Pomona College

Computer Science

# Fall 2024: CSCI 181RT

## Real-Time Systems in the Real World

### Lecture 16

Thursday, October 22, 2024
Edmunds Hall 105
2:45 PM - 4:00 PM

Professor Jennifer DesCombes

# Agenda

- Go Backs
- Discussion on Reading
- Pop Quiz [“pop” is in the sense of something appearing suddenly (“popping up”)]
- Lab #8 Review
- More Interrupts and OS Support
- Look Ahead
- Assignment
- Action Items

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# Go Backs

- General?
- Action Item Status
  - AI240910-2: Find recommended book on computer architecture.
  - AI240924-1: At what point as a development team grows does it make sense to have dedicated software and integration testers?

# Discussion on Reading

- The Mythical Man Month
  - Chapter 17 & 18: “No Silver Bullet” Refired, Propositions of *The Mythical Man Month*: True or False?

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# Pop Quiz
# Interrupts and OS Support - Terms

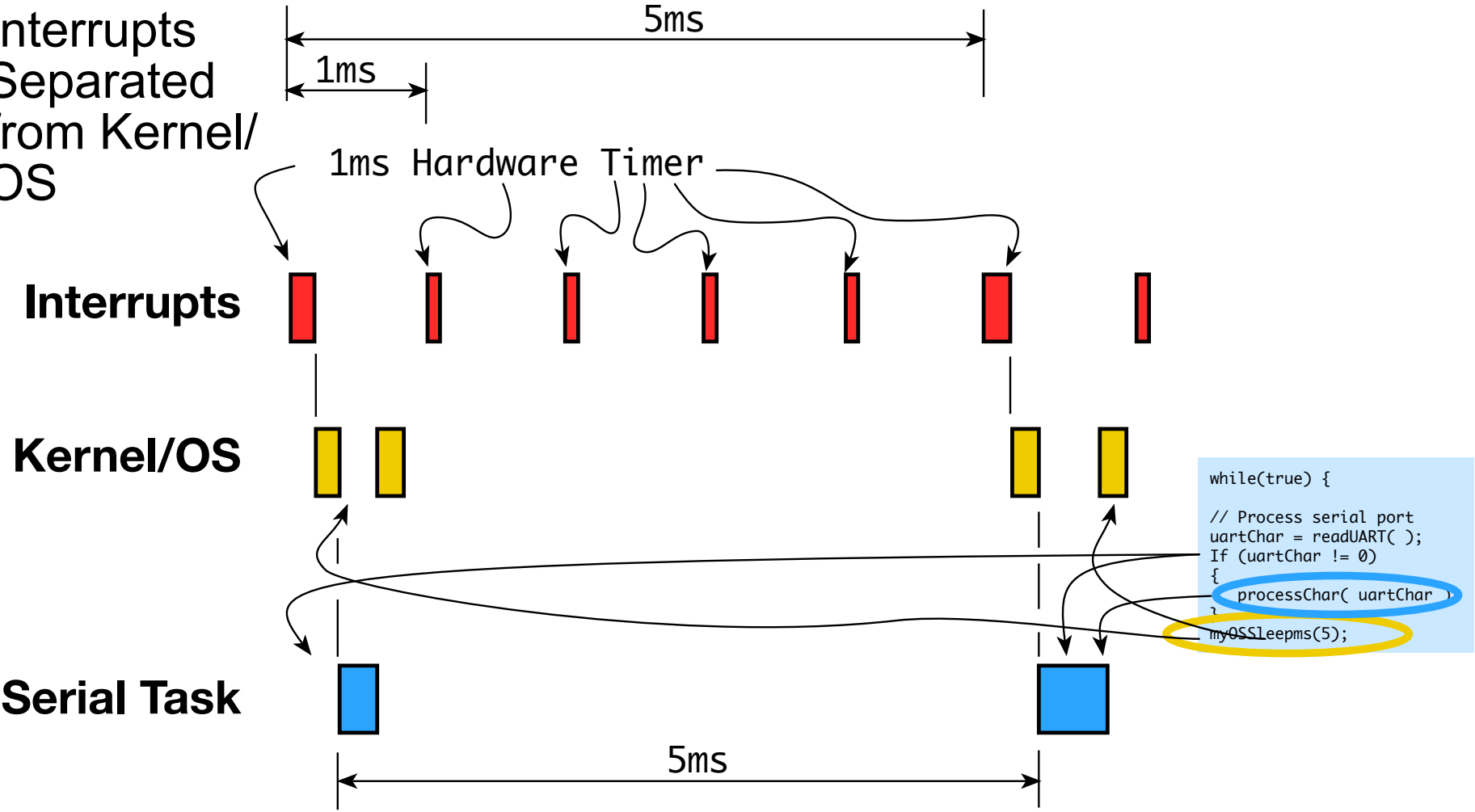
- **Running -** _____
- **Runnable or Ready -** _____
  _____
- **Waiting or Blocked -** _____
  _____
- **Suspended -** _____
  _____
- **Reschedule -** _____
  _____
- **Highest Priority Runnable -** _____
  _____
- **Critical Transition -** _____
  _____

