

Thoughts Concerning Stretch

Date? 1956

by

Preston C. Hammer

1. Input design to avoid wasting time either by having two or more direct inputs switchable. For some uses elimination of console settings for programmed settings (eg cards) might be useful. Both could be available by switching or by giving the console priority.

2. Output: The fanciest type of output I have thought of could be motion pictures of surfaces representing functions being calculated. How such could be achieved, I don't know. The printing mechanism will be important relatively then now since there will be an increased emphasis on preparing answers for direct machine use and on presenting visual aids directly.

3. It is conceivable that a device not only to read curves into digital (coordinate form) but also to read surfaces of physical objects by some means of scanning would be desirable. Milling machines are in existence which can convert tape instructions into surfaces cut from a blank. Question, is there a reasonable "cheap" way of representing surfaces in 3-space? Is direct coding of 3-D television type pictures feasible?

4. The numerical analysis of the future will need to curtail the emphasis on finite differences, especially, publication of tables of functions of 3 or 4 independent variables may be necessarily avoided. One way of avoiding these, when conditions permit, is to use non-tabular representations of functions or tables with more information per number. Such tables may list in a chosen order the numerical coefficients in an expansion of the desired functions, or list in order functions of which the desired one is a composition, etc.

In terms of Stretch one would like to manipulate polynomial and rational functions for as high as 3 independent variables and similarly for Fourier type truncated series.

5. The increasing importance of matrices for many approximations indicates that matrix algebra be handled as easily as possible. To implement this, it is one suggestion that indexing be fixed so as to allow effectively consideration of each address as a pair m_1, m_2 of integers rather than a single integer. It is not impossible that it might generally be better to consider addresses as number pairs. The product of two polynomials of one variable is a peculiar form of vector product--for two or more variables the situation is more complicated.

6. For some sorting uses it might be convenient to be able to compare two numbers in the memory and place the address of the larger in either the accumulator or a memory location.

7. Branching on comparison of two number in the memory would sometimes be convenient. This might require two "phantom" registers. If (6) were not available this could be useful in sorting decisions.

8. A clock of some sort to express elapsed time in, say, units of 10^{-7} sec. or cycles as a number in the memory could be useful, especially so if a means were available of determining elapsed time between two given instructions or memory addresses. The clock could be a form of index register.

9. Any means of dealing with number pairs more easily could be of use for handling complex numbers or rational numbers. Rational number arithmetic may be very useful in deriving exact formulas by machines.

10. The following types of processes, if done, will probably be subroutines but any features making them simpler might be considered.

- (a) Least square curve-fitting (linear and non-linear)
- (b) Roots of polynomials

- (c) Differentiation of functions (exact)
- (d) Integration of functions (exact)
- (e) Minimax function approximation.
- (f) Proofs of recursion formulas, eg. for orthogonal polynomials in one, two, or three variables.
- (g) Factoring algebraic expressions, etc.

11. In regards to Monte Carlo operations, if the digits are to be generated systematically, allowance should be made for changing the sequence in case one becomes suspect or "worn out".

12. Numbers shown for direct checking on the console should be in readable form--in addition to octal representation if necessary.