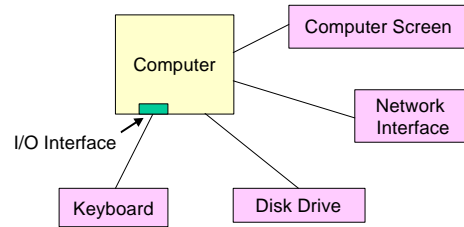


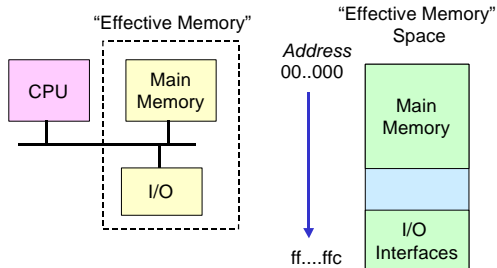
## Input/Output (I/O)

- What is I/O?
- Waiting Loop
- Exceptions, or Interrupts
  - Hardware interrupt
  - Software interrupt
  - Application: Hurricane detector
  - Application: Time sharing

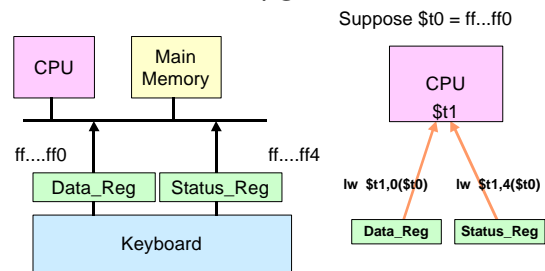
## I/O



## I/O



## I/O



## Waiting Loop

ff...ff0

Data\_Reg

ff...ff4

Status\_Reg

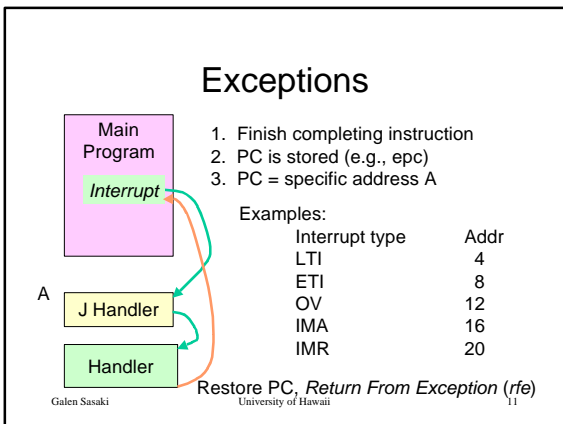
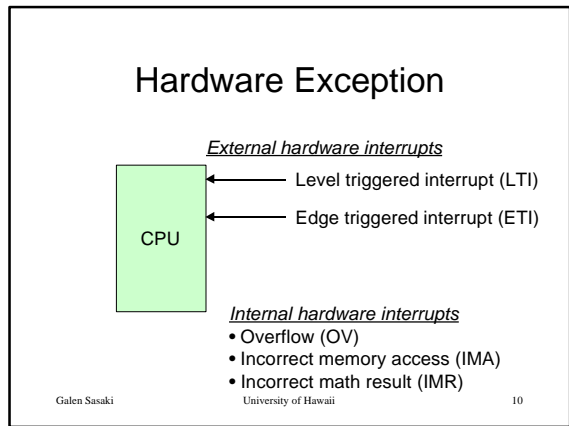
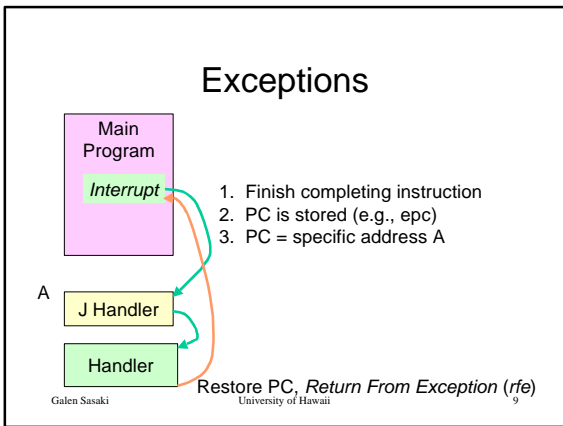
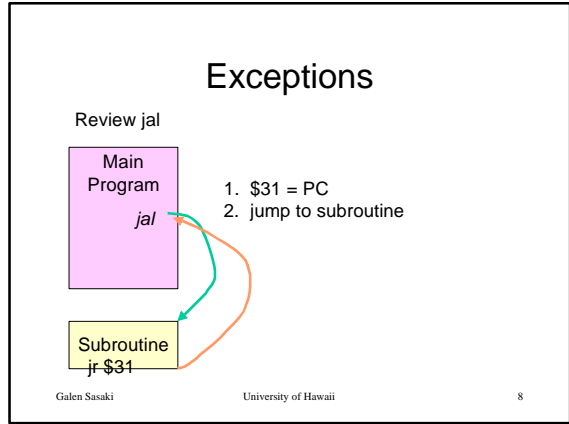
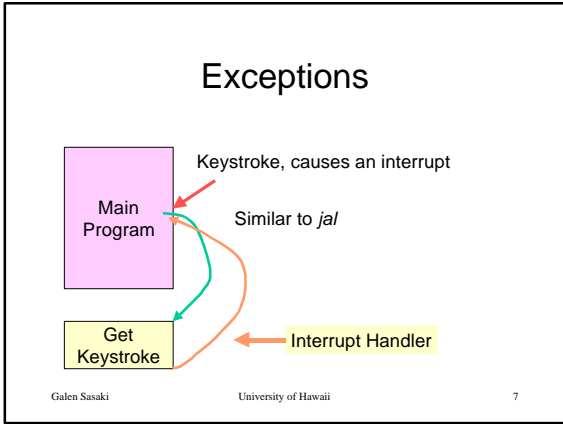
RDY bit (bit 0)  
= 1 if Data\_Reg has new byte  
= 0 otherwise

```
# Loads $t1 with next key stroke
waiting_lp:
    load $t1 with mem cell ff...ff4
    $t1 = $t1 & 1
    if $t1 = 0 then goto waiting_lp
    load $t1 with mem cell ff...ff0
```

