15-292
History of Computing

Partial History of Programming Languages

Based on slides originally published by Thomas J. Cortina in 2004 for a course at Stony Brook University. Revised in 2013 by Thomas J. Cortina for a computing history course at Carnegie Mellon University.

The first assembler

- Assembler - a computer program for translating assembly language into executable machine code
  - Example: ADD R1, R2, R3 0110000100100011
- The EDSAC programming system was based on a subroutine library
  - commonly used functions that could be used to build all sorts of more complex programs
  - the first version, Initial Orders 1, was devised by David Wheeler, then a research student, in 1949
- Team published “The Preparation of Programs for an Electronic Digital Computer”
  - the only programming textbook then available
  - computers today still use Cambridge model for subroutines library

The first compiler

- A compiler is a computer program that translates a computer program written in one computer language (the *source* language) into a program written in another computer language (the *target* language).
  - Typically, the target language is assembly language
  - Assembler may then translate assembly language into machine code
    - Machine code are directions a computer can understand on the lowest hardware level (1s & 0s)
- A-0 is a programming language for the UNIVAC I or II, using three-address code instructions for solving mathematical problems.
- A-0 was the first language for which a compiler was developed.
  - It was produced by Grace Hopper's team at Remington Rand in 1952
  - Grace Hopper had previously been a programmer for the Harvard Mark machines
    - One of U.S.'s first programmers
    - She found a moth in the Mark I, which was causing errors, and called it a computer "bug"

FORTRAN (1957)

- First successful high-level programming language
  - Code more readable and understandable by humans
- Developed by John Bachus at IBM
  - Stands for: FORmula TRANslation
  - Started development in 1954
  - Released in 1957, is still in use today (how many technologies can say that?)
- A key goal of FORTRAN was efficiency, although portability was also a key issue
  - automatic programming that would be as good as human programming of assembly code
  - resulted in making programs 90% as good as humans
- Programs that took weeks to write could now take hours
- 1961 – First FORTRAN programming textbook
  - Universities began teaching it in undergrad programs
- Provided standard exchange of programs despite different computers
- Became the standard for scientific applications

FORTRAN

```
REAL SUM6,SUM7,SUM8,DIF6,DIF7,DIF8,SUMINF
OPEN(6,FILE='PRN')
SUM6=.9*(1.-0.1**6)/0.9
SUM7=.9*(1.-0.1**7)/0.9
SUM8=.9*(1.-0.1**8)/0.9
******COMPUTER SUM OF INFINITE TERMS
SUMINF=0.9/(1.0-0.1)
******COMPUTE DIFFERENCES BETWEEN FINITE & INFINITE SUMS
DIF6 = SUMINF - SUM6
DIF7 = SUMINF - SUM7
DIF8 = SUMINF - SUM8
WRITE(6,*) 'INFINITE SUM = ', SUMINF
WRITE(6,*) 'SUM6 = ', SUM6, '    INFINITE SUM - SUM6 = ', DIF6
WRITE(6,*) 'SUM7 = ', SUM7, '    INFINITE SUM - SUM7 = ', DIF7
WRITE(6,*) 'SUM8 = ', SUM8, '    INFINITE SUM - SUM8 = ', DIF8
STOP
```

COBOL (1960)

