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6 – Processes and Threads

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What is a Process?

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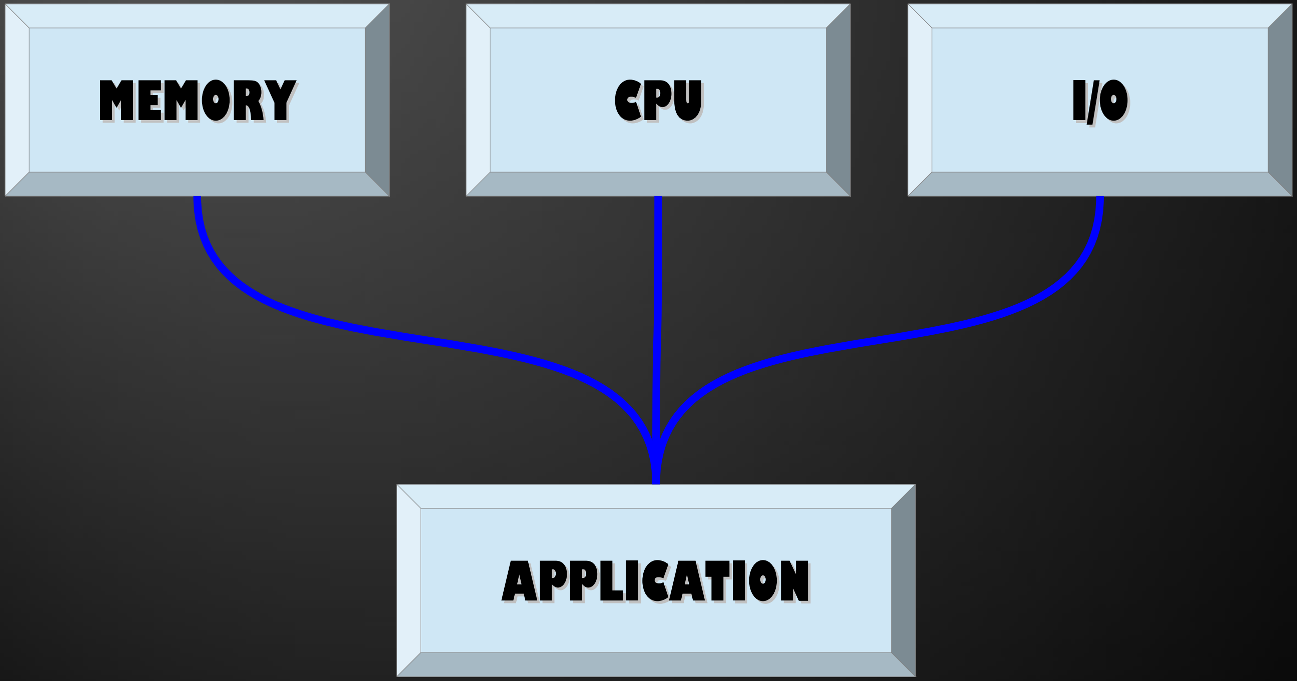
What is a Process?

- Single process OS – Arduino
- Multy process OS – Any modern kernel

What is a Process?



