Lecture 4

Interprocess Communication

2 September, 2011

why **IPC**?

message passing

shared memory

UNIX **IPC**

signal

event notification mechanism
for process or thread

```c
#include <signal.h>

   :

// pid is the process ID to send the
//     signal to
// sig is the ID of the signal.

kill(pid, sig);

kill(pid, SIGTERM);
```

at the receiver, default actions are defined for each signals but reaction to most signals can be customized

C
function pointers

```
// function taking in a
// char * and returning an int.

int foo(char *name) { ... }

// declare a function pointer



// initialize a function pointer



// call the function
```

```
return type (* var name )( arg type )
```

function pointers can be:

(i) passed into function,

(ii) returned

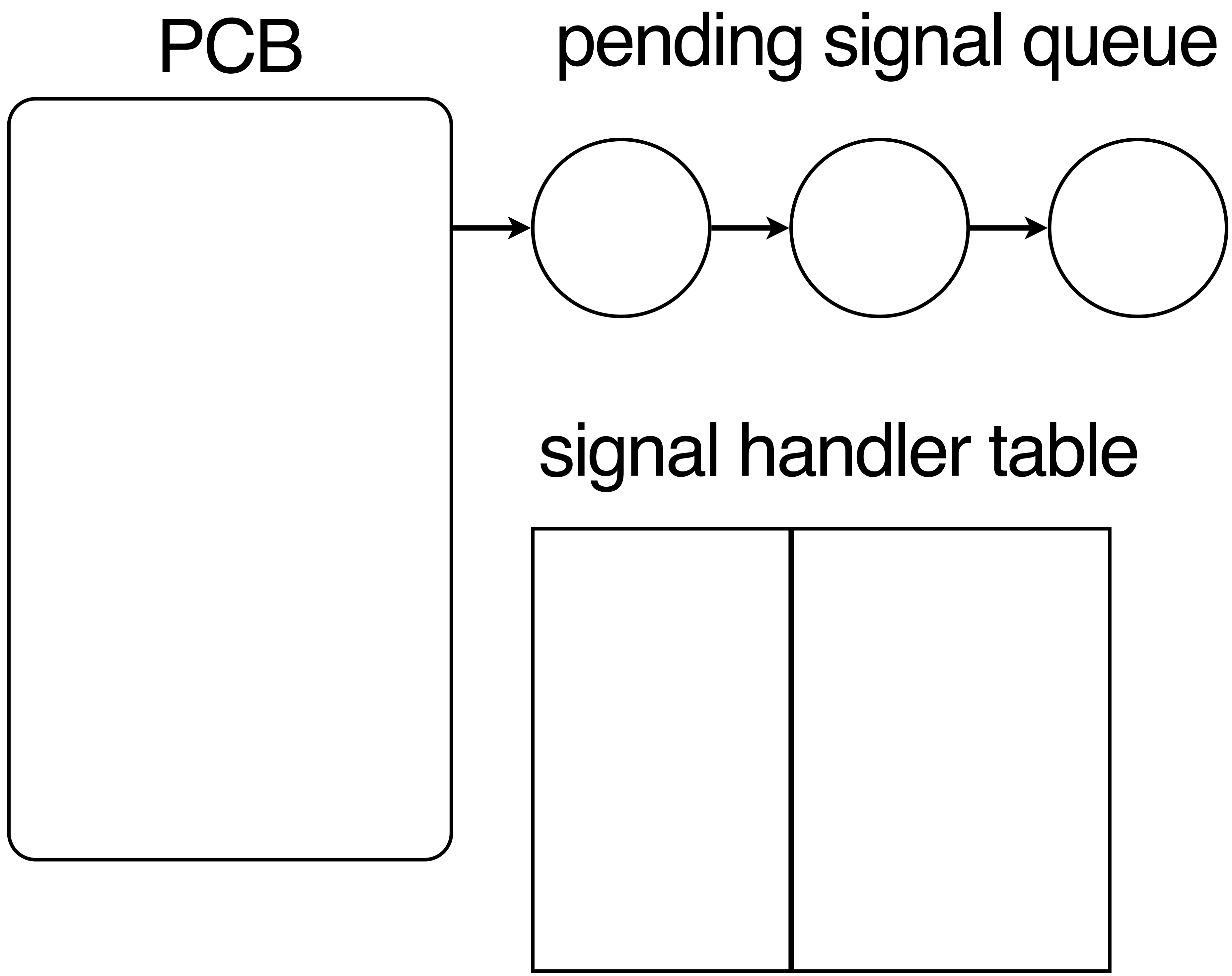
(iii) defined as new type

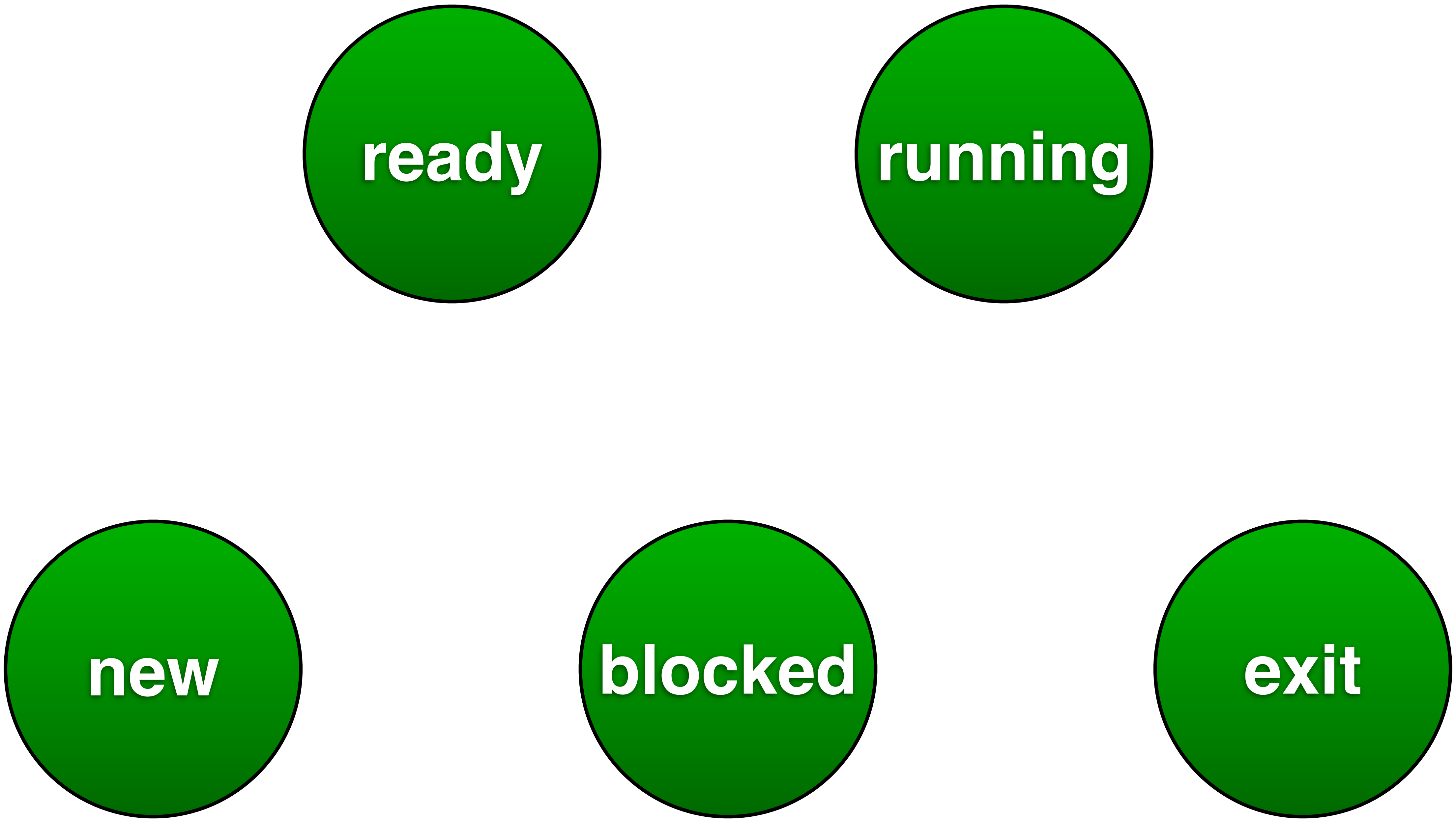
```c
#include <signal.h>

void my_handler(int sig) { return; }
 :

void (*prev_handler)(int);

prev_handler = signal(SIGTERM, my_handler);

    :
    :
// restore back original handler
signal(SIGTERM, prev_handler);
```

