# OS 2018

## Homework3: scheduling simulation

(Due date 12/13 23:59:59)

https://classroom.github.com/a/1tfOjSId

# Objectives

- Simulate task scheduling
- Understand how to implement context switch
- Understand how signal works in Linux

# Requirements (1/2)

1. Write a user application (scheduling_simulator)
    - Shell mode
        - Implement 4 commands (*must follow the formats in slide 6*)
            - ***add***: Add new task(s)
            - ***remove***: Remove task(s)
            - ***ps***: Show the information of all tasks (PID, task name, task state, queueing time, priority and time quantum)
            - ***start:*** Start or continue simulation (switch to simulation mode)
    - Simulation mode
        - Use ucontext and the related APIs to implement context switch
        - Implement the priority-based variable-time-quantum RR(round robin) scheduling
            - As in *slide 7*
            - Should receive a signal (SIGALRM) every 10 ms (in the Simulation mode), then determine whether to reschedule or not
        - ***Ctrl + z*** should pause the simulation and switch to shell mode
            - Time counting should be stopped in the Shell mode
        - ***start*** should resume the simulation
            - continue simulation from where it pauses

# Requirements (2/2)

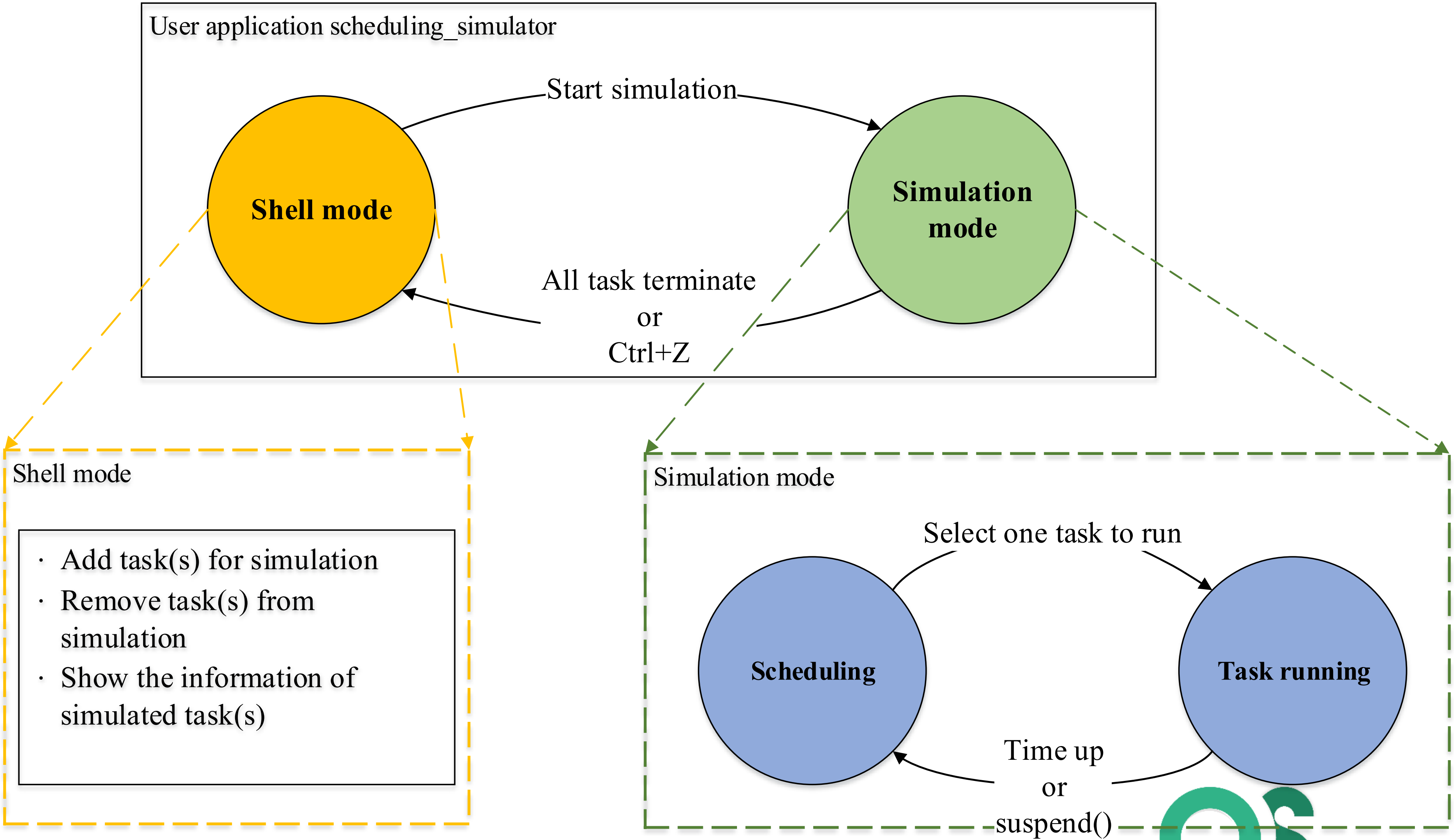
2. Implement the APIs that can be used by the tasks (*described in slide 8*)
   - void hw_suspend(int msec_10);
   - void hw_wakeup_pid(int pid);
   - int hw_wakeup_taskname (char *task name);
   - int hw_task_create(char *task_name);

