Lecture 14: Scheduling II, Scheduling worksheets

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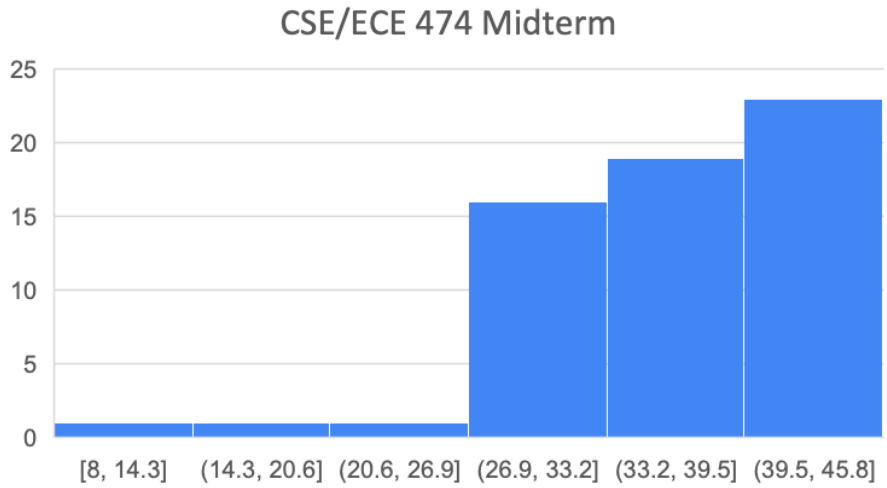
Adapted from material by Blake Hannaford

Announcement/Reminders

- Midterm
  - Average = 36.6 (out of 45)
  - Standard Deviation = 7
- Lab 3 is posted, due 5/26



Round Robin Scheduler

So far we've had very simple programs

```
while(1) {
  taskA();
  taskB();
  taskC();
  time_delay();
}
```

Part I: Using function pointers to start a task

We learned that the syntax:

```
type (*name)(type arg1, type arg2, ...)
```

indicates a function pointer called name which can point to any function having the same prototype. For example

```
int (*fp)(char x, int y, double z)
```

```
void start_function(void (*functionPTR)() ){
  functionPTR();
}
```

Part II: Keeping lists of functions

We can create an array of function pointers as follows:

```
#define NUMBER_OF_FUNCTIONS 10

void (*list_of_functions[NUMBER_OF_FUNCTIONS])(void *p)
```

Example:

```
#define NT_RUNNING 10
void (*runningTasks[NT_RUNNING])(void *p)
```

... a list of all the tasks which are currently running.

We can use a NULL pointer at the end of the list if there are less than NT RUNNING active tasks (similar to the zero byte at the end of a string).

```
//function prototypes for tasks
void taskA(void *p);
void taskB(void *p);
...

// function prototype for
scheduler void scheduler();


#define NTASKS 4

// lets make the task list global
// an array of function pointers,
// each one has a void*
// parameter.

void (*readytasks[NTASKS])
  (void *p);
```

```
//continued…
main() {
  // initialize array of pointers
  // to tasks

  readytasks[0] = taskA;
  readytasks[1] = taskB;
  ...

  // NULL signals the last task
  readytasks[2]= NULL;

  // now start scheduler
  while(1) {
    scheduler();
    time_delay(); // 1 ms timer
  }
} // end of main
```

Scheduler function (pseudocode)

```
scheduler() {
  if(readytasks[task_index] == NULL && task_index != 0) {
    task_index=0;
  }
  if(readytasks[task_index] == NULL && task_index == 0){
    // figure out something to do because
    // there are no tasks to run!
  } else {
    start_function(readytasks[task_index]);
    task_index++;
  }
  //   Round Robin/we're taking turns
  return;
}
```

Part III: Manipulating the Task Lists

```
halt_me() {
  // 1. Identify which task is currently running (i.e.
  //    look at task_index)

  // 2. Copy the function pointer from
  //    readytasks[task_index] to the
  //    haltedtasks array

  // 3. Move the remaining tasks up in readytasks[] to
  //    fill the empty hole and copy NULL into the
  //    last element.

  return;
}
```

Sleep function (pseudocode)

```
sleep(int d) {
  // 1. Copy function pointer from
  //    readytasks[task_index] to the
  //    waitingtasks[] array.
  // 2. Clean up readytasks[] as in halt_me();
  //    copy d into the delays array with the same
  //    index as the function pointer has in
  //    waitingtasks[]
}
```

Keeping track of sleep delays

```
  // continued...
  // 5. for each element of waitingtasks which is
  //    not NULL: decrement the delay value d.
  //    if (d==0) move the function pointer to the
  //    end of the readytasks[] array and remove
  //    it from waitingtasks.
  // end of scheduler
  return;
}
```

Alternative Data Structure for Scheduling

Let's set up a struct **Task Control Block (TCB)** which contains everything we need to track about a Task:

```
typedef struct TCBstruct {
  void (*ftpr)(void *p);     // the function pointer
  void *arg_ptr;             // the argument pointer
  unsigned short int state; // the task state
  unsigned int delay;        // the task state
} ;
```

```
#define STATE_RUNNING  0
#define STATE_READY    1
#define STATE_WAITING  2
#define STATE_INACTIVE 3
TCBStruct TaskList[N_MAX_TASKS];

// Then we can set up the task // list as follows:
int j=0;
int task_B_Arg;

TaskList[j].ftpr = task_A();
TaskList[j].arg_ptr = NULL;
TaskList[j].state = STATE_INACTIVE;
TaskList[j].delay = 0;
j++;
```

```
// continued… start task B
TaskList[j].ftpr = task_B();

// (example: let's say we need an arg value of 56)
task_B_Arg = 56;
int *ip = &task_B_Arg;
TaskList[j].arg_ptr = (void*)ip;
TaskList[j].state = STATE_READY;
TaskList[j].delay = 0;
j++;

TaskList[j].fptr = NULL;        // marks end of list

... maybe other tasks   ...
```

Examples of halt_me(), start_task() and delay()

```
halt_me() {
  TaskList[t_curr].state = STATE_INACTIVE;
}

start_task(int task_id) {
  TaskList[task_id].state =  STATE_READY;
}

sleep(int d) {
  TaskList[t_curr].delay = d;
  TaskList[t_curr].state = STATE_WAITING;
}
```