

# Key to Practical 2

## Branches and Loops

### Step 1

```

                                org      $4
Vector_001  dc.l      Main

                                org      $500

Main
clr.l      d1                  ; 0 -> D1
move.l     #$80000007,d0       ; $80000007 -> D0.L (D0.W = $0007 = 7)
loop1      addq.l     #1,d1      ; D1 + 1 -> D1
           subq.w     #1,d0      ; D0.W - 1 -> D0.W ; Only D0.W is decremented
           bne        loop1      ; Branch if Z = 0 (D0.W ≠ 0)
                                ; D1 = 7

           clr.l      d2                  ; 0 -> D2
loop2      move.l     #$fe2310,d0       ; $fe2310 -> D0.L (D0.B = $10 = 16)
           addq.l     #1,d2      ; D2 + 1 -> D2
           subq.b     #2,d0      ; D0.B - 2 -> D0.B ; Only D0.B is decremented
           bne        loop2      ; Branch if Z = 0 (D0.B ≠ 0)
                                ; D2 = 8

           clr.l      d3                  ; 0 -> D3
loop3      moveq.l    #125,d0          ; 125 -> D0
           addq.l     #1,d3      ; D3 + 1 -> D3
           dbra       d0,loop3      ; DBRA = DBF
                                ; D0.W - 1 -> D0.W
                                ; Branch if D0.W ≠ -1 (D0.W ≠ $FFFF)
                                ; D3 = 126

           clr.l      d4                  ; 0 -> D4
loop4      moveq.l    #10,d0          ; 10 -> D0
           addq.l     #1,d4      ; D4 + 1 -> D4
           addq.l     #1,d0      ; D0 + 1 -> D0
           cmpi.l     #30,d0       ; Compare D0 to 30
           bne        loop4      ; Branch if Z = 0 (D0.L ≠ 30)
                                ; D4 = 20

illegal

```

**Step 2**

```

VALUE      equ      18

           org      $4

Vector_001 dc.l      Main

           org      $500

Main       move.b    #VALUE,d1

           tst.b     d1          ; Set N and Z according to D1.B
           bne       next1       ; If Z = 0 (D1.B ≠ 0), then branch to Next1
           move.l     #200,d0     ; If not (D1.B = 0), 200 -> D0.L
           bra        quit        ; Exit

next1      bmi       next3       ; If N = 1 (D1.B < 0), then branch to Next3
           cmp.b     #$61,d1     ; If not (D1.B ≥ 0), D1.B is compared to $61 ($61 = 97)
           blt       next2       ; If D1.B < $61, then branch to Next2
           move.l     #400,d0     ; If not (D1.B ≥ $61), 400 -> D0.L
           bra        quit        ; Exit

next2      move.l     #600,d0     ; D1.B < $61, 600 -> D0.L
           bra        quit        ; Exit

next3      move.l     #800,d0     ; D1.B < 0, 800 -> D0.L

quit       illegal

```

1. What value is returned by the program when the VALUE label is set to 18?

The program returns the value **600**.

2. What value is returned by the program when the VALUE label is set to -5?

The program returns the value **800**.

3. What value is returned by the program when the VALUE label is set to 0?

The program returns the value **200**.

4. What value is returned by the program when the VALUE label is set to 96?

The program returns the value **600**.

### Step 3

```

                org      $4
Vector_001     dc.l      Main

                org      $500
Main           ; Initialize D0.
               move.l    #-1,d0
Abs            ; Set Z and N according to D0.
               ; If D0 ≥ 0, then 0 -> N.
               ; If D0 < 0, then 1 -> N.
               tst.l     d0

               ; Branch to quit if N = 0 (if D0 ≥ 0).
               bpl       quit

               ; Otherwise N = 1 (D0 < 0).
               ; 0 - D0 -> D0
               neg.l     d0

quit           ; Stop the program.
               illegal

```

### Step 4

```

                org      $4
Vector_001     dc.l      Main

                org      $500
Main           ; A0 points to the string.
               movea.l    #STRING,a0
StrLen         ; Initialize the character counter to 0.
               ; (D0 = character counter).
               clr.l     d0
loop           ; Test if a character is null.
               ; A0 is incremented by one
               ; (it now points to the next character).
               tst.b     (a0)+

               ; If the tested character is null, it is the end of string.
               ; We can exit.
               beq       quit

               ; Otherwise, the counter is incremented by one.
               ; Then, branch to loop.
               addq.l    #1,d0
               bra       loop

quit           ; Stop the program.
               illegal

                org      $550
STRING         dc.b      "This string is made up of 40 characters.",0

```

**Step 5**

```

                                org      $4
Vector_001  dc.l      Main

                                org      $500
Main        ; A0 points to the string.
            movea.l  #STRING,a0

SpaceCount  ; Initialize the space counter to 0.
            ; (D0 = space counter).
            clr.l    d0

loop        ; A character is loaded into D1.
            ; The MOVE instruction updates the flags
            ; in the same way as the TST instruction.
            ; Therefore :
            ; - If D1 ≠ 0, then 0 -> Z.
            ; - If D1 = 0, then 1 -> Z.
            ; The BEQ instruction can then be used.
            ; It jumps to quit if Z = 1 (if D1 = 0).
            move.b   (a0)+,d1
            beq      quit

            ; If the character in D1 is not a space,
            ; branch to loop.
            cmp.b    #' ',d1
            bne      loop

            ; Otherwise, the character is a space.
            ; The space counter is incremented.
            ; Then branch to loop.
            addq.l   #1,d0
            bra      loop

quit        ; Stop the program.
            illegal

                                org      $550
STRING      dc.b     "This string contains 4 spaces.",0

```

**Step 6**

```

                                org      $4
Vector_001  dc.l      Main

                                org      $500
Main        ; A0 points to the string.
            movea.l  #STRING,a0

LowerCount  ; Initialize the small-letter counter to 0.
            ; (D0 = small-letter counter).
            clr.l    d0

loop        ; A character is loaded into D1.
            ; The MOVE instruction updates the flags
            ; in the same way as the TST instruction.
            ; Therefore :
            ; - If D1 ≠ 0, then 0 -> Z.
            ; - If D1 = 0, then 1 -> Z.
            ; The BEQ instruction can then be used.
            ; It jumps to quit if Z = 1 (if D1 = 0).
            move.b   (a0)+,d1
            beq      quit

            ; If the ASCII code of the character is lower
            ; than that of 'a', the character is not a small letter.
            ; So, branch to loop.
            cmp.b    #'a',d1
            blo      loop

            ; If the ASCII code of the character is higher
            ; than that of 'z', the character is not a small letter.
            ; So, branch to loop.
            cmp.b    #'z',d1
            bhi      loop

            ; Otherwise, the character is a small letter.
            ; The small-letter counter is incremented.
            ; Then, branch to loop.
            addq.l   #1,d0
            bra      loop

quit        ; Stop the program.
            illegal

                                org      $550
STRING      dc.b     "This string contains 29 small letters.",0

```