Computers as Aids to Linguistic Studies

Kathy J. Scheiern

Western Michigan University, kathy.scheiern@gmail.com

Follow this and additional works at: http://scholarworks.wmich.edu/honors_theses

Recommended Citation

http://scholarworks.wmich.edu/honors_theses/2145

This Honors Thesis-Open Access is brought to you for free and open access by the Lee Honors College at ScholarWorks at WMU. It has been accepted for inclusion in Honors Theses by an authorized administrator of ScholarWorks at WMU. For more information, please contact maira.bundza@wmich.edu.
SENIOR HONORS PROJECT:
"Computers As Aids To Linguistic Studies"

by

Kathy J. Scheiern

FEBRUARY 15, 1977
The main bulk of my senior honors project consists of a computer program. Therefore, I will attempt, in this paper, to give a brief general description of this program in regards to its development, its uses, and its possible classroom applications.

Development

This program was begun in May of this year as a student assistantship under the direction of Mr. Robert Dloughy of the Linguistics department. Our original goal was to develop a computer program which generated models of linguistic environments in the form of "words" that contained minimal pair contrasts and allowed for the occurrence of allophones.

After doing considerable library research, I found that very little, if anything, was being done in this area. Computerized linguistics has focused on two main areas:

1) Machine translation of natural languages, i.e. computers as language processors, and

2) Computation of occurrence rates and probabilities for certain types of words in specific types of literature, e.g. X number of adjectives occur in War and Peace in comparison to a probability of Y number of adjectives in Gone With The Wind.

The term "words" will be used in the following sense throughout this paper— as individual units consisting of letters arranged in specific manners and not necessarily having meaning in any natural language.

For definitions of linguistic terms, see Appendix A.
To demonstrate the current trends in computerized linguistics, the following passage was adapted from Harold Borko's *Automated Language Processing* (John Wiley and Sons, Inc., New York, 1967):

Computers were originally developed for processing numerical data. As these systems were put into wider service, their capabilities were expanded and within two decades, their arithmetic abilities were overshadowed by the implications of their abilities to read, execute and even modify instructions. These instructions involve functions that include conjunction, selection, merging, collating, conditionality, sorting, etc., so that they are not computers so much as they are symbol manipulators and, therefore, potential language processors.

Conventional digital computers main limitation in regards to language processing is their exceedingly high needs regarding the specificity of both the algorithms that they can accept for execution and their data, which makes them not primarily suitable as organs for incremental data assimilation through adaptively growing and incrementally modifiable algorithms and machines.

While the above constitutes a fascinating area of study, it was not applicable to what we were attempting to do. I did find a thesis concerning the construction of a "random word generator for pronounceable passwords" for use in computer user identification. However, this thesis, and the related computer program that it contained, were beyond my range of knowledge in this area. Several more years of study on my part would have been necessary to make effective use of its contents.

Therefore, I found myself left, more or less, to my own devices. Within two months, the basic program was operational. This first program generated words according to specific instructions given it by the user. However, the words generated contained no minimal pair contrasts and made no allowances for the occurrence of allophones.

At this point, the complexity of the situation became evident in the probability factors involved and it was necessary to limit the amount and type of data which the program would accommodate. Even after

---

3See Appendix B for rules and procedures governing data input.
these restrictions, the addition of minimal pair contrasts to the basic program involved the expansion of the program to include 33 subroutines, each approximately 18 lines in length (see program—subroutines CMPR1 to CMPR33.)

The problem of making allowances for the occurrence of allophones was the only matter remaining, but this, for a time, proved to be exceedingly difficult. After some time, I devised a method by which this final requirement could be added to the already existing program. However, this involved the expansion of the program once again, this time to include another 30 subroutines, ranging in length from 12 to 21 lines (see program—subroutines ALNV1 to ALNV30.)

Needless to say, there were a variety of difficulties encountered throughout. For the occasional programming problem, I consulted Dr. Alden Wright of the Mathematics department. Other times, I consulted Mr. Robert Dloughy. Numerous requests for additional computer time have been necessary and once a request for additional blocks (storage space in the computer) was necessary.

All in all, this has been a very time-consuming project (for the computer as well as for the humans involved), but, at the same time, it has been a most rewarding experience.

Uses

The function of this program is, as previously stated, to generate models of linguistic environments that contain minimal pair contrasts and allow for the occurrence of allophones.

This program was designed for use as a teaching aid in the Linguistics 100 course offered here at Western Michigan University.
It serves to aid the instructor in the following basic ways:

1) To give the students practice in recognizing minimal pair contrasts, and thus to facilitate their understanding of this area.

2) To allow the students to view the occurrence of allophones in specific environments, and thus to aid them in their attempts to grasp this particular linguistic concept.

3) To accustom the students to the validity of words in other than recognizable constructions, i.e. to aid the students in grasping the linguistic use of the term "words."

4) To increase the students' knowledge of computers and to expose them to the broader concept of language as it applies to machine and programming languages as well as to the natural languages (with which the students are already familiar).

5) To ease the burden on the instructor to create such examples as those generated by this program, so that he is free to concentrate more of his time and efforts on the explanation of the ideas involved, rather than on the mechanical generation of examples.

Thus, while its functions are very basic in nature, they provide the foundation for further investigation into this very fascinating area of research.

Applications

There are two main applications of this program to the classroom situation, both of which contain certain faults.

---

No attempts to instruct the students in a computer language will be made as the purpose here is only to increase the students' contact and familiarity with the concept of the existence of languages in this broader sense.
First, the simpler method involves the use of this program by the instructor only. He could run the program several times and use the words generated as examples in a classroom situation; or, he could devise a specific set of data and then obtain n number of identical print-outs to be distributed among the students as models, classroom exercises, homework assignments, etc.

The disadvantage of this method is that the student has no actual contact with the computer. While this is not mandatory, it could be helpful to the student in that it involves his direct participation and, therefore, hopefully, would increase his comprehension and retention of the material.

The second method involves the use of the program by the students (under the instructor’s direction.) In this method, each student would be issued a computer number and password and between $60 and $75 worth of computer time (enough for 4-6 runs of the program.) By means of a few fairly simple commands, the program could be copied into the student’s file, run and then cleared from his file as he logs off the computer.5 The data specifications could be set by the instructor, or left to the design of the student, depending upon the desires of the instructor. Executions of the program, with suitable student identification of minimal pairs and allophones, could be submitted as homework assignments, extra credit options, etc.

The disadvantage of this method is that it is more time consuming for the student and the instructor and it involves an increase in the already large number of people using the computer.

5See Appendix B—Copying Commands.
The method of application employed would be left to the individual instructor, who could then choose either method or use a combination of the two. As already explained, each individual method can also be applied in several ways, allowing for a fairly high degree of flexibility in application, so as to better suit the needs of the instructor.

In closing, I would like to state that I feel that this program could be used to advantage in the Linguistics 100 course offered here at Western. I hope that some instructor will at least attempt to do so on an experimental basis, for I would like to see the practical results of my work. Thank you.
APPENDIX A

The following are definitions of some basic linguistic terms used in this paper. These definitions are designed to equip the layman with a working knowledge of these terms as they are used in this paper. They are not to be taken as the actual technical linguistic definitions.

ALLOPHONE: Any of the variant forms of a phoneme; for example, the p of nip and the p of spin are allophones of the English phoneme p.

MINIMAL PAIR: An example of a phonemic contrast in a language that provides evidence of phonemic difference in that language; for example, p and b are contrasted in the words pat and bat. This provides evidence for the assumption that p and b are different phonemes in English.

NATURAL LANGUAGE: Language that is used as a means of communication between two or more people (or to oneself) as contrasted with MECHANICAL or PROGRAMMING LANGUAGES, which are used to communicate with machines and are artificially derived.

PHONEME: A member of the set of the smallest units of speech that serve to distinguish one utterance from another in a language or dialect; for example, the p of the English pin and the g of the English gin are different phonemes.

WORD: An individual unit consisting of letters arranged in a specified manner (or in specified manners) and not necessarily having meaning in any natural or mechanical language; for example, degpo, tirku, mypli and twkgu are words which have no recognizable meaning in any language.
APPENDIX B

Getting On The Computer

In the following discussion, all characters printed by the computer will be underlined. Follow these steps to get on the computer:

1) Turn the teletype on by turning the knob on the lower right side of the terminal to the ON or LINE position. If your teletype has a separate acoustic coupler, you may also have to turn this on.

2) a) If your teletype is located other than in the main computer center teletype room in Rood Hall, contact with the computer facility must be made by phone. There will then be a phone near your teletype. Pick up the receiver, dial 3-6250, and wait for a high pitched tone. If the telephone has a data button on the top, pull this up and hook the receiver on the side of the phone. If there is an acoustic coupler, place the receiver on the coupler. If all the phone lines into the computer are in use, the response will be a busy signal. Wait and dial again later.

   b) If you are in the main computer center in Rood Hall, type CTRL-C (hold down the CTRL key and depress the letter C.)

3) The computer now prints

   PLEASE LOGIN OR ATTACH

After the computer's period, you type the word LOGIN and then push the RETURN key. The computer will then type

#

Then you type in your project-programmer number as follows

#xxxxx,xxxxx
and then push the RETURN key. The computer will then type something like:

    JOB 18 W.M.U. LEVEL-D TTY75

    PASSWORD:

Then you type in your password and push RETURN. (Your password will not
be printed on the paper for security reasons.)

If you have made no errors, the computer will respond with your
quota, balance, the time, date, teletype number, the message of the day
and a period.

