

THE 80 NOTEBOOK

JULY 1980

ISSUE #4

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NLOS/1 AND NLOS/2

A Natural Language Operating System for the TRS-80

What is natural language? For our purposes, natural language is common, ordinary English - the expression of facts using simple sentences. NLOS/1 is a system which allows the computer to "understand" the information conveyed to it through simple sentences and to answer questions concerning the information conveyed. This ability makes the system an excellent tool for the creation, management and inquiry to a conversational data base of facts and figures. It can also be an educational tool - as a study in artificial intelligence through an examination of the internal workings of the program, or by its reaction to math reading problems of various complexity. It can be an excellent tool in teaching English grammar, sentence structure and logical deductive reasoning to students, young and old alike. In any case, holding a conversation with your computer can be a lot of fun.

Let's see how the system accomplishes this and what its limitations are:

First, we have to get down to the basics of English. The system recognizes phrases grouped together in a sentence. A phrase is a group of one or more words that, together, convey a concept or identify an entity. These phrases can convey a subject, a verb, a preposition, a conjunction, a modifier or a question invoker. These represent the grammatical types that NLOS/1 can handle. You may ask - why not recognize individual words rather than phrases so that the conventional grammatical types - nouns, adjectives, verbs, adverbs, prepositions, conjunctions, interjections, and pronouns may be used? Well, recognizing nothing smaller than a phrase alleviates the problem of context usage. For example - "the President of the United States" contains adjectives, nouns and a preposition, yet the phrase identifies a single subject. Each grammatical type further conveys a type of information. Subjects identify a person (a who - "Tom", etc.), a place (a where - "New York City", etc.), or a thing (a what - "a banana", etc.).

Verbs convey the type of object clause they affect - in "Tom said nothing" and "Tom went home", etc., "said" acts on "what" and "went" acts on "where".

Every sentence must have a verb. Prepositions introduce subjects which show what ("as a clown"), when ("on my birthday"), where ("in town"), why ("to go home") and how ("by going home").

"Why" or "how" prepositional phrases are usually a combination of prepositions and verbs (such as why - "to go to"), while most other prepositional phrases consist of a single prepositional word.

Conjunctions show no type of information but are used to combine two adjacent subject phrases into a single subject clause. Because of this, conjunctions are restricted to "and" type conjunctive phrases. Also, only one conjunction may be used in each sentence analyzed by the system. The reason for this lies in the way NLOS/1 associates one subject to another in its deductive reasoning processes. This will be discussed further when I explain the problem solving algorithm.

Modifiers are adjectives and adverbs. As adjectives, modifiers appearing immediately before a subject relate to that subject. These show what ("red", "lazy", etc.), association ("a", "the", "their", etc. - associative modifiers are generally for aesthetic use only and are ignored by the system in its deductive reasoning), multiplication ("times as many", etc.) and numeric ("100", etc.). Multiplicative and numeric modifiers are very important in the deductive reasoning processes but numbers must appear before multiplicative modifiers in subject clauses (as in "10 times as many boxes", etc.). As adverbs, modifiers may appear before or after a verb phrase and show how ("quickly", etc.).

With all of the above taken into consideration, you can see how the system can break down a sentence into who, what, when, where, why and how categories of information.

Simple sentences used with the system should have only one piece of information in each of these categories.

Question invokers may be used in a sentence to request the missing category of information represented by the question invoker. For example - if you tell the system "Tom ran home to have dinner", you could later ask "who ran home to have dinner?" and the system would reply "Tom"; or "Tom ran where" would reply "home"; or "why did Tom run home" would reply "to have dinner" assuming that "ran" and "did run" have the same root verb - this will be discussed later.

Question invokers, therefore, can request who, what, when, where, why or how. A special class of question invoker "how many" exists which is used to invoke the deductive reasoning process.

Also, a sentence beginning with a verb phrase invokes a yes/no type of response (given "Tom shined his shoes" you could ask "did Tom shine his shoes?"). Notice that the verb phrase "did shine" has been broken up around the subject to do this. The system would respond "yes" if the information was true or "no" if the information was false or unknown.

Punctuation is not allowed within a defined phrase and is ignored in sentences. Also, numeric modifiers are recognized without formal definition and are not allowed within defined phrases. This would disallow contractions or non-integer numeric modifiers in sentences.

