Pomona College

Computer Science

Fall 2024: CSCI 181RT

Real-Time Systems in the Real World

Lecture 8

Thursday, September 19, 2024
Edmunds Hall 105
2:45 PM - 4:00 PM

Professor Jennifer DesCombes

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Agenda

- Go Backs
- Discussion on Reading
- Lab Discussion
- Event Types and Hardware Support
- More Discussions of Tasks
- Assignment
- Look Ahead
- Action Items

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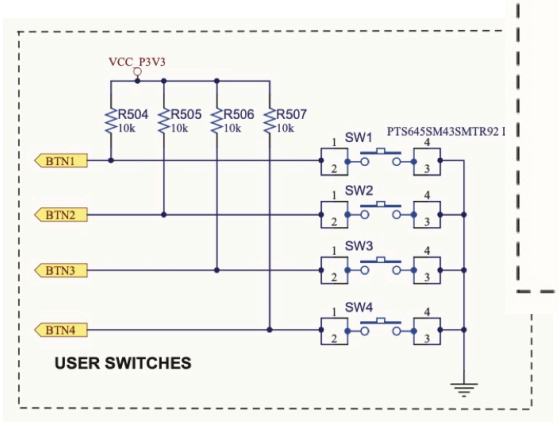
Go Backs

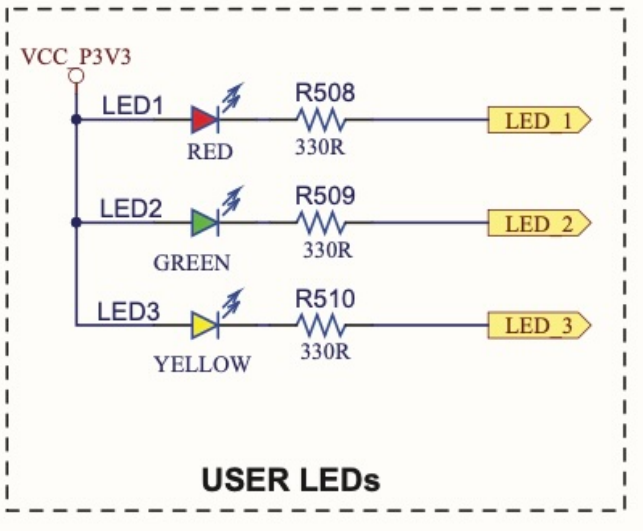
- General?
- Action Item Status
  - AI240910-2: Find recommended book on computer architecture.
  - AI240917-1: Purchase USB-C Adapters for Evaluation Boards - OK to Close?

Discussion on Reading - The Mythical Man Month

Lab Discussion

- Hardware Abstraction
  - Polarity - Low True? High True?
  - Code Simplification

