Fall 2024: CSCI 181RT

Real-Time Systems in the Real World

Lecture 6

Thursday, September 12, 2024
Edmunds Hall 105
2:45 PM - 4:00 PM

Professor Jennifer DesCombes

Agenda

- Go Backs
- Discussion on Reading
- Discussion on Lab
- Quick Review of Interrupts
- More on Interrupts
- Assignment
- Look Ahead
- Action Items

Go Backs

- General?

- Action Item Status

    - AI240905-1: Add slides about basic computer architecture - OK to Close?

    - AI240905-2: Add slides about microcode - OK to Close?

    - AI240910-1: Collect additional reading questions for Thursday Lecture - OK to Close?

    - AI240910-2: Find recommended book on computer architecture.

Discussion on Reading

- K & R
  - General Questions?
- CU Charts on Stack Operations

Discussion on Lab

- Some Software Up and Running
- Applications Mostly Up and Running - Yea!!
- Debug Connection is Operational (Board Detected)
- Satisfactory Starting Software from Microchip?
- Other Comments?
- Things to Improve?

Initial Investigation of Interrupts - Review

- Complexity - Next Level Up from Simple Polling
- Respond to Internal or External Events
  - Internal - Timers, Fault Conditions
  - External - Logic Inputs, Ports, Input Compare, Input Count
- How Do I Stop?
- How Do I Start?
- Hardware and Toolset Awareness

More on Interrupts

- Terms
- Single Interrupt Stack
- Multiple Nested Interrupts
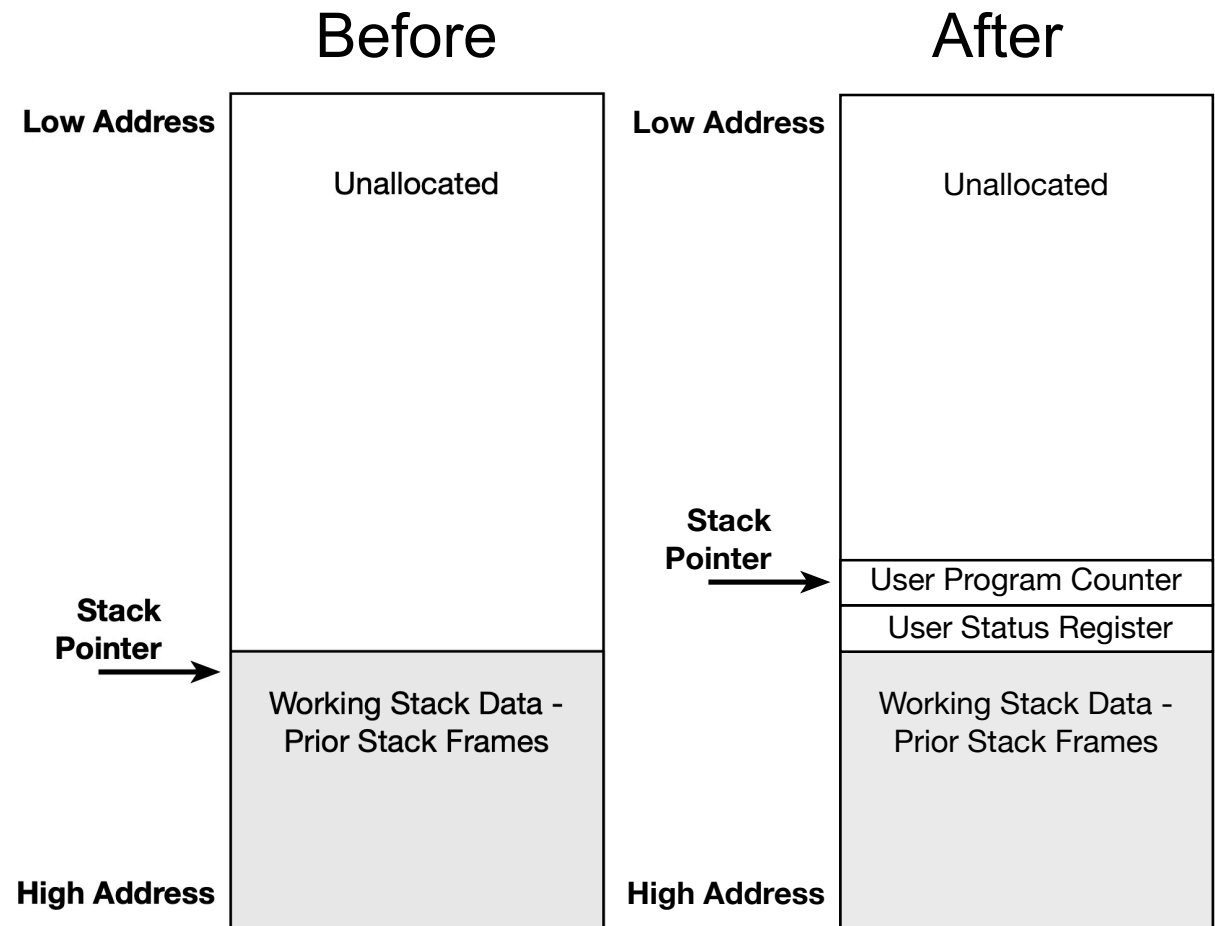- Nested Stack Frames
  - User Space
  - Supervisor Space
- So What?