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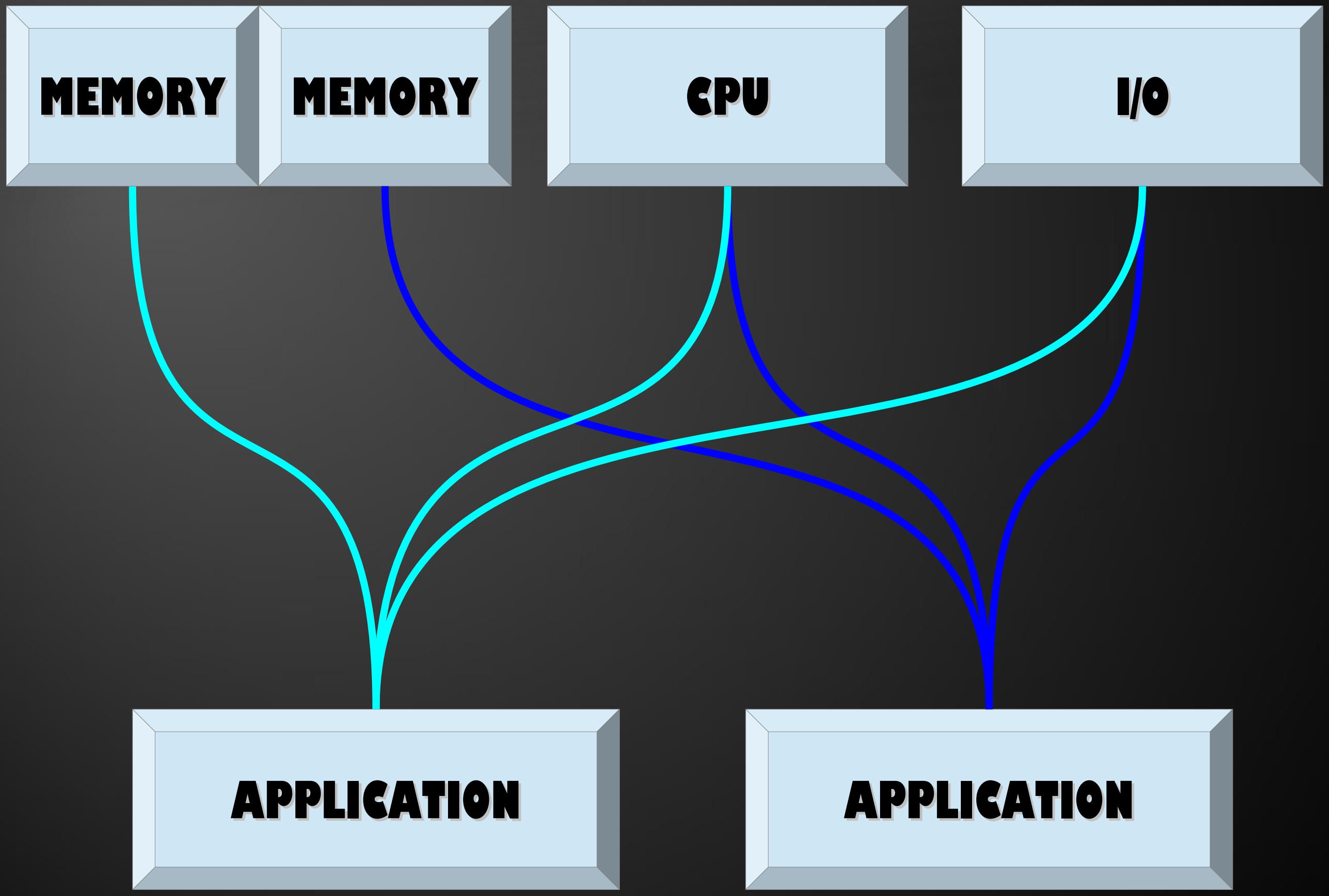
Multiple Processes?



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Multiple Processes?

- Segmentation Fault
- Bus Error
- Access violation

SEGFAULT/SIGSEGV

- Since Linux 3.2

  CROSS MEMORY ATTACH

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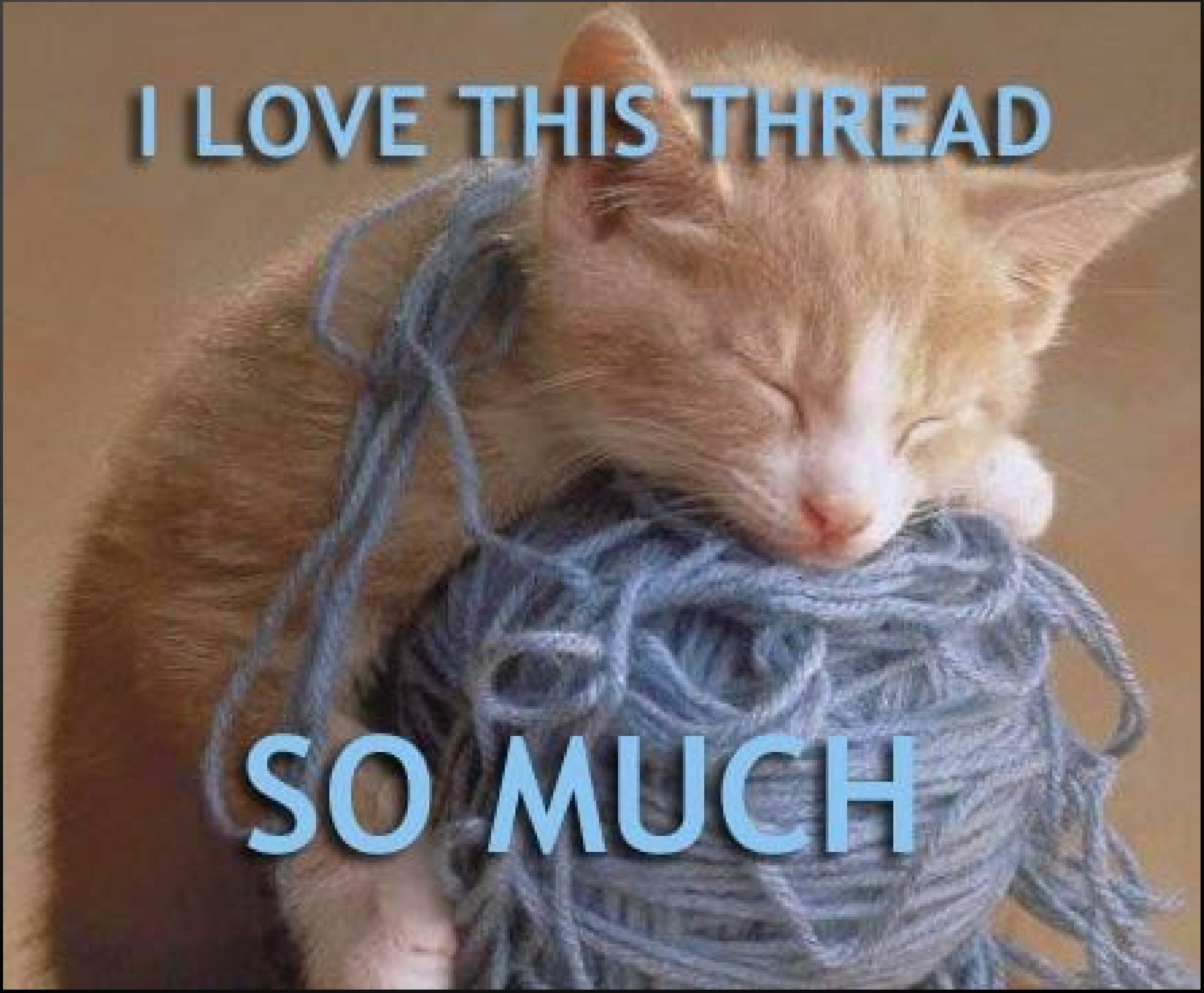
What is a Thread?