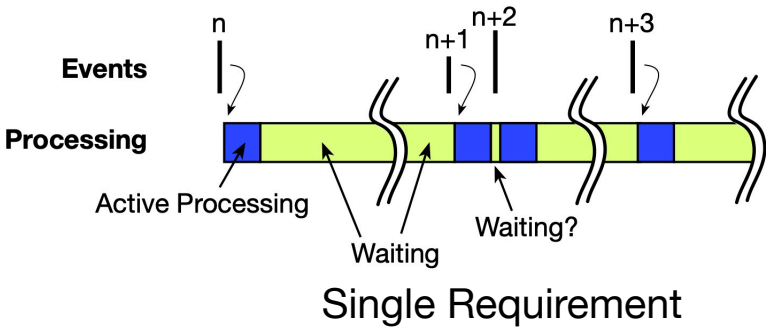


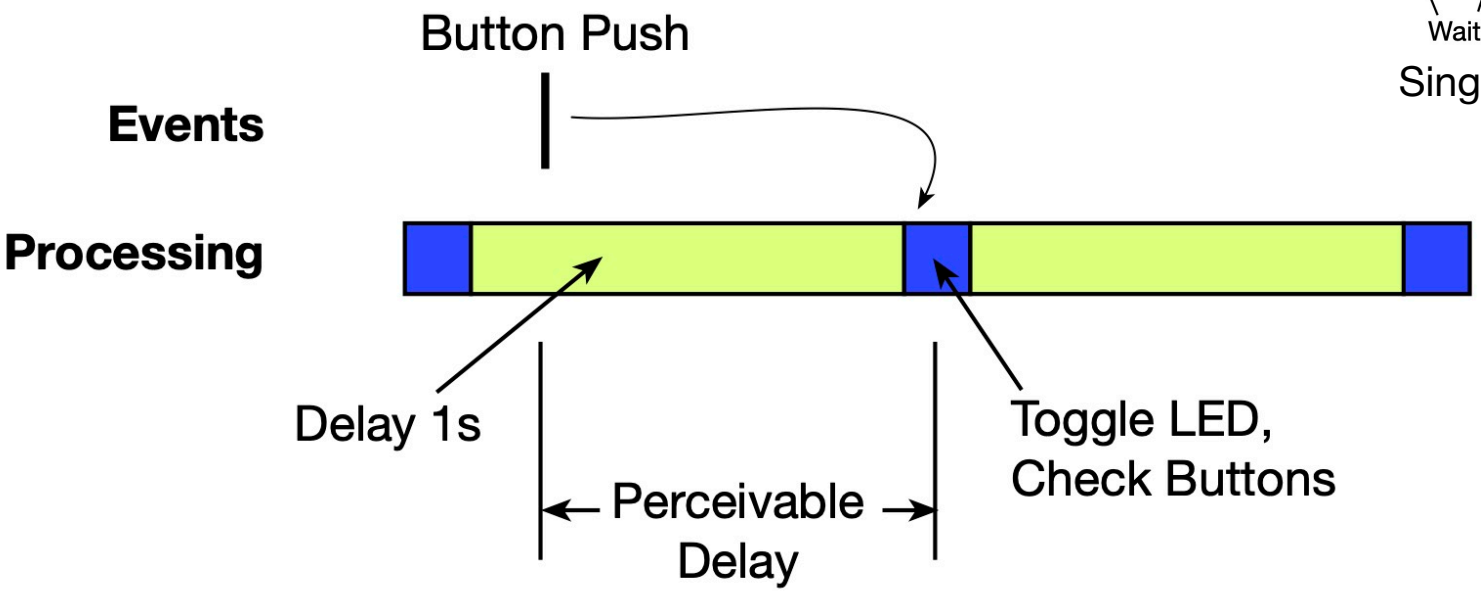



```
.
.
.

// Heartbeat LED Control

void myIOHeartbeatLEDOn(void);
{
    // LED is low true, set to
    // zero to turn on
    clearIOPin(LED_1);
}

void myIOHeartbeatLEDOff(void);
{
    // LED is low true, set to
    // high to turn off
    setIOPin(LED_1);
}

.
.
.
```

Lab Discussion

- System Tuning - Test Equipment (TE)
- Response Delays - Button Push to LED On / Off



