Operating Systems

User-level Applications

↓

Operating System

↓

Hardware Resources

Control Flow Abstraction

Time ⬇

Process A *Process B* *Process C*
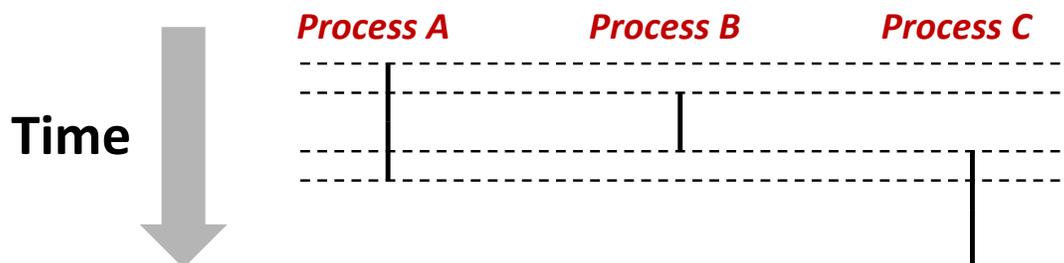
Control Flow Time-Sharing

Process A   **Process B**   **Process C**

Time

Context Switching

Process A   **Process B**

Time

user code

kernel code   } *context switch*

user code

kernel code   } *context switch*

user code
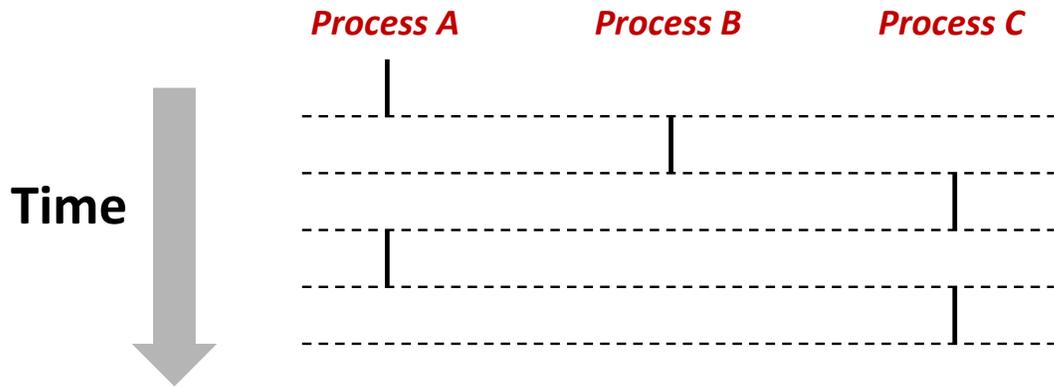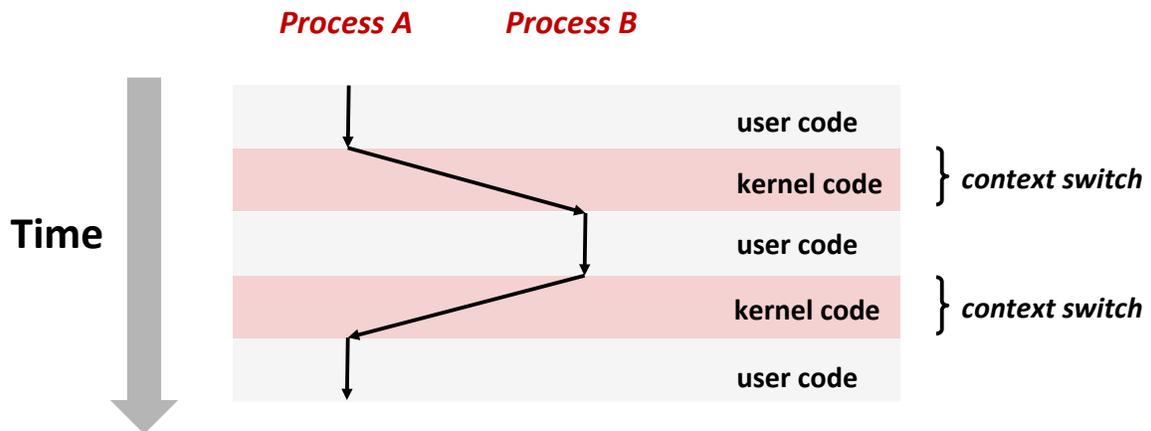
Physical Control Flow

Physical control flow

Time

$\downarrow$

<startup>
inst_1
inst_2
inst_3
…
inst_n
<shutdown>

Exceptions

User Process   OS

event →

exception

exception processing
by *exception handler*

return or abort

Exception Tables

Exception numbers

Exception Table

```
      0
      1
      2
     ...
    n-1
```

Code for
exception handler 0

Code for
exception handler 1

Code for
exception handler 2

...

