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Cannibals & Missionary Write-up

My project was created using xcode, and the outputs were given. For threads, I included pthreads. I coded so that each person is a thread. The struct I created has a string type that holds either Missionary or Cannibal and an integer ID. I have 4 main functions: OnePerson, rowboat, MissiArrives, and CanniArrives. The OnePerson calls MissiArrives or CanniArrives depending on the type of person they are (Missionary or Cannibal). Also, the directories for the input and output files must be changed because they were set for my computer.

The main function reads from the text file, and stores the type and ID into the structure described earlier. It then creates threads and the structure is passed in as a parameter. MissiArrives and CanniArrives takes in a string type and an integer ID for parameters. Inside that function, it prints out which person arrived and increments the number of Missionary that are not on the boat. Rowboat function is only called when the boat is full. Once it is called, it initialized the number of people on the boat currently. This function also outputs to a text file.

In the OnePerson function, I have a while loop that traps the threads during certain conditions. A cannibal will be waited when there is only 1 missionary on the boat. A missionary will be waited when there are more than 1 cannibal on the boat. The if statements are put in there after the thread gets woken up by broadcast. Once it leaves the while loop, the threads will go on the boat and increment the value. The thread will then call the rowboat function if the boat capacity has been reached.

I monitored the threads using mutex. Whenever I changed a value, I locked that variable so that no other threads can access it. I also put a lock whenever a function called that variable or used in if statements, so that the variable doesn’t get changed while inside that statement. I put a mutex called print\_mutex whenever I had a cout so that the threads don’t print out anything at the same time.

The difficulties I had in this project was to manage all of the mutex locks. I kept getting deadlocks in unnecessary spots. I also had trouble with visualizing this whole project. Since I am used to just single thread programming (main function), it was especially hard to visualize some threads moving quicker than other threads.

In this project, I assumed that the people come and go (they don’t come in all at once). Since we do not know how many people are coming, there will be some cases where there will be a deadlock at the end. For example, on the last boat ride, there will be a deadlock when the last group of people only has 1 missionary. I purposely left it like that because in the assignment sheet, it says that we send the group as soon as there is a safe state.

Example Outputs:

This one is when there is a deadlock in the end :

**<Arrived> Person type is Cannibal ID is 1**

**Cannibal 1 is on the boat**

**<Arrived> Person type is Cannibal ID is 2**

**Cannibal 2 is on the boat**

**<Arrived> Person type is Missionary ID is 1**

**<Arrived> Person type is Missionary ID is 2**

**<Arrived> Person type is Cannibal ID is 3**

**Cannibal 3 is on the boat**

**----->People released<-----**

**Cannibal 1 Cannibal 2 Cannibal 3  is leaving**

**Missionary 1 is on the boat**

**Missionary 2 is on the boat**

**<Arrived> Person type is Missionary ID is 4**

**Missionary 4 is on the boat**

**----->People released<-----**

**Missionary 1 Missionary 2 Missionary 4  is leaving**

**<Arrived> Person type is Missionary ID is 3**

**Missionary 3 is on the boat**

**<Arrived> Person type is Cannibal ID is 4**

**<Arrived> Person type is Cannibal ID is 5**

This one has no deadlock, it was successfully ran:

**<Arrived> Person type is Cannibal ID is 1**

**Cannibal 1 is on the boat**

**<Arrived> Person type is Cannibal ID is 2**

**Cannibal 2 is on the boat**

**<Arrived> Person type is Missionary ID is 1**

**<Arrived> Person type is Missionary ID is 2**

**<Arrived> Person type is Cannibal ID is 3**

**Cannibal 3 is on the boat**

**----->People released<-----**

**Cannibal 1 Cannibal 2 Cannibal 3  is leaving**

**<Arrived> Person type is Missionary ID is 4**

**Missionary 4 is on the boat**

**<Arrived> Person type is Missionary ID is 3**

**Missionary 3 is on the boat**

**<Arrived> Person type is Cannibal ID is 4**

**Cannibal 4 is on the boat**

**----->People released<-----**

**Missionary 4 Missionary 3 Cannibal 4  is leaving**

**<Arrived> Person type is Cannibal ID is 5**

**Cannibal 5 is on the boat**

**Missionary 1 is on the boat**

**Missionary 2 is on the boat**

**----->People released<-----**

**Cannibal 5 Missionary 1 Missionary 2  is leaving**