A Brief System z Assembler History

SHARE 120, Session 12235

John R. Ehrman
ehrman@us.ibm.com

(Contents not guaranteed --- my memory is fallible)

IBM Silicon Valley Lab
555 Bailey Avenue
San Jose, CA 95141

Feb. 4, 2013

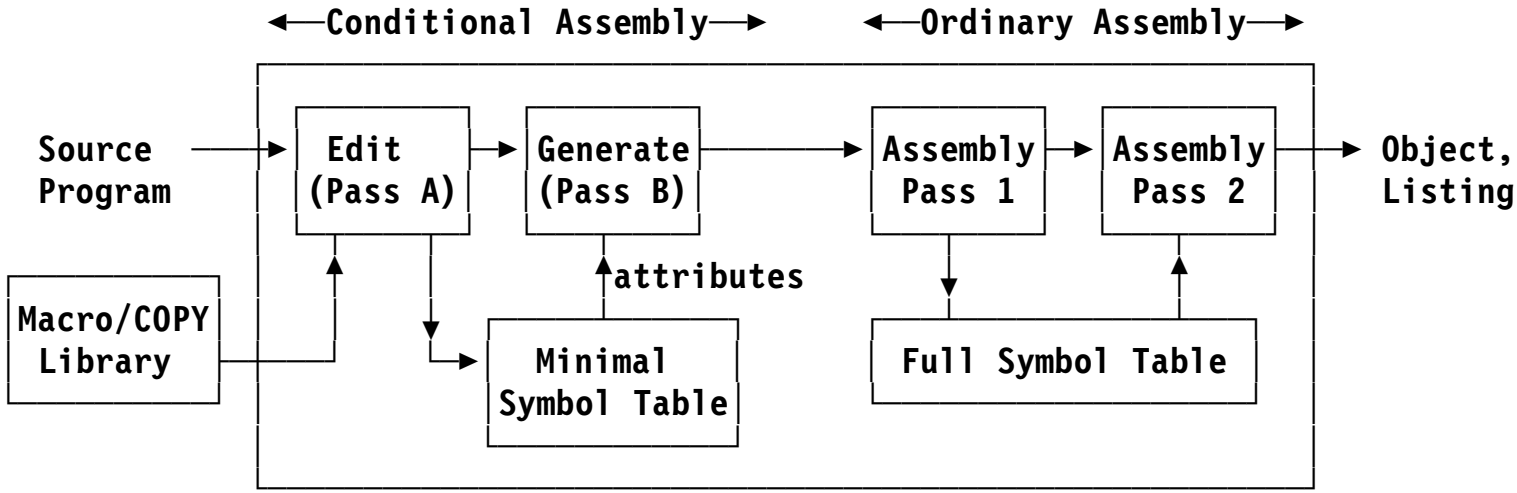
Bootstrapping an assembler

1. You have machine A (7094?), need an assembler for machine B (360)
2. Decide on a basic assembler language for B, BAL-B
3. Write a cross assembler ASMX on A for BAL-B in some language X
4. Verify that it generates correct object code OBJ-X for B (key step!)
5. Now write a basic assembler ASMB on A for BAL-B, in BAL-B
6. Assemble it using ASMX, compare its OBJ-B to OBJ-X
   - Fix BAL-B source on ASMX until OBJ's compare correctly
7. A test machine executing B instructions is now available...
8. Load OBJ-B on B, use it to assemble ASMB source
9. Compare OBJ-B from ASMB on machine B to OBJ-B from machine A
   - If there's a mismatch, fix whatever caused it
10. You now have an $ASMB_1$ executing on B:
    You have "bootstrapped" ASMX to ASMB!
11. Now, add features to $ASMB_1$ to create $ASMB_2$ for language $BAL\text{-}B_2$
    - Repeat previous step as needed, using $ASMB_n$ to create $ASMB_{n+1}$

- Initial development on existing processors (7090/94, 7030 “Stretch”)
  - Emulated System/360 instructions
    - Very slow, not always consistent across emulators
- Assembler Language definition had to be fixed very early
  - Language was limited by what *could* (not *should*) be done
- Cross-assembled object code “bootstrapped” to early 360 processors
- First System/360-based assembler (“BOS”, Basic Operating System) had to run in 10K bytes
  - 4K for code, 3K for buffers, 3K for tables