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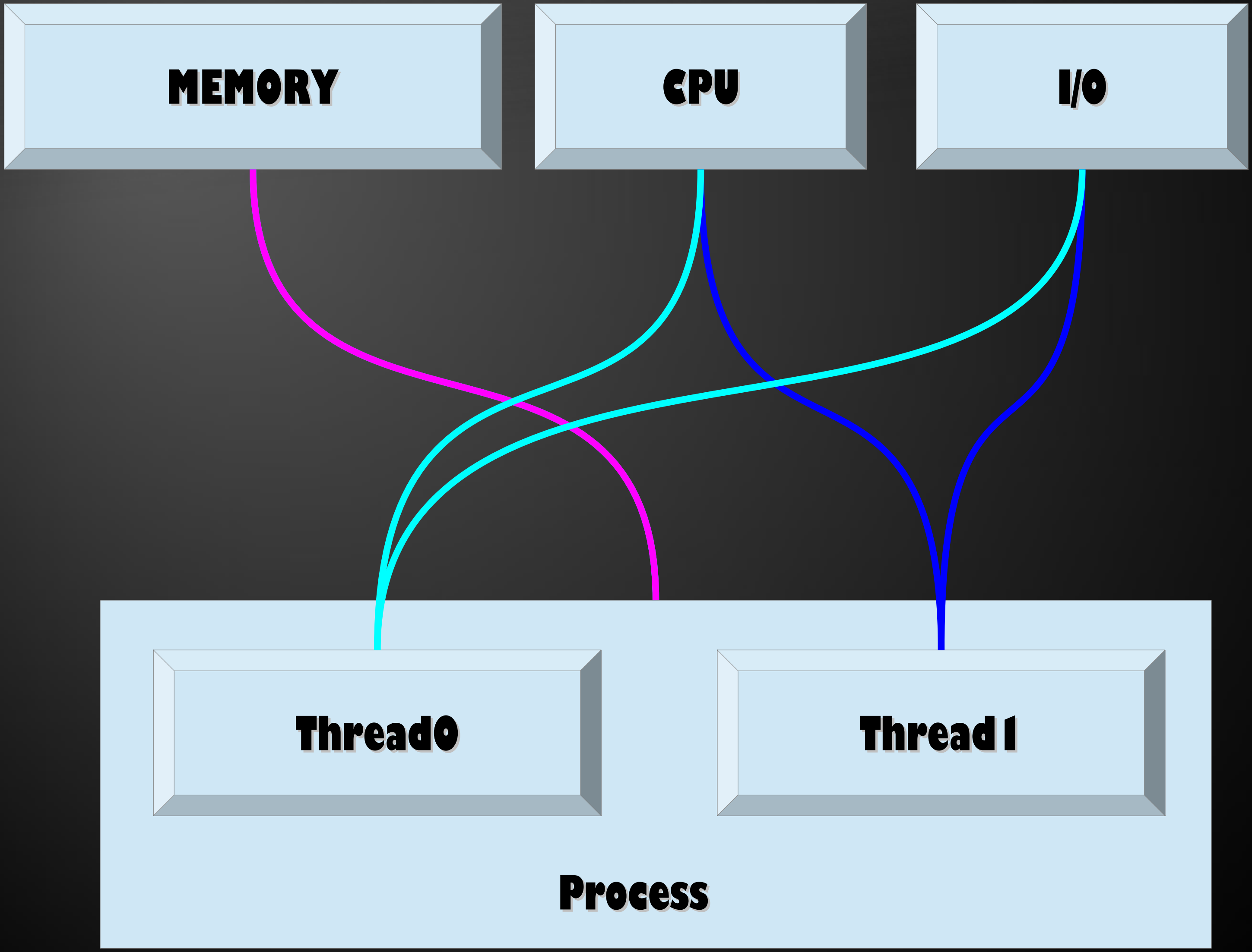
What is a Thread?



