CS122A: Intermediate Embedded and Real Time Operating Systems

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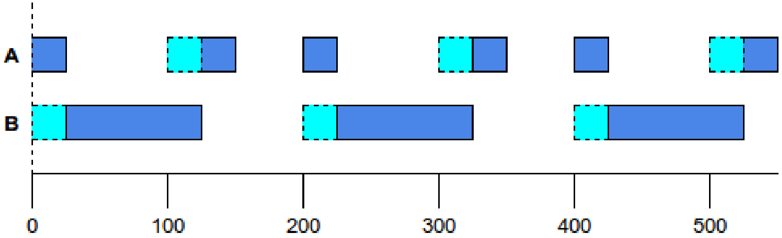
Non-Preemptive vs. Preemptive Scheduler

- Non-preemptive schedulers run a task until completion



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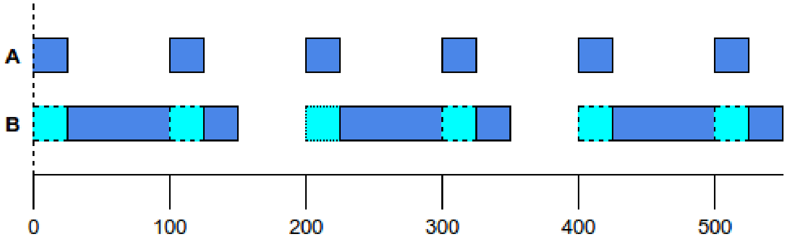
- Preemptive schedulers are able to interrupt a task it a higher priority task becomes available



Non-Preemptive Scheduler

```
typedef struct task{
  int state;
  unsigned long period;
  unsigned long elapsedTime;
  int (*TickFct)(int);
}

void TimerISR() {
  unsigned char i;
  for(i = 0;i < tasksNum;++i){
        if(tasks[i].elapsedTime >= tasks[i].period){
        tasks[i].elapsedTime = 0;
      tasks[i].state = tasks[i].TickFct(tasks[i].state);
    }
    tasks[i].elapsedTime += tasksPeriodGCD;
  }
}
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Preemptive Scheduler

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typedef struct task{
  unsigned char running;
  int state;
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  int (*TickFct)(int);
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Preemptive Scheduler

```
unsigned char runningTasks[3] = {255};// Track running tasks
const unsigned long idleTask = 255; // 0 highest priority, 255 lowest
unsigned char currentTask = 0; // Index of highest priority task

void TimerISR() {
  unsigned char i;
  for(i = 0;i < tasksNum;++i){
    if( (tasks[i].elapsedTime >= tasks[i].period) )
      && (runningTasks[currentTask] > i)
      && (!tasks[i].running) ) {// Prevent self-preemption
        tasks[i].elapsedTime = 0;
        tasks[i].running = 1;
        currentTask += 1;
        runningTasks[currentTask] = i;
        tasks[i].state = tasks[i].TickFct(tasks[i].state);
        tasks[i].running = 0;
        runningTasks[currentTask] = idleTask;
        currentTask -= 1;
    }
    tasks[i].elapsedTime += tasksPeriodGCD;
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  - First element is always idle
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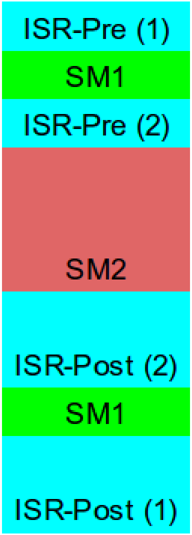
If the ISR is running when the timer ticks again, the ISR will be called again, causing a **nested interrupt**.

1. ISR (1) is called



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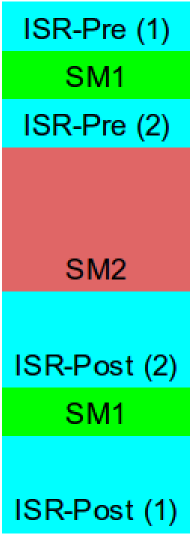

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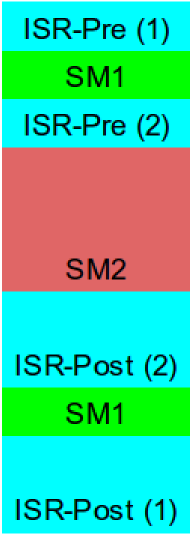

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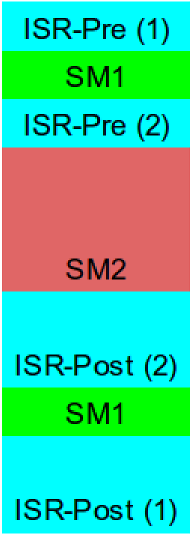

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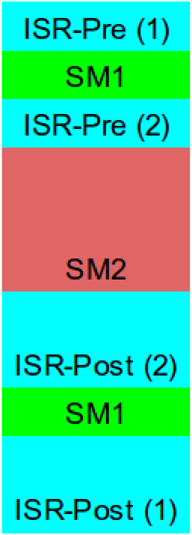

