Project 3

- **Description:**
  - (**50** points) Write a new system call `int get_number_of_context_switches(unsigned int *)` so that a process can use it to get the number of context switches the scheduler makes upon it. If `get_number_of_context_switches(unsigned int *)` executes successfully, it returns 0; otherwise, it returns a negative value.

    1.
    ```
    //prototype of the new system call is as follows:

    int get_number_of_context_switches(unsigned int *)
    ```

    2. What follows is a code excerpt that you need to use in your program.

    ```
    #include <stdio.h>
    #define  NUMBER_OF_ITERATIONS     99999999

    int main ()
    {
      int          i,t=2,u=3,v;
      unsigned int w;


      for(i=0; i<NUMBER_OF_ITERATIONS; i++)
           v=(++t)*(u++);

      if(get_number_of_context_switches(&w)!=0)
        printf("Error!\n");
      else
        printf("This process encounters %u times context switches.\n", w);
    }
    ```

- (**50** points) Write a new system call `int get_number_of_entering_a_wait_queue(unsigned int *)` so that a process can use it to get the number of its entering a wait queue. If `get_number_of_entering_a_wait_queue(unsigned int *)` executes successfully, it returns 0; otherwise, it returns a negative value.

  1.
  ```
  //prototype of the new system call is as follows:

  int get_number_of_entering_a_wait_queue(unsigned int *)
  ```

  2. What follows is a code excerpt that you need to use in your program.

  ```
  #include <stdio.h>
  #define  NUMBER_OF_IO_ITERATIONS     6
  #define  NUMBER_OF_ITERATIONS        99999999

  int main ()
  {
    char         c;
    int          i,t=2,u=3,v;
    unsigned int w;

    for(i=0; i<NUMBER_OF_IO_ITERATIONS; i++)
    {
      v=1;
      c = getchar();
    }

    for(i=0; i<NUMBER_OF_ITERATIONS; i++)
         v=(++t)*(u++);

    if(get_number_of_context_switches(&w)!=0)
      printf("Error (1)!\n");
    else
      printf("This process encounters %u times context switches.\n", w);

    if(get_number_of_entering_a_wait_queue(&w)!=0)
      printf("Error (2)!\n");
    else
      printf("This process enters a wait queue %u times.\n", w);


    for(i=0; i<NUMBER_OF_IO_ITERATIONS; i++)
    {
       v=1;
       printf("I love my home.\n");
    }


    if(get_number_of_entering_a_wait_queue(&w)!=0)
      printf("Error (3)!\n");
    else
      printf("This process enters a wait queue %u times.\n", w);
  }
  ```

  - Hint:
    1. Inside the Linux kernel, you need to use function `copy_to_user()` to copy data to a user address buffer.
    2. You may need to add a new system call to do project 3.
       - Check the "Referenced Material" part of the Course web site to see how to add a new system call in Linux.
    3. Inside Linux kernel, kernel function `schedule()` is in charge of the context switch operation.
    4. NEW If you need to add a new field into `struct task_struct`, append it as the last field of `struct task_struct`. **Do not** insert it between existing fields. You can initialize the value of this new field inside kernel fucntion `copy_thread()`. (updated: 27th Dec.)
    5. Inside Linux kernel, kernel function `default_wake_function()` is used to wake up a process in a wait queue.
- **Project Submission:**
  - The due day of report submission is **9th Jan. 2022**
  - The demo will be held on **11th Jan. 2022** and **12th Jan. 2022**
  - NEW Please fill out this form to choose your project 3 demo time before **7th Jan. 2022**. (updated: 5th Jan. 2022)
  - Demo of this project is required.
  - During a demo, the TAs will execute several programs written by them to check the correctness of your system calls.
  - When demonstrating your projects, the TAs will ask you some questions regarding to your projects. Part of your project grade is determined by your answers to the questions.
  - You need to submit both an electronic version and a hard-copy of your project report to the TAs.
    - The electronic versions could be sent to the TAs through e-mails.
    - Do not forget writing the names and student IDs of all members in your team.
    - Your report should contain:
      - Your source code
      - the execution results
  - Late submission will **NOT** be accepted.