CENG3420 Homework 1

Due: Feb. 19, 2021

All solutions should be submitted to the blackboard in the format of **PDF/MS Word**.

Q1 (15%) We have a technology process to manufacture a specific processor. Suppose we use 30cm-diameter wafer for a die. A die is 2 cm on each side.

1. Find the maximum number of dies on the wafer.
2. If the defects per unit area is 0.02, and the cost per wafer is approximately \$7000. Find the yield and the cost per die. (Can we apply the empirical equation?) p.s. accurate to 2 decimal places
3. We can increase our yield since we have incorporated the new technology to manufacture the processor. If the maximum number of dies per wafer is increased by 10% and the corresponding defects per unit area is reduced by 10%, find the yield and the cost per die. p.s. accurate to 2 decimal places

Q2 (10%) Draw the gate schematic for the function $Y = \overline{(A + B + C) \cdot D}$.

Q3 (10%) We develop a new processor which can reduce 20% of the capacitive load compared with the previous generation. The new processor can adjust the voltage to reduce the power dissipation. In this way, the new processor can reduce the average voltage by 10%, which results in a 15% shrink in frequency comapred with the previous generation. Find how much the dynamic power dissipation ratio between the new processor and the previous generation?
p.s. accurate to 2 decimal places

Q4 (10%) Assume `a0=0xBA, a1=0xDC`. Find the value of `a2` after the following instructions, respectively.

1.
```
xor a2, a0, a1
ori a2, a2, 3
```

2.
```
slli a2, a0, 3
andi a2, a2, 0x1F
```

3.
```
srai  a2, a0, 3
and a2, a2, a1
```

Q5 (15%) Assume that the variables a, b, c, d, and e are assigned to registers `t0`, `t1`, `t2`, `t3`, and `t4`, respectively. Given RISC-V assembly instructions:

```
        slli t2, t4, 3
        bge t0, t2, label1
        add t3, t1, t2
        j label2
label1:
        mul t3, t1, t2
label2:
        addi t3, t3, 1
```

Translate the RISC-V assembly instructions above into the corresponding C statements. **Please include comments for each instruction in your solution.**

Q6 (15%) Assume that a0 = n and a1 = rst. Given the C statement:

```
int sum(int n, int rst){
        if (n > 0)
                return sum(n-1, rst + n);
        else
                return rst;
}
```

Translate C statements above into corresponding RISC-V assembly instructions. **Please include comments for each instruction in your solution.**

Q7 (15%) Write down the step by step procedure to calculate 7×3 or 0111×0011. Use Multiplier0 to indicate the least significant bit of the multiplier

Q8 (10%) We want to compare the computers C1 and C2, which differ that C1 has the machine instructions for the floating point operations, while C2 has not (FP operations are implemented in the software using several non-FP instructions). Both computers have a clock frequency of 400 MHz. In both we perform the same program, which has the following mixture of commands:

The command type	Dynamic share of instructions in program	CPI	
		C1	C2
FP addtion	16%	6	20
FP multiplication	10%	8	32
FP division	8%	10	66
Non-FP instructions	66%	3	3

1. Find the MIPS for the computers C1 and C2.
2. Find the CPU program execution time on the computers C1 and C2 when there are 12000 instructions in the program.