If you did make an error, the computer will print

    INVALID ENTRY--TRY AGAIN

    #

Then you start over by reentering your number. If you fail to log on
to the computer correctly after a minute or so, the terminal will freeze
up. Then you must type CTRL-C and start from the very beginning by
typing LOGIN after the computer's period.

If you make a typing error and have not yet pushed the RETURN key
for that line, you can do the following:

Push the RUBOUT or DELETE key. This deletes the last character
typed. To delete several characters, press this key once for each
character to be deleted.

Example: If you typed _LAGIN and had not yet pushed the RETURN
key, you could press the RUBOUT key four times. The result would look
like this _LAGIN/N/1/G/A (Underlined area is what the computer types.)
At this point, the only thing which the computer sees is _L
Now you may type in the word correctly. It would appear like this on
your paper _LAGIN/N/1/G/AOGIN, but like this in the computer _LOGIN.
If your connection with the computer is broken and it will no longer accept information that you type in through the teletype, hang up the phone and dial again. When you hear the high pitched tone, pull up the data button on the phone and wait.

If you're not on a telephone hook-up, type CTRL-C. In either case, the computer will respond with

**PLEASE LOGIN OR ATTACH**

Now refer back to your original LOGIN at the top of your paper and find your job number. In the earlier example JOB 18 W.M.U. LEVEL-D, the job number is 18. Now, after the computer's period, you type

```
^ATTACH 18[xxxxx,xxxxx] where 18 is your job number and xxxxx,xxxxx is your project-programmer number. Use square brackets to enclose your project-programmer number. The character [ is a SHIFT K and ] is a SHIFT M (like typing capital K and M on a regular typewriter.)
```

**Copying And Running The Program**

Now that you have logged on the computer, you will need to copy the necessary program into your own file. To do this, use the following command after a period

```
^COPY LING.F4 40430,40431
```

The computer will type another period, after which, you will type

```
^EXECUTE LING.F4
```

At this point you will have to wait several minutes for the program to compile.

**Data Specifications**

After the program has finished compiling, the computer will go on to print

```
INPUT FORMAT SPECIFICATIONS:

NO. OF CONSONANTS?
```
and then it will stop. Here, you will type a number from 1 to 9 (or one which your instructor has previously specified), depending upon how many consonants you want to use. After typing in the number you choose, push the RETURN key. The computer will then type

**NO. OF VOWELS?**

after which it will again stop. Follow the same procedure as for the number of consonants. **NOTE:** The number of consonants and the number of vowels which you choose should be equal. Otherwise, blanks will result in your answers.

The computer will now type

**NO. OF ALLOPHONES DESIRED?**

Here, you will type a number from 1 to 10 (or one given you by your instructor.) This number will indicate to the computer the number of allophones which you desire to use. Push RETURN.

The computer will now type

**NO. OF VOWEL CONTRASTS DESIRED?**

You will type a number from 1 to 5 (or one specified by your instructor), depending upon how many pairs of vowels you wish to contrast. Push RETURN.

The computer will go on to type

**NO. OF CONSONANT CONTRASTS DESIRED?**

You will follow the same procedure as for the number of vowel contrasts. **NOTE:** The number of vowel contrasts should equal the number of consonant contrasts. Otherwise, blanks will result in your answers.

The computer will go on to type

**VOWELS?**

Here, you will type in the vowels that you want to use. Type them in one at a time and after each one, push RETURN. Remember that you must type in the same number of vowels here that you specified earlier.
The computer will now type

**CONSONANTS?**

You will follow the same procedure as for typing in the vowels that you want to use. Always remember to input the same number of consonants that you specified earlier. Don’t forget to push RETURN after each one.

The computer will type

**ALLOPHONES/ENVIRONMENTS?**

Here, you must input the information according to the following rules: First, type in your initial allophone. Right next to that (don’t space), type in the allophone to which the first one you typed in is going to be changed—so, if you want K to change to C in certain instances, type KC. Now space once. Here, you will type in the letter which, if it occurs in front of your first allophone, will cause your first allophone to change to your second allophone. Then, without spacing, type in the letter which, if it occurs after your first allophone, will cause your first allophone to change to your second allophone. Now push RETURN. Your data entry should look like this XY WZ and then a RETURN. This means that X will change to Y if it occurs after W, and X will change to Y if it occurs before Z. Continue this procedure until you have typed in the same number of these allophone sets as the number of allophones which you specified earlier. If, for any reason, you do not want to specify an initial environment (a letter in the W position) or a final environment (a letter in the Z position), simply type in a letter in this position which you have not yet used in the program.

The computer will now type

**VOWEL CONTRASTS?**

Here, you will type in the vowels that you want to contrast. Type them in pairs and after each pair, push RETURN. Remember to input the same
number of vowel contrasts as you specified earlier in the program under NO. OF VOWEL CONTRASTS DESIRED?

The computer will go on to type

CONSONANT CONTRASTS?

You will follow the same procedure as for typing in the vowel contrasts.

The computer will now type

HOW MANY SYLLABLES IN EACH WORD?

Here, you will type a number—either 1 or 2, depending upon whether you want one or two syllables in each word (and depending upon the specifications of your instructor.) Push RETURN.

The computer will type

SYLLABLE FORM? (USE: C AND V)

and then stop. Here, you will type in either 1 or 2 syllables, depending upon how many you specified earlier. You have four choices: CVC, CV, VC, and V. C's stand for consonants and V's for vowels. The computer reads these in sections of three. Therefore, if you choose V and CVC, you must type it in like this: V CVC (There are two spaces between V and CVC.) If you desire VC and V, you must type VC V. (There is one space between VC and V.) Never space before your first syllable and always start your second syllable three spaces from the beginning of your first syllable. Choosing CVC and CV, you would type CVCCV because the syllable CVC uses up all three spaces in front of CV. Push RETURN.

Now the computer will type

FOR ___, IF DESIRE __________ CONTRAST, TYPE -1

IF __ CONT. 0

IF __________ CONT. 1

The blanks will be filled with—first, a syllable form that you chose,
then with different types of contrasts, such as final consonant contrasts, initial vowel contrasts, etc. The abbreviations are as follows: cons. for consonant, vow. for vowel, and cont. for contrast. You will type -1, 0, or 1 depending upon which type of contrast you want. Then push RETURN. The computer will then proceed to type a list of syllables in the form which you specified earlier. If you specified a second syllable form, this procedure will be repeated for that one.

Now the computer will type

WHAT SYLLABLES FOR WORDS?

Here, you will type in the syllables you want to form your words. These should be typed in the same manner as those which you typed after SYLLABLE FORM? (USE: C AND V). It is recommended that you use the same syllables for both of these, so as to have a better basis for comparison when analyzing your final data. Push RETURN.

The computer will go on to type

FOR INITIAL CONTRAST, TYPE -1/ FOR 2ND POSITION 0
FOR FINAL POS. 1

You will type in your preference here (or the number supplied by your instructor.) This provides for a minimal pair contrast somewhere within the final list of words which you will obtain. Push RETURN.

Now the computer prints your final list of words, which contains all the information which you have previously specified. This list contains a least one minimal pair contrast and all the allophones which you have provided for. After the computer prints this list of words, it types CARE TO GO AGAIN? If you type YES, it will start all over again with the statement INPUT FORMAT SPECIFICATIONS, etc.
If you type NO, it will type an exit message and then give you a period. To log off the computer type KJOB after the computer's period. The computer will respond with

CONFIRM:

You will then type K and that is the end. The computer will now print a message that lists your job and project-programmer number, the date, the number of files you used, the runtime of your program, your connect time (how long you were on the computer), and, finally, the approximate cost of the run. Be sure to turn the teletype off before you leave (turn the knob from ON or LINE to OFF.)

NOTE: Appendix B is designed for use as an explanation to the student of how to log on the computer, execute the program, and log off again. It can be separated from this paper and reproduced as is to make any time consuming, detailed explanations by the instructor unnecessary.
WRITE (5,2)
   FORMAT(1X,2B1)
WRITE (9,3)
   FORMAT (1H0/1X,18HND. OF CONSONANTS?)
READ (5,33)NCON

WRITE (5,4)
   FORMAT (1H0/1X,14HND. OF VOWELS?)
READ (5,1)NVOK

WRITE (5,9188)
   FORMAT (1H0/1X,26HND. OF ALLOPHONES DESIRED?)
READ (5,9188)HALF

WRITE (5,5)
   FORMAT (1H0/1X,3HND. OF VOKEL CONTRASTS DESIRED?)
READ (5,44)NVOKCD

WRITE (5,6)
   FORMAT (1H0/1X,35HND. OF CONSONANT CONTRASTS DESIRED?)
READ (5,55)NCNCONI

WRITE (5,888)
   FORMAT (1X,7HVOKELS?)
READ(5,888)(A(I),I=1,NVOK)

DO 43119 NUCNG=1,NVOK
   CONTINUE

WRITE (5,889)
   FORMAT (1X,11HCONSONANTS?)
READ (5,211)(B(J),J=1,NCON)

11 FORMAT (A8)

DO 43118 NUCNG1=1,NCON
   D(NUCNG1)=B(NUCNG1)
   CONTINUE

WRITE (5,9189)
   FORMAT (1X,24HALLOPHONES/ENVIRONMENTS?)
   DO 91998 J21=1,NALF
      READ(5,91981)(ALF(J21,J28),J28=1,2), (ALF(EV(J21,J27),J27=1,2)
91991 FORMAT(2A1,1X,2A1)
WRITE(5,891)
FORMAT(1X,16HVOWEL CONTRASTS?)
DO 222 I=1,NVOWCO
READ (5,12)(A1(I1,K1),K1=1,2)
12 FORMAT(2A1)
222 CONTINUE