Interrupts - Terms and Definitions

- User Space, User Mode, Others…
- Supervisor Space, Supervisor Mode, Others…
- PUSH - Predecrement and Move Data onto Stack
  - Preincrement
  - Postincrement
  - Postdecrement
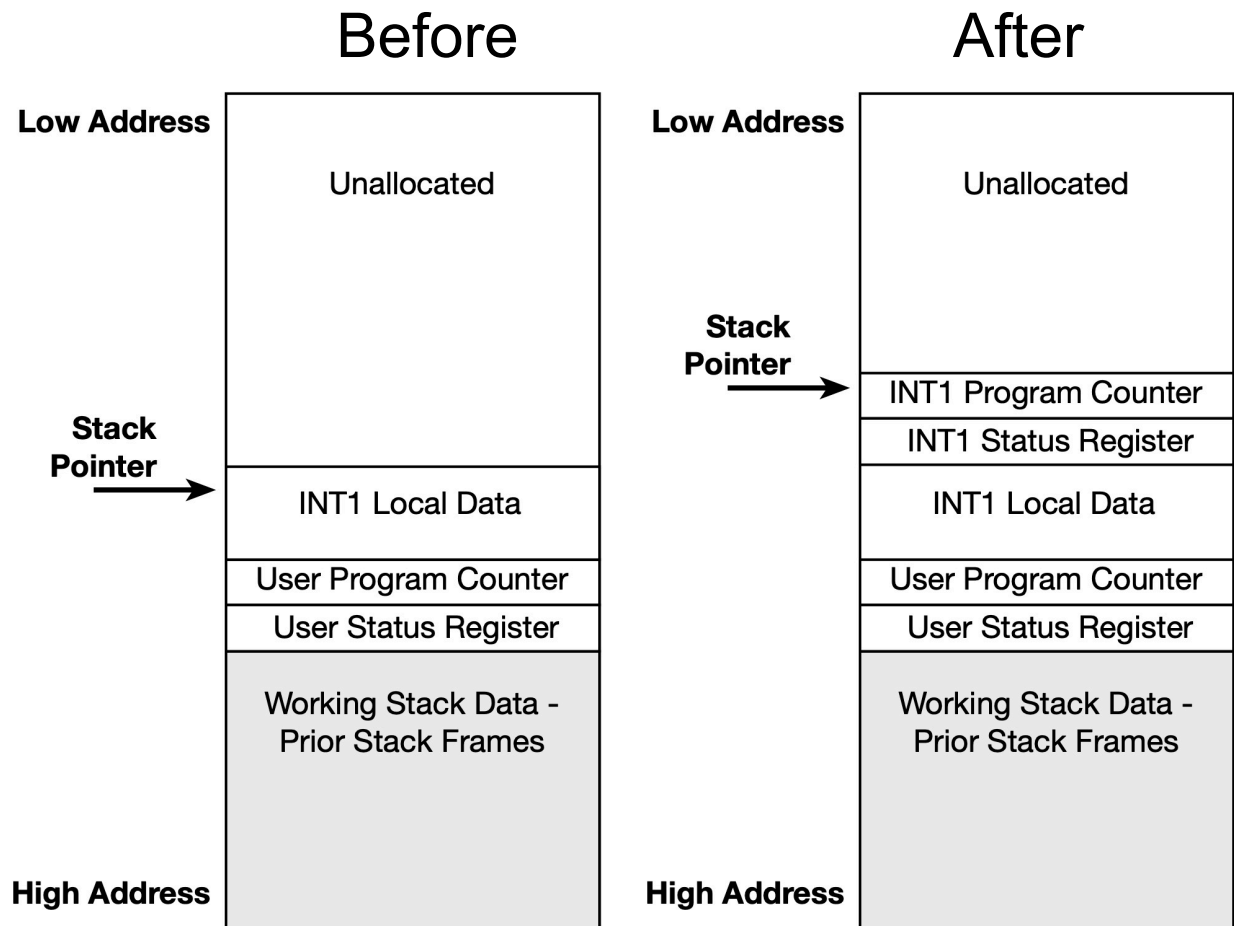- POP - Move Data off of Stack and Postincrement

