CS143A
Principles on Operating Systems
Discussion 02:
OS Interfaces

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TA: Sae**hans**eul Yi (Hans)

Oct 16, 2020 **Noon**

Revision: 3

About me

- Link for all office hours/discussion:
  https://uci.zoom.us/j/93369206818

- Teaching staff office hours:

  Hari: *Mon* 12:00 PST
  Zhaofeng Li: Tue 12:00 PST
  Deep: *Wed* 9:00 AM PST
  Hans: *Thu* 12:00 PST
  Se-Min Lim: *Fri* 9:00 PST

Motivating example: redirection

- Best example for explaining pipe(),fork(), and exec()
- Program output -> *stdout* (default: screen)
- | (pipe *operator*): send outputs to somewhere else

```
$
$ ls
a.out    b.out    asdfasdf
$
```

```
$
$ ls | grep asdf
asdfasdf
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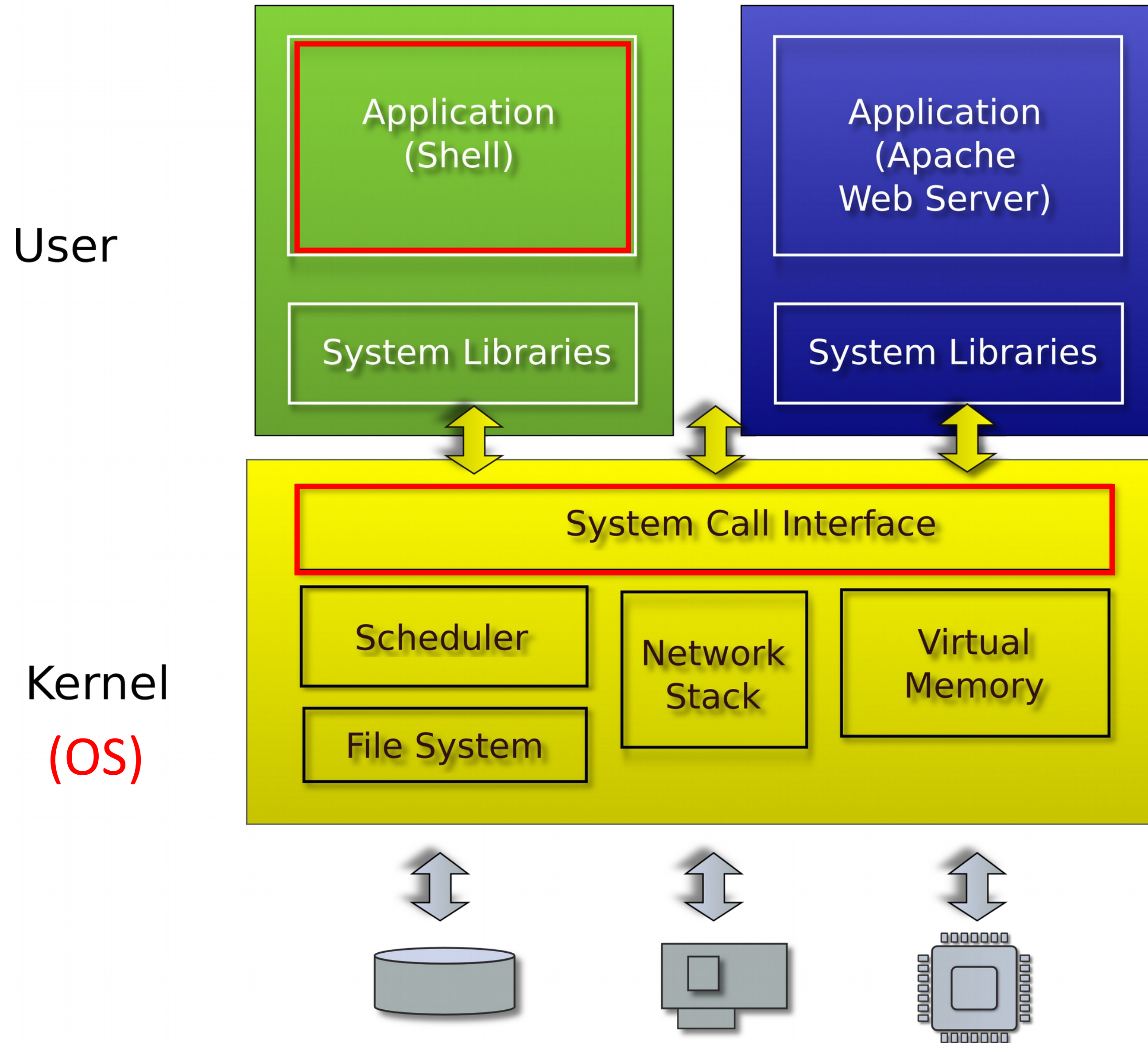
```

Typical UNIX OS



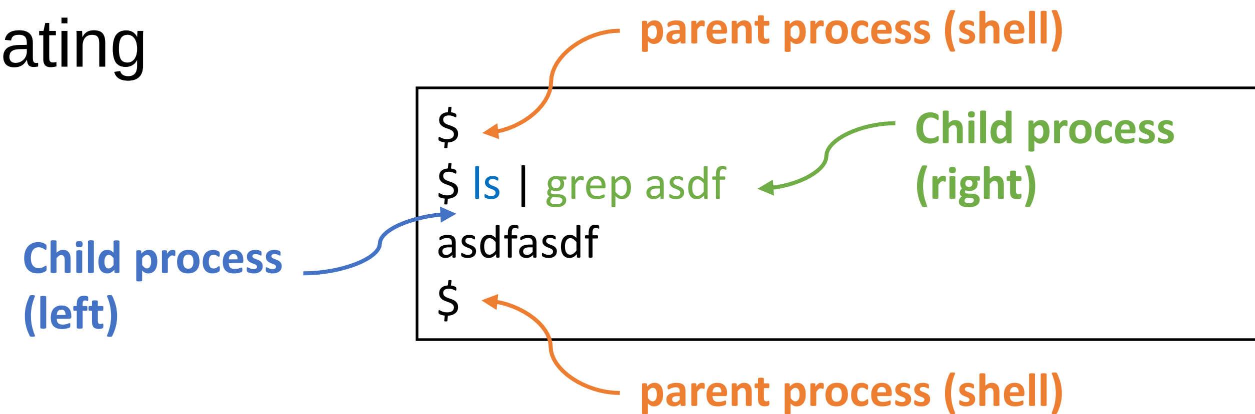
System calls are
the interface of the OS

But what is shell?

- Normal process
  - Kernel starts it for each user that logs in into the system
  - In xv6 shell is created after the kernel boots
- Shell interacts with the kernel through system calls
  - E.g., starts other processes

System calls, interface for...

- Processes
  - Creating, exiting, waiting, terminating
- Memory
  - Allocation, deallocation
- Files and folders
  - Opening, reading, writing, closing
- Inter-process communication
  - Pipes



Wait… stdin? stdout?

(standard input, standard output)

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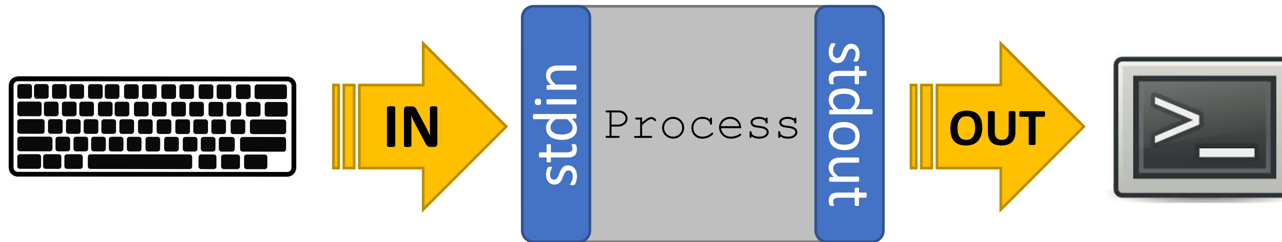

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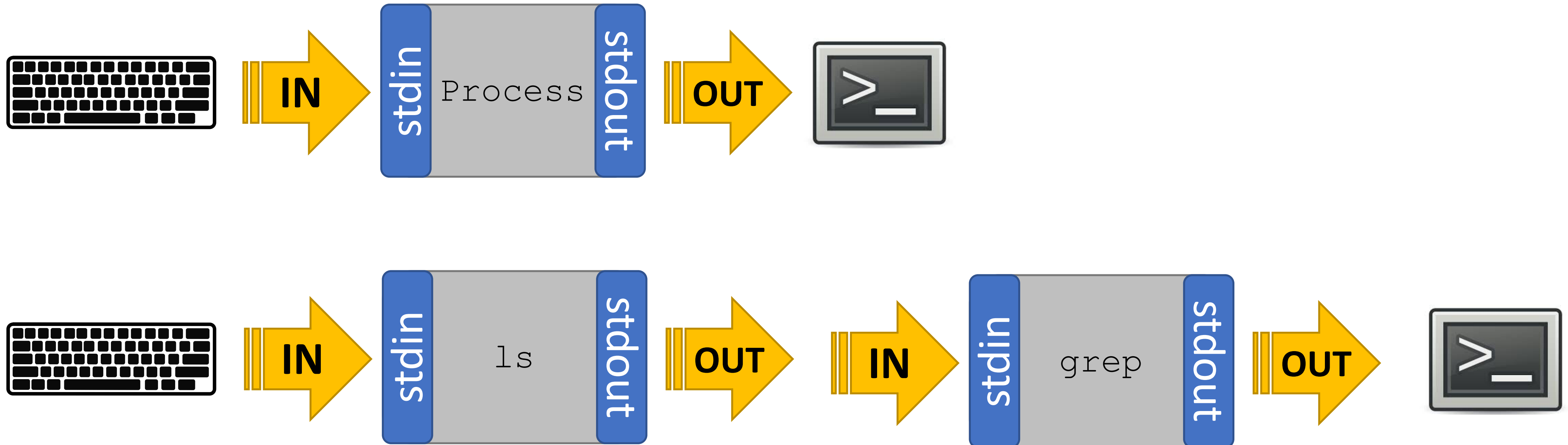

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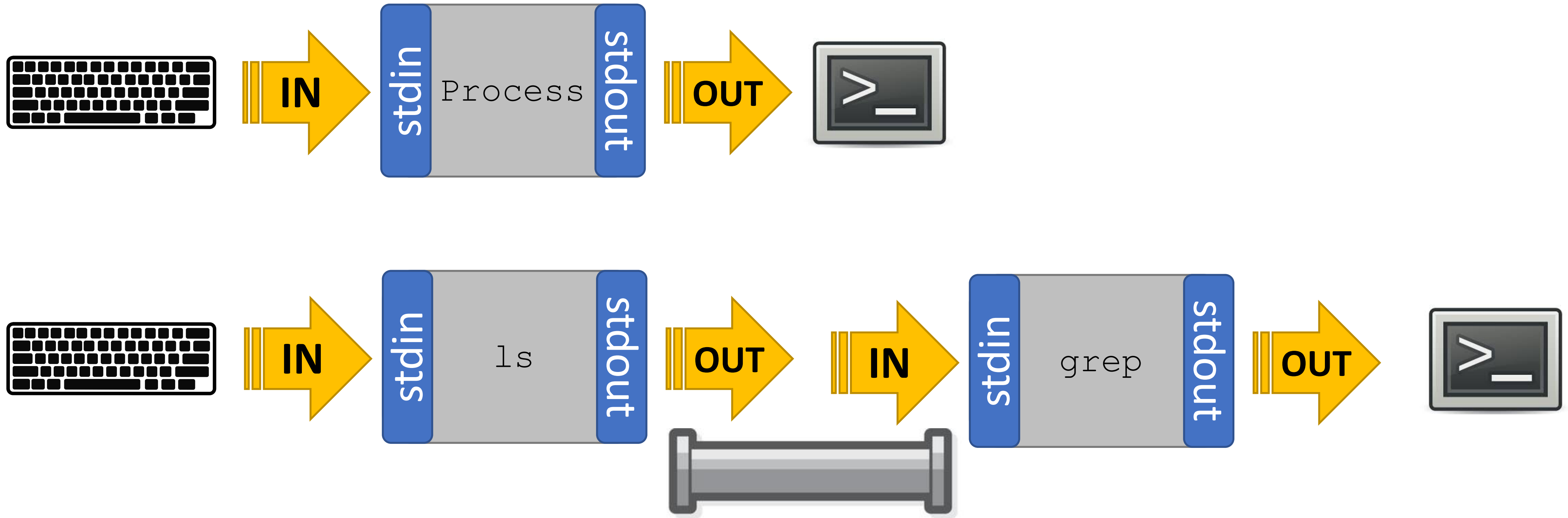