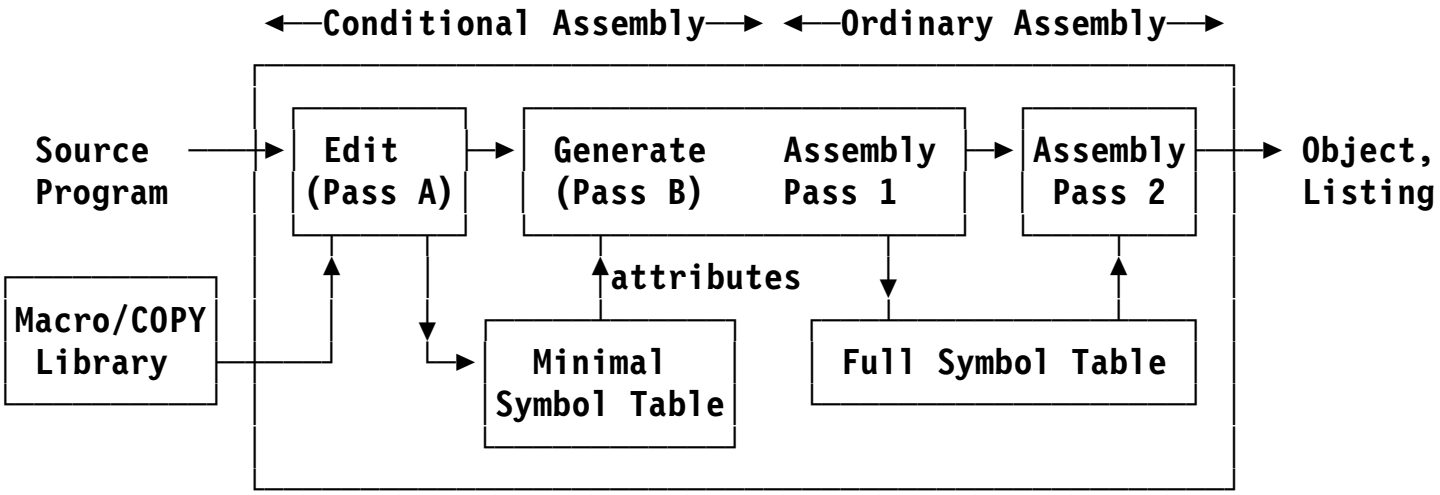
- Assembler: the primary (only?) internal development language
  - Critical to OS's and many key products (CICS, IMS, PL/I, Fortran, ...)
- System/360/370/390 assemblers for OS/360 and their descendants
  - E-Level Assembler (IET: 18K), F-Level Assembler (IEU: 44K): 1966
    - DOS/TOS assemblers (IJQ, 1968; IJY, 1966-7)
  - TESTRAN: debugging macros for Assembler Language programs: 1966
    - TESTRAN SVCs still used by many debuggers (TSO TEST, ASMIDF, ...)
  - Assembler XF (IFOX): 1972; DOS/VSE assembler (IPK): 1973
  - H-Level Assembler (IEV): Ver. 1 June 1970; Ver. 2 Jan. 1983 to 10/31/1995
  - High Level Assembler (ASMA): May 1992
- Many university-based student-oriented assemblers:
  - SOS ((Brown), ZAP (Cornell), ESP (Iowa State), ASSIST (Penn State), SPASM (Stanford), STASS360 (British Columbia and Michigan), SWAP (Ohio State), FASTAM (Texas A&M), FGA (New Mexico Tech), TIGER1 (LSU), ASSIST/I (NIU)
  - ... and many assembler textbooks (some were pretty good ...)

- 4 passes: 2 conditional assembly, 2 ordinary assembly



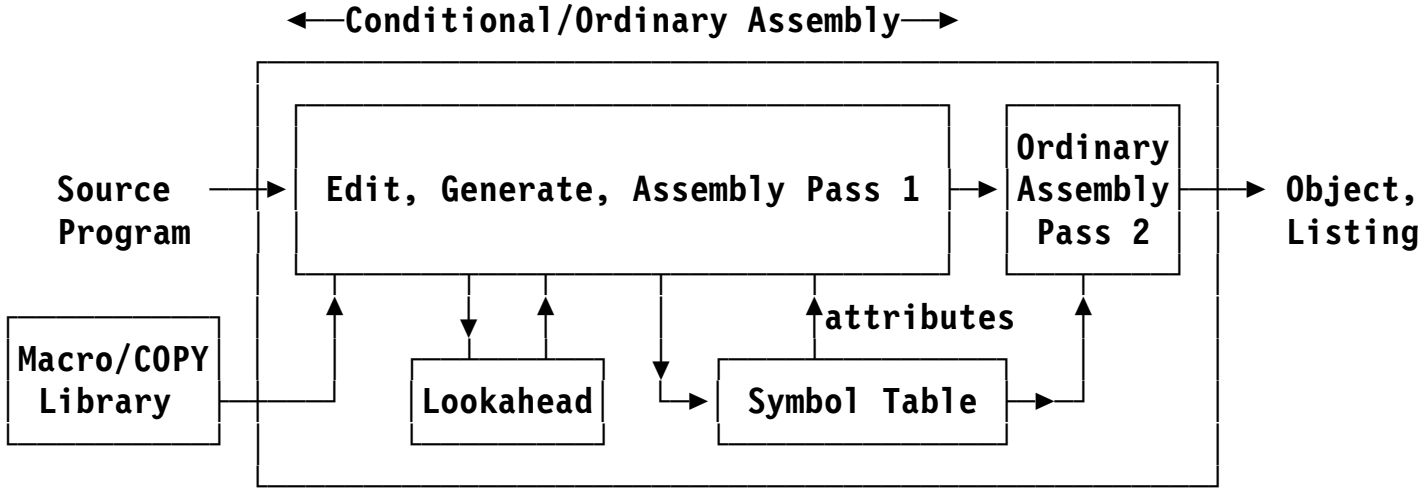
- Considerably faster than ASME
  - Larger memory simplified processing (44K vs. 18K)
  - Some new language features (e.g., OPSYN)
- Free ASMF source was used to build Univ. of Waterloo's Assembler G
  - Used more storage, combined Pass B and Pass 1, added load-to-memory option for student programs

