COS-10004 (Computer Systems)

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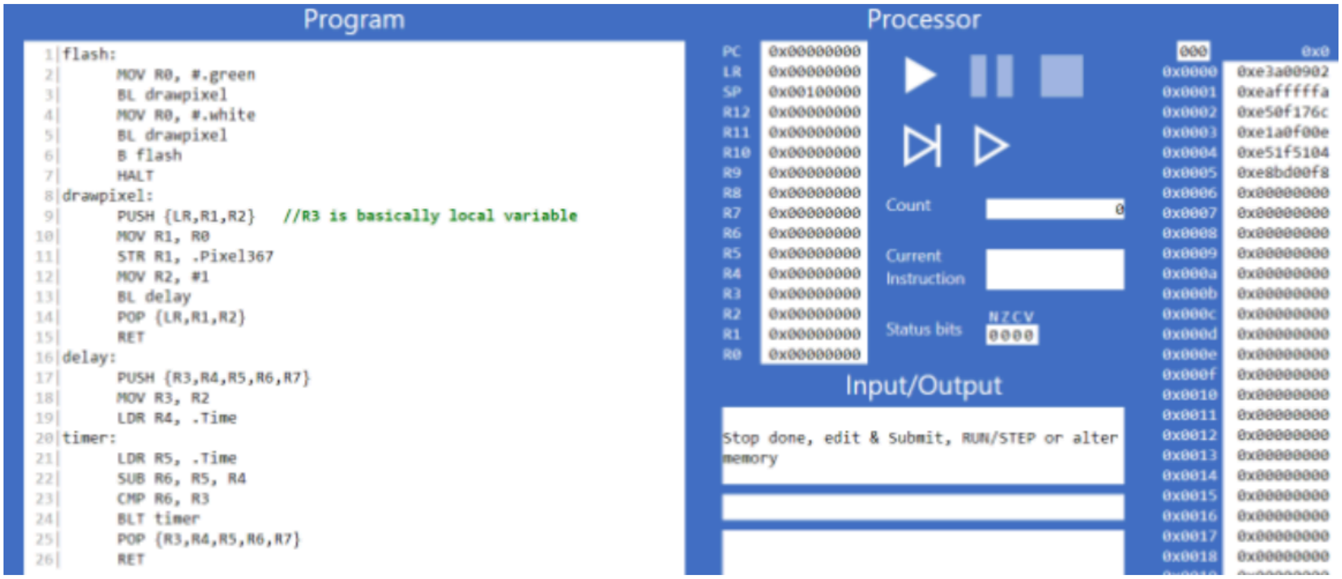
Q10.1:



```
flash:
        MOV R0, #.green
        BL drawpixel
        MOV R0, #.white
        BL drawpixel
        B flash
        HALT
drawpixel:
        PUSH {LR,R1,R2}    //R3 is basically local variable
        MOV R1, R0
        STR R1, .Pixel367
        MOV R2, #1
        BL delay
        POP {LR,R1,R2}
        RET
delay:
        PUSH {R3,R4,R5,R6,R7}
        MOV R3, R2
        LDR R4, .Time
timer:
        LDR R5, .Time
        SUB R6, R5, R4
        CMP R6, R3
        BLT timer
        POP {R3,R4,R5,R6,R7}
        RET
```

```
PC   0x00000000
LR   0x00000000
SP   0x00100000
R12  0x00000000
R11  0x00000000
R10  0x00000000
R9   0x00000000
R8   0x00000000
R7   0x00000000
R6   0x00000000
R5   0x00000000
R4   0x00000000
R3   0x00000000
R2   0x00000000
R1   0x00000000
R0   0x00000000
```

```
Count                 0
Current Instruction
Status bits     N Z C V
                0 0 0 0
```

