

COMPUTER SCIENCE TRIPOS Part IB – 2021 – Paper 4

1 Programming in C and C++ (djg11)

(a) (i) In programming languages in general, what is the difference between statically and dynamically-allocated variables? Without using the `static` keyword, give examples of both types of variable in the C language. [2 marks]

(ii) What effect do the `static` and `extern` keywords have in C for both forms of variable? [3 marks]

(b) There are 32 characters in the ASCII set between ‘A’ and ‘a’. All are printable. A potentially-infinite stream of 8-bit bytes can be made printable by encoding into base 32 and represented by a longer stream just using these characters. Give a syntactically-accurate definition in C for `encode32(unsigned char a)`, called for each byte, which invokes `putchar(char c)` once or twice per call to render the encoded output. [5 marks]

(c) Show how the `for` statement in C can be used to traverse a linked list. Explain the benefits of this coding style, mentioning whether the `continue` statement works appropriately. [4 marks]

(d)

```
typedef char * mystring;
mystring s201 = "201";
mystring s202 = s201;
s202[2] += 1;
```

A novice programmer writes the above code. What do you think they are intending to do and what two problems might they suffer? [2 marks]

(e) An interpreter for a string processing language is written in C. Describe four storage and efficiency-related considerations when designing the module for storing strings for the interpreter? [4 marks]