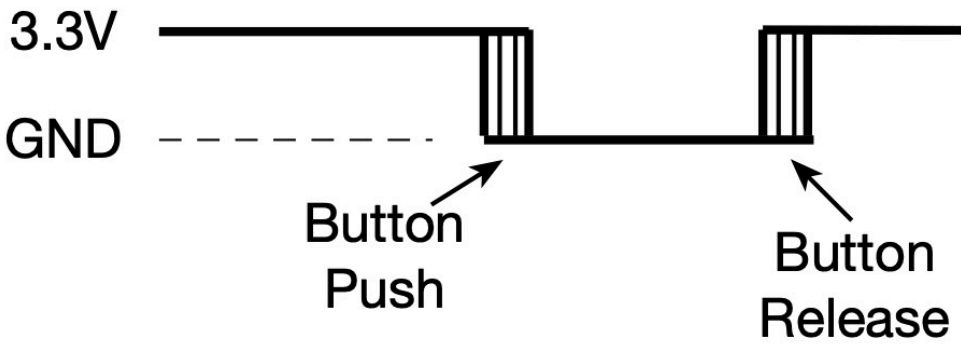


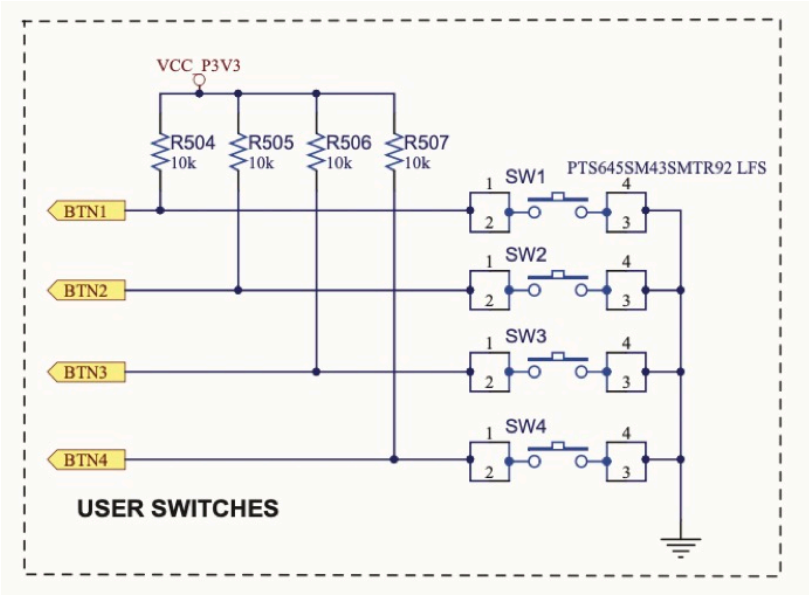
Event Types and Hardware Support

- Transient Events
- Latched Events
- Buffered Events

Event Types - Transient Events

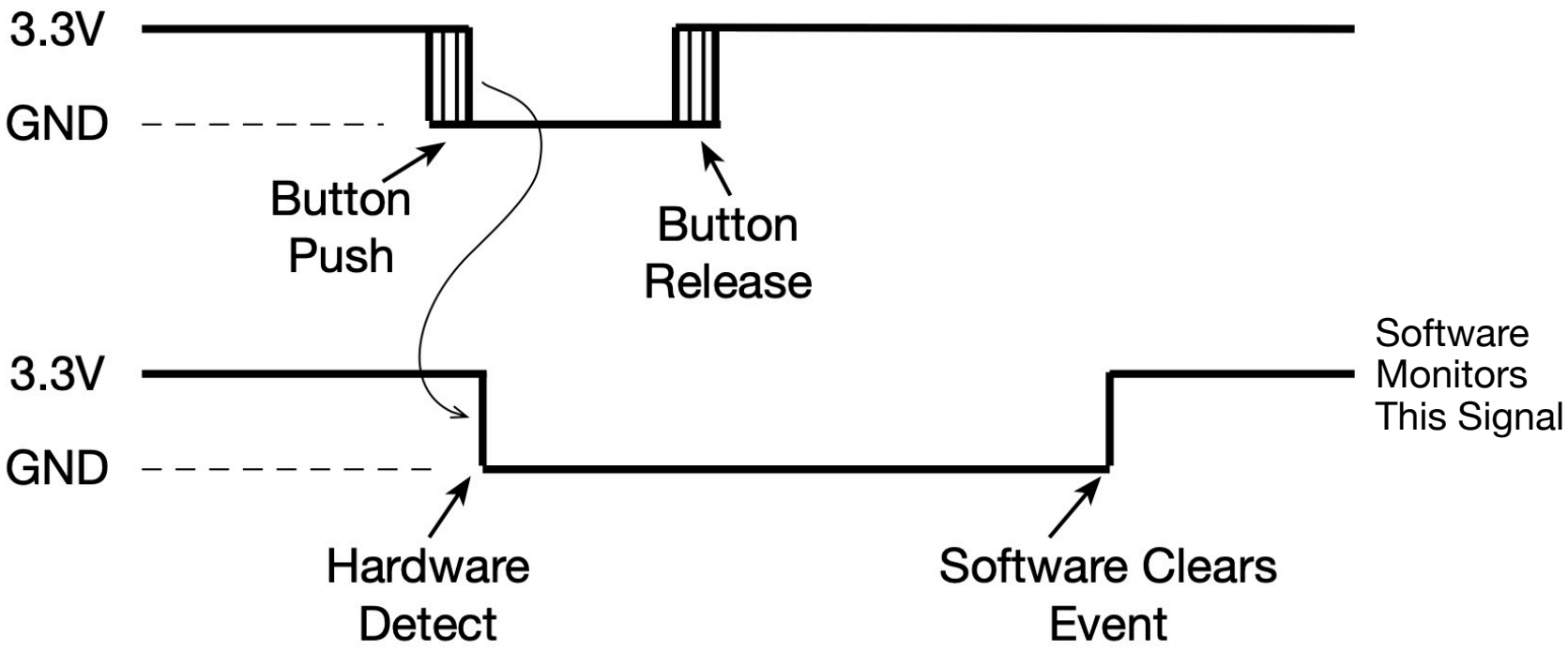
- Event Does Not Persist
- Need to Detect During Lifetime of the Event





