Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge 39, Massachusetts

SUBJECT: BIWEEKLY REPORT, JUNE 15, 1953

To: Jay W. Forrester

From: Scientific and Engineering Computation Group

1. MATHEMATICS, CODING AND APPLICATIONS

1.1 Introduction

During the period covered by this report 194 coded programs were run on the time allocated to the Scientific and Engineering Computation (S&EC) Group. These programs represent part of the work that has been carried on in 25 of the problems that have been accepted by the S&EC Group. Progress on each of these problems is given below in terms of programming hours, minutes of computer time, and progress reports as submitted by the programmers in question.

The Comprehensive System of Service Routines (CS) has been adjusted to make use of both banks of ES. The official adoption by the S&EC Group of this two bank CS was made on 1 June. In addition to this change, the assignment of most of test storage to other uses necessitated the storage of the input program on the auxiliary magnetic drum and the correction of programs that had made use of flip-flop registers 4,5, and 6. Despite the period of transition that was set up, these changes did cause some difficulties. However, most of these have been corrected. The only other changes contemplated in this CS will be the use of a delayed punch for punching the converted 556 tapes and the inclusion of additional output routines and improved post mortems. These changes should not create any inconvenience for programmers. Details about these changes are given under problem #100.

Even though the CS that has been described under problem #100 will be "frozen" as regards day-to-day operation, ideas on conversion will continue to be active. Two comprehensive systems are under development, one for the 1953 Summer Session course (S&EC problem #140) and the other to enable programmers to make more extensive use of the auxiliary magnetic drum (S&EC problem #150). The latter system, called the Drum CS, is intended to be the successor of our present CS system. However, no transition will be made until the new system has been completely developed.

One new problem was initiated during this period by R. Summers of the MIT Instrumentation Lab. This problem (#137) investigates the effects of atmospheric turbulence as a noise input to an airborne control system. Details are given below.

Problem #124 has been completed and will be written up as a Master's Thesis in the MIT Physics Department by D. Combelic of our staff. This problem has studied the effect of different potential forms on the deuteron binding energy. A summary of this problem is also given below.

1.2 Programs and Computer Operation

100. Comprehensive System of Service Routines: Briscoe, 72.75 hours; Combelic, 5 hours; Frankovich, 11 hours; Hazel, 22.5 hours; Helwig, 20 hours; Kopley, 41 hours; Porter, 17 hours; WWI, 643 minutes; Demurjian, 31.5 hours

On 2 June the changeover to the CS conversion program using the drum input program took place. Some difficulties for outside programmers ensued because of the altered location of the PA interpretive routine in ES. Most of these difficulties have now been eliminated. No further changes which will alter a programmer's logic are to be anticipated in the CS.

Modifications have been made in the CS so that it will now convert both of the new WWI orders ab and md. The modifications to enable the CS to use the delayed punch instead of the direct punch for punching the converted 556 tapes are still undergoing tests, but are expected to be in use by the end of the next biweekly period.

Frankovich

A scope post mortem, which will be locked out on Drum group 11, has been written and awaits testing. Its purpose is to enable operators to give a programmer a fast post mortem of all of ES merely by pressing the read-in button and starting over at register 1000(o) after a program has operated unsatisfactorily. This post mortem returns ES to the status it had immediately preceding the post mortem.

This type of post mortem will be primarily used where

(1) a programmer wishes to have a PA post mortem in addition to a post mortem of all of storage;

(2) a programmer has not requested any form of post mortem and his program has failed to operate properly.

In the latter case, it has often been necessary to re-run the program merely to obtain a post mortem.

All the 16 scope post mortems referred to in memorandum M-2188 and Bulletin Board Memo #16 are now available.

Kopley

The routine to record on the magnetic tape in the two-way post mortem has been changed to shorten the record time and the new routine is also easier on the magnetic tape equipment. The erratic condition of zero suppression and non-suppression in the four-way post mortem has been corrected. In general, a program that is to be post mortemed is lost if there is any kind of read-in difficulty on the post mortem. A procedure to save the program will soon be completed.

Hazel

An error in the old title display routine in the magnetic tape CS was found and corrected.

All basic conversion programs, present and future, have been modified to add special characters every 48 feet of 556 tape and to convert md. These modifications have not been tested.

Briscoe

A curve-plotting program that handles single-length fixed-point numbers has been written and is under test. This program is being extended to handle (30-j,j) numbers. It is in this extension that these routines are expected to find their widest use.

Porter

The (24,6) Delayed Print subroutine (File 2299) has been modified for use with the MRA in the second bank of ES.

Combelic

101. Optical Properties of Thin Metal Films: Denman, 6.5 hours; Loeb, 10 hours; WWI, 39 minutes

After several runs with alarms at different places it was discovered that in the conversion one block was converted twice, with different sets of floating addresses. Also the automatic selection of output was converted incorrectly. These errors were corrected and consistent program alarms obtained. Because of a fire in the power plant the scope post mortem came out blank.

