CS143A
Principles on Operating Systems
Discussion 08:

Instructor: Prof. Anton Burtsev

TA: Saehanseul Yi (Hans)

Nov 22, 2019 **Noon**

Agenda

- pipe() and fork(): visualization
- How to debug a user-program in xv6
- sh.c call structure

pipe() and fork()

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case PIPE:
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if(pipe(p) < 0)
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   runcmd(pcmd>left);
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wait();
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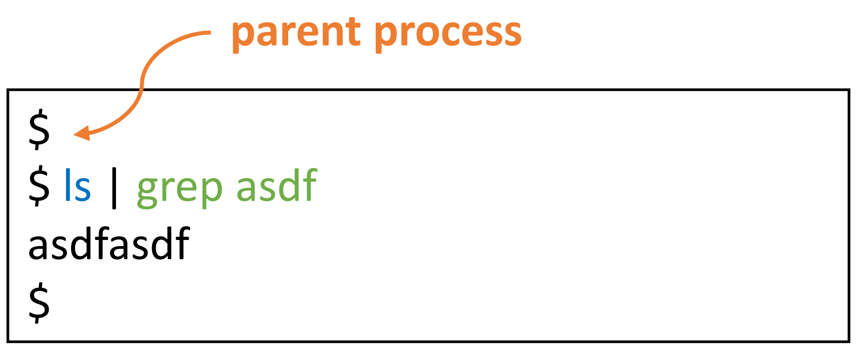

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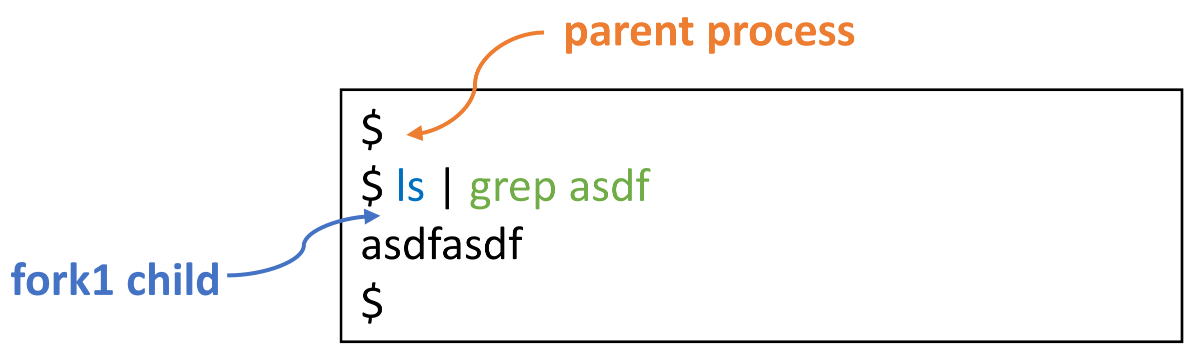

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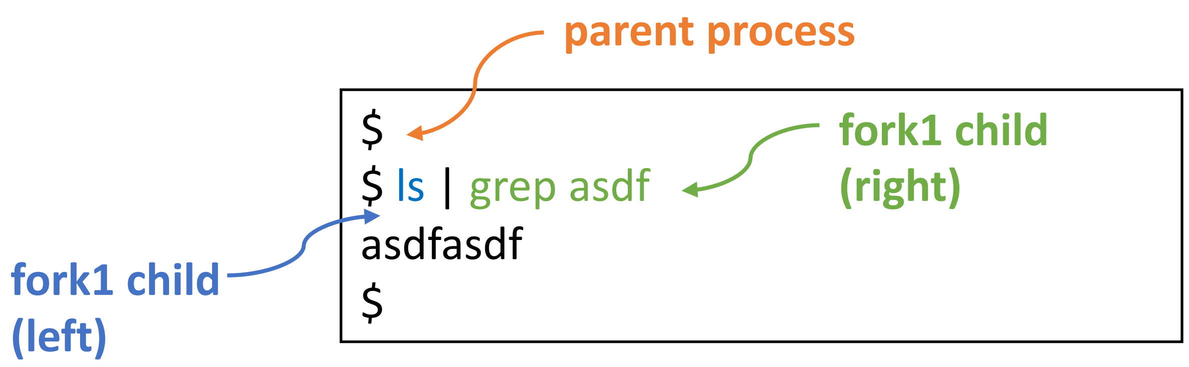

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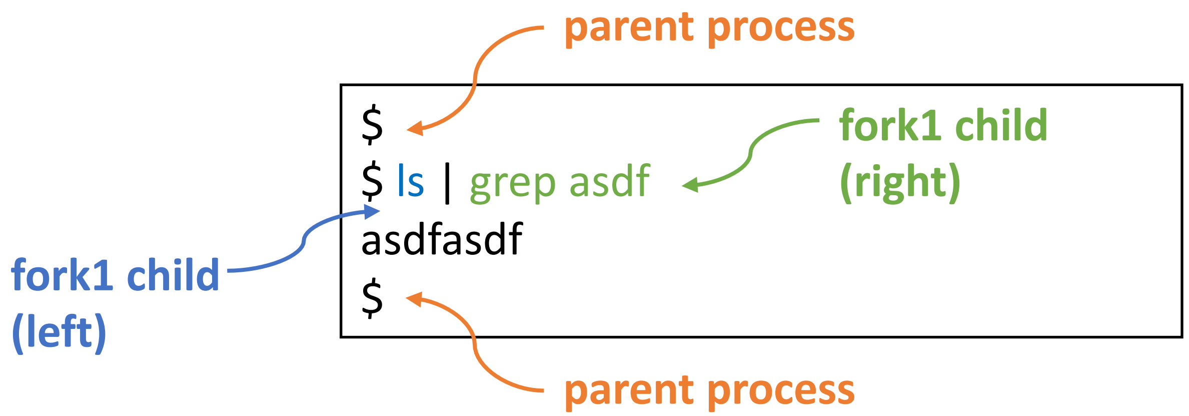

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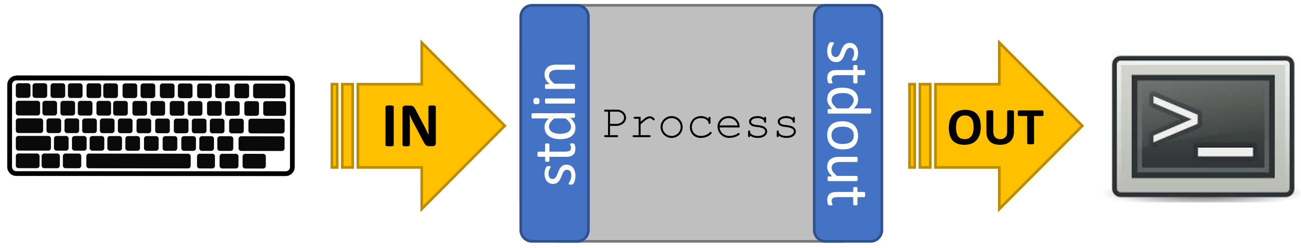

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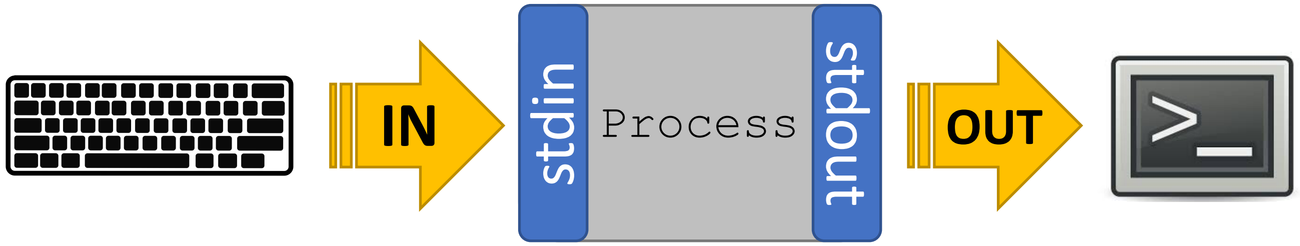

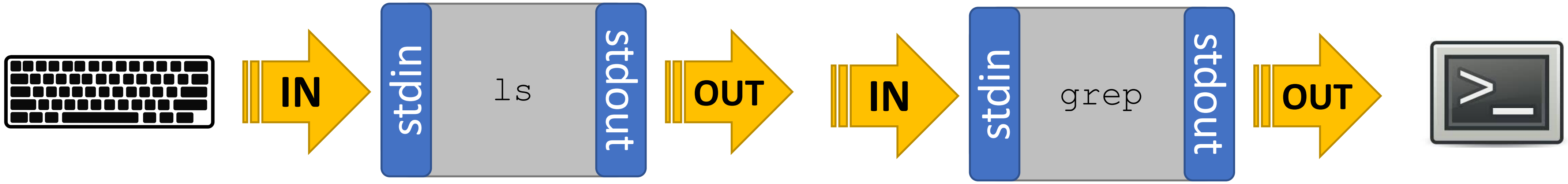

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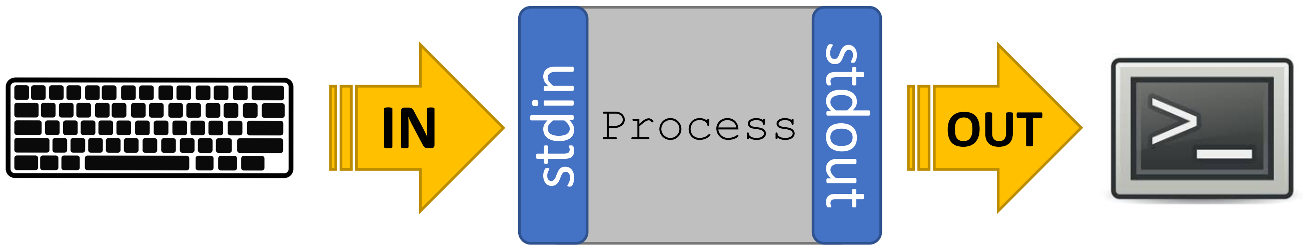

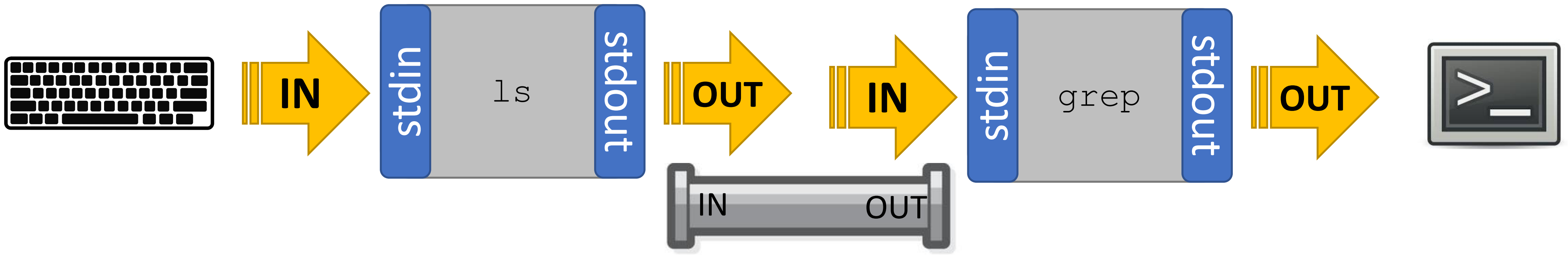

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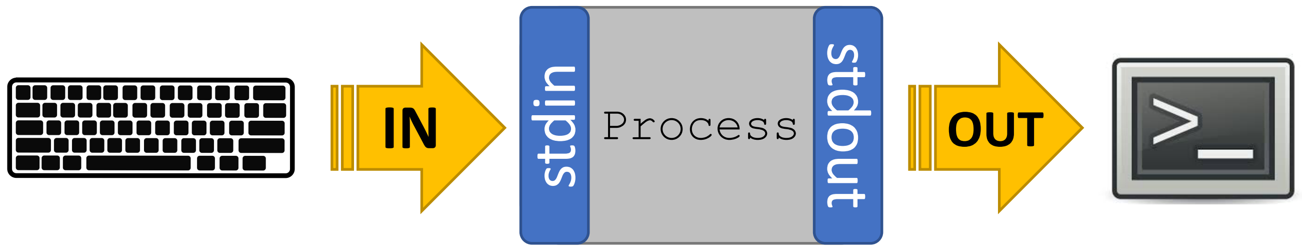