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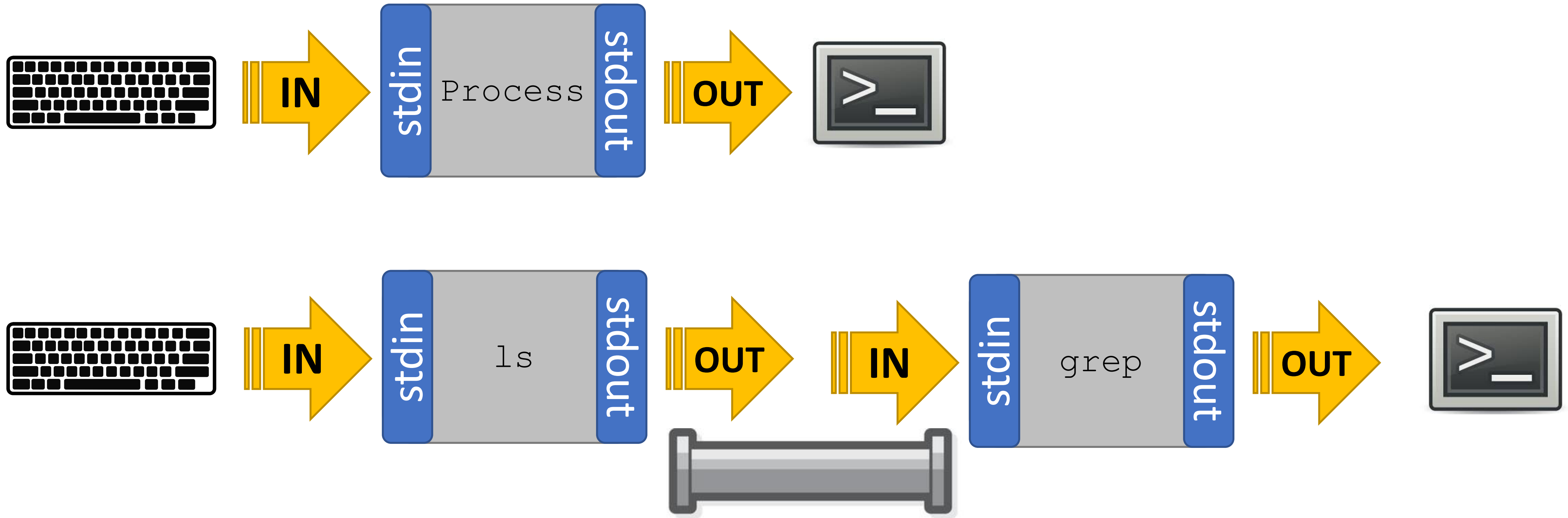
- stdin(0), stdout(1), and stderr(2) are file descriptors(**just an integer** in user-program)



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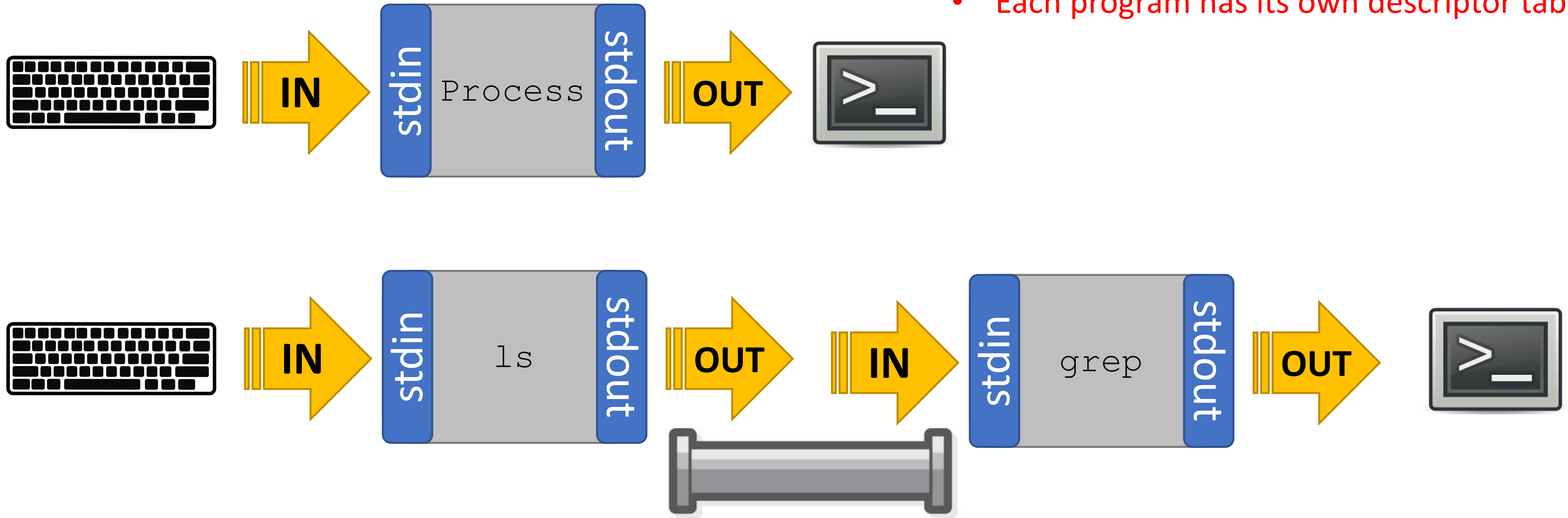
- Each program has its own descriptor table



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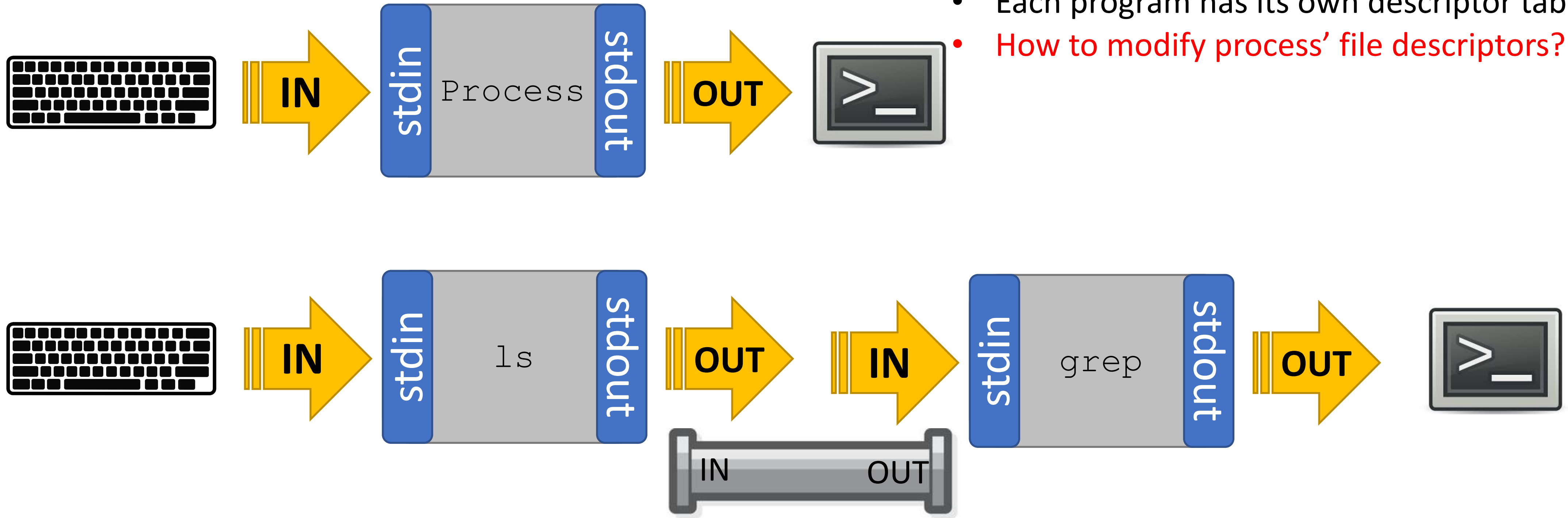
- How to modify process' file descriptors?



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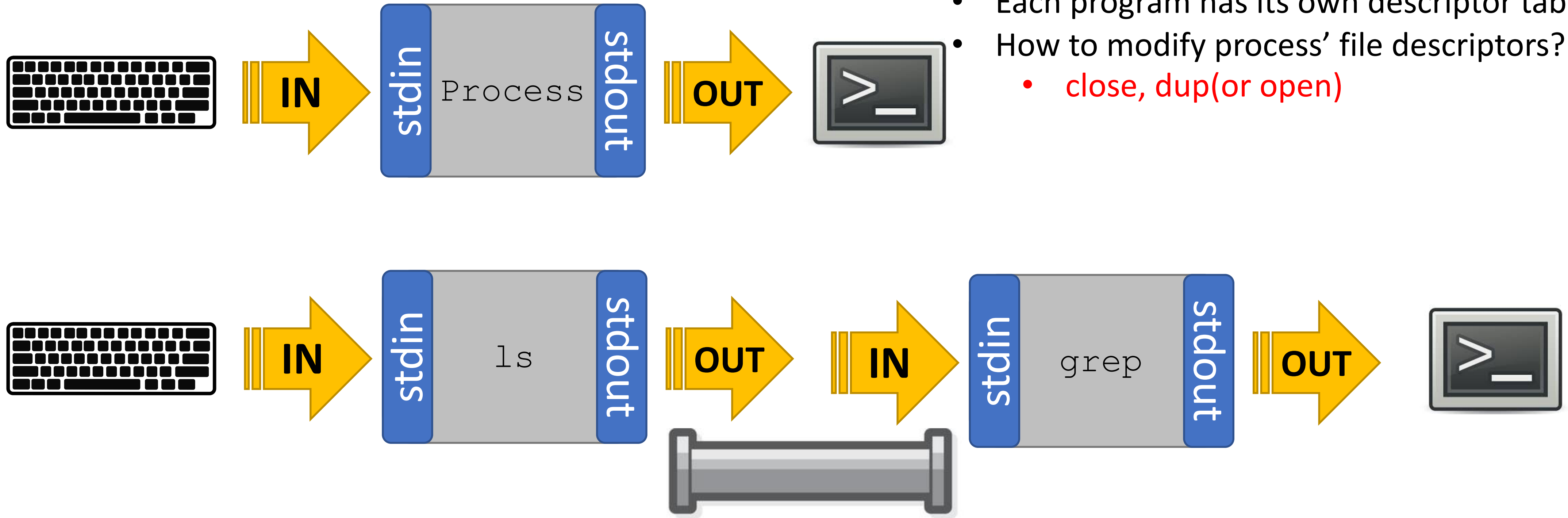

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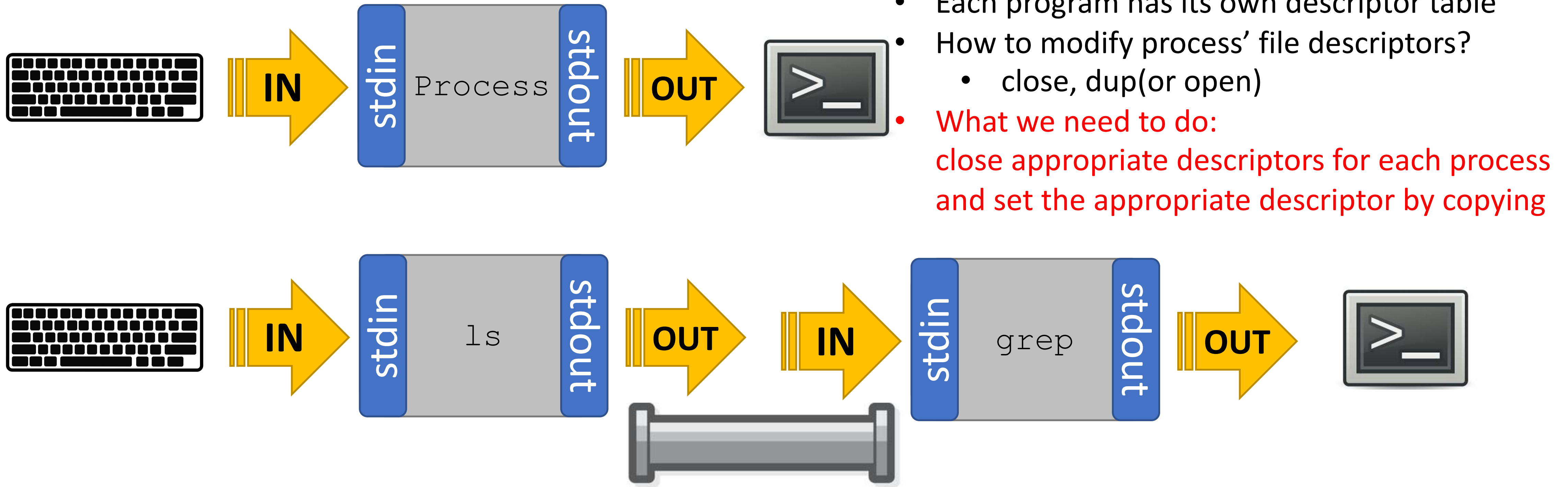
- What we need to do:
  close appropriate descriptors for each process and set the appropriate descriptor by copying



