CS 240 Spring 2020
Foundations of Computer Systems
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Exceptional Control Flow

Hardware support for reacting to the rest of the world.

Control Flow

Processor: read instruction, execute it, go to next instruction, repeat

Physical control flow

time

<startup>
$inst_1$
$inst_2$
$inst_3$
…
$inst_n$
<shutdown>

Explicit changes:

Exceptional changes:

Exceptions

Synchronous: caused by instruction

Traps: system calls

Faults: unintentional, maybe recoverable

Aborts: unintentional, unrecoverable

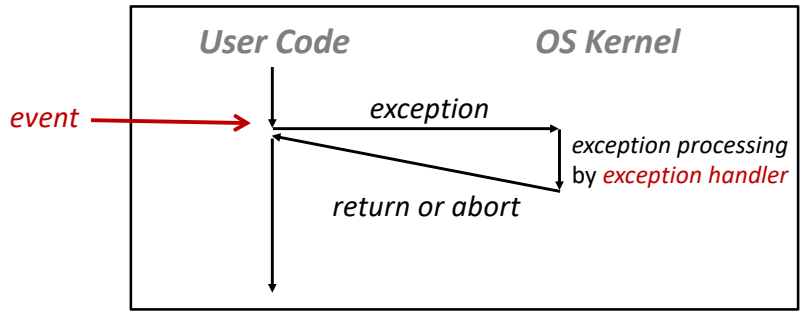
Asynchronous (Interrupts): caused by external events

incoming I/O activity, reset button, timers, signals

Exceptions: hardware support for OS

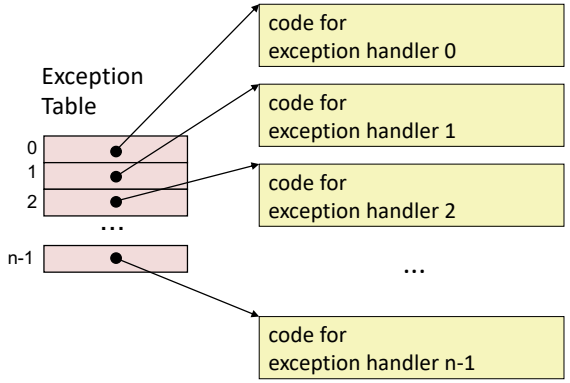
transfer control to OS in response to *event*

What code should the OS run?



Interrupt Vector

in memory
special register holds base address



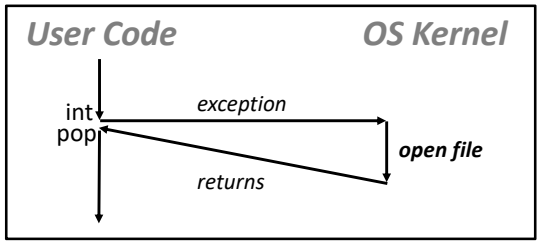
a jump table for exceptions…

Open a file (trap/system call)

User process calls: `open(filename, options)`

`open` executes system call instruction `int`

```
0804d070 <__libc_open>:
 . . .
 804d082:   cd 80                    int    $0x80
 804d084:   5b                       pop    %ebx
 . . .
```

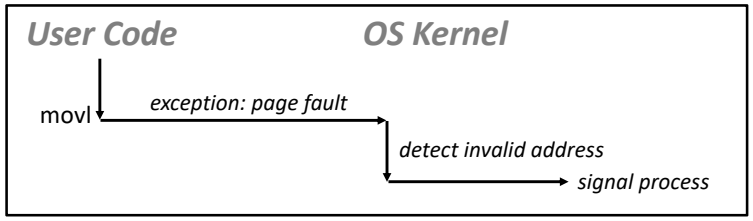


Segmentation Fault

```
int a[1000];
void bad () {
    a[5000] = 13;
}
```

Write to invalid memory location.

```
80483b7:   c7 05 60 e3 04 08 0d   movl   $0xd,0x804e360
```



aborts process with SIGSEGV signal

Page Fault

```
int a[1000];
main () {
    a[500] = 13;
}
```

Write to valid memory location

... but contents currently on disk instead

(more later: virtual memory)

```
80483b7:   c7 05 10 9d 04 08 0d   movl   $0xd,0x8049d10
```