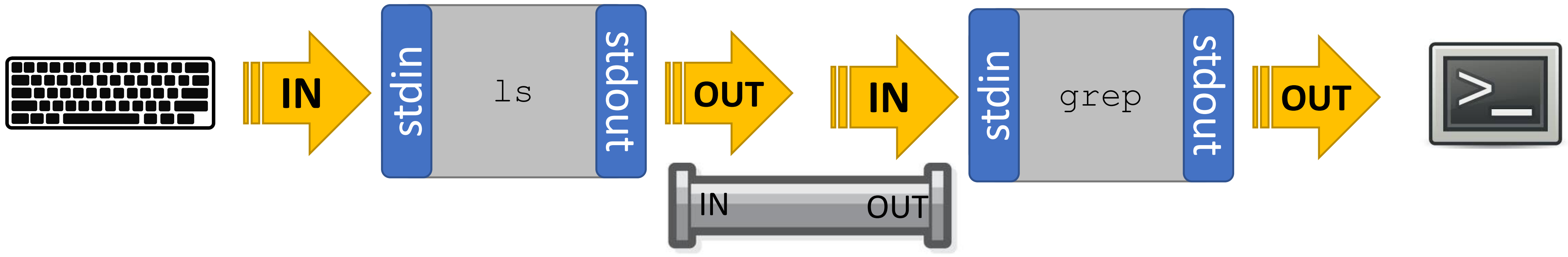

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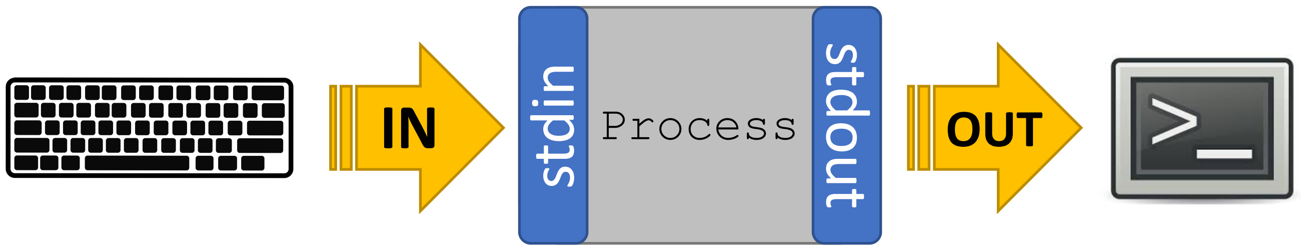

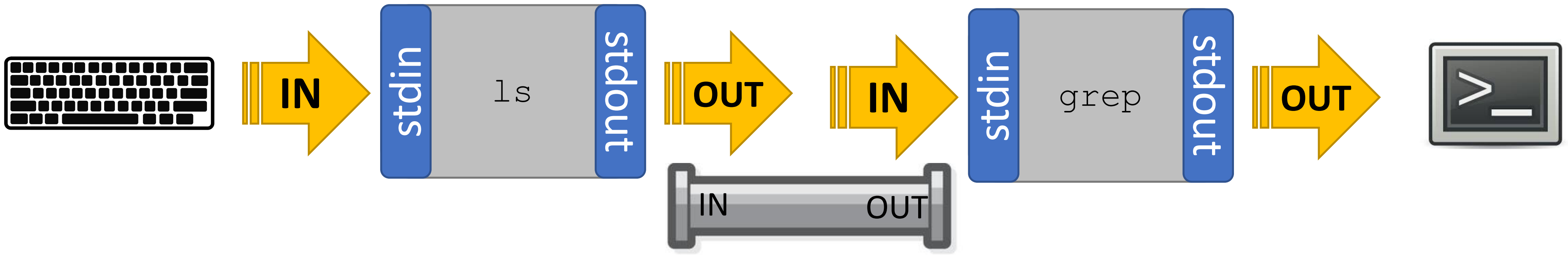

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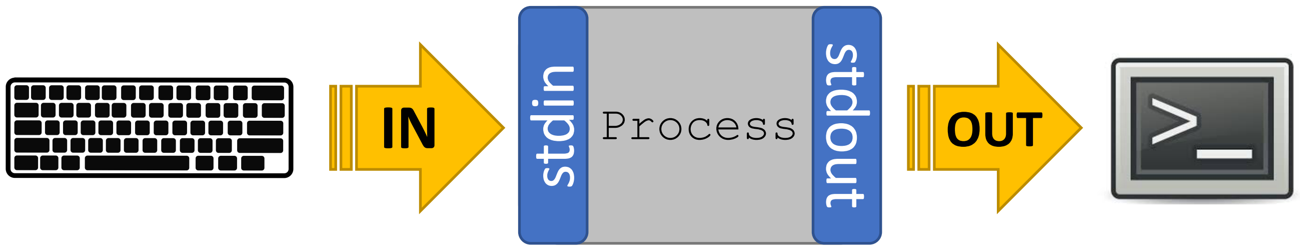

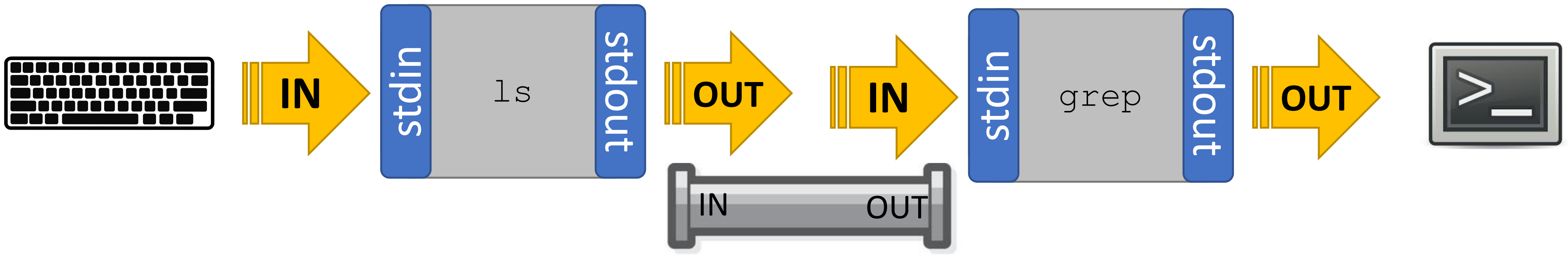

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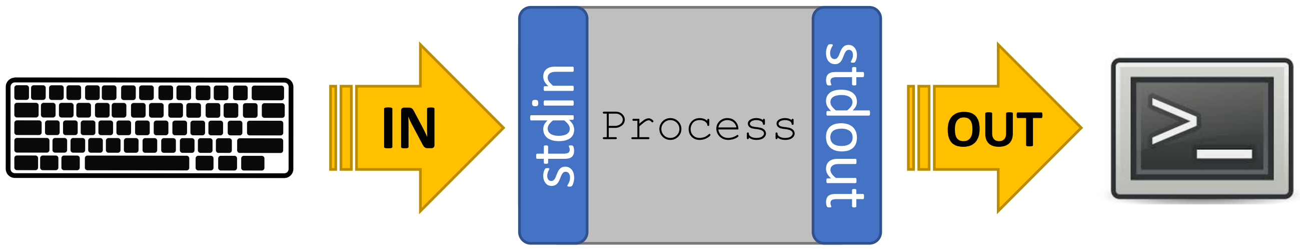

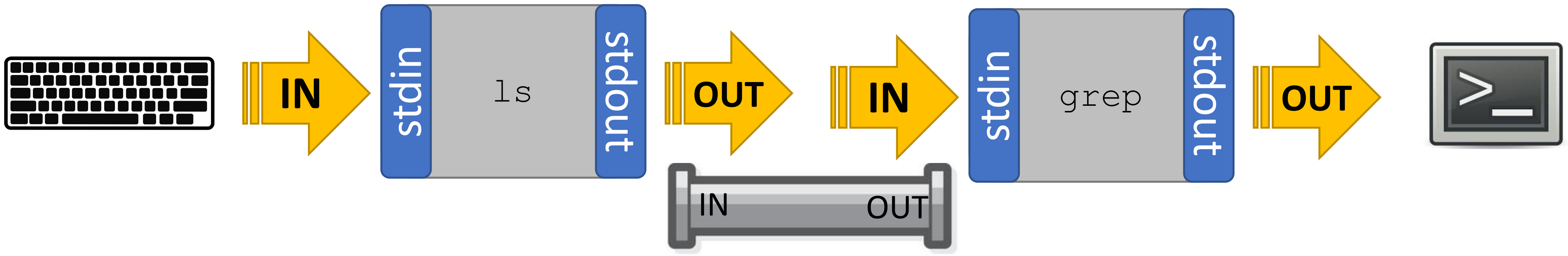

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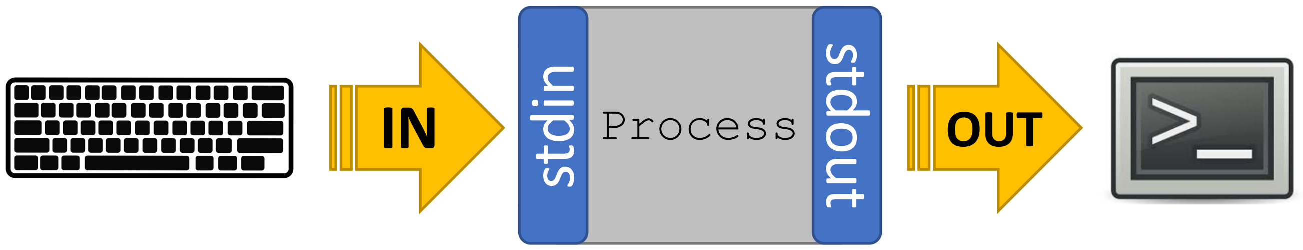

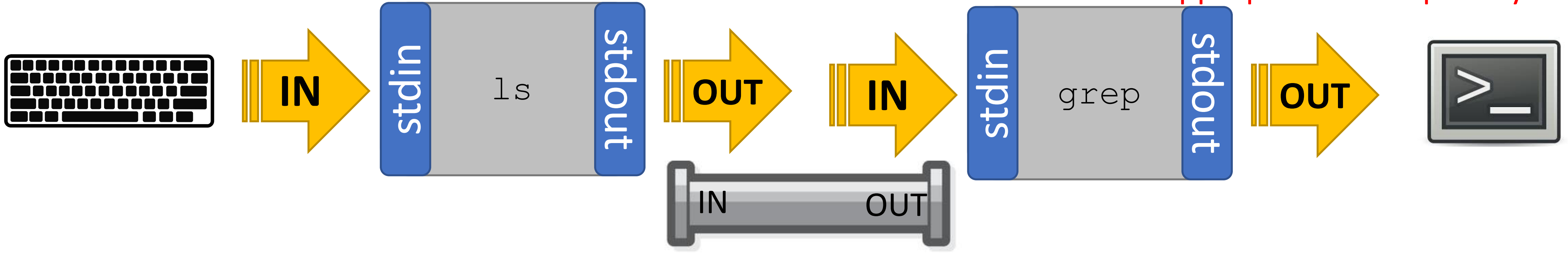

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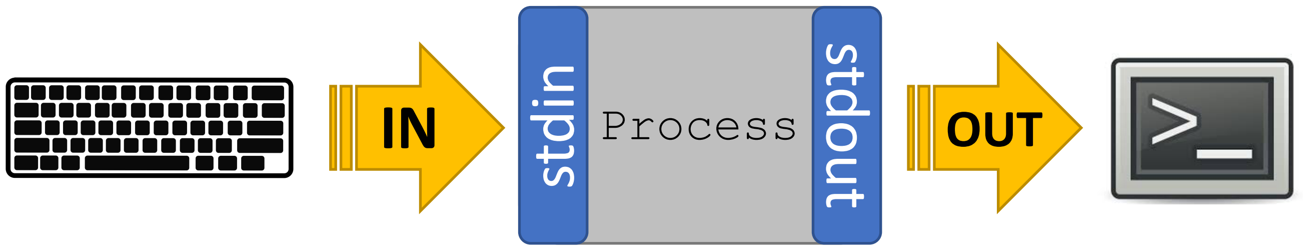