Loeb

102. Scattering of Electrons from Gases: Uchiyamada, .5 hours; Uretsky, 2 hours; Combelic, 1 hour; WWI, 90 minutes

The past period has been spent in obtaining the scattering phase shifts for Helium for energies of 0 and 6 e.v. using the Morse-Allis exchange approximation. The first energy (0 e.v.)run confirmed the deduction that the phase shift is 180° (in contradiction to the Born approximation). The 6 e.v. run will be used to obtain the initial conditions at the "boundary" of the atom for use in a hand-computed solution of the adiabatic perturbation approximation. This solution should constitute a critical test of this approximation.

Due to the fact that I will not be at MIT during the following year, further work on this problem will be delayed.

Uretsky

106. MIT Seismic Project: Briscoe, 1.75 hours; Robinson, 20 hours; Simpson, 25 hours; WWI, 200 minutes

The Geophysical Analysis Group was initiated in 1949 as an MIT Project in the Math Department under Professor G. P. Wadsworth and has since become a joint Math and Geology project sponsored by Grants-in-Aid from interested oil companies, under Professors Wadsworth and P. M. Hurley and directed by E.A.Robinson. Its purpose is to investigate the use of statistical analysis techniques on seismographs. These are records of earth waves generated by dynamite explosions. Their study can reveal underground structures, information vital to the discovery of possible oil bearing formations. The crucial step in the analysis is the selection of "reflection times", or times of pulse travel to underground interfaces and back. This can be done visually if the signal to noise ratio is sufficiently high and this is the case on many records. On more complicated records visual techniques fail whereas statistical methods seem to give the desired information.

The seismic traces are converted to digital form and considered as stationary time series. A linear operator is fitted to a small segment of a trace and used to predict the entire trace. The prediction is poor where the dynamical change is great as at a reflection time, since the stationary hypothesis breaks down. Thus the error of prediction may be interpreted in terms of reflected energy.

The form of the linear operator we have been using is

$$\hat{x}_{i+k} = c + \sum_{s=o}^{M} (a_s x_{i-s} + b_s y_{i-s})$$

In this expression $\hat{x}_{i+k}$ is the approximated value of the future value x_{i+k}, where k is the number of time units ahead which the operator predicts. That is, the prediction distance is given by kh. The M+1 past values of trace x are given by x_{i-s} where s = 0,1,...M, and the corresponding M+1 past values of trace y are given by y_{i-s} where s = 0,1,...M. The 2M+3 constants of the operator given by c, a_s, and b_s (s=0,1,...M) are constants determined in an optimum sense by the least squares method. The normal equations for these constants may be written as

$$c\,n + \sum_s \left(a_s \sum_i x_{i-s} + b_s \sum_i y_{i-s}\right) = \sum_i x_{i+k}$$

$$c \sum_i x_{i-r} + \sum_s \left(a_s \sum_i x_{i-r}\, x_{i-s} + b_s \sum_i x_{i-r}\, y_{i-s}\right) = \sum_i x_{i-r} x_{i+k} \quad \text{for } r = 0,1,\ldots M$$

$$c \sum_i y_{i-r} + \sum_s \left(a_s \sum_i y_{i-r} x_{i-s} + b_s \sum_i y_{i-r}\, y_{i-s}\right) = \sum_i y_{i-r} x_{i+k} \quad \text{for } r = 0,1,\ldots M$$

Once the constants have been determined, the running average of errors

$$E_i = \frac{1}{2p} \sum_{j=i-p}^{i+p-1} (x_j - \hat{x}_j)^2$$

is computed and plotted giving the "error curve" a graph whose peaks are found to correspond with the time of arrival of reflected energy.

Since the spring of 1952 our group has been using Whirlwind to help optimize this type of analysis. Most of our computation has been in finding the auto and cross correlations which comprise the formal equation coefficients and in predicting and forming the errors and error curves. The matrix solutions have been done on desk calculators and by computing services. We are experimenting with matrix solutions on Whirlwind I, which is a difficult problem due to the near singularity of the matrices we deal with. In addition we have been experimenting with slightly different approaches to the problem such as frequency and pure correlation studies, as well as certain theoretical problems that arise from the attempt to optimize the form of the linear operator.

The results have been encouraging and it is hoped that once the methods are thoroughly understood they will be directly applicable to the treatment of other types of geophysical data such as gravitational and magnetic data.

Robinson

109. Fighter Gunsight Calibration, 8th Order D.E.: WWI, 0 minutes

Almost all of our time has been devoted to the investigation of the three dimensional pursuit course problem. It has not been definitely decided which set of equations will be best for machine computation; however, this question is now being studied.

An effort is being made to eliminate the error in the two dimensional pursuit course program.

Hellman

111. Fourier Analysis--Autocorrelation Problem: Hazel, 1 hour; WWI, 58 minutes

#111 was run four times, the first three times the program hardly got started due to a tape error and two subsequent miscorrections of this error. The fourth time it stopped due to a technical program error.