By means of a utility routine in the system, phrases are formally defined to and maintained by the system in a dictionary which stores the phrase, its grammatical usage and the type of information it conveys.

A phrase already in the dictionary may be redefined. To have a phrase deleted or ignored, you simply redefine it as an associative modifier since this type of phrase is for aesthetic purposes only and is ignored in sentence analysis. If a phrase is redefined, the redefinition only applies to sentences analyzed after the redefinition.

Different phrases may contain the same word or words but in different sequences or in combination with other words.

For verb phrases, the system also requires a root phrase which normalizes the time references implied by verbs. For example - "went" and "did go" are both "past go". Whenever a verb phrase is encountered in sentence analysis, it is replaced by its root phrase. This allows such analysis as "Tom went home" and "did Tom go home" with the system replying "yes".

An additional utility lists the vocabulary of phrases along with their characteristics to allow the user to review his dictionary.

As sentences are received and analyzed by the system, the information extracted is stored in a special section of the dictionary structured like an encyclopedia. This section is referenced by use of question invokers or yes/no question invokers as discussed earlier.

A special note - a simple form of compound sentences can be handled by the system during sentence analysis.

A noun followed by a verb may introduce another sentence (as in "Tom said Dick went home"). In this example the system treats the one sentence as two statements: "Tom said what (Dick went home)" and "Dick went home".

The system also contains a utility routine for scrolling thru the encyclopedia section of the dictionary to allow the user to view the information the system has thus far received, analyzed and cataloged. This display shows the information in the sentences and the "information type" categories they were assigned. The sentences are shown in the sequence they were received to show the flow of changes in facts.

Another function of sentence analysis, which is critical to the deductive reasoning process, is the association of one subject in a sentence relative to the other subjects in the sentence.

For example - in "Tom has 3 balls in a box", two relationships are extracted: "Tom" with "3 balls" and "3 balls" with "box". If you were to ask "how many balls has Tom", the system would reply "3". Notice that the "how many" questioning sentence can relate only one subject to another and can not be conditioned by any how, why or when type clauses.

If a conjunction is used as in "Tom and Dick have a car", the relationships extracted are: "Tom" with "car" and "Dick" with "car"; but, in "Tom and Dick have a car and a truck", if two conjunctions were allowed, the relationships would be "Tom" with "car", "Dick" with "car", "Tom" with "truck" and "Dick" with "truck".

The system can only handle up to 3 subjects in a relationship at one time; so, only one conjunction is allowed per sentence.

These relationships are also stored in a special section of the dictionary structured to handle one to one associations. Along with each of the two subjects in a relationship, the dictionary also stores the numeric modifiers, if any, and the multiplicative modifiers, if any, associated with those subjects. Both subjects in a relationship may not contain multiplicative modifiers and association dictionary entries are not built if the sentence has how, why or when type clauses because the system can not handle conditional relationships in its deductive reasoning processes. For example - in "Tom ran quickly to the store" would not relate "Tom" with "store" because of the how "quickly". Also, "3 times as many balls are used for 2 times the boxes" because of the abstract nature of the relationship between balls and boxes.

And now for the deductive reasoning process - let's consider the following sample problem: given the following dictionary of phrases - a when preposition "on", an associative modifier "their", a what subject "vacation", a who subject "Tom", a who subject "Dick", a where verb "visited" with root "past visit", an associative modifier "a", a where subject "farm", a when preposition "while", a where subject "there", a who subject "he", a what verb "noticed" with root "past notice", a what subject "pen", a what verb "containing" with root "present contain", a what subject "chickens", a what subject "pigs", a what verb "said" with root "past say", a who subject "they", a what verb "were" with root "past be", a multiplicative modifier "times as many", a what preposition "as", a what verb "counted" with root "past count", a what subject "legs", a where preposition "in", an associative modifier "the", a what verb "have" with root "present have", a conjunction "and", and a how many question invoker "how many"; the following sentences can be analyzed by the system - "chickens have 2 legs", "pigs have 4 legs", "on their vacation Tom and Dick visited a farm", "while there they noticed a pen containing chickens and pigs", "Tom said there were 3 times as many chickens as pigs", "Dick said he counted 100 legs in the pen" and "how many chickens were in the pen". The system would reply to the last questioning sentence - "30".