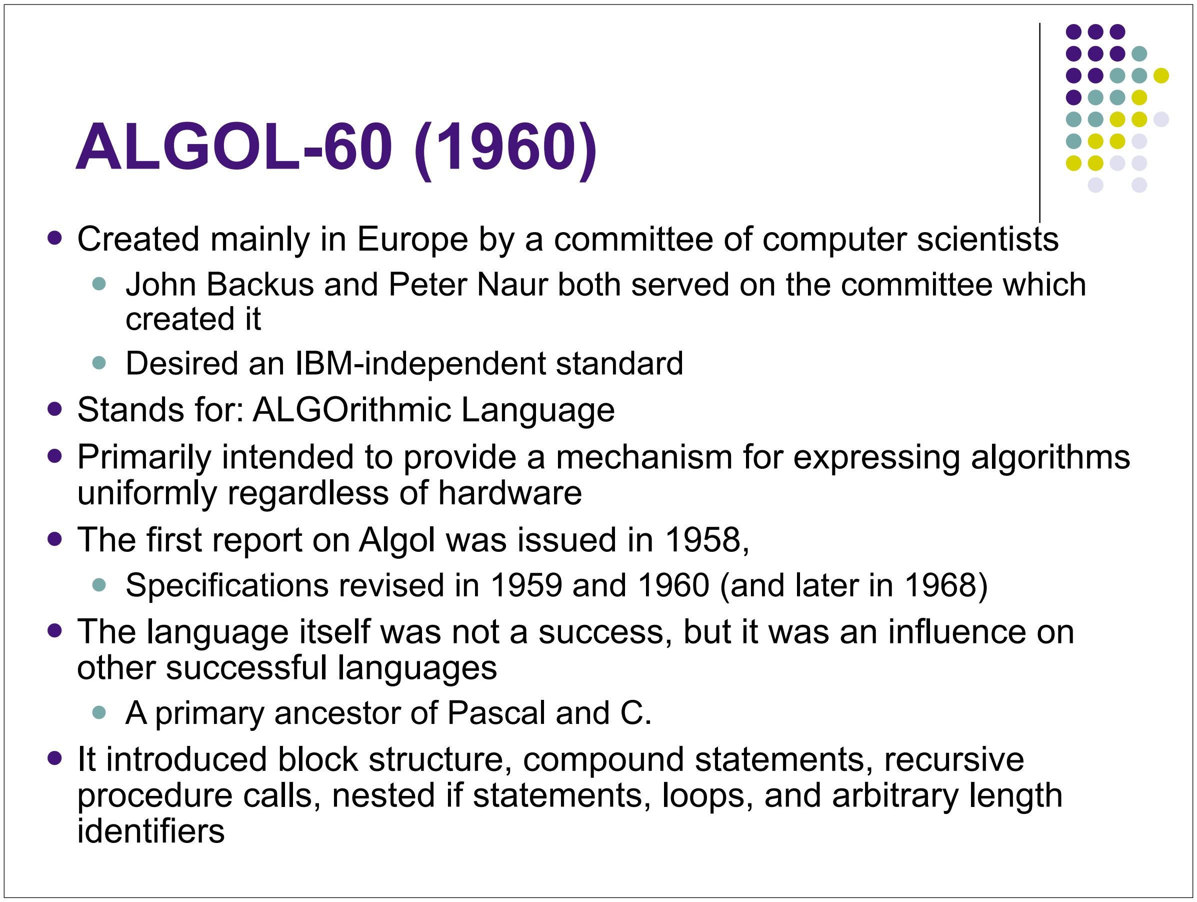
- Stands for: COmmon Business-Oriented Language
- COBOL was initially created in 1959 (and released in 1960 as Cobol 60) by a group of computer manufacturers and government agencies
  - US Government wanted a standard for its computers
- One goal of COBOL's design was for it to be readable by managers, so the syntax had very much of an English-like flavor.
  - The specifications were to a great extent inspired by the FLOW-MATIC language invented by Grace Hopper
    - She then promoted COBOL's use
- Became the standard for business applications
  - Still used in business applications today.
- 90% of applications over next 20 years were written in either COBOL or FORTRAN
  - Old programmers came out of hiding for Y2K

COBOL

```
000100 ID DIVISION.
000200 PROGRAM-ID.  ACCEPT1.
000300 DATA DIVISION.
000400 WORKING-STORAGE  SECTION.
000500 01   WS-FIRST-NUMBER      PIC 9(3).
000600 01   WS-SECOND-NUMBER     PIC 9(3).
000700 01   WS-TOTAL             PIC ZZZ9.
000800*
000900 PROCEDURE DIVISION.
001000 0000-MAINLINE.
001100     DISPLAY 'ENTER A NUMBER: '.
001200     ACCEPT WS-FIRST-NUMBER.
001300*
001400     DISPLAY 'ANOTHER NUMBER: '.
001500     ACCEPT WS-SECOND-NUMBER.
001600*
001700     COMPUTE WS-TOTAL = WS-FIRST-NUMBER + WS-SECOND-NUMBER.
001800     DISPLAY 'THE TOTAL IS: ', WS-TOTAL.
001900     STOP RUN.
```

