IBM 701 Simulator Usage

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# 1. 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 The 701 was withdrawn from the market October 1, 1954 replaced by 704 and 702.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.

# 2. 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. |

# 2. 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 701 simulator implements several unique stop condition:

* + - undefined CPU instruction
    - divide check on a divide and halt instruction
    - write select of a write protected device

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

## 2.1 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 |

## 2.2 I/O Channel (CH)

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

## 2.3 Peripherals

### 2.3.1 711 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. |

The card reader can be booted with the:

|  |  |
| --- | --- |
| 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

### 2.3.2 721 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

### 2.3.3 716 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=*lpp* | 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 1 | 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

### 2.3.4 729 Magnetic Tape (MT)

These come in groups of 10 units each. The controller defines which channel the devices will be on. 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 MTxn | Read in first three words of record. |

### 2.3.4 733 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. |

# 3 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 |
|  | 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.

# 4 Sim Load

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

|  |  |
| --- | --- |
| .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 string  address OCT octal  octal |

# 5 Character Codes

| 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 |