How could the system have deduced this? Let's look at the approach the system takes: the system would first make all the subject to subject relationships possible - "chickens" with "2 legs", "pigs" with "4 legs", "pen" with "chickens", "pen" with "pigs", "Tom" with "there", "there" with "3 times as many chickens", "3 times as many chickens" with "pigs", "Dick" with "he", "he" with "100 legs" and "100 legs" with "pen". Since "pen" is the area of concern in which to search for "how many", the relationships involving "pen" are selected - "chickens", "pigs", "100 legs".

If a non-multiplicative numeric modifier had been associated with chickens, that number would be the answer (the system accepts facts given it as truth; but, if the system had been asked "how many chickens were in 3 pens", the answer found would be multiplied by 3). The system must now look for a relationship with a non-multiplicative numeric modifier to give "pen" a numerical base of equivalence. This relationship would be "100 legs". Since "100 legs" is to be treated as "pen", the remaining "pen" relationships are matched against all of the other relationships in the dictionary in order to pick out these relationships with "legs". This would result in the selection of the following relationships -

"chickens" with "2 legs" and "pigs" with "4 legs". The system must also check for any relationships between the resultant subjects. This search shows the relationship of "3 times as many chickens" with "pigs".

With all of this selected information, an equation can be formulated - "100 legs" equals "3 times as many chickens" plus "pigs". Substituting the number of legs represented by chickens and pigs, a common unit of measure can be applied to the equation. This yields the equation - "100 legs" equals "3 times as many" times "2 legs" plus "4 legs" or $100 = 6X + 4X$. Then X equals 10 and since there are "3 times as many chickens", there must be 3 times 10 or 30 chickens. At this point, the system would simply print "30" and ask for another sentence.

The above algorithm can be applied to a wide variety of math reading style problems. It can be an educational experience just exploring the many variations possible.

The dictionary you construct and its component phrases, sentences and subject relationships can be stored as a file on cassette tape and then reloaded at the beginning of a session. This allows an accumulated data base of information to be maintained for inquiry purposes.

Operationally, NLOS/1, a 16K Level 2 BASIC program, is divided into sections which flow one to another. To begin with, the program asks if you want it to read a dictionary tape created in a previous run. This allows you to build and retain dictionary tapes on various problems and subjects and to re-use this information as needed by having the system re-input the information from tape in a later run. Enter "yes" if you wish a previously created dictionary tape to be read or enter "no" to go on.

After you have entered "no" or the dictionary tape has been read, the system will ask if you are defining a phrase. This section of the program allows the user to add phrase definitions to the system dictionary in memory or to redefine a phrase previously known to the system.

After the phrase definition is entered, this section of the program will repeat until a "no" response is entered to the "DEFINING PHRASES" question. If you enter "yes" to the "DEFINING PHRASES" prompt, you will be expected to answer a series of questions which will supply the information needed to define a phrase to the system.

The first thing the system must know is the phrase text itself. Next, it must be told if the phrase is a 1) subject, 2) verb, 3) preposition, 4) conjunction, 5) modifier, or 6) question invoker by entering the appropriate code.

Once this grammatical usage information is known about a phrase, the system will ask for the type of information that the phrase will convey when used in a sentence. You must enter the proper code from the following list: 1) who, 2) what, 3) when, 4) where, 5) how, 6) how many, 7) association, 8) multiplicative, 9) why.

As discussed previously, the allowable type of information conveyed by a phrase is determined by the grammatical usage. If an improper type of information code is entered, the type of information question will be repeated.

If the phrase being defined is a verb you must next enter the verb phrase which must have been defined which represents the root verb phrase. As discussed previously, this is required to commonize the various phrases which have the same functional usage.

If you wish to delete a phrase from the system's dictionary, simply redefine it with a modifier grammatical usage and an association information type. This will cause the phrase to be ignored during sentence analysis since this class of phrases normally includes words such as "the" or "an" which are functionally unneeded in a sentence.

Once the user has defined all of the phrases needed, you will be given the opportunity to list all the phrases in the dictionary as a review. This will happen if you enter "yes" to "WANT VOCABULARY LIST". If you enter "no" the program will go on.

