PRODUCT PLANNING & MARKET ANALYSIS DIVISION

MEETING OR CONTACT REPORT

70-6076-0

Project: Stretch Mathematical Planning Meeting	Date of Report: 9/11/56
Purpose of Meeting or Contact: To investigate the mathematical planning effort for Stretch.	Date of Meeting or Contact: 9/5, 6, 7/56
	Reported by: D. W. Sweeney
	Dept.: Product Planning
Place of Meeting or Contact: ☐ WHQ ☐ Phone Other: Poughkeepsie	Follow-up Date:

List Personnel Participating
Give Report (including next action)
Indicate Distribution

Group present:

Los Alamos	DPSPD	Engineering
B. Carlson	L. Sarahan	S. Dunwell
H. Kolsky	J. Griffith	W. Buchholz
R. Lazarus	D Sweeney	F. Brooks
D. Wood	F. Beckman	J. Cocke
R. Frank	F. Johnson	W. Wolensky
E. Voorhee		W. Stringfellow
		W. Hunt
		R. Seeber
		J. Pomerene
		P. Hurwitz

This was the first meeting of the group to investigate the mathematical planning effort for Stretch. The group met at 2:15 p.m. on September 5, 1956. Mr. S. Dunwell welcomed the Los Alamos group and introduced the IBM members present. Mr. B. Carlson, Chairman of the Los Alamos Stretch committee, introduced the members from Los Alamos.

A general discussion followed on the subject of classified information and "Q" clearance. It was felt by the group that as far as possible they would stay away from discussions of classified material, but that clearance should be started for the people involved so that they could participate if it became necessary to discuss such information.

The next discussion was the agenda and some questions from Los Alamos about Stretch. The meeting was to be confined as closely as possible to mathematical discussion. Los Alamos requested that design criteria such as instruction set and word formats be reported to Los Alamos as soon as possible so that their large computing staff could examine them for possible oversights.

Los Alamos wanted to know what was going to be done with the problem material which they furnished. They were answered that we were looking for fundamental functions in the problem statements and flow diagrams.

Mr. R. Lazarus then presented the first problem which was to a large extent an indexing and information retrieval problem. (See appendix A).

In the discussion that followed, Mr. R. Lazarus pointed out that the 704 had too few index registers and that 8 to 9 would have substantially simplified the programming. It was also felt that there was a rather inflexible testing facility for the index registers.

One of the main points of interest in the problem was that there were many large matrices which had mostly zero elements off the main diagonal (about 15% of the elements were non-zero) and to fit these in the machine the matrix elements were represented by bits in several words. A one indicated a non-zero element and a zero represented a zero element. The zero elements were then removed and the remaining elements collapsed into a small amount of storage. When operating on a matrix, the bits in the identification words were examined in sequence and two counts were kept, one of the total number of bits that had been examined, and one of the number of one bits in the total number examined.

This method enabled the coder to skip the calculation on the zero elements and to easily find the non-zero elements by adding the second address to the base address of the table containing the non-zero matrix elements.

Some suggestions were made to achieve the same result by letting each non-zero element carry with it the identification of the next non-zero element.

Another problem pointed out was that in the 704 it was necessary to get $\frac{A+B}{2}$ by a floating point divide rather than by subtracting one from the exponent, because of the definition of zero and exponent underflow. It was felt that this was time consuming compared to the same operation in binary fixed point.

Mr. Lazarus stated that he felt that the machine balance (i.e. the ratio of executed data handling instructions to house keeping instructions), was good and that the code length was not unreasonable, but that too much time was spent in organizing the problem to fit the machine. He also thought that the testing of single bits without disturbing the arithmetic registers would speed up the problem.

With respect to problem magnitude, he pointed out that this example was a trivial portion of a large problem which in trun was one-tenth of a larger problem. He also pointed out that this was a developing code (i.e. changes were being made continually) and that to facilitate changes, the coding structure should be close to the physics of the problem.

Mr. B. Carlson then started the description of the problem of Neutron Transport. (See Appendix B).

The next day (September 6, 1956), the group met a 9:00 a.m. Mr. B. Carlson made a few remarks then continued his description of the Neutron Transport problem. He pointed out that present day machines are allowing us to do numerical exploration of problems and techniques which have been defined and are fairly well known, but that we were beginning to border on a wide spectrum of problems of which mathematical models are not too well known, and that this type of mathematical exploration is extremely difficult. He felt that machines will have to be able to translate mathematics to numerics easily to facilitate this exploratory work.

Following the presentation of the Neutron Transport problem, Mr. Carlson pointed out that he felt that there were too few index registers. Another problem was since the program was a general purpose program with a widely varying input of parameters, there was a good deal of the program devoted to one-shot set up. He said that he certainly resented this part of the code writing the most and that it represented over 20% of the total number of orders (110 out of 500). With respect to the matter of too few index registers, he stated that there were 25 Store Decrement instructions in the main body of the program.

The meeting was then turned over to Mr. H. Kolsky who discussed the problem of Fluid Dynamics or hydrodynamics. (See Appendix C). The majority of time was spent in the theoretical statement of the problem and some of the numerical difficulties encountered. The flow diagram was not presented to the group, but is included in the appendix.

A good portion of the discussion was about the two dimensional case and the problem of nearest neighbors. In the present problems being run the neighbors are forced to stay in close juxtaposition. This represents in some cases a severe restriction because of the development of vortices which causes a break-down in the machine solution of the problem. He pointed out that in many cases if these local situations are sidestepped that the other portions of the mesh could be carried forward to give meaningful results, but that this represents a very difficult programming problem to overcome some of the floating point exception cases.

Dr. W. Buchholz then asked if there was to be a presentation of the problems encountered in Monte Carlo. Mr. B. Carlson spoke briefly, saying that the problem was very simple in concept but required the calculation of many cases since the accuracy was of the order of $1/\sqrt{N}$ where N is the number of cases investigated. He stated that there were a very large number of square roots and that figure accuracy was not as important as speed. If low precision trigonometric functions can give significant speed increase, this is preferable. The generation of random numbers was also discussed. It was pointed out that during problem check-out it was very important to regenerate the same random numbers so that errors could be located in the code.

Mr. R. Lazarus then indicated a large problem of which the problems presented by Mr. B. Carlson and Mr. H. Kolsky were only parts. This was the assembly and disassembly of bombs. In the first stages the two dimensional hydrodynamics problem would dominate followed by the neutron transport problem followed by the radiation energy transport problem.

The next day (September 7, 1956) was spent discussing Stretch. Mr. S. Dunwell described the various parts of the calculator (memory, input-output exchange, input-output units, input-output computer, high speed control unit, and high speed arithmatic unit). The rest of the morning was spent in discussion of these aspects of the machine. Mr. B. Carlson requested the earliest possible date for a preliminary machine vocabulary so that some preliminary programming could begin.

Mr. B. Sarahan then led a discussion of the agenda for the next meeting which is to be at Los Alamos on September 19, 20, and 21. The proposed agenda follows:

1. Review problems presented at the previous meeting.
2. Input-output considerations.
3. Monte Carlo problem in detail.
4. Auto coding.
5. Floating point definition (overflow, underflow, zero, rounding, normalization, and precision index).
6. Plan attack on significance.
7. Matrix problems.

The meeting adjourned at 12:30 a.m.