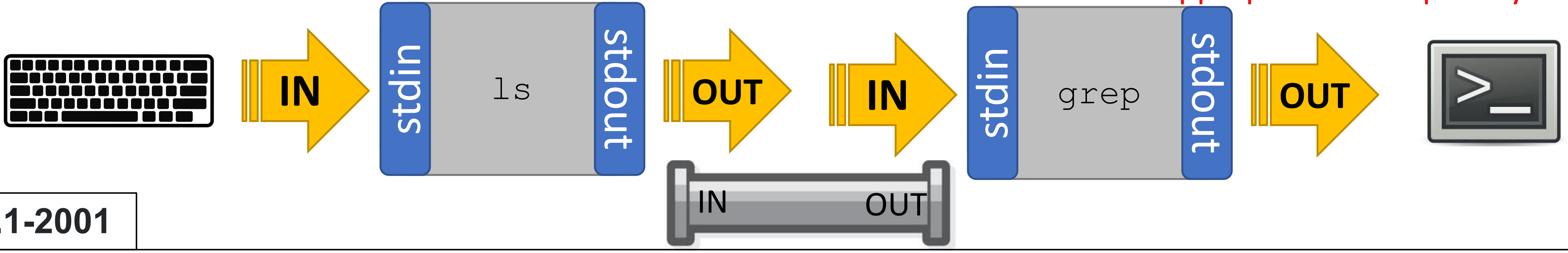

POSIX.1-2001

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()

※ 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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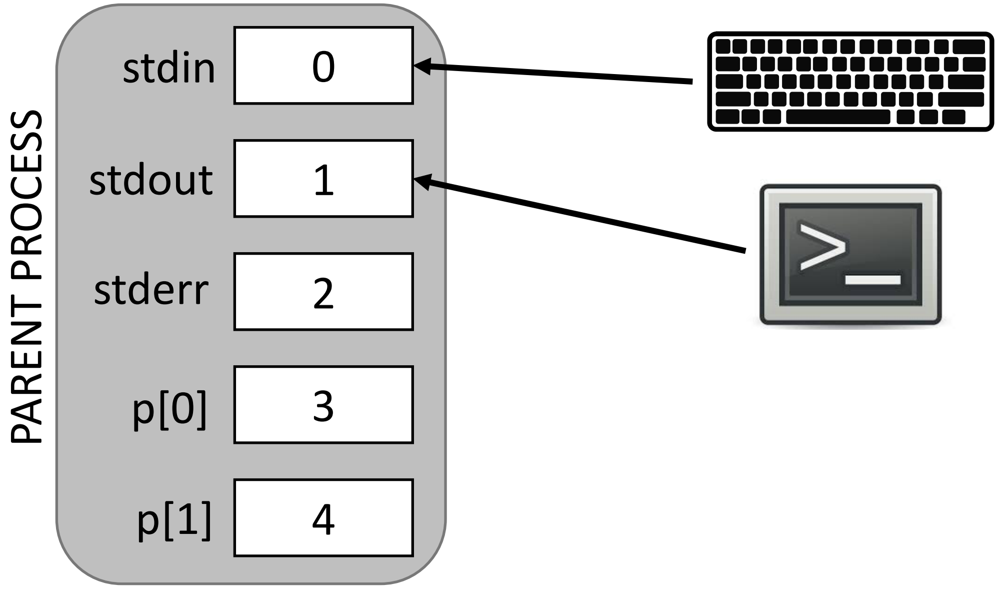

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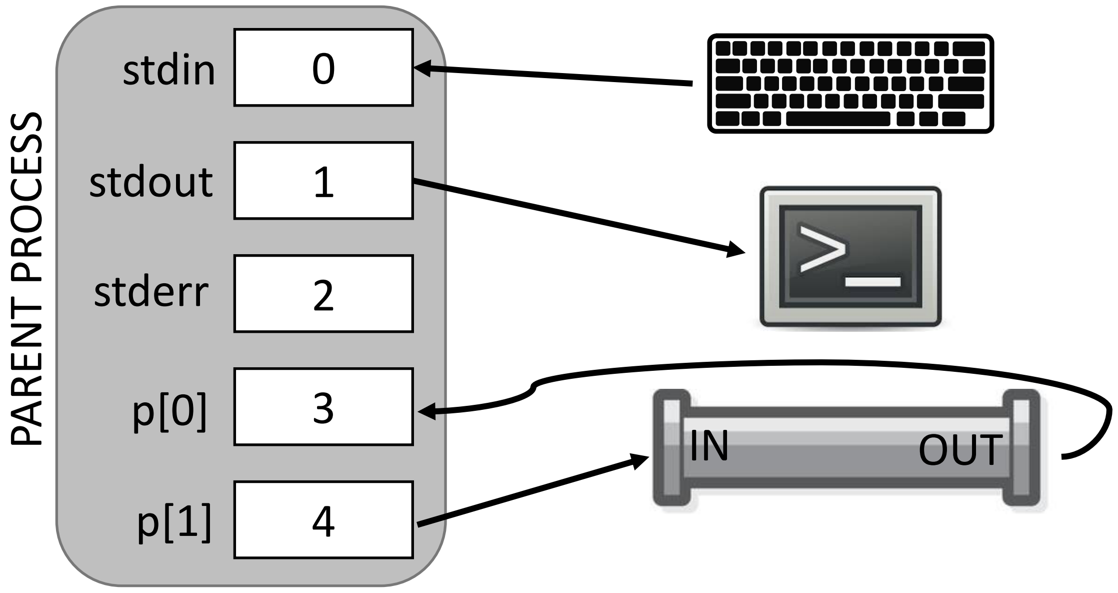

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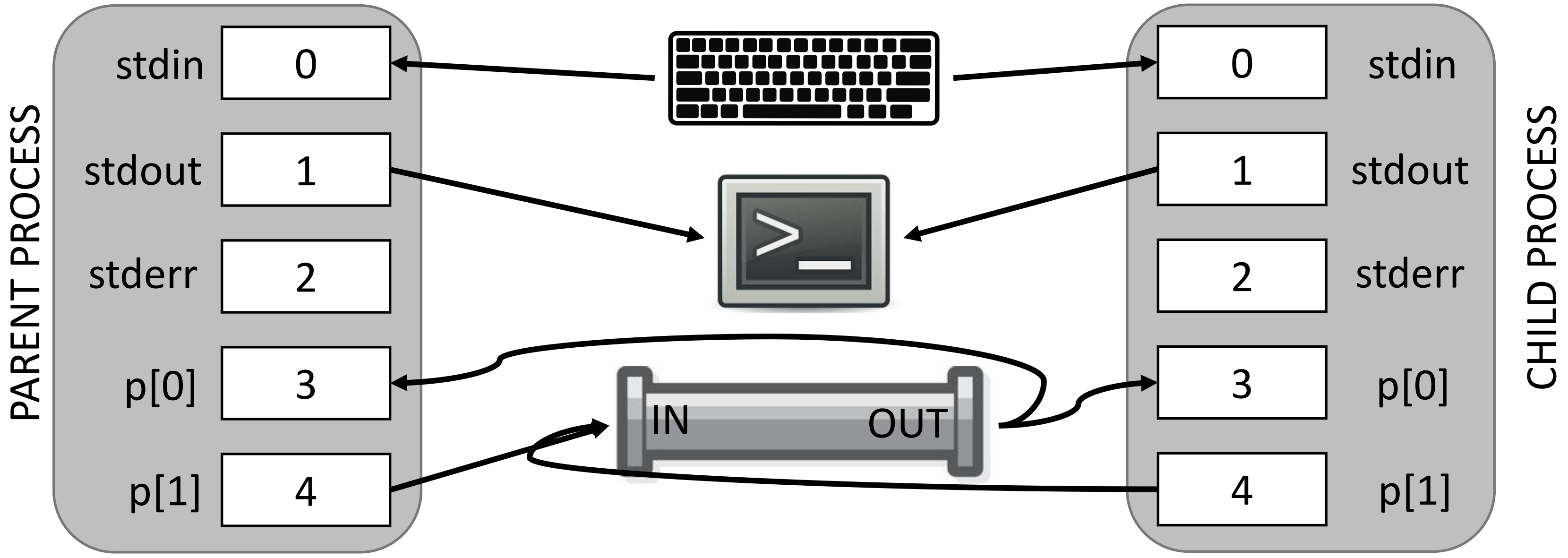
fork() copies the descriptors too!



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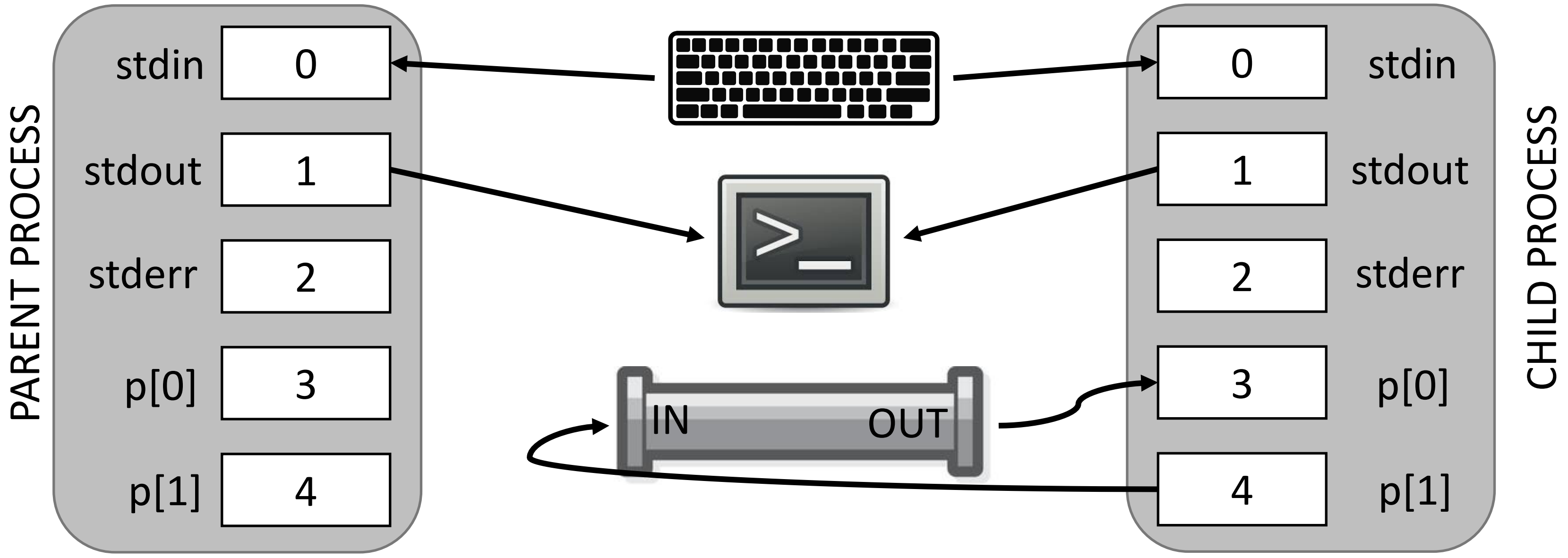

