

Homework 1 Solution

Problem 1

```
int Median = [  
    (A <= B && B <= C) || (C <= B && B <= A)    : B  
    (B <= A && A <= C) || (C <= A && A <= B)    : A  
    1                                             : C  
];
```

Problem 2

Stage	Generic	Specific
	<code>irmovl V, rB</code>	<code>irmovl \$128, %esp</code>
Fetch	$\text{icode:ifun} \leftarrow M_1[\text{PC}]$ $\text{rA:rB} \leftarrow M_1[\text{PC} + 1]$ $\text{valC} \leftarrow M_4[\text{PC} + 2]$ $\text{valP} \leftarrow \text{PC} + 6$	$\text{icode:ifun} \leftarrow M_1[0x00c] = 3:0$ $\text{rA:rB} \leftarrow M_1[0x00d] = f:4$ $\text{valC} \leftarrow M_4[0x00e] = 128$ $\text{valP} \leftarrow 0x00c + 6 = 0x012$
Decode		
Execute	$\text{valE} \leftarrow 0 + \text{valC}$	$\text{valE} \leftarrow 0 + 128 = 128$
Memory		
Write Back	$R[\text{rB}] \leftarrow \text{valE}$	$R[\%esp] \leftarrow \text{valE} = 128$
Update PC	$\text{PC} \leftarrow \text{valP}$	$\text{PC} \leftarrow \text{valP} = 0x012$

Problem 3

Stage	Generic	Specific
	<code>pushl rA</code>	<code>pushl %edx</code>
Fetch	$\text{icode:ifun} \leftarrow M_1[\text{PC}]$ $\text{rA:rB} \leftarrow M_1[\text{PC} + 1]$ $\text{valP} \leftarrow \text{PC} + 2$	$\text{icode:ifun} \leftarrow M_1[0x018] = \text{a:0}$ $\text{rA:rB} \leftarrow M_1[0x019] = \text{2:f}$ $\text{valP} \leftarrow 0x018 + 2 = 0x01a$
Decode	$\text{valA} \leftarrow R[\text{rA}]$ $\text{valB} \leftarrow R[\%esp]$	$\text{valA} \leftarrow R[\%edx] = 9$ $\text{valB} \leftarrow R[\%esp] = 128$
Execute	$\text{valE} \leftarrow \text{valB} + (-4)$	$\text{valE} \leftarrow 128 + (-4) = 124$
Memory	$M_4[\text{valE}] \leftarrow \text{valA}$	$M_4[124] \leftarrow 9$
Write Back	$R[\%esp] \leftarrow \text{valE}$	$R[\%esp] \leftarrow 124$
Update PC	$\text{PC} \leftarrow \text{valP}$	$\text{PC} \leftarrow 0x01a$

Problem 4

Stage	Generic	Specific
	<code>popl rA</code>	<code>popl %eax</code>
Fetch	$\text{icode:ifun} \leftarrow M_1[\text{PC}]$ $\text{rA:rB} \leftarrow M_1[\text{PC} + 1]$ $\text{valP} \leftarrow \text{PC} + 2$	$\text{icode:ifun} \leftarrow M_1[0x01a] = \text{b:0}$ $\text{rA:rB} \leftarrow M_1[0x01b] = \text{0:f}$ $\text{valP} \leftarrow 0x01a + 2 = 0x01c$
Decode	$\text{valA} \leftarrow R[\%esp]$ $\text{valB} \leftarrow R[\%esp]$	$\text{valA} \leftarrow R[\%esp] = 124$ $\text{valB} \leftarrow R[\%esp] = 124$
Execute	$\text{valE} \leftarrow \text{valB} + 4$	$\text{valE} \leftarrow 124 + 4 = 128$
Memory	$\text{valM} \leftarrow M_4[\text{valA}]$	$\text{valM} \leftarrow M_4[124] = 9$
Write Back	$R[\%esp] \leftarrow \text{valE}$ $R[\text{rA}] \leftarrow \text{valM}$	$R[\%esp] \leftarrow 128$ $R[\%eax] \leftarrow 9$
Update PC	$\text{PC} \leftarrow \text{valP}$	$\text{PC} \leftarrow 0x01c$