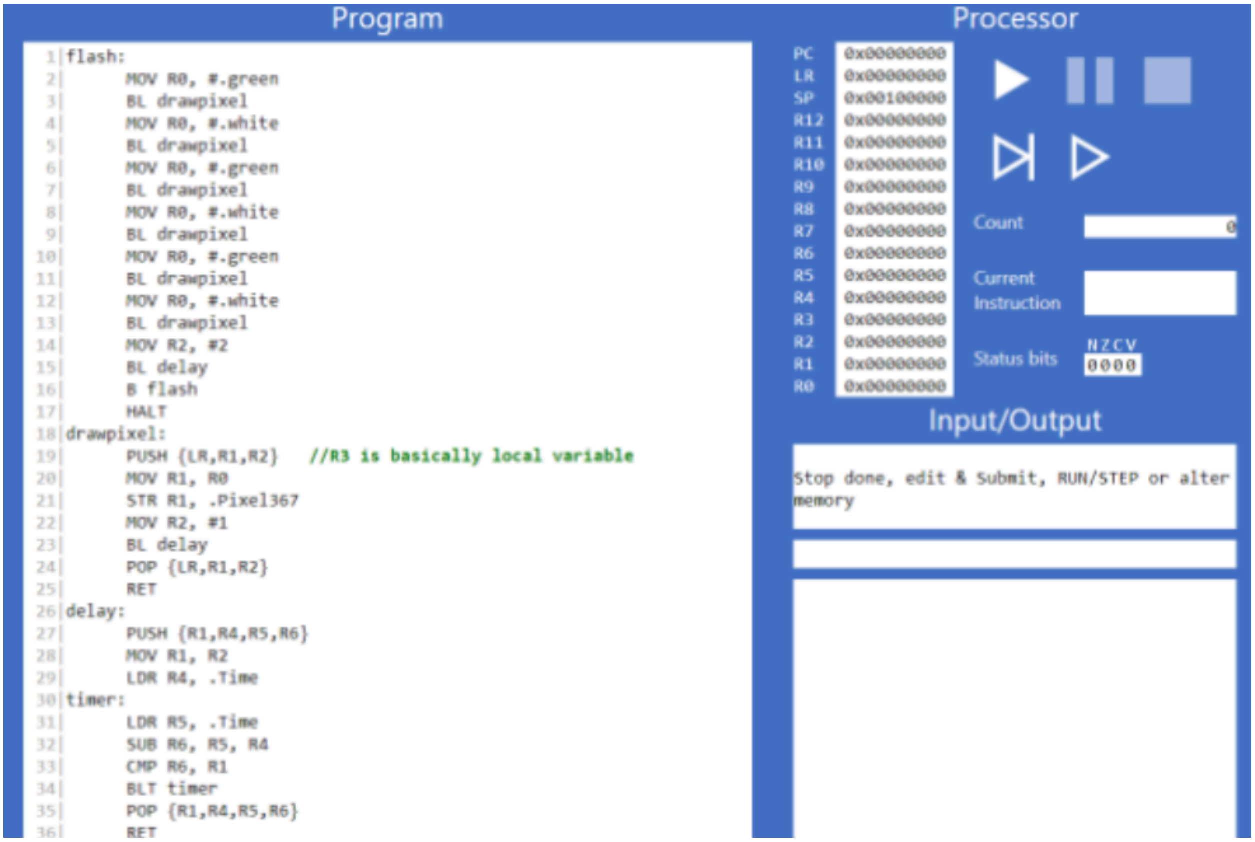
```
000       0x0
0x0000    0xe3a00902
0x0001    0xeafffffa
0x0002    0xe50f176c
0x0003    0xe1a0f00e
0x0004    0xe51f5104
0x0005    0xe8bd00f8
0x0006    0x00000000
0x0007    0x00000000
0x0008    0x00000000
0x0009    0x00000000
0x000a    0x00000000
0x000b    0x00000000
0x000c    0x00000000
0x000d    0x00000000
0x000e    0x00000000
0x000f    0x00000000
0x0010    0x00000000
0x0011    0x00000000
0x0012    0x00000000
0x0013    0x00000000
0x0014    0x00000000
0x0015    0x00000000
0x0016    0x00000000
0x0017    0x00000000
0x0018    0x00000000
```

```
Stop done, edit & Submit, RUN/STEP or alter memory
```

Q10.1 (c):

The above code uses indirect addressing since it may store the exact value of R2 in [R4], containing a memory location and its value. In the code, 4 bytes are added to the pixel each time until it reaches 80, and data is moved to the memory location (4 bytes, 32 bits). R1 is the base address; if we add a value in R3, it will be added to R1, which holds the address and may be used to create a new pointer to the subsequent pixel.

Q10.2:



```
flash:
        MOV R0, #.green
        BL drawpixel
        MOV R0, #.white
        BL drawpixel
        MOV R0, #.green
        BL drawpixel
        MOV R0, #.white
        BL drawpixel
        MOV R0, #.green
        BL drawpixel
        MOV R0, #.white
        BL drawpixel
        MOV R2, #2
        BL delay
        B flash
        HALT
drawpixel:
        PUSH {LR,R1,R2}   //R3 is basically local variable
        MOV R1, R0
        STR R1, .Pixel367
        MOV R2, #1
        BL delay
        POP {LR,R1,R2}
        RET
delay:
        PUSH {R1,R4,R5,R6}
        MOV R1, R2
        LDR R4, .Time
timer:
        LDR R5, .Time
        SUB R6, R5, R4
        CMP R6, R1
        BLT timer
        POP {R1,R4,R5,R6}
        RET
```