Interrupts - Single Interrupt Stack Frame

- PUSH SR

- PUSH Program Counter

- User Mode Code is Now Interrupted by INT1, Which is Now Running

- INT1 Local Data Routine Data Can Be Placed On Stack

Before

Low Address

Unallocated

Stack Pointer →

Working Stack Data - Prior Stack Frames

High Address

After

Low Address

Unallocated

Stack Pointer →

User Program Counter

User Status Register

Working Stack Data - Prior Stack Frames

High Address

Interrupts - Multiple Nested Stack Frames

- PUSH INT1 SR
- PUSH INT1 Program Counter
- Note INT1 Local Data Storage Space on Stack
- INT1 is Now Interrupted by INT2, Which is Now Running

Before

Low Address

Unallocated

Stack Pointer →

INT1 Local Data
User Program Counter
User Status Register
Working Stack Data - Prior Stack Frames

High Address

After

Low Address

Unallocated

Stack Pointer →

INT1 Program Counter
INT1 Status Register
INT1 Local Data
User Program Counter
User Status Register
Working Stack Data - Prior Stack Frames

High Address

# Interrupts - Unwinding and Returning (RINT)

- Use POP to Restore PC and SR
- Compliler Knows How Much Local Data to Purge
- Determine User Mode, from SR, to End Interrupt Processing
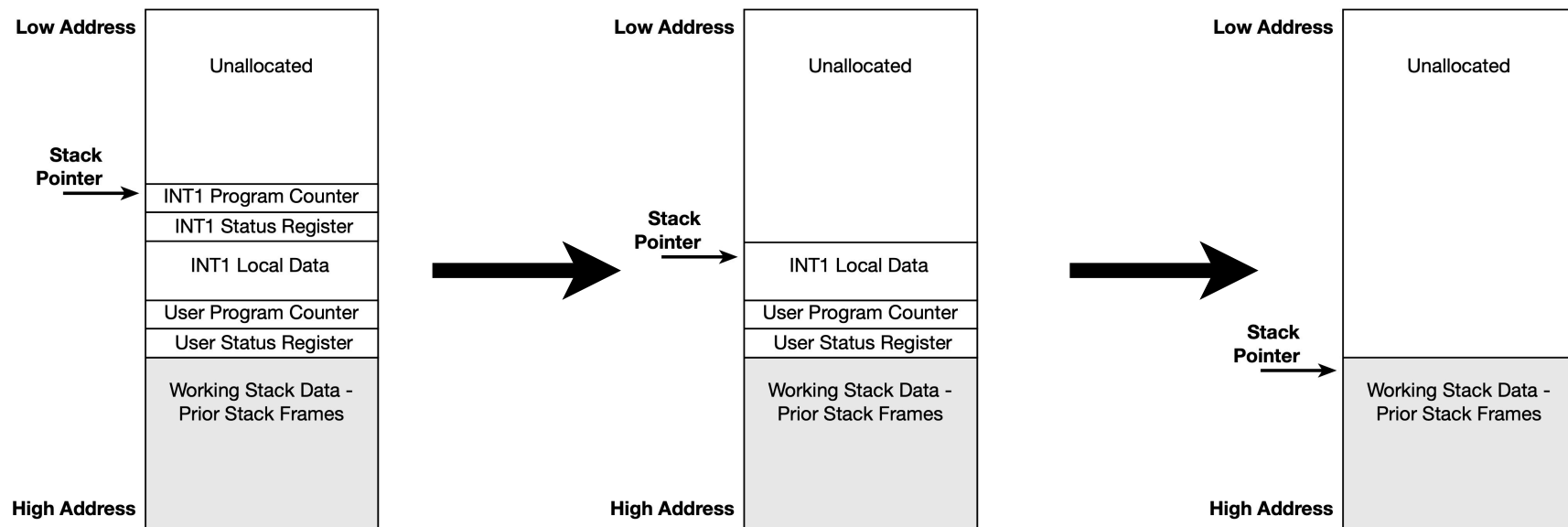
Interrupts - Use of SR to Detect User Mode

