DEC PDP-8: History and Design

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DEC PDP-8

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DEC History

- Founded 1957 by Ken Olson, Harlan Anderson
- Located in Maynard, MA (until 1992)
- Created PDP, VAX families of Minicomputers
- Created Alpha Workstations
- Created VT100 Terminal
- At its peak, employed over 140,000
- Eventually acquired by Compaq (1998), then HP.

PDP Family

- Programmable Data Processor
- Inexpensive Minicomputer ($120,000 instead of $1.2 Million)
- Began with PDP-1 - 18-bit word size, ~200 Kilohertz Clock Speed
  - *First computerized video game: Spacewar!*
  - *First Text Editor, Word Processor*
- PDP-4, PDP-5, PDP-7 (Original Unix Machine)

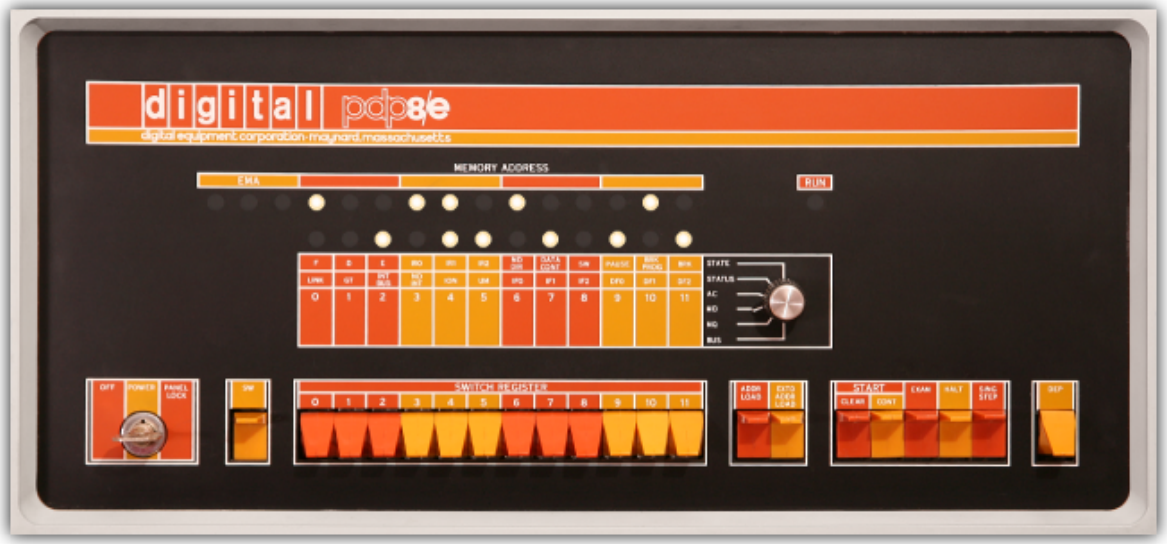
PDP8

- Introduced March 22, 1965
- First commercially successful Minicomputer
- Over 50,000 systems sold - more then any other minicomputer to date.
- Original price $18,000 (1/5 cost of IBM/360)

Hardware

- CPU with 4K of Memory (4,096 twelve-bit words)
- Teletype interface: ASR-33 Teletype
- Programmed I/O Bus (Negibus) - Printers / Teletypes
- DMA Bus - ADs, DAs, Tape, Disk Drives


DATA DYNAMICS


digital pdp8/e
digital equipment corporation maynard massachusetts
MEMORY ADDRESS
EMA
RUN
STATE
STATUS
AC
MD
MQ
BUS
SWITCH REGISTER
0 1 2 3 4 5 6 7 8 9 10 11
OFF
POWER
PANEL LOCK
SW
ADDR LOAD
EXTD ADDR LOAD
START
CLEAR
CONT
EXAM
HALT
SING STEP
DEP

PDP-8 Software

- Original Model had 8 Instructions, 2 Registers, Magnetic Core memory
- No 'Operating System' originally - just raw opcode entry via switches.
- Moved on to Paper Tape 'Operating Systems' - single function programs stored on Paper Tape (PAL or FORTRAN Compiler/Runtime)
- Eventually more complex operating systems evolved, such as OS/8.

PDP-8 Instructions

- 12-bit Instruction Words
  - *0-2 - Instruction Code*
  - *3 - Indirection Bit*
  - *4 - Use Program Counter to complete Address*
  - *5-11 - Offset (Used for 7-bit addresses or OPR Codes)*
- 4096 word memory, divided into 128-word 'pages'.
- Routines had to fit within 128 words of memory
- Assembler Instructions:
  - *000 – AND – AND the memory operand with AC.*
  - *001 – TAD – Two's complement ADd the memory operand to (a 13 bit signed value).*
  - *010 – ISZ – Increment the memory operand and Skip next instruction if result is Zero.*
  - *011 – DCA – Deposit AC into the memory operand and Clear AC.*
  - *100 – JMS – JuMp to Subroutine (storing return address in first word of subroutine!).*
  - *101 – JMP – JuMP.*
  - *110 – IOT – Input/Output Transfer.*
  - *111 – OPR – microcoded OPeRations.*

OPR Instruction

- Special instruction used for program control, not containing a memory address.
- 'Microcoded' - One OPR Word could contain several instructions (basically a bitfield).
- Instructions for Setting, Clearing and modifying the Accumulator and registers
- Also used for arithmetic operations.

Assembler Examples

```
*10                     / Set current assembly origin to address 10,
STPTR,    STRNG-1       / An auto-increment register (one of eight at 10-17)

*200                    / Set current assembly origin to program text area
HELLO,  CLA CLL         / Clear AC and Link again (needed when we loop back from tls)
        TAD I Z STPTR   / Get next character, indirect via PRE-auto-increment address from the zero page
        SNA             / Skip if non-zero (not end of string)
        HLT             / Else halt on zero (end of string)
        TLS             / Output the character in the AC to the teleprinter
        TSF             / Skip if teleprinter ready for character
        JMP .-1         / Else jump back and try again
        JMP HELLO       / Jump back for the next character

STRNG,  310             / H
        345             / e
        354             / l
        354             / l
        357             / o
        254             /,
        240             / (space)
        367             / w
        357             / o
        362             / r
        354             / l
        344             / d
        241             / !
        0               / End of string
$HELLO                  /DEFAULT TERMINATOR
```

Historical Relevance

- Large family of PDP-8 Models were produced, using different internal designs.
- Eventual sales across all models topped 300,000.
- Had a vast number of peripheral devices (Storage, I/O, control, memory)
- Eventually supplanted by microcomputers - and faded out by the introduction of the IBM PC.

References

- http://www.faqs.org/faqs/dec-faq/pdp8/
- http://www.divms.uiowa.edu/~jones/pdp8/
- http://www.grc.com/pdp-8/pdp-8.htm
- http://www.pdp8online.com/