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What is a Thread?

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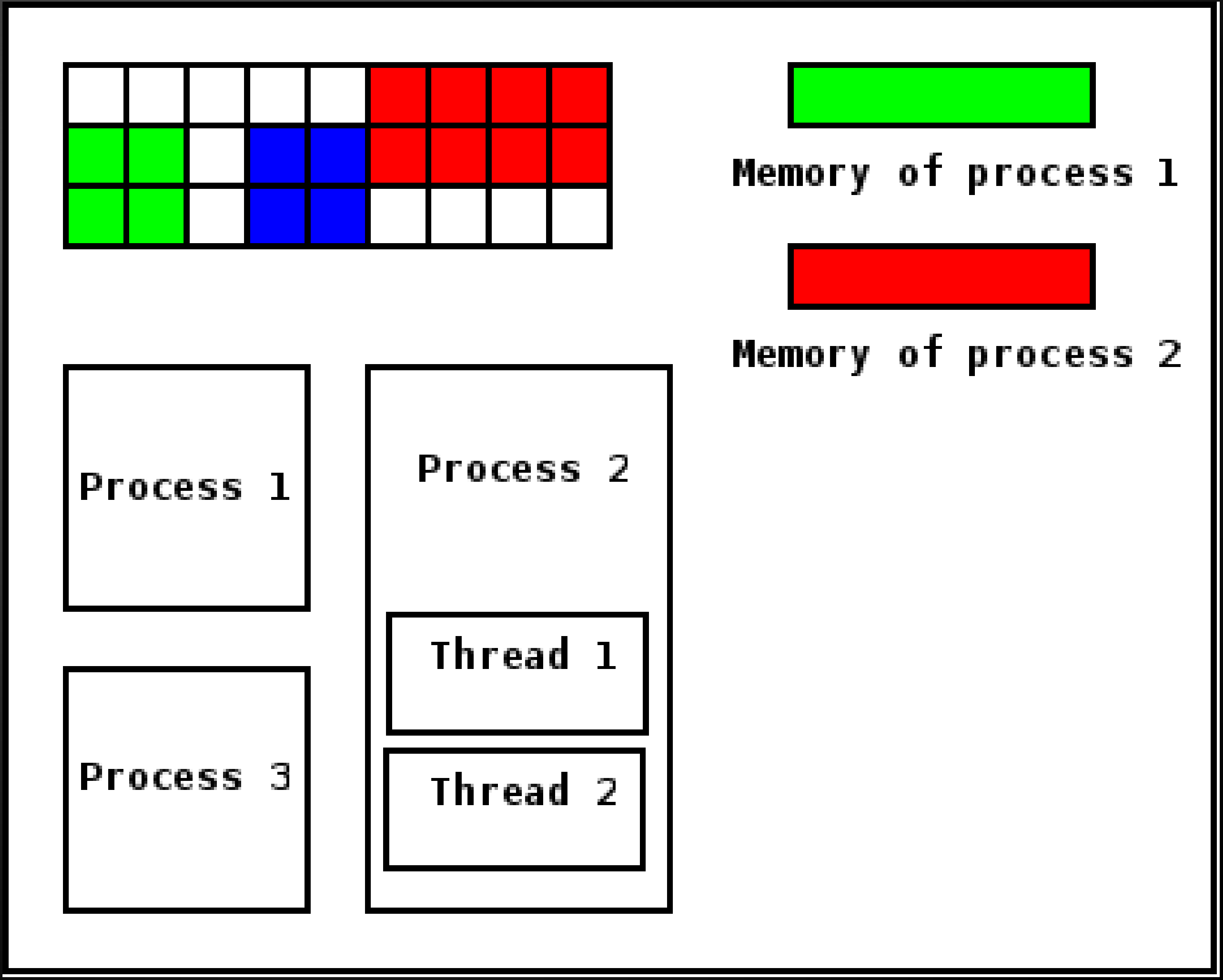
Creating a process

- FORK
  - Copy the memory of the parent
  - Inherit FD table
  - Inherit credentials
  - Inherit security
- EXEC
  - Create new memory space
  - Inherit FD table
  - Inherit credentials

What is a Thread?



