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);
}
```

```
##### 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
```