# Interrupts and OS Support

- OS Hardware Interrupts - Time and Timers
- Peripheral Hardware Interrupts
  - Input Compare (IC)
  - Serial Port (UART, USART)

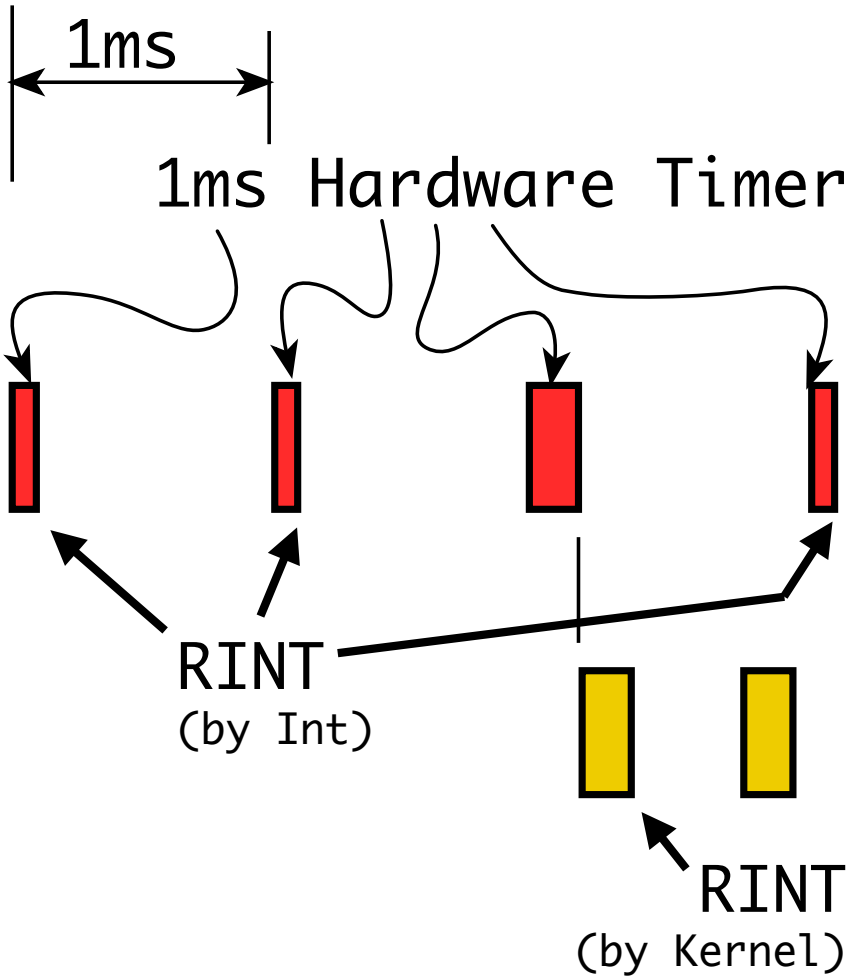
# Interrupts and OS Support - Timer

- Interrupts Separated from Kernel/ OS



# Interrupts and OS Support - Timer

- Interrupt Code Determines if Reschedule is Necessary
- If Not Necessary, Interrupt Performs RINT
- Reschedule Necessary , Reschedule Performs RINT