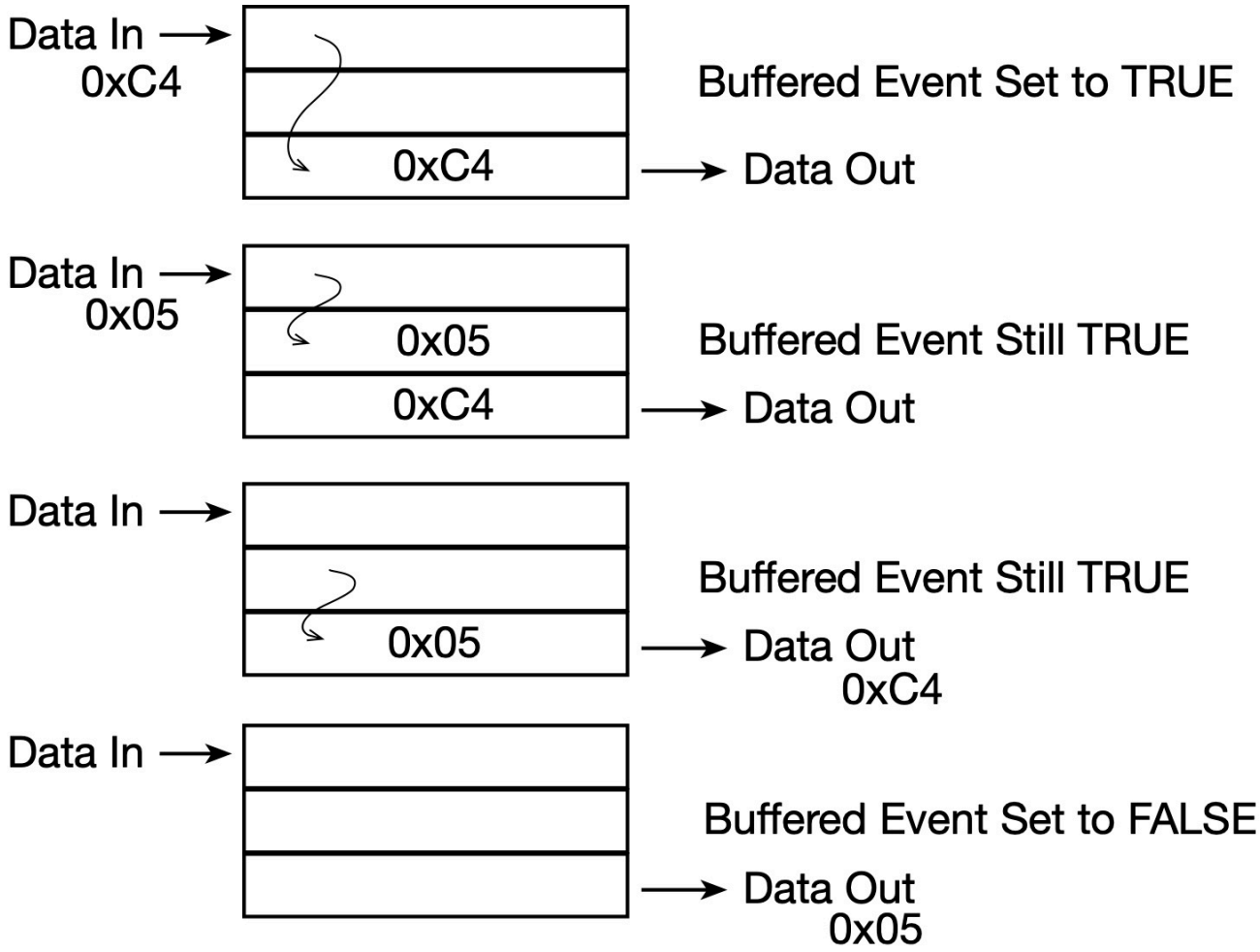
Event Types - Latched Events

- Hardware Support Required
- Software Must Clear Event



Event Types - Buffered Events

- Continue to Remove Data Until Buffer Empty
- Event Follows Buffer Status
- False = Empty



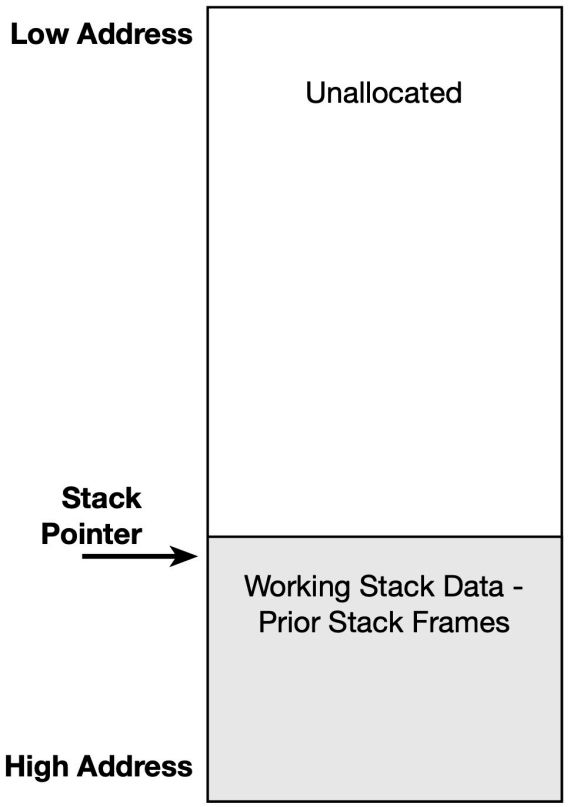
More Discussion on Tasks

- Why Create a Task
  - Perform Functions with Similar Timing Constraints / Periods
  - Perform Functions with Similar Functional Operations
  - Manage a Device, Especially a Shared IO Device
  - Resolve Complex System Timing and Priorities
- What Defines a Task
  - Endless Loop [while (true), do (forever), etc.]
  - Timing and Start / Stop Controlled by OS Calls and Events
  - Dedicated Memory Area - Stack / Heap Structure