DO 4317 NUCNG2#1,NVOWCO
DO 4317 NMLPER#1,2
A2(NUCNG2,NMLPER)#1(NUCNG2,NMLPER)
4317 CONTINUE

WRITE(5,892)
FORMAT(1X,20HCONSONANT CONTRASTS?)
DO 223 J=1,NCONCO
READ(3,13)(S1(J2,K2),K2=1,2)
13 FORMAT(2A1)
223 CONTINUE

DO 4318 NUCNG3#1,NCONCO
DO 4318 NMLPR1#1,2
B2(NUCNG3,NMLPR1)#1(B1(NUCNG2,NMLPER))
4318 CONTINUE

WRITE(5,102)
FORMAT(1H6/1X,32HMANY SYLLABLES IN EACH WORD?)
READ (5,103) NSYL
103 FORMAT(11)

WRITE (5,104)
FORMAT (11H8/1X,31MSYLLABLE FORM? (USE: C AND V)?)
READ (5,105)(ASV(1,M),M#1,NSYL)
105 FORMAT(2A3)

2222 DO 229 M95#1,NSYL
IF (ASV(1,M95),EQ,2HCV) GO TO 100
IF (ASV(1,M95),EQ,2HVC) GO TO 200
IF (ASV(1,M95),EQ,3HCV) GO TO 10300
IF (ASV(1,M95),EQ,1HV) GO TO 700
GO TO 3233
100 WRITE(5,16)
16 FORMAT(1H8/1X,41HFOR CV, IF DESIRE CONS. CONTRAST, TYPE -1/1
11X,12HIF VOW, CONT. 9/1X,12HIF NEITHER 1)
READ (9,17) NANS
17 FORMAT(12)
IF(NANS)10,20,30

200 WRITE(5,18)
18 FORMAT(1H8/1X,41HFOR VC, IF DESIRE CONS. CONTRAST, TYPE -1/1
11X,12HIF VOW, CONT. 9/1X,12HIF NEITHER 1)
READ (9,19)NANS1
19 FORMAT(12)
IF(NANS1)40,50,60
300  WRITE(5,21)
21  FORMAT(148/1X,48HFOR CVC, IF DESIRE FINAL CONS., CONTRAST,
2   1 TYPE =1/1X,13HIF VON, CONT, 0/1X,24HIF INITIAL CONS. CONT. 1)
302  IF(NANS2)70,92,92
10  DO 1000 M#1,NVONCO
DO 1000 M#1,2
DO 1000 M#1,NVOK
CALL SWITCH(NVON,NVONCO,A,B,C,D,A1,A2,B1,B2)
CALL ALNV5(N1,ALF,ALFEV,M1,N1,B1,A,MH1)
WRITE(5,34)B1(M,N),A1(M,N)
34  FORMAT(1X,2A1)
4000 CONTINUE
GO TO 229
20  DO 1101 M#1,NVONCO
DO 1101 M#1,2
DO 1101 M#1,NVON
CALL SWITCH(NVON,NVONCO,A,B,C,D,A1,A2,B1,B2)
CALL ALNV2(NALF,ALF,ALFEV,M1,N1,B1,A,MH2)
WRITE(5,35)B1(MH2),A1(M,N)
35  FORMAT(1X,2A1)
1101 CONTINUE
GO TO 229
30  DO 1102 M#1,NVONCO
DO 1102 M#1,2
DO 1102 M#1,NVON
CALL SWITCH(NVON,NVONCO,A,B,C,D,A1,A2,B1,B2)
CALL ALNV3(NALF,ALF,ALFEV,M1,B)
WRITE(5,36)B(M1),A(M)
36  FORMAT(1X,2A1)
1102 CONTINUE
GO TO 229
40  DO 1002 M#1,NVONCO
DO 1002 M#1,2
DO 1002 M#1,NVON
CALL SWITCH(NVON,NVONCO,A,B,C,D,A1,A2,B1,B2)
CALL ALNV4(NALF,ALF,ALFEV,M1,N1,MH3,A,B1)
WRITE(5,37)A(MH3),B1(M1,N1)
37  FORMAT(1X,2A1)
1002 CONTINUE
GO TO 229
50  DO 1202 M#1,NVONCO
DO 1202 M#1,2
DO 1202 M#1,NVON
CALL SWITCH(NVON,NVONCO,A,B,C,D,A1,A2,B1,B2)
CALL ALNV5(NALF,ALF,ALFEV,M1,N1,MH4,A1,B)
WRITE(5,38)A(M1,N1,B(MH4))
38  FORMAT(1X,2A1)
1202 CONTINUE
GO TO 229
60  DO 1303 M#1,NVON
CALL SWITCH(NVON,NVONCO,A,B,C,D,A1,A2,B1,B2)
CALL ALNF (HALF, ALF, ALFEL, M1, A, B)
WRITE (9, 39) A(M1), B(M1)
FORMAT (1X, 2A1)
CONTINUE
GO TO 229

70 DO 1064 N2 = 1, NCONDO
DO 1064 N2 = 1, 2
DO 1064 M = 1, NVON
CALL SWITCH (NVOM, NVONCO, A, B, M, A1, A2, B1, B2)
CALL ALNF (HALF, ALF, ALFEL, M, M2, M3, B, A, B1)
WRITE (9, 41) B(M1), A(M1), B2(M1), M2(M1)
FORMAT (1X, 2A1)
CONTINUE
GO TO 229

80 DO 1065 M = 1, NCONCO
DO 1065 M = 1, 2
DO 1065 M = N6, 1, NCON
M = M + 1
CALL SWITCH (NVOM, NVONCO, A, B, M, A1, A2, B1, B2)
CALL ALNF (HALF, ALF, ALFEL, M, M2, M3, B, A, B1)
WRITE (9, 42) B(M6), A(M2), B(M1), M(M6)
FORMAT (1X, 3A1)
CONTINUE
GO TO 229

90 DO 1066 M = 1, NCONCO
DO 1066 M = 1, 2
DO 1066 M = 1, NCON
CALL SWITCH (NVOM, NVONCO, A, B, M, A1, A2, B1, B2)
CALL ALNF (HALF, ALF, ALFEL, M, M2, M3, B, A, B1)
WRITE (9, 43) B(M6), A(M2), B(M1), M(M6)
FORMAT (1X, 3A1)
CONTINUE
GO TO 229

702 DO 1014 M = 1, NVONCO
DO 1014 M = 1, 2
WRITE (9, 56) A(M6), M6
FORMAT (1X, 1A)
CONTINUE
GO TO 229

56 WRITE (9, 56)
FORMAT (1X, 2A1)
CALL SYLFM, SYLFM2
READ (9, 56) SYLFM1, SYLFM2
FORMAT (1A)
WRITE (9, 1928)
FORMAT (1H0/1X, 2HFOR INITIAL CONTRAST, TYPE = 1/1X,
11HFOR 2ND POSITION 2/1X, 15HFOR FINAL POS. 1)
READ (9, 1965) NVF5
FORMAT (12)
IF (SYLFM1, EU, 2HCV) GO TO 110
IF (SYLFM1, EU, 2HNC) GO TO 120
IF (SYLFM1, EU, 2HNC) GO TO 120
IF(SYLFH.M1,ED,2HVG) GO TO 178
GO TO 4444

110 IF(SYLFH.M2,ED,2HVG) GO TO 23
IF(SYLFH2,ED,2HVC) GO TO 24
IF(SYLFH2,ED,3HVC) GO TO 25
IF(SYLFH2,ED,1HV) GO TO 26
GO TO 4444

120 IF(SYLFH2,ED,2HVC) GO TO 49
IF(SYLFH2,ED,2HVG) GO TO 46
IF(SYLFH2,ED,3HVC) GO TO 47
IF(SYLFH2,ED,1HV) GO TO 48
GO TO 4444

130 IF(SYLFH2,ED,2HVG) GO TO 51
IF(SYLFH2,ED,2HVC) GO TO 52
IF(SYLFH2,ED,3HVC) GO TO 53
IF(SYLFH2,ED,1HV) GO TO 54
GO TO 4444

170 IF(SYLFH2,ED,2HVC) GO TO 48
IF(SYLFH2,ED,2HVG) GO TO 498
IF(SYLFH2,ED,3HVC) GO TO 46
GO TO 4444

23
L#1
DO 3091 M#1, NCOND
DO 3091 MH#1, NV0X
CALL SHTRCH(NV0X,NV0XDD,A,B,C,D,A1,A2,B1,B2)
CALL ALNV1(NHALF,ALF,ALFEB,H#1,B1,A1,MB#1)
CALL ALNV6(NHALF,ALF,ALFEB,H#1,A,B)
WRITE(5,27)H#1,M#1,L#1,A1,MB#1

27
FORMAT(1X,2A1)
CALL ALNV2(NHALF,ALF,ALFEB,H#1,B1,A1,MB#1)
WRITE(5,28)B(MB#1),A1(M#1),L#1

28
FORMAT(1H#2,2H#2)
L#1=1
IF(L#1.GT.2) L#1=1

3091 CONTINUL
GO TO 54

24
IF(NH#1,1941,1951,1961)
1941 CALL QMP8(A,B,A1,B1) GO TO 2442
1951 CALL QMP8(A,B,A1,B1) GO TO 2442
1961 CALL QMP8(A,B,A1,B1) GO TO 2442