Creating a process

```
#include <stdio.h>
#include <unistd.h>
int main() {
    int i;
    pid_t p;
    p = fork();
    if (p == 0) {
        for (i=0;i<=3;i++)
            printf("I'm the child(%d)!\n", p);
    } else {
        for (i=0;i<=3;i++)
            printf("My child is %d\n", p);
    }
    return 0;
}
```

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Creating a process

```
hackman@terion:~$ ./f
My child is 3721
My child is 3721
My child is 3721
My child is 3721
I'm the child(0)!
I'm the child(0)!
I'm the child(0)!
I'm the child(0)!
hackman@terion:~$
```

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Creating a process

```
#include <stdio.h>
#include <unistd.h>
int main() {
    int i;
    pid_t p;
    p = fork();
    if (p == 0) {
        for (i=0;i<=3;i++)
            printf("I'm the child(%d)!\n", getpid());
    } else {
        for (i=0;i<=3;i++)
            printf("My child is %d\n", p);
    }
    printf("This is not good(%d)!\n", getpid());
    return 0;
}
```

Creating a process

```
hackman@terion:~$ ./f
My child is 3762
My child is 3762
My child is 3762
My child is 3762
This is not good(3761)!
I'm the child(3762)!
I'm the child(3762)!
I'm the child(3762)!
I'm the child(3762)!
This is not good(3762)!
hackman@terion:~$
```

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Creating a process

EXEC functions

```
int execl(const char *path, const char *arg, ...);
int execlp(const char *file, const char *arg, ...);
int execle(const char *path, const char *arg,
        ..., char * const envp[]);
int execv(const char *path, char *const argv[]);
int execvp(const char *file, char *const argv[]);
int execvpe(const char *file, char *const argv[],
        char *const envp[]);
```

Exec functions does not return

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Creating a process

```
system() = exec('/bin/sh -c CMD')

Which means:

your process
    - exec /bin/sh
        - exec CMD
```

Types of processes

- Foreground
- Background
- Daemons
  - co-relation with terminal

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Foreground processes

- It has access to the terminal's
  - STDIN – 0
  - STDOUT – 1
  - STDERR – 2
- It is directly controlled by the user
- It is connected to the terminal (text or graphic)

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Background processes

- It has access only to the terminal's
  - STDOUT – 1
  - STDERR – 2
- It is NOT directly controlled by the user
- It is connected to the terminal (text or graphic)

Daemon processes

- Its STDIN/OUT/ERR are redirected to files
- It is NOT directly controlled by the user
- It is NOT connected to the terminal (text or graphic)

IPC

- FS PIPES
- Process PIPES
- Unix Domain Socket
- Shared Memory SHM (SysV/POSIX)
- Message Queues (SysV/POSIX)
- Semaphores (SysV/POSIX)
- Signals

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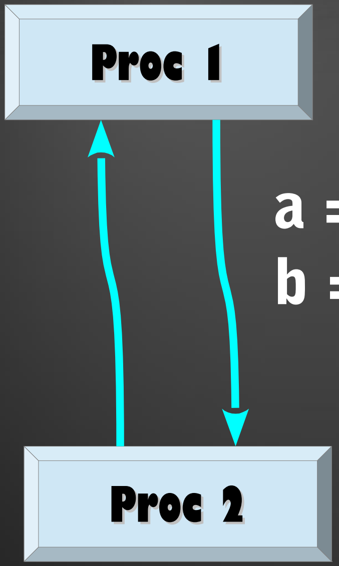
IPC – process PIPEs



```
a = open(PIPE, "r");
b = open(PIPE, "w");
```

```
close(a); close(b);
a = open(PIPE, "w");
b = open(PIPE, "r");
```

