**Assembly Language Assembled
for the
Sinclair ZX81**

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Assembly Language Assembled for the Sinclair ZX81

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Contents

Preface	ix	
1	INSIDE THE COMPUTER	1
1.1	Microcomputers	1
1.2	The Z80 Central Processing Unit	2
1.3	Memory	3
1.4	Instructions	4
1.5	Assembly Language	5
2	ASSEMBLY LANGUAGE PROGRAMS	7
2.1	Assembling Programs	7
2.2	The ZXAS Program	7
2.3	Using ZXAS	10
2.4	The ZXDB Program	11
2.5	ZXDB Commands	12
2.6	Single Stepping	15
2.7	Program Storage	17
3	SOME SIMPLE INSTRUCTIONS	19
3.1	The Basic Operations	19
3.2	Loading a Register	19
3.3	Simple Addition and Subtraction	19
3.4	Moving Between Registers	20
3.5	Increment and Decrement	20
3.6	Finding a Negative	21
3.7	Addressing Modes - Immediate and Extended	21
3.8	An Example Program	22
3.9	Program	23
4	SUBROUTINES AND OUTPUT TO THE SCREEN	25
4.1	Subroutines	25
4.2	The CALL and RET Instructions	26
4.3	Another Subroutine Instruction	27
4.4	Some Useful Subroutines	28
4.5	Labels	29
4.6	Program	29
5	UNCONDITIONAL JUMPS AND KEYBOARD INPUT	30
5.1	Unconditional Jumps	30
5.2	Keyboard Input	31
5.3	Character Codes and Values	32
5.4	Program	34

6	CONDITIONAL JUMPS AND COMPARISONS	35
6.1	The Flag Register	35
6.2	Conditional Jump Instructions	36
6.3	The Compare Instruction	38
6.4	Conditional Loop Termination	39
6.5	Program	40
7	COUNTING LOOPS	41
7.1	Counting Loops	41
7.2	Number Input	44
7.3	Stacks	45
7.4	Stack Instructions	46
7.5	Saving and Restoring Registers	47
7.6	Program	48
8	LOOPS WITHIN LOOPS	49
8.1	Nested Loops	49
8.2	More Addressing Modes	50
8.3	Text Output	53
8.4	The Display File	54
8.5	The Subroutine Mechanism	56
8.6	Program	57
9	CARRY AND OVERFLOW	58
9.1	Arithmetic Conditions	58
9.2	Carry	58
9.3	The Carry Flag	59
9.4	Overflow	60
9.5	The Overflow Flag	60
9.6	Conditional Calls and Returns	61
9.7	Program	62
10	MULTIPLICATION AND DIVISION	63
10.1	Shifts	63
10.2	The SRL Instruction	63
10.3	The SRA Instruction	64
10.4	The SLA Instruction	65
10.5	Eight-bit Multiplication and Division	65
10.6	Program	67
11	THE LOGICAL BITS	68
11.1	Bit Instructions	68
11.2	The Bit Test Instruction	68
11.3	The SET and RES Instructions	69
11.4	The Index Registers	69
11.5	Logic Operators	70
11.6	Logical Instructions	71
11.7	Program	72
12	ROTATE INSTRUCTIONS AND PARITY	74
12.1	Rotate Instructions	74
12.2	Accumulator Rotate Instructions	74
12.3	Register and Memory Byte Rotations	76
12.4	Packing and Unpacking	76
12.5	Parity	77

12.6	The Parity Flag	78
12.7	Program	79
13	MULTIPLE BYTE ARITHMETIC	80
13.1	Why Multiple Byte	80
13.2	The Sixteen-bit Arithmetic Instructions	80
13.3	Extended Loops	82
13.4	Multiple Byte Arithmetic	85
13.5	Program	86
14	BLOCK TRANSFER AND SEARCH	87
14.1	Block Instructions	87
14.2	Block Transfer	87
14.3	Block Search Instructions	90
14.4	Program	92
15	DECIMAL ARITHMETIC	93
15.1	Binary Coded Decimal	93
15.2	BCD Arithmetic	94
15.3	The DAA Instruction	95
15.4	The Digit Rotate Instructions	96
15.5	Program	98
16	MISCELLANEOUS INSTRUCTIONS	100
16.1	Other Instructions	100
16.2	The Auxiliary Registers	100
16.3	Exchange Instructions	100
16.4	Input and Output Instructions	101
16.5	Interrupt Instructions	101
16.6	The Halt Instruction	102
Appendix A	NUMBER SYSTEMS	103
A.1	Other Number Systems	103
A.2	Binary and Hexadecimal Numbers	103
A.3	Binary-hexadecimal Conversion	104
A.4	Decimal to Binary Conversion	105
A.5	Binary to Decimal Conversion	106
A.6	Decimal-hexadecimal Conversion	106
A.7	Binary and Hexadecimal Arithmetic	107
A.8	Bytes	107
A.9	Signed Numbers	108
Appendix B	HAND ASSEMBLY	111
B.1	General Method	111
B.2	Numbers and Addresses	111
B.3	Jump Instructions	113
B.4	Bit Instructions	114
B.5	Index Register Instructions	114
Appendix C	HEXADECIMAL-DECIMAL CONVERSION TABLES	116
Appendix D	CHARACTER CODES	118