Wastes CPU cycles while waiting

## Exceptions

- Do your usual processing BUT when the keyboard is pressed then go get the keystroke. Then resume the usual processing

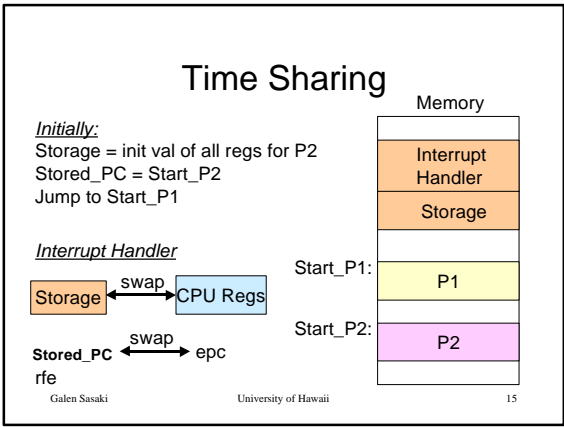
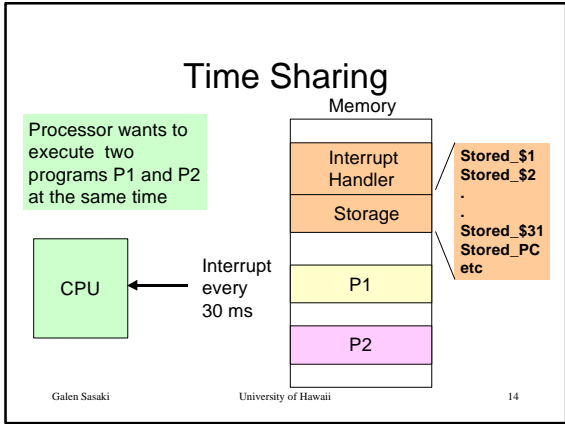
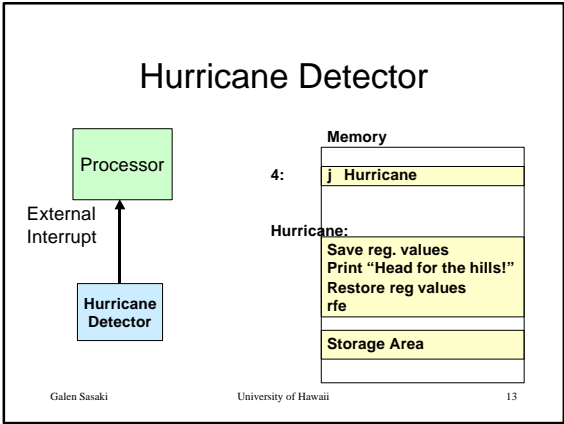


### Exceptions

**Memory**

| Addr | Contents               |
|------|------------------------|
| 0    | <i>j</i> Reset_Routine |
| 4    | <i>j</i> Handler_LTI   |
| 8    | <i>j</i> Handler_ETI   |
| 12   | <i>j</i> Handler_OV    |
| 16   | <i>j</i> Handler_IMA   |
| 20   | <i>j</i> Handler_IMR   |

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- ### Software Exception
- Special instructions, when executed then an interrupt occurs
  - Graceful way of moving from user status to supervisor status
    - User status: instructions are executed but restrictions
    - Supervisor status: no restrictions
  - Application: used in debuggers such as for breakpoints
- Galen Sasaki
University of Hawaii
16