# Interrupts and OS Support - Timer Interrupt Code

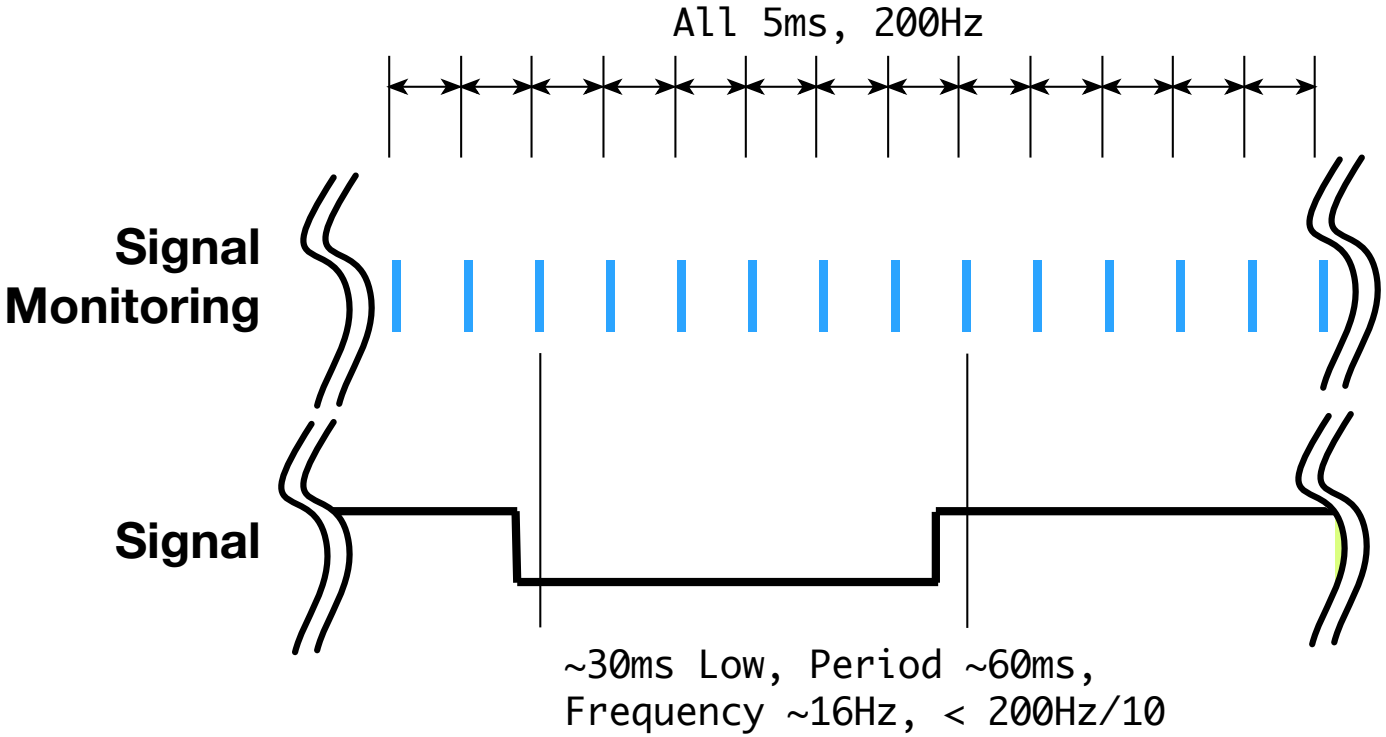
- Increment Time (typically 1ms = timer period)
- Determine if Any Task is Waiting for This Time
  - Possible Implementations
    - Linked List
    - Que
  - Check for a Time Match
- If a Match Exists
  - Increment the Semaphore for that Task
  - Transfer Control to Reschedules (goto)
- If no Match - Nothing to Change - RINT

# Interrupts and OS Support - Kernel Reschedule Code

- Check for any Critical Transitions (might be done in interrupt)
- Update Runnable/Waiting Status
- Determine Highest Priority Runnable Task
- Perform Task Swap if Necessary
  - Save Registers on Prior Task
  - Stack Information for Prior Task
  - Restore Resisters on New Task
  - Update/Modify Stack Information for New Task
- RINT