2.1.3 Status Register

The status register (SR),contains the interrupt mask (eight levels available) and the following condition codes: overflow (V), zero (Z), negative (N), carry (C), and extend (X). Additional status bits indicate that the processor is in the trace (T) mode and/or in the supervisor (S) state (see Figure 2-4). Bits 5, 6, 7, 11, 12, and 14 are undefined and reserved for future expansion
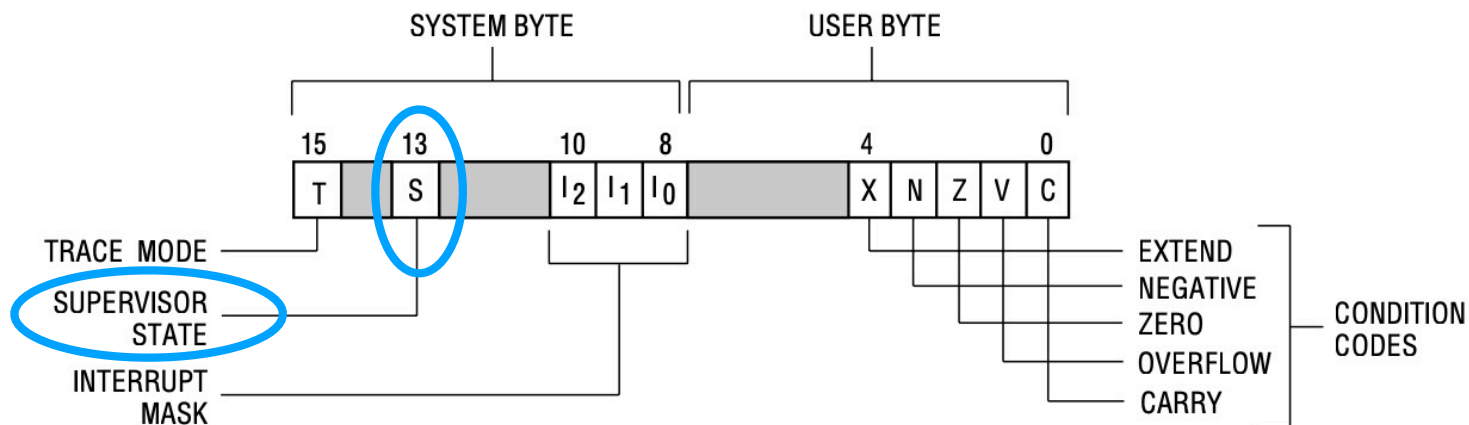
Interrupts - Variations In Stack Processing

- Various Systems Will Implement Different Techniques
- Single Stack, Supervisor Mode Stack, Multiple Stacks
- Takeaway - They Are All Using The Same Concept
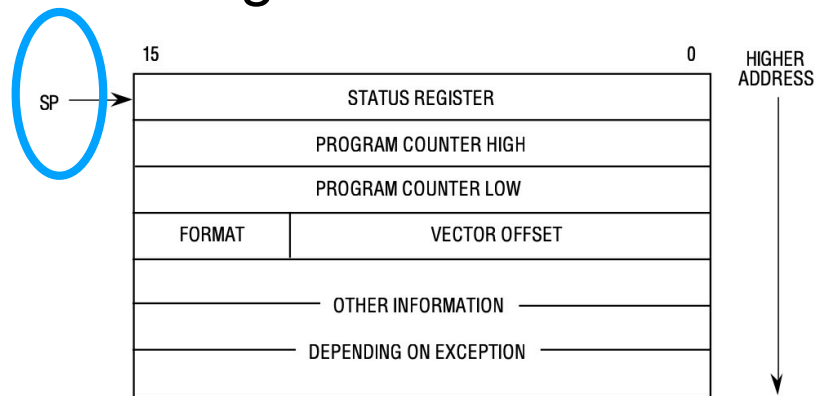
Single Stack Pointer