After this you will be given the opportunity to review the sentences previously inputted if a dictionary tape was loaded by entering "yes" to the "LIST ENCYCLOPEDIA" prompt. These sentences will be displayed in a form broken down into its information type components.

After all of this maintenance and review activity has taken place, the user may begin entering sentences conveying various information by combining phrases previously defined to the system using simple English grammar and enter questions made up of previously defined phrases which ask about information conveyed in previously entered sentences or calculate unknown numerical statistics from quantitative information and relationships conveyed in previously inputted sentences.

The system recognizes a sentence as a question if it begins with a question invoker phrase or if it begins with a verb phrase, in which case the question is taken to be a yes/no confirmation of an informational sentence previously inputted.

Each sentence or question must be entered one at a time in response to the "ENTER SENTENCE OR HIT ENTER". If you hit enter only in response to this prompt, the program will go on to the last section of the system.

During sentence analysis, several error messages may appear. "UNRECOGNIZABLE PHRASE" means that the present sentence being analyzed contains a phrase not in the current dictionary. Any sentences inputted prior to this message are saved in the dictionary. The user can hit the BREAK key and type in "GOTO 455" (ENTER) to put the program back into the "DEFINING PHRASES" section so that the missing phrase can be defined. After doing this and going through the program until you get back to the "ENTER SENTENCE" prompt, you may re-enter the sentence which caused the original error message.

The "INVALID GRAMMAR" message occurs if the sentence being analyzed is too complex for the system. The user should re-enter the same information but using one or more simpler sentences which collectively express the same thought.

"UNKNOWN" and "TOO COMPLEX" messages occur when a "how many" question is too difficult or insufficient data exists in the dictionary. Additional informational sentences may be needed to be inputted before the question is retried or the question might need to be re-expressed in a different form that the system may

understand better.

Finally, the last section of the program writes the dictionary of phrase definitions and sentences to cassette tape if the user responds "yes" to the "SAVE DICTIONARY ON TAPE" prompt. If you respond "no" or after the tape is written, the program ends.

It should be noted that the format of the dictionary uses all string storage. Because of this, the system does not allow punctuation in sentences and numeric modifiers involved in subject associations may only contain non-negative integer numbers. Also, sentence analysis may require several minutes, especially involving "how many" question computation.

In contrast, let us look at the improvements found in NLOS/2 not found in NLOS/1. First, NLOS/2 is a larger, more involved program requiring 32K. The dictionary format has been changed to allow faster execution and more conservation in storage. One drawback to this is that NLOS/2 can not read an NLOS/1 dictionary tape.

Numeric modifiers may contain decimal points and negative values to allow for greater computational flexibility.

Rather than sequentially running through each functional section of the program as we did in NLOS/1, NLOS/2 allows the user to select the section desired by use of a series of commands. Rather than using sectional (yes/no availability) prompts, NLOS/2 uses a general command prompt of a right arrow. The response to this prompt should be "DEFINITION" or "DEF" to initiate a phrase definition, "VOCABULARY" to list the phrase definition portion of the dictionary, "SENTENCE" to list the sentences currently stored in the dictionary, "END" to write the dictionary to tape and end the program, and "PROCEDURE" to input or update the subroutine associated with an action verb phrase.

If the text entered at the arrow prompt is other than one of the above commands, it is assumed to be a sentence or question to be analyzed.

Concerning action verb subroutines maintained by the procedure command, if a question starts with a verb phrase with a subroutine, the sentence is passed to the subroutine and the subroutine is executed as if it were an order or command with the remainder of the sentence treated as a parameter to be interrogated by the subroutine, rather than the sentence being treated as a yes/no question as is implied in a verb phrase with no subroutine associated with it.

As you can see, NLOS/2 has some large advantages as compared to NLOS/1. Some of the other smaller changes include the ability to configure the maximum number of phrase definitions, sentence storage and subject association entries allowed in the dictionary as opposed to NLOS/1 which has a fixed limit on the size of the dictionary; and an instructional subroutine which teaches the user how to set up the coding structure needed for an action verb phrase subroutine to function.