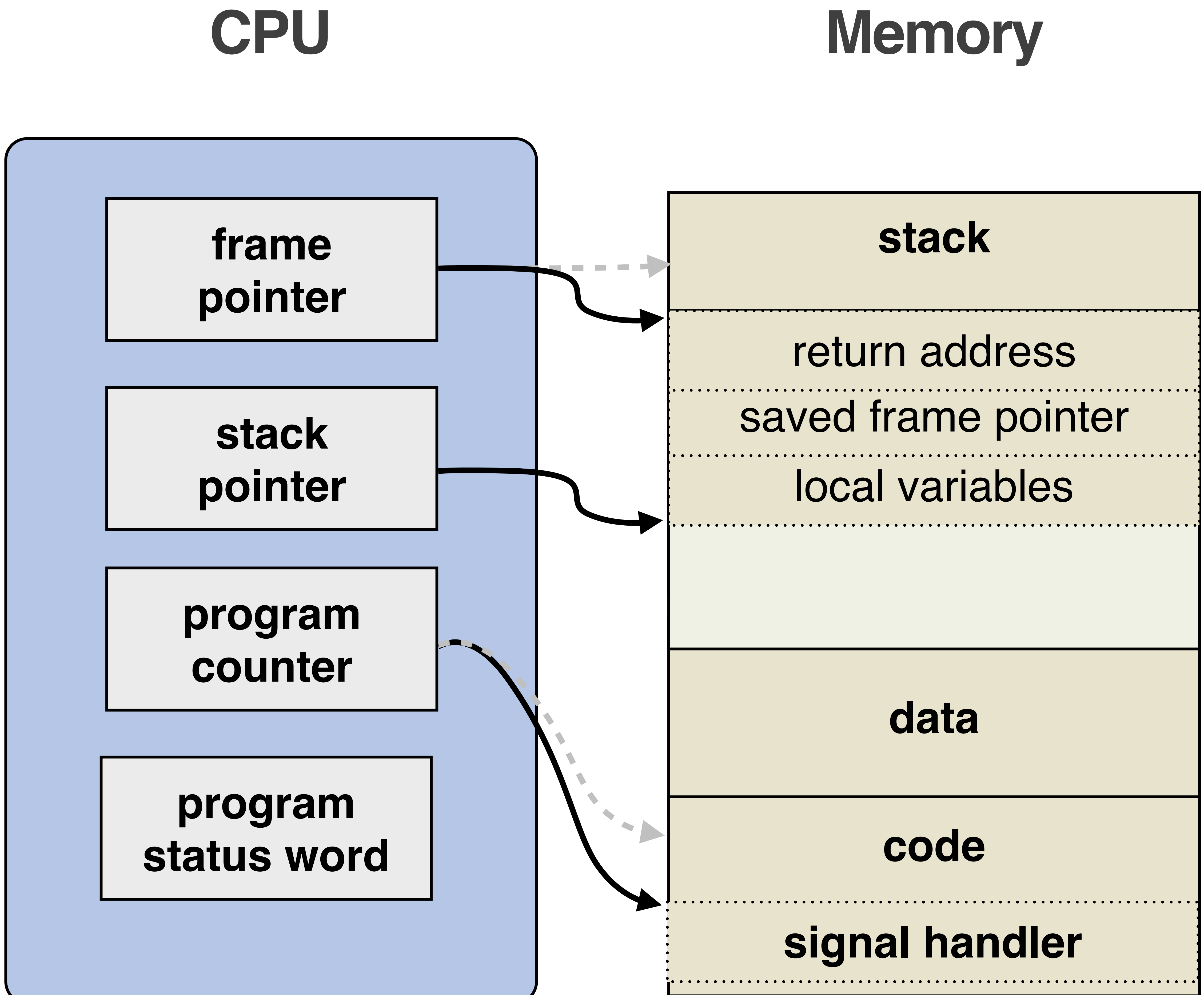
execution order

```
void my_handler
(int sig)                        :
{                                :
 :                               :
 :                              kill(pid, SIGTERM)
}                                :


   :
   :
   :
```

