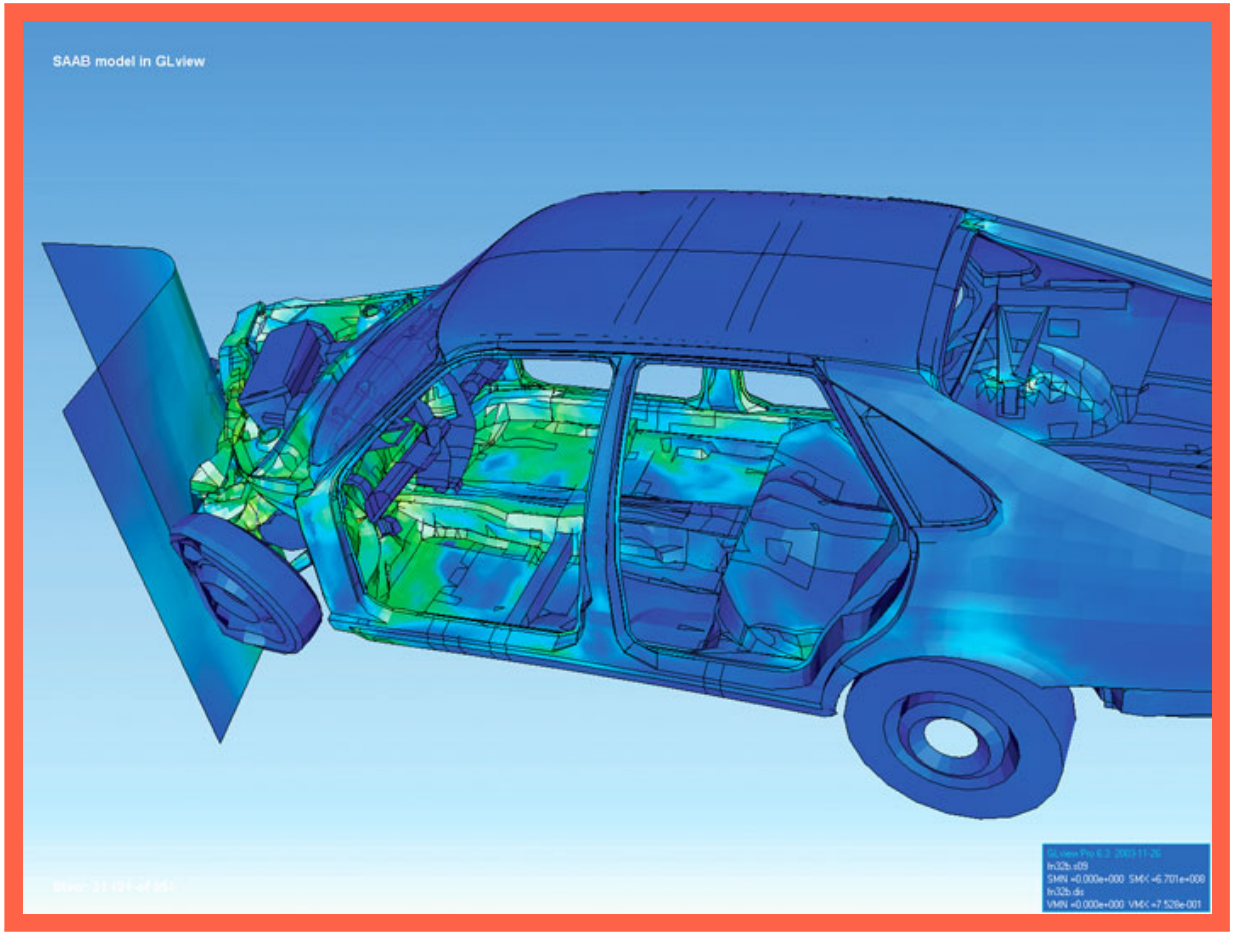
What is...computational science?