2442
L#1=1
M#2
DO 3092 M#2, NCOND
DO 3092 MH#2, NV0X
M#1=1
IF(M#1.GT.5) M#1=1
CALL SHTRCH(NV0X,NV0XDD,A,B,C,D,A1,A2,B1,B2)
CALL ALNV1(ALNF, ALF, ALF, ELEV, M, L, B1, A, MH1)
CALL ALNV2(ALNF, ALF, ALF, ELEV, M, L, A)
WRITE(9, 354) (M(L), A1(L))
FORMAT(1X, 2A1)
LBL=1
IF(L, GT, 2) LBL=1
CALL ALNV4(ALNF, ALF, ALF, ELEV, M, L, A, B1)
WRITE(9, 354) (M(L), A1(M, L))
FORMAT(1X, 2A1)
LBL=1
IF(L, GT, 2) LBL=1
CALL ALNV5(ALNF, ALF, ALF, ELEV, M, L, A, B1)
WRITE(9, 354) (M(L), A1(M, L))
FORMAT(1X, 2A1)
LBL=1
IF(L, GT, 2) LBL=1
CALL ALNV6(ALNF, ALF, ALF, ELEV, M, L, B, A1)
WRITE(9, 463) (N, A, M(H), B(L))
FORMAT(1X, 2A1)
LBL=1
IF(L, GT, 2) LBL=1
CALL MHK13(A, B, A1, B1)
GO TO 2652
LBL=1
DO 3004 M#1, NCONCO
DO 3004 MH12#2, NVOX
CALL SWITCH(NVOK, NVOKO, A, B, C, D, A1, A2, B1, B2)
CALL ALNV2(ALNF, ALF, ALF, ELEV, M, L, A, B1, A1)
WRITE(9, 266) (M(L), A1(M, L), A1(M, L))
FORMAT(1X, 3A1)
LBL=1
IF(L, GT, 2) LBL=1
CONTINUE
GO TO 4444
IF(NANS3, 1943, 1953, 1963)
1943 CALL MHK13(A, B, A1, B1)
GO TO 2652
1953 CALL MHK13(A, B, A1, B1)
GO TO 2652
1963 CALL MHK13(A, B, A1, B1)
GO TO 2652
2652 CALL MHK13(A, B, A1, B1)
GO TO 2652
3004 CONTINUE
GO TO 4954
49 IF(NANS3, 1944, 1954, 1964)
1944 CALL MHK13(A, B, A1, B1)
GO TO 4954
1954 CALL MHK13(A, B, A1, B1)
GO TO 4954

1954 CALL OMHR1B(A,B,A1,B1)
GO TO 4954

4954 L#1
N#2
DO 3009 N#1,NVWDCC
DO 3009 MH12#1,NVDC
N#1=1
IF(N#1.GT.NCON)N#1
CALL SWITCH(NVDC,NVWDCC,A,B,C,D,A1,A2,B1,B2)
CALL ALNV3(NALF,ALF,ALFEV,ML,MH12,A1,B1)
WRITE(3,455)ALF,ALFEVMH12,B1
FORMAT(1X,2A1)
L#1=1
IF(L#1.GT.2)L#1=1
CALL ALNV2(NALF,ALF,ALFEV,ML,B1,A1,N)
WRITE(3,456)BL1,A1,X,L1
FORMAT(1H+,2X,2A1)
3009 CONTINUE
GO TO 4444

46 L#1
DO 3006 N#1,NVWDCC
DO 3006 MH13#1,NVDC
CALL SWITCH(NVDC,NVWDCC,A,B,C,D,A1,A2,B1,B2)
CALL ALNV3(NALF,ALF,ALFEV,ML,MH13,A1,B1)
CALL ALNV4(NALF,ALF,ALFEV,ML,MH13,B1,A1)
WRITE(3,466)ALF,ALFEVMH13,B1(A1,L1)
FORMAT(1X,4A1)
L#1=1
IF(L#1.GT.2)L#1=1
3006 CONTINUE
GO TO 1869

47 IF(NANS31966,1956,1966
1946 CALL OMHR19(A,B,B1)
GO TO 4774

1956 CALL OMHR28(A,B,A1,B1)
GO TO 4774

1966 CALL OMHR21(A,B,A1,B1)
GO TO 4774

4774 L#1
N#2
DO 3007 N#1,NCONDC
DO 3007 MH14#1,NVDC
N#1=1
IF(N#1.GT.NCON)N#1
CALL SWITCH(NVDC,NVWDCC,A,B,C,D,A1,A2,B1,B2)
CALL ALNV4(NALF,ALF,ALFEV,ML,MH14,A1,B1)
CALL ALNV2(NALF,ALF,ALFEV,ML,B1,A1,B1)
WRITE(3,477)ALF,MH14,B1(A1,L1)
3010 CONTINUE
GO TO 4444

530 IF(NANS3)=1949,1959,1969
1969 CALL CMPR28(A,B,A1,B1)
GO TO 5335
1959 CALL CMPR29(A,B,A1,B1)
GO TO 5339
1949 CALL CMPR30(A,B,A1,B1)
GO TO 5339

5335 L=1
N=2
13010 MW=1,NVONCO
13011 MW=161,NCON
CALL SWITCH(MVONCO,A,B,C,D,A1,A2,B1,B2)
CALL ALNV1(NALF,ALF,ALFEV,M,L,B1,A,MM17)
CALL ALNV27(NALF,ALF,ALFEV,M,L,MM16,N,B1)
WRITE(5,5333)B1(M,L),A(N),B(N)

533 FORMAT(1x,3A1)
N=1
IF(N,N'T,NCON)=1
CALL ALNV7(NALF,ALF,ALFEV,M,L,N,B,A,B1)
WRITE(5,5343)B(N),A(N),B1(M,L)

534 FORMAT(1x,3X,3A1)
L=1
IF(L,L'T,1)=1
CONTINUE
GO TO 4444

540 IF(NANS3)=1948,1958,1968
1948 CALL CMPR2(A,B,A1,B1)
GO TO 5445
1958 CALL CMPR2(A,B,A1,B1)
GO TO 5445
1968 CALL CMPR3(A,B,A1,B1)

5445 L=1
DO 3012 MW=1,NVONCO
GO TO 10099

1955  CALL CMPB17(A,B,A1,B1)
GO TO 10099

1955  CALL CMPB18(A,B,A1,B1)

12299  L=1
DO 3015  M=1,NVOK
DO 3015  MH22=1,NVOK
CALL SNTCH(NVOK,NVOKCO,A,B,C,D,A1,A2,B1,B2)
CALL ALNVX(NALF,ALF,ALFVX,ML,MH22,A,B1)
CALL ALNV29(NALF,ALF,ALFVX,ML,ML,A1,B1)
CALL ALNV4(NALF,ALF,ALFVX,ML,MH22,A1,B1)
WRITE(*,10099)A(MH22),B1(M,L),A1(M,L),B1(MH22)

10099  FORMAT(1X,4A1)
L=1
IF(L.GT.2)GOTO1

3015  CONTINUE

4444  WRITE(*,50698)
50698  FORMAT(1X,17HCARE TO GO AGAIN)
READ(5,50699)REPEAT

50699  FORMAT(A3)
IF(REPEAT.EQ."YES")GO TO 37152
END

SUBROUTINE SNTCH(NVOK,NVOKCO,A,B,C,D,A1,A2,B1,B2)
DIMENSION A1(10),B1(10),C(10),D(10),A1(5,5),A2(5,5)
IF(A1(NVOKCO),NE,0)RETURN
CALL SNTCH(NVOKCO,A,B,C,D,A1,B1,B2)
CONTINUE

98541  FORMAT(A3)
IF(REPEAT.EQ."NO")GO TO 37152
END

SUBROUTINE CMPB17(AK,BX,A1X,B1X)
DIMENSION A1X(5,5),B1X(5,5)
LX1=2
NX=2
DO 2999  MX=1,NVOK
LX1=LX1+1
NX=NX+2
IF(LX1.GT.NVOK)LX1=1
IF(NX.GT.NVOK)NX=1
DO 2999  LX1=1
CALL ALVX2(NALF,ALF,ALFVX,LX1,B1X,A1X,LX1)
CALL ALNV29(NALF,ALF,ALFVX,LX1,NX,BX,A1X)
WRITE(*,2999)B1X(MX,LX1),A1X(LX1),BX(LX1),AX(LX1)

2999  FORMAT(1X,4A1)
CONTINUE
RETURN

SUBROUTINE CMPR2(AX, BX, AIX, BIX)
DIMENSION AX(10), BX(10), AIX(5,5), BIX(5,5)
LX=1
NX=1
DO 2902 MX=1, NVQNC0
   LX= LX+1
   NX= NX+1
   IF(LX, GT, NVQNC) LX=1
   IF(NX, GT, NVQNC) NX=1
   CALL ALNV2(NALF, ALF, ALFEV, MX, LX, BX, AIX, LX)
   CALL ALNVB(NALF, ALF, ALFEV, MX, LX, NX, AIX, BX)
   CALL ALNV3(NALF, ALF, ALFEV, NX, LX, BX, AX)
   WRITE(6, 2903) BAX(LX), AIX(LX, 2), BIX(NX, AX(LX))
2903 FORMAT(1X, 4A1)
2902 CONTINUE
RETURN
END