What Defines a Task

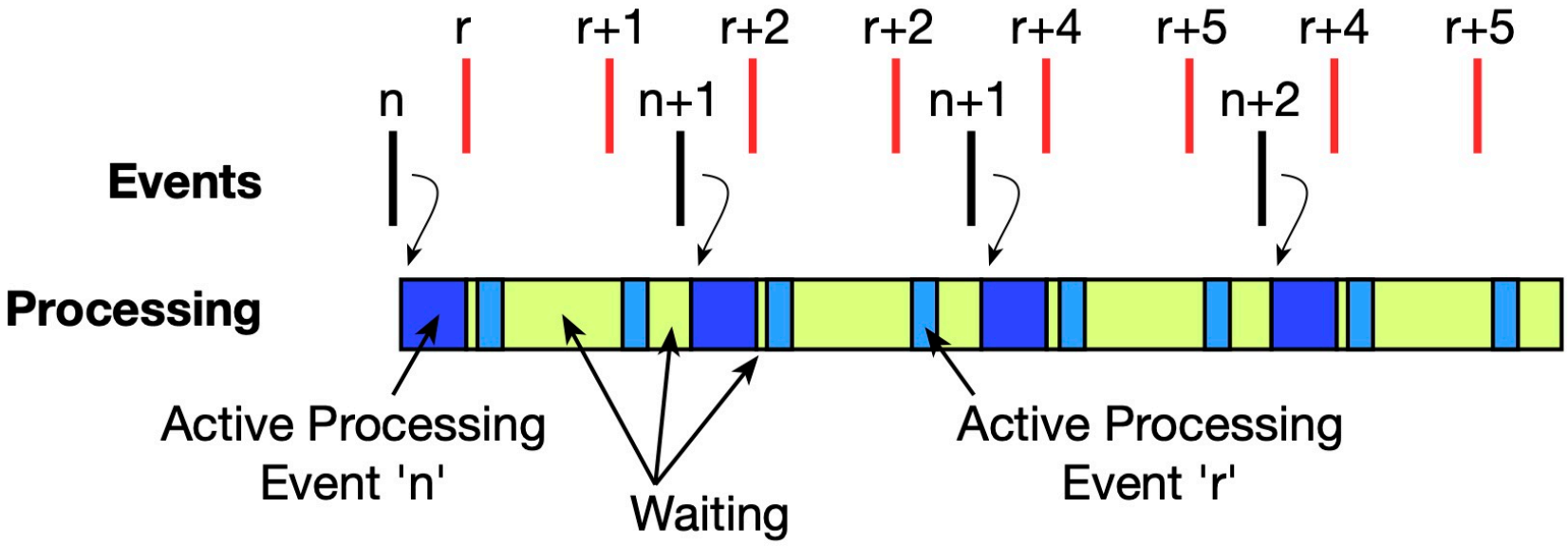
- Simple Low-priority Heartbeat Task

```
// Heartbeat task

#include myOSCalls;
#include myIOAbstraction;

#define true 1

while(true) {

    // turn on and off heartbeat
    // LED at a half-second rate
    myIOHeartbeatLEDOn();
    myOSSleepms(1000);
    myIOHeartbeatLEDOff();
    myOSSleepms(1000);

}
```