Or: Subfields of mathematics 35

The power of visualization



- Visualization = technique for creating images etc. to communicate a message
- The visualization of experiments and phenomena is as old as science itself
- This became successful also because computer science is not just for computer scientists anymore

The good (?) old days

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MONITOR FOR 6802 1.4          9-14-80  TSC ASSEMBLER  PAGE    2


 C000                   ORG    ROM+$0000 BEGIN MONITOR
 C000 8E 00 70  START   LDS    #STACK

                ****************************************
                * FUNCTION: INITA - Initialize ACIA
                * INPUT: none
                * OUTPUT: none
                * CALLS: none
                * DESTROYS: acc A

 0013           RESETA  EQU    %00010011
 0011           CTLREG  EQU    %00010001

 C003 86 13     INITA   LDA A  #RESETA   RESET ACIA
 C005 B7 80 04          STA A  ACIA
 C008 86 11             LDA A  #CTLREG   SET 8 BITS AND 2 STOP
 C00A B7 80 04          STA A  ACIA

 C00D 7E C0 F1          JMP    SIGNON    GO TO START OF MONITOR

                ****************************************
                * FUNCTION: INCH - Input character
                * INPUT: none
                * OUTPUT: char in acc A
                * DESTROYS: acc A
                * CALLS: none
                * DESCRIPTION: Gets 1 character from terminal

 C010 B6 80 04  INCH    LDA A  ACIA      GET STATUS
 C013 47                ASR A            SHIFT RDRF FLAG INTO CARRY
 C014 24 FA             BCC    INCH      RECIEVE NOT READY
 C016 B6 80 05          LDA A  ACIA+1    GET CHAR
 C019 84 7F             AND A  #$7F      MASK PARITY
 C01B 7E C0 79          JMP    OUTCH     ECHO & RTS

                ****************************************
                * FUNCTION: INHEX - INPUT HEX DIGIT
                * INPUT: none
                * OUTPUT: Digit in acc A
                * CALLS: INCH
                * DESTROYS: acc A
                * Returns to monitor if not HEX input

 C01E 8D F0     INHEX   BSR    INCH      GET A CHAR
 C020 81 30             CMP A  #'0       ZERO
 C022 2B 11             BMI    HEXERR    NOT HEX
 C024 81 39             CMP A  #'9       NINE
 C026 2F 0A             BLE    HEXRTS    GOOD HEX
 C028 81 41             CMP A  #'A
 C02A 2B 09             BMI    HEXERR    NOT HEX
 C02C 81 46             CMP A  #'F
 C02E 2E 05             BGT    HEXERR
 C030 80 07             SUB A  #7        FIX A-F
 C032 84 0F     HEXRTS  AND A  #$0F      CONVERT ASCII TO DIGIT
 C034 39                RTS