SUBROUTINE CMPR3(AX, BX, AIX, BIX)
DIMENSION AX(10), BX(10), AIX(5,5), BIX(5,5)
LX=1
NX=0
DO 2904 MX=1, NVQNC0
   LX= LX+1
   NX= NX+1
   IF(LX, GT, NVQNC) LX=1
   IF(NX, GT, NVQNC) NX=1
   CALL ALNV3(NALF, ALF, ALFEV, LX, MX, BX, AX)
   CALL ALNV4(NALF, ALF, ALFEV, MX, NX, LX, BX, BIX)
   WRITE(5, 2905) BAX(LX), AX(LX), BIX(NX), BIX(MX, LX)
2905 FORMAT(1X, 4A1)
2904 CONTINUE
RETURN
END

SUBROUTINE CMPR4(AX, BX, AIX, BIX)
DIMENSION AX(10), BX(10), AIX(5,5), BIX(5,5)
LX=1
NX=0
DO 2906 MX=1, NVQNC0
   LX= LX+1
   NX= NX+1
   IF(LX, GT, NVQNC) LX=1
   IF(NX, GT, NVQNC) NX=1
   CALL ALNV5(NALF, ALF, ALFEV, MX, LX, BIX, AX, LX)
   CALL ALNV6(NALF, ALF, ALFEV, MX, AZ, AX, BX)
   WRITE(5, 2907) BAX(MX, LX), AX(LX), AX(NX), BX(NX)
2907 FORMAT(1X, 4A1)
2906 CONTINUE
RETURN
END
SUBROUTINE CMPR9(AX, BX, A1X, B1X)
DIMENSION AX(10), BX(10), A1X(5, 5), B1X(5, 5)
LX1 = 0
NX = 0
DO 2900 MX = 1, 2000
LX1 = LX1 + 1
NX = NX + 2
IF (NX = GT, NVW0, LX1 = 1)
   THEN
   IF (NX, GT, NVW0, NX = 1)
   DO 2900 LX1 = 1, 2
   CALL ALNV2(NALF, ALF, ALFEV, MX, LX, BX, A1X, LX1)
   CALL ALNV21(NALF, ALF, ALFEV, MX, LX, LX1, NX, A1X, AX, BY)
   WRITE(5, 2909) BX(LX1), A1X(MX, LX), AX(LX1), BX(NX)
   CONTINUE
   FORMAT(1X, 4A1)
   RETURN
   END

SUBROUTINE CMPR8(AX, BX, A1X, B1X)
DIMENSION AX(10), BX(10), A1X(5, 5), B1X(5, 5)
LX1 = 0
NX = 0
DO 2900 MX = 1, 2000
LX1 = LX1 + 1
NX = NX + 2
IF (NX = GT, NVW0, LX1 = 1)
   THEN
   IF (NX, GT, NVW0, NX = 1)
   DO 2900 LX1 = 1, 2
   CALL ALNV2(NALF, ALF, ALFEV, LX1, AX, BX)
   CALL ALNV23(NALF, ALF, ALFEV, LX1, AX, MX, LX, AX, B1X)
   WRITE(5, 2911) BX(LX1), A1X(LX1), AX(NX), BX(NX, LX)
   CONTINUE
   FORMAT(1X, 4A1)
   RETURN
   END

SUBROUTINE CMPR7(AX, BX, A1X, B1X)
DIMENSION AX(10), BX(10), A1X(5, 5), B1X(5, 5)
LX1 = 0
NX = 0
DO 2912 MX = 1, 2000
LX1 = LX1 + 1
NX = NX + 2
IF (NX = GT, NVW0, LX1 = 1)
   THEN
   IF (NX, GT, NVW0, NX = 1)
   DO 2912 LX1 = 1, 2
   CALL ALNV2(NALF, ALF, ALFEV, MX, LX, BX, A1X, LX1)
   CALL ALNV217(NALF, ALF, ALFEV, MX, LX1, RX, AX)
   WRITE(5, 2913) B1X(MX, LX), AX(LX1), BX(NX), AX(NX), BX(LX1)
   CONTINUE
   FORMAT(1X, 9A1)
   RETURN
   END

SUBROUTINE CMPR6(AX, BX, A1X, B1X)
DIMENSION AX(10), BX(10), A1X(5, 5), B1X(5, 5)
LX1 = 0
NX = 0
DO 2914 MX = 1, 2000
LX1 = LX1 + 1

SUBROUTINE CMPH9(AX, BX, ALF, A1X, B1X)
DIMENSION AX(10), BX(10), A1X(5, 5), B1X(5, 5)

NX = 0
DO 2915 MX = 1, NCONCOUNT
    L1 = L1 + 1
    NX = NX + 2
    IF (NX, GT, NCON) L1 = 1
    IF (NX, GT, NCONCOUNT) NX = 1
    DO 2915 LX = 1, 2
        CALL ALNMV9(NALF, ALF, ALF, LX, L1, NX, BX, AX)
        CALL ALNMV19(NALF, ALF, ALF, MX, LX, L1, NX, B1X, AX)
        WRITE(9, 2917) BX(LX), ALX(L1), B1X(NX, AX, AX, AX)
        WRITE(9, 2916) AX(LX), AX(NX, AX, AX, AX)
        WRITE(9, 2919) BX(LX), AX(L1), AX(NX)
        FORMAT(1X, 5A1)
    CONTINUE
RETURN
END

SUBROUTINE CMPH10(AX, BX, ALF, A1X, B1X)
DIMENSION AX(10), BX(10), A1X(5, 5), B1X(5, 5)

NX = 0
DO 2918 MX = 1, NCONCOUNT
    L1 = L1 + 1
    NX = NX + 2
    IF (NX, GT, NCON) L1 = 1
    IF (NX, GT, NCONCOUNT) NX = 1
    DO 2918 LX = 1, 2
        CALL ALNMV19(NALF, ALF, ALF, MX, LX, L1, NX, B1X, AX)
        WRITE(9, 2919) B1X(MX, LX), AX(L1), AX(NX)
        FORMAT(1X, 5A1)
    CONTINUE
RETURN
END

SUBROUTINE CMPH11(AX, BX, ALF, A1X, B1X)
DIMENSION AX(10), BX(10), A1X(5, 5), B1X(5, 5)

NX = 0
DO 2920 MX = 1, NCONCOUNT
    L1 = L1 + 1
    NX = NX + 2
    IF (NX, GT, NCON) L1 = 1
    IF (NX, GT, NCONCOUNT) NX = 1
    DO 2920 LX = 1, 2
        CALL ALNMV16(NALF, ALF, ALF, LX, NX, L1, NX, BX, AX)
        WRITE(9, 2921) BX(LX), AX(NX, AX, AX, AX)
        FORMAT(1X, 5A1)
    CONTINUE
RETURN
END
2920 CONTINUE
RETURN
END

SUBROUTINE CMPH12(AX, BX, A1X, B1X)
DIMENSION AX(10), BX(10), A1X(5,5), B1X(5,5)
LX1=#
MX=#

DO 2922 MX=1, NV0X00
LX1=lx1+i
IF(LX1.GT.NV0X00) LX1=1
DO 2922 LX=1, 2
CALL ALNV7(NALF, ALF, ALFEV, MX, LX, LX1, BX, AX, A1X)
WRITE(5, 2923) BX(LX1), AX(LX1), A1X(NX, LX)
2923 CONTINUE
RETURN
END

SUBROUTINE CMPH13(AX, BX, A1X, B1X)
DIMENSION AX(10), BX(10), A1X(5,5), B1X(5,5)
LX1=#
NX=#

DO 2924 MX=1, NV0X00
LX1=lx1+i
NX=NX+1
IF(LX1.GT.NV0X00) NX=1
DO 2924 LX=1, 2
CALL ALNV5(NALF, ALF, ALFEV, MX, LX, LX1, A1X, BX)
CALL ALNV25(NALF, ALF, ALFEV, LX1, NX, BX)
CALL ALNV9(NALF, ALF, ALFEV, MX, BX, AX)
WRITE(5, 2925) A1X(MX, LX), BX(LX1), BX(NX), AX(NX)
2925 CONTINUE
RETURN
END

SUBROUTINE CMPH14(AX, BX, A1X, B1X)
DIMENSION AX(10), BX(10), A1X(5,5), B1X(5,5)
LX1=#
NX=#

DO 2926 MX=1, NV0X00
LX1=lx1+i
NX=NX+1
IF(NX.GT.NV0X00) NX=1
DO 2926 LX=1, 2
CALL ALNV4(NALF, ALF, ALFEV, MX, LX+LX1, AX, B1X)
CALL ALNV24(NALF, ALF, ALFEV, MX, LX, LX1, NX)
CALL ALNV29(NALF, ALF, ALFEV, MX, BX, AX)
WRITE(5, 2927) AX(LX1), BX(NX, LX), BX(LX1), AX(NX)
2927 CONTINUE
RETURN
END

SUBROUTINE CMPH15(AX, BX, A1X, B1X)
DIMENSION AX(10), BX(10), A1X(5,5), B1X(5,5)
LX1=#

NX=8
DO 2928 MX=1,NVOMCO
   LX1=LX1+1
   NX=NX+2
   IF (LX1,GT,NVOM)LX1=1
   IF (NX,GT,NVOM)NX=1
   DO 2928 LX=1,2
   CALL ALNV5(NALF,ALF,ALFEV,LX1,AX,BX)
   CALL ALNV25(NALF,ALF,ALFEV,LX1,NX,BX)
   CALL ALNV24(NALF,ALF,ALFEV,MX,LX,AX,AIX,DX)
   WRITE(5,2929)AX(LX1),BX(LX1),BX(NX),AIX(LX1),DX(LX1)
2929 FORMAT(1X,4A1)
2928 CONTINUE
   RETURN
END