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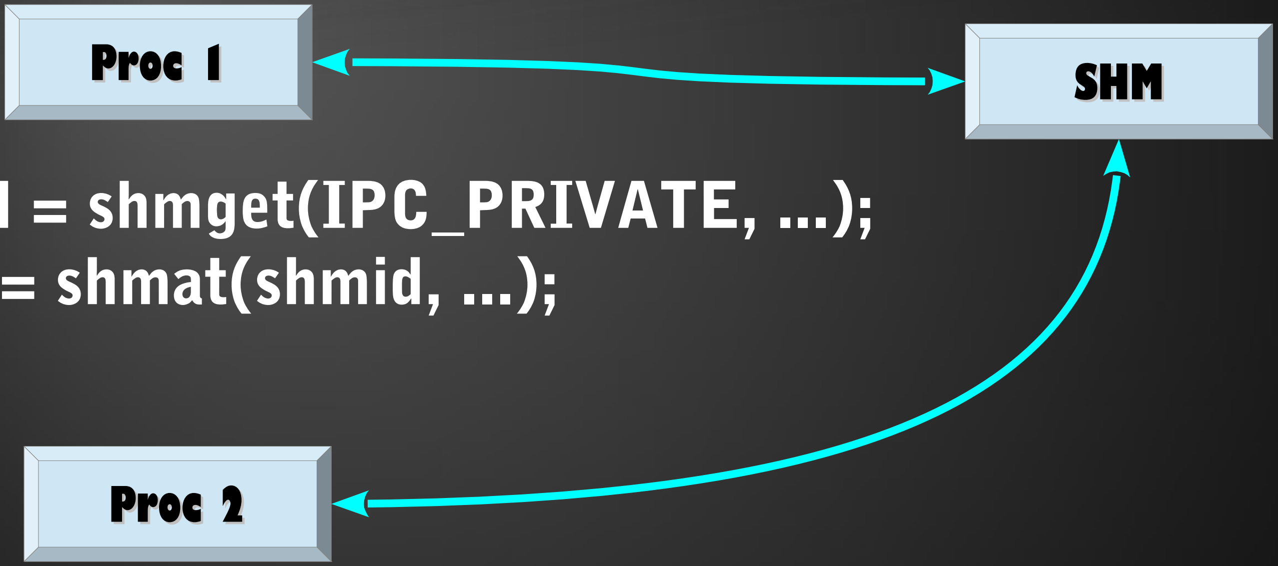
IPC – Shared Memory



```
shmid = shmget(IPC_PRIVATE, ...);
mem = shmat(shmid, ...);
```

```
memset(mem, '\0', 200);
```

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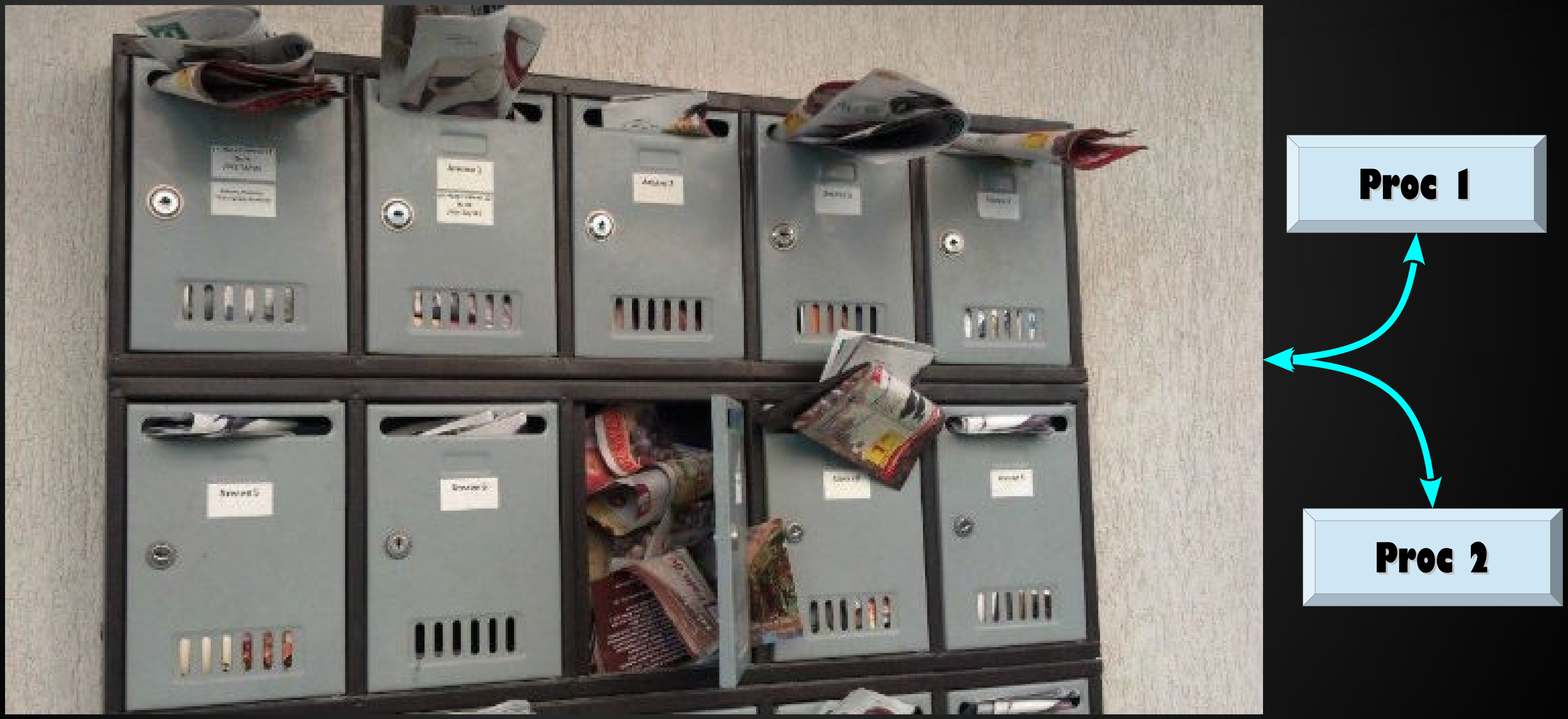
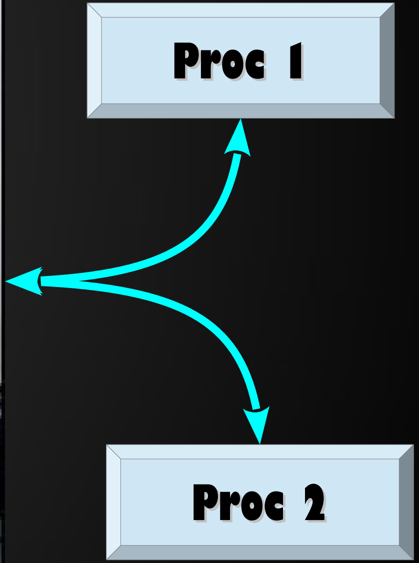
IPC – Message Queues