3. Task
   - The state of each task is shown in *slide 5*
   - A task is a function in ‘tasks.c’ (***task_name*** = function name)
   - All the functions are provided by TAs and can not be changed

Notice:

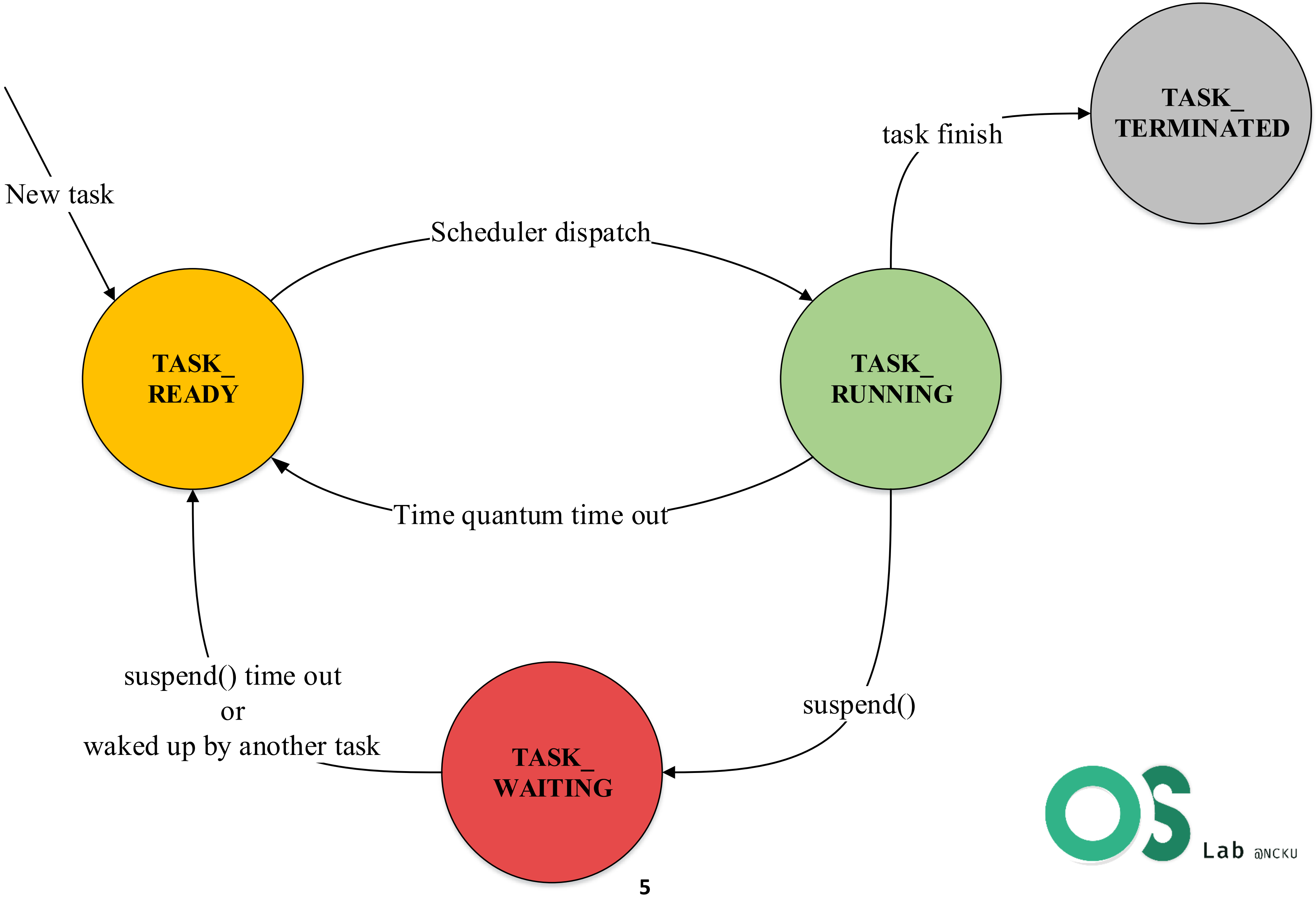
- Register signal handlers to handle ctrl+z and SIGALRM
- Signal may occur anytime even in signal handlers and APIs