# Simple Monitoring of Digital Signals

- If Sampling Rate is >10x Event Rate - Easy to Poll
  - Would Support Debounce If Necessary
  - Would Support Other Software Processing



# Input Compare Interrupt with Digital Signals

- Input Compare Hardware Monitors Transitions in Signal
  - Generates Interrupt on Transition
  - Interrupt Performs *sem_post( & semInputCompare1)*

```
// Input Signal Interrupt
sem_post(&semInputCompare1);
goto(kernelReschedule);
```

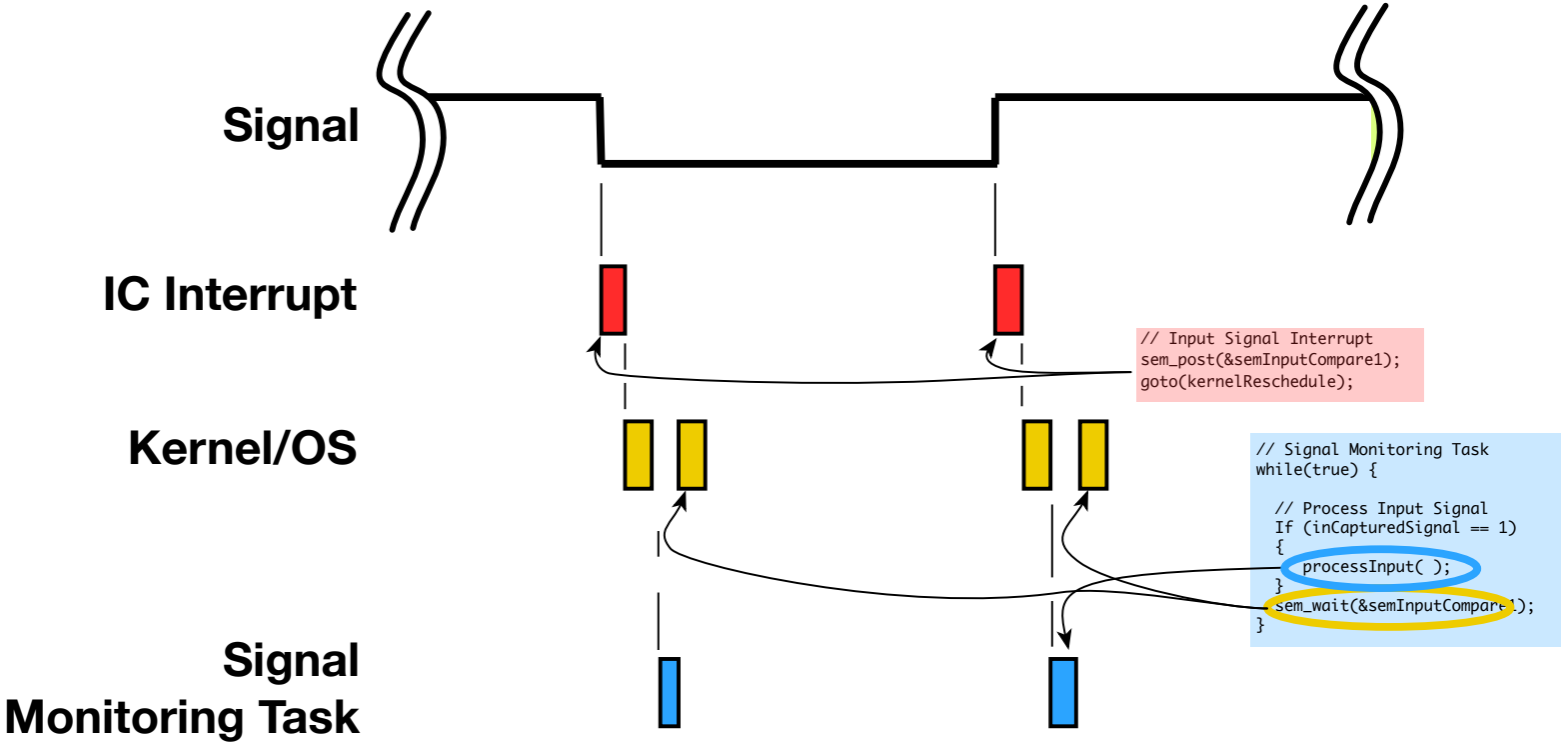
```
// Signal Monitoring Task
while(true) {

  // Process Input Signal
  If (inCapturedSignal == 1)
  {
    processInput( );
  }

  sem_wait(&semInputCompare1);
}
```

