OS

lab#03
Synchronization and Mutual Exclusion
Water Reaction

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Code Organization:

reaction-runner.c

have the main function which call reaction_h and reaction_o by creating threads and check if the returned threads is correct or not
have Make_Water function

reaction.h

have a declaration for methods in reaction.c and the structure of reaction reaction:

- Mutex lock_mutex → to lock and unlock critical section
- Condition Variable getting_new_H → for received new H atom
- Condition Variable ready_to_react → the reaction is ready .. there are H2O
- int number_of_h → a counter fro H atoms we have

reaction.c

- think about it as producer (reaction_H) & consumer (reaction_o)
- for consumer (reaction_o)

1 start critical section in order to no coming atom during preparing he reaction
2 wait for getting two H atom → number of H = 2
3 while number_of_H < 2
4 wait until next coming H atom
5 recheck after each getting H atom
6 once get at least 2 H atom → reaction is ready
7 make_water
8 we consume 2 H atoms → must decrease number of H by 2
9 wake up any two H atoms that ready to react
10 end critical section
11 after exit critical section O atom will return

- for producer (reaction_h)

1 start critical section in order to no coming atom during preparing the reaction
2 we getting new H atom → increase number of H ++
3 number of H may be > 2 →wake up thread O in line 4
4 there is less than 2 H atoms →wait until ready to react
5 end critical section
6 after exit critical section h atom will return

the various mutex and condition variables that you used:

as mention above in reaction structure

- **Mutex:** lock_mutex → to lock critical section at the start the reaction_o and reaction_h, and to unlock critical section at thee end of them.

- **Condition Variable:** getting_new_H → for received new H atom, signal waiting O that there is a new H atom received.

- **Condition Variable:** ready_to_react → the reaction is ready .. there are two H atoms and one O atom ready to react and make water.

Sample Runs:

```
mohamed@mohamed-HP-Pavilion-g6-Notebook-PC:~/Desktop/Shell project/lab03_Water_Reaction$ make run
./reaction 0
Created 0 H and 200 O atoms (0.0% H), expecting 0 H2O molecules
Looks good!
./reaction 0
Created 0 H and 200 O atoms (0.0% H), expecting 0 H2O molecules
Looks good!
./reaction 20
Created 30 H and 170 O atoms (15.0% H), expecting 15 H2O molecules
Looks good!
./reaction 20
Created 36 H and 164 O atoms (18.0% H), expecting 18 H2O molecules
Looks good!
./reaction 40
Created 78 H and 122 O atoms (39.0% H), expecting 39 H2O molecules
Looks good!
./reaction 40
Created 74 H and 126 O atoms (37.0% H), expecting 37 H2O molecules
Looks good!
./reaction 60
Created 111 H and 89 O atoms (55.5% H), expecting 55 H2O molecules
Looks good!
./reaction 60
Created 116 H and 84 O atoms (58.0% H), expecting 58 H2O molecules
Looks good!
./reaction 80
Created 158 H and 42 O atoms (79.0% H), expecting 42 H2O molecules
Looks good!
./reaction 80
Created 153 H and 47 O atoms (76.5% H), expecting 47 H2O molecules
Looks good!
./reaction 100
Created 200 H and 0 O atoms (100.0% H), expecting 0 H2O molecules
Looks good!
./reaction 100
Created 200 H and 0 O atoms (100.0% H), expecting 0 H2O molecules
Looks good!
mohamed@mohamed-HP-Pavilion-g6-Notebook-PC:~/Desktop/Shell project/lab03_Water_Reaction$
```

```
mohamed@mohamed-HP-Pavilion-g6-Notebook-PC:~/Desktop/Shell project/lab03_Water_Reaction$ make run
cc -g -Wall -Wno-unused-value -o reaction reaction-runner.c reaction.c -lpthread
./reaction 0
Created 0 H and 200 O atoms (0.0% H), expecting 0 H2O molecules
Looks good!
./reaction 0
Created 0 H and 200 O atoms (0.0% H), expecting 0 H2O molecules
Looks good!
./reaction 20
Created 39 H and 161 O atoms (19.5% H), expecting 19 H2O molecules
Looks good!
./reaction 20
Created 48 H and 152 O atoms (24.0% H), expecting 24 H2O molecules
Looks good!
./reaction 40
Created 85 H and 115 O atoms (42.5% H), expecting 42 H2O molecules
Looks good!
./reaction 40
Created 86 H and 114 O atoms (43.0% H), expecting 43 H2O molecules
Looks good!
./reaction 60
Created 115 H and 85 O atoms (57.5% H), expecting 57 H2O molecules
Looks good!
./reaction 60
Created 118 H and 82 O atoms (59.0% H), expecting 59 H2O molecules
Looks good!
./reaction 80
Created 160 H and 40 O atoms (80.0% H), expecting 40 H2O molecules
Looks good!
./reaction 80
Created 161 H and 39 O atoms (80.5% H), expecting 39 H2O molecules
Looks good!
./reaction 100
Created 200 H and 0 O atoms (100.0% H), expecting 0 H2O molecules
Looks good!
./reaction 100
Created 200 H and 0 O atoms (100.0% H), expecting 0 H2O molecules
Looks good!
```