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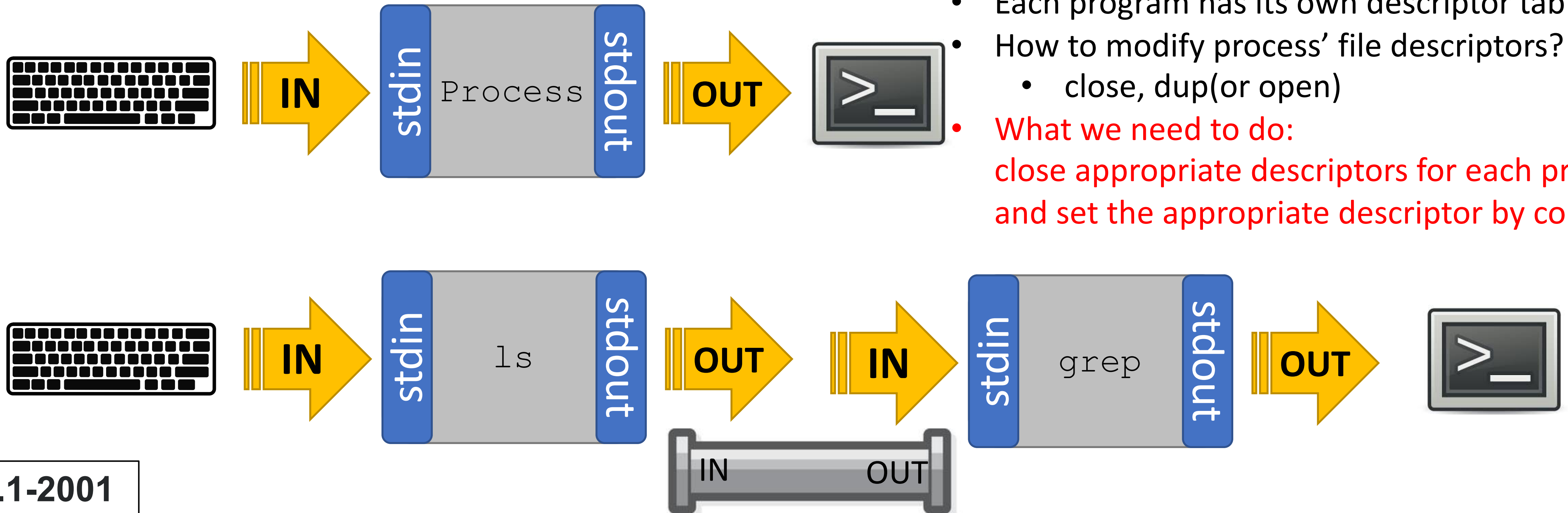


POSIX.1-2001

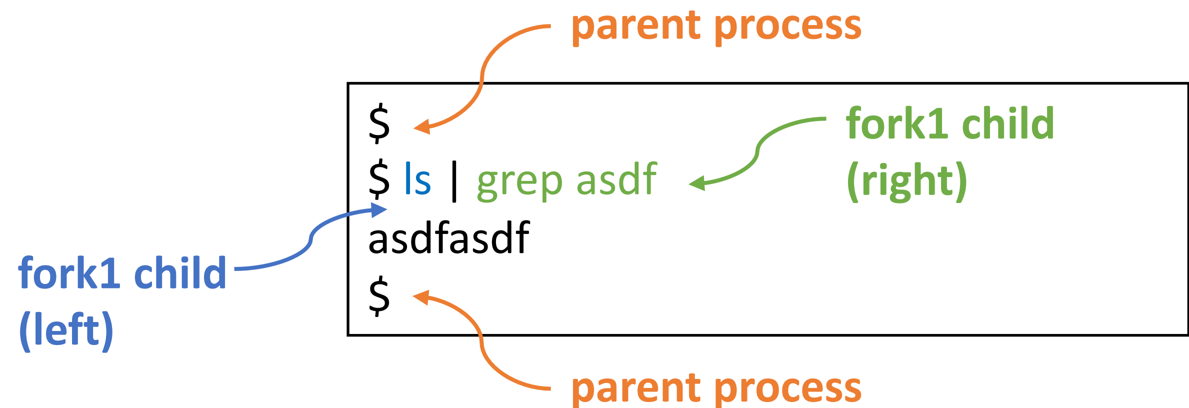
pipe() creates a pair of file descriptors, pointing to a pipe inode, and places them in the array pointed to by filedes. filedes[0] is for reading, filedes[1] is for writing. **pipe is uni-directional**

pipe() and fork()

```
--------------------Point 0--------------------
case PIPE:
pcmd = (struct pipecmd*)cmd;
if(pipe(p) < 0)
   panic("pipe");
--------------------Point A--------------------
if(fork1() == 0){
   close(1);
   dup(p[1]);
   close(p[0]);
   close(p[1]);
--------------------Point B--------------------
   runcmd(pcmd->left);
}
if(fork1() == 0){
   close(0);
   dup(p[0]);
   close(p[0]);
   close(p[1]);
   runcmd(pcmd->right);
}
close(p[0]);
close(p[1]);
--------------------Point C--------------------
wait();
wait();
break;
```

int pipe(int *pipefd*[2]);
Create a pipe & assign each end to pipefd

pid_t fork(void);
Copy the current process (parent)
Returns the PID of the child (parent)
or 0 (child)



pipe() and fork()

※ Throughout the example, stderr is always connected to the screen. Omitted for simplicity as well as p[0] and p[1] to the parent process

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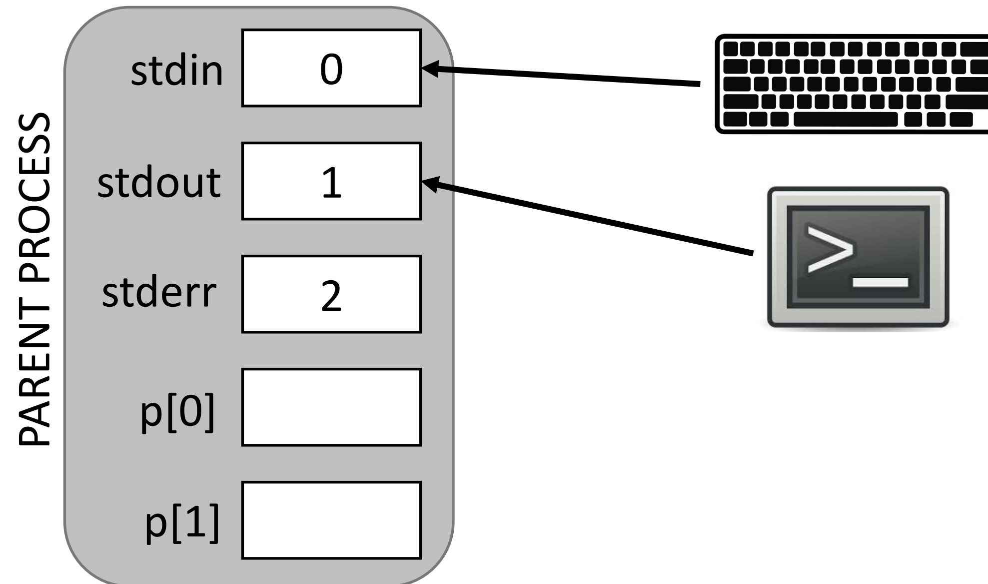

pipe() and fork()

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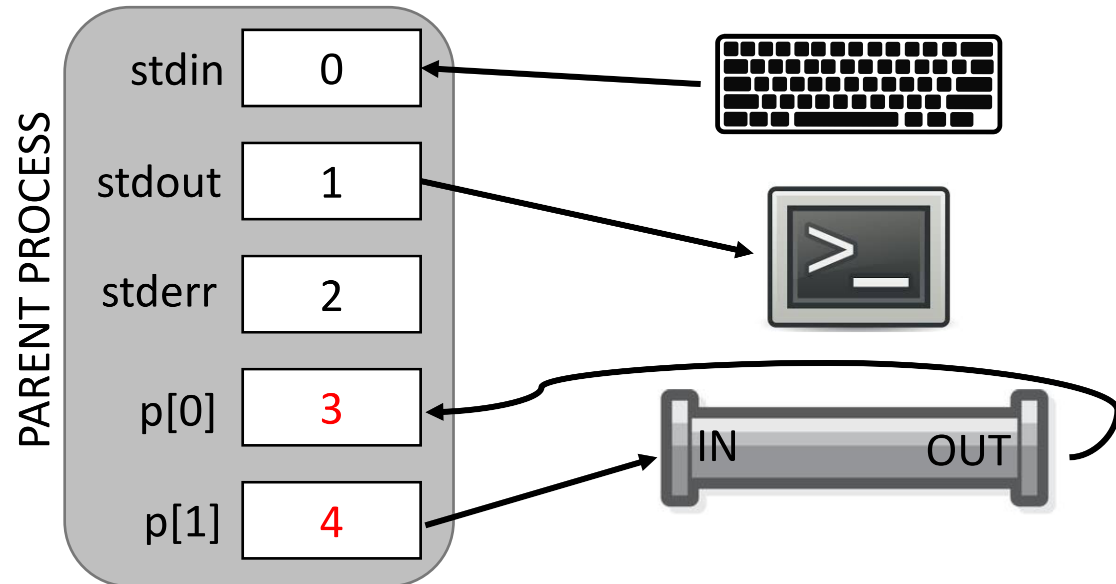