# Input Compare Interrupt with Digital Signals

- Input Compare Hardware Monitors Transitions in Signal
  - Generates Interrupt on Transition
  - Interrupt Performs *sem_post( & semInputCompare1)*



# Input Compare Interrupt with Digital Signals

- Interrupt Performs *sem_post( & semInputCompare1)* on Rising Edge Transitions Only

```
// Input Signal Interrupt
If (inCapturedSignal == 1)
{
  sem_post(&semInputCompare1);
  goto(kernelReschedule);
}
else
{
  asm(RINT);
}
```

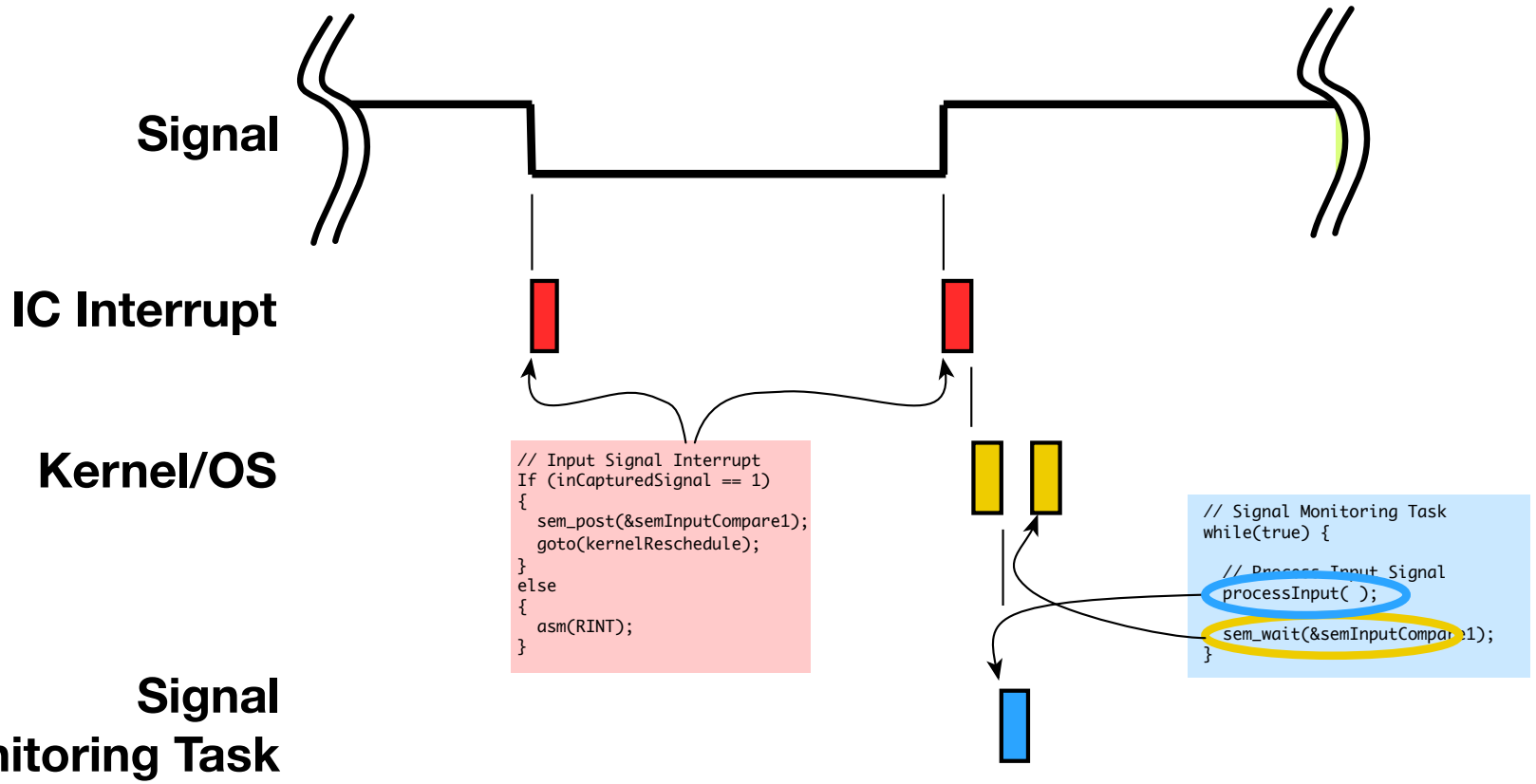
```
// Signal Monitoring Task
while(true) {

  // Process Input Signal
  processInput( );

  sem_wait(&semInputCompare1);
}
```

