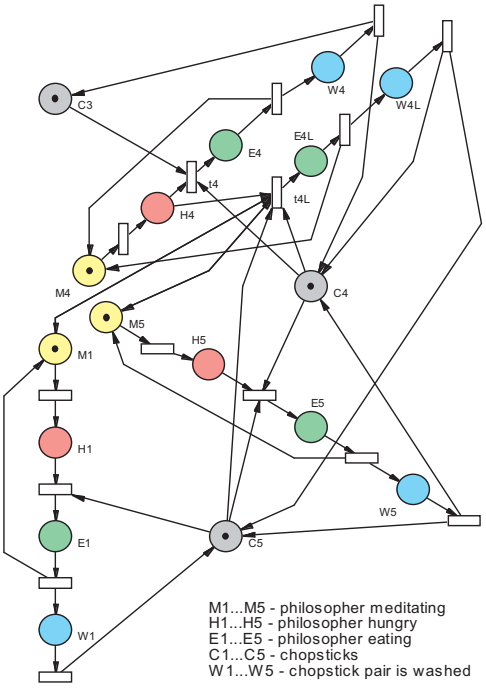

Figure 1: Refined and extended Place/Transition net.

Refinement of the model. A place 'Hungry' has been inserted between the places 'Meditating' and 'Eating'. After the eating the philosopher continues the meditating. His chopsticks are cleaned simultaneously and they are put back in pairs on their places after that. The cleaning is modeled by the place 'Washing'. The refinement increases the reachability set to 352 while the classic problem had 11 states. An analysis with INA confirms the liveness of the net. Figure 1 shows the refinement for the philosopher P5.

Additional chances. If a hungry philosopher is missing a chopstick, he shall get the possibility to borrow a chopstick of a neighbour.
To this end the model is extended by two alternative branches per philosopher.

The left completion of philosopher P4 is obvious from Figure 1. He can only borrow the chopstick C5 if P5 and P1 are meditating (test arcs to M5 and M1). After cleaning, C5 is put back on its place together with the own chopstick C4. By means of the right branch, P4 would try to eat with C3 and the borrowed C2. The competition doesn't intensify this way but the chances improve for a fair treatment. The own chopsticks are always preferred trough a higher priority, e.g. of transtion t4 compared to t4L or t4R. Altogether 3581 states were generated and the Petri net was recognized as lively.

Colored Petri Net. The complete PT-net consists of 45 places and 50 transitions. The folding to a CPN with individual tokens reduces this number to a fifth and simplifies the structure. The arcs are labeled with variables, their colors and values are assigned by CHROMOS in the menu *Function symbols* see Figure 2 for details of the coloured net).
A further folding of the place-triples 'Eating' and 'Washing' and their corresponding transitions reduces the CPN to five places and four transitions. However, the original structure is no longer recognizable.
INA confirms the liveness and the reachability set above.

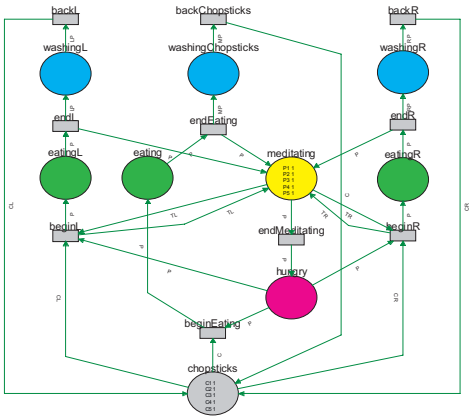

Figure 2: Complete couloured Petri net.

Classification: Petri net modelling and net analysis

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