Turing's Pilot ACE

Why Not Important?

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Resources

- Wilkinson, James (1953) "The Pilot ACE", *Automatic Digital Computation,* NPL, Teddington, U.K.,March, pp. 5-14.

  Reprinted in Bell & Newell (1971), *Computer Structures,* Chapter 11.

- Lavington, Simon, ed. (2012). *Alan Turing and His Contemporaries: Building the World's First Computers,* Swindon, UK, British Informatics Society, Ltd.

ACE Highlights

- AMT's 1945 proposal document
  - More engineering detail than von Neumann's *EDVAC Report*.
  - Register-level description
  - More general-purpose.

- Aim: max performance,min equipment.
  - ~5x faster than UK contemporaries.
  - ~1/4 electronic equipment of Wilkes's EDSAC

ACE 1945 Architectural Innovations

- 3-address, packed instruction
  - Fewer instruction fetches
  - Obsoleted by larger addressable memory
- Next-instruction-address enabled optimal inst^{n} placement in delay lines
  - Followed in IBM 650 (1956), etc.
  - Obsoleted by random-access memories
- Variable-length block transfers
- Punched-card I/O directly attached

ACE Peculiarities

- Assumption: hardware dear, people cheap
- A beast to program.
- No accumulator. 11 central registers, with various individual properties.
- Op codes implied by register addresses.
- No general multiply
- Chained program, hand-optimized.
- No straightforward conditional branch.
- "Backwards binary"—Low-order bits on left

DEUCE Instruction Format

U	Next	Source	Dest	CH	Wait	U	Timing	U	Go
O	1-3	4-8	9-13	14-15	16-20	21-24	25-29	30	31
1	3	5	5	2	5	4	5	1	1

Why so little influence?

Hodges, Yates re Personal Factors

- "He was not by nature an easy person with whom to communicate….sometimes intolerant of questions or interruptions….
- His many revisions of his design for the ACE computer must have exasperated his colleagues." (Hodges)
- "Turing's combination of dominance of the project with a lack of ability to collaborate..been a significant factor in the delay." (Yates)

Wilkes re Technical Factors

- [Wilkes] "considered that his ideas were widely at variance with what the main stream…was going to be."
- Wilkes had an uncanny judgment of the main stream.
- Turing apparently didn't foresee random-access memories as inevitable because vital.

Brooks re Other Factors

- Turing didn't publish his 1945 proposal.
- Machine was too late—2½ years >Baby; 1½ years >EDSAC
  - Too late—Just like Blaauw & Brooks, *Computer Architecture* (1997)
- Didn't foresee importance of programming ease, effort, cost