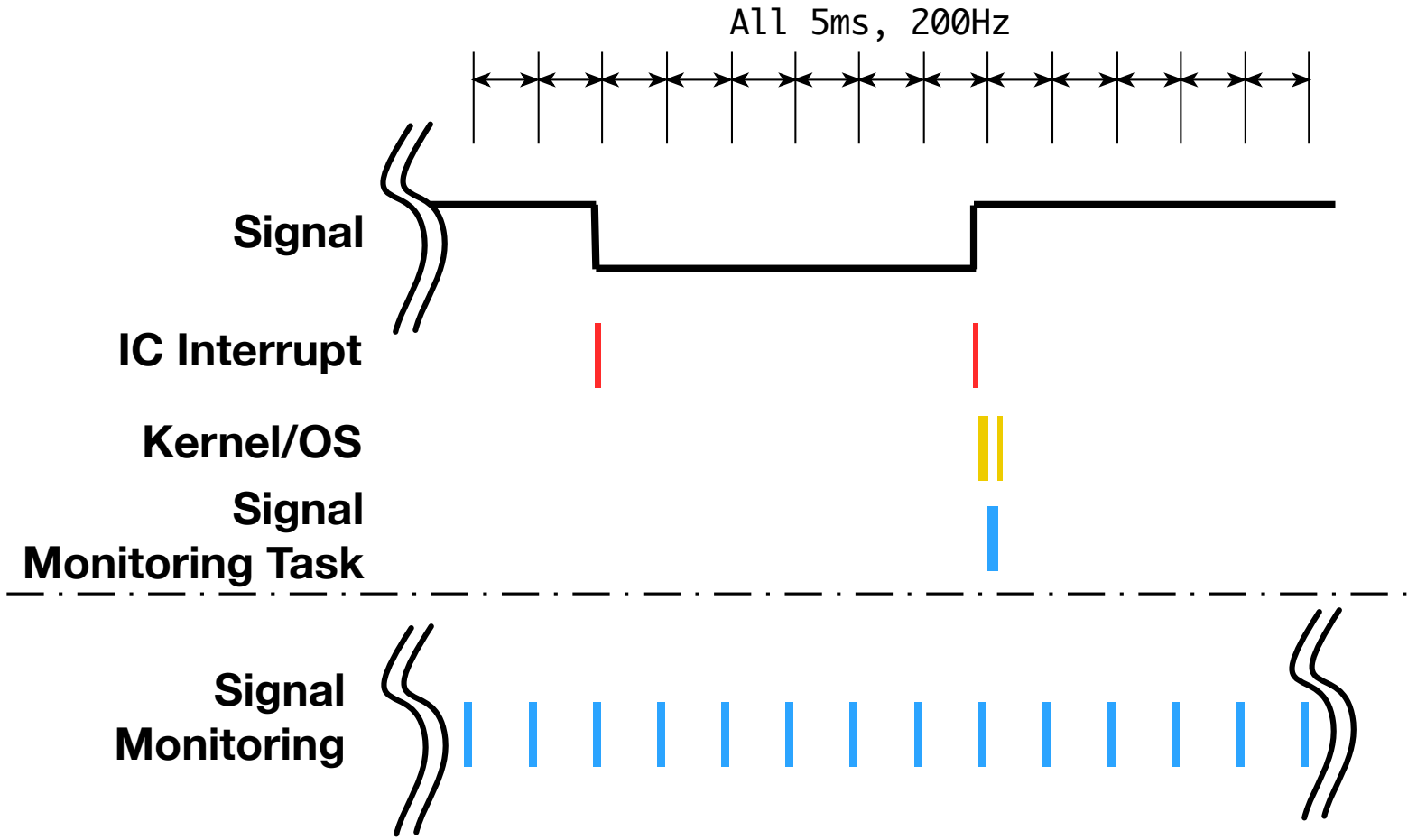
# Input Compare Interrupt with Digital Signals