If you would like to run NLOS/2 in only 16K, you would have to give up the action verb subroutine capability. This can be done by using the following changes:

DELETE 1600-1945
DELETE 7500-7585
DELETE 9800-9974

1600 RETURN
7500 RETURN
9800 GOTO 1140

This would give you a super NLOS/1 with the storage and execution advantages of NLOS/2.

And now, here is the programming listing for NLOS/2:

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1 CLS:PRINTCHR$(23):PRINTTAB(14)"NLOS":PRINT:PRINTTAB(15)"A":PRINTTAB(8)"NATURAL
  LANGUAGE":PRINTTAB(8)"OPERATING SYSTEM":PRINT
2 PRINTTAB(9)"COPYRIGHT 1979":PRINTTAB(10)"CYBERWATE CO.":PRINTTAB(8)"R. D. #3 BOX
  192A":PRINTTAB(6)"NAZARETH, PA. 18964":PRINTTAB(7)"PHONE 215-759-6873"
3 PRINT:PRINT" CASSETTE $4.95, SOURCE $1.95":PRINT:INPUT"NEED INSTRUCTIONS(Y/N)"
  ;V$:IFV$="Y"THENGOSUB1600
4 CLS:PRINT"I NEED TO KNOW SOME STATISTICS":DEFINTA,B,C,I
5 INPUT"HOW MUCH STRING SPACE MAY I USE":J:CLRABJ:I4=32:IL=4:IK=10
6 INPUT"WHAT IS THE MAXIMUM NUMBER OF DIFFERENT PHRASES THAT YOU WILL TEACH ME":
  I1:IFI1<10THENI1=10
7 INPUT"WHAT IS THE MAXIMUM NUMBER OF SENTENCES USING THOSE PHRASES THAT YOU WILL
  INPUT TO INFORM ME ON TOPICS":I2:IFI2<10THENI2=10
8 INPUT"WHAT IS THE MAXIMUM NUMBER OF SUBJECT ASSOCIATIONS I MAY LEARN ABOUT":I3
  :IFI3<10THENI3=10
9 DIMA$(I1),A1(I1,4),A2$(I2,8),A3$(I3,2),A4(I3,2),A5(I4),A6$(I4),H(IK,IL),A8(I
  I3,2),A9(I2)
10 I9=(MEM-256)/5:DIMA7(I9):PRINT"THANK YOU!"
11 FORI6=0TOI1:A0$(I6)=" ":FORI7=0TO4:A1(I6,I7)=0:NEXTI7:NEXTI6:C1=0
12 FORI6=0TOI2:FORI7=0TO8:A2$(I6,I7)=" ":NEXTI7:A8(I6)=0:NEXTI6:C2=0
13 FORI6=0TOI3:FORI7=0TO2:A3$(I6,I7)=" ":A4(I6,I7)=0:A8(I6,I7)=0:NEXTI7:NEXTI6:
  C3=0
14 FORI6=0TOI4:A5(I6)=0:A6$(I6)=" ":NEXTI6
15 FORI6=0TOI9:A7(I6)=-1:NEXTI6:C9=0
16 FORI6=0TOIK:FORI7=0TOIL:H(I6,I7)=0:NEXTI7:NEXTI6:V2$=" "
18 PRINT"YOU HAVE A TOTAL OF ";I9;" INSTRUCTION SPACES FOR PROCEDURES!"
25 INPUT"SHOULD I LOAD A DATA BASE TAPE(Y/N)":V$:IFV$<>"Y"THEN1140
30 INPUT#-1,C1,C2,C3,B1
40 IFC1<1THEN50
45 FORI6=1TOC1:INPUT#-1,A0$(I6),A1(I6,1),A1(I6,2),A1(I6,3),A1(I6,4):A0$(I6)=" "+
  A0$(I6):NEXTI6
50 IFC2<1THEN60
55 FORI6=1TOC2:INPUT#-1,A2$(I6,1),A2$(I6,2),A2$(I6,3),A2$(I6,4),A2$(I6,5),A2$(I6,
  6),A2$(I6,7),A2$(I6,8),A9(I6):NEXTI6
56 FORI6=1TOC2:FORI7=1TO8:A2$(I6,I7)=" "+A2$(I6,I7):NEXTI7:NEXTI6
60 IFC3<1THEN70
65 FORI6=1TOC3:INPUT#-1,A3$(I6,1),A3$(I6,2),A4(I6,1),A4(I6,2),A8(I6,1),A8(I6,2
  ):NEXTI6
66 FORI6=1TOC3:FORI7=1TO2:A3$(I6,I7)=" "+A3$(I6,I7):NEXTI7:NEXTI6
70 IFB1<1THEN1140
72 C9=0
75 FORI6=1TOB1
80 INPUT#-1,B0,B1,B2,B3,B4,B5,B6,B7,B8,B9,BA,BB,BC,BD,BE,BF,BG
85 IFB0<1THENC9=C9+1:A7(C9)=B0
90 IFB1<1THENC9=C9+1:A7(C9)=B1
95 IFB2<1THENC9=C9+1:A7(C9)=B2
100 IFB3<1THENC9=C9+1:A7(C9)=B3
105 IFB4<1THENC9=C9+1:A7(C9)=B4
110 IFB5<1THENC9=C9+1:A7(C9)=B5
115 IFB6<1THENC9=C9+1:A7(C9)=B6
120 IFB7<1THENC9=C9+1:A7(C9)=B7
125 IFB8<1THENC9=C9+1:A7(C9)=B8
130 IFB9<1THENC9=C9+1:A7(C9)=B9
135 IFB0<1THENC9=C9+1:A7(C9)=BA
140 IFB1<1THENC9=C9+1:A7(C9)=BB
145 IFB2<1THENC9=C9+1:A7(C9)=BC
150 IFB3<1THENC9=C9+1:A7(C9)=BD
155 IFB4<1THENC9=C9+1:A7(C9)=BE
160 IFB5<1THENC9=C9+1:A7(C9)=BF
165 IFB6<1THENC9=C9+1:A7(C9)=BG
170 NEXTB1:GOTO1140
200 IFN=21THENB1=A1(I6,4)
205 RETURN
460 MB$=" ":INPUT"PHRASE":MB$:J=LEN(MB$)
465 MA$=" ":I7=0:B1=0
470 N=0:PRINT"1=SUBJECT, 2=VERB, 3=PREPOSITION, 4=CONJUNCTION, 5=MODIFIER, 6=QUESTION
  INVOKER":INPUTN:IFN<1ORD6THEN470