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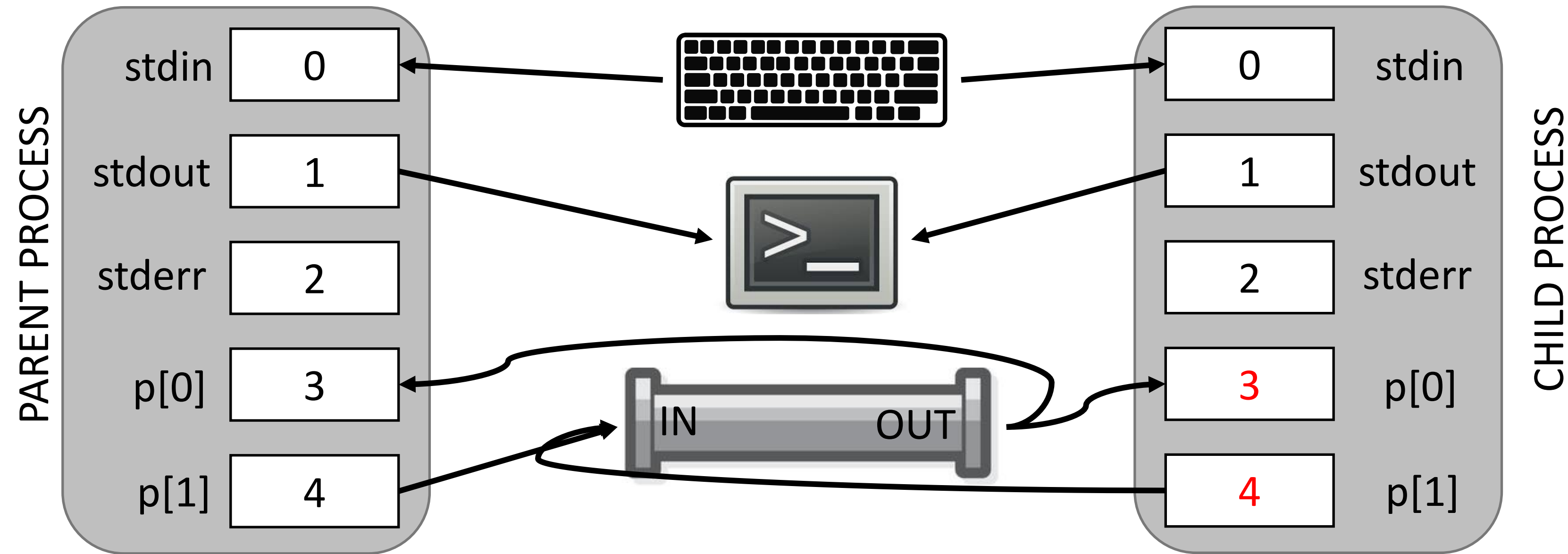
```

Executed by child process

fork() copies the descriptors too!



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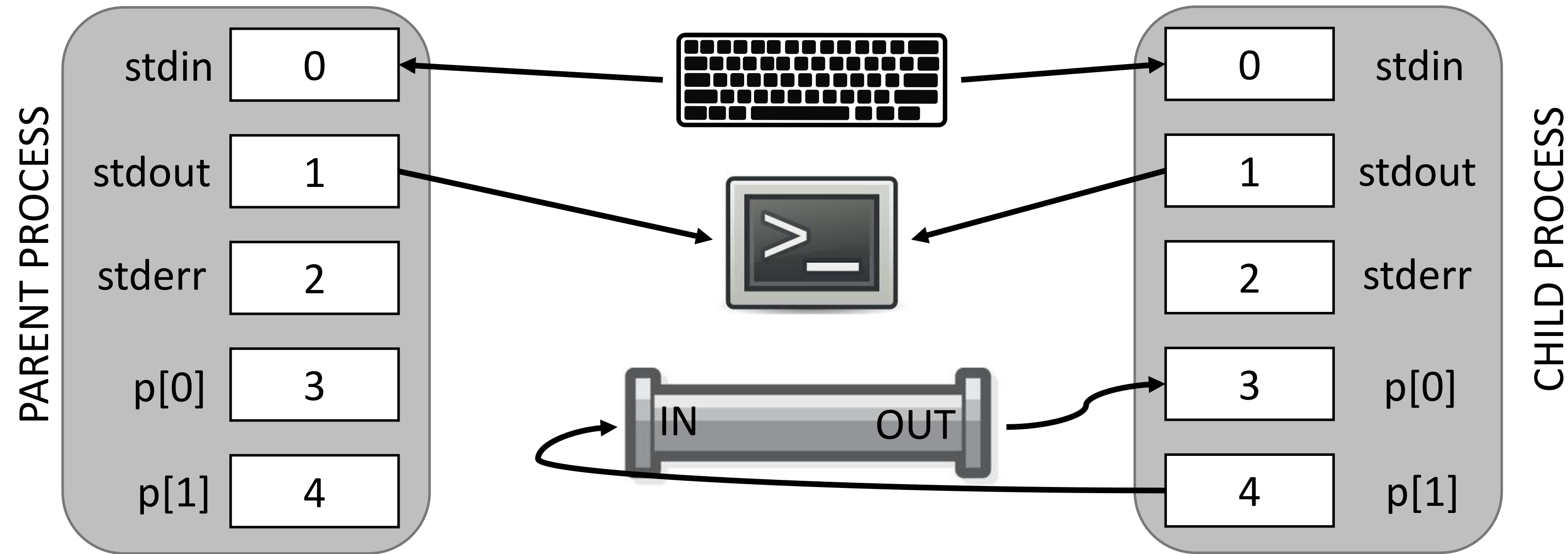

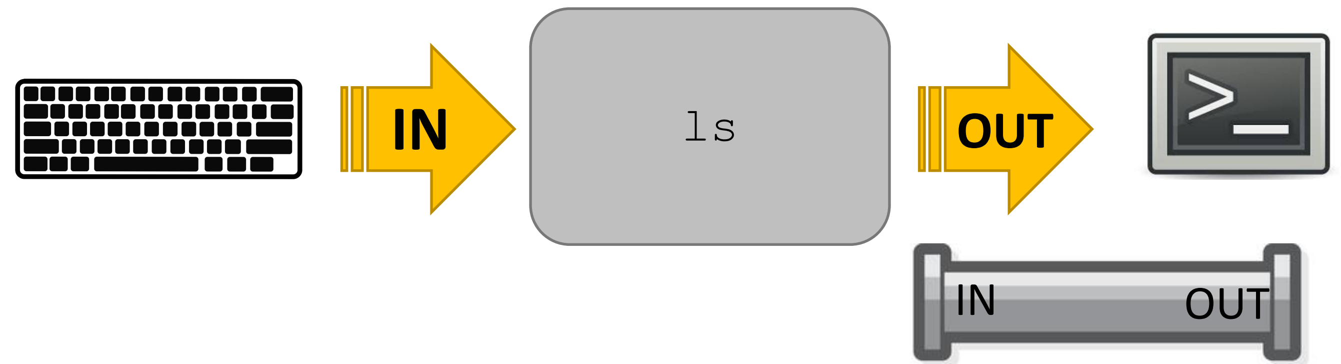

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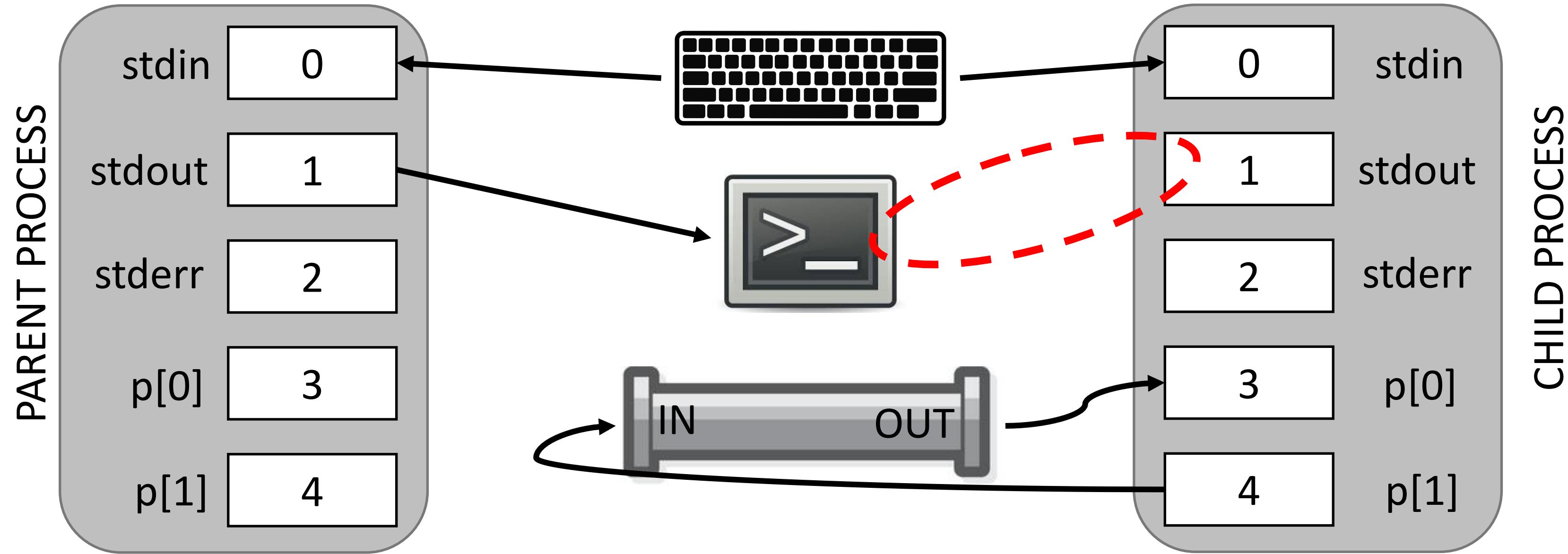

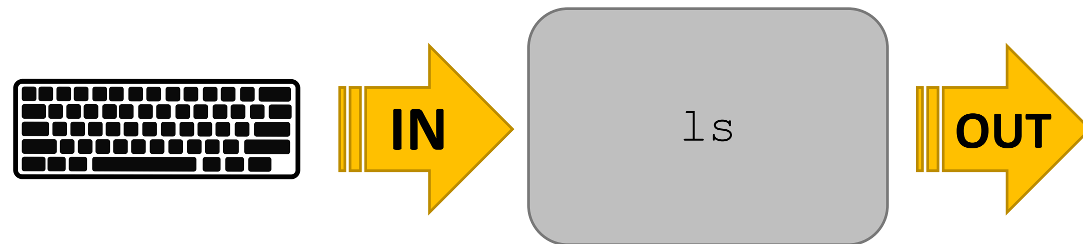

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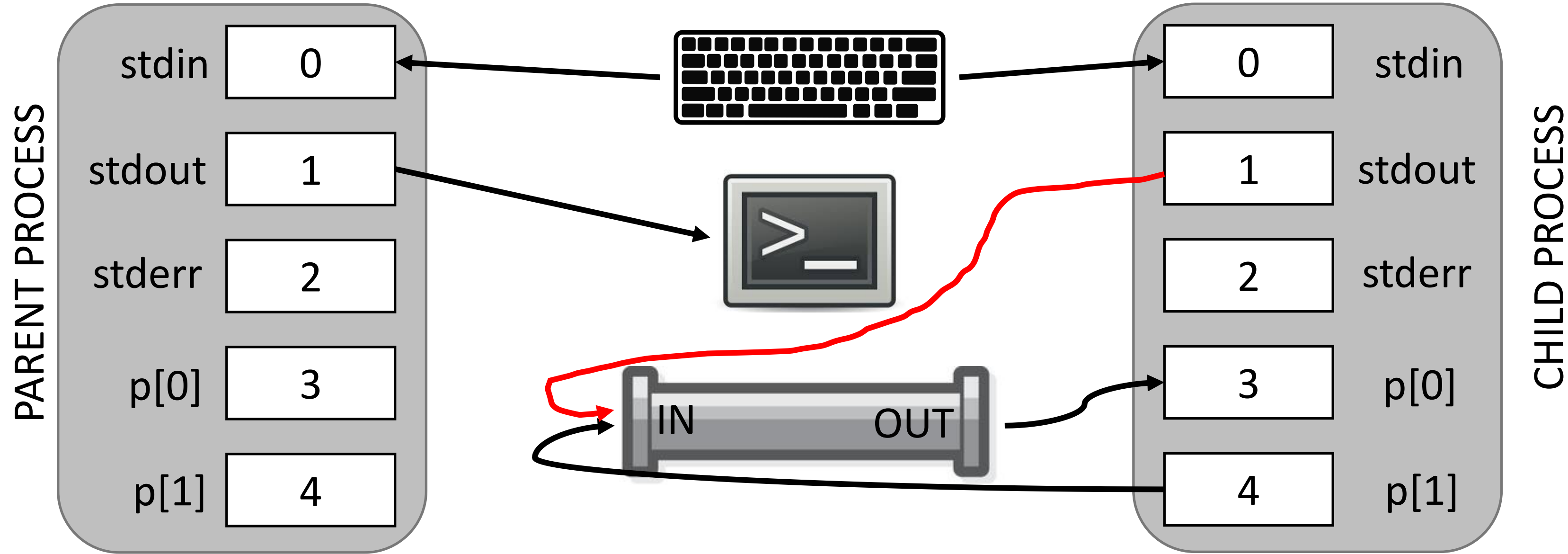