- 4 logical passes; Pass B and Pass 1 merged where possible

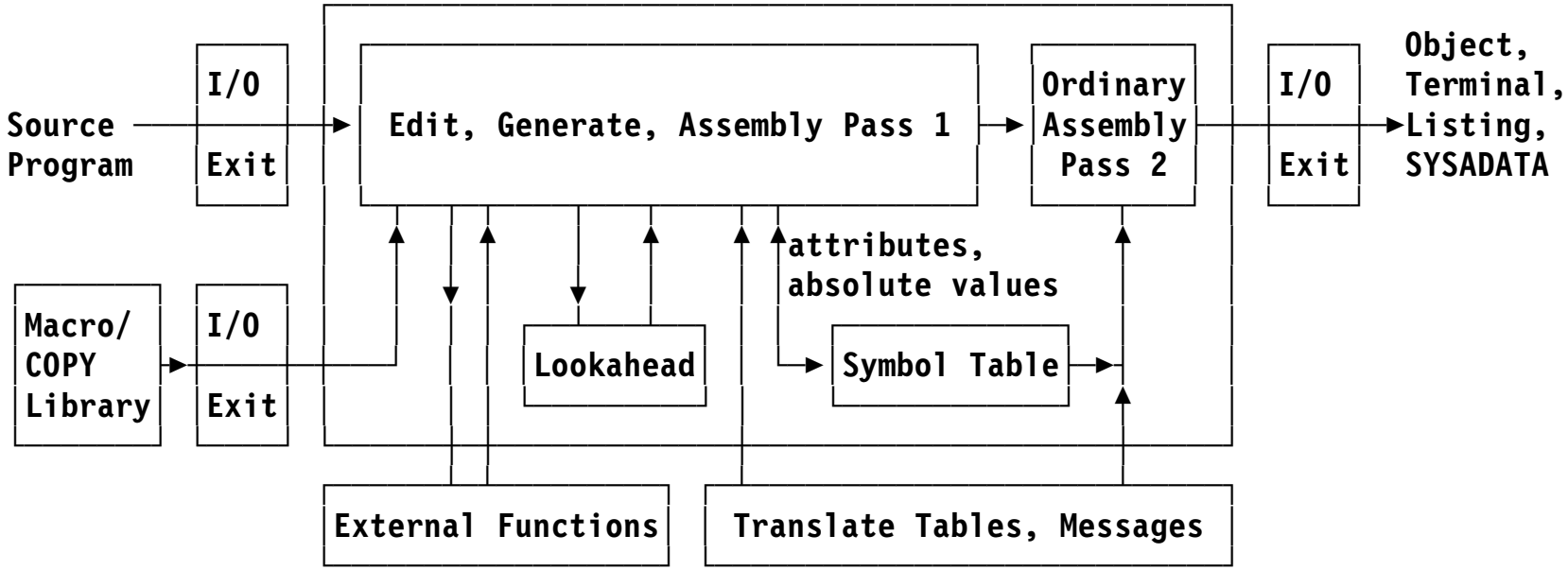


- Better performance
- Some language enhancements
- Rewritten publications were very popular

- Started as an internal experiment; became first IBM Program Product



- **Much** new function; **far** faster than all previous assemblers
  - Was used by IBM field staff to generate customer systems
    - SYSGENs took only an afternoon, rather than a weekend
  - Was almost “killed” but rapidly displaced all predecessors
  - The base for the popular “SLAC Mods”



- Supplanted all previous “mainframe” assemblers
- Many powerful new language features and functions
- I/O exits for all input and output files
- SYSADATA file contains all information about the assembly
- Supports ***The world's most powerful macro language!***