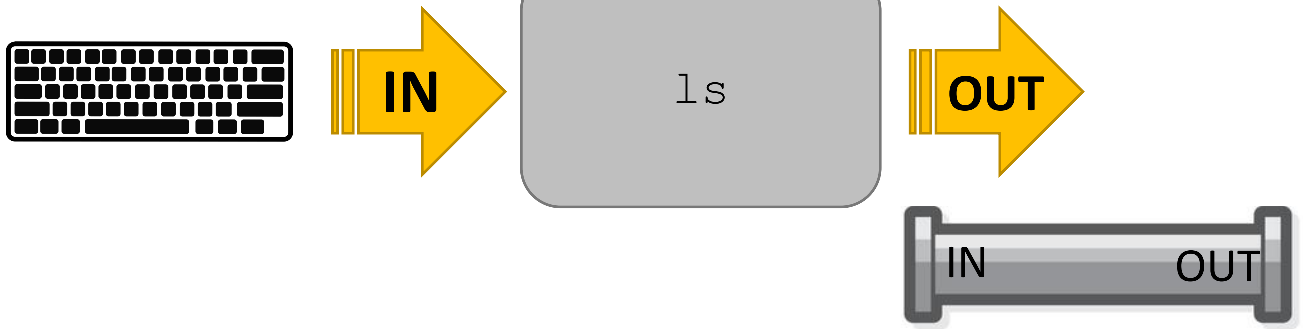

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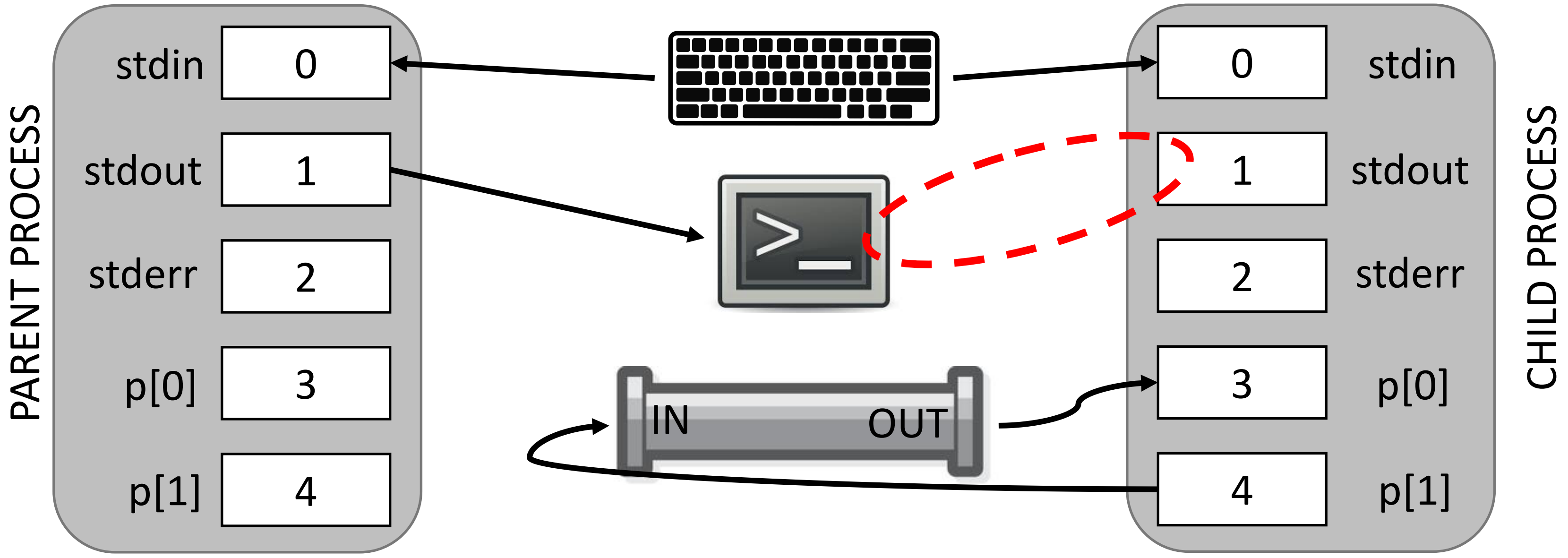

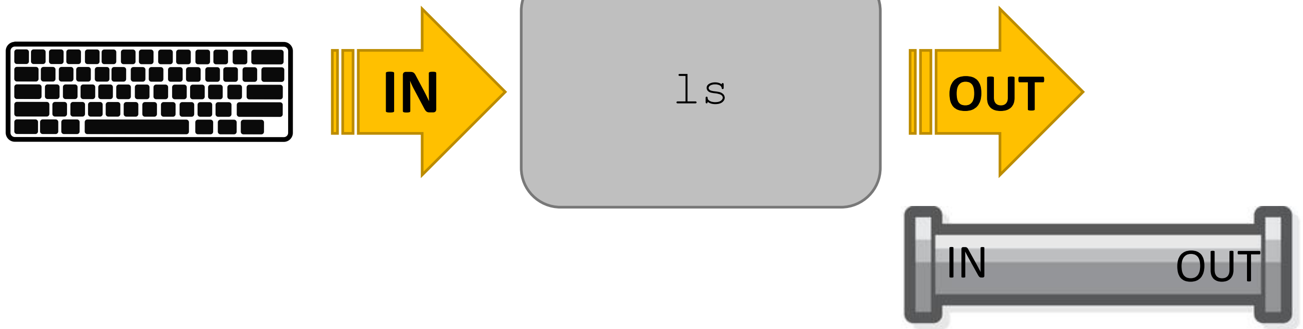

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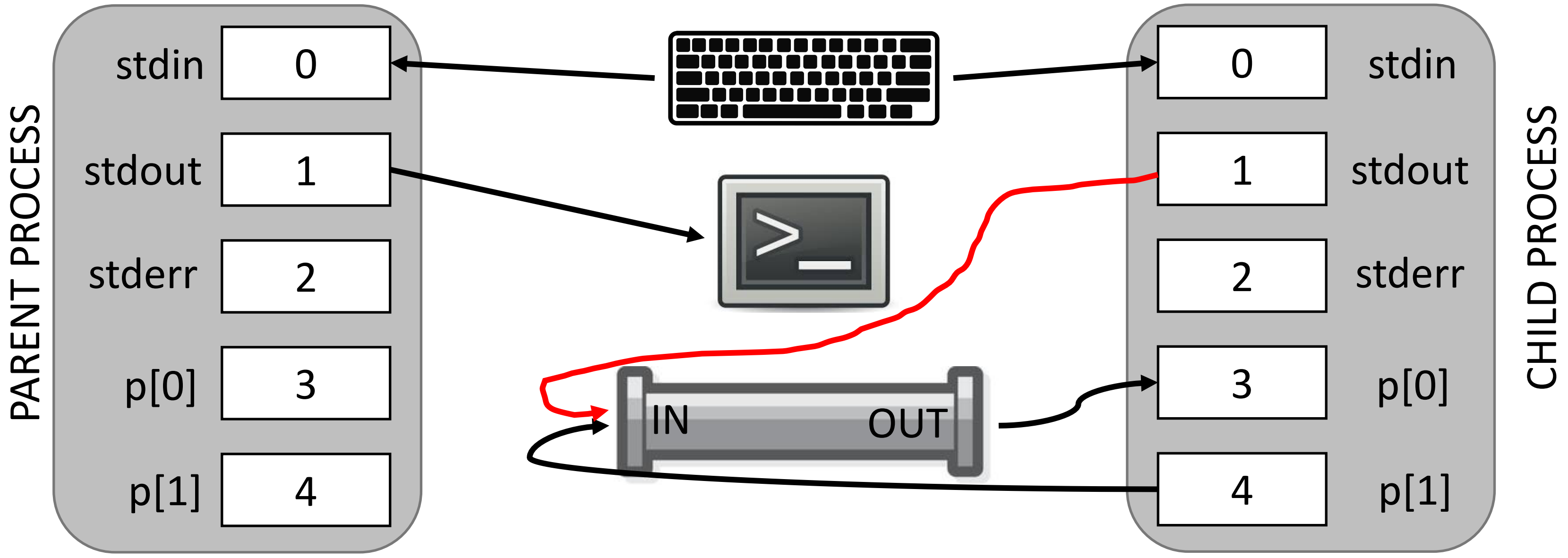
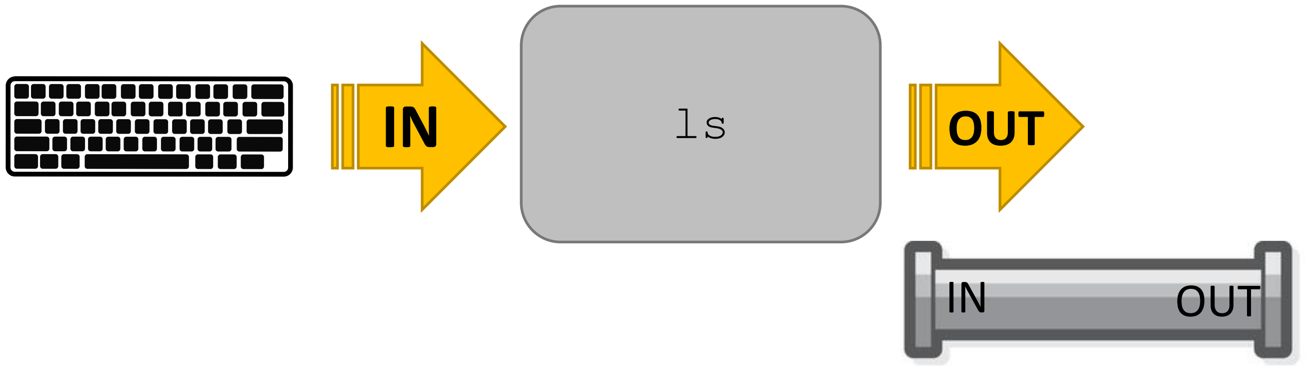
fork() copies the descriptors too!

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





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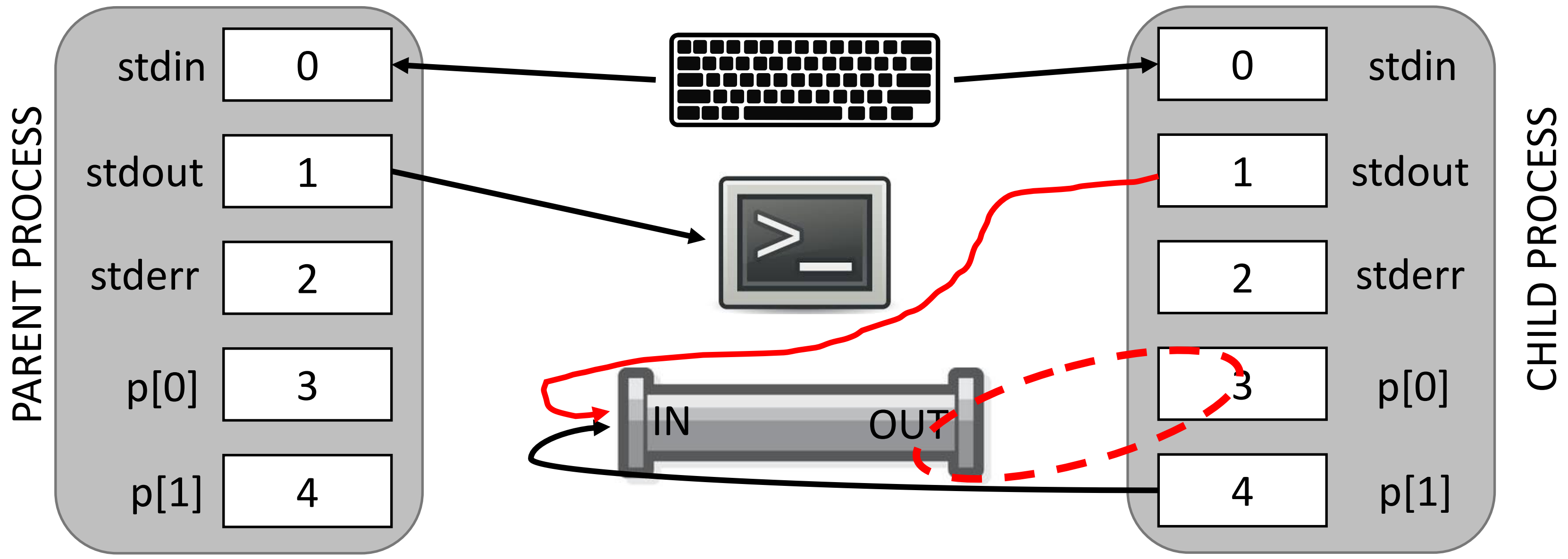