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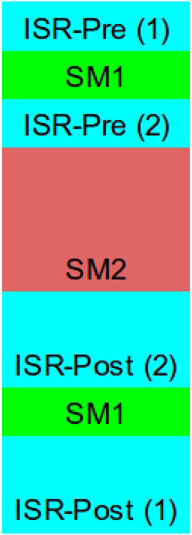

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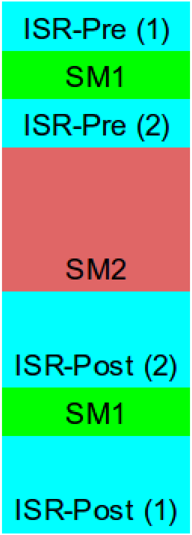

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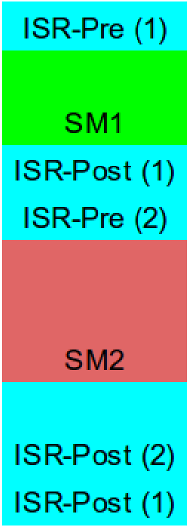

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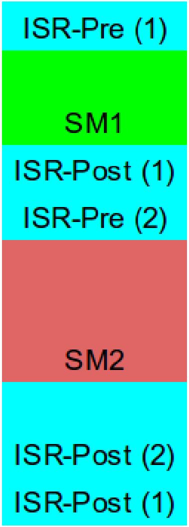

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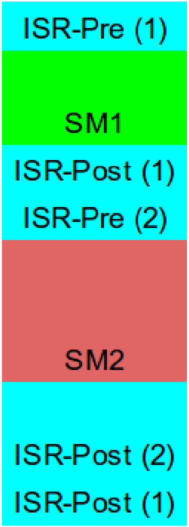

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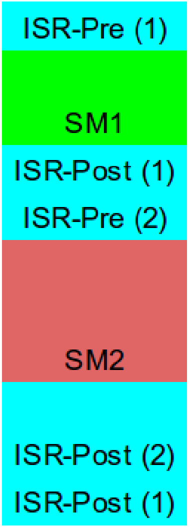

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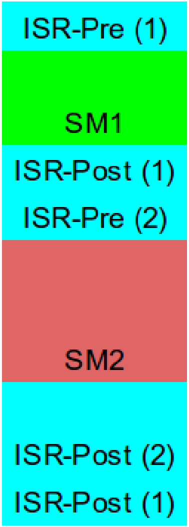

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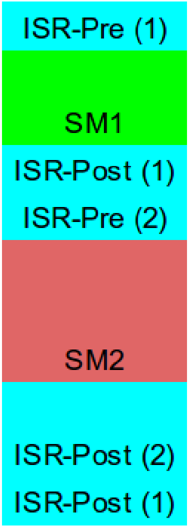

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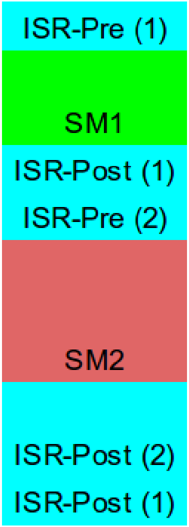

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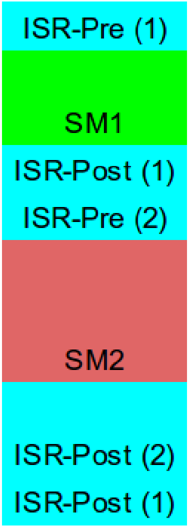

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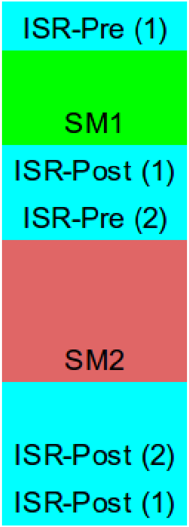

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- This section of code would be called a **critical section**, a section of code that must not be interrupted.
- Interrupts need to be disabled during the **critical section**.

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  unsigned char i;
  for(i = 0;i < tasksNum;++i){
    if( (tasks[i].elapsedTime >= tasks[i].period) )
      && (runningTasks[currentTask] > i)}
      && (!tasks[i].running) ) {// Prevent self-preemption
        DisableInterrupts();
        tasks[i].elapsedTime = 0;
        tasks[i].running = 1;
        currentTask += 1;
        runningTasks[currentTask] = i;
        EnableInterrupts();
        tasks[i].state = tasks[i].TickFct(tasks[i].state);
        DisableInterrupts();
        tasks[i].running = 0;
        runningTasks[currentTask] = idleTask;}*//
        currentTask -= 1;
        EnableInterrupts();
    }
    tasks[i].elapsedTime += tasksPeriodGCD;
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- In RIMS the scheduler takes 10ms per task to executed.
- A period less than 10ms will cause **stack overflow**.
- The microcontroller runs out of memory, causing a fatal error, due to repeated nested calls of TimerISR().

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- This may require low level assembly for this switching
- The above scheduler handles context switches with nested calls to the ISR

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- Allow users to define tasks, including perios and priorities
- Provides a scheduler (such as the one we have created here).
- Frequently supports both preemptive and non-preemptive scheduling.