- Interrupt Performs *sem_post( & semInputCompare1)* on Rising Edge Transitions Only



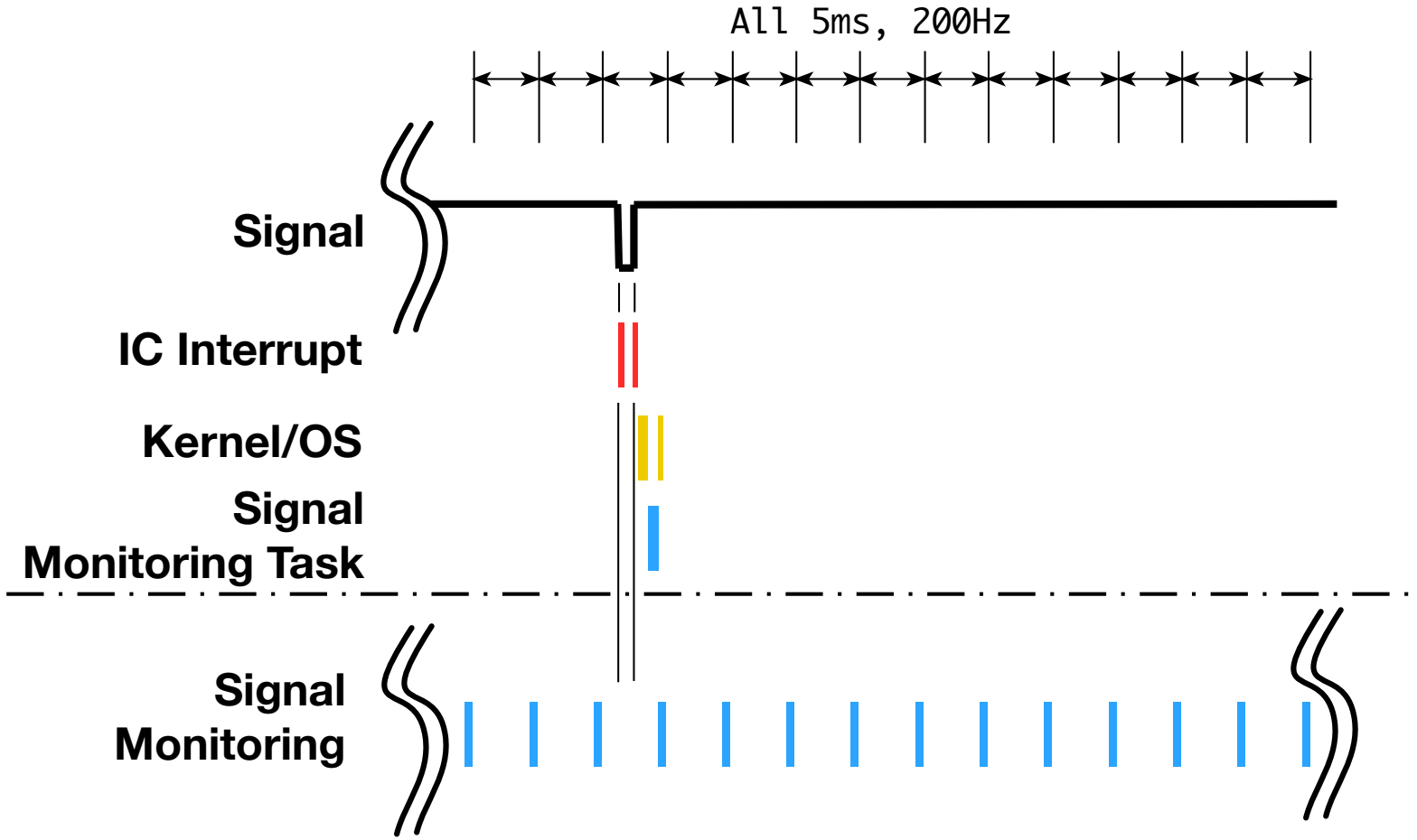
# Input Compare Interrupt with Digital Signals