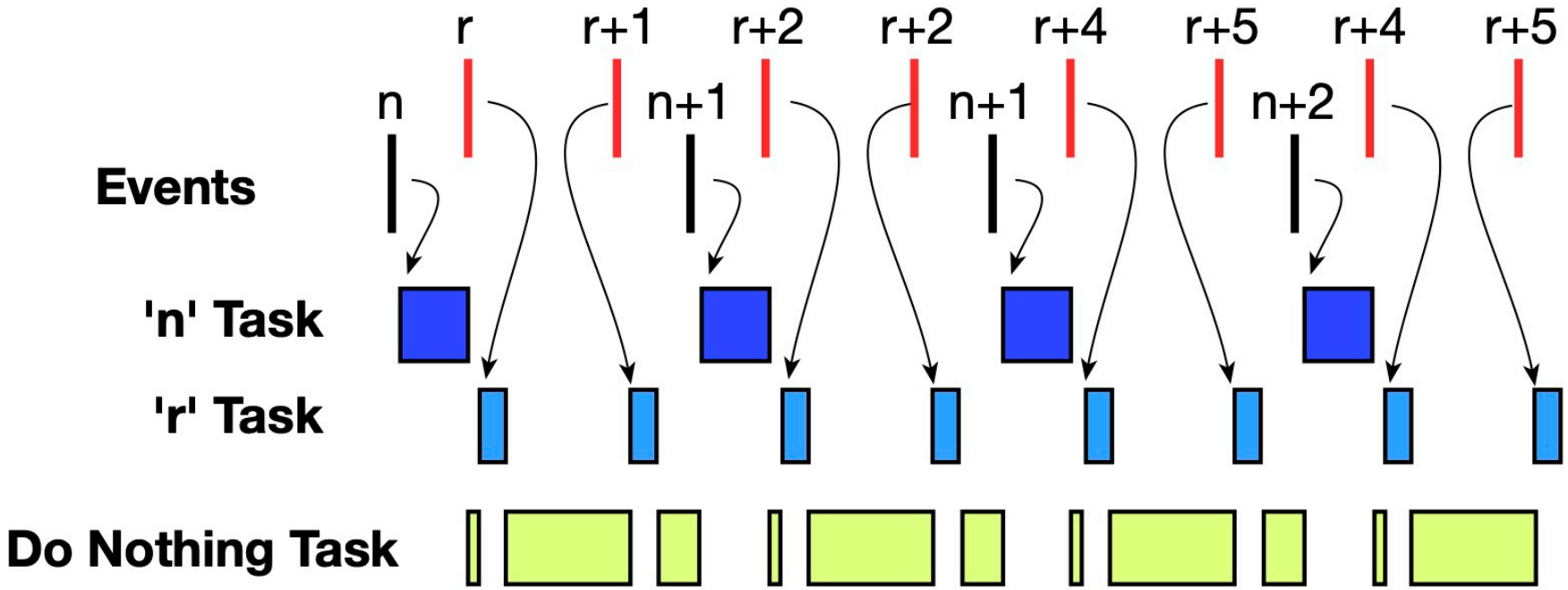
Processing - Multi-synchronous

- Repetition at a Variable Rates
- Repetition of More Than One Group of Events at Different Rates
- Events and Processing May be Locked to Each Other
- Events and Processing May be Locked to Multiple Events



