COMPUTER SCIENCE TRIPOS Part Ib – 2021 – Paper 5

1 Computer Design (swm11)

(a) Moore's law and Dennard scaling both predict scaling properties of CMOS chips. What are the differences between these predictions and which predictions are valid today? [4 marks]

(b) How is the critical path in a clocked digital CMOS circuit determined and how does it impact the maximum clock frequency? [4 marks]

(c) What is a function calling convention and how does it impact the design of the RISC-V instruction set architecture (ISA)? [4 marks]

(d) Consider the following C function that computes the greatest common divisor, and the assembler produced by the compiler. The assembler has been split into segments. Describe what function each segment performs. [8 marks]

```
int gcd(int n1, int n2) {
  if (n2 == 0)
    return n1;
  else
    return gcd(n2, n1 % n2);
}

##### Segment A #####
gcd:
        bne     a1,zero,.L7
        jr      ra
##### Segment B #####
.L7:
        addi    sp,sp,-16
        sw      ra,12(sp)
##### Segment C #####
        mv      a5,a1
        rem     a1,a0,a1
        mv      a0,a5
        jalr    ra, gcd
##### Segment D #####
        lw      ra,12(sp)
        addi    sp,sp,16
        jr      ra
```