- Interrupt Reduces Processing Load



# Input Compare Interrupt with Digital Signals

- Interrupt Increases Maximum Signal Frequency



# Lab #8 Preview

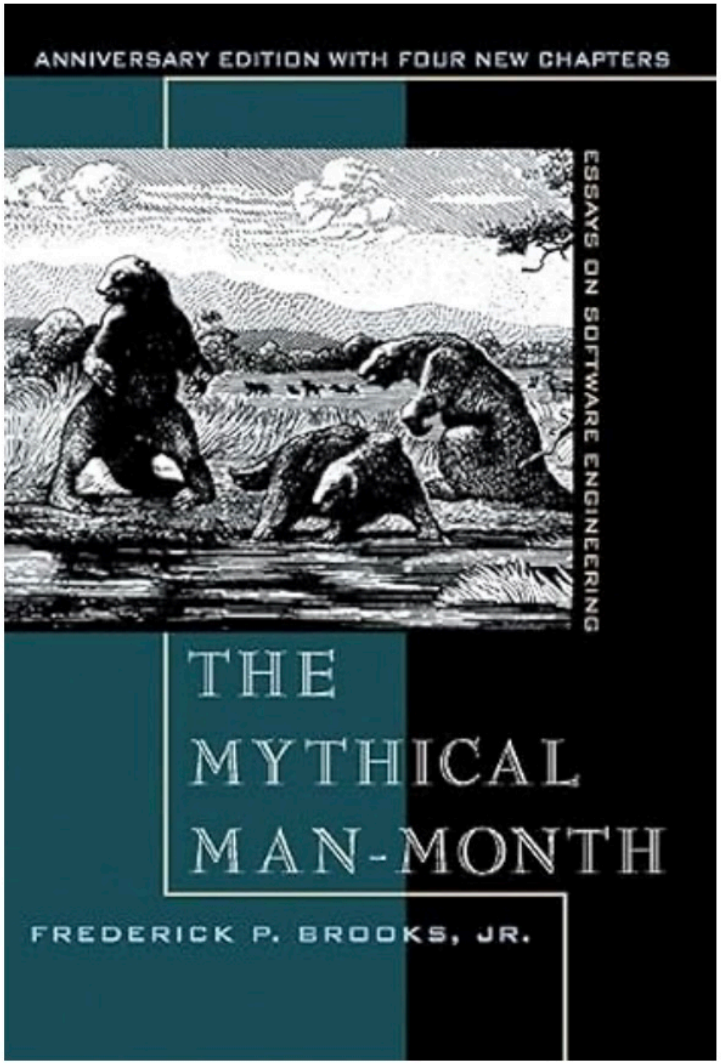
- Review New Transition Framework
- Incorporate New Transition Framework
- Goals for Lab (from Lab 7)
  - Read Digital Input (GPIO1, Connector 501-Pin 5, Processor RK4)
  - Drive LED to Match Digital Input
- Sampling Rate and Data Input Rate (from Lab 7)
  - Use Function Generator to Experiment

# Look Ahead

- Review of Reading
- Review of Lab 8
- Interrupts and OS Support - More User and IO Devices

# Assignment - Readings

- The Mythical Man Month
  - Chapter 20 & Epilog: *The Mythical Man Month* after 20 Years and the Epilogue.
  - Send Me Discussion Topics by 10:00 AM on Thursday, Oct. 24, 2024.



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# Action Items and Discussion

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