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480 K=7:ONNGOTO490,500,510,560,530,550
490 INPUT"1=WHO, 2=WHAT, 4=WHERE";K:IFK=10RK=20RK=4THEN560ELSE490
    INPUT"2=WHAT, 4=WHERE";K:IFK=20RK=4THEN560ELSE500
    INPUT"2=WHAT, 3=WHEN, 4=WHERE, 5=HOW, 9=WHY";K:IFK=20RK=30RK=40RK=50RK=9THEN560E
LSE510
530 INPUT"2=WHAT, 5=HOW, 7=ASSOCIATION, 8=MULTIPLICATIVE";K:IFK=20RK=50RK=70RK=87THE
N560ELSE530
550 INPUT"1=WHO, 2=WHAT, 3=WHEN, 4=WHERE, 5=HOW, 6=HOW MANY, 9=WHY";K:IFK=10RK=20RK=30
RK=40RK=50RK=60RK=9THEN560ELSE550
560 IFN<2THEN600
575 IFC1<1THEN612
580 INPUT"ROOT VERB PHRASE";M#
582 FORI6=1TOC1:IFA0$(I6)=M#THENI7=I6
583 NEXTI6
600 IFC1<1THEN612
610 FORI6=1TOC1:IFA0$(I6)=M#THENGOSUB200:GOTO620
611 NEXTI6
612 I6=C1+1:IFI6>I1THENPRINT"TOO MANY PHRASES!":RETURN
620 A0$(I6)=M#:A1(I6,1)=N:A1(I6,2)=K:A1(I6,3)=I7:A1(I6,4)=B1:C1=I6
621 IFI7=0THENA1(I6,3)=I6
622 RETURN
775 INPUT"PHRASE";M#:I6=1:IFM#="ALL"ANDC1>0THEN790
776 IFC1<1THENRETURN
777 FORI6=1TOC1:IFA0$(I6)=M#THEN790
778 NEXTI6:RETURN
779 IFI6<1THENRETURN
790 N=A1(I6,1):K=A1(I6,2):I7=A1(I6,3):I8=A1(I6,4)
800 PRINT"PHRASE-";A0$(I6)
840 IFN=1V#="SUBJECT"
850 IFN=2V#="VERB"
860 IFN=3V#="PREPOSITION"
870 IFN=4V#="CONJUNCTION"
880 IFN=5V#="MODIFIER"
900 IFN=6V#="QUESTION INVOKER"
920 PRINT"GRAMMAR-";V#:P=P+1:IFN=1V#="WHO"
940 IFK=2V#="WHAT"
950 IFK=3V#="WHEN"
960 IFK=4V#="WHERE"
970 IFK=5V#="HOW"
980 IFK=6V#="HOW MANY"
990 IFK=7V#="ASSOCIATION"
1000 IFK=8V#="MULTIPLICATIVE"
1015 IFK=9V#="WHY"
1020 PRINT"USAGE-";V#:IFN=2THENPRINT"ROOT VERB PHRASE-";A0$(I7)
1028 IFM#="ALL"THENINPUT"HIT ENTER TO CONTINUE";V#:I6=I6+1:GOTO779