Block

112. Lawley's Method of Factor Analysis; Characteristic Vectors (modified): Denman, 11.5 hours; WWI, 38 minutes

Further testing of the new program using the drum revealed difficulty in selection of proper scale factors to avoid overflow. Work is now being done toward obtaining the proper scale factors. When they are found, the problem should be ready for production runs.

Denman

113. Shear Wall Analogy, Simultaneous Linear Equations: Kopley, 1.5 hours; Sydney, 30 hours; WWI, 75 minutes

Parameters have been prepared for a theoretical analysis of several shear walls with varying amounts of reinforcing steel and with a variable strength of concrete. Four of these parameters have been run, three of which were successful.

The difficulty encountered with the fourth run was due to an incorrect tape conversion of one parameter.

Sydney

114. Design of Optical Instruments: Combelic, 2.5 hours; Mahoney, 48 hours; WWI, 73 minutes

The optical ray tracing program mentioned in the last biweekly is still being tested with no results as yet. In the program for computing third-order terms, it was found that the program failed to work for a special case of a zero parameter. The program was revised to include this case but had not been run by the end of the biweekly period.

Mahoney

116. Torpedo Impulse Response; Convolution: Hamilton, 10 hours; WWI, 5 minutes

The inverse transform program was completed for one run but did not give a satisfactory solution to our problem. We are taking the Fourier transform of our data again with smaller sampling intervals to give smoother and more comprehensive results.

Hamilton

118. Quantized Group Communication and Learning; Non-Markovian Stochastic Process: K. Ralston, 4 hours; WWI, 0 minutes

Delays in preparing the data necessary to simulate the last communications network have prevented work being done during this period. The problem is to be completed during the next biweekly period.

K. Ralston

119. Spherical Wave Propagation: A. Ralston, 6 hours; Fox, 6 hours; Combelic, 1 hour; WWI, 78 minutes

A tape suitable for doing a complete computation was assembled. The running of this tape involved the correct operation of magnetic tape unit #1. The run was successful. However, a modification of the tape which changed only a number indicative of mesh size has been tried twice with no success; the trouble may be due to the incorrect functioning of tape unit #1 in the rerecord mode.

Fox

120. Thermodynamic and Dynamic Effects of Water Injection into Gas Streams of High Temperature and High Velocity; simultaneous differential equations: Combelic, 3 hours; Porter, 7 hours; Gavril, 80 hours; WWI, 348 minutes

The work carried out during the current biweekly period was concerned with final testing of the program, testing of various extrapolation techniques and increment sizes, and, finally, the successful initiation of production runs.

Considerable difficulty manifested by erratic performance of a formerly correct program resulted when an additional computational block was added to the program. This difficulty was later found to be due to the location of the instruction isp x in register 3777. This location is incompatible with the PA program in the first half of storage, for upon execution of the order isp x, the PA program counter changed from ca 3777 to 1.04000 which was of course read as cs rather than ca from that point on, and further computation became impossible. Other difficulty resulted from use of parameter tapes inadvertently converted by the new conversion program resulting in an incorrect starting address, etc.

The Newton polynomial extrapolation formula, discussed in the previous biweekly report, was tested and found to increase instability. This can be understood if it is remembered that the curvature introduced by such a formula can actually increase truncation error. It was finally concluded that all the extrapolation techniques tested failed because they were applied to only a single equation of the set, and the necessary "feedback" in the other variables was not available from the remaining equations of the set. In any case, reduction of the increment size was always successful in carrying the solution further ahead.

As a further test of the program, a parameter was written, using primarily the order isp, which when read in with the main program enabled elimination of all effects of water injection and the consequent calculation of the well known "Fanno Process". The results obtained indicated that the blocks of the main program used were correct, but that truncation error could be quite severe when choking conditions are approached. This is due to the fact that all slopes approach infinity as the Mach number approaches unity. The choking states, however, are of lesser importance in the Aerothermopressor process, and truncation error will not be so severe.

In this connection, two runs, using the final program, were made, each differing only in increment size. The first was at an increment of .01 in the fractio

evaporated; the second at .005. The final results were found to differ by only a negligible amount. Specifically, a linear extrapolation to zero increment size indicates that after 75% evaporation the distance travelled by the droplet as computed using the larger increment is in error due to accumulated truncation error by less than 1.7%. The curve of distance vs. fraction evaporated is the one with the greatest slope compared to the other computed properties.

Production runs began at the conclusion of this biweekly period using an increment size of .01. The time of computation for each increment (a complete execution of the program) was approximately 9 seconds, with each run taking on the average of 12 to 15 minutes and several going nearly to complete evaporation without difficulty with instability. About 12 such runs have been made, and it is estimated that this is equivalent to about 1920 man-hours(48 weeks) of arduous hand computation. This progress thoroughly justifies months of preparatory work and demonstrates the value of Whirlwind I.

Currently, the results of these runs are being graphed and studied in preparation for further production runs. All computations thus far have been at constant area for the purpose of comparison with experimental data. Computations at variable cross-sectional area will also be carried out.

