1 Suppose we have a system with three users \(a, b\) and \(c\) and ten files \(f_0, f_1, \ldots, f_9\).

Further suppose we have four operations for which we wish to control access: read, append, replace and modify.

(a) Do we require all of these or can some be described by combinations of others?

(b) Create a nontrivial example set of access tuples of the the form \((\text{user, file, permission})\) and show how it might be represented as:

(i) an access matrix,

(ii) access control lists,

(iii) capability sets

2 Indicate if the follow statement is true or false, and explain why:

“A paged virtual memory is smaller than a segmented one.”

3 (a) What is the address binding problem?

(b) The address binding problem can be solved at compile time, load time or run time. For each case, explain what form the solution takes, and give one advantage and one disadvantage.
4 Most operating systems provide each process with its own *address space* by providing a level of indirection between virtual and physical addresses.

(a) Give *three* benefits of this approach.

(b) Are there any drawbacks? Justify your answer.

5 A processor may support a *paged* or a *segmented* virtual address space.

(a) Sketch the format of a virtual address in each of these cases, and explain using a diagram how this address is translated to a physical one.

(b) In which case is physical memory allocation easier? Justify your answer.

(c) Give *two* benefits of the segmented approach.

6 (a) In the context of memory management, under which circumstances do *external* and *internal* fragmentation occur? How can each be handled?

(b) What is the purpose of a page table? What sort of information might it contain? How does it interact with a TLB?

(c) Describe with the aid of a diagram a two-level page table. Explain the motivation behind the structure and how it operates.

7 Past paper questions

- y2015p2q4 [not the last part of (c) about segment faults]
- y2013p2q4
- y2009p2q3 [not (b)]
- y2009p2q4
- y2011p2q4 (a)