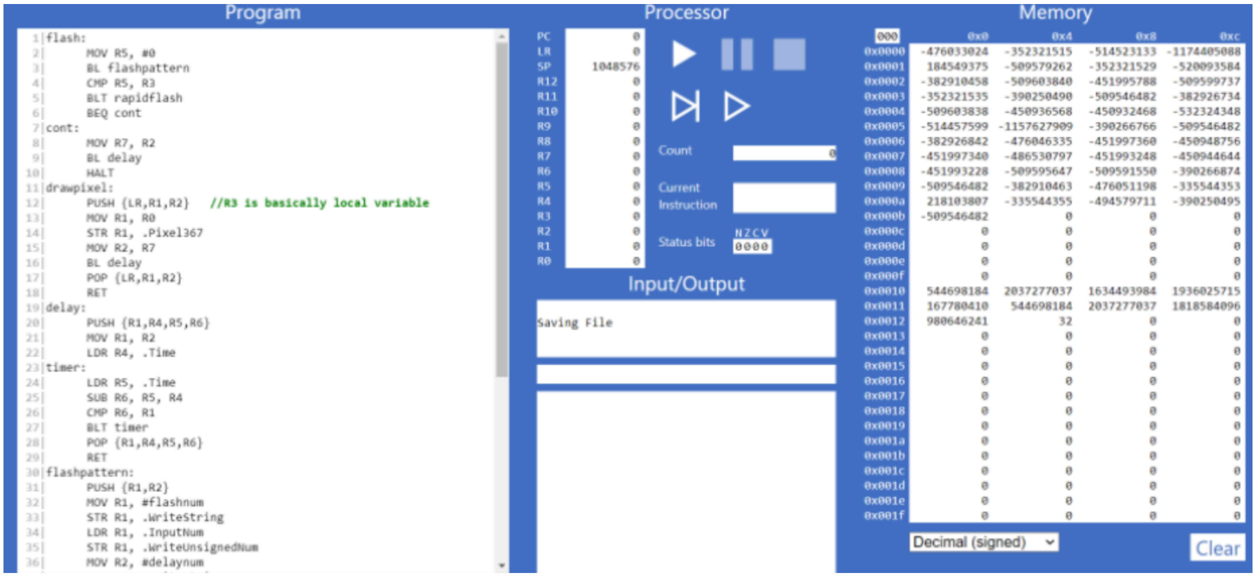
```
PC   0x00000000
LR   0x00000000
SP   0x00100000
R12  0x00000000
R11  0x00000000
R10  0x00000000
R9   0x00000000
R8   0x00000000
R7   0x00000000
R6   0x00000000
R5   0x00000000
R4   0x00000000
R3   0x00000000
R2   0x00000000
R1   0x00000000
R0   0x00000000
```

Count 0

Status bits NZCV 0000

```
Stop done, edit & Submit, RUN/STEP or alter memory
```

Q10.3:



```
flash:
        MOV R5, #0
        BL flashpattern
        CMP R5, R3
        BLT rapidflash
        BEQ cont
cont:
        MOV R7, R2
        BL delay
        HALT
drawpixel:
        PUSH {LR,R1,R2}   //R3 is basically local variable
        MOV R1, R0
        STR R1, .Pixel367
        MOV R2, R7
        BL delay
        POP {LR,R1,R2}
        RET
delay:
        PUSH {R1,R4,R5,R6}
        MOV R1, R2
        LDR R4, .Time
timer:
        LDR R5, .Time
        SUB R6, R5, R4
        CMP R6, R1
        BLT timer
        POP {R1,R4,R5,R6}
        RET
flashpattern:
        PUSH {R1,R2}
        MOV R1, #flashnum
        STR R1, .WriteString
        LDR R1, .InputNum
        STR R1, .WriteUnsignedNum
        MOV R2, #delaynum
```

```
PC         0
LR         0
SP   1048576
R12        0
R11        0
R10        0
R9         0
R8         0
R7         0
R6         0
R5         0
R4         0
R3         0
R2         0
R1         0
R0         0
```

Count 0

Status bits NZCV 0000

```
Saving File
```

```
000            0x0         0x4         0x8         0xc
0x0000  -476033024  -352321515  -514523133 -1174405088
0x0001   184549375  -509579262  -352321529  -520093584
0x0002  -382910458  -509603840  -451995788  -509599737
0x0003  -352321535  -390250490  -509546482  -382926734
0x0004  -509603838  -450936568  -450932468  -532324348
0x0005  -514457599 -1157627909  -390266766  -509546482
0x0006  -382926842  -476046335  -451997360  -450948756
0x0007  -451997340  -486530797  -451993248  -450944644
0x0008  -451993228  -509595647  -509591550  -390266874
0x0009  -509546482  -382910463  -476051198  -335544353
0x000a   218103807  -335544355  -494579711  -390250495
0x000b  -509546482           0           0           0
0x000c           0           0           0           0
0x000d           0           0           0           0
0x000e           0           0           0           0
0x000f           0           0           0           0
0x0010   544698184  2037277037  1634493984  1936025715
0x0011   167780410   544698184  2037277037  1818584096
0x0012   980646241          32           0           0
0x0013           0           0           0           0
0x0014           0           0           0           0
0x0015           0           0           0           0
0x0016           0           0           0           0
0x0017           0           0           0           0
0x0018           0           0           0           0
0x0019           0           0           0           0
0x001a           0           0           0           0
0x001b           0           0           0           0
0x001c           0           0           0           0
0x001d           0           0           0           0
0x001e           0           0           0           0
0x001f           0           0           0           0
```

Decimal (signed)