Gavril

121. Determination of Weak Signal plus Noise Probability Functions: Porter, 3 hours; Sponsler, 4 hours; WWI, 42 minutes

A test run was made of the program written to carry out one convolution of the probability density function. The analysis of the results of this run indicated a few errors in the formulation. These are now being corrected.

Sponsler

123. Earth Resistivity Interpretation: Integration of empirical functions: Briscoe, .25 hour; Vozoff, 50 hours; WWI, 14 minutes

A program has been written which stores the original potential data as a set of orthogonal polynomials for the special case of a fifth-order set of polynomials and a 20-point data set. This has not yet been tested. In addition, the difficulty in the Bessel function tape was located, and steps have been taken to correct it. The next couple of weeks will be spent checking out the two programs and tying them together.

Vozoff

124. Deuteron Binding Energy and Wave Functions: Combelic, 2 hours; WWI, 195 minutes

Computer time during this period was used in an attempt to extend the calculations beyond the range already completed. However, due to some peculiarity in the new Drum Input program, results were of little value, and no further attempts are contemplated. Therefore the calculations for this problem have been completed and the problem is now terminated.

Since this is the last biweekly, a brief resumé of the problem is given along with a few remarks about the results obtained. The results will become part of a Thesis to be submitted in partial fulfillment of a Master's Degree in the MIT Physics Department.

The equation for the spherically symmetric relative motion of a neutron and proton reduces to a solution of

$$\frac{d^2u}{dx^2} = \left[\epsilon - v(x)\right] u \qquad (u(0) = u(\infty) = 0)$$

where, $u = \psi(r)$

$x = r/r_c$, r_c is to be determined

$\epsilon \sim E_B$, the binding energy of the deuteron

$v(x)$ is the potential of the interaction

A potential of the form $A \frac{e^{-x} - e^{-bx}}{x}$ $(b>1)$ has been studied in this problem. (A and b together determine the depth and "range" of the potential.) The main task has been to find those combinations of A and b (out of the more than 70 combinations tried) which yield calculated values of the deuteron binding energy and of the so-called scattering length, a, consistent with the experimentally observed values of these two quantities.

For a given value of b, the value of A is determined by the intersection of two curves, one related to the eigen-value, ϵ, the other to the scattering length, a. (a is proportional to the value of x for which $u = 0$ when ϵ is set equal to zero.) It has turned out that these two curves intersect at a very small angle (4-5 degrees), and since the two intersecting curves are thickened, as it were, because of probable errors in the experimental values of E_B and a, a unique value of A cannot be determined for each value of b. However, the results obtained are useful in giving a good idea of the shape of the true nuclear potential.

Further studies may include consideration of the quadripole moment of the deuteron as a factor in a better determination of the potential parameters.

Combelic

126. Data Reduction: Frankovich, .5 hour; Ross, 25 hours; Hamilton, 44 hours; WWI, 48 minutes

No further progress has been made during the present biweekly period due to malfunction of a post mortem routine, the only means for output in the program. A scope post mortem disclosed that the program actually has been converted for two banks and corresponding changes are being made in future additions to the program.

Ross

130. Six-component Distillation, Variable Enthalpy and Equilibrium Data Simultaneous Non-linear Equations: Briscoe, 3.25 hours; Horowitz, 50 hours; WWI, 8 minutes

A post mortem of O'Donnell's program, 2546m5, printing out all of storage, was obtained to facilitate the line-by-line scrutiny of the program. Code-checking will be completed in O'Donnell's absence. It is expected that no more than one or two coding mistakes remain to be found. These will be corrected and an attempt will be made to obtain one correct run to check against hand-computed results.

Horowitz

131. Special Problems (Staff training, demonstrations, etc.): Kopley, 7.5 hours; WWI, 48 minutes

The Demonstration tapes are being modified to embrace all the pre-July 1 WWI innovations necessary for proper performance. These include a redistribution

of flip-flop storage, change in Read In program and reversal of scope decoders.

The fixing of the viewer knob and the resetting of the gain on the camera-scope combination have improved the camera-scope performance considerably.

Lloyd Sanford took additional pictures of several oscilloscope displays. These pictures will be incorporated into albums of photographs for Group Leaders and for DCL visitors.

Kopley

132. Revision, Extension and Testing of Subroutine Library Used in Programs for Obtaining Data for the Numerically Controlled Milling Machine; routine numerical and logical operations: Runyon, 30 hours; WWI, 18 minutes

The testing of library type subroutines for NCMM computations was continued. Some difficulty was encountered when the change in location of the PA routine was made due to the fact that some library routines referred to registers in the MRA whose locations were altered. Newer versions of these routines were substituted for the old ones to eliminate this trouble. A divide alarm of undetermined origin has also been causing trouble.

Runyon

133. Non-linear Meson Equation: Finkelstein, 14 hours; WWI, 38 minutes

One solution to the equation under study was obtained. The elimination of errors continues.