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1029 RETURN
1140 V#=" ":INPUT">";V#:P=0
1141 IFV#="PROCEDURE"THENGOSUB7500:GOTO1140
1142 IFV#="DEFINITION"THENGOSUB460:GOTO1140
1143 IFV#="VOCABULARY"THENGOSUB775:GOTO1140
1144 IFV#="DEF"THENGOSUB460:GOTO1140
1145 IFV#="SENTENCE"THENGOSUB8500:GOTO1140
1146 IFV#="END"ORV#=" "ORV#=" "THEN8000
1149 V#-V#+ " "
1150 J=LEN(V#):ZB=0:T=0:Z0#=" ":B#=" "
1151 P1=0:P2=0
1160 ZH=0:ZI=0:ZO=0:N=0:K=0:L=0:ZB=0:ZE=0:XN=0:ZZ=0
1165 M1#=" ":M2#=" ":M3#=" ":M4#=" ":M5#=" ":M6#=" ":M7#=" ":E#=" ":ZB=0:B#=" ":
ZY=0:Q#=" "
1167 S1#=" ":S2#=" ":S3#=" ":S4#=" ":V1=0:V2=0:V3=0:V4=0:X1=0:X2=0:X3=0:X4=0:D#="
" "
1168 SR=0
1170 P=P+1:IFP>JTHEN6000
1180 F1=ASC(MID$(V#,P,1)):IFF1=32THEN1170
1181 IFSR=0THENSR=P
1182 IFF1=43ORF1=45ORF1=46THEN1196
1190 IFF1<48ORF1>57THEN1240
1196 SL=1
1198 SR=P
1200 P=P+1:IFP>JTHEN1230
1220 F1=ASC(MID$(V#,P,1)):IFF1=32THEN1230
1221 SL=SL+1:GOTO1200
1230 C#-MID$(V#,SR,SL)
1231 T=VAL(C#):N=5:K=10
1232 S9=0:SR=1:SL=1
1233 GOTO1340
1240 SR=-1:SL=0:IFC1<1THEN1250
1241 FORI6=1TOC1
1242 IFLEN(V#)-P+1<LEN(A0$(I6))THEN1246
1243 S0=LEN(A0$(I6))
1245 IFA0$(I6)=MID$(V#,P,S0)ANDS0>SLTHENSR=I6:SL=S0
1246 NEXTI6
1250 IFSR=-1THEN2222
1260 C#-A0$(SR):N=A1(SR,1):K=A1(SR,2):S9=SR:SR=SL
1340 IFN=1ANDZH<3ANDZB=1THEN2222
1341 IFZH=9ANDN<4THENZH=0:GOSUB3070
1342 IFN=4ANDZB<1THEN2222
1343 IFZH=3ORZH=9THEN4100
1344 IFN=4ANDZB=1THEN2222
1345 IFN=4ANDZ0=7THEN2222

