C4 Dining Philosophers – Enterprise Dynamics (Taylor ED)

Simulation Approach

Simulator: Taylor ED (Enterprise Dynamics) is a family of software products for modelling, visualisation and control business processes. The 4Dscript Language is the interface through which all Taylor ED functionality is controlled. It's used to define editing fields, to define atom functionality, to create run and analyse models, to define model logic, to control Taylor ED from outside, etc.

Model: For the implementation of this problem in ED the event based approach was chosen, using only main atoms already available in the ED atom library.

The five philosophers are *Servers*, the chopsticks are *Products* to be processed. A *cleaning process* was introduced to manage certain properties.

After having satisfied his hunger the philosopher puts the chopstick back on the table. After a cleaning time of 1 it is now free to be seized on need. In the simulation the chopstick is stored in a queue until being requested again. Figure 1 shows the event / process-oriented graphical model layout in ED.

Each philosopher may be in one of three status: meditating, hungry or eating. He stays in this status for a uniformly distributed time period in the interval (1,10). A full simulation run lasts for 1000 time units.

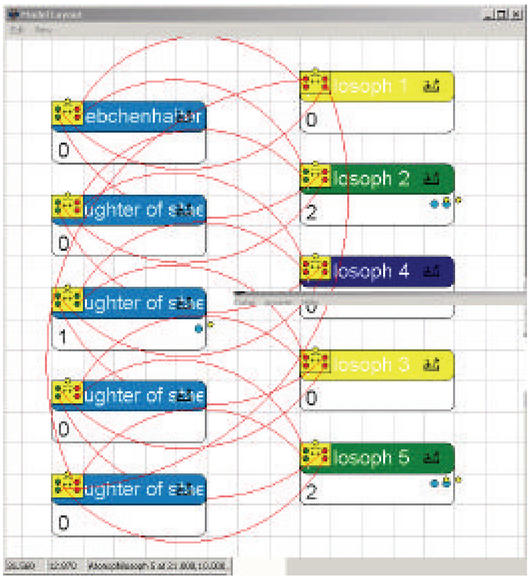

Figure 2: ED Model Layout

Task a: Simulation/Analysis of behaviour: As expected the philosopher's habit of picking up one chopstick first and waiting for the second to be free, leads to their doom: if all five of them get hungry at approximately the same time they will all seize one chopstick to wait for the other one. Therefore all resources are blocked an the system is caught in a deadlock.

Task b: Different strategies. To keep our philosophers from starving to death three different strategies were compared:

- **Strategy 1:** a philosopher has to wait until both needed chopsticks are available until he may pick them up. Using this strategy prevents a deadlock from occurring. Results shown in table 1

	Percentage Eating	Percentage Mediating	Percentage Waiting
Mean	35.84	34.95	29.21
Stand. Dev.	2.622	2.975	4.221

Table 1: Results for Strategy 1

- **Strategy 2:** adding the status dead:
  We assume that a philosopher can only go for a certain time without eating. Then he dies and his chopstick is free. It turns out that at leadt two deaths need to occur until the system is stable, in the worst case only one philosopher survives. A deadlock no longer happens, but the number of philosophers is reduced. Results see table 2.

- **Strategy 3:** returning the chopstick after a certain time:
  After holding one chopstick for a certain time a philosopher gets bored and returns to mediating, his hunger temporarily forgotten. This does not prevent the situation were each philosopher holds one chopstick from happening, but no deadlock occurs.

	Percentage Eating	Percentage Mediating	Percentage Waiting
Mean	23.28	23.36	53.35
Stand. Dev.	1.925	2.31	4.12

Table 2: Results for Strategy 2

For collecting the data needed for analysis the Experiment Atom was used. Here only the number of runs to be done needs to be set. Additionally a task to be executed at the end of each simulation run can be defined. This was used to write the needed data into an Excel file.

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