Process Protection

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In particular, protection of resources between users

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Exercise. Find out the userid allocated to you on the Uni's `linux.bath.ac.uk` machine

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In particular, root can suspend or kill any user's processes and read or modify their files

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In the OS there is the equivalent of

if uid_of_process == uid_of_resource or uid_of_process == uid_of_root then
    allow access
else
    disallow access

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When a user logs in to a system a process, owned by root, starts up, changes its userid to the user, and then starts other processes as that user

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Any shutdown program will need to have root ownership and this will be carefully policed by the system

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Doing everyday stuff as administrator is just asking for trouble, and is throwing away many of the protection mechanisms that OSs have developed to provide

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Not ideal, but better than letting the malware have full reign over the entire machine

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Virus scanners address the *symptom*, not the *problem*

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And don’t confuse it with kernel/user mode

Inter-Process Communication

We now look at how processes communicate amongst themselves

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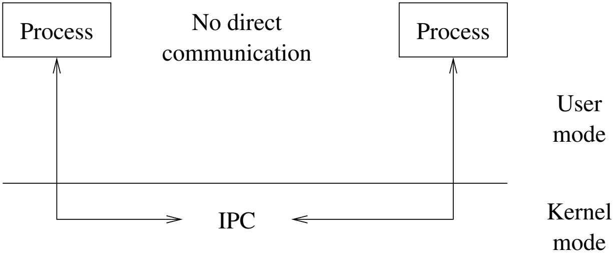
For example, a new program starting might wish to tell the process managing the display that it wishes to pop up a window on the display

Or one process has to wait for another to finish some action (e.g., pop up a window) before it can progress itself: this is *synchronisation*

Inter-Process Communication

Inter-Process Communication (IPC) can be achieved in many different ways, but all must be, at base, supported by the OS; recall that by default the kernel tries to stop one process interfering with another



Inter-Process Communication

IPC contradicts this non-interference, and so must be treated very carefully by the kernel

There must be rules and restrictions, or else one process could just blast another process with data, preventing it from doing any useful work

Inter-Process Communication

We shall be looking at

- Files
- Pipes
- Shared memory

as a sample of IPC mechanisms

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But it's much harder than this, of course

Inter-Process Communication

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- Which file to use? A and B need to agree on a filename to use, but this is not so easy. They can use a single “well-known” file, but this is problematic if many processes are all writing to the same file simultaneously. For example, C wants to communicate with D at the same time via the same file

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- There could be a separate file for each pair of processes, but to agree on a file name A and B must have previously communicated…
- How does B know when data has arrived? B might have to repeatedly poll the file until the data arrives. This doesn't scale well to large numbers of files or processes

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Exercise Read about the mechanism of choice to transfer the data describing the first ever image of a black hole (April 2019)

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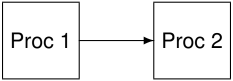

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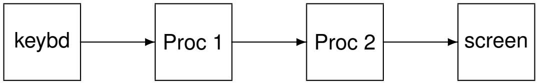

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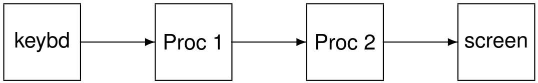

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And the pipes go via the kernel, not directly between processes

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But pipes also provide *synchronisation*

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Note there are two kinds of communication here: (1) the data, and (2) synchronisation on production/consumption of the data

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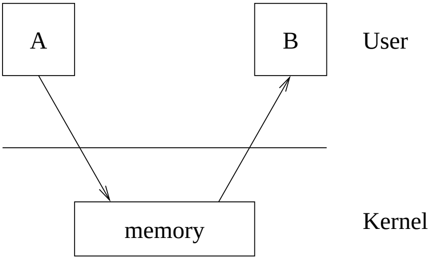
This is how the kernel can control blocking A and B, making sure A does not overfill the buffer and making sure B is not reading data that is not there

Inter-Process Communication

Pipes



Implementation of a Pipe

Inter-Process Communication

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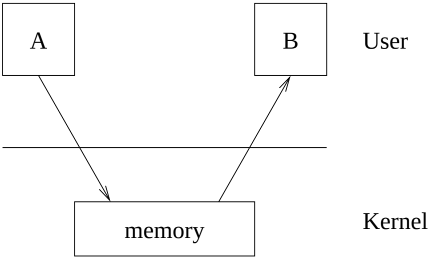

Implementation of a Pipe

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Inter-Process Communication

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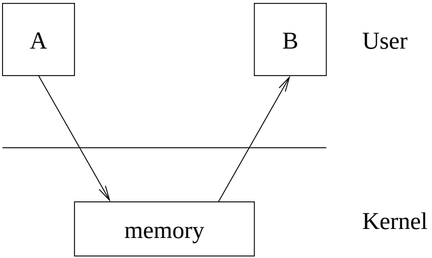

Implementation of a Pipe

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Symmetrically for B reading from the pipe

Pipes are supported well by Unix and are very easy to create and use when using a shell

Aside

A *shell* is just a program that waits for you to type something and then possibly creates some new processes according to what you typed: it provides a *command line* interface (CLI)

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Popular with Unix derivatives, unpopular with Windows derivatives

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So this displays a sorted list of processes

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Inter-Process Communication

Pipes

Pipes are

- simple and efficient
- easy to use from programs and from a shell
- a powerful way of combining processes and programs
- used a great deal

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- technical detail: are only between *related* processes. Often one is the parent of the other
- can trivially create deadlocks if you use them carelessly (A creates a child process B with two pipes A$\rightarrow$B and B$\rightarrow$A...)

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- Named Pipes: these can can be shared by unrelated processes, but have the naming problem that IPC using files have
- Sockets: pipes between processes on different machines. The basis of the Internet

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A lot of the modern world is built on top of sockets!