SUBROUTINE CMPK16(AX,BX,AIX,BIX)
DIMENSION AX(12),BX(12),AIX(5,5),BIX(5,5)
   LX1=8
   NX=8
   DO 2930 MX=1,NVOMCO
   LX1=LX1+1
   NX=NX+2
   IF (LX1,GT,NVOM)LX1=1
   IF (NX,GT,NVOM)NX=1
   DO 2930 LX=1,2
   CALL ALNV5(NALF,ALF,ALFEV,MX,LX,AX,AIX,BX)
   CALL ALNV17(NALF,ALF,ALFEV,LX1,NX,BX,AX)
   WRITE(5,2931)AIX(LX1),BIX(LX1),AX(LX1),BX(NX)
2931 FORMAT(1X,4A1)
2930 CONTINUE
   RETURN
END

SUBROUTINE CMPK17(AX,BX,AIX,BIX)
DIMENSION AX(12),BX(12),AIX(5,5),BIX(5,5)
   LX1=8
   NX=8
   DO 2932 MX=1,NVOMCO
   LX1=LX1+1
   NX=NX+2
   IF (LX1,GT,NVOM)LX1=1
   IF (NX,GT,NVOM)NX=1
   DO 2932 LX=1,2
   CALL ALNV4(NALF,ALF,ALFEV,MX,LX,AX,AIX,BX)
   CALL ALNV9(NALF,ALF,ALFEV,MX,LX,NX,BIX,AX,BX)
   WRITE(5,2933)AX(LX1),BIX(MX,LX),AX(NX),BIX(NX)
2933 FORMAT(1X,4A1)
2932 CONTINUE
   RETURN
END

SUBROUTINE CMPK18(AX,BX,AIX,BIX)
DIMENSION AX(10),BX(10),AIX(5,5),BIX(5,5)
   LX1=8
   NX=8
   DO 2934 MX=1,NVOMCO
   LX1=LX1+1
   NX=NX+2
   IF (LX1,GT,NVOM)LX1=1
2934 CONTINUE
RETURN

SUBROUTINE CMPE19(AX, BX, AL1X, B1X)
DIMENSION AX(10), BX(10), AL1X(5, 5), B1X(5, 5)
LX = 1
NX = 0
DO 2936 LX = 1, NX+1
NX = NX + 1
IF (NX.GT.5) NZAD NX = 1
IF (NX.GT.5) NZAD NX = 1
DO 2936 LX = 1, 2
CALL ALN7(NALF, ALF, ALFEV, MX, LX, LX1, AL1X, BX)
CALL ALN6(NALF, ALF, ALFEV, MX, LX, LX1, NX, BX)
WRITE(5, 2937) AX(MX, LX), BX(LX1), AX(NX), BX(NX)
2937 FORMAT (1x, 5A1)
2936 CONTINUE
RETURN

SUBROUTINE CMPE20(AX, BX, AL1X, B1X)
DIMENSION AX(10), BX(10), AL1X(5, 5), B1X(5, 5)
LX = 1
NX = 0
DO 2938 NX = 1, NX+1
NX = NX + 1
IF (NX.GT.5) NZAD NX = 1
IF (NX.GT.5) NZAD NX = 1
DO 2938 LX = 1, 2
CALL ALN6(NALF, ALF, ALFEV, MX, LX, NX, AX, B1X)
CALL ALN6(NALF, ALF, ALFEV, MX, LX, LX1, B1X, BX)
CALL ALN7(NALF, ALF, ALFEV, MX, LX, LX1, NX, BX)
WRITE(5, 2939) AX(NX, LX1), B1X(MX, LX1), AX(LX1), BX(NX)
2939 CONTINUE
2938 CONTINUE
RETURN

SUBROUTINE CMPE21(AX, BX, AL1X, B1X)
DIMENSION AX(10), BX(10), AL1X(5, 5), B1X(5, 5)
LX = 0
NX = 0
DO 2940 NX = 1, NX+1
NX = NX + 1
IF (NX.GT.5) NZAD NX = 1
IF (NX.GT.5) NZAD NX = 1
DO 2940 LX = 1, 2
CALL ALN6(NALF, ALF, ALFEV, LX1, AX, BX)
DIMENSION Ax(10), Bx(10), A1x(5,5), B1x(5,5)
Lx1=0
N=0
DO 2948 N=1, NCON
LX1=LX1+1
NX=NX+2
IF(LX1,LX1,NCON)LX1=1
IF(NX,LX1,NCON)LX1=1
DO 2948 LX1=LX1+1
CALL ALNV(NALF, ALF, ALFEV, LX1, NX, BX, AX)
CALL ALNV2(NALF, ALF, ALFEV, LX1, NX, BX, AX)
CALL ALNV3(NALF, ALF, ALFEV, NX, BX, AX)
WRITE(*,2949) Bx(Nx, Lx1), Ax(Lx1), Bx(Lx1), Ax(Nx), Bx(Nx), Ax(Nx)
2949 FORMAT(1X,9A1)
2946 CONTINUE
RETURN
END

SUBROUTINE CMPS26(Ax, Bx, A1x, B1x)
DIMENSION Ax(10), Bx(10), A1x(5,5), B1x(5,5)
Lx1=0
N=0
DO 2952 N=1, NCON
LX1=LX1+1
NX=NX+2
IF(LX1,LX1,NCON)LX1=1
IF(NX,LX1,NCON)LX1=1
DO 2956 LX1=LX1+1
CALL ALNV(NALF, ALF, ALFEV, MX, LX1, NX, BX, AX)
CALL ALNV2(NALF, ALF, ALFEV, MX, NX, BX, AX)
CALL ALNV3(NALF, ALF, ALFEV, NX, BX, AX)
WRITE(*,2951) Bx(Lx1), Ax(Mx, Lx1), Bx(Mx), Ax(Nx), Bx(Nx), Ax(Nx)
2951 FORMAT(1X,9A1)
2950 CONTINUE
RETURN
END

SUBROUTINE CMPS27(Ax, Bx, A1x, B1x)
DIMENSION Ax(10), Bx(10), A1x(5,5), B1x(5,5)
Lx1=0
N=0
DO 2952 N=1, NCON
LX1=LX1+1
NX=NX+2
IF(LX1,LX1,NCON)LX1=1
IF(NX,LX1,NCON)LX1=1
DO 2956 LX1=LX1+1
CALL ALNV(NALF, ALF, ALFEV, Lx1, BX, AX)
CALL ALNV2(NALF, ALF, ALFEV, NX, BX, AX)
CALL ALNV3(NALF, ALF, ALFEV, MX, Lx1, BX, A1x, AX)
WRITE(*,2950) Bx(Lx1), Ax(Lx1), Bx(Nx), Bx(Nx), A1x(Mx, Lx1)
2950 FORMAT(1X,9A1)
2952 CONTINUE
RETURN
END

SUBROUTINE CMPS28(Ax, Bx, A1x, B1x)
DIMENSION Ax(10), Bx(10), A1x(5,5), B1x(5,5)
Lx1=0
N=0
DO 2954 NLX=1, NDCOND
LXL = LXL + 1
NLX = NLX + 2
IF (LXL, GT, NDCOND) LXL = 1
IF (NLX, GT, NDCOND) NLX = 1
DO 2954 LXL = 1
CALL ALNV9 (NLX, ALF, ALFEV, MX, LX, LXL, BX, AX)
CALL ALNV23 (NLX, ALF, ALFEV, LXL, NX, BX)
CALL ALNV17 (NLX, ALF, ALFEV, MX, NX, BX, AX)
WRITE (5, 2955) BX(LXL), AX(LXL), BX(LXL), BX(NX), AX(NX), BX(NX)
2955 FORMAT (1X, 6A1)
2954 CONTINUE
RETURN
END

SUBROUTINE CMPH29 (AX, BX, A1X, B1X)
DIMENSION AX(10), BX(10), A1X(5, 5), B1X(5, 5)
LXL = 0
NLX = 0
DO 2956 NLX = 1, NDCOND
LXL = LXL + 1
NLX = NLX + 2
IF (LXL, GT, NDCOND) LXL = 1
IF (NLX, GT, NDCOND) NLX = 1
DO 2956 LXL = 1, 2
CALL ALNV02 (NLX, ALF, ALFEV, MX, LX, LXL, NX, BX, A1X)
CALL ALNV23 (NLX, ALF, ALFEV, LXL, NX, BX, AX)
CALL ALNV17 (NLX, ALF, ALFEV, MX, NX, BX, AX)
WRITE (5, 2957) BX(LXL), A1X(LXL), BX(NX), BX(LXL), AX(LXL), BX(NX)
2957 FORMAT (1X, 6A1)
2956 CONTINUE
RETURN
END

SUBROUTINE CMPH30 (AX, BX, A1X, B1X)
DIMENSION AX(10), BX(10), A1X(5, 5), B1X(5, 5)
LXL = 0
NLX = 0
DO 2958 NLX = 1, NDCOND
LXL = LXL + 1
NLX = NLX + 2
IF (LXL, GT, NDCOND) LXL = 1
IF (NLX, GT, NDCOND) NLX = 1
DO 2958 LXL = 1, 2
CALL ALNV17 (NLX, ALF, ALFEV, LXL, MX, BX, AX)
CALL ALNV23 (NLX, ALF, ALFEV, MX, NX, BX)
CALL ALNV17 (NLX, ALF, ALFEV, MX, NX, BX, A1X)
WRITE (5, 2959) BX(LXL), AX(LXL), BX(NX), BX(NX), AX(NX), B1X(NX, LX)
2959 FORMAT (1X, 6A1)
2958 CONTINUE
RETURN
END