 C035 7E C0 AF  HEXERR  JMP    CTRL      RETURN TO CONTROL LOOP
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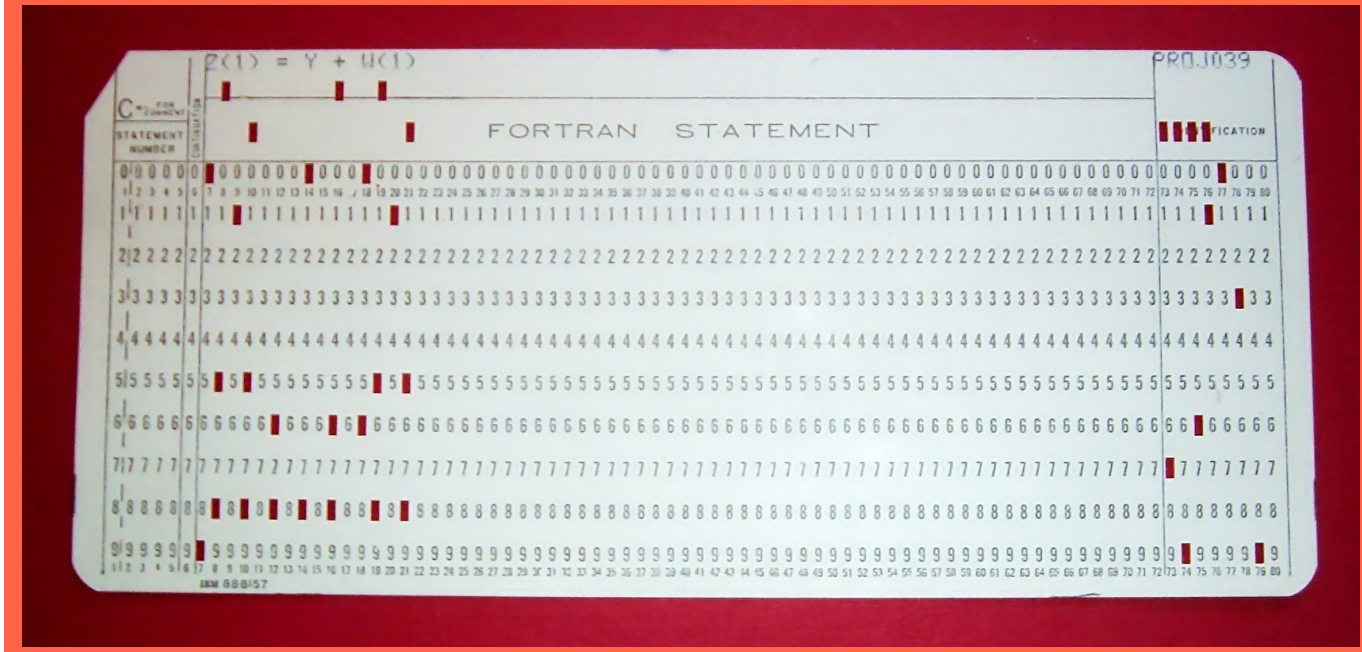
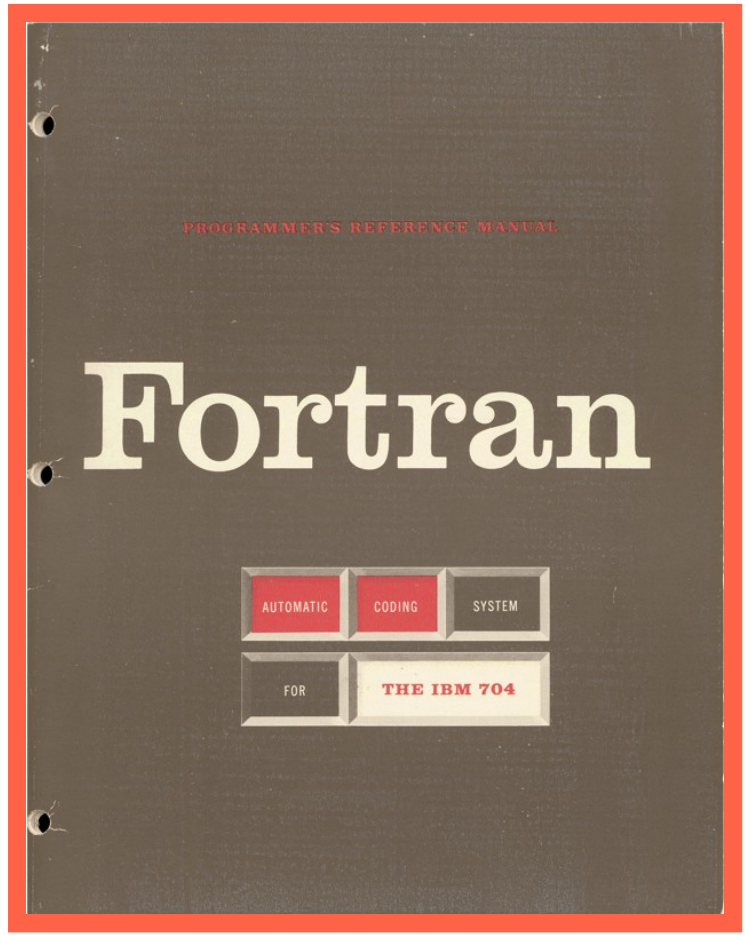


