UNIVERSITY COMPUTER SCIENCE • EXERCISE SHEET

3.5 The operating-system interface

Name: _____ Class: _____ Date: _____ **Total: 24 marks**

KEY WORDS context switch • virtual memory

Objective

Reason about processes, memory and files as services.

1 Key knowledge and worked examples

■ The services

Process = program + state; context switch saves registers, PC, memory mappings, open-file table ✓. Virtual memory: page tables + TLB; a page fault is a fetch from disk. Files: named byte streams via system calls ✓.

■ Worked example: what a switch preserves

Everything the next instruction needs (the four above); what does NOT carry: the cache contents – shared hardware, just cold ✓.

2 Practice

2.1 Name the four items a context switch saves. [3]

2.2 What translates virtual to physical addresses? [3]

2.3 Name three system calls for files. [3]

3 Exam-style questions

3.1 Two processes A and B timeshare one CPU; A faults on a page.

Explain the sequence of events from the fault to A resuming. State what of A is preserved during the wait and what the CPU does meanwhile. Name the states A passes through, in order. [8]

3.2 Why virtual memory serves three needs at once.

Name the three needs virtual memory serves at once. For each, state the mechanism that provides it and what would break without it. [7]

Solutions

2.1

- Registers, PC, memory mappings, open-file table ✓.

2.2

- The page tables (with the TLB as their cache) ✓.

2.3

- open, read, write (close also) ✓.

3.1

- A faults → blocked; scheduler runs B; disk completes → A ready; scheduler resumes A with its saved state ✓.
- Preserved: registers, PC, mappings, files – the CPU cache is shared hardware and is merely cold ✓.
- The CPU runs B during A's wait – a page fault creates useful I/O concurrency ✓.
- States: running → blocked → ready → running ✓.

3.2

- Isolation gone: any bug in one process could read or corrupt another's memory ✓.
- Illusion gone: total program size capped by physical RAM – big working sets fail to load ✓.
- Convenience gone: every load would need relocation against the machine's actual physical layout ✓.

exercises.lol exercises.com.cn