IPC – Semaphores



IPC – Signals

Proc 1

Proc 2

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Signals - Kill

Proc 1

Proc 2

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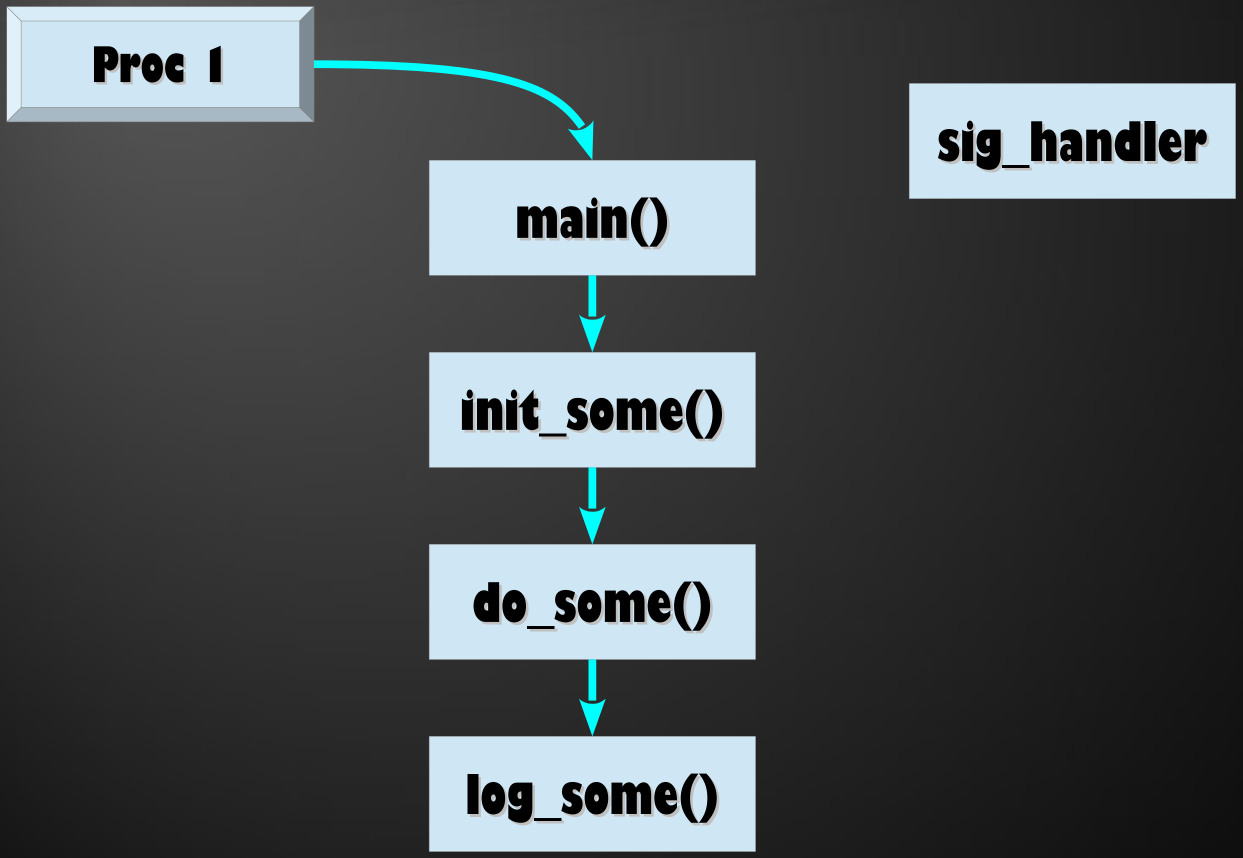
Signals – Signal handlers



