COMPUTER SCIENCE TRIPOS Part IB – 2025 – Paper 4

5 Programming in C and C++ (djg11)

A handheld device uses a rotary encoder with a circle of LED indicators around it. All behaviour is implemented in permanent C code running on an internal micro-controller.

- (a) For the C code running in the device, what is the minimum support needed (if any) from an operating system or run-time system? [4 marks]
- (b) Can C code in the device or in general operate without a heap? Would it then have no pointers? [4 marks]
- (c) The following code turns two adjacent LEDs on. Explain four features of the code.

#define IO_BASE 0xE000
((volatile unsigned char *)IO_BASE)[4] = 0x60;

[4 marks]

(d) The rotary encoder has two output bits (as in the ECAD classes) that advance through the following infinitely repeating pattern in the low two bits read at offset 8 from the IO_BASE when rotating clockwise, ...0132013... The sequence is reversed when the encoder is turned the other way. Define a C subroutine poll() that is to be repeatedly called at a suitable rate (eg 1 kHz). The outcome should be that a single LED is lit at any time, with which one being suitably adjusted by the encoder. [8 marks]