IBM 701 Simulator Usage

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Introduction

The IBM 701 also know as "Defense Calculator" was introduced by IBM on April 7, 1953. This computer was start of IBM 700 and 7000 line. Memory was 2048 36 bit words. Each instruction could be signed plus or minus, plus would access memory as 18 bit words, minus as 36 bit words. There was a expansion option to add another 2048 words of memory, but I can't find documentation on how it worked. Memory cycle time was 12 microseconds. The 701 was withdrawn from

the market October 1, 1954 replaced by 704 and 702. A total of 19 machines were installed.

Simulator Files

To compile the IBM 701, you must define USE_INT64 and I701 as part of the compilation command line.

Subdirectory	File	Contains
I7000	i7000_defs.h	IBM 7000 simulators general definitions
	i701_defs.h	IBM 701 simulator specific definitions
	i7000_chan.c	Generic channel interface.
	i701_cpu.c	701 CPU, Channel, interface
	i701_chan.c	701 Channel.
	i701_sys.c	701 System interface
	i7090_cdr.c	711 Card reader
	i7090_cdp.c	721 Card punch
	i7090_lpr.c	716 Line printer
	i7090_drum.c	733 Drum memory interface.
	i7000_mt.c	729 Tape controller

IBM 701 Features

The IBM 701 simulator is configured as follows:

Device Name(s)	Simulates
CPU	701 CPU with 2KW of memory
CH	701 Channel Device
MT	729 Magnetic Tape Controller
CDR	711 Card Reader
CDP	721 Card Punch
LP	716 Line Printer
DR0	733 Drum

The LOAD command will load a card binary image file into memory. An octal dump file, or a pseudo assembly code.

Stop conditions

The 701 simulator implements several unique stop conditions:

- undefined CPU instruction

- divide check on a divide and halt instruction
- write select of a write protected device

CPU

Memory size is 2KW on a standard CPU.

CPU registers include the visible state of the processor as well as the control registers for the interrupt system.

Name	Size	Comments
IC	15	Program Counter
AC	38	Accumulator
MQ	36	Multiplier-Quotient
SW1..SW6	1	Sense Switches 1..6
SW	6	Sense Switches
SL1..4	1	Sense Lights 1..4
ACOVF	1	AC Overflow Indicator
DVC	1	Divide Check Indicator
IOC	1	I/O Check Indicator

The CPU can maintain a history of the most recently executed instructions. This is controlled by the SET CPU HISTORY and SHOW CPU HISTORY commands:

```
SET CPU HISTORY           clear history buffer
SET CPU HISTORY=0         disable history
SET CPU HISTORY=n         enable history, length = n
SHOW CPU HISTORY          print CPU history
SHOW CPU HISTORY=n        print first n entries of CPU history
```

I/O Channel (CH)

The channel device on the 701 is only used by simulator, and has no controls or registers.

Peripherals

Card Reader (CDR)

The card reader (CDR) reads data from a disk file. Cards are simulated as ASCII lines with terminating newlines. Card reader files can either be text (one character per column) or column binary (two characters per column). The file type can be specified with a set command:

```
SET CDR FORMAT=TEXT       Sets ASCII text mode
```

```
SET CDR FORMAT=BINARY          Sets for binary card images
SET CDR FORMAT=BCD             Sets for BCD records
SET CDR FORMAT=CBN             Sets for column binary BCD records
SET CDR FORMAT=AUTO            Automatically determines format.
```

or in the ATTACH command:

```
ATTACH CDR file               Attaches a file
ATTACH CDR -f <format> <file>  Attaches a file with the given format.
ATTACH CDR -s <file>          Added file onto current cards to read.
ATTACH CDR -e <file>          After file is read in, the reader will receive an end of file
```

The card reader can be booted with:

```
BOOT CDR                      Loads first 3 words of card.|
```

Error handling is as follows:

error	processed as
not attached	report error and stop
end of file	out of cards
OS I/O error	report error and stop

721 Card Punch (CDP)

The card reader (CDP) writes data to a disk file. Cards are simulated as
ASCII lines with terminating newlines. Card punch files can either be text (one
character per column) or column binary (two characters per column). The file
type can be specified with a set command:

```
SET CDP FORMAT=TEXT           Sets ASCII text mode
SET CDP FORMAT=BINARY         Sets for binary card images.
SET CDP FORMAT=BCD            Sets for BCD records.
SET CDP FORMAT=CBN            Sets for column binary BCD records.
SET CDP FORMAT=AUTO           Automatically determines format.
```

or in the ATTACH command:

```
ATTACH CDP <file>             Attaches a file
ATTACH CDP -f <format> <file>  Attaches a file with the given format.
```

Error handling is as follows:

error	processed as
not attached	report error and stop
OS I/O error	report error and stop

716 Line Printer (LP)

The line printer (LP) writes data to a disk file as ASCII text with terminating newlines. Currently set to handle standard signals to control paper advance.

```
SET LP NO/ECHO              Sets echoing to console of line-printer output.
SET LP LINESPERPAGE=n       Sets number of lines per page on printer.
```

The Printer supports the following SPRA n selection pulses for controlling spacing (spacing occurs before the line is printed):

SPRA	Action
SPRA 1	Slew to top of form.
SPRA 2	Single space.
SPRA 3	Double space. Before printing line.
SPRA 4	Triple space. Before printing line.
SPRA 9	Suppress linefeed after print. Prints characters 73-120
SPT	Will skip if any printer line has been pulsed.