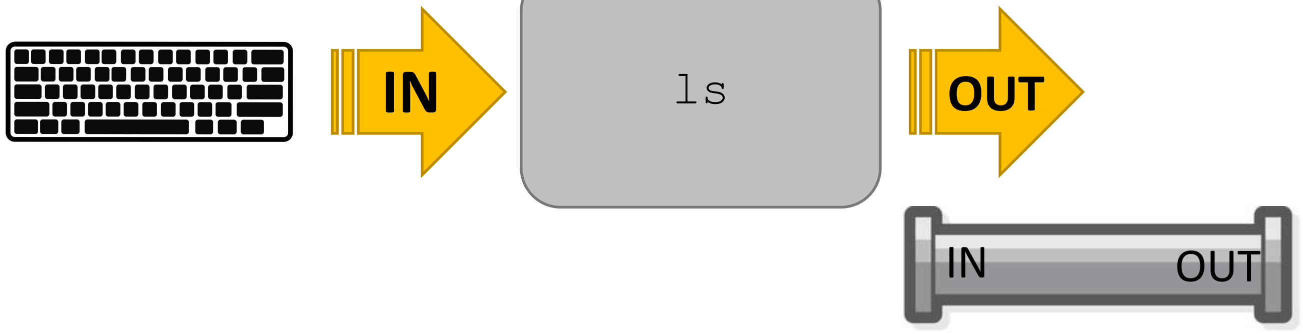

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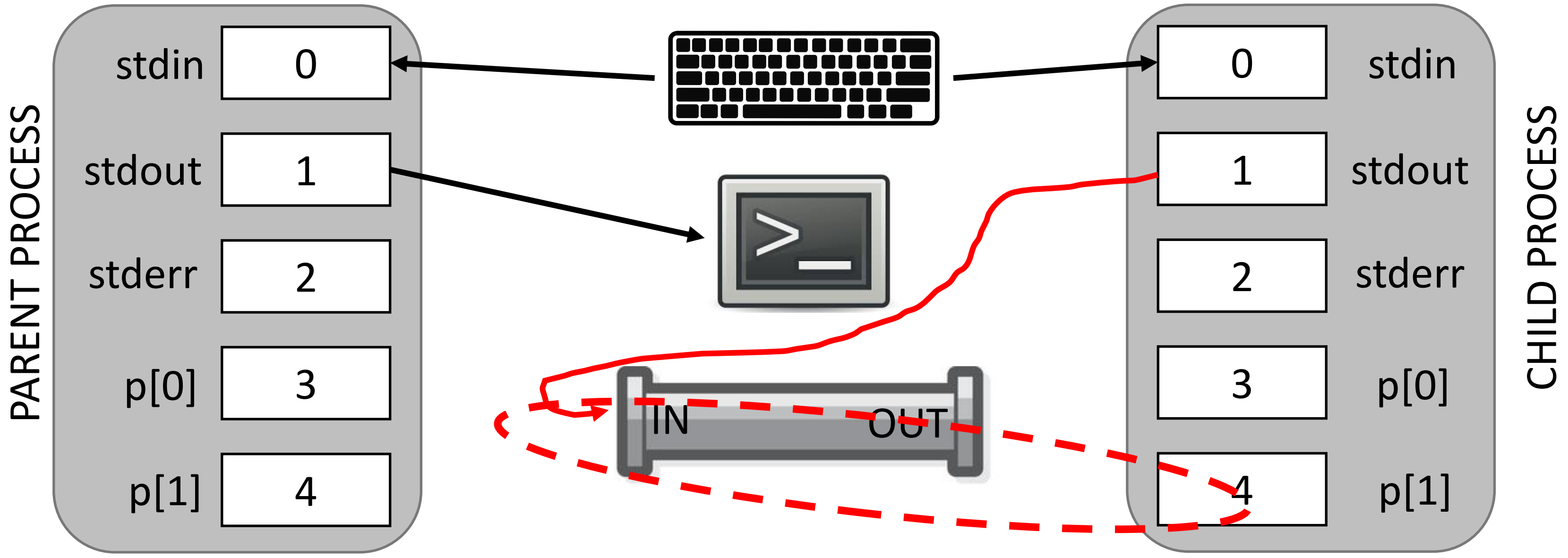

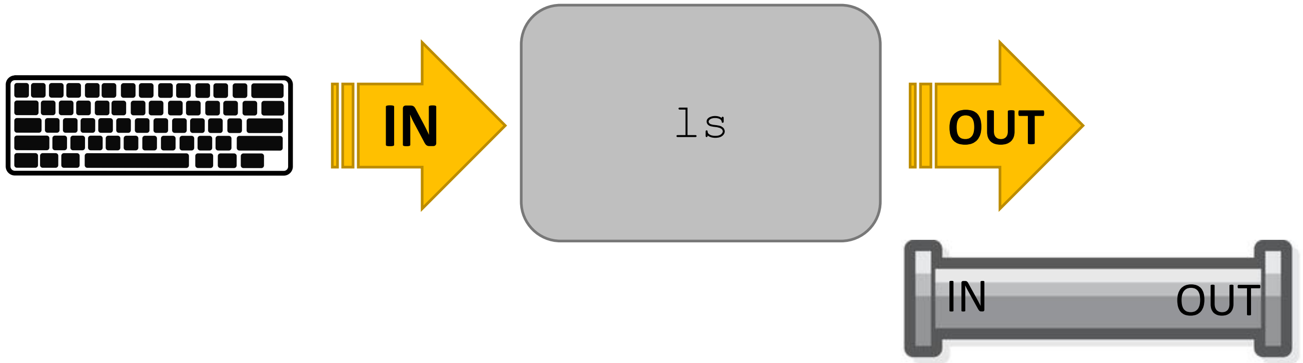

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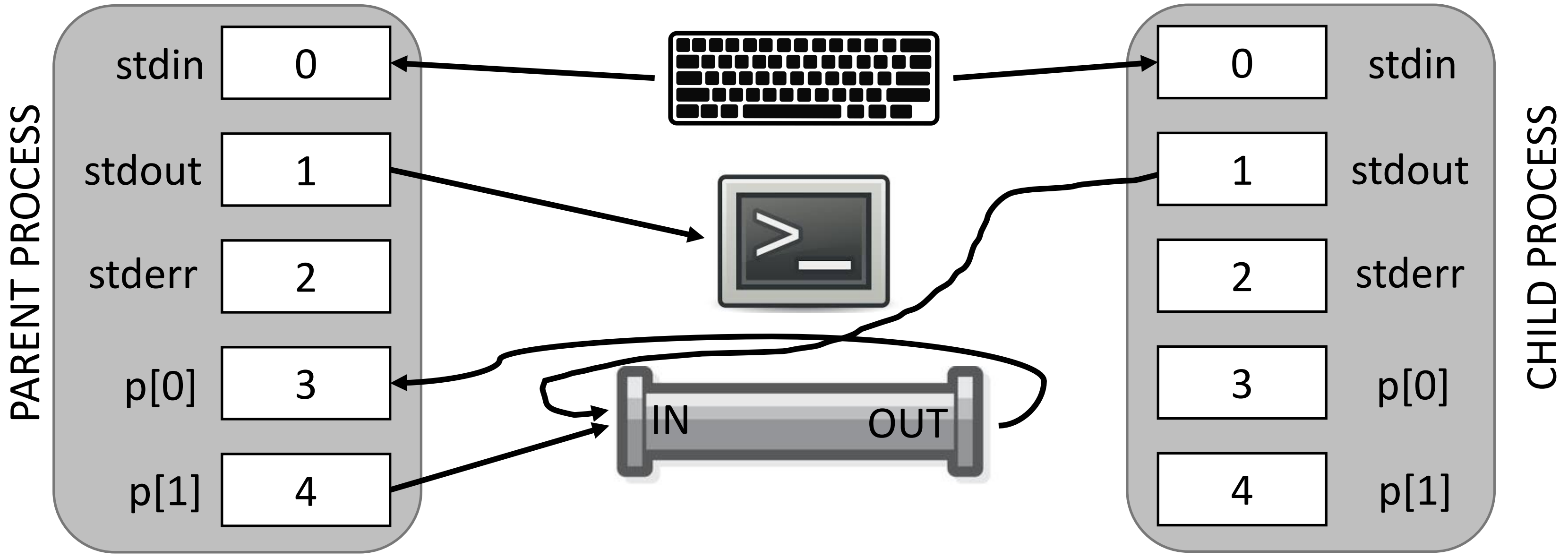

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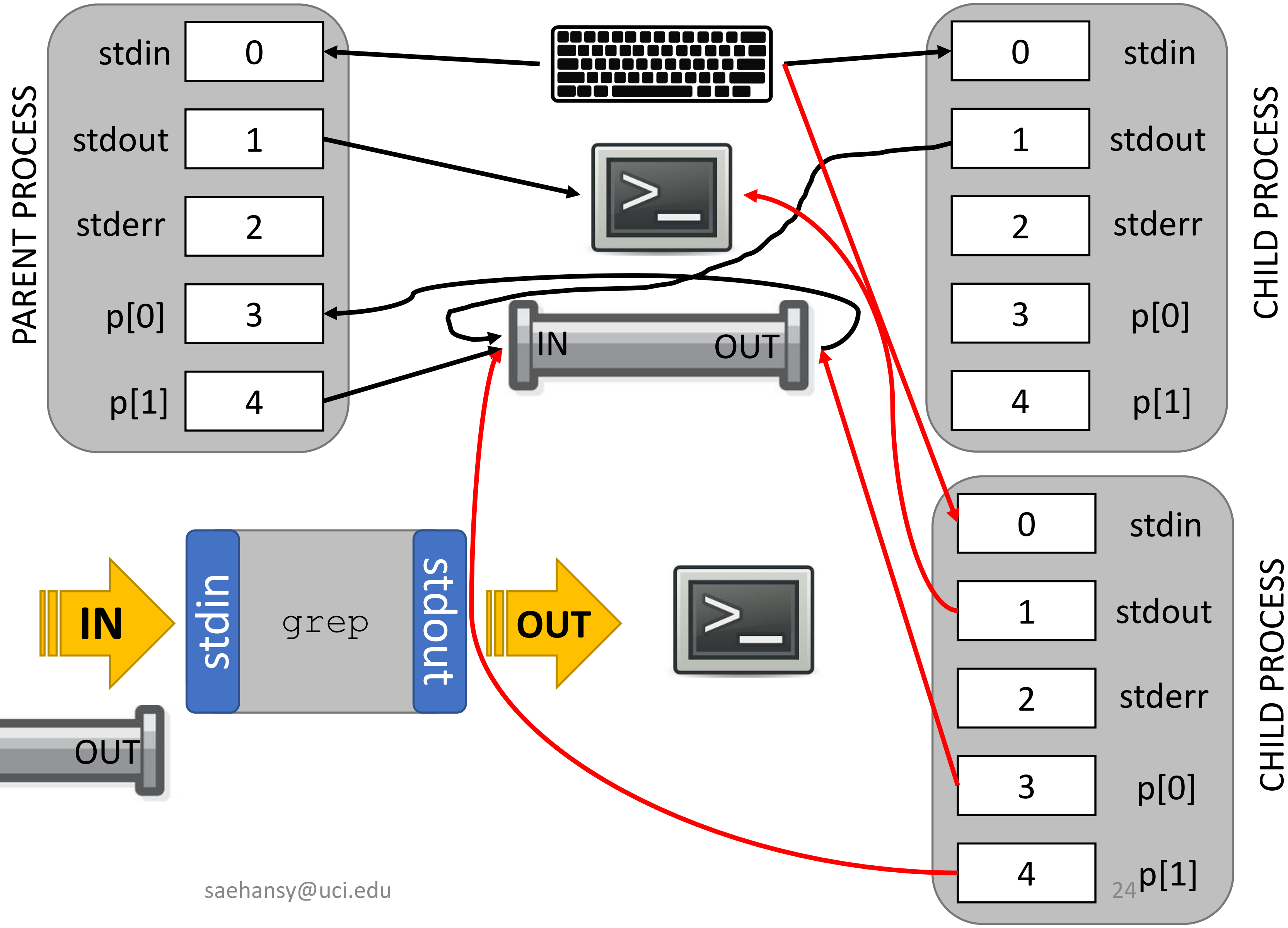