Finkelstein

134. Numerical Diagonalization Procedure: Meckler, 16 hours; WWI, 16 minutes

No results were obtained. The program was modified to make use of the two bank CS. The modification was in error and is being corrected.

Meckler

136. Matrix Equations: Arden, 11 hours; WWI, 47 minutes

Several coding errors have been discovered and corrected.

Arden

137. Investigation of Atmospheric Turbulence; Autocorrelation, Crosscorrelation and Fourier Transforms: WWI, 28 minutes

Atmospheric turbulence, acting directly on the aircraft, is a significant noise input to any airborne control system. A quantitative description of this input is therefore necessary before the design study of an airborne control system can be completed. If the turbulence is assumed to be a stationary random process, the methods of generalized harmonic analysis may be used.

In 1950, some data was obtained for the power spectrum of vertical gust velocity which is the principal noise unput for the longitudinal motion of an aircraft. However, no satisfactory data was obtained for those gust inputs which excite the aircraft laterally. A simplified model of the lateral gust structure has now been postulated. In order to determine the validity of this model (and properly modify it, if necessary),the power spectra of each of three assumed lateral gust components are now being determined simultaneously by flight measurements using an automatically controlled aircraft as a "probe". Three autocorrelations and three crosscorrelations must be calculated in order to determine, by Fourier

transformation, the power spectrum matrix for three selected outputs of the aircraft control system. By an inversion of the aircraft control system performance matrix, the three desired input power spectra are then to be calculated. A suitable cross-power analysis has been developed for this calculation.

The successful analysis of this data should provide a complete, quantitative description of the gust structure in the atmosphere in a form suitable for analysis and synthesis of linear control systems.

An attempt has been made to use the autocorrelation program written by D.T. Ross. One quantity (the 1234^{th}) for each of three parameter tapes (2640m0, 2641m0, 2642m0) was omitted in the data supplied to the tape room by the programmer. These quantities will be supplied and new performance requests will be submitted.

Summers

140. Summer Session System: Combelic, 8 hours; Finkelstein, 80 hours; Rotenberg, 60 hours; WWI, 8 minutes

Development of an instruction code, conversion program, interpretive routine, post mortem and mistake diagnosis routines to be used by students participating in the MIT 1953 summer session course on "Digital Computers and Their Applications", has been begun.

A complete, but tentative, instruction code (M-2227) and the description of a proposed conversion routine(M-2235) have been written.

Rotenberg

150. Drum Comprehensive System of Service Routines: Arden, 29 hours; Combelic, 40 hours; Denman, 5.5 hours; Frankovich, 18 hours; Helwig, 50 hours

Many S&EC programmers are now using the magnetic drum as auxiliary storage--if transfers to and from the drum are made in large blocks the loss of time from straight ES operation is not large. The primary purpose of problem #150 is to devise a way of integrating the drum so completely into the machine that a programmer may use as many as 10,000 registers in one program in much the same way as he now uses 2,000. In this so-called "Drum Comprehensive System of Service Routines" (Drum CS) all references to the drum would be made by an interpretive routine. Of several possible methods, two appear to have possibilities; their details are being worked out. If the detailed programs are not too much slower (say, not more than 50% slower) than the present interpretive programs (24,6 for example) it would appear worthwhile to continue with the project. The Final system will include automatic mistake anticipation and semi-automatic post mortems and mistake diagnosis. A complete write-up of the system, including instructions for its use and a technical description of its vocabulary and interpretive program will be developed concurrently with the conversion and interpretive programs themselves.

Combelic

1.3 Computer Time

The following indicates the distribution of WWI time allocated to the S&EC group.

Programs	36 hours, 02 minutes
Conversion	14 hours, 05 minutes
Scope Calibration	1 hour , 16 minutes
Magnetic-Tape Test	05 minutes
Magnetic Drum Test	12 minutes
Demonstrations (#131)	46 minutes
Total Time Used	52 hours, 26 minutes
Total Time Assigned	61 hours, 11 minutes
Usable Time, Percentage	85.7%
Number of Programs Operated	194

1.4 Summary of Tape Room Bulletin Board Memoranda (H. Uchiyamada)

(These memos are intended to inform programmers of changes in coding procedure, WWI facilities etc.)

Nullification of blocks of words on 556 tape

Many programmers have been nullifying blocks of words on 556 tape by making all the words in that block negative. A similar procedure will work for the drum input program if both digit positions 0 and 1 of the modified words contain ones. The word -n+1 must be the first word in the block immediately following the nullified block.

Flip-Flop Reset

Flip-Flops #2 and #3 no longer get reset on a restart order. In order to insure that the flip-flops are reset, the start over button should be used. Start at 40(o) also resets and sil0 (o) automatically resets flip-flops.

Instruction "sp" for Read-in

The instruction sp21(d) or sp25(o) which was used for read-in with the old Input Program is not valid for use with the new Input Program. The instruction sp26(d) or sp32(o) should be used with the new Input Program.

