CMPT 295 Assignment 6 Solutions (2%)

1. [10 marks] *Operand Reduction*

   (a) (b) + (c) [7 marks]

   Consider the design of a 3-operand machine. The desired addressing modes include immediate mode, direct mode and relative mode.

Instruction	Format	$f+d$	*exec*
`movi $val, rC`	OPC | C | -	6	0
`movmr addr, rC`	OPC | C | -	4	4
`movrr rA, rC`	OPC | C | A | -	2	0
`movrm rA, addr`	OPC | - | A	4	4
`add rA, rB, rC`	OPC | C | A | - | - | B | -	3	0
`jle rA, rB, disp`	OPC | B | A | - | -	5	0
`movi` $\$val_{21}$`, rC`	OPC | C	4	0
`jle rA, rB,` $disp_{10}$	OPC | B | A	3	0
`add rA, rC`	OPC | C | A | -	2	0
`jle rA, disp`	OPC | - | A	4	0
`jle rA,` $disp_5$	OPC | A	2	0

   (d) [3 marks]

3-Operand		$f+d$	*exec*
`movmr`	`x, r1`	4	4
`movmr`	`y, r2`	4	4
`add`	`r1, r2, r3`	3	0
`sub`	`r1, r2, r4`	3	0
`mul`	`r3, r4, r5`	3	0
`movrm`	`r5, z`	4	4

Total = 33

2-Operand		$f+d$	*exec*
`movmr`	`x, r1`	4	4
`movmr`	`y, r2`	4	4
`movrr`	`r1, r3`	2	0
`add`	`r2, r1`	2	0
`sub`	`r2, r3`	2	0
`mul`	`r1, r3`	2	0
`movrm`	`r3, z`	4	4

Total = 32

2. [10 marks] *Branch Reduction*

(c) [4 marks]

```
        # var map:
        #   %rdi - int *A
        #   %esi - int n
        #   %edx - int target
        #   %r8  - int *endptr
        #   %r9d - tmp
        #   %eax - int i / return value if found
        #   %ecx - copy of A[i]

        # if (n <= 0) return -1;

        # endptr = &(A[--n]);

        # tmp = *endptr;
        # *endptr = target
        # i = 0;
        # if (A[0] == target) goto endwhile

        # do {
        #    ecx = *(++A);
        #    i++;
        # } while (ecx != target);

    endwhile:
        # *endptr = tmp

        # if (i < n) return i;
        # else if (tmp == target) return n-1;
        # else return -1;
```