An Event-Oriented Approach to ARGESIM Comparison C10 "Dining Philosophers II" with Taylor ED

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Simulator. The simulator Taylor Enterprise Dynamics is an object-oriented software application used to model, simulate, visualize and control processes. It provides all the benefits and disadvantages of a windows application.

Everything in Taylor ED is an atom. These atoms are hierarchically structured, one main Atom containing all others. Each atom has four dimensions: location and time.

The user surface is graphic oriented – creating a model is easily done with dragging the model elements from the library tree into the Model Layout Window. Behind the graphic surface the 4d script is hidden; it allows the user to add or remove functionality to atoms as he wishes. Therefore a high level of flexibility is provided.

Model. Five philosophers are sitting around a table. They are all going through the same cycles, starting out with a thinking-phase, followed by a hungry state and then eating-phase. The problem is that every philosopher needs two chopsticks to eat, but between the philosophers it is only one available: each philosopher must share chopsticks with his neighbours, leading to simultaneous access to the same chopstick and occurrence of deadlock.

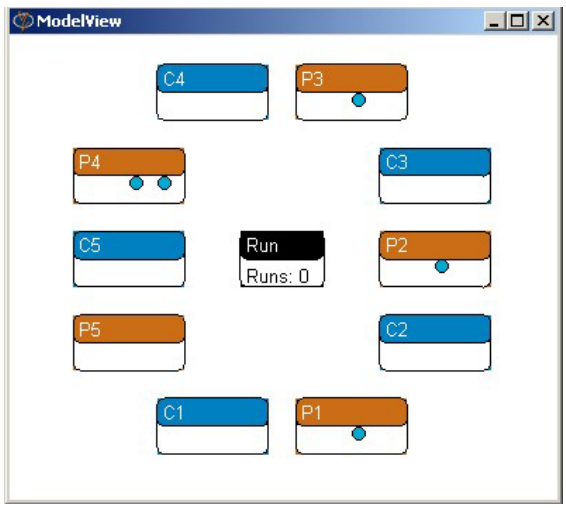


Figure 1: Model View in Taylor

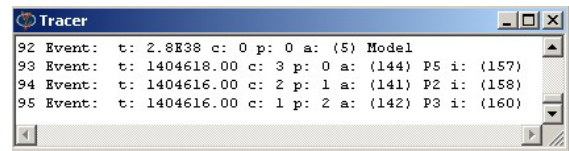
Time for thinking and eating follows a discrete uniform distribution in the interval (1,10).

The chopsticks are Product atoms to be processed. They are stored in own atoms until being requested again. These atoms and the philosopher atoms are Base class atoms. Their functionality is programmed with the 4d script code.

Task a: Single simulation run. Average times (+/- standard deviation) of thinking, waiting and eating periods; rate of chopstick utilisation are given in the following table, produced by Taylor ED's statistical output features:

philosophers	thinking time	eating time	waiting time	chopstick	utilisation
P1	5.49+/-2.87	5.51+/-2.87	11.44+/-8.05	C1	91.95 %
P2	5.50+/-2.87	5.51+/-2.87	11.44+/-8.05	C2	92.01 %
P3	5.49+/-2.87	5.49+/-2.87	11.44+/-8.07	C3	91.98 %
P4	5.51+/-2.87	5.49+/-2.87	11.44+/-8.07	C4	91.92 %
P5	5.49+/-2.87	5.49+/-2.87	11.45+/-8.07	C5	91.94 %
all	5.50+/-2.87	5.50+/-2.87	11.44+/-8.06	all	91.96 %

Task b - Simultaneous access. In a simultaneous access situation the philosopher sitting on the right gets the chopstick first and the philosopher to his left must wait. In the simulation this was realized with the capability to prioritise an event in the event list. In the following a snapshot from Taylor ED's event list (in trace modus). As default, in case of simultaneous events, Taylor ED processes that event first, which belongs to first defined block atom.



Task c - Deadlock detection. Taylor ED does not recognise a deadlock for what it is – the simulation continues until no more events are listed. So a time overflow occurs, simulation does not stop. To prevent this overflow, a query is made each time a philosopher seizes his left chopstick: if a global variable containing the number of philosophers holding a chopstick is equal to five the simulation run is stopped. In the following the so-called 4D-script code (Taylor ED's) programming language) for the deadlock prevention.

```
If(label([send],last(c))=1,
do(inc(dead),
{deadlock}
if(dead=5,stop)))
```

The minimum and maximum termination time evaluated on 50 simulation runs is 32259 s or 14354390 s.

C10 Classification: DEVS Approach

Simulator: Taylor ED 6