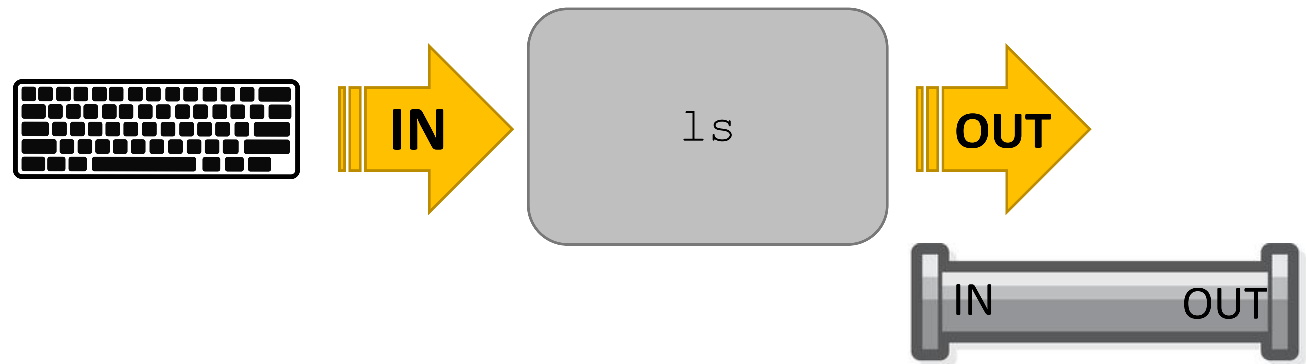
fork() copies the descriptors too!

dup()'s destination is the lowest & unused file descriptor!





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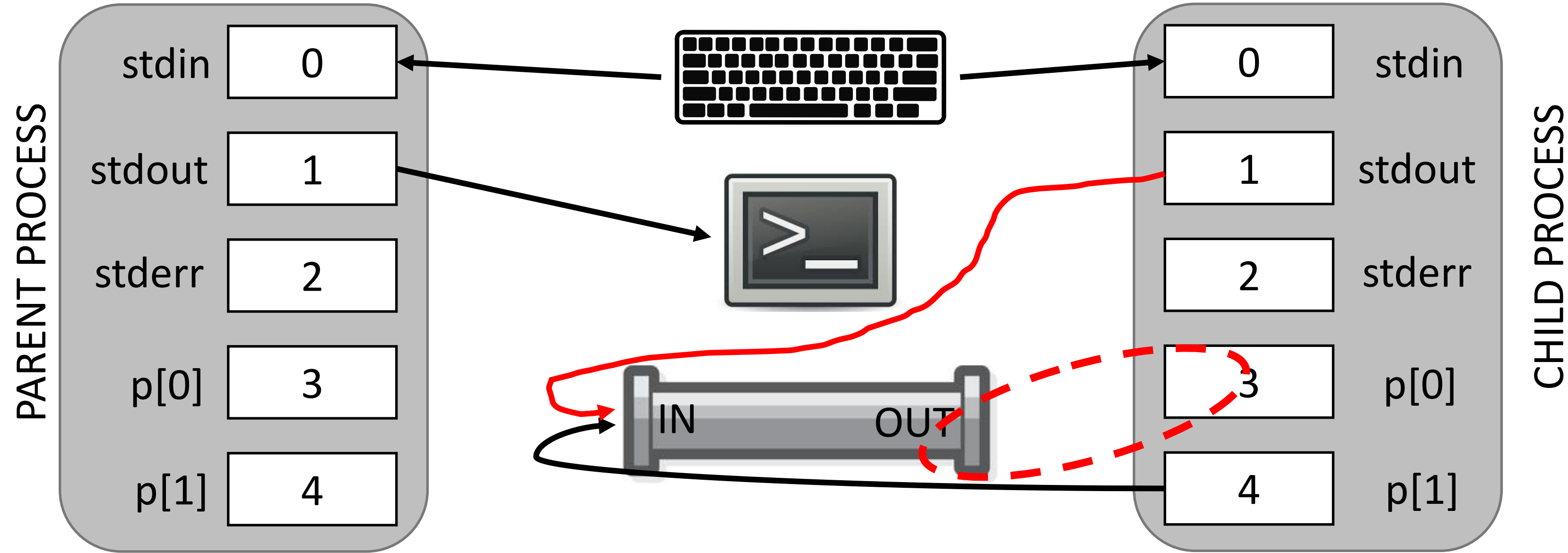

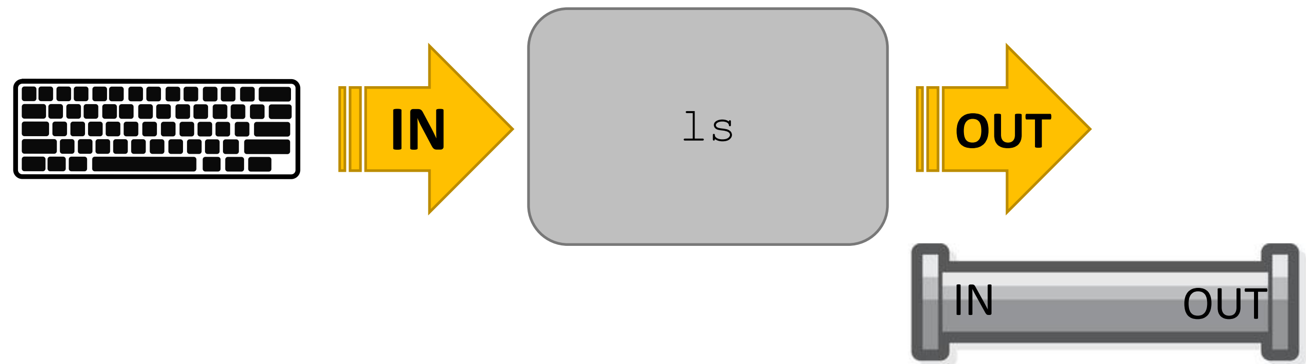

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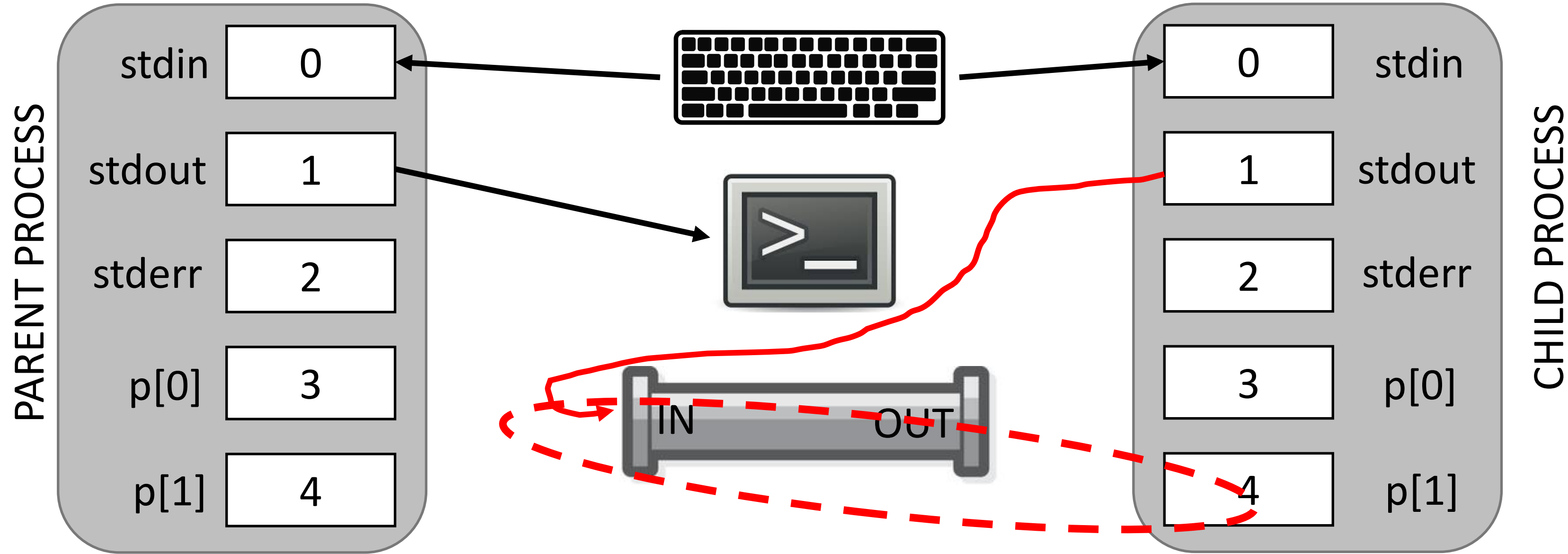

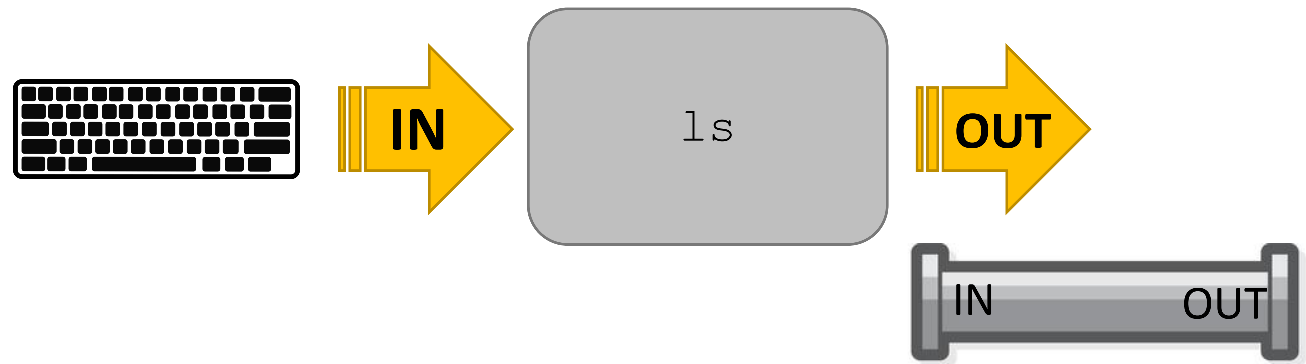

pipe() and fork()

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fork() copies the descriptors too!