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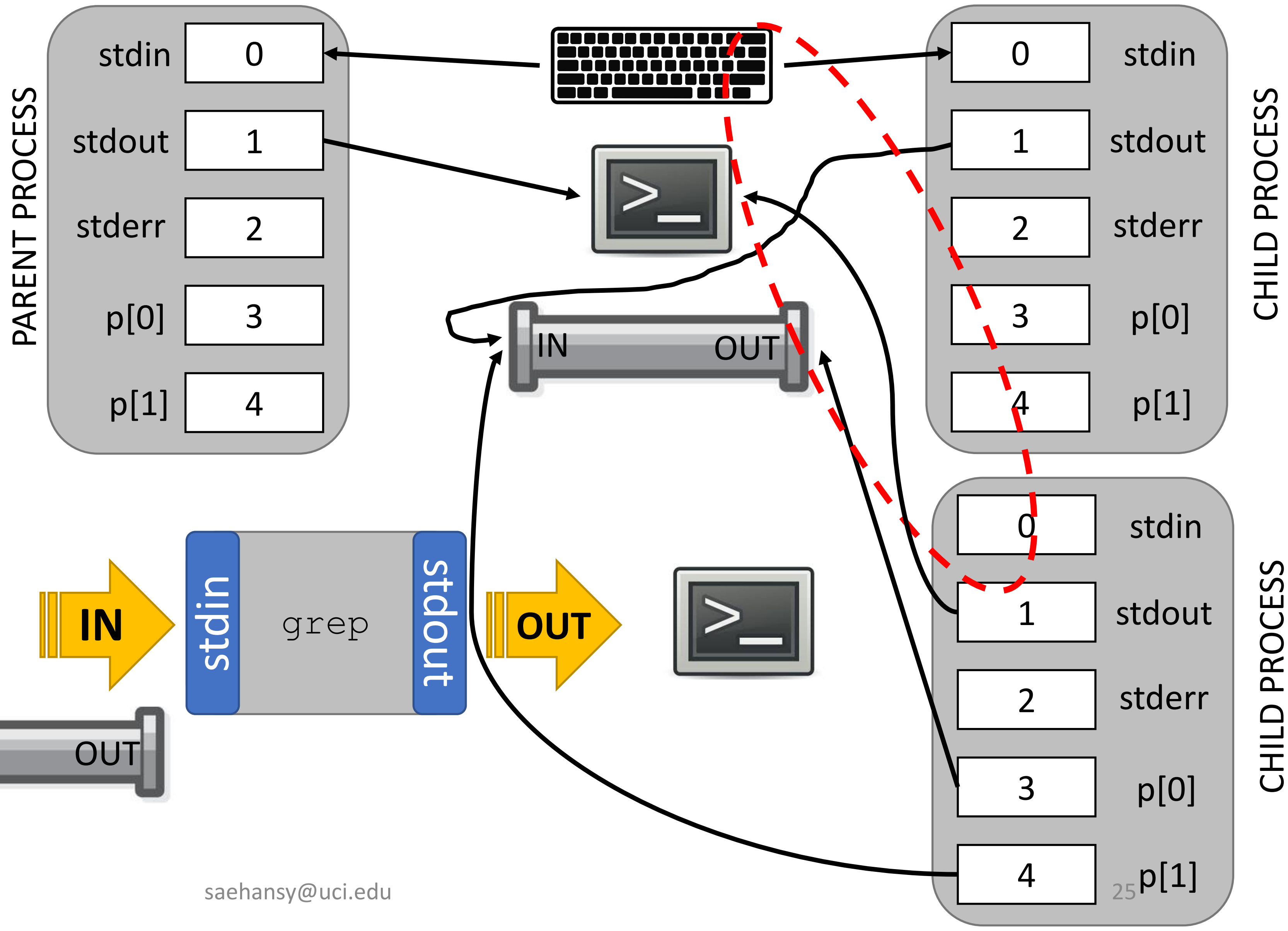

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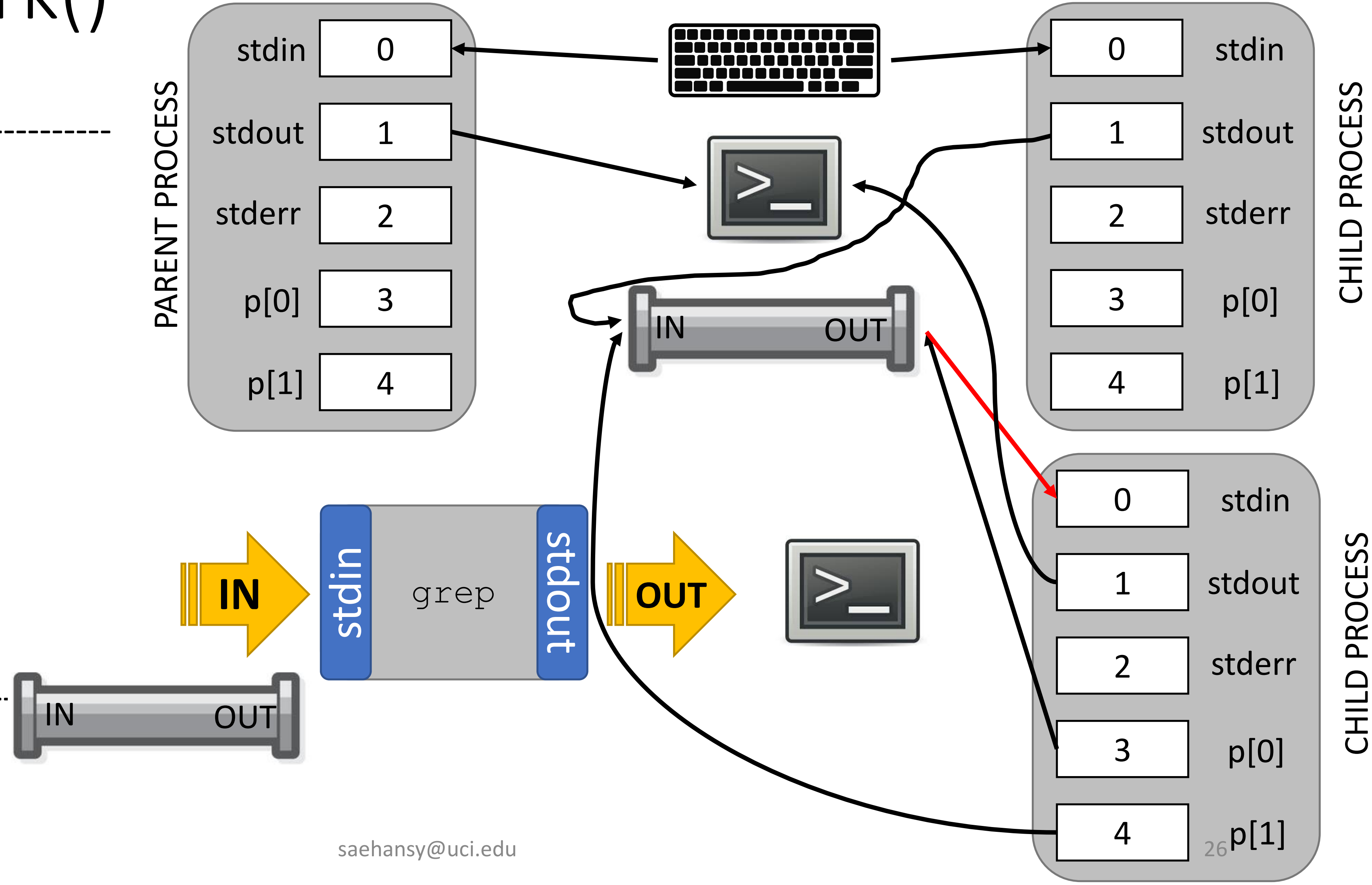

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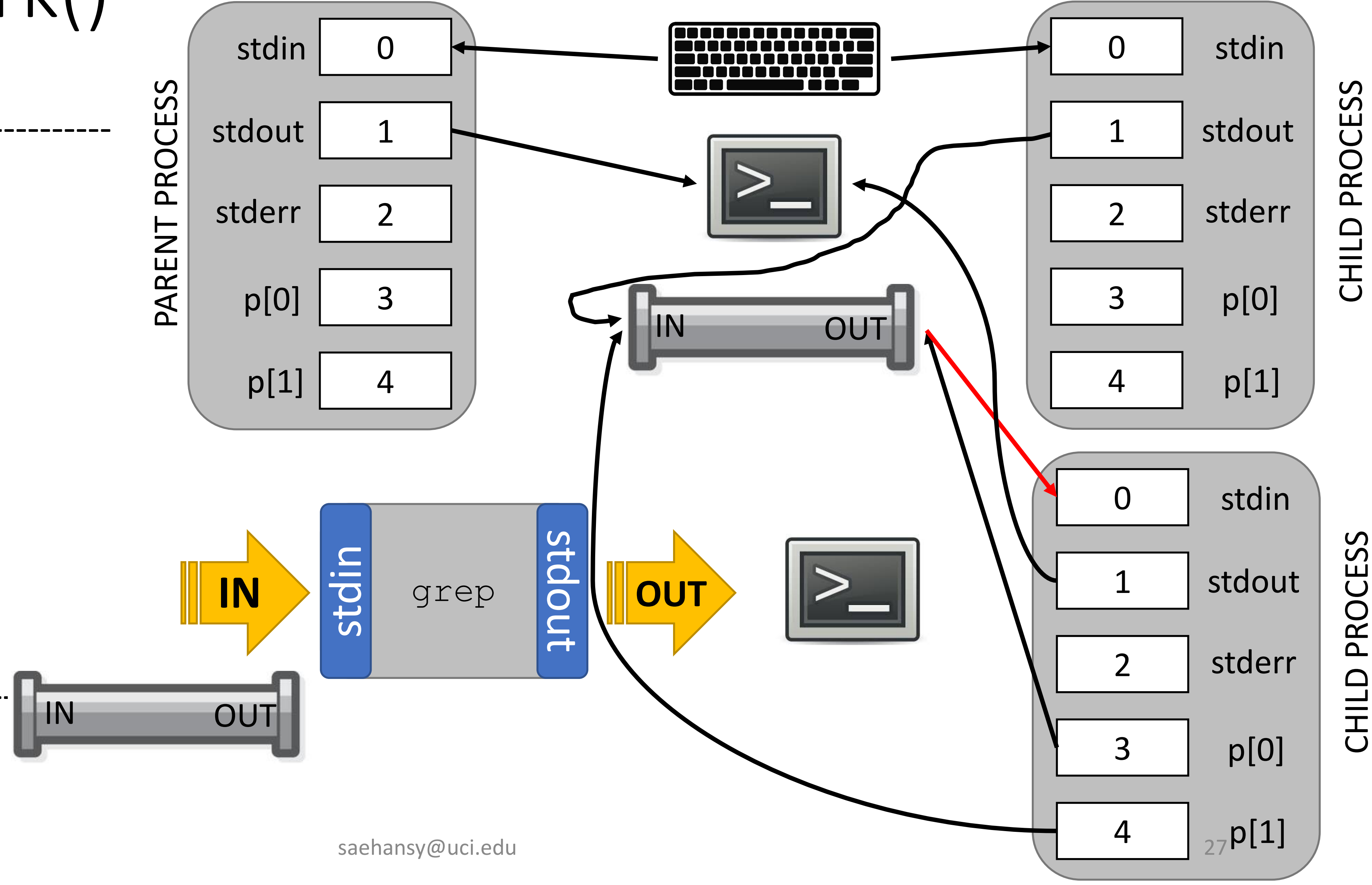

