COMPUTER SCIENCE TRIPOS Part IB – 2012 – Paper 3

5 Compiler Construction (DJG)

(*a*) Define the following forms of variable: [1 mark each]

(*i*) statically allocated global variable

(*ii*) local variable (to a function)

(*iii*) free variable

(*b*) In an object-oriented language, which of the above three terms best describes a field? [1 mark]

(*c*) How are storage addresses typically allocated for each of these types of variable? Describe the stage/pass of the compiler that makes the allocation and also describe any changes made by the operating system linker or loader. [3 marks]

(*d*) What addressing mode or sequence of instructions is typically used in compiled code to read (or write) each of the variable forms from part (*a*)? [1, 1, 4 marks]

(*e*) With dynamic storage allocation, how does the memory manager 'new' operator know how much memory to allocate? Discuss both compilation to machine code and execution on a VM. [2 marks]

(*f*) Why is garbage collection easier to implement in strongly-typed languages (compared with weakly-typed languages)? [1 mark]

(*g*) What overheads does allocating arrays and class objects on the stack cause compared with placing them on the heap? What are the advantages and disadvantages of each method? [4 marks]