ECE-350 L4 Report

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DATA STRUCTURES AND ALGORITHMS

For this lab, we reused structures from all previous labs to facilitate scheduling of real-time tasks based on EDF protocol, specifically using our FIFO queue to organize and sort tasks by their period

TEST SUITE DESCRIPTIONS

Note: we use helper functions initialize_msg_(MSG_TYPE) and validate_message in our test suites.

Test Suite 1 - ae_tasks1_G10.c

SUMMARY:
This test suite will create tasks1-3, elevate all to real-time w/ different periods, have them all send messages back to priv_task1 and ensure the order of messages received is correct (through a long period of time). There will also be another (non real-time) task4, which will do the same thing (send a message back to priv_task1), and should only execute when all of the real-time tasks are in the SUSPENDED state. We should therefore have an expected order of execution that can be verified through the received messages to priv_task1.

The test suite will also verify that rt_tsk_get, tsk_get, tsk_ls, mbx_ls, and mbx_get return the expected results throughout program execution.

TESTS:
- EDF scheduling policy
    - integration with previous preemptive priority scheduling (SUSPENDED)
    - includes all Lab4 system calls
    - tests all _get and _ls functions
    - non real-time task runs only when all real-time tasks SUSPENDED
        - once real-time task unsuspended, immediately preempts
- some real-time edge cases?
- uses artificial delay

STEPS:
- priv_task1

        - create_mbx() for priv_task1
        - tsk_set_prio() priority of priv_task1 to LOWEST
        - **TEST CASE 1: create_mbx(), tsk_set_prio(), mbx_ls(), tsk_ls()**
        - tsk_create() task1 (prio=LOW)
        - tsk_create() task2 (prio=MED)
        - tsk_create() task3 (prio=HIGH)
        - tsk_create() task4 (prio = MED)
        - **TEST CASE #: tsk_create()**
        - recv_msg()
            - (repeat 31 times to verify correct order printed)
        - **TEST CASE #: recv_msg() gives messages in order (use multiple?)**
        - test_exit()
- task1
    - rt_tsk_set() to elevate to real-time
        - period = 0.1s
    - inside finite while loop (6 iterations):
        - send_msg() of “1” to priv_task1
        - rt_task_susp() to yield remaining period to other real-time tasks
    - tsk_exit()
- task2
    - rt_tsk_set() to elevate to real-time
        - period = 0.2s
    - inside finite while loop (3 iterations):
        - send_msg() of “2” to priv_task1
        - rt_task_susp() to yield remaining period to other real-time tasks
    - tsk_exit()
- task3
    - rt_tsk_set() to elevate to real-time
        - period = 0.3s
    - inside finite while loop (2 iterations):
        - send_msg() of “3” to priv_task1
        - rt_task_susp() to yield remaining period to other real-time tasks
    - tsk_exit()
- task4
    - inside finite while loop (20 iterations):
        - send_msg() of “4” to priv_task1

Test Suite 2 - ae_tasks2_G10.c

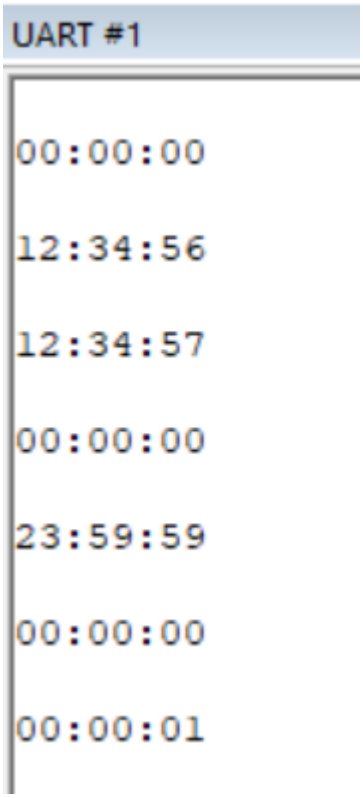
This test suite focuses on these aspects of the Wall Clock:

- **Wall Clock properly displayed**
  - **Correct format HH:MM:SS, 24 hour**
- **Task registers itself correctly.**
- **All 3 commands**
  - **%WR**
    - **Properly resets the wall clock to 00:00:00. Sends to console display task, displays on console terminal updating every second.**
  - **%WS HH:MM:SS**
    - **Properly sets the wall clock to HH:MM:SS. Sends to console display task, displays on console terminal updating every second.**
    - **If invalid input, no operation.**
  - **%WT**
    - **Properly removes the wall clock from the console terminal.**

Tests:

- Test 1
  - Verify sending a %WS HH:MM:SS command to the TID_WCLCK tid's mailbox works with no error
  - Manually verify that at the next period for the Wall Clock (After 1 second) the wall clock updates to HH:MM:SS
- Test 2
  - Verify sending a %WS HH:MM:SS where HH:MM:SS is an invalid string to the TID_WCLCK tid's mailbox works with no error.
  - Manually verify that at the next period for the wall clock, the wall clock goes up 1 second and does not set the wall clock to the invalid value in the message.
- Test 3
  - Verify sending a %WR command to the TID_WCLCK tid's mailbox works with no error
  - Manually verify that after 1 second, the wall clock updates to 00:00:00
- Test 4
  - Verify sending a %WT command to the TID_WCLCK tid's mailbox works with no error
  - Manually verify that after 1 second, the wall clock is no longer displaying on the console terminal
- Test 5
  - Verify sending %WS 23:59:59 command to the TID_WCLCK tid's mailbox works with no error.
  - Manually verify that after 1 second, the wall clock updates to 24:59:59
  - Manually verify that after another second, the wall clock updates to 00:00:00

Expected Output on Console for Test Suite 2:


UART #1
00:00:00
12:34:56
12:34:57
00:00:00
23:59:59
00:00:00
00:00:01

Test Suite 3 - ae_tasks3_G10.c

SUMMARY:
This test suite tests the functionality of the KCD and CON tasks with the newly implemented real-time task support with EDF scheduling policy. We employ two real-time tasks with the same period, one created after the other. We register (and re-register) command IDs inside each real-time task, and verify that the same command strings sent from various tasks (eg. task1->task2, task1->task1) are sent and received by the correct mailbox. We verify that the task that most recently registered a common command takes precedence.

Additionally, we verify that %LT and %LM work, and call tsk_ls() and mbx_ls() to manually check.

TESTS:
- 2 real-time tasks with the same period, executes in order created each period
- KCD task, CON task
    - registering command ids inside real-time task
        - re-registering command id - most recent
    - sending command id from one real-time task to another
        - also send to self
    - %LT - manually check matches w/ tsk_ls()
    - %LM - manually check matches w/ mbx_ls()
- rt_tsk_get()

STEPS:
- priv_task1
    - create_mbx()
    - tsk_set_prio() priority of priv_task1 to LOWEST
    - **TEST CASE 1: create_mbx(), tsk_set_prio(), mbx_ls(), tsk_ls()**
    - tsk_create() task1 (prio=MED) - will preempt, run to rt_task_susp
    - tsk_create() task2 (prio=HIGH) - will preempt, run to rt_task_susp
    - //step3
        - send_msg() KEY_IN command %A to KCD
            - should go to task2, since most recently registered
    - **TEST CASE 4: tsk_create(), send_msg(), mbx_get(TID_KCD) same**
    - artificially delay long enough to let task1 and task2 unsuspend
        - should allow to unsuspend multiple times
    - //to fill
    - test_exit()
- task1
    - create_mbx()
    - send_msg() KCD_REG command A
    - send_msg() KCD_REG command C
    - rt_tsk_set() to elevate to real-time
        - period = 0.1s
    - //step1
        - send_msg() KEY_IN command %C to KCD

        - should go to self
    - **TEST CASE 2: send_msg(), mbx_get(TID_KCD) down**
    - rt_task_susp()
- //step4
    - recv_msg() to get KEY_IN command %C from task1
    - **TEST CASE 5: recv_msg(), validate_msg()**
    - send_msg() KEY_IN command %B to KCD
        - should go to task2
    - **TEST CASE 6: send_msg(), mbx_get(TID_KCD) down**
    - rt_task_susp()
- //step6
    - send_msg() KEY_IN command %LT to KCD
    - **TEST CASE 9: send_msg(), mbx_get(TID_KCD) down**
    - tsk_ls()
    - rt_tsk_get()
    - **TEST CASE 10: tsk_ls(), rt_tsk_get()**
    - rt_task_susp()
- tsk_exit()

- task2
    - create_mbx()
    - send_msg() KCD_REG command B
    - rt_tsk_set() to elevate to real-time
        - period = 0.1s
    - //step2
        - send_msg() KCD_REG command A to KCD
        - **TEST CASE 3: send_msg(), mbx_get(TID_KCD) down**
        - rt_task_susp()
    - //step5
        - recv_msg() to get KEY_IN command %A from priv_task1
            - most recent
        - **TEST CASE 7: recv_msg(), validate_msg()**
        - recv_msg() to get KEY_IN command %B from task1
        - **TEST CASE 8: recv_msg(), validate_msg()**
        - rt_task_susp()
    - //step7
        - send_msg() KEY_IN command %LM to KCD
        - **TEST CASE 11: send_msg(), mbx_get(TID_KCD) down**
        - mbx_ls()
        - rt_tsk_get()
        - **TEST CASE 12: mbx_ls(), rt_tsk_get()**
        - rt_task_susp()
    - tsk_exit()

<u>Expected Output on Console for Test Suite 3:</u>

```
00:00:00
 % L T
TID: 1 State: READY

TID: 2 State: SUSPENDED

TID: 3 State: SUSPENDED

TID: 13 State: SUSPENDED

TID: 14 State: READY

TID: 15 State: RUNNING
  % L M
TID: 1 State: READY Free: 128

TID: 2 State: SUSPENDED Free: 128

TID: 3 State: SUSPENDED Free: 128

TID: 13 State: SUSPENDED Free: 128

TID: 14 State: READY Free: 39

TID: 15 State: RUNNING Free: 512

00:00:01

00:00:02
```