Length of Tapes

Any programmer who suspects his tape to be over 48 feet long must notify the tape room of this fact as soon as possible in order that certain changes necessary for the new input program may be made before the tape is run. As an indication of length, 1920 registers will result in a 48 foot tape. Any modifications which lengthen the tape must also be taken into account.

Scope Post Mortems

A table which summarizes the available scope post mortems (including information such as the registers displayed, number of frames used and starting addresses for each frame) may now be obtained in the tape room upon request.

Scope Routines

Programmers using scope-routines (other than post mortems) must indicate whether "old" or "new" decoders are being used.

Instruction Code

A one-page tabular form of the WWI instruction code is now available and may be obtained in the tape room upon request. A two-page spread of the instruction code is available for internal users. For the two-page form see H. Uchiyamada-Barta 111.

New Instruction "md"

Effective Monday, June 15th the new instruction md, multiply digits, will be ready for use. The function of the instruction md is to take the number in the accumulator and multiply each of its digits by the corresponding digit of the number in register x. Thus, if both the accumulator and register x have a one in a particular digit then the corresponding digit of the result will be a one. But if either or both have a zero then the corresponding digit of the result will be a zero. For example:

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10101010
00111100
00101000
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The digit by digit product is left in the AC and the complement of this is in the AR. For more details see M-1889.

Unassigned "si" instructions

The actions which occur if an unassigned si command is used in a program are summarized in a memo,copies of which may be obtained in the tape room.

Library Subroutines--Corrected Versions

Programmers who have made use of Library Subroutines in programs converted by CS should be sure that they are now using versions of these subroutines corrected for the present two bank PA. The old version written for one bank PA will not work in programs converted by CS after June 1, 1953. A table, which may be obtained from the tape room, shown former addresses in the one-bank systems and the present addresses in the two-bank system of the following: buffer, PC, Index Resigter, Comparison Register, AR, PR, MRA and Start of PA.

2. Computer Engineering

2.1 WWI System Operation (N.L.Daggett)

The WWI system has been plagued by a particularly high number of installation troubles during the past two weeks. In an attempt to reduce some of this, a tighter inspection system for power-wiring changes has been set up. A number of these changes have been made to provide for the spare ES digits, work for which should be completed within a few weeks.

2.11 Electrostatic Storage (A.J.Roberts, D.M.Fisher)

Since the replacement of the ESD output panels, storage reliability has become excellent. Both banks have wide operating margins which remain fairly constant. A circuit has been added for performing a second "ES read" when a parity alarm occurs. If the second read is successful computer operation is not interrupted. The use of this circuit has considerably reduced the down time due to transient errors. As new tubes become available those tubes which switch positive consistently will be replaced. Very few positive swtichings have occurred in the newer-type tubes.

(L.L.Holmes)

Progress has been made in converting rack EX5 into an ES digit. At the conclusion of the next installation day all ES control panels of this rack will be relocated. The newly required power wiring will also start at this time.

2.12 Auxiliary-Drum System (K.E.McVicar, H.L.Ziegler)

Most of the work presently being done on the auxiliary-drum system is concerned with routine maintenance and checking. A set of switches has been installed which will give an indication in test control whenever any of the connections between the drum and the computer have been broken for test purposes. This light is marked "Drum Maintenance Switches On" and is located in TC-3 in the test control room.

We seem to be having some trouble with writing between the slots on the drum surface. This is partially due to the fact that all the voltages are dropped at once when the computer is turned off or switched to standby. Filter condensers in the plate supply lines are not completely discharged by the time the bias disappears unless the positive voltages are removed first. Some planning is now being done on a system to provide a more satisfactory timing for the voltage drop-outs.

Occasional writing between the slots as mentioned above does not affect reliability of the drum system. However, there is a cumulative effect which can cause occasional marginal operation. The accumulation of these spuriously written signals can be satisfactorily controlled, pending installation of the new system for turning power off, by regular erasing of the drum surface. It is for this reason that we are currently renewing our efforts on a system which can quickly and easily erase the entire drum surface. The system previously used has been marginal in operation and frequently left a bias on the tracks. These bugs are now being ironed out.

Work on the drum monitor system is progressing satisfactorily. The necessary ERA-type chassis have been received from the shop and are now in the process of being wired.

(P.W.Stephan)

A new program (2658) for testing the auxiliary drum for reliability has been completed. It is now used by all groups as the standard auxiliary-drum test tape. Both this and other tapes were modified to work with the new placement of flip-flop registers.

A quite intermittent error shown up by the fast marginal-checking program has yet to be located.

Group 11 is now locked in read, and programmers are advised not to use Group 10 since it is no longer considered reliable and is not checked by the new test tape.

2.13 System Logic (J.H.Hughes)

IMPORTANT NOTE for users of computer. There is no longer a FF Storage Reset after read-in as there was when the read-in program was in Test Storage. The order si 10 now calls for an unconditional reset of all FF Storage Registers.

