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]

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

```assembly
##### Segment A #####
    .text
    .global gcd
    gcd:
        bne   a1,zero,.L7
        jr   ra
    .L7:
        addi   sp,sp,-16
        sw   ra,12(sp)
##### 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
```