

Example of an Machine Code / Assembly Language Program

This printout was created by using the debug utility in MS-DOS. It was used to disassemble the DOS program CHOICE.COM. Choice is a little system routine which is used to offer the user a choice, and waits for him to respond. eg Whenever the system says "Do you want another go [Y/N]" it is probably using the CHOICE.COM routine.

This is the raw machine code of the program in Hex.

Address	Contents of memory bytes	ASCII equivalent
1949:0100	E9 32 04 59 4E 00 00 00-00 00 00 00 00 00 00	.2.YN.....
1949:0110	00 00 00 00 00 00 00 00-00 00 00 00 00 00 00
1949:0120	00 00 00 00 00 00 00 00-00 00 00 00 00 00 00
1949:0130	00 00 00 00 00 00 00 00-00 00 00 00 00 00 00
1949:0140	00 00 00 00 00 00 00 00-00 00 00 00 00 00 00
1949:0150	00 00 00 00 00 00 00 00-00 00 00 00 00 00 00
1949:0160	00 00 00 00 00 00 00 00-00 00 00 00 00 00 00
1949:0170	00 00 00 00 00 00 00 00-00 00 00 00 00 00 00
1949:0180	00 00 00 00 00 57 61 69-74 73 20 66 6F 72 20 74Waits for t
1949:0190	68 65 20 75 73 65 72 20-74 6F 20 63 68 6F 6F 73	he user to choos
1949:01A0	65 20 6F 6E 65 20 6F 66-20 61 20 73 65 74 20 6F	e one of a set o
1949:01B0	66 20 63 68 6F 69 63 65-73 2E 0D 0A 0D 0A 00 43	f choices.....C
1949:01C0	48 4F 49 43 45 20 5B 2F-43 5B 3A 5D 63 68 6F 69	HOICE [/C:]choi
1949:01D0	63 65 73 5D 20 5B 2F 4E-5D 20 5B 2F 53 5D 20 5B	ces] [/N] [/S] [
1949:01E0	2F 54 5B 3A 5D 63 2C 6E-6E 5D 20 5B 74 65 78 74	/T[:c,nn] [text
1949:01F0	5D 0D 0A 0D 0A 00 2F 43-5B 3A 5D 63 68 6F 69 63]...../C:]choic
1949:0200	65 73 20 53 70 65 63 69-66 69 65 73 20 61 6C 6C	es Specifies all
1949:0210	6F 77 61 62 6C 65 20 6B-65 79 73 2E 20 44 65 66	owable keys. Def
1949:0220	61 75 6C 74 20 69 73 20-59 4E 0D 0A 2F 4E 20 20	ault is YN../N
1949:0230	20 20 20 20 20 20 20 20-20 44 6F 20 6E 6F 74 20	Do not
1949:0240	64 69 73 70 6C 61 79 20-63 68 6F 69 63 65 73 20	display choices
1949:0250	61 6E 64 20 3F 20 61 74-20 65 6E 64 20 6F 66 20	and ? at end of
1949:0260	70 72 6F 6D 70 74 20 73-74 72 69 6E 67 2E 0D 0A	prompt string...
1949:0270	2F 53 20 20 20 20 20 20-20 20 20 20 54 72 65	/S Tre
1949:0280	61 74 20 63 68 6F 69 63-65 20 6B 65 79 73 20 61	at choice keys a
1949:0290	73 20 63 61 73 65 20 73-65 6E 73 69 74 69 76 65	s case sensitive
1949:02A0	2E 0D 0A 2F 54 5B 3A 5D-63 2C 6E 6E 20 20 20 20	.../T[:c,nn