Code for
exception handler n-1
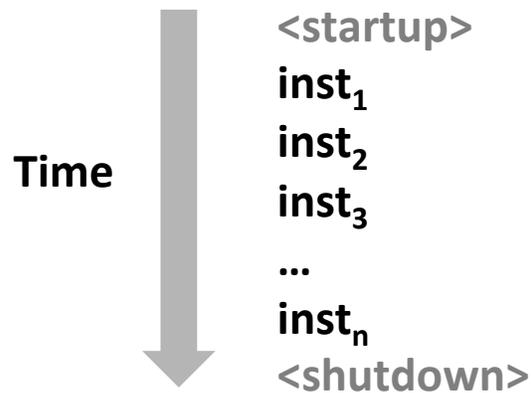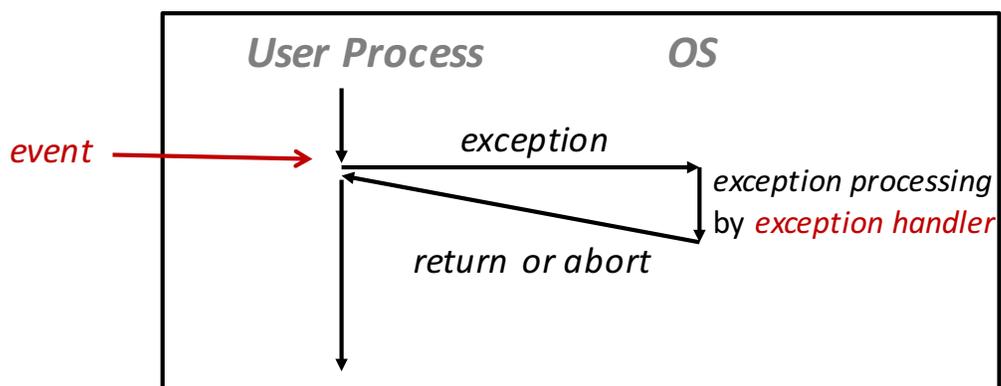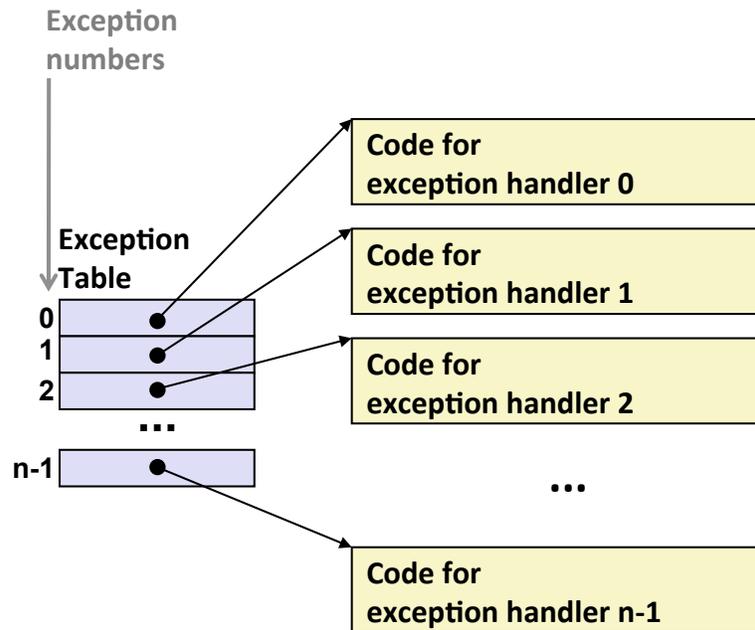
Example: Segmentation Fault

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

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

User code   *Kernel code*

movl

Exception: page fault

Detect invalid address

Signal process