# Architecture



- Add task(s) for simulation
- Remove task(s) from simulation
- Show the information of simulated task(s)

# Task state


New task
Scheduler dispatch
task finish
TASK_
TERMINATED
TASK_
READY
TASK_
RUNNING
Time quantum time out
suspend() time out
or
waked up by another task
suspend()
TASK_
WAITING

# Shell commands

- add

```
$ add TASK_NAME -t TIME_QUANTUM –p PRIORITY
```

- What task to add
- Optional argument
  - L for the larger time quantum
  - S for the small time quantum
  - Default value is S
- Optional argument
  - H for high priority
  - L for low priority
  - Default value is L

- remove

```
$ remove PID
```

Remove a task with *PID*

- start

```
$ start
simulating…
```

- ps

```
simulating…
^Z
$ ps
1    task1    TASK_READY          50    H    L
2    task2    TASK_TERMINATED     10    H    S
3    task2    TASK_READY          50    L    L
4    task3    TASK_WAITING        50    L    S
```

PID Task name Task state (in slide p.5) Queueing time Priority Time Quantum

queueing time

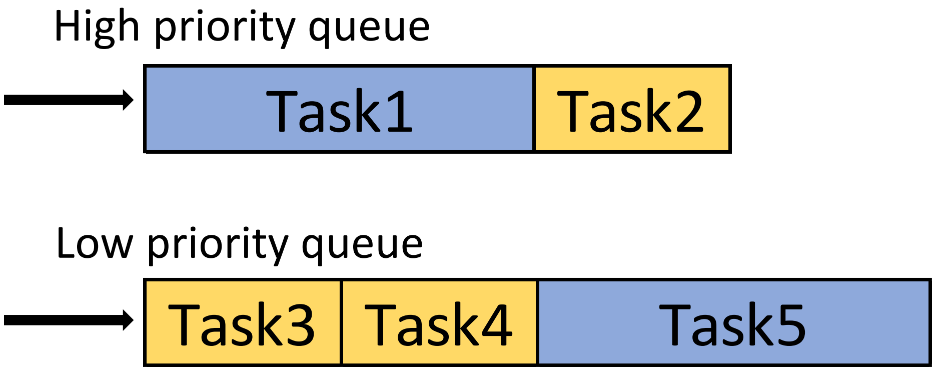
- The total time the task stays in the ready queue during all the simulation period

# Priority-based Variable-Time-Quantum RR Scheduling

- Scheduling each task by priority
  - Round robin(RR) for same priority tasks
- Two types of time quantum
  - Larger time quantum: 20 ms
  - Small time quantum: 10 ms

```
$ add Task1 -t L -p H
$ add Task2 -t S -p H
$ add Task3 -t S
$ add Task4
$ add Task5 -t L
$ start
```

Example



High priority queue

Task1 | Task2

Low priority queue

Task3 | Task4 | Task5

Low priority tasks will be postponed until high priority tasks finished

# API Description

- void hw_suspend(int msec_10);
  - The running task change its state to ***TASK_WAITING***
  - Reschedule (schedule next task to run)
  - Change the state of the suspended task to ***TASK_READY*** after ***msec_10*****10 ms

- void hw_wakeup_pid(int pid);
  - Change the state of task ***PID*** from ***TASK_WAITING*** to ***TASK_READY***
  - Reschedule if needed

- int hw_wakeup_taskname(char *task_name);
  - Change the state of all the tasks with ***task_name*** from ***TASK_WAITING*** to ***TASK_READY***
  - Return how many tasks are waken up
  - Reschedule if needed

- int hw_task_create(char *task_name);
  - Create task ***task_name***
  - Return ***PID*** of the created task
  - Return -1 if there is no function named ***task_name***
  - Reschedule if needed

# References

1. ucontext
   - The Open Group Library
   - IBM® IBM Knowledge Center
     - getcontext()
     - setcontext()
     - makecontext()
     - swapcontext()

2. signal handler
   - Gitbook
   - Linux manual page

3. timer
   - Linux manual page
   - IBM® IBM Knowledge Center