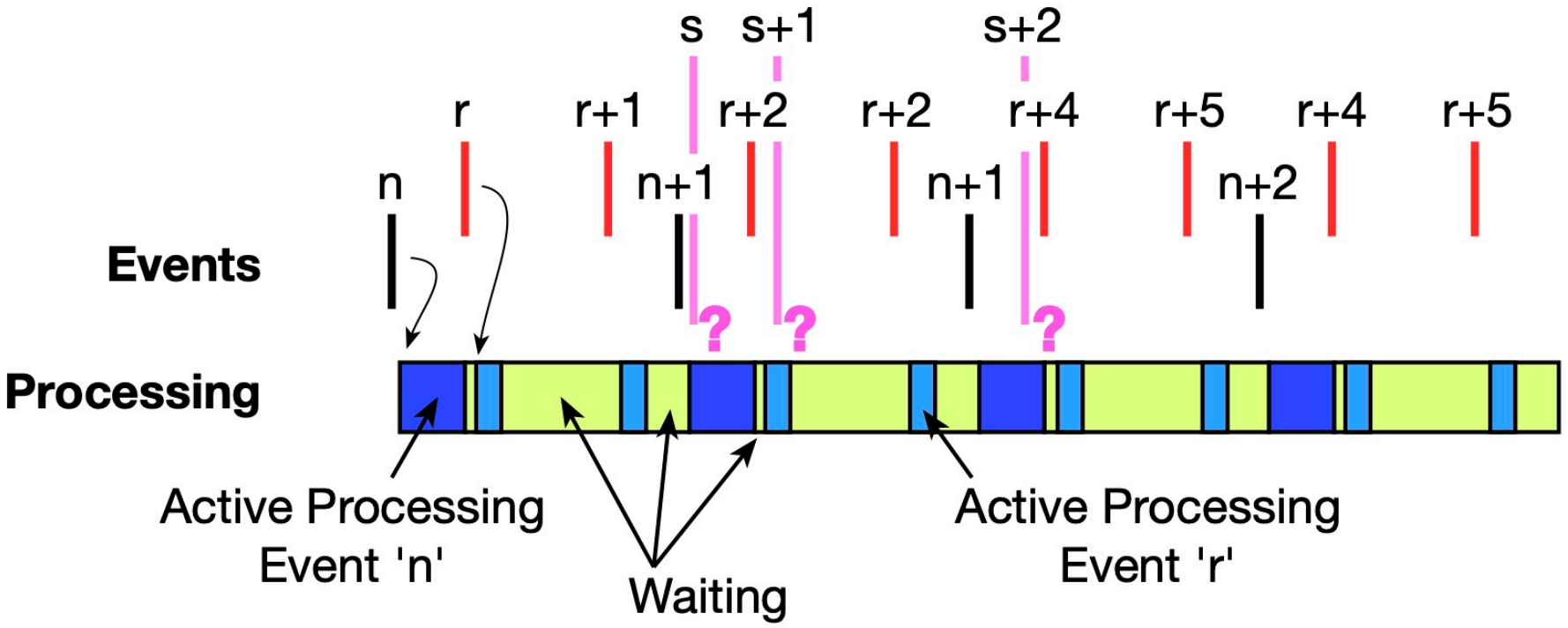
Task Option - Multi-synchronous

- OS Detects Events
- OS Starts Tasks Based on Events That Have Occurred



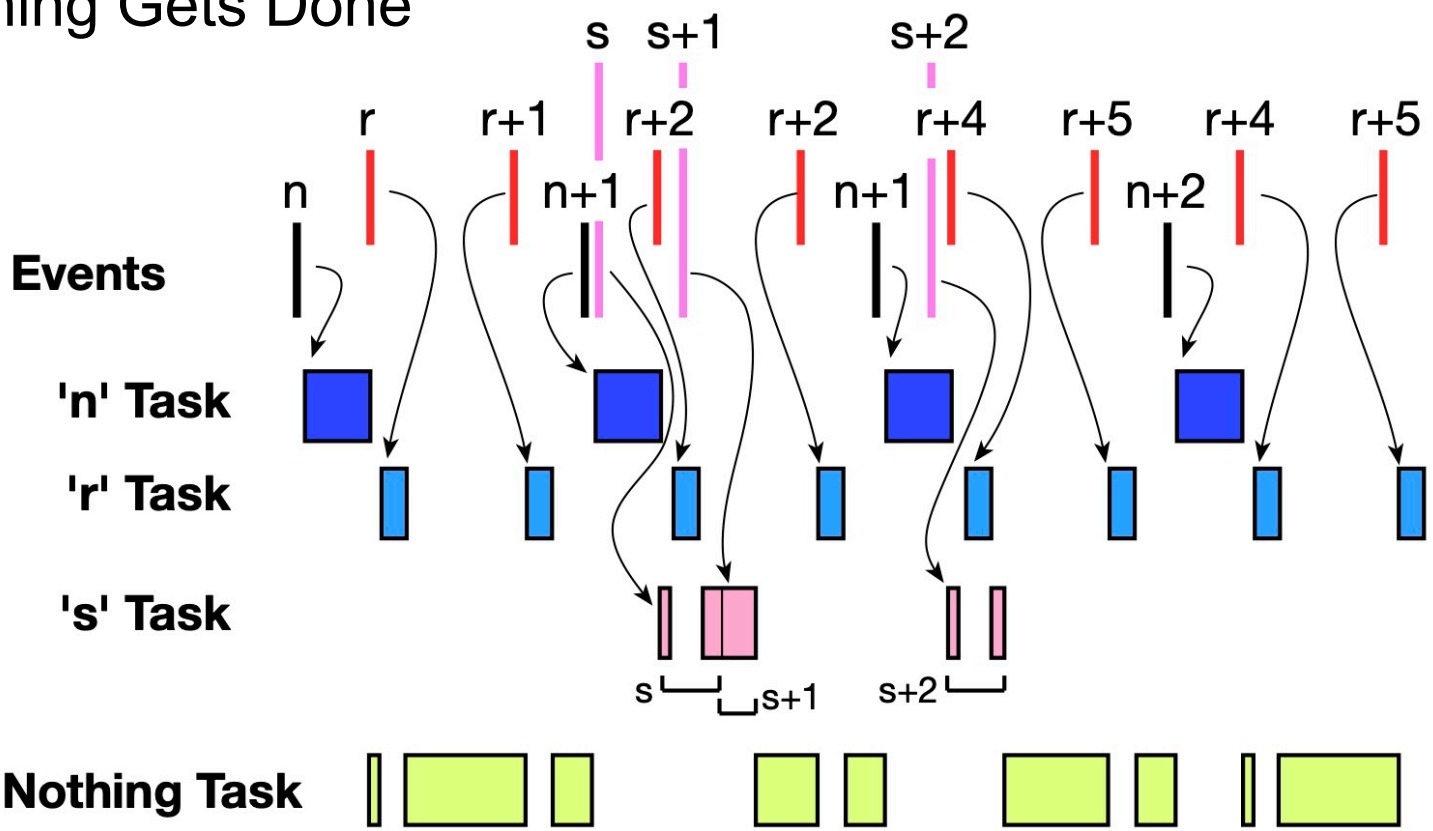
Processing - Fully Mixed

- Everything at Once
- Issues?