2.14 Marginal-Checking System, Mod. II (J.H.Hughes)

The new Automatic Pot. Control Panel has been operating satisfactorily on bench test. A dust cover is being built for it.

2.15 Marginal Checking (T. Leary)

Checking of the auxiliary-drum system is expected to be worked into our daily marginal-checking routine during the next biweekly period.

Several of our test programs are once again being modified because of the new locations of the flip-flop registers in the new input program.

2.16 Flexowriter

During the past two weeks, an investigation was made to determine the cause of intermittent failures of our FL punch and translator clutches to disengage at the end of each cycle. It is believed that the trouble was due to wear in the clutch armature stops. When the tops of the stops were rounded off to their original shape, the trouble disappeared entirely.

2.2 Terminal Equipment (J.A.O'Brien)

The installation of the new in-out equipment is nearing completion. All of the computer components are now installed, i.e., In-Out Switch, insertion registers, activate registers, indicator-light registers,and the various drivers, gates, gate generators, cathode followers, etc. All of these except the activate registers have been operated with the computer.

2.21 New In-Out System (R.H.Gould)

An addition to In-Out Control has been made to provide a Flip-Flop Storage Reset on time pulse 1 of si 0010 (0).

A new film for the Fairchild Display Scope Camera has been tested. It gives much better contrast than the presently used film but is also much less sensitive Another type of film that may be even better will be tested in the near future.

2.22 Numerical Display System (F.E.Irish)

The location of the seven-digit code used for selecting the character to be displayed by the numerical display system has been temporarily shifted from digits 0 through 6 to digits 1 through 7 of the IOR.

2.23 Magnetic-Tape System (E.P.Farnsworth)

No troubles have been encountered with the magnetic-tape system during this period. The shipment of high-output green magnetic tape which was defective has been returned to 3M for replacement.

2.24 Magnetic-Tape Print-Out (E.P.Farnsworth)

An FL Flexowriter has been connected to magnetic-tape units 3A and 3B for computer use as the new control circuits are now operating satisfactorily. A switch has been provided on TC17 to permit use of either the new delayed print-out Flexo code positions (digits 0-5, same as direct print-out, plus digits 6 and 7 to punch seventh hole and select the delayed punch, respectively) or the old location (digits 2-7) with manually selected punch or punch and print only. The timing discrepancy which has been causing intermittent printing errors in the FL delayed output equipment was traced to malfunction of the printer translator clutch. Increase in printing speed from six to ten characters per second and punching to 15 lines per second was achieved by circuit changes to reduce relay drop-out times and by modifying the interlocking logic to reduce delays.

2.25 Magnetic-Tape Mechanisms (E.P.Farnsworth)

Two visits were made to Raytheon in Waltham to observe production-line adjustments and timing of one of our capstan units which had deteriorated to 12-msec starting time. We obtained useful information on the procedure, gap tolerances, clearances, etc. used in adjusting these units. Search for an explanation of the dissimilarity between our over-all tape-unit start and stop times and Raytheon's measurements on the same capstan revealed the lack of any mechanical loading in Raytheon's timing jig to simulate the drag of the tape, reels, idlers, etc. in the complete mechanism. The addition of a 2-mil shim was found necessary to obtain the proper magnetic-path air gaps. After adjustment, we measured at the almost optimum 7-msec start time. Study of this unit is continuing to determine any additional factors affecting its performance.

2.3 Records of Operation (F.J.Eramo)

The following is an estimate by the computer operators of usable percentage of assigned operation time and the number of computer errors for the period May 22 - June 4, 1953:

Number of assigned hours	104
Usable percentage of assigned time	78
Usable percentage of assigned time since March, 1951	85
Number of transient errors	65
Number of steady-state errors	11
Number of intermittent errors	2

3. LIBRARY ACCESSIONS LISTS

The following material has been received in the Library, W2-325.