Figure 6-6. MC68010 Stack Frame
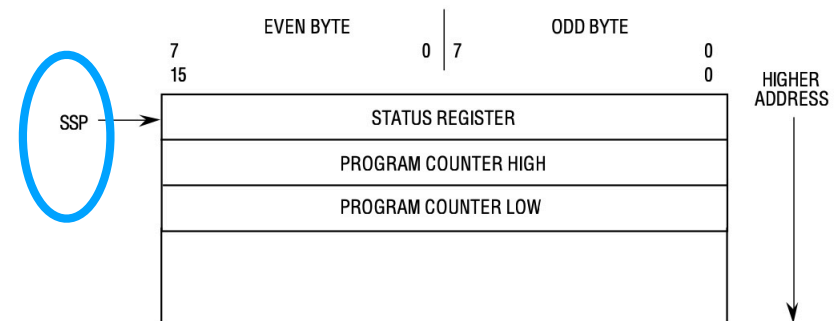
Supervisor Stack Pointer

Figure 6-5. Group 1 and 2 Exception Stack Frame
(MC68000, MC68HC000, MC68HC001, MC68EC000, and MC68008)

Interrupts - So What?

- Interrupts Interrupt, Process, and End
- Users Code is Interrupted, and Then Resumes
- Determining Transition from Supervisor to User is Critical
  - Interrupts Denote State Changes - Something Happend
  - Is the Proper Task Now Running?
  - Is that Important?

Assignment - Readings

- The Mythical Man Month
  - All Introcductions and Forwards
  - Chapter 1: The Tar Pit
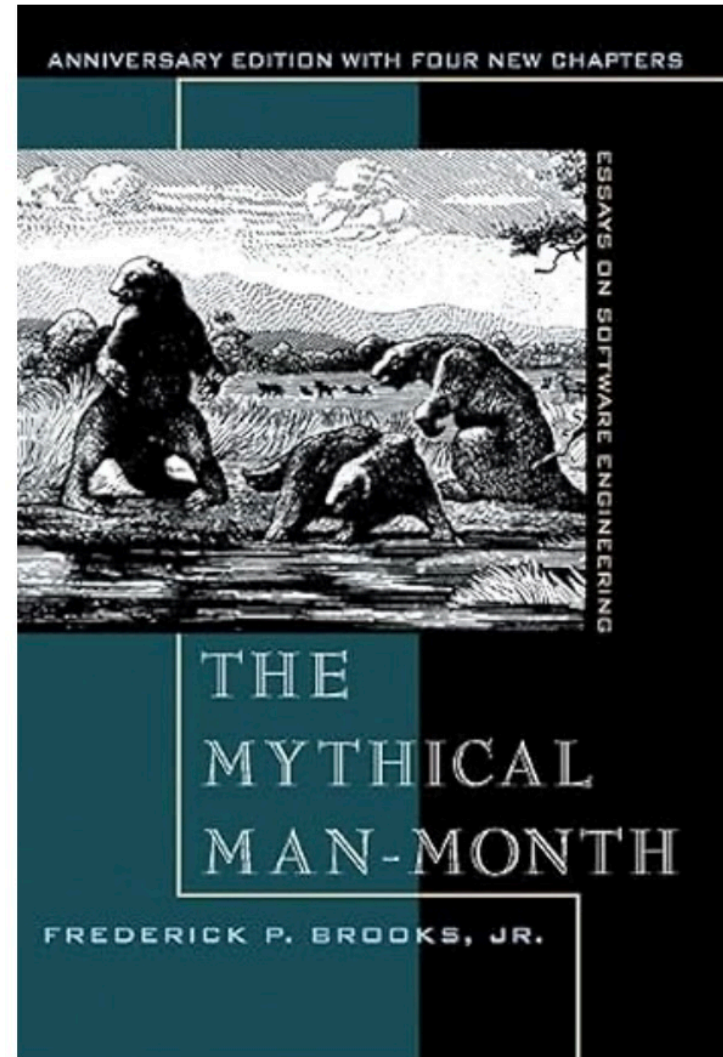
Look Ahead

- Review of Reading
- Initial Discussions of Task Design
- Lab 3 Preparation

Action Items and Discussion

AI#:	Owner	Slide #	Document	Action