C4 Dining Philosophers I – Arena

Simulator. Arena product family (Arena Business, Standard and Professional Editions, Arena Call Center, Arena Packaging, OptQuest) fulfills the needs for mapping processes and simulating discrete and continuous systems. With SIMAN inside, Arena exploits a heritage of power simulation software in a natural, graphical interface. The power afforded by Arena extends to its ability to integrate with other technologies, databases, drawing/modelling products or spread- sheets (ActiveX, Visual Basic for Applications - VBA, Oracle, Visio, AutoCAD, Microsoft Office, etc.).

Model. Two different ways of seizing the chopsticks are used: A1- waiting until both chopsticks are available, A2- taking first the left then the right chopstick. Deadlock may occur only in the case A2.

Figure 1 shows the model of a philosopher for the case A2. The philosopher is modelled by using Arena logic modules. At the beginning of simulation, one entity is created using the *Create* module. This entity moves throw logic modules in loop. The entity is delayed in modules *Delay* for a "Meditating" time, "Eating" time and "Cleaning" time.

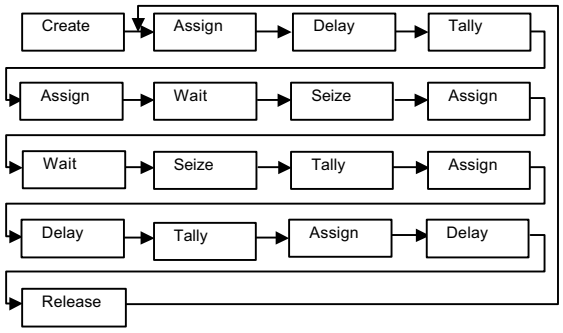

Figure 1: Model of a philosopher

Task a: Simulation/Analysis of behaviour (including deadlock). The following strategy is used to prevent the deadlock. Before a philosopher Pi obtain the left chopstick, a part of the main model checks whether other four philosophers already holds the left chopstick. If other four philosophers hold the left chopstick, he will continue waiting in Hungry state. The philosopher in the left side of Pi will obtain his right chopstick and will step in Eating state.

First, each of cases A1 and A2 is implemented as a separate model in Arena. For Meditating time and Eating time, it is used discrete uniform distribution U [1,10]. For Cleaning of chopsticks, it is used discrete uniform distribution U [1,2]. Table 1 shows the mean Hungry time and the Chopstick utilization. In case A1, the obtained values of the Hungry time and chopstick utilization are smaller then in A2.

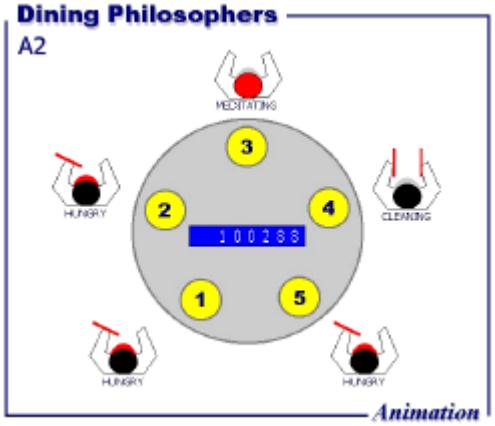

Figure 2: The view of the animation at the simulation time 100288

Task b: Different strategies. Later, we have assumed that only the first philosopher P1 needs more time to clean chopsticks (discrete uniform distribution U [9,10] is used). Cases A1 and A2 after this change, are denoted with B1 and B2. Table 2 shows the results. In case B1, this change had strong influence in values of Hungry time of neighbourhood philosophers P2 and P5. In case B2, the values of Hungry time for P2, P3, P4 and P5 are increased significantly in comparison with P1.

Results:

	Both chopsticks (A1)		First left then right (A2)	
	Ph.Hungry	Ch.Utilization	Ph.Hungry	Ch.Utilization
1	7.582	0.697	26.454	0.936
2	7.573	0.698	26.484	0.936
3	7.569	0.697	26.462	0.936
4	7.581	0.697	26.463	0.936
5	7.580	0.697	26.480	0.936

Table 1: Simulation time 10000000

	Both chopsticks (B1)		First left then right (B2)	
	Ph.Hungry	Ch.Utilization	Ph.Hungry	Ch.Utilization
1	7.596	0.786	27.070	0.947
2	15.229	0.619	34.982	0.948
3	6.602	0.733	34.902	0.947
4	6.600	0.619	34.850	0.947
5	15.266	0.786	35.043	0.960

Table 2: Simulation time 10000000

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