Appendix E	SUMMARY OF Z80 INSTRUCTIONS	119
E.1	Summary of Flag Operations	120
E.2	8-bit Load Group	121
E.3	16-bit Load Group	122
E.4	Exchange Group and Block Transfer and Search Group	123
E.5	8-bit Arithmetic and Logical Group	124
E.6	General Purpose Arithmetic and CPU Control Groups	125
E.7	16-bit Arithmetic Group	126
E.8	Rotate and Shift Group	127
E.9	Bit Set, Reset and Test Group	128
E.10	Jump Group	129
E.11	Call and Return Group	130
E.12	Input and Output Group	131
Appendix F	SAMPLE PROGRAMS	132
F.1	The Programs	132
F.2	Life	132
F.3	Mailing List	138
	ANSWERS TO EXERCISES	144

Preface

This book is for ZX81 users who feel competent at writing programs in BASIC but now want to take their ZX81, and themselves, further.

Assembly language programming takes you into the heart, or should we say brain, of the ZX81 and lets you program it in much finer detail than is possible with BASIC.

The usual reason for writing programs in assembly language is to gain increased processing speed either to give better moving graphics or faster processing of calculations that are repeated often.

Assembly language programming is also used to enable a better program to fit into a small area of memory. All readers will be aware of the limitations of the ZX81 when used with 1K of memory and programmed in BASIC. As you will see later, 1K of memory means that the computer has approximately 1000 places in its memory, which can be used to store data.

If you write a BASIC program, approximately 30 lines of program will fill this memory. If the program is written in assembly language and then translated into machine code, 30 lines of program will only fill about forty or fifty of the places in memory. However, to be truly comparable an assembly language program which is equivalent to the 30-line BASIC program, will probably need to be 100 or 150 lines long. This will still only use something like 200 places in memory, leaving enough memory for a display which fills all of the screen.

Until you have written and run some assembly language programs, it is difficult to appreciate the increase in speed which it will give. As a rough guide an assembly language program will run at least twenty times faster than the equivalent BASIC program.

The main problem with programs in assembly language is that you are working directly with the microprocessor of the computer and you are not protected from it, or it from you, as you are when you write BASIC programs. This means that if you make an error in your program, and everyone does, then instead of stopping and waiting for your correction, the computer is likely to go off on its own and it will try to run anything that is in the memory, as though it was a program. This is a computer 'crash' and the only way of regaining control of the ZX81 is to switch off the machine and start again.

Before an assembly language can be run on a computer it must be translated into the language used by the computer. This is known as machine code language and consists of a series of numbers; all programs that run on the computer, even BASIC programs, are translated into this form before they are run. The translation from assembly language to machine code language can be performed manually or it can be performed by the computer using a program called an assembler. The assembler program used and described in this book is called ZXAS and I consider it to be the best assembler available for the Sinclair ZX81.

Because machine code language does not have any facilities for finding program errors, finding and correcting errors can be a long and difficult task. Many of the problems involved in correcting a machine code program can be eased by using another computer program which enables you to see what is happening inside the computer while your program is running. The ZXDB program has been used in producing this book and it carries out this function admirably.

Remember that assembly language is just another programming language, like BASIC. You will find that it is no more difficult to learn than BASIC, and possibly easier.

After the first two chapters, each chapter consists of a series of short sections. Each section introduces a new idea and usually includes an exercise on the idea. The exercises are meant to be challenging and they encourage readers to make many discoveries for themselves. Some of the exercise answers include notes on the answers, to extend the reader's understanding.

At the end of each chapter the reader is asked to write a program; the program should be coded, run and tested before starting the next chapter. Each program is designed, as far as possible, to include the ideas introduced in the chapter.

All exercises should be done when they are encountered, before continuing with the text. The whole text is designed on the premise that the best way to learn a programming language is by plenty of practical experience. Proficiency in programming is only achieved by programming.

Finally I would like to express my thanks to my wife, Marilyn, for typing the text and her support during the preparation of the book. Thanks are due too to Stephen for acting as a guinea pig and working through the text; by his efforts he has helped to remove the worst of the errors in the text.

Anthony Woods