

S (programming language)

S

Paradigm(s)	multi-paradigm: imperative, object oriented
Appeared in	1976
Developer	Rick Becker, Allan Wilks, John Chambers
Typing discipline	dynamic, strong
Major implementations	R, S-PLUS
Influenced by	C, APL, PPL, Scheme
License	depends from implementation
Website	stat.bell-labs.com/S/ ^[1]

S is a statistical programming language developed primarily by John Chambers and (in earlier versions) Rick Becker and Allan Wilks of Bell Laboratories. The aim of the language, as expressed by John Chambers, is "to turn ideas into software, quickly and faithfully."

The two modern implementations of S are R and S-PLUS. The R implementation is listed in TIOBE index (February 2012) at position 20, S-Plus and generic S are listed among the 100 most popular programming languages.

History

"Old S"

S is one of several statistical computing languages that were designed at Bell Laboratories, and first took form between 1975–1976. Up to that time, much of the statistical computing was done by directly calling Fortran subroutines; however, S was designed to offer an alternate and more interactive approach. Early design decisions that hold even today include interactive graphics devices (printers and character terminals at the time), and providing easily accessible documentation for the functions.

The first working version of S was built in 1976, and operated on the GCOS operating system. At this time, S was unnamed, and suggestions included *Interactive SCS (ISCS)*, *Statistical Computing System*, and *Statistical Analysis System* (which was already taken: see SAS System). The name 'S' (used with single quotation marks, until 1979) was chosen, as it has the common letter used in statistical computing, and is consistent with other programming languages designed from the same institution at the time (namely the C programming language).

When UNIX/32V was ported to the (then new) 32-bit DEC VAX, computing on the Unix platform became feasible for S. In late 1979, S was ported from GCOS to UNIX, which would become the new primary platform.

In 1980, the first version of S distributed outside of Bell Laboratories, and in 1981, source version were made available. In 1984 two books were published by the research team at Bell Laboratories: *S: An Interactive Environment for Data Analysis and Graphics*^[2] (1984 Brown Book) and *Extending the S System*.^[3] Also, in 1984 the source code for S became licensed through AT&T Software Sales for education and commercial purposes.

"New S"

By 1988, many changes were made to S and the syntax of the language. *The New S Language*^[4] (1988 Blue Book) was published to introduce the new features, such as the transition from *macros* to *functions* and how functions can be passed to other functions (such as `apply`). Many other changes to the S language were to extend the concept of "objects", and to make the syntax more consistent (and strict). However, many users found the transition to *New S* difficult, since their macros needed to be rewritten. Many other changes to S took hold, such as the use of X11 and PostScript graphics devices, rewriting many internal functions from Fortran to C, and the use of double precision (only) arithmetic. The *New S* language is very similar to that used in modern versions of S-PLUS and R.

In 1991, *Statistical Models in S*^[5] (1991 White Book) was published, which introduced the use of formula-notation^[6] (which use the '~' operator), data frame objects, and modifications to the use of object methods and classes.

S4

Version 4 of S, often abbreviated S4, provides advanced object-oriented features. S4 classes differ markedly from S3 classes.

References

- [1] <http://stat.bell-labs.com/S/>
- [2] Becker, R.A.; Chambers, J.M. (1984). *S: An Interactive Environment for Data Analysis and Graphics*. Pacific Grove, CA, USA: Wadsworth & Brooks/Cole. ISBN 0-534-03313-X.
- [3] Becker, R.A.; Chambers, J.M. (1985). *Extending the S System*. Pacific Grove, CA, USA: Wadsworth & Brooks/Cole. ISBN 0-534-05016-6.
- [4] Becker, R.A.; Chambers, J.M., and Wilks, A.R. (1988). *The New S Language: A Programming Environment for Data Analysis and Graphics*. Pacific Grove, CA, USA: Wadsworth & Brooks/Cole. ISBN 0-534-09192-X.
- [5] Chambers, J.M.; Hastie, T.J. (1991). *Statistical Models in S*. Pacific Grove, CA, USA: Wadsworth & Brooks/Cole. p. 624. ISBN 0-412-05291-1.
- [6] Wilkinsons, G.N.; Rogers, C.E. (1973). "Symbolic description of factorial models for analysis of variance". *Applied Statistics* **22** (3): 392–399. doi:10.2307/2346786. JSTOR 2346786.

External links

- A Brief History of S (<http://cm.bell-labs.com/stat/doc/94.11.ps>), by Richard A. Becker (in PostScript format)
- Evolution of the S Language (<http://cm.bell-labs.com/stat/doc/96.7.ps>), by John M. Chambers, discusses the new features in Version 4 of S (in PostScript format)
- Stages in the Evolution of S (<http://cm.bell-labs.com/cm/ms/departments/sia/S/history.html>), by John M. Chambers

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