signal in Linux




ready
running
new
blocked
exit


CPU
Memory
frame pointer
stack pointer
program counter
program status word
stack
return address
saved frame pointer
local variables
data
code
signal handler

demo

pipe

race conditions

demo

mutual exclusion

only one process can
access a shared
resource at a time

critical region

processes typically alternate between critical and non-critical region.

```
while (1)
  enter( )
  critical_region
  leave( )
  noncritical_region
```

how to implement enter( ) and leave( )

lock variable

```
enter( )
    while (lock);
    lock = 1;

leave( )
    lock = 0;
```

process A

```
while (lock);

lock = 1;
```

process B

```
while (lock);
lock = 1;
```

interrupts

enter( )

disable interrupt

leave( )

enable interrupt

works for **single CPU**

reduce responsiveness of the system

may **hang** the system if critical region is buggy

Peterson’s Algorithm

variables:

`interested[x]`

== 1 iff x is interested in entering the critical region.

`turn`

== x if x can enter the critical region

process A

enter( )

```
interested[A] = 1
turn = B
while (turn == B && interested[B]);
```

leave( )

```
interested[A] = 0
```

process B

enter( )

```
interested[B] = 1
turn = A
while (turn == A && interested[A]);
```

leave( )

```
interested[B] = 0
```

process A	process B
i [A] = 1	
t = B	
	i [B] = 1
	t = A
	while (t is A && i [A]);
while (t is B && i [B]);	
critical region	
i [A] = 0	

process A

```
i [A] = 1
t = B

while (t is B

    && i [B]);
```

process B

```
i [B] = 1

t = A
while (t is A && i [A]);
```

atomic instructions

TSL R, lock

in one atomic step,
copy lock to R &
set lock to 1

enter( )

```
TSL R, lock
CMP R, #0
JNE enter
RET
```

leave( )

```
MOV lock, #0
```

test&set(lock)

return lock and
set lock to 1

enter( )

```
while (test&set(lock));
```

leave( )

```
lock = 0;
```

XCHG R, lock

in one atomic step, swap
values of two locations

enter()

```
MOV R, #1
XCHG R, lock
CMP R, #0
JNE enter
RET
```

leave()

```
MOV lock, #0
```

```
while (1)
  enter( )
  critical_region
  leave( )
  noncritical_region
```