Laboratory Files

No.	Title	No. of Pages	Date	Author
E-541	Transistor Collector Characteristic Curve Plotter	8	11-28-52	I. Aronson et al.
E-543	Final Specifications of the High-Speed Flip-Flop	6	5-12-53	H. Boyd
E-558	556 Drum Input Program, May, 1953	3	5-26-53	F.C.Helwig
M-1985	Operation of Indicator Lights and Intervention Registers	11	5-1-53	B. Morriss et al.
M-1987	First Note on Pulse Transformers for Memory Drives	4	5-27-53	(F. Durgin (E. Gates
M-2111	Proposed WWII Indexing System	4	4-24-53	S.L.Thompson
M-2114	Program Counter and Address Register	1	4-27-53	"
M-2121	Memory Address Register and Memory Buffer Register	1	4-27-53	(R. Mayer (W. Papian
M-2158	B.C.-Contacts (Single Pulse Synchronizer)	1	5-8-53	C. Laspina
M-2159	Calculation of Spontaneous Magnetization in the Region of the Curie Temperature	10	5-8-53	(A. Loeb (N. Menyuk
M-2160	Energy Dissipation in Square Loop Ferromagnetic Materials with Specific Applications to Switch Cores	7	5-12-53	N. Menyuk
M-2161	Specifications on Improved Decoder Output Amplifier	1	5-8-53	H. Zieman
M-2163	Pulse Delay Unit No. 7	2	5-8-53	J. Woolf
M-2176	Proposal for Expediting Procurement and Construction of Prototype Models-TS	3	5-19-53	A. Kromer
M-2178	Reorganization of S&EC Group Biweekly	2	5-20-53	J. Porter
M-2179	An Investigation of Coordinate Conversion in a Multiplexed System	4	5-20-53	J. Dintenfass
M-2181	Model Shop Facilities	2	5-20-53	H. Wainright
M-2189	Vacuum Tube Failures for the Month of April	7	5-6-53	(H.B.Frost (A. Parisi
M-2190	Character Generator No. 30	1	5-25-53	J. Woolf
M-2191	Meeting on Packaging of WWII, Hartford,Conn.	3	5-27-53	A. Ayer
M-2194	Pulse Standardizer No. 6	1	5-26-53	J. Woolf
M-2196	General Description of Decoder	1	5-27-53	R. Best
M-2198	WWI Service File	1	5-28-53	D. Morrison
M-2200	Flexowriter Equipment Reallocation	2	5-27-53	M. Demurjian et al.
M-2201	Meeting on WWII Tubes, May 22, 1953	3	5-29-53	R. Fallows

Library Files

No.	Identifying Information	Source
2372	Some Properties of Signal Flow Graphs	R.L.E.
2373	A Generalization of the Kronecker-Capelli Theorem on a System of Linear Equations	N.B.S.
2374	A Numerical Solution of Schrodinger's Equation in the Continuum	N.B.S.

No.	Identifying Information	Source
2375	The Measurement of Frequency Modulations in Pulsed Magnetrons with a Microwave Interferometer	Lincoln Laboratory
2378	A Generalization of the Theory of the Purely Discontinuous Stochastic Process of W. Feller	C. R. A. S.
2379	Partial Differential and Difference Equations	N.B.S.
2380	Chopper-Stabilized Amplifiers for General Instrumentation	Jet Propulsion Lab.
2381	Polaresistivity and Polaresistors	Proc. IRE, 5-52
2383	An RF Readout System for a Coincident-Current Magnetic Core Memory, M.S.Thesis	B. Widrowitz
2384	Magnetic Amplifiers with High Carrier Frequency, M.S.Thesis	A. Pugh
2385	Analytical Differentiation on a Digital Computer, M.S.Thesis	J. Nolan
2386	A Synchronized Direct Reading Pulsed Voltmeter, M.S.Thesis	A. Roberts
2387	The Manchester Electronic Computer	ONR/London
2388	Interference Factors for Slender Finned Bodies	NAVORD Report
2389	Determination of an Optimal Lens System	ONR/Harvard
2392	Magnetic-Core Pulse Amplifiers for Digital Computer Applications, M.S.Thesis	H.K.Rising
2393	Test Checking of a Magnetic-Drum Buffer-Storage System, M.S.Thesis	A. A. Zraket

The following material has been received by the S&EC Group Library, Barta 109.

No.	Identifying Information	Source
C-39	Lagrangian Interpolation by Clarence Ross WADC Tech. Report 52-133 Sept '52 (Wh.Lib.#2363)	Wright Air Development Center
C-40	An Outline of a Theory of Semantic Information by Rudolf Carnap Tech. Report No. 247 Oct. 27, 1952 (Wh. Lib #2369)	Research Lab. of Electronics MIT
D-23	An Experimental Rapid Access Memory Using Diodes and Capacitors by A.W.Holt (Wh.Lib. #2367)	N.B.S.
JMP-	Journal of Math and Physics April '53	M.I.T.
C-38	Large Primes by J.C.P.Miller	Reprinted from Eureka Oct '5 Nature Nov.'5

4. PERSONNEL

Staff Terminations

A.J.Cann
A. Katz

(J.C.Proctor)

New Non-Staff

Andrew Bowen is an MIT student who has returned for the summer to work for Mercer.

Claire Coates is a new messenger girl for the summer only.

David Goldman is an MIT student who will work for the summer in Group 60 for Sutro.

Herbert Goldstein is a new laboratory assistant in the Inspection Department.

Russell Kraynick is the Laboratory's new truck driver.

Lois Rutland is a secretary who has joined the Purchasing Department.

Leroy Silva is a summer student in Group 63.

Mary Sexton is a new Librarian.

Richard Thompson is an MIT student working for the summer for Jacobs in Group 62.

Barbara Zalon is a former MIT secretary who will be working in the Production Control Department for the summer.

Non-Staff Terminations

Donald Baumgartner
Reynald Boisvert
Joyce Bowers
Raymond Bradley
Vincent Early
Robert Fleak
Richard Markham
Edward McCluskey
William McEachern
Roger Prager
Anne Sparling
Arvid Strom

(R. A. Osborne)