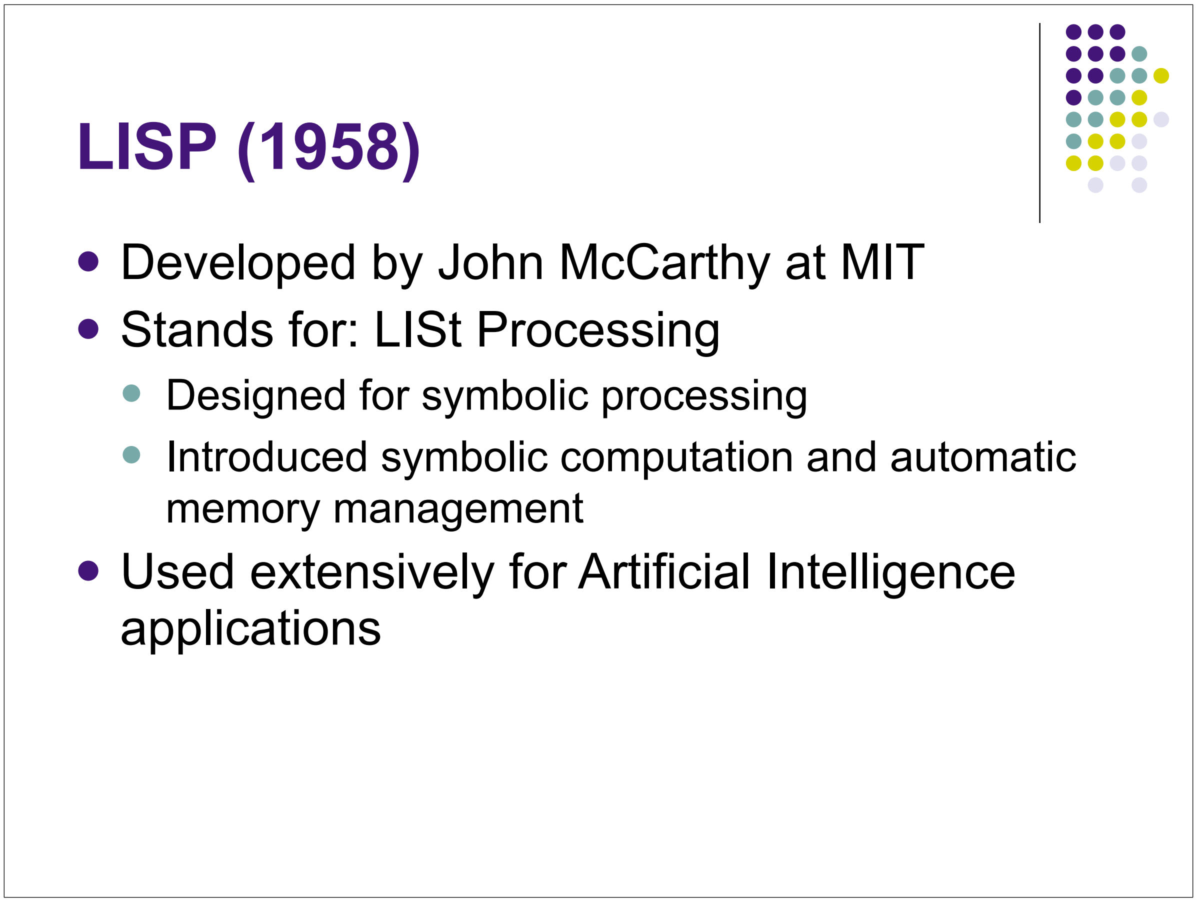
Living & Dead Languages

- Hundreds of programming languages popped up in the 1960s, most quickly disappeared
- Some dead:
  - JOVIAL, SNOBOL, Simula-67, RPG, ALGOL, PL/1, and many, many more
- Some still kicking:
  - LISP (1957)
  - BASIC (1964)
  - Pascal (1970)
  - Prolog (1972)
  - And of course, C (1973)



ALGOL-60 (1960)