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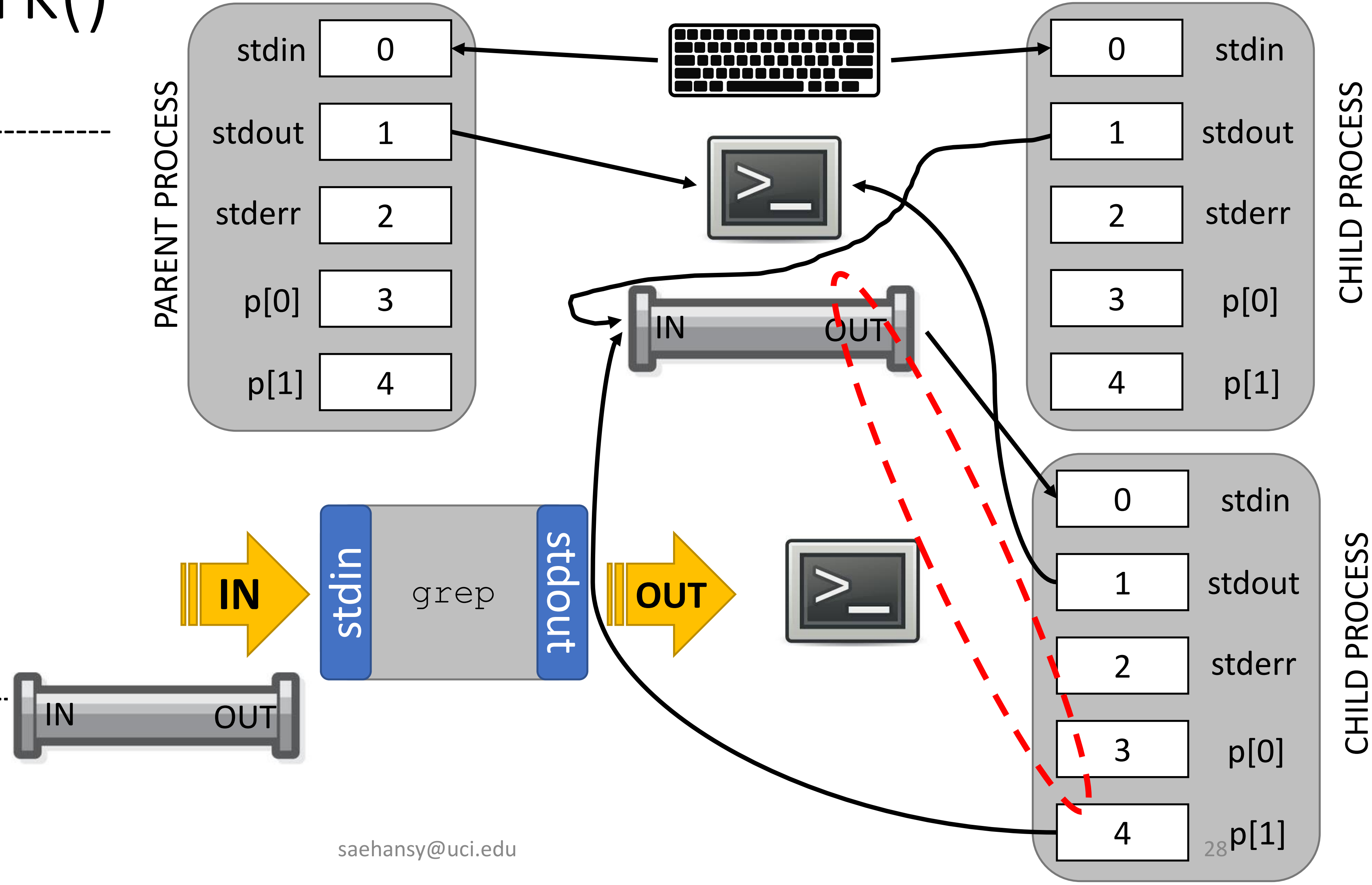
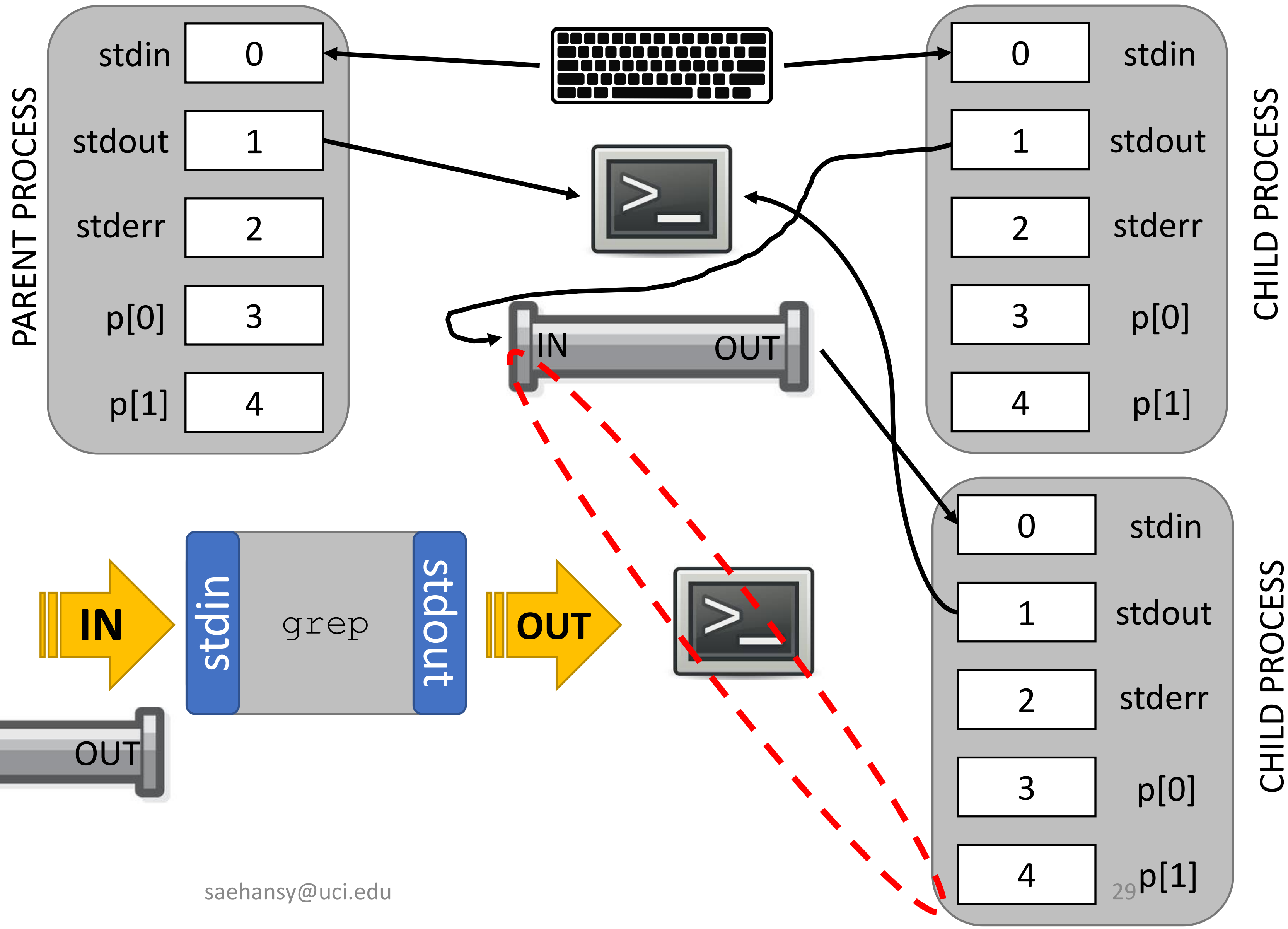
break;
```



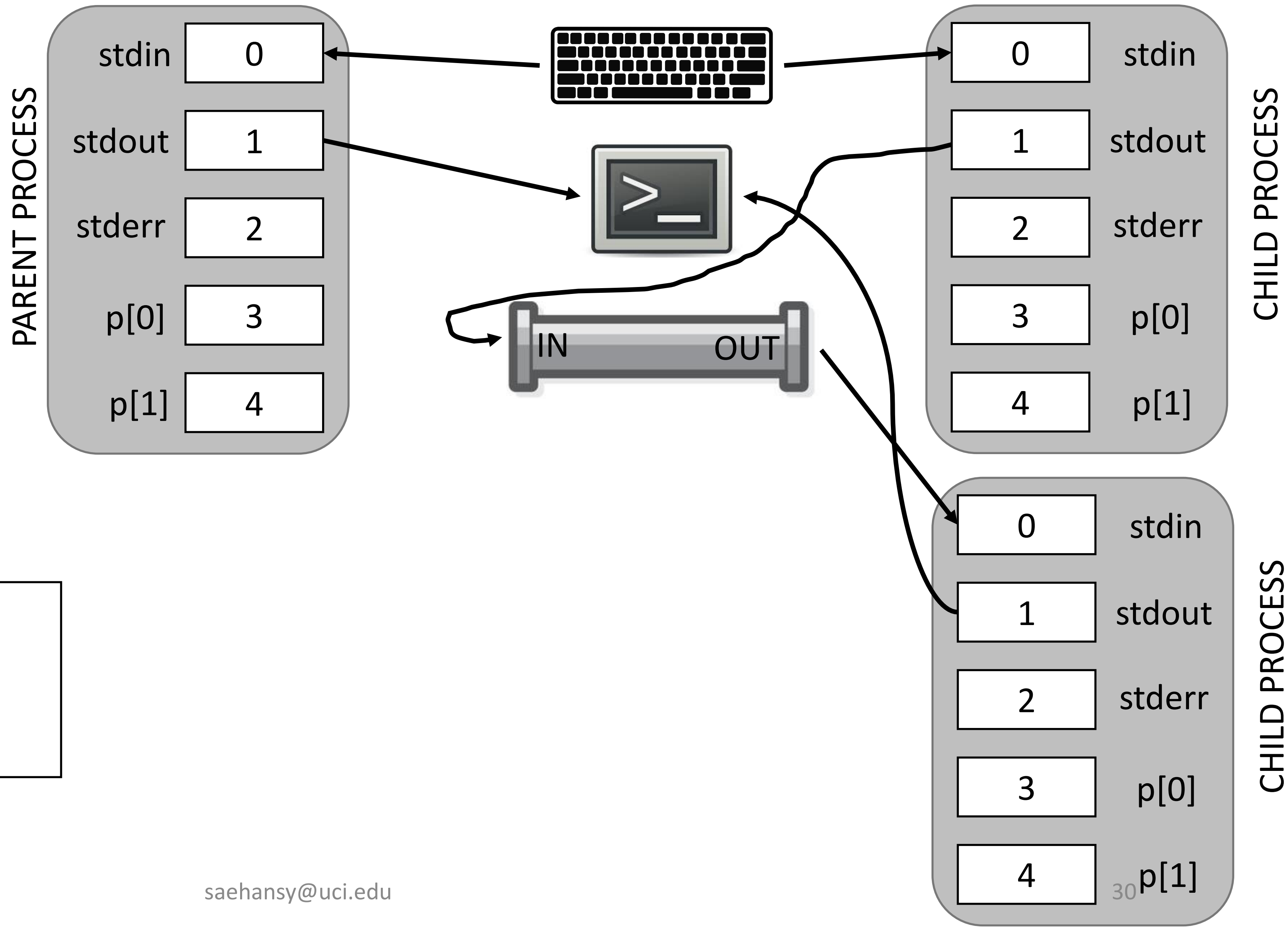
fork() copies the descriptors too!
dup()'s destination is the lowest & unused file descriptor!

pipe() and fork()

