

6 Programming in C and C++ (djg11+am21)

- (a) Describe the two main forms of dynamic storage in languages such as C and OCaml? How does each potentially interact with a garbage collector? [4 marks]
- (b) Does any aspect of C or C++ prevent a compiler from implementing the ‘tail-recursion optimisation’ exploited in functional languages and would this tend to reduce memory leak problems (e.g. a web server running out of memory)? [2 marks]
- (c) An ‘in-core’ database system uses a number of client processes that share a segment of memory with a server process which manages data storage. Assuming there are currently four client processes running, describe or compute the total number of user-space segments likely to be allocated in physical memory. How might memory in the shared segment be allocated? [4 marks]
- (d) C++ allows multiple inheritance, e.g.

```
class D: B,C { int d1, d2; };
```

where classes B and C have previously been defined. [Note: Your answer need not consider access qualifiers nor member functions.]

- (i) First assume that classes B and C do not inherit from other classes. Give C code which summarises the storage layout of a variable `x` of type `class D`. [3 marks]
- (ii) Given `class D *p`, how can C++-style “cast to pointer to base class”, exemplified by `(B *)p` and `(C *)p`, be achieved by C code? [2 marks]
- (iii) Now suppose that classes B and C both inherit from class A. Explain a conceptual choice which arises as to how data members of class A appear within the storage layout for a variable `x` of type `class D`. [2 marks]
- (iv) Explain how the `virtual` keyword allows a programmer to select between the alternatives in Part (d)(iii). [3 marks]