Pipes

CSC 328 - Network Programming

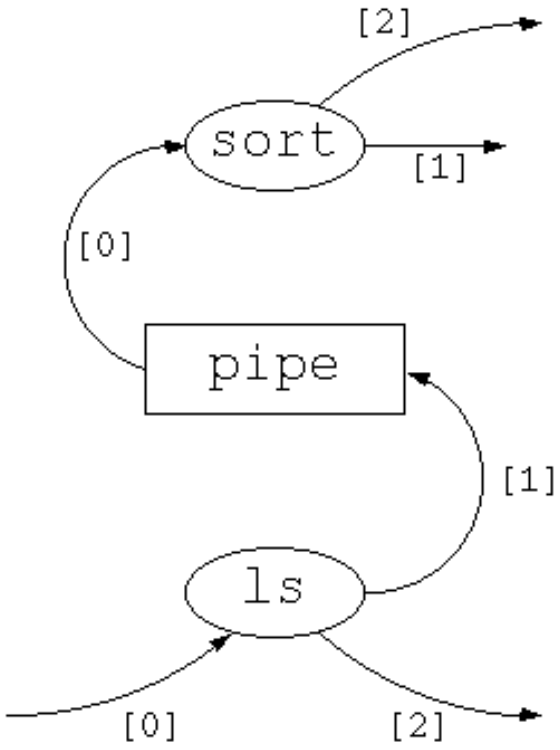
Pipes

- Interprocess Communication (IPC)
- Characteristics
  - Half-duplex (data flows in one direction)
  - Common ancestor
- Types
  - Unnamed
  - Named

Pipes in the shell

- Vertical bar (|): connect the standard out of one process to the standard in of another process
- Example: `ls | sort`
- Pipe commands
  - Need a pipe
  - Need a process (fork) for each command
  - Redirect standard out for first command to write end of pipe
  - Redirect standard in for second command to read end of pipe

Pipe Example



`sort`

file descriptor table

[0]	`pipe` *read*
[1]	*standard output*
[2]	*standard error*

`ls`

file descriptor table

[0]	*standard input*
[1]	`pipe` *write*
[2]	*standard error*

Pipe Creation

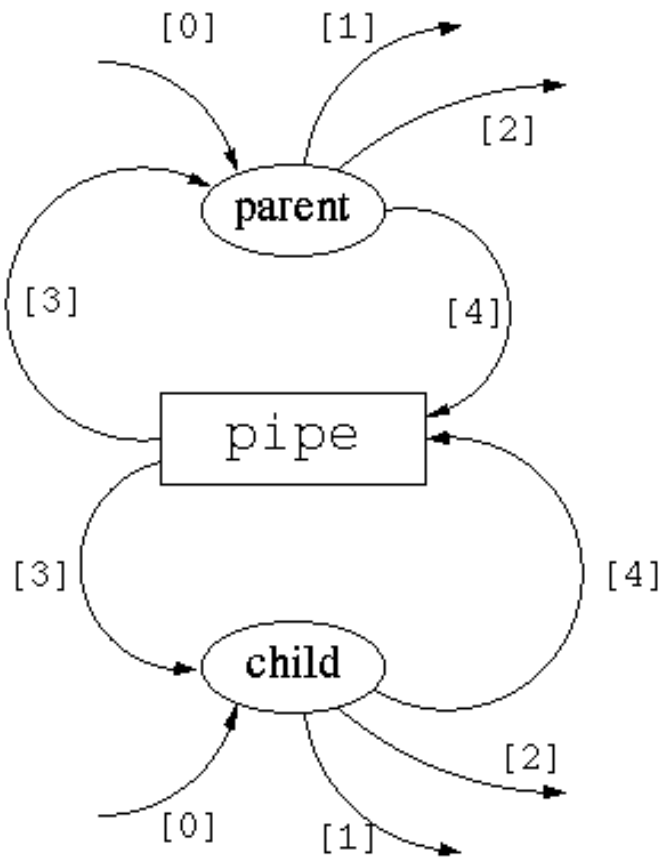
- `pipe()` takes two file descriptors: read and write
- File descriptors after `fork()`
- Example:

```
int fd[2];
pipe(fd);
```

Pipe Example

```
int fd[2];
pipe(fd);
pid_t child_pid = fork()
switch (child_pid) {
    case 0:
        dup2(fd[1]), STDOUT_FILENO);
        close(fd[0]); // close read end
    default:
        dup2(fd[0], STDIN_FILENO);
        close(fd[1]); // close write end
}
```