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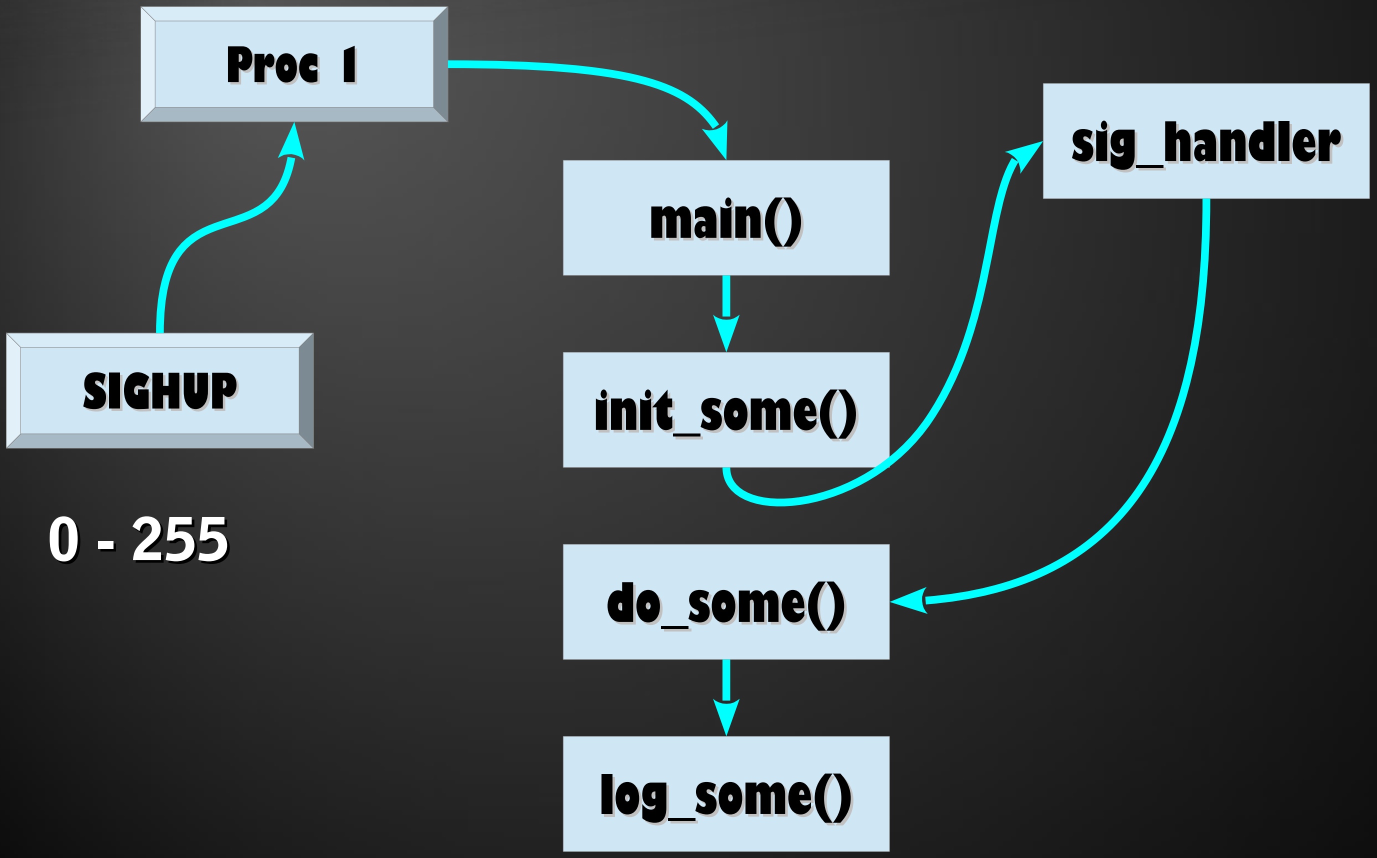
Signals – Signal handlers



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Processes and Threads

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