1949:02B0	44 65 66 61 75 6C 74 20-63 68 6F 69 63 65 20 74	Default choice t
1949:02C0	6F 20 63 20 61 66 74 65-72 20 6E 6E 20 73 65 63	o c after nn sec
1949:02D0	6F 6E 64 73 0D 0A 74 65-78 74 20 20 20 20 20 20	onds..text
1949:02E0	20 20 20 50 72 6F 6D 70-74 20 73 74 72 69 6E 67	Prompt string
1949:02F0	20 74 6F 20 64 69 73 70-6C 61 79 0D 0A 0D 0A 45	to display....E
1949:0300	52 52 4F 52 4C 45 56 45-4C 20 69 73 20 73 65 74	RRORLEVEL is set
1949:0310	20 74 6F 20 6F 66 66 73-65 74 20 6F 66 20 6B 65	to offset of ke
1949:0320	79 20 75 73 65 72 20 70-72 65 73 73 65 73 20 69	y user presses i
1949:0330	6E 20 63 68 6F 69 63 65-73 2E 0D 0A 0D 0A 00 49	n choices.....I
1949:0340	6E 76 61 6C 69 64 20 73-77 69 74 63 68 20 6F 6E	nvalid switch on
1949:0350	20 63 6F 6D 6D 61 6E 64-20 6C 69 6E 65 2E 20 45	command line. E
1949:0360	78 70 65 63 74 65 64 20-66 6F 72 6D 3A 0D 0A 20	xpected form...
1949:0370	20 20 20 00 43 48 4F 49-43 45 3A 20 69 6E 76 61	.CHOICE: inva
1949:0380	6C 69 64 20 63 68 6F 69-63 65 20 73 77 69 74 63	lid choice switc
1949:0390	68 20 73 79 6E 74 61 78-2E 20 45 78 70 65 63 74	h syntax. Expect
1949:03A0	65 64 20 66 6F 72 6D 3A-20 2F 43 5B 3A 5D 63 68	ed form: /C:]ch
1949:03B0	6F 69 63 65 73 0D 0A 00-43 48 4F 49 43 45 3A 20	oices...CHOICE:
1949:03C0	49 6E 63 6F 72 72 65 63-74 20 74 69 6D 65 6F 75	Incorrect timeou
1949:03D0	74 20 73 79 6E 74 61 78-2E 20 20 45 78 70 65 63	t syntax. Expec
1949:03E0	74 65 64 20 66 6F 72 6D-20 54 63 2C 6E 6E 20 6F	ted form Tc,nn o
1949:03F0	72 20 54 3A 63 2C 6E 6E-0D 0A 00 43 48 4F 49 43	r T:c,nn...CHOIC
1949:0400	45 3A 20 54 69 6D 65 6F-75 74 20 64 65 66 61 75	E: Timeout defau
1949:0410	6C 74 20 6E 6F 74 20 69-6E 20 73 70 65 63 69 66	lt not in specif
1949:0420	69 65 64 20 28 6F 72 20-64 65 66 61 75 6C 74 29	ied (or default)
1949:0430	20 63 68 6F 69 63 65 73-2E 0D 0A 00 43 48 4F 49	choices....CHOI
1949:0440	43 45 3A 20 6F 6E 6C 79-20 6F 6E 65 20 70 72 6F	CE: only one pro
1949:0450	6D 70 74 20 73 74 72 69-6E 67 20 61 6C 6C 6F 77	mppt string allow
1949:0460	65 64 2E 20 45 78 70 65-63 74 65 64 20 46 6F 72	ed. Expected For
1949:0470	6D 3A 0D 0A 20 20 20 20-00 43 48 4F 49 43 45 3A	m:... .CHOICE:
1949:0480	20 72 65 71 75 69 72 65-73 20 4D 53 2D 44 4F 53	requires MS-DOS
1949:0490	20 76 65 72 73 69 6F 6E-20 34 2E 30 20 6F 72 20	version 4.0 or
1949:04A0	6C 61 74 65 72 2E 0D 0A-00 00 00 01 00 00 00 00	later.....

