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EECS 678
Lab 7 Report

Lab 7 Report: The Dining Philosophers

1. Describe the asymmetric solution. How does the asymmetric solution guarantee the philosophers never enter a deadlocked state?

- The asymmetric solution has each philosopher pick up their chopsticks in a different order depending on their position around the table. If the philosopher is at an even numbered seat, he picks up the left chop stick before picking up the right chopstick. If a philosopher is at an odd numbered seat, he picks up the right chop stick before picking up the left. This solution guarantees that a deadlocked state is never entered because if an even numbered philosopher picks up his left chop stick, and the philosopher to his right picks up the right chop stick (odd numbered), there's still always going to be a chopstick in the middle of them, so whoever wins the race will eventually rest, and release the chopstick.

2. Does the asymmetric solution prevent starvation? Explain.

- No, the asymmetric solution does not prevent starvation. If an even philosopher has the left chop stick, and the philosopher to the right of him has both, the odd philosopher may pick the chop stick back up before the even numbered philosopher has the chance to acquire the lock.

3. Describe the waiter's solution. How does the waiter's solution guarantee the philosophers never enter a deadlocked state?

- The waiter's solution uses a waiter mutex to be the only interaction between philosophers and their chopsticks. If a philosopher wants to eat, they must acquire the waiter mutex lock. Once they've acquired this lock, they check if both chopsticks are available. If not, they sleep until signaled that one has become available by another philosopher. However, if both chopsticks are available, they will be granted the chopsticks. This philosopher then releases the waiter lock so he can grant other philosophers chopsticks. Once the philosopher ate, they acquired the waiter lock again, released the chopsticks, and signaled to the other philosophers that the chopsticks were available.

4. Does the waiter's solution prevent starvation? Explain.

- No, starvation is still a problem with this solution. This happens because when a philosopher is awakened, they have to wait to acquire the waiter lock, should it already be locked. This makes it easy for the philosopher who just signaled that the chopstick was empty to get to the waiter first and start eating again. Or, in another situation, a philosopher could simply never interact with the waiter because other philosophers acquired the lock first.

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5. Consider a scenario under a condition variable based solution where a philosopher determines at the time it frees its chopsticks that both chopsticks of another philosopher (Phil) it shares with are free, and so it sends the (possibly) waiting Phil a signal. Under what circumstances may Phil find that both of its chopsticks are NOT free when it checks?

- This philosopher Phil may find that both of the chopsticks aren't free upon checking if another philosopher acquired the lock before Phil did. The philosopher who puts down the chopstick signals Phil, who may be waiting. However, before Phil can acquire this lock, another philosopher who also shares chopsticks with Phil, and who may have been waiting as well might swoop in and take one of the chopsticks necessary for Phil to eat.