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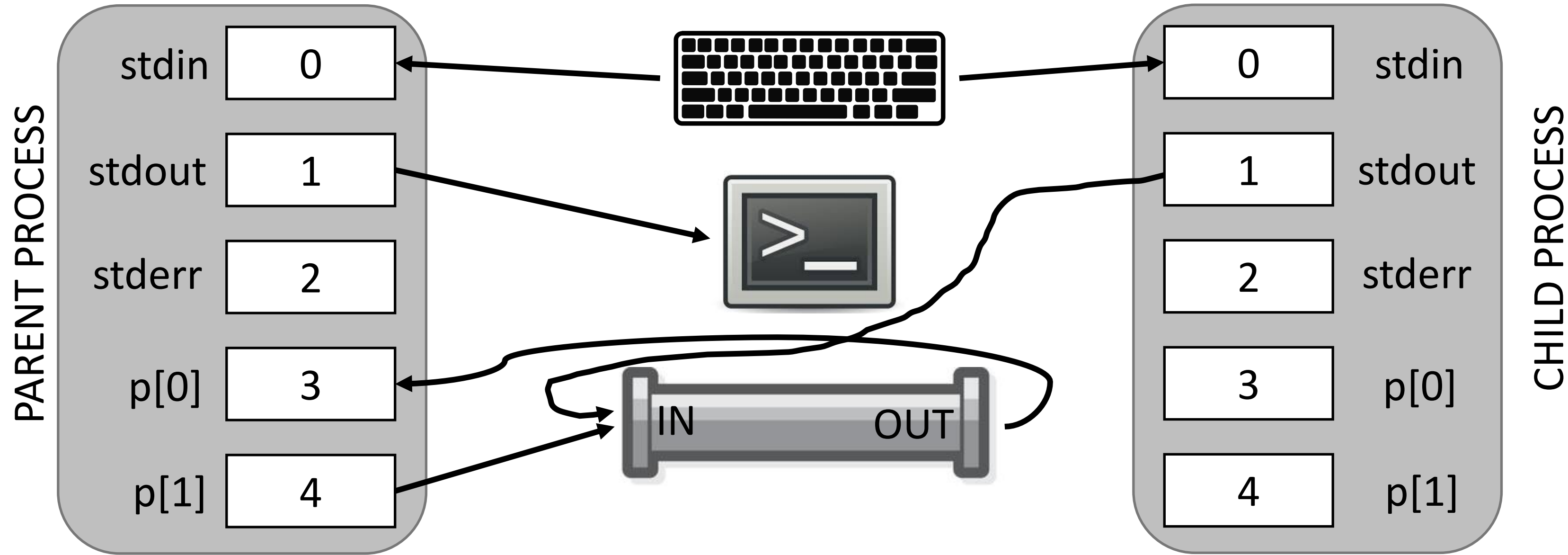

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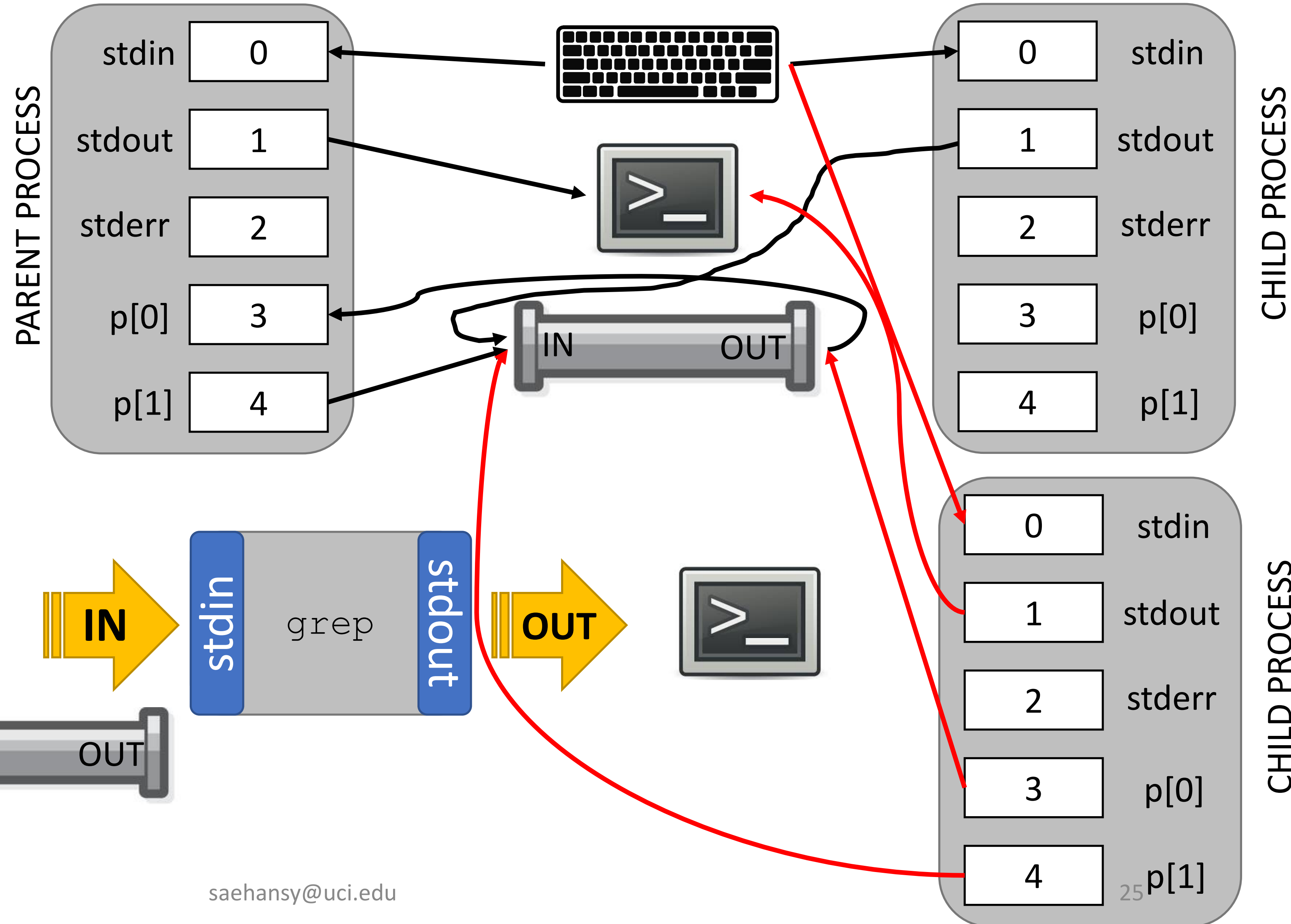

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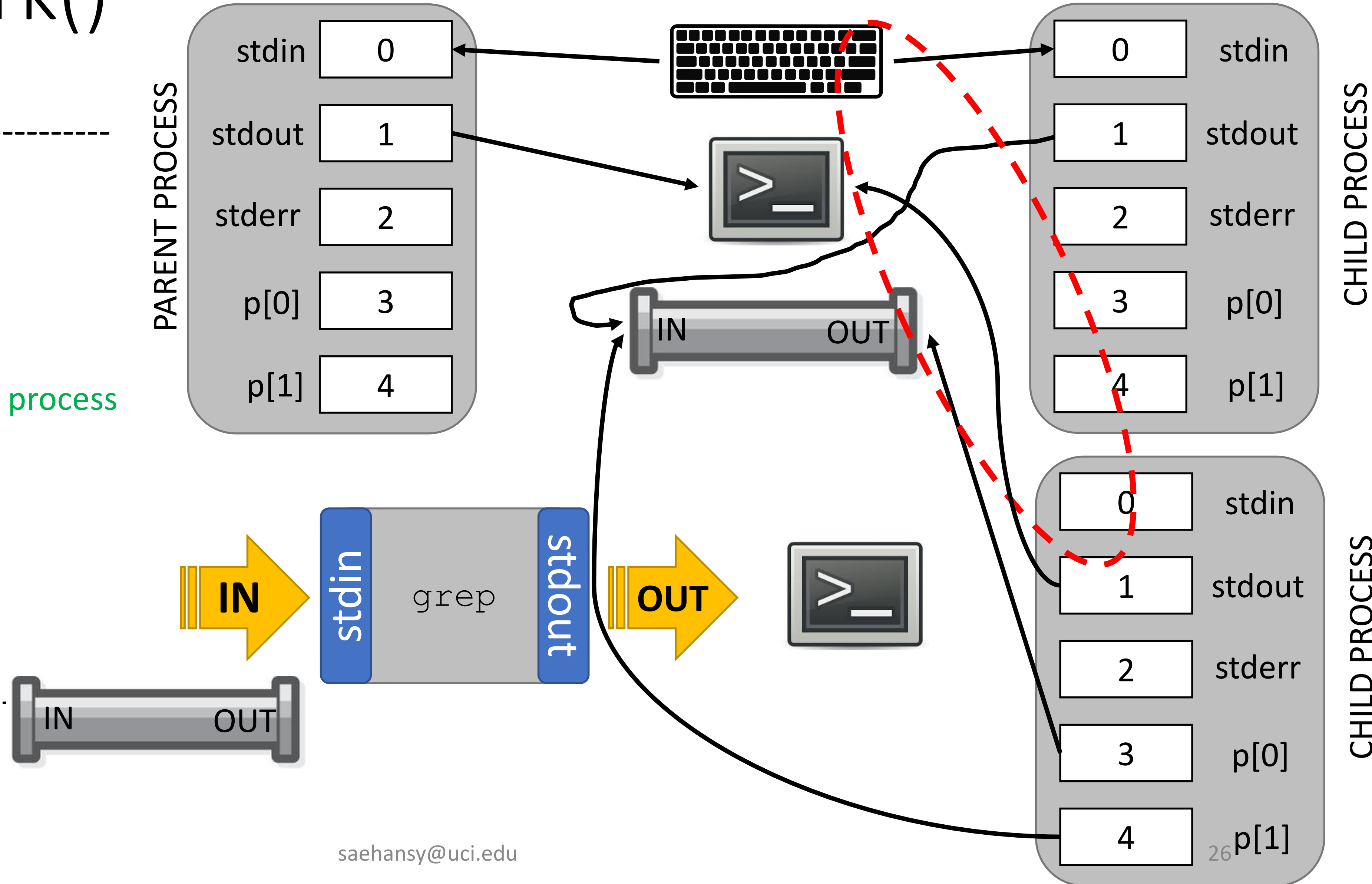

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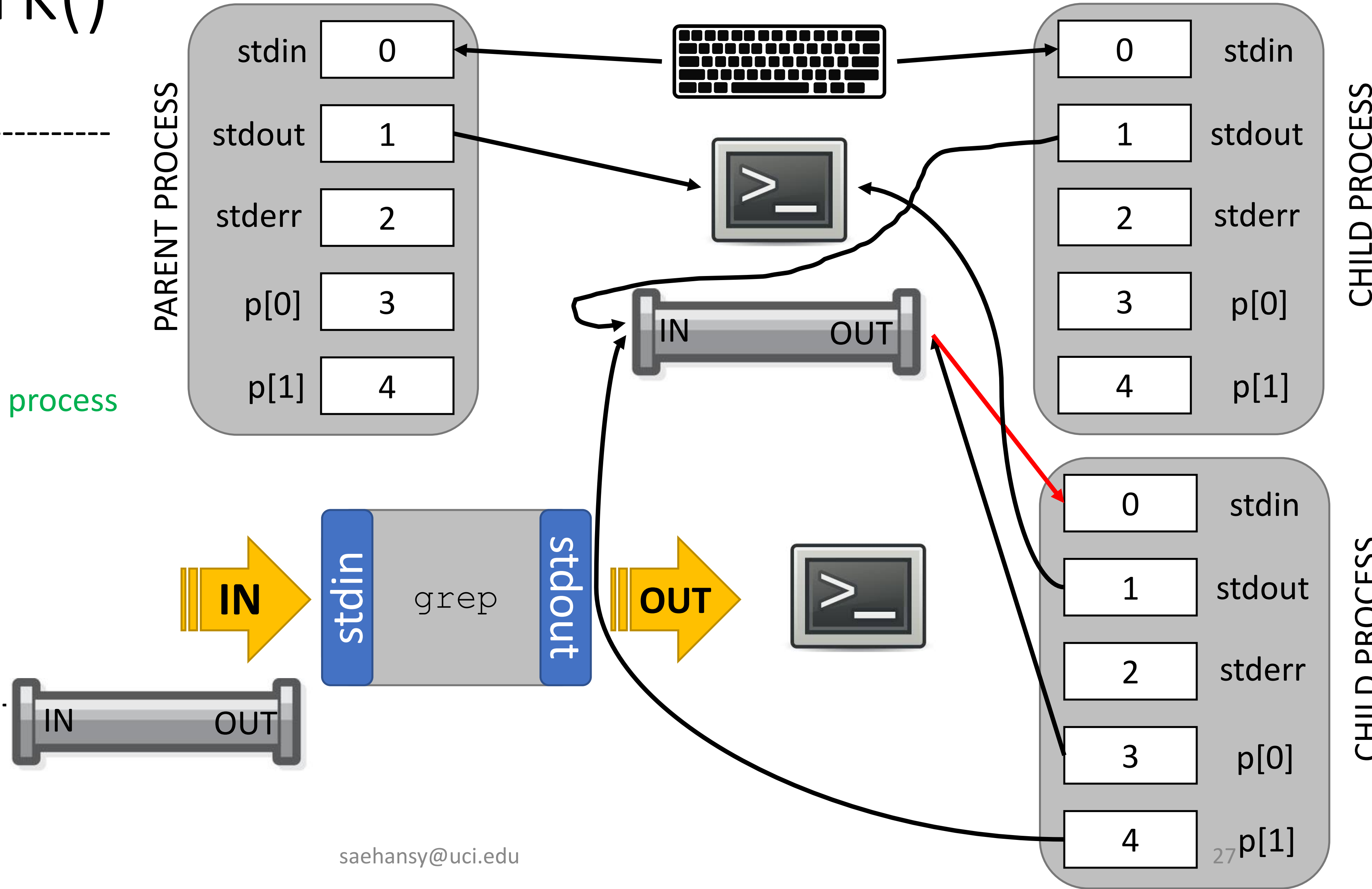

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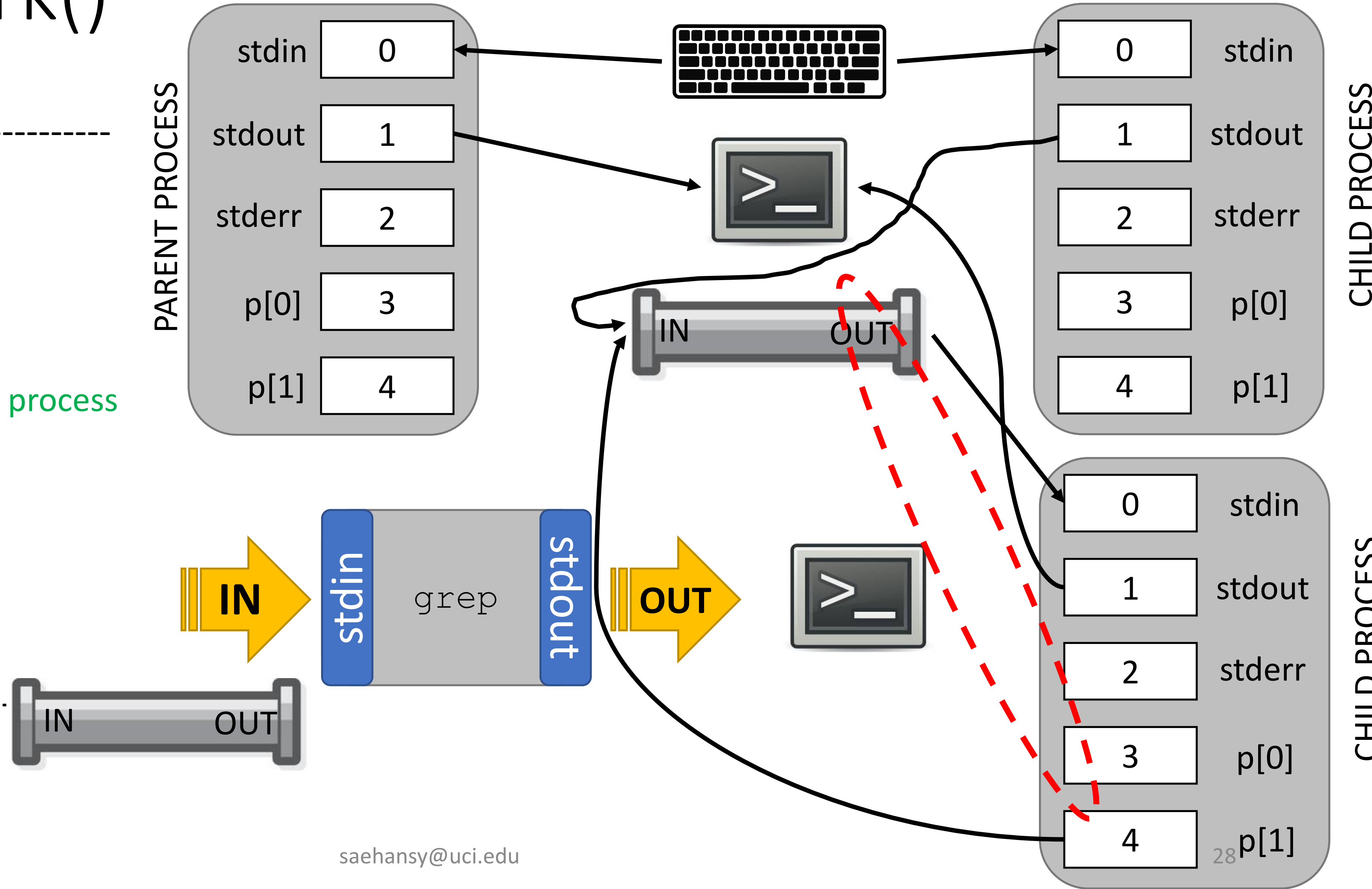

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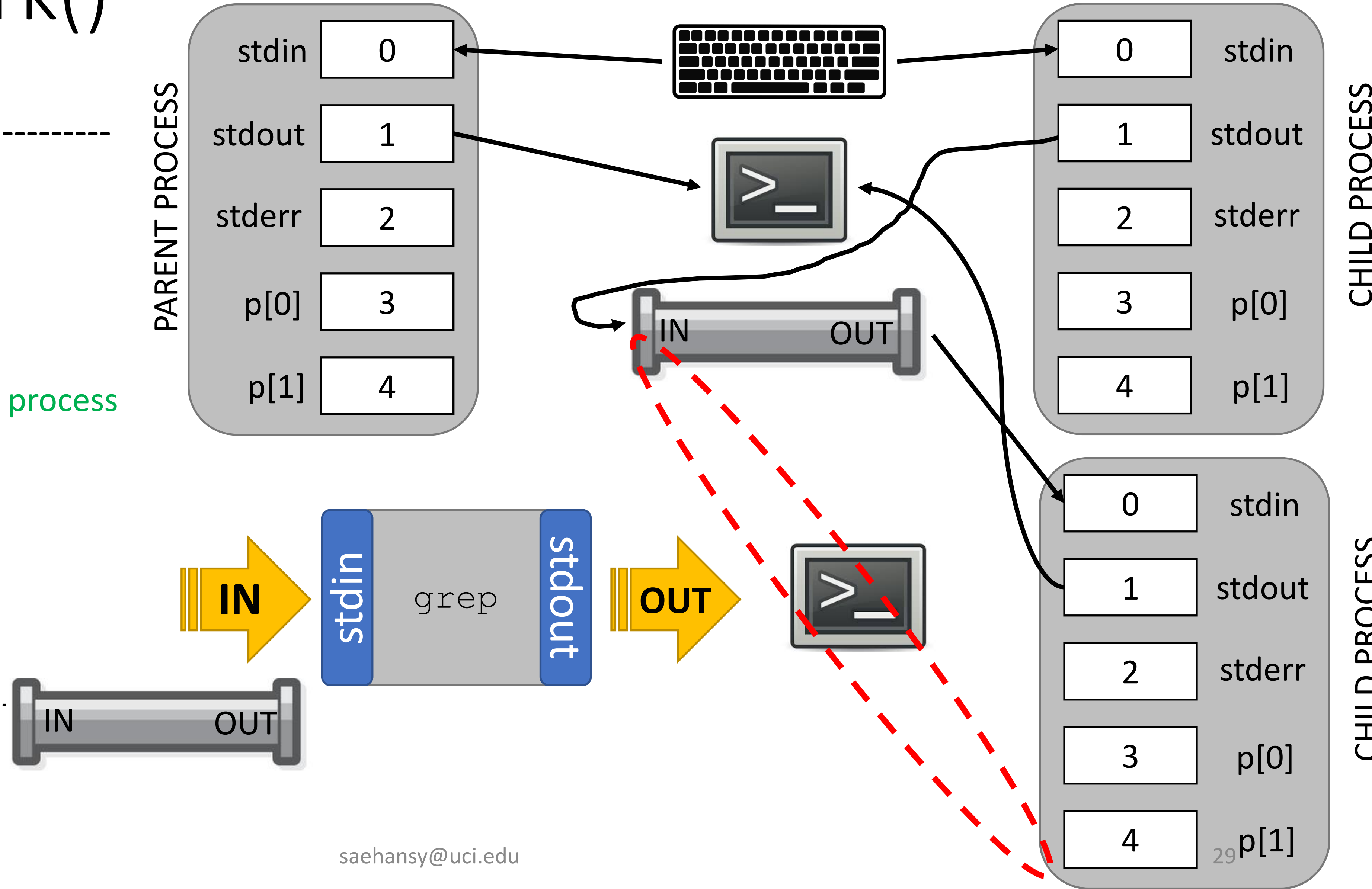

