

# Advanced Operating Systems:

## Lab 2 – IPC

### L41 Assignment

Prof. Robert N. M. Watson

2022-2023

Your lab report will explore the behaviour of UNIX pipe IPC across a range of buffer sizes, the impact of VM optimisation, and the potential probe effect arising from using performance counters.

### Approach

The following questions are with respect to a fixed total IPC size of 16MiB (the default for the benchmark). Take measurements across a spectrum of powers-of-two buffer sizes between 64 bytes and 16MiB. Use `2thread` mode, and the `-i pipe` IPC type in all experiments. To explore the impact of virtual-memory optimisation, also vary the value of `kern.ipc.pipe_mindirect` across the buffer-size space, considering how the optimisation affects each potential buffer size.

### Submitting your completed assignment

Your submitted lab report will be a single PDF file using the the L41 lab-report LaTeX provided. All submissions are via the course's Moodle page.

### Data collection

First, gather data on the performance of pipe IPC with various configurations of the VM optimisation feature:

- Create a plot illustrating how pipe IPC performance changes across a range of buffer sizes, using the default `kern.ipc.pipe_mindirect` threshold.
- Create a plot showing the performance of two data sets across a range of buffer sizes: one with VM optimisations enabled, and the other disabled.

Explore pipe performance using OS-based techniques to understand the performance curves in these plots:

- Create two plots drawing on message sent and received information gathered using `getrusage(2)` across a range of buffer sizes: one with, and the other without, VM optimisations.
- Partition and analyse the IPC performance plots; then use DTrace profiling and, as necessary, tracing (e.g., of system calls, context switches), to explore and explain OS behaviors across a range of buffer sizes.

Now extend your analysis to include hardware performance counters as well as the results of DTrace analysis:

- Explore how varying buffer sizes, as well as configuration of VM optimisation, affects the architectural and micro-architectural aspects of cache and memory behaviour.

Conclude your data collection by gathering data on the probe effect associated with performance-counter use:

- Explore the impact of the probe effect on your investigation, focusing on how DTrace may have changed the behavior of the benchmark and impacted the accuracy of our analysis.

## **Lab report**

In your lab report, evaluate the lab hypotheses (see *Advanced Operating Systems: Lab 2 – IPC – General Information*) in light of this data and analysis, as well as using other data you may have collected.