busy waiting
vs.
sleep/wake

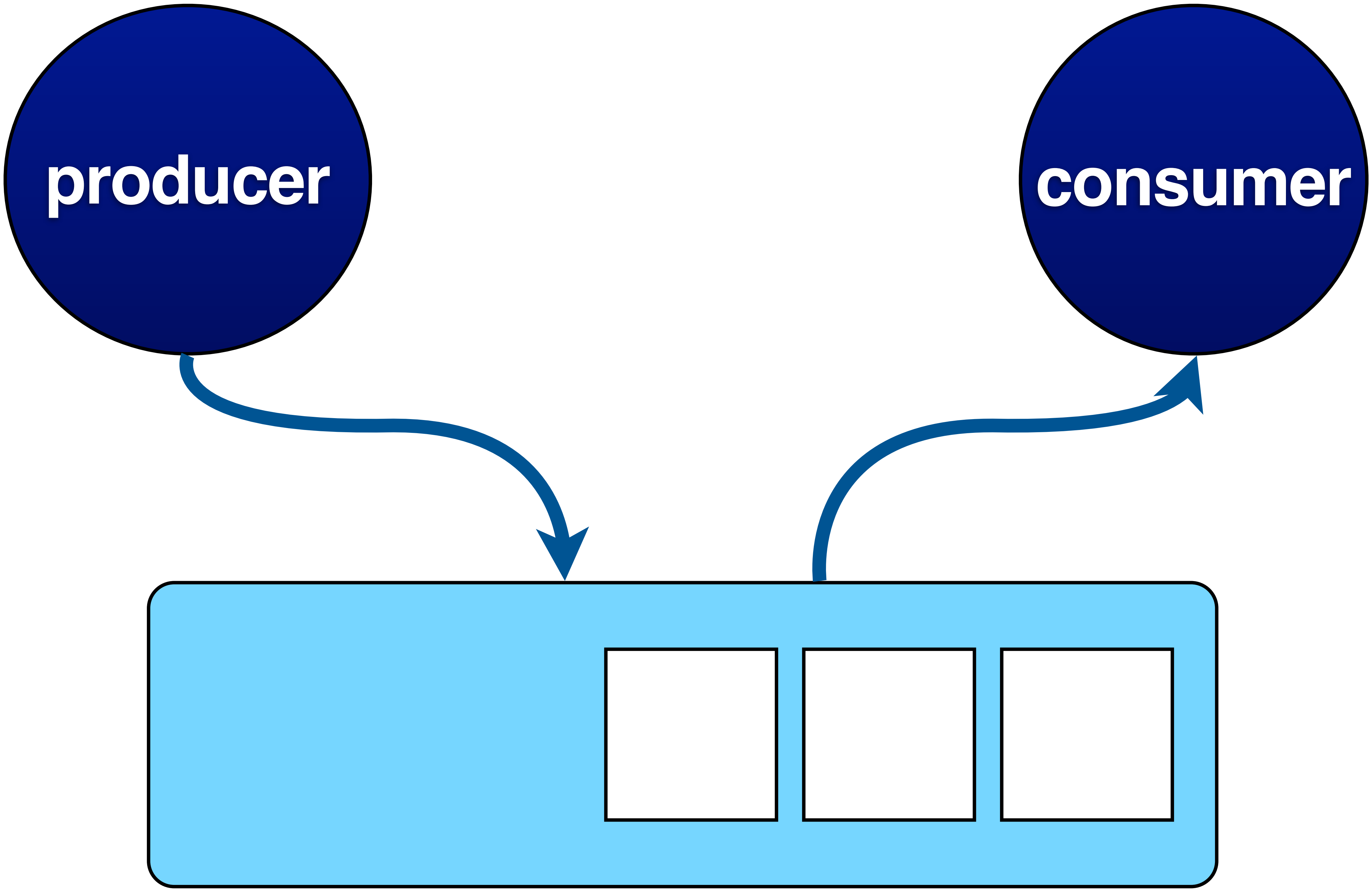
```
while (1)
  if (lock) sleep(A)
  critical_region
  if (B is sleeping)
    wake(B)
  noncritical_region
```

```
while (1)
  if (lock) sleep(B)
  critical_region
  if (A) is sleeping
    wake(A)
  noncritical_region
```

the

producer-consumer

problem


producer
consumer

while (1)

    if (buffer is full)

        sleep

    if (buffer is empty)

        produce

        wake up consumer

    else

        produce

producer

consumer

```
while (1)
    if (buffer is empty)
        sleep
    if (buffer is full)
        consume
        wake up producer
    else
        consume
```

while (1)
if (buffer is empty)

while (1)
if (buffer is full)
sleep
if (buffer is empty)
produce
wake up consumer

sleep
if (buffer is full)
consume
wake up producer
-