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1949:04B0 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00 .....
1949:04C0 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00 .....
1949:04D0 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00 .....
1949:04E0 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00 .....
1949:04F0 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00 .....
1949:0500 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00 .....
1949:0510 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00 .....
1949:0520 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00 .....
1949:0530 00 00 00 00 00 00 FC B0 01-B4 30 CD 21 3C 03 7F 0B .....0.!<...
1949:0540 BB 79 04 E8 57 02 B0 FF-E9 4E 02 06 B8 02 65 BB .y..W....N....e.
1949:0550 FF FF B9 05 00 8B D3 0E-BF 2F 05 CD 21 47 C4 3D ...../...!G.=
1949:0560 26 8B 1D B8 00 01 2B C3-A3 33 05 83 C7 02 89 3E &.....+...3.....>
1949:0570 2F 05 8C 06 31 05 07 BE-81 00 AC 3C 0D 75 03 E9 /...1.....<.u..
1949:0580 38 01 3C 2F 74 41 3C 20-74 F0 3C 09 74 EC BF AF 8.</tA< t.<.t...
1949:0590 04 80 3D 00 75 20 3C 22-75 04 B2 22 EB 03 B2 2F ..=.u <"u..".../
1949:05A0 AA 8A 04 3C 0D 74 D3 3A-C2 74 04 AA 46 EB F2 3C ...<.t.:.t..F.<
1949:05B0 2F 74 C7 46 EB C4 BB 3C-04 E8 E1 01 BB BF 01 E8 /t.F...<.....
1949:05C0 DB 01 B0 FF E9 D2 01 AC-E8 E9 01 3C 3F 74 24 3C .....<?t$<
1949:05D0 43 74 37 3C 4E 74 6D 3C-54 74 71 3C 53 75 03 E9 Ct7<Ntm<Ttq<Su..
1949:05E0 D0 00 BB 3F 03 E8 B5 01-BB BF 01 E8 AF 01 B0 FF ...?.....
1949:05F0 E9 A6 01 BB 85 01 E8 A4-01 BB BF 01 E8 9E 01 BB .....
1949:0600 F6 01 E8 98 01 B0 FF E9-8F 01 BF 03 01 8A 04 3C .....<
1949:0610 3A 75 03 46 8A 04 3C 20-74 12 3C 09 74 0E 3C 0D :u.F..< t.<.t.<.
1949:0620 74 0A 3C 2F 74 06 AA 46-8A 04 EB EA B0 00 88 05 t.</t..F.....
1949:0630 81 FF 03 01 74 03 E9 41-FF BB 74 03 E8 5E 01 B0 ...t..A..t..^...
1949:0640 FF E9 55 01 C6 06 AB 04-00 E9 2E FF 8A 04 3C 3A ..U.....<:
1949:0650 75 03 46 8A 04 3C 0D 74-4E 3C 2F 74 4A 3C 20 74 u.F..<.tN</tJ< t
1949:0660 46 3C 09 74 42 A2 AE 04-46 8A 04 3C 2C 75 38 46 F<.tB...F..<,u8F
1949:0670 8A 04 3C 30 72 31 3C 39-77 2D 83 E0 0F A2 AD 04 ..<0r1<9w-.....
1949:0680 46 8A 04 3C 30 73 03 E9-F0 FE 3C 39 76 03 E9 E9 F..<0s....<9v...
1949:0690 FE A0 AD 04 BA 0A 00 F6-E2 8A 1C 80 E3 0F 02 C3 .....
1949:06A0 A2 AD 04 46 E9 D3 FE BB-B8 03 E8 F0 00 B0 FF E9 ...F.....
1949:06B0 E7 00 C6 06 AC 04 01 E9-C0 FE 80 3E AC 04 01 74 .....>...t
1949:06C0 1B A0 AE 04 E8 ED 00 A2-AE 04 BE 03 01 80 3C 00 .....<.

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Below is the machine code disassembled into Assembly language instructions

Address	Machine code	Assembly Language
1949:0100	E93204	JMP 0535
1949:0103	59	POP CX
1949:0104	4E	DEC SI
1949:0105	0000	ADD [BX+SI],AL
1949:0107	0000	ADD [BX+SI],AL

I've cut out a chunk here that corresponds to the message data. You can see from the little bit here that the disassembler isn't aware that these codes are ASCII character codes which represent data, and blindly goes on displaying them as the equivalent assembly language instructions.

1949:03CE	6F	DB 6F
1949:03CF	7574	JNZ 0445
1949:03D1	207379	AND [BP+DI+79],DH
1949:03D4	6E	DB 6E
1949:03D5	7461	JZ 0438

The first instruction in the program was a jump to location 0535, so that is presumably where the program carries on from.

1949:0535	FC	CLD
1949:0536	B001	MOV AL,01
1949:0538	B430	MOV AH,30
1949:053A	CD21	INT 21
1949:053C	3C03	CMP AL,03
1949:053E	7F0B	JG 054B
1949:0540	BB7904	MOV BX,0479
1949:0543	E85702	CALL 079D
1949:0546	B0FF	MOV AL,FF
1949:0548	E94E02	JMP 0799

And so on