Laboratory 3
Assembly Loop Programming and Debugging

Part 0:

Iteration	Code Line	PC	X	A	B	N	Z	V	C
0	4: **BEQ** **endLoop**	$4106	$3000	0	5	0	0	0	0
1	4: **BEQ** **endLoop**	$4106	$3001	3A	04	0	0	0	0
2	4: **BEQ** **endLoop**	$4106	$3002	98	03	0	0	0	0
3	4: **BEQ** **endLoop**	$4106	$3003	96	02	0	0	0	1
4	4: **BEQ** **endLoop**	$4106	$3004	21	01	0	0	0	1
5	4: **BEQ** **endLoop**	$4106	$3005	77	00	0	1	0	0
	10:BRA endmain	$4111	$3005	77	00	0	0	0	0

Figure 7 - Breakpoint Trace (Part I)

Part I:

Q1: Where is the sum value saved in the memory location? What is the sum of the given array in hex and in decimal?
   The sum is stored at location $1009. In hex, the result is: 7C. In decimal, the result is 124.
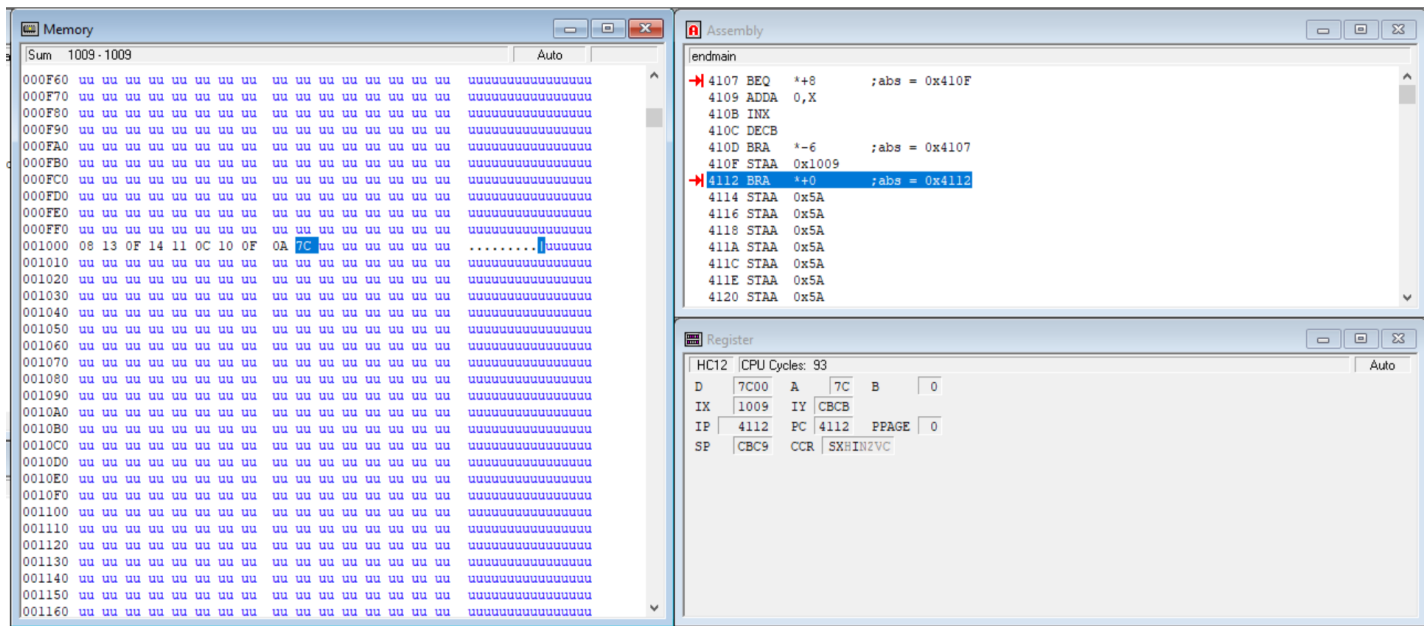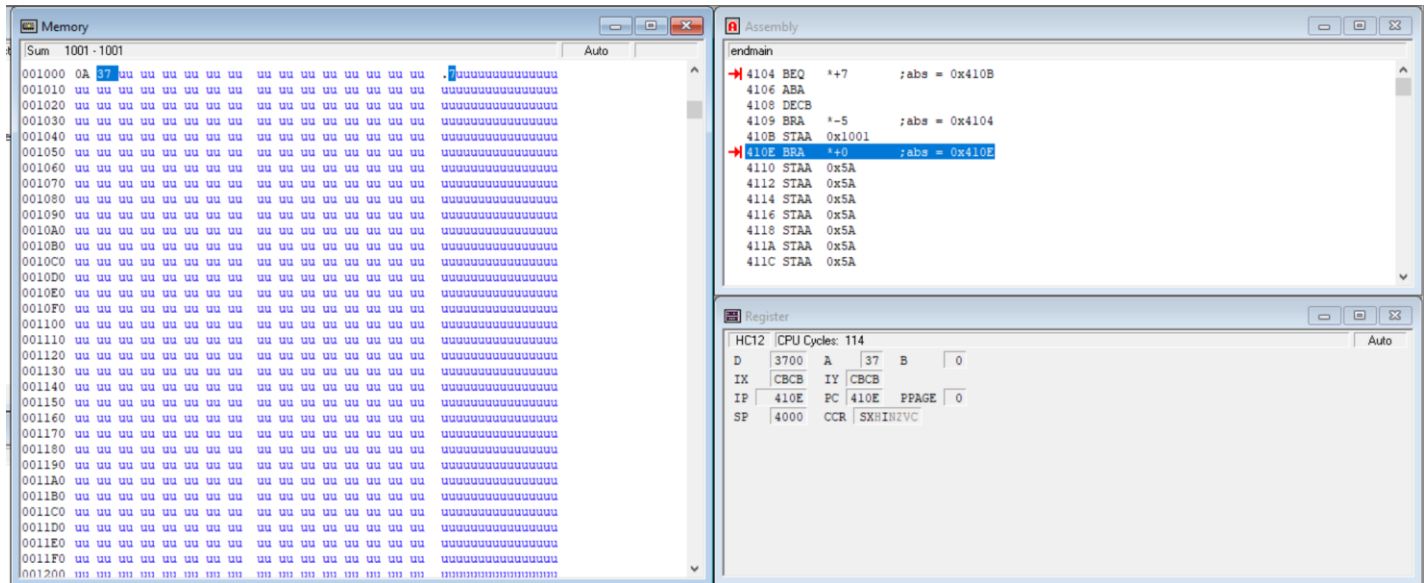
Part II:

Q2: Where is the sum value saved in the memory location? What is the *sum of the first N natural numbers* in hex and in decimal?
   The sum is stored at location $1001. For N=10, in hex, the result is: 37. For N=10, in decimal, the result is 55.

Screenshot for Project3_Part1

Memory

```
Sum  1009 - 1009                                    Auto
000F60 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
000F70 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
000F80 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
000F90 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
000FA0 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
000FB0 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
000FC0 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
000FD0 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
000FE0 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
000FF0 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001000 08 13 0F 14 11 0C 10 0F  0A 7C uu uu uu uu uu uu  .........|uuuuuu
001010 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001020 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001030 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001040 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001050 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001060 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001070 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001080 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001090 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
0010A0 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
0010B0 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
0010C0 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
0010D0 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
0010E0 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
0010F0 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001100 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001110 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001120 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001130 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001140 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001150 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001160 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
```

Assembly

```
endmain
4107 BEQ   *+8        ;abs = 0x410F
4109 ADDA  0,X
410B INX
410C DECB
410D BRA   *-6        ;abs = 0x4107
410F STAA  0x1009
4112 BRA   *+0        ;abs = 0x4112
4114 STAA  0x5A
4116 STAA  0x5A
4118 STAA  0x5A
411A STAA  0x5A
411C STAA  0x5A
411E STAA  0x5A
4120 STAA  0x5A
```

Register

```
HC12  CPU Cycles: 93                                Auto
D    7C00   A   7C   B      0
IX   1009   IY  CBCB
IP   4112   PC  4112   PPAGE  0
SP   CBC9   CCR  SXHINZVC
```

Screenshot for Project3_Part2

Memory

```
Sum  1001 - 1001                                    Auto
001000 0A 37 uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  .7uuuuuuuuuuuuuu
001010 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001020 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001030 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001040 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001050 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001060 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001070 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001080 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001090 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
0010A0 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
0010B0 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
0010C0 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
0010D0 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
0010E0 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
0010F0 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001100 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001110 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001120 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001130 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001140 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001150 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001160 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001170 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001180 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001190 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
0011A0 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
0011B0 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
0011C0 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
0011D0 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
0011E0 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
0011F0 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
001200 uu uu uu uu uu uu uu uu  uu uu uu uu uu uu uu uu  uuuuuuuuuuuuuuuu
```

Assembly

```
endmain
4104 BEQ   *+7        ;abs = 0x410B
4106 ABA
4108 DECB
4109 BRA   *-5        ;abs = 0x4104
410B STAA  0x1001
410E BRA   *+0        ;abs = 0x410E
4110 STAA  0x5A
4112 STAA  0x5A
4114 STAA  0x5A
4116 STAA  0x5A
4118 STAA  0x5A
411A STAA  0x5A
411C STAA  0x5A
```

Register

```
HC12  CPU Cycles: 114                               Auto
D    3700   A   37   B      0
IX   CBCB   IY  CBCB
IP   410E   PC  410E   PPAGE  0
SP   4000   CCR  SXHINZVC
```