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pipe() and fork()

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Parent waits child processes

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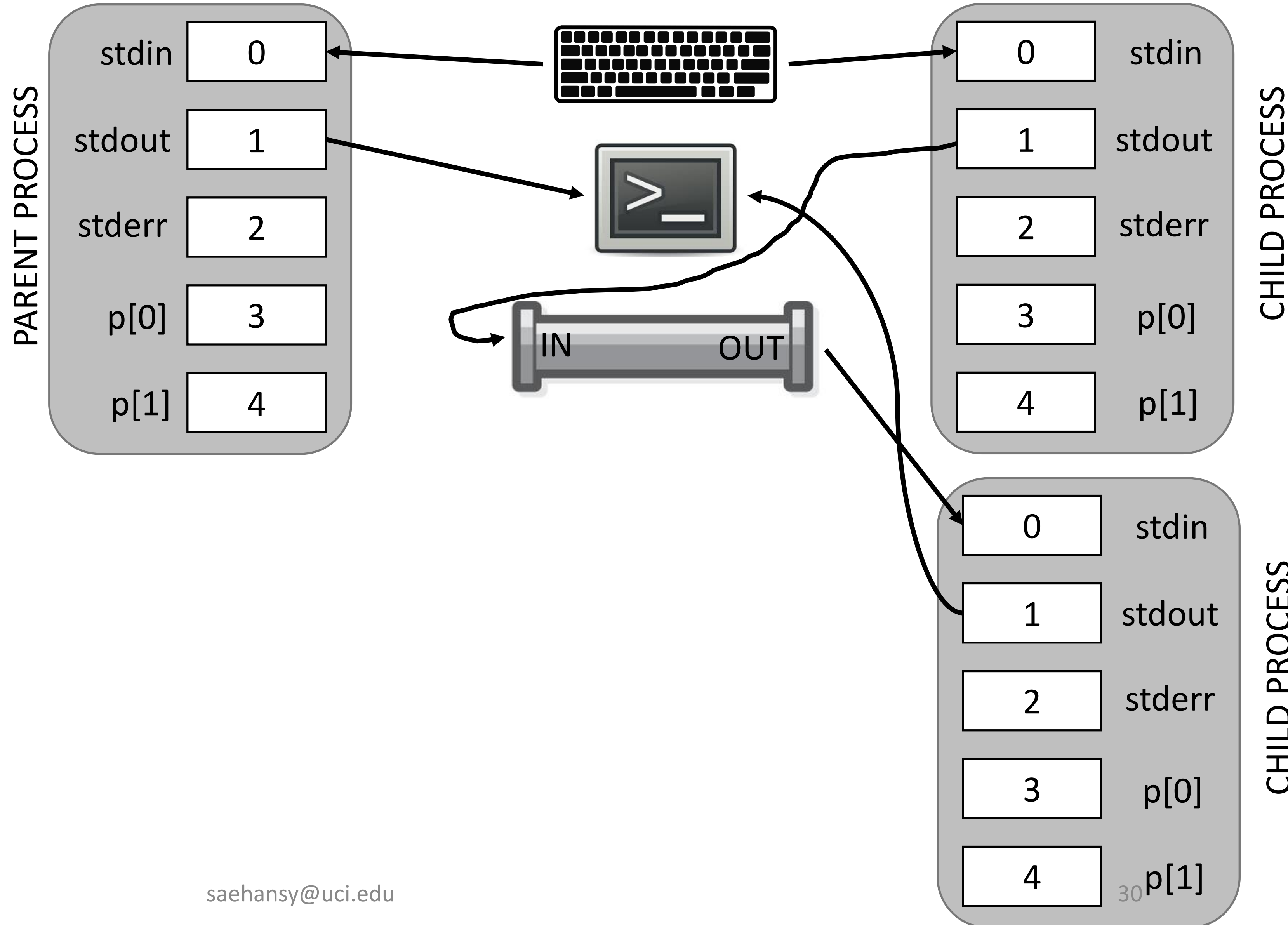

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pipe() and fork() and **exec()**

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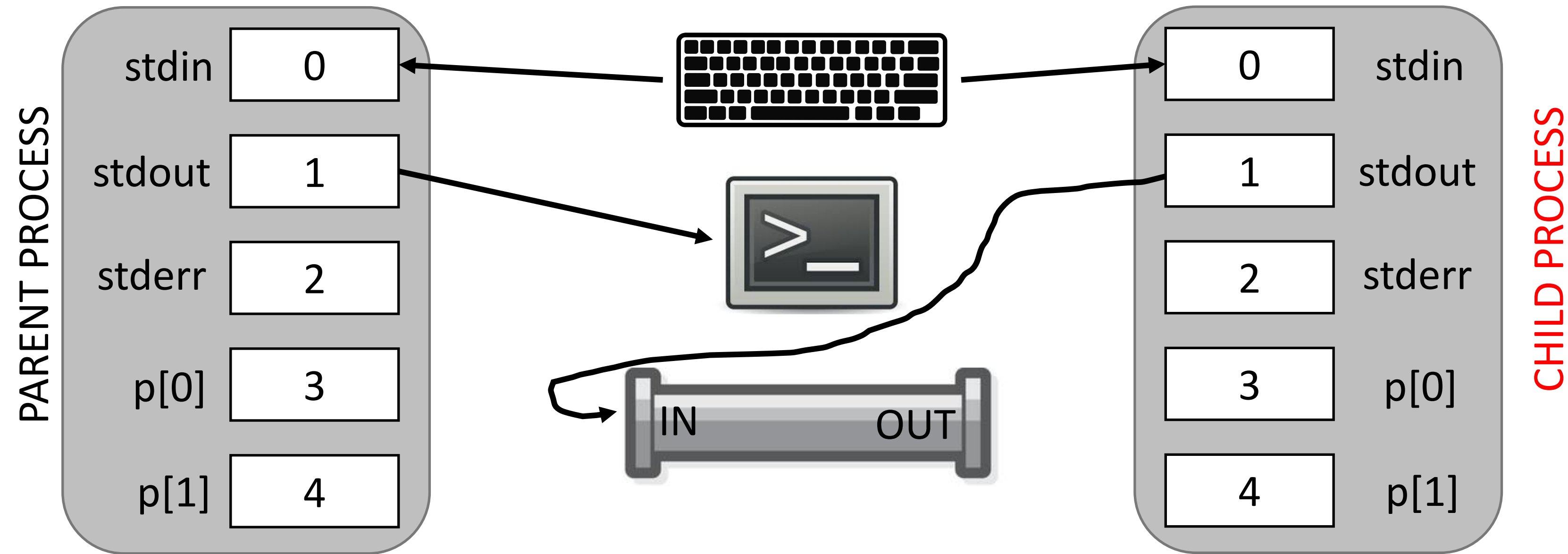
runcmd() contains exec functions