- Traditional programming was very time consuming and “only for experts”
- Key words Paper tape, punched cards, magnetic-tape, assembly language, ...
- Idea (at IBM in 1950s) Make programming more accessible

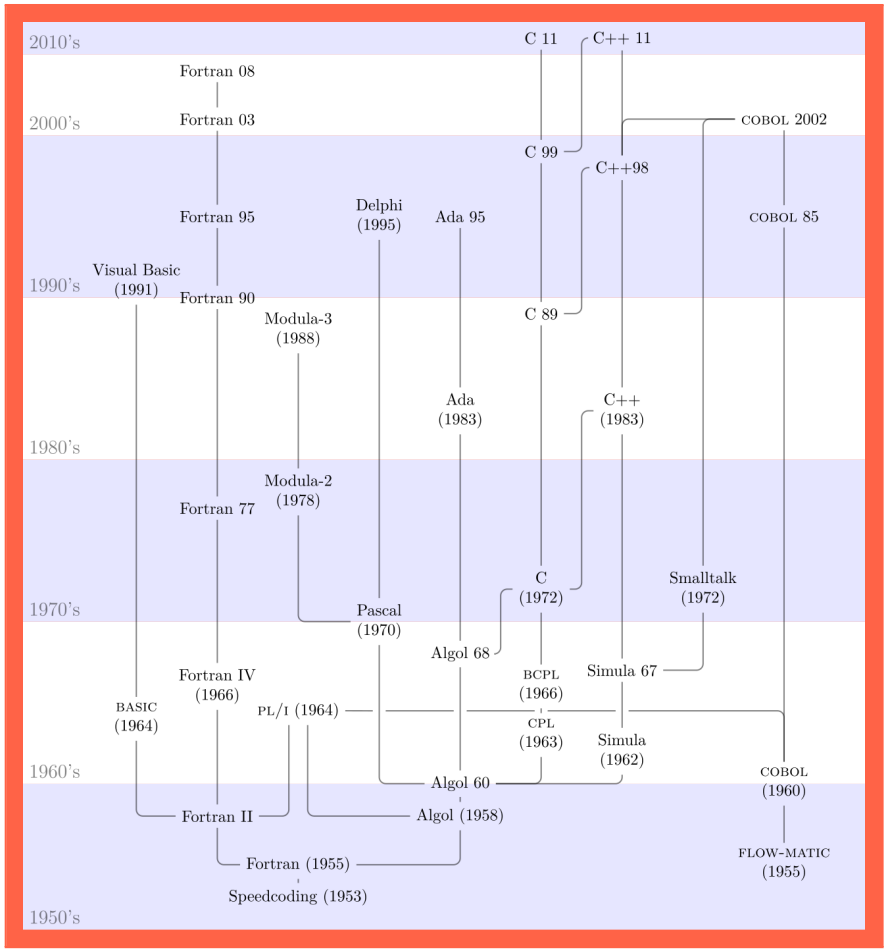
Fortran (∼1955)



- Fortran = Formula Translating System = compiled programming language that is suited to numeric and scientific computing
- Fortran produced efficient enough code for assembly language programmers to accept a high-level programming language replacement

Enter, the theorem

Fortran = ancestor of "modern" programming languages



- Upshot Programming became feasible for nonexperts and fueled the scientific revolution
- Computational science answers similar questions!

Algorithms of the century

- Metropolis Algorithm for Monte Carlo
- Simplex Method for Linear Programming
- Krylov Subspace Iteration Methods
- The Decompositional Approach to Matrix Computations
- The Fortran Optimizing Compiler
- QR Algorithm for Computing Eigenvalues
- Quicksort Algorithm for Sorting
- Fast Fourier Transform
- Integer Relation Detection
- Fast Multipole Method

- Above From the IEEE Computer Society Journal
- No such list can be perfect but that Fortran made it on it should tell us something ☺

Thank you for your attention!

I hope that was of some help.