Pipe Example



parent

file descriptor table

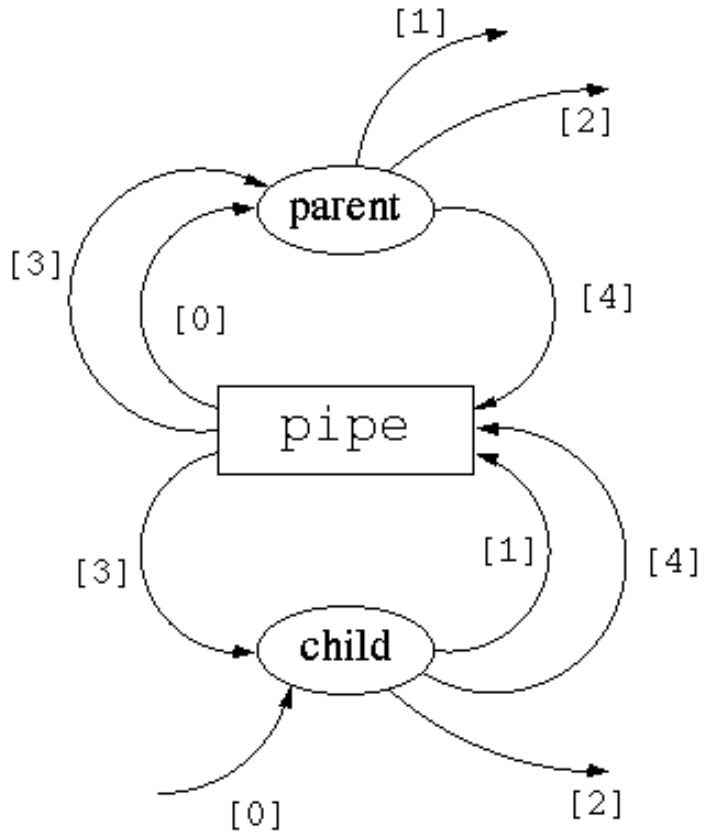
[0]	*standard input*
[1]	*standard output*
[2]	*standard error*
[3]	`pipe` *read*
[4]	`pipe` *write*

child

file descriptor table

[0]	*standard input*
[1]	*standard output*
[2]	*standard error*
[3]	`pipe` *read*
[4]	`pipe` *write*

Pipe Example



parent

file descriptor table

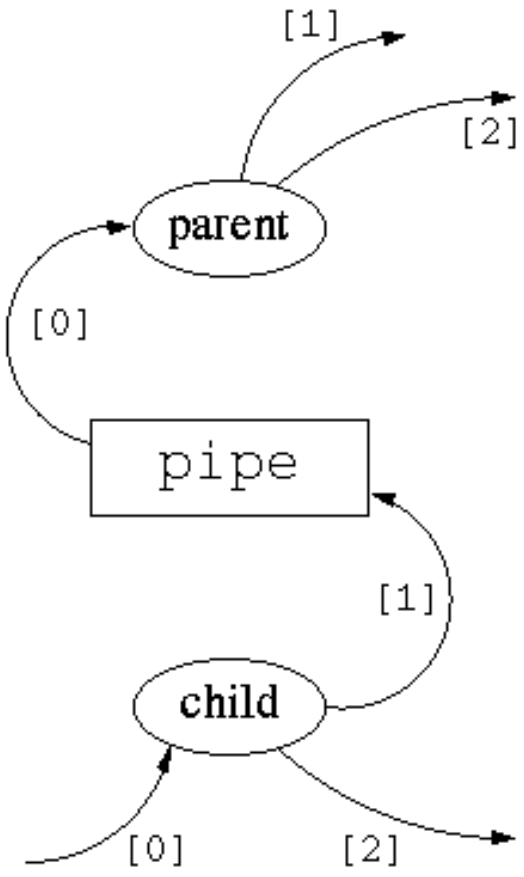
[0]	pipe *read*
[1]	*standard output*
[2]	*standard error*
[3]	pipe *read*
[4]	pipe *write*

child

file descriptor table

[0]	*standard input*
[1]	pipe *write*
[2]	*standard error*
[3]	pipe *read*
[4]	pipe *write*

Pipe Example



parent

file descriptor table

[0]	pipe *read*
[1]	*standard output*
[2]	*standard error*

child

file descriptor table

[0]	*standard input*
[1]	pipe *write*
[2]	*standard error*

Pipe Usage

- `read`
- `write`
- `close`
- Need a protocol for reading and writing

Reading and Writing

- Finite size
- Read
  - Blocks on empty pipe
  - Otherwise, returns immediately
  - Returns 0 on `EOF`
- Write
  - Blocks on full pipe
  - Fails if read end not open

Pipe Synchronization

- For bidirectional communication we need two pipes
- We need to create a synchronization point or barrier