SUBROUTINE CMPH31 (AX, BX, A1X, B1X)
DIMENSION AX(10), BX(10), A1X(5, 5), B1X(5, 5)
LXL = 0
NLX = 0
DO 2960 NLX = 1, NDCOND
LXL = LXL + 1
NLX = NLX + 2
IF (LXL, GT, NDCOND) LXL = 1
IF (NLX, GT, NDCOND) NLX = 1
DO 2960 LXL = 1, 2
CALL ALNV21(NALF,ALF,ALFEV,MLX,LMX,LMX1,LMX1,ALX,AX,AX)
WRITE(5,2961)ALX(MX,LMX),AX(LMX1,AX,AX)

2961 FORMAT(1X,3A1)
2960 CONTINUE
RETURN
END

SUBROUTINE CMHR32(AX,AX,AX,AX)
DIMENSION AX(10),BX(10),ALX(5,5),BLX(5,5)
MX=0
DO 2962 MX=1,10000
MX=MX+1
IF(ALX(1,0),NV0,MX)=1
DO 2962 MX=1,5
CALL ALNV22(NALF,ALF,ALFEV,LMX,LMX1,AX,AX,AX,AX)
WRITE(5,2963)AX(1L),ALX(1M,LMX1,AX,AX,AX)

2963 FORMAT(1X,3A1)
2962 CONTINUE
RETURN
END

SUBROUTINE CMHR33(AX,AX,AX,AX)
DIMENSION AX(10),BX(10),ALX(5,5),BLX(5,5)
MX=0
DO 2964 MX=1,10000
MX=MX+1
IF(ALX(1,0),NV0,MX)=1
DO 2964 MX=1,5
CALL ALNV24(NALF,ALF,ALFEV,LMX1,AX,AX)
CALL ALNV4(NALF,ALF,ALFEV,LMX1,AX,AX,AX,AX)
WRITE(5,2965)AX(1L),AX(1M,AX,AX,AX)

2965 FORMAT(1X,3A1)
2964 CONTINUE
RETURN
END

SUBROUTINE ALNV11(NALF,ALF,ALFX,ALFEV,MLX,MLX1,AX,AX,AX,AX)
DIMENSION AX(10),BLX(5,5),ALFX(10,2),ALFEV(10,2)
DO 21387 MLX=1,10
MLX=MLX+1
IF(BLX(MLX,AX),EQ,ALFEV(MLX1,1)) GO TO 2147
IF(AX(MLX1),EQ,ALFX(MLX1,2)) GO TO 2146
GO TO 21387
2147 IF(AX(MLX1),EQ,ALFX(MLX1,1)) AX(MLX1)=ALFX(MLX1,2)
GO TO 21387
2146 IF(BLX(MLX1,AX),EQ,ALFEV(MLX1,1)) BLX(MLX,AX)=ALFX(MLX1,2)
GO TO 21387

21387 CONTINUE
RETURN
END

SUBROUTINE ALNV21(NALF,ALF,ALFX,ALFEV,MLX,MLX1,AX,AX,AX,AX)
DIMENSION ALFX(10,2),ALFEV(10,2),BLX(10),AX(5,5)
DO 22207 MLX=1,10
MLX=MLX+1
IF(BLX(MLX,AX),EQ,ALFEV(MLX1,1)) GO TO 2241
IF(AX(MLX1),EQ,ALFX(MLX1,2)) GO TO 2242
GO TO 22207

2241 IF(AX(MLX1,AX),EQ,ALFX(MLX1,2)) AX(MLX,AX)=ALFX(MLX1,2)
GO TO 22207
GO TO 21287
IF (BX(MH2X), EQ, ALFX(MX(2,1))); BX(MH2X) = ALFX(MX(2,2))

21287 CONTINUE
RETURN
END

SUBROUTINE ALNV3(NALFX, ALFX, ALFEX, MX, BX, AX)
DIMENSION ALFX(10,2), ALFEX(10,2), BX(10), AX(10)
GO 21288 MXL5=1, NALFX
IF (BX(MX), EQ, ALFEX(MXL5,1)) GO TO 2128
IF (AX(MJ), EQ, ALFEX(MXL5,2)) GO TO 2129
GO TO 21288

2128 IF (AX(MX), EQ, ALFX(MXL3,1)); AX(MX)  = ALFX(MXL3,2)
GO TO 21288

21288 CONTINUE
RETURN
END

SUBROUTINE ALNV4(NALFX, ALFX, ALFEX, MX, NIX, MXH3X, AX, BX)
DIMENSION ALFX(10,2), ALFEX(10,2), AX(10), BX(10)
GO 21289 MXL6=1, NALFX
IF (AX(MH3X), EQ, ALFEX(MXL6,1)) GO TO 2178
IF (BX(MH3X), NIX, EQ, ALFEX(MXL6,1)) BX(MH3X, NIX) = ALFX(MXL6,2)
GO TO 21289

2178 IF (BX(MH3X, NIX), EQ, ALFX(MXL6,1)); BX(MH3X, NIX) = ALFX(MXL6,2)
GO TO 21289

21289 IF (AX(MH3X), EQ, ALFX(MXL6,1)); AX(MH3X) = ALFX(MXL6,2)
CONTINUE
RETURN
END

SUBROUTINE ALNV5(NALFX, ALFX, ALFEX, MX, NIX, MXH4X, AX, BX)
DIMENSION ALFX(10,2), ALFEX(10,2), AX(10), BX(10)
GO 21291 MXL6=1, NALFX
IF (AX(MH4X), EQ, ALFEX(MXL6,1)) GO TO 2191
IF (BX(MH4X), EQ, ALFEX(MXL6,2)) GO TO 2192
GO TO 21291

2191 IF (BX(MH4X), EQ, ALFX(MXL5,1)); BX(MH4X) = ALFX(MXL5,2)
GO TO 21291

2192 IF (AX(MH4X), NIX, EQ, ALFX(MXL5,1)); AX(MH4X, NIX) = ALFX(MXL5,2)
CONTINUE
RETURN
END

SUBROUTINE ALNV6(NALFX, ALFX, ALFEX, MX, AX, BX)
DIMENSION ALFX(10,2), ALFEX(10,2), AX(10), BX(10)
GO 21293 MXL6=1, NALFX
IF (AX(MH5X), EQ, ALFEX(MXL6,1)) GO TO 2193
IF (BX(MH5X), EQ, ALFEX(MXL6,2)) GO TO 2194
GO TO 21293

2193 IF (BX(MH5X), EQ, ALFX(MXL6,1)); BX(MH5X) = ALFX(MXL6,2)
GO TO 21293

2194 IF (AX(MH5X), EQ, ALFX(MXL6,1)); AX(MH5X) = ALFX(MXL6,2)
CONTINUE
RETURN
END

SUBROUTINE ALNV7(NALFX, ALFX, ALFEX, MX, NIX, MXH5X, AX, BX)
DIMENSION ALFX(10,2), ALFEX(10,2), AX(10), BX(10), AX(10), BX(10)

8119  IF(AX(NX),EQ,ALFX(MXL15,1))AX(NX)=ALFX(MXL15,2)
GO TO 31588
8219  IF(L1(XM,X),EQ,ALFX(MXL15,1))B1X(XM,X)=ALFX(MXL15,2)
31586  CONTINUE
RETURN
END

SUBROUTINE ALFX16(NALFX,ALFX,ALFXV,AX,XM,XM,LM,LM,AX,A1X,AX)
DIMENSION ALFX(10,2),ALFXV(10,2),AX(12),A1X(5,5),AX(12)
GO 31587 MXL16=1,NALFX
LE1
7444  IF(BX(LMX),EQ,ALFXV(MXL16,1))GO TO 8816
LE1-1
IF(A1X(LM,X),EQ,ALFXV(MXL16,1))GO TO 8116
IF(L,LE,2)GO TO 31567
IF(A1X(LM,X),EQ,ALFXV(MXL16,2))GO TO 8216
IF(A1X(LM,X),EQ,ALFXV(MXL16,2))GO TO 8016
GO TO 31587
8816  IF(A1X(LM,X),EQ,ALFX(MXL16,1))A1X(LM,X)=ALFX(MXL16,2)
LE1-1
IF(L,LE,1)GO TO 7444
GO TO 31567
8116  IF(A1X(LM,X),EQ,ALFXV(MXL16,1))A1X(LM,X)=ALFXV(MXL16,2)
GO TO 31587
8216  IF(BX(LMX),EQ,ALFXV(MXL16,1))BX(LMX)=ALFXV(MXL16,2)
31587  CONTINUE
RETURN
END