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int execvp(const char *_file_, char *const _argv_[]);
replaces the current process image with a new process image.

pipe() and fork() and **exec()**

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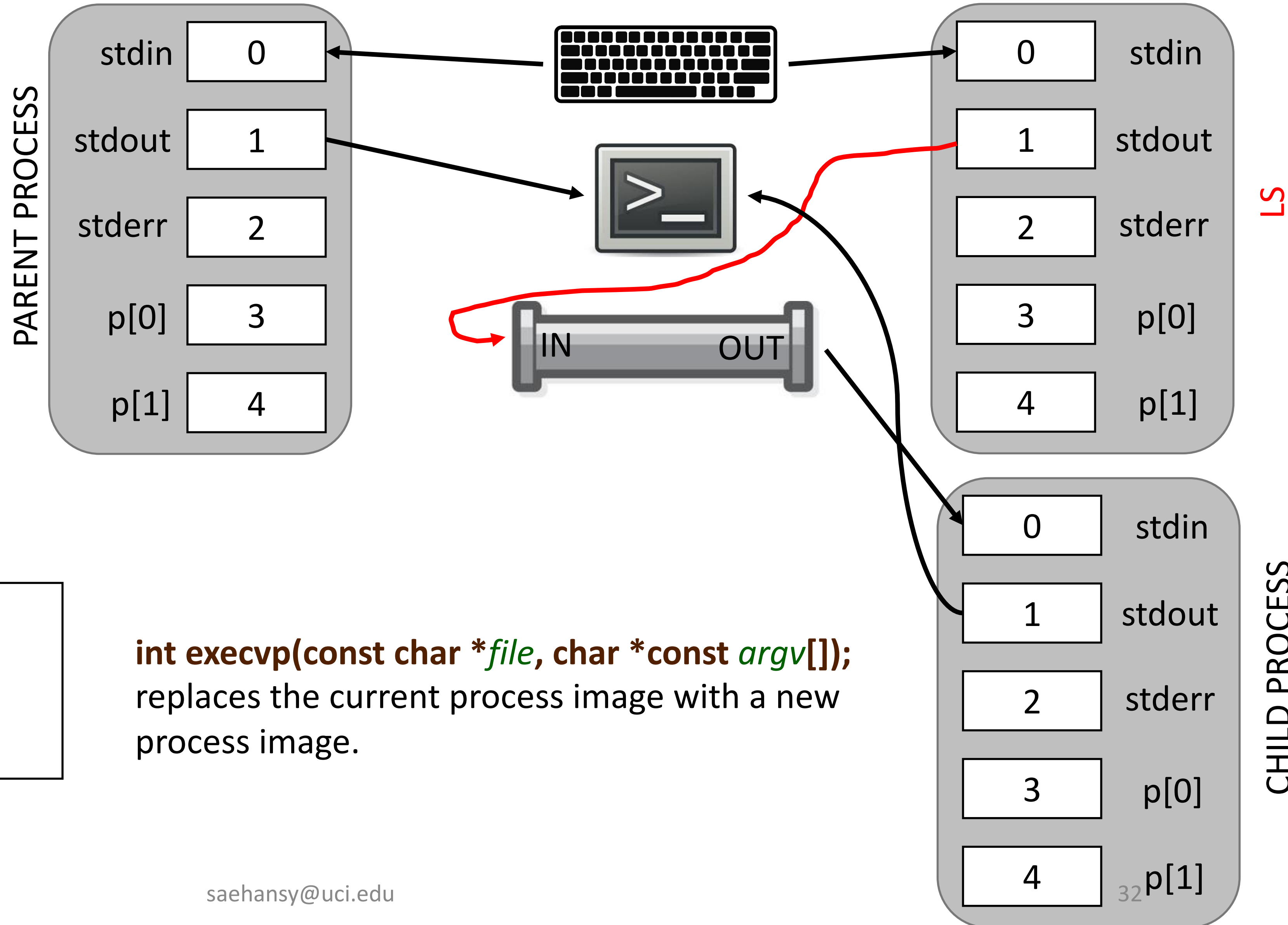

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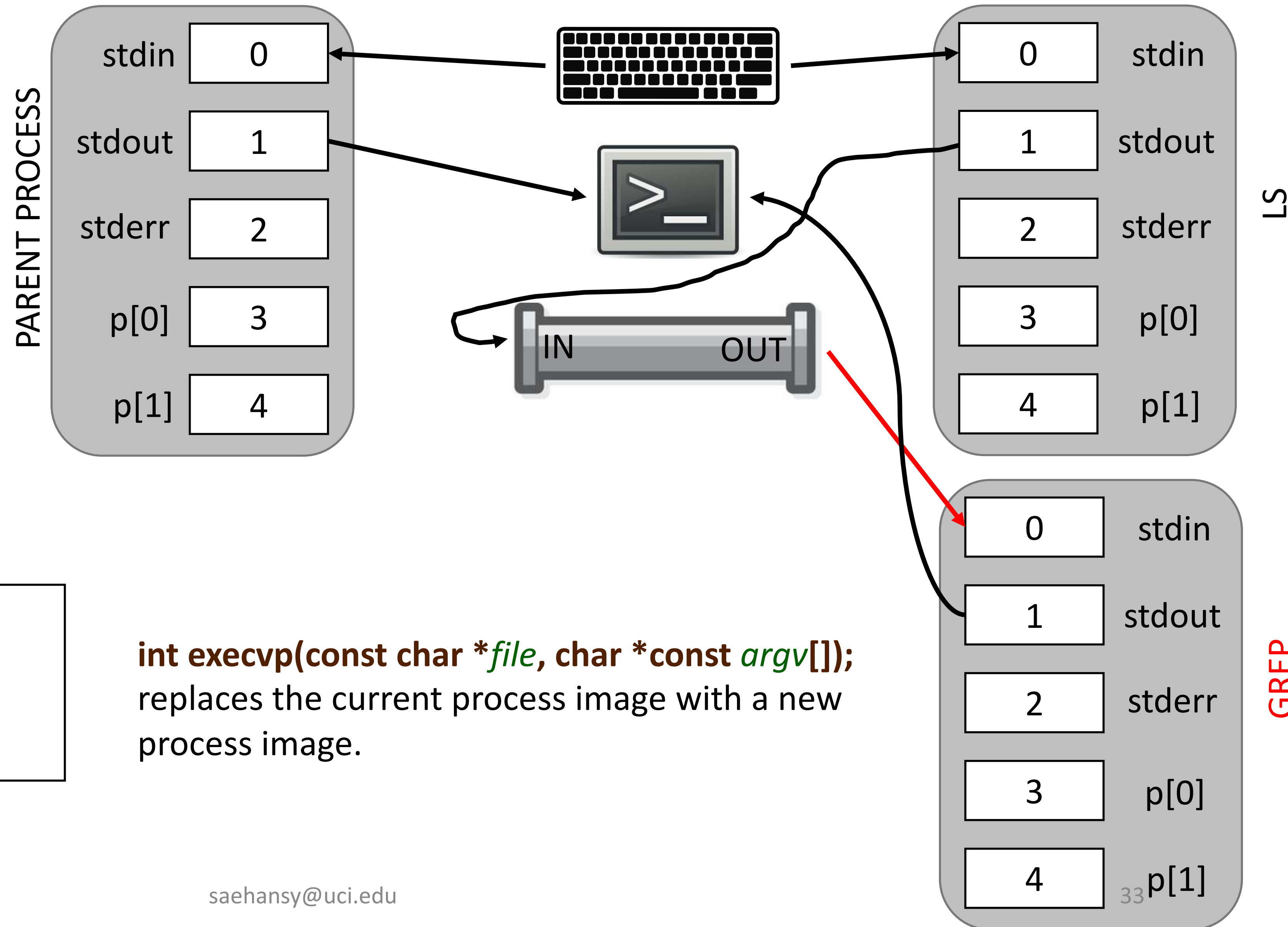


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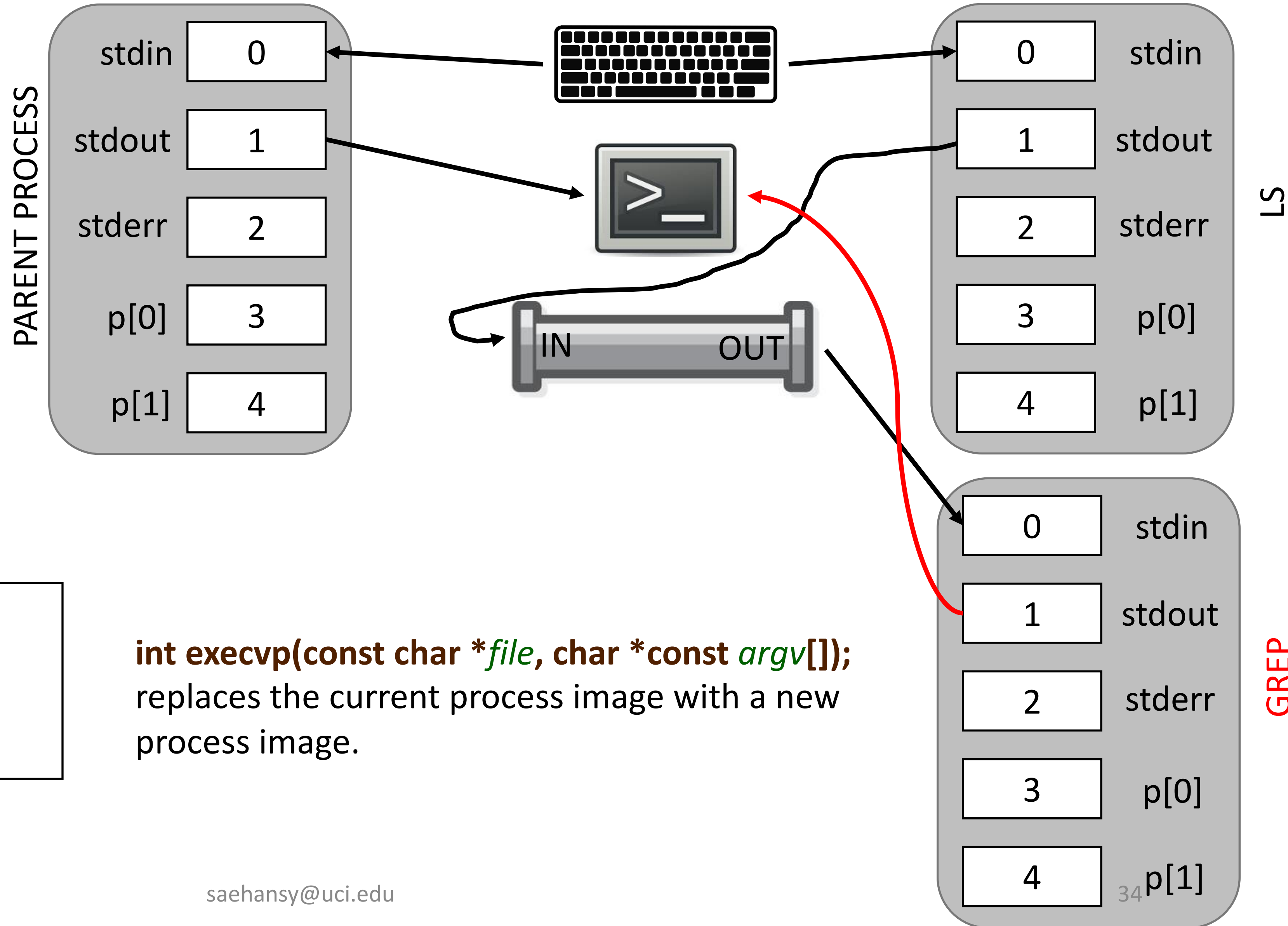

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