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1345 IFZ=31HEND4=0#+" "+C#
1347 IFZ=4RANDOM11HEN2222
1350 IFN=5ANDK<71HEND4=0#+" "+C#
1355 IFN=50#="0#+" "+C#
1360 IFN=31HEND4=0#;Z=3;Z1=K
1370 IFZ=3RANDOM=1Z=9
1390 IFN=61HEN2820
1400 IFN=5ANDK=2NM=1
1405 IFN=5ANDK=6AND1<21HEN2222
1410 IFN=2ANDZ=6ANDZ=8Z=8
1415 IFZ=6ANDR1(53,4)>01HEN3000
1420 IFN=3ANDZ=2AND0#<0 "M4=M6#/"+"0#;0#=" ".0#=" "
1425 IFN=11HEN#="0#+" "+C#;0#=" "
1430 IFN=1AND0#<0 "C#="0#+" "+C#;0#=" ".0#=" "
1435 IFZ=3RANDOM=100SUB4300
1440 IFN=2AND0#<0 "M6=M6#/"+"0#;0#=" ".0#=" "
1460 IFN=4Z=1
1472 IFN=2ANDZ=0ANDP1<01HENZ0#="MID$(V$,P1);Z2=P2:GOSUB2135:P=P1:GOTO1150
1480 IFN=200SUB3100
1490 IFN=1ANDZ=300SUB4600
1500 IFN=1ANDZ=200SUB4600
1510 IFN=1ANDZ=400SUB4800
1520 IFN=1ANDZ=0400SUB4700
1530 IFN=11-0:NM=0:ZY=ZY+1
1540 GOTO2000
1600 CLS:PRINT"MS/DOS/2 USERS MUST HAVE A WORKING KNOWLEDGE OF MS/DOS/1!"
1695 PRINT"WHEN THE > PROMPT APPEARS, YOU MUST ENTER A COMMAND OR"
1700 PRINT"A SENTENCE OR QUESTION. THE COMMANDS ARE AS FOLLOWS-"
1705 PRINT"DEFINITION - ALLOWS YOU TO DEFINE A PHRASE TO THE SYSTEM"
1710 PRINT"VOCABULARY - ALLOWS YOU TO EXAMINE A PHRASE DEFINITION OR"
1715 PRINT"ENTER ALL TO EXAMINE ALL PHRASES. SENTENCE - ALLOWS YOU TO"
1720 PRINT"EXAMINE SENTENCES PREVIOUSLY INPUTTED. PROCEDURE - ALLOWS"
1725 PRINT"YOU TO DEFINE A BASIC PROGRAM TO BE RUN WHEN THE SYSTEM"
1730 PRINT"SEES A PARTICULAR VERB PHRASE. THIS INVOLVES ENTERING A"
1735 PRINT"SERIES OF OP CODES AND THEIR OPERANDS WHICH THE SYSTEM WILL"
1740 PRINT"TRANSLATE INTO A BASIC PROGRAM. THE SYSTEM SUPPLIES WORK"
1745 PRINT"SPACE FOR YOUR BASIC ROUTINE IN THE FORM OF 33 SINGLE"
1750 PRINT"PRECISION FIELDS NUMBERED 0 THRU 32 AND 33 STRING FIELDS"
1755 PRINT"NUMBERED 0 THRU 32. THE WORK SPACE IS INITIALIZED PRIOR"
1760 PRINT"TO RUNNING THE VERB PROCEDURE EXCEPT FOR STRING 0 WHICH"
1762 INPUT"HIT ENTER TO CONTINUE";V$:CLS
1765 PRINT"CONTAINS THE SENTENCE CONTAINING THE VERB PHRASE JUST"
1770 PRINT"INPUTTED. THE VERB PROCEDURE IS INPUTTED INTO A BUFFER"
1775 PRINT"ALLOCATED FROM CONTIGUOUS INTEGER FIELDS. YOU MUST TELL"
1780 PRINT"THE SYSTEM HOW MANY INTEGER SPACES TO ALLOW FOR A VERB."

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1785 PRINT"EACH SPACE IS ADDRESSED NUMERICALLY FROM 1 TO N. FOR A NEW"
1790 PRINT"PROCEDURE, ALL SPACES ARE INITIALIZED TO 0. SPACES MAY BE"
1