Homework 4.

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1.

a). Control: 0
RegWrite: 1
ALUOp: 0000
ALUSrc: 0.
MemWrite: 0
MemRead: 0.
MemtoReg: 0.
Zero: 0
Uncondbranch: 0.
Branch: 0.

b). PC, instruct memory, ALU, MUX, Registers.
We are not using memory or jumping.

c). Data memory. Branch.

2.

	R-type 24%	I-type 28%	ldur. 25%	stur 10%	cbz 11%	b. 2%
data memory.	x	X	✓	✓	X.	X
instruction memory	✓	✓	✓	✓	✓	✓
sign extend.	X	✓	✓	✓	✓	✓
x need sign extend	X	X	X	X	X	X.

data memory: 35%.
instruction mem: 100%.
sign extend: 76%.
~~no need sign extend output. 0%~~ waiting for the next instruction.

3. a) all the instructions
b) cbz, add, sub, ldur.
c) stur, add, sub ldur.

4. 0xF8014062 = (1111 1000 000 | 0 0001 0100 | 00 | 00 01 | 0 0010)$_2$
opcode → stur. (11 bits) — DT address | op | Rn | Rt
The instruction is stur.

a). ① ~~0000 0000 14~~
0X 0000 0000 0000 0014
(64 bits).
② 0 (??).

b) ALU control. : 0010.

c) PC+4. (??).

d) ~~0~~ ?

addunit:
e). ~~Add~~: PC address + 4. 0x0000 0000 0000 0050
2addunit: current PC address + ~~0000 0050~~
ALU:

f) RReg1: 0001. (3). WReg: 0010 (2)

5.

a)

b) · execute operation : ALU_result ← op(data1, data2)

RegDst : 0.

RegWrite : 1.

ALUSrc : 1.

MemRead : 0

MemWrite : 0

MemtoReg X : ⟶ there is no information to pass on.

Zero : X ⟶ no use.

Branch : 0.

Uncond branch : 0

ALUOp : 0010

6. 1) P1 : 3GHz / 1.5 = 2 * 10^9 instructions per second.

P2 : 2.5GHz / 1.0 = 2.5 * 10^9 instructions per second.

P3 : 4GHz / 2.2 = 1.82 * 10^9 instructions per second.

2) Cycles :

P1 : 3GHz * 10 = 3 * 10^10 cycles.

P2 : 2.5GHz * 10 = 215 * 10^10 cycles

P3 : 4GHz * 10 = 4 * 10^10 cycles.

Number of instructions

P1 : 3GHz * 10 / 1.5 = 2 * 10^9 instructions

P2 : 2.5GHz * 10 / 1.0 = 2.5 * 10^10 instructions

P3 : 4GHz * 10 / 2.2 = 1.82 * 10^10 instructions.

7. a) class A : 10^5 instructions. class B : 2*10^5 instructions. class C : 5*10^5 instructions
class D : 2*10^5 instructions.

Time = numbers of instruction × CPI / clock rate.

Total time of P1 = $\frac{(10^5 + 2\times10^5\times2 + 5\times10^5\times3 + 2\times10^5\times3)}{2.5\times10^9} = 10.4\times10^{-4}$ s.

Total time of P2 = $\frac{10^5\times2 + 2\times10^5\times2 + 5\times10^5\times2 + 2\times10^5\times2}{3\times10^9} = 6.66\times10^{-4}$ s.

~~CPI(P1) = 10.4×10^-4 s × 2.5×10^9 / 10^6 = 2.6~~

~~CPI(P2) = 6.66×10^-4 s × 3×10^9 / 10^6 = 2.0~~

P1 > P2

∴ P2 is faster.

b) clock cycles(P1) = 1×10^5 + 2×10^5×2 + 5×10^5×3 + 2×10^5×3 = 2.6×10^6

clock cycles(P2) = 2×10^5 + 2×10^5×2 + 5×10^5×2 + 2×10^5×2

≈ 2×10^6.