

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
```