- Created mainly in Europe by a committee of computer scientists
  - John Backus and Peter Naur both served on the committee which created it
  - Desired an IBM-independent standard
- Stands for: ALGOrithmic Language
- Primarily intended to provide a mechanism for expressing algorithms uniformly regardless of hardware
- The first report on Algol was issued in 1958,
  - Specifications revised in 1959 and 1960 (and later in 1968)
- The language itself was not a success, but it was an influence on other successful languages
  - A primary ancestor of Pascal and C.
- It introduced block structure, compound statements, recursive procedure calls, nested if statements, loops, and arbitrary length identifiers



LISP (1958)

- Developed by John McCarthy at MIT
- Stands for: LISt Processing
  - Designed for symbolic processing
  - Introduced symbolic computation and automatic memory management
- Used extensively for Artificial Intelligence applications

BASIC (1964)

- Created by John Kemeny and Thomas Kurtz at Dartmouth College
- Stands for: Beginner's All-purpose Symbolic Instruction Code
  - one of the first languages designed for use on a time-sharing system
  - one of the first languages designed for beginners
- Variants like Visual BASIC still used today by Microsoft.

Pascal (1970)

- Developed by Niklaus Wirth in an effort to make structured programming easier for a compiler to process.
- Based on Algol
  - Named in honor of mathematician and philosopher Blaise Pascal
- Wirth also developed Modula-2 and Oberon, languages similar to Pascal which also support object-oriented programming.
- Pascal was the most popular programming language for teaching computer programming in the 1970s and 1980s (now it’s very, very ill)

Prolog (1972)

- Created by Alain Colmerauer and Phillipe Roussel of the University of Aix-Marseille and Robert Kowalski of the University of Edinburgh
- Stands for: PROgramming in LOGic.
- Prolog is the leading *logical* programming language.
  - used in artificial intelligence programs, computer linguistics, and theorem proving.

Prolog

```
parents(william, diana, charles).
parents(henry, diana, charles).
parents(charles, elizabeth, philip).
parents(diana, frances, edward).
parents(anne, elizabeth, philip).
parents(andrew, elizabeth, philip).
parents(edwardW, elizabeth, philip).
married(diana, charles).
married(elizabeth, philip).
married(frances, edward).
married(anne, mark).
parent(C,M) <= parents(C,M,D).
parent(C,D) <= parents(C,M,D).
sibling(X,Y) <= parents(X,M,D) and parents(Y,M,D).
```

C (1973)

- Developed by Ken Thompson and Dennis Ritchie at AT&T Bell Labs for use on the UNIX operating system.
  - now used on practically every operating system
  - popular language for writing system software
- Features:
  - An extremely simple core language, with non-essential functionality provided by a standardized set of library routines.
  - Low-level access to computer memory via the use of pointers.
- C ancestors: C++, C#, Java
- We'll see more when we talk more about software

C++ (C with Classes)

- Bjarne Stroustrup began work on C with Classes in 1979, renamed C++ in 1982.
  - Developed at AT&T Bell Laboratories.
  - Added features of Simula to C.
  - Contained basic object-oriented features:
    - classes (with data encapsulation), derived classes, virtual functions and operator overloading
  - In 1989, release 2.0 added more features:
    - multiple inheritance, abstract classes, static member functions, and protected members
  - Standard Template Library (STL) official in 1995

Java

Naughton (L)
and Gosling (R)

- Created by Patrick Naughton and James Gosling at Sun Microsystems
  - Originally designed for small consumer devices
  - Original project code name: Green
  - Main feature: Code is generated for a virtual machine that can run on any computer with an appropriate interpreter
  - Original name of the language: Oak
  - First project from the Green team: Star7 (*7), an extremely intelligent remote control in 1992

Java (cont'd)

"Duke"

- Java finds its application niche in the Internet
  - HotJava Browser and Applets
  - Java 1.0 debuts in May 1995
  - The course language is small with an API (Application Programmers Interface) supplying many additional operations

Version	Classes & Interfaces	Methods & Fields
1.0	212	2125
1.1	504	5478
1.2	1781	20935
1.3	2130	23901
1.4	3020	32138

Python

- Created by Guido van Rossum in the late 1980s.
  - “Benevolent Dictator For Life”
- Allows programming in multiple paradigms: object-oriented, structured, functional
- Uses dynamic typing and garbage collection
- The Zen of Python:
  Beautiful is better than ugly.
  Explicit is better than implicit.
  Simple is better than complex.
  Complex is better than complicated.
  Readability counts.
  ...