SUBROUTINE ALFX17(NALFX,ALFX,ALFXV,AX,XM,XM,LM,LM,AX)
DIMENSION ALFX(20,2),ALFXV(20,2),AX(10),AX(10)
GO 31588 MXL17=1,NALFX
LE1
7555  IF(BX(LMX),EQ,ALFXV(MXL17,1))GO TO 8817
LE1-1
IF(A1X(LM,X),EQ,ALFXV(MXL17,1))GO TO 8117
IF(L,LE,2)GO TO 31568
IF(A1X(LM,X),EQ,ALFXV(MXL17,2))GO TO 8217
IF(BX(LMX),EQ,ALFXV(MXL17,2))GO TO 8017
GO TO 31588
8817  IF(A1X(LM,X),EQ,ALFXV(MXL17,1))A1X(LM,X)=ALFXV(MXL17,2)
LE1-1
IF(L,LE,1)GO TO 7555
GO TO 31588
8117  IF(A1X(LM,X),EQ,ALFXV(MXL17,1))B1X(NX)=ALFXV(MXL17,2)
GO TO 31588
8217  IF(BX(LMX),EQ,ALFXV(MXL17,1))B1X(LMX)=ALFXV(MXL17,2)
31588  CONTINUE
RETURN
END

SUBROUTINE ALFX18(NALFX,ALFX,ALFXV,AX,XM,XM,LM,LM,AX,A1X,AX)
DIMENSION ALFX(10,2),ALFXV(10,2),AX(10),AX(10)
GO 31589 MXL18=1,NALFX
LE1
7666  IF(A1X(LM,X),EQ,ALFXV(MXL18,1))GO TO 8818
LE1-1
IF(BX(LMX),EQ,ALFXV(MXL18,1))GO TO 8118
IF(L,LE,2)GO TO 31589
IF(BX(LMX),EQ,ALFXV(MXL18,2))GO TO 8218
IF(ALFX(NX), EQ, ALFX(LX1, 2)) GO TO 8819
GO TO 31991
8819 IF(ALFX(LX1), EQ, ALFX(MXL18, 1)) AX(NX) = ALFX(MXL18, 2)
LXL 1
IF(L(EQ, 1)) GO TO 7888
GO TO 31991
8118 IF(ALFX(NX), EQ, ALFX(MXL18, 1)) AX(NX) = ALFX(MXL18, 2)
GO TO 31991
8218 IF(A(LX1, 2), EQ, ALFX(MXL18, 1)) AX(NX, LX) = ALFX(MXL18, 2)
CONTINUE
31991 RETURN
END

SUBROUTINE ALNV19(ALFX, ALFX, ALFX, ALFX, LX1, NX, LX, NX, AX, B1X)
DIMENSION ALFX(10, 2), ALFX(10, 2), AX(10), B1X(5, 5)
GO 31991 XL19 = 1, ALFX

7888 LXL 1
IF(ALFX(LX1), EQ, ALFX(MXL19, 1)) GO TO 8819
IF(L(EQ, 1)) GO TO 7888
GO TO 31991
819 IF(ALFX(NX), EQ, ALFX(MXL19, 1)) GO TO 819
GO TO 31991
8819 IF(B1X(NX, LX), EQ, ALFX(MXL19, 2)) B1X(NX, LX) = ALFX(MXL19, 2)
LXL 1
IF(L(EQ, 1)) GO TO 7888
GO TO 31991
819 IF(ALFX(NX), EQ, ALFX(LX1, 2)) AX(NX) = ALFX(MXL19, 2)
GO TO 31991
8219 IF(ALFX(LX1), EQ, ALFX(MXL19, 1)) AX(LX1) = ALFX(MXL19, 2)
CONTINUE
31991 RETURN
END

SUBROUTINE ALNV20(ALFX, ALFX, ALFX, ALFX, LX1, NX, LX, AX, BX, A1X)
DIMENSION ALFX(10, 2), ALFX(10, 2), AX(10), BX(10), A1X(5, 5)
GO 31991 XL20 = 1, ALFX

7999 LXL 1
IF(ALFX(LX1), EQ, ALFX(MXL20, 1)) GO TO 8828
LXL 1
IF(ALFX(NX), EQ, ALFX(MXL20, 1)) GO TO 8122
GO TO 31991
8122 IF(ALFX(NX), EQ, ALFX(MXL20, 1)) AX(NX, LX) = ALFX(MXL20, 2)
GO TO 31991
8228 IF(ALFX(LX1), EQ, ALFX(MXL20, 1)) AX(LX1) = ALFX(MXL20, 2)
CONTINUE
31991 RETURN
END

SUBROUTINE ALNV21(ALFX, ALFX, ALFX, ALFX, LX, LX1, NX, A1X, AX, BX)
DIMENSION ALFX(10, 2), ALFX(10, 2), AX(10), BX(10), A1X(5, 5)
GO 31991 XL21 = 1, ALFX
IF (A1X(MX, LX), EQ, ALFEXV(MXL21, 1)) GO TO 8321

6001
LEL*1
IF (AX(LX1), EQ, ALFEXV(MXL21, 1)) GO TO 8321
IF (X, EQ, 2) GO TO 31592
IF (AX(LX1), EQ, ALFEXV(MXL21, 2)) GO TO 8221
IF (BX(NX), EQ, ALFEXV(MXL21, 2)) GO TO 8221.
GO TO 31592
8221 IF (AX(LX1), EQ, ALFEXV(MXL21, 1)) AX(LX1) = ALFEXV(MXL21, 2)
LEL+1
8321 IF (X, EQ, 1) GO TO 6001
GO TO 31592
8121 IF (EX(NX), EQ, ALFEXV(MXL21, 1)) EX(NX) = ALFEXV(MXL21, 2)
GO TO 31592
31992 CONTINUE
RETURN
END

SUBROUTINE ALNX22(NALFX, ALFX, ALFEXV, LK1, NX, LX, AX, A1X, BX)
DIMENSION ALFX(10, 2), ALFEXV(10, 2, AX(10)), ALK(5, 5), BX(10)
GO 31593 MXL22#1, NALFX
6002
LEL+1
IF (AX(LX1), EQ, ALFEXV(MXL22, 1)) GO TO 8422
8422 IF (AX(LX1), EQ, ALFEXV(MXL22, 1)) AX(LX1) = ALFEXV(MXL22, 2)
LEL+1
8422 IF (X, EQ, 1) GO TO 6002
GO TO 31593
8122 IF (WX(LX1), EQ, ALFEXV(MXL22, 1)) MX(LX1) = ALFEXV(MXL22, 2)
GO TO 31593
31993 CONTINUE
RETURN
END

SUBROUTINE ALNX23(NALFX, ALFX, ALFEXV, LK1, NX, LX, AX, BI1X)
DIMENSION ALFX(10, 2), ALFEXV(10, 2), AX(10), BI1X(10, 5)
GO 31594 MXL23#1, NALFX
6003
LEL+1
IF (AX(LX1), EQ, ALFEXV(MXL23, 1)) GO TO 8323
8323 IF (AX(NX), EQ, ALFEXV(MXL23, 1)) GO TO 8123
IF (X, EQ, 2) GO TO 31594
IF (AX(NX), EQ, ALFEXV(MXL23, 2)) GO TO 8223
IF (BX(NX), EQ, ALFEXV(MXL23, 2)) GO TO 8223.
GO TO 31594
8223 IF (AX(NX), EQ, ALFEXV(MXL23, 1)) AX(NX) = ALFEXV(MXL23, 2)
LEL+1
8323 IF (X, EQ, 1) GO TO 6003
GO TO 31594
8123 IF (BX(NX), EQ, ALFEXV(MXL23, 1)) BX(NX) = ALFEXV(MXL23, 2)
GO TO 31594
31994 CONTINUE
DIMENSION ALFX(16,2), ALFVX(16,2), A1X(9,3), B1X(5,2)
DO 31789 MXL29=1, NALFX
IF(B1X(MX,LX), EQ, ALFVX(MXL29, 1)) GO TO 7584
IF(A1X(MX,LX), EQ, ALFVX(MXL28, 2)) GO TO 7685
GO TO 31785
7584 IF(B1X(MX,LX), EQ, ALFX(MXL29, 1)), B1X(MX,LX)=ALFX(MXL29, 2)
GO TO 31785
7685 IF(A1X(MX,LX), EQ, ALFX(MXL28, 1)), A1X(MX,LX)=ALFX(MXL28, 2)
31785 CONTINUE RETURN
END

SUBROUTINE ALFX29(MALFX, ALFX, ALFVX, MX, LX, B1X, A1X)
DIMENSION ALFX(16,2), ALFVX(16,2), A1X(5,3), B1X(5,2)
DO 31789 MXL29=1, NALFX
IF(B1X(MX,LX), EQ, ALFVX(MXL29, 1)) GO TO 8012
IF(A1X(MX,LX), EQ, ALFVX(MXL29, 2)) GO TO 8112
GO TO 31785
8012 IF(B1X(MX,LX), EQ, ALFX(MXL29, 1)), B1X(MX,LX)=ALFX(MXL29, 2)
GO TO 31785
8112 IF(A1X(MX,LX), EQ, ALFX(MXL29, 1)), A1X(MX,LX)=ALFX(MXL29, 2)
31786 CONTINUE RETURN
END

SUBROUTINE ALFX30(MALFX, ALFX, ALFVX, LX1, MX, B1X, A1X)
DIMENSION ALFX(16,2), ALFVX(16,2), A1X(10), B1X(10)
DO 31789 MXL30=1, NALFX
IF(B1X(LX1), EQ, ALFVX(MXL30, 1)) GO TO 8013
IF(A1X(NX), EQ, ALFVX(MXL30, 2)) GO TO 8113
GO TO 31787
8013 IF(B1X(NX), EQ, ALFX(MXL30, 1)), B1X(NX)=ALFX(MXL30, 2)
GO TO 31787
8113 IF(A1X(LX1), EQ, ALFX(MXL30, 1)), B1X(LX1)=ALFX(MXL30, 2)
31787 CONTINUE RETURN
END