```
--------------------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;
```

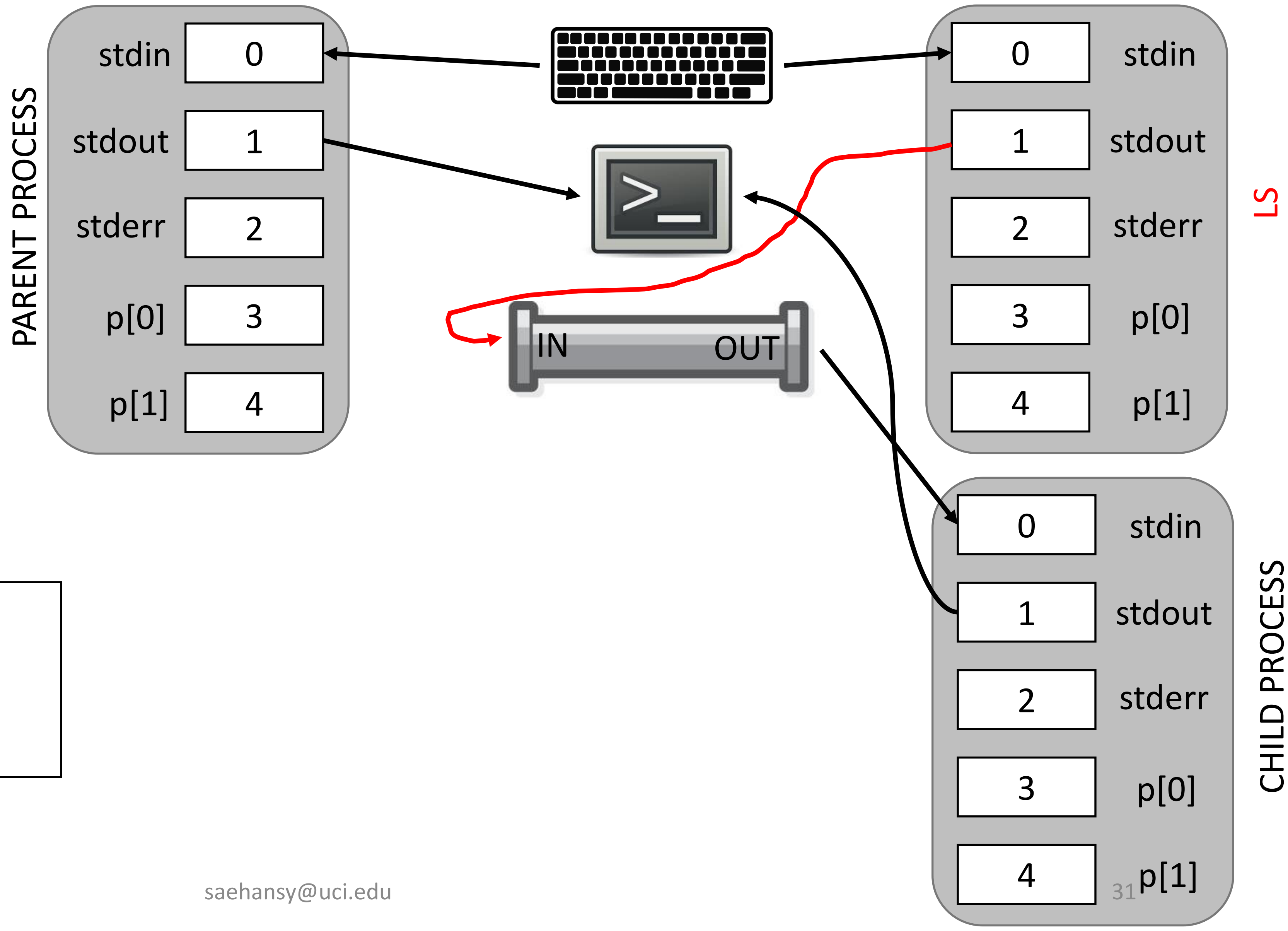


pipe() and fork()



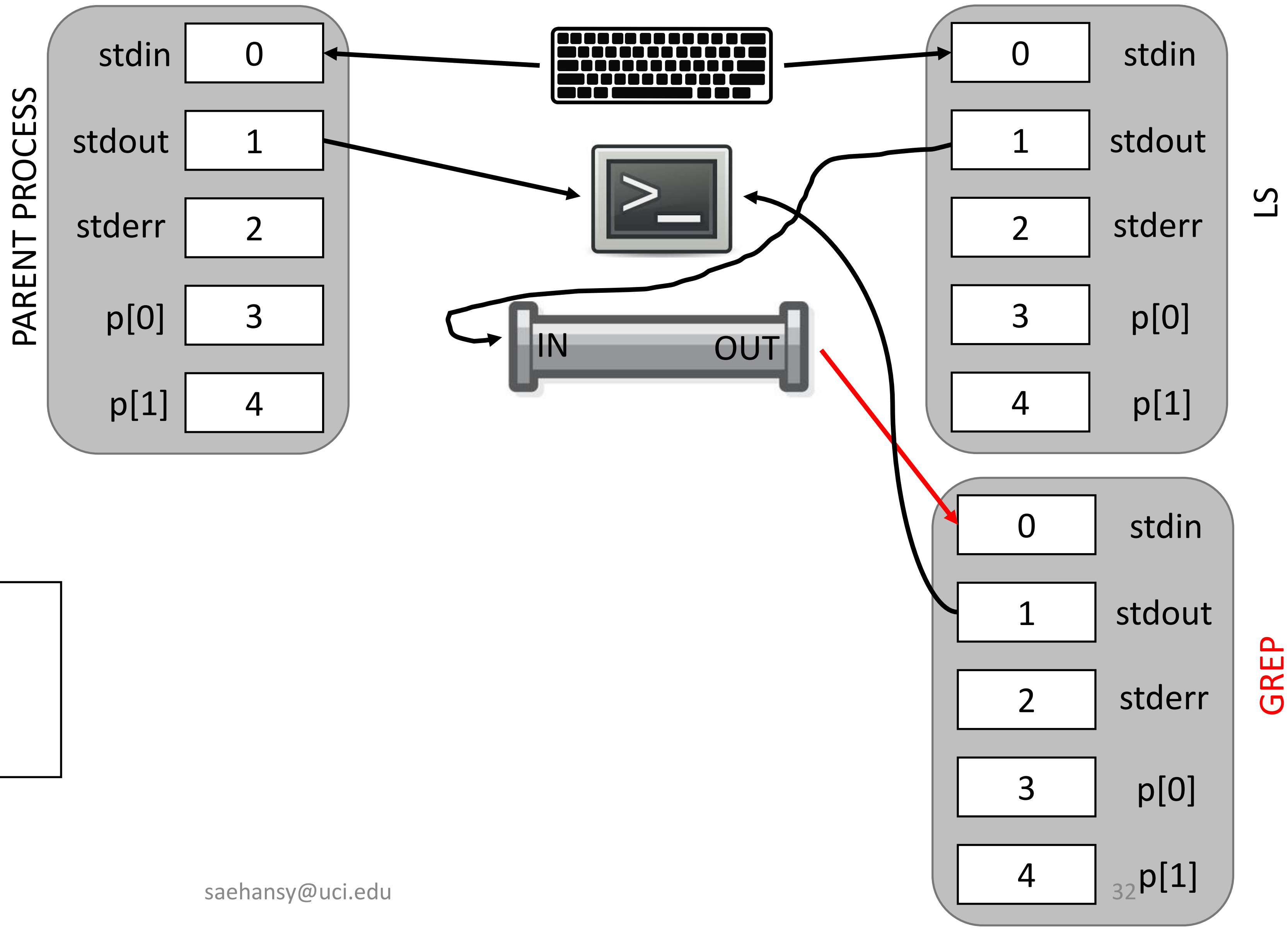
```
$
$ ls | grep asdf
asdfasdf
$
```

pipe() and fork()



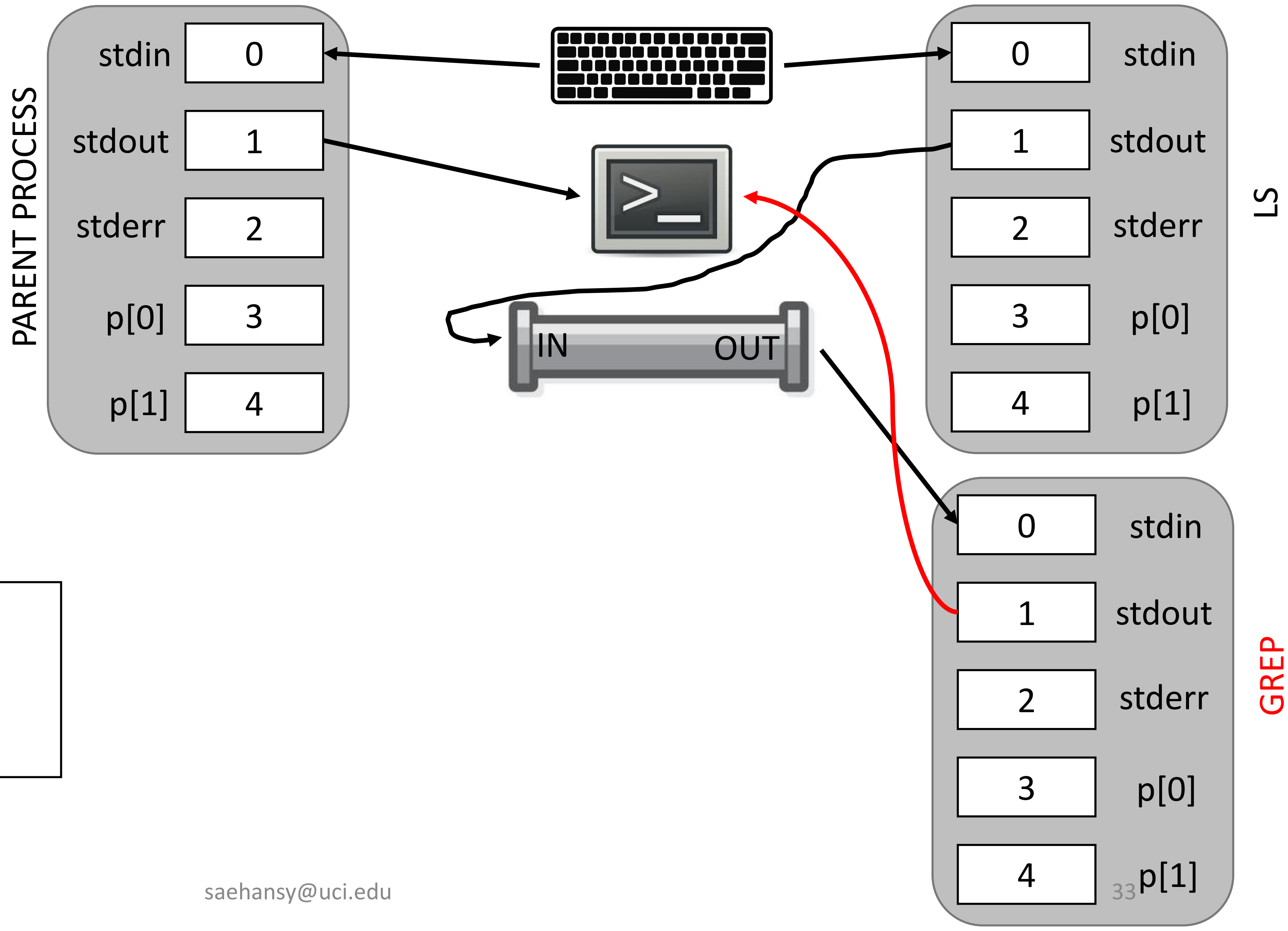
```
$
$ ls | grep asdf
asdfasdf
$
```

pipe() and fork()



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

pipe() and fork()



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

Debugging xv6 user-programs

- If you start gdb with make ‘qemu-nox-gdb’ only kernel symbols are loaded
- The symbols of user programs(UPROGS in Makefile)—including sh, grep, ls—must be loaded for debugging
- *file <binary>* followed by *break main*
- UPROGS binary names start with _ (e.g. _sh)

```
(gdb) file _nsh
A program is being debugged already.
Are you sure you want to change the file? (y or n) y
Load new symbol table from "/home/saehansy/Workspace/ics143a/FQ19/qemu/xv6-public/_nsh"? (y or n)y
Reading symbols from /home/saehansy/Workspace/ics143a/FQ19/qemu/xv6-public/_nsh...done.
```

Debugging xv6 user-programs

- We are dealing with shell which has fork() and exec()
- Tell GDB what to follow (parent? children? or new process? old one?)
    - set follow-fork-mode (parent|**children**)
    - set follow-exec-mode (**new**|old)
    - make sure set the breakpoint inside child's code!
- if you having trouble booting xv6 after setting breakpoints, set them just before sh is executed
    - break exec
    - continue
    - 1st break
    - continue
    - 2nd break
    - if you type continue here, it will execute the shell. Type necessary things before typing continue including *del br 1*

it's a little buggy.. gdb is not always correct

Understanding sh.c

- Try out various commands, and use gdb to follow the call stack(graph)
- Make a note on each function
- Drawing a call graph for each scenario helps understanding the structure