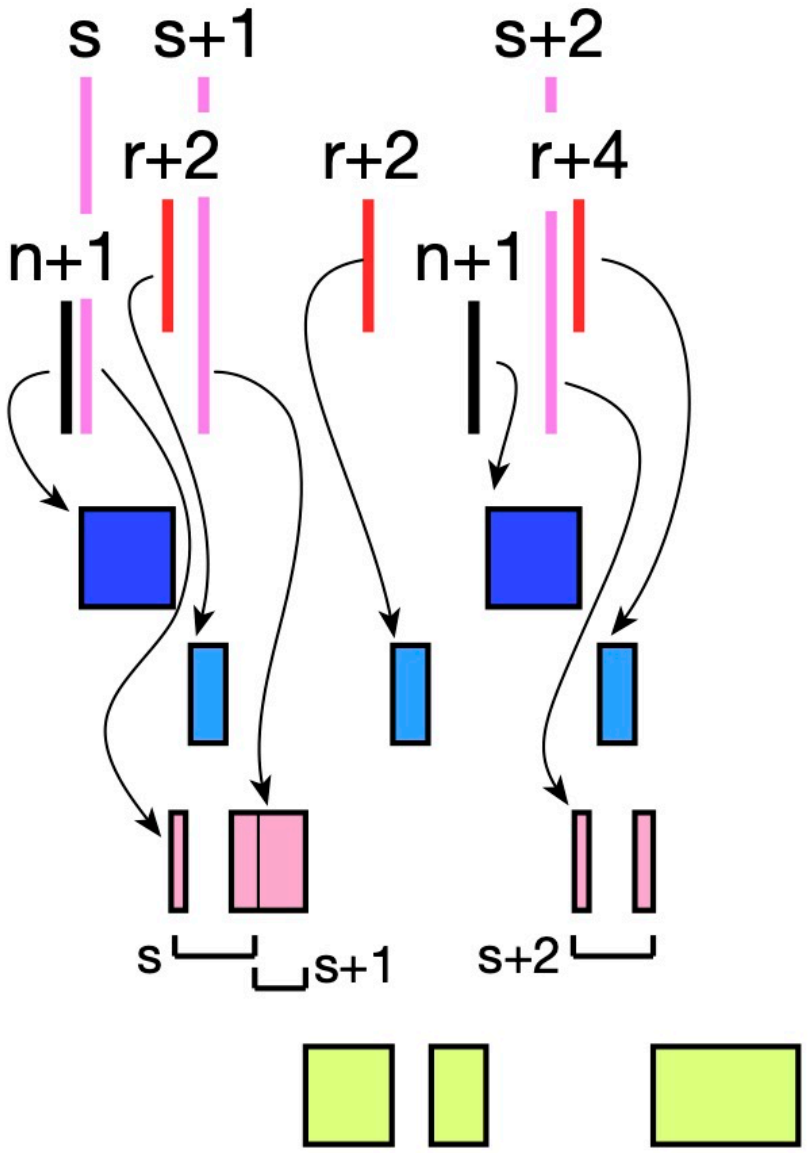
Task Option - Fully Mixed

- OS Can Suspend Tasks Based On Priority
- Everything Gets Done



Task Option - Fully Mixed

- 'n' And 'r' Tasks May Have Same Priority
- 's' Task Has Lowest Priority
- 's' Task Only Executes When 'n' And 'r' Tasks Have Nothing To Do
- Processing of Events 's' and 's+2' Are Suspended During the Event Processing
- Processing of Event 's+1' Occurs Immediately After Processing of Event 's'

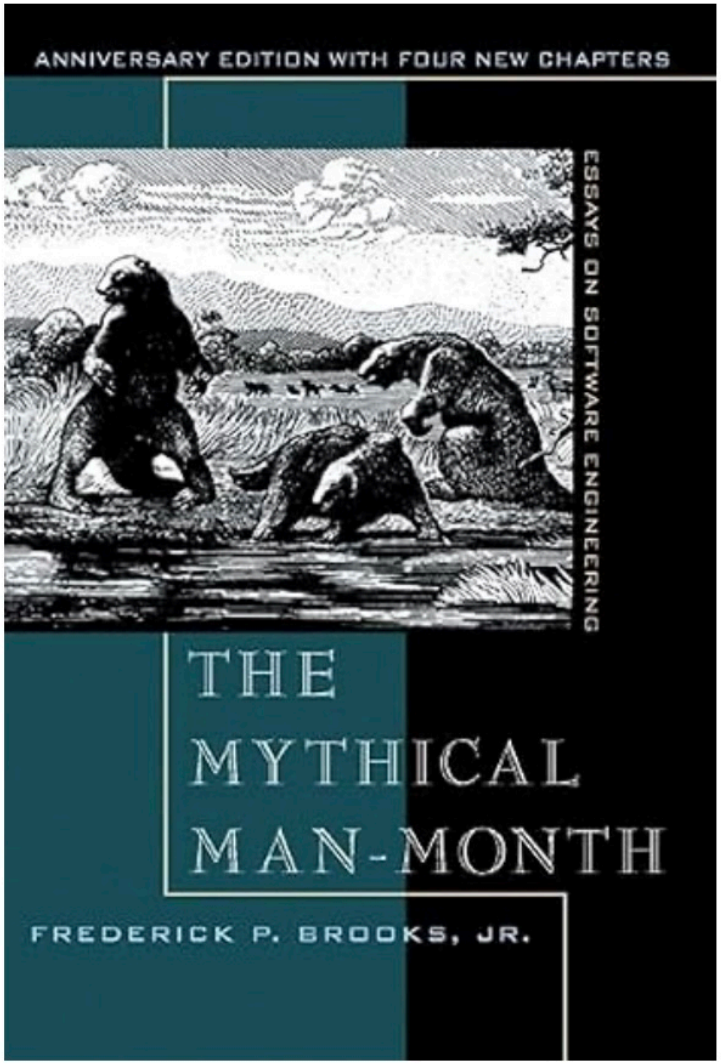


Initial Discussions of Semaphores

- The semaphore concept was invented by Dutch computer scientist **Edsger Dijkstra** in 1962 or 1963, when Dijkstra and his team were developing an operating system for the Electrologica X8. That system eventually became known as the *THE multiprogramming system*.
- Counting semaphores are equipped with two operations, historically denoted as P and V. Operation V increments the semaphore *S*, and operation P decrements it.

Assignment - Readings

- The Mythical Man Month
  - Chapter 2: The Mythical Man-month
- Send Me Discussion Topics by 10:00 on Tuesday, Sep. 24, 2024.



Look Ahead

- Review of Reading
- More Discussions Semaphores and OS Control
- Discussion of Lab 4

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Action Items and Discussion

AI#:	Owner	Slide #	Document	Action