Default with no SPRA is to single space before printing.

Error handling is as follows:

error	processed as
not attached	report error and stop
OS I/O error	report error and stop

729 Magnetic Tape (MT)

These come in groups of 10 units each. MT0 is unit 10.

Each individual tape drive support several options: MTA used as an example.

```
SET MT*n* REWIND            Sets the mag tape to the load point.
SET MT*n* LOCKED            Sets the mag tape to be read only.
SET MT*n* WRITEENABLE       Sets the mag tape to be writable.
SET MT*n* LOW               Sets mag tape to low density.
SET MT*n* HIGH              Sets mag tape to high density.
```

Options: Density LOW/HIGH does not change format of how tapes are written. And is only for informational purposes only.

Tape drives can be booted with:

```
BOOT MT*n*                  Read in first three words of record.
```

733 Drum (DR)

Up to 16 units can be attached to the CPU, all are on pseudo channel 0. Each drum is 2048K words in size. They are all stored in one file.

```
SET DR0 UNITS=n           Set number of units to of storage to attach.
```

Drum unit 0 can be booted with:

```
BOOT DR0n                 Read in first three words of record.
```

Symbolic Display and Input

The IBM 701 simulator implements symbolic display and input. These are controlled by the following switches to the EXAMINE and DEPOSIT commands:

```
-m                        Display/Enter Symbolic Machine Code
-c                        Display/Enter BCD Characters
<none>                    Display/Enter Octal data
```

The symbolic input/display supports 1 format for instruction display:

- <opcode>,<sign><octal address>,<opcode>,<sign><octal address>

A negative address specifies the lower 18 bits of the given memory location.

Sim Load

The load command looks at the extension of the file to determine how to load the file.

Ext	Load action and format
.crd	Loads a card image file into memory.Standard 709 format + 1 card loader.
.oct	Loads an octal deck:address <blank> octal <blank> octal...
.sym	Loads a 709 symbolic deck.
	address instruction..address BCD stringaddress OCT octaloctal

Character Codes

This is the mapping between character codes used by the simulator:

Commercial	Scientific	ASCII	BCD	Card	Remark
			00		Blank
1		0	01	1	
2		0	02	2	
3		0	03	3	
4		0	04	4	
5		0	05	5	
6		0	06	6	
7		0	07	7	
8		0	10	8	
9		0	11	9	
0		0	12	10	
#	=	=	13	3-8	
@	'	'/@	14	4-8	
:		:	15	5-8	
>		>	16	6-8	
√		"	17	7-8	Tape Mark
ƀ		_	20	2-8	
/		/	21	10-1	
S		S	22	10-1	
T		T	23	10-2	
U		U	24	10-3	
V		V	25	10-4	
W		W	26	10-5	
X		X	27	10-6	
Y		Y	30	10-7	
Z		Z	31	10-8	
#		#	32	10-2-8	Word Mark
,		,	33	10-3-8	
%	(	%/(	34	10-4-8	
`		`	35	10-5-8	
\		\	36	10-6-8	
⧣		{	37	10-7-8	Segment Mark

Commercial	Scientific	ASCII	BCD	Card	Remark
-		-	40	11	also -0
J		J	41	11-1	
K		K	42	11-2	
L		L	43	11-3	
M		M	44	11-4	
N		N	45	11-5	
O		O	46	11-6	
P		P	47	11-7	
Q		Q	50	11-8	
R		R	51	11-9	
!		!	52	11-2-8	
$		$	53	11-3-8	
*		*	54	11-4-8	
]		]	55	11-5-8	
;		;	56	11-6-8	
△		^	57	11-7-8	
&	+	&/+	60	12	also +0
A		A	61	12-1	
B		B	62	12-2	
C		C	63	12-3	
D		D	64	12-4	
E		E	65	12-5	
F		F	66	12-6	
G		G	67	12-7	
H		H	70	12-8	
I		I	71	12-9	
?		?	72	12-2-8	
.		.	73	12-3-8	
□	)	)	74	12-4-8	Lozenge
[		[	75	12-5-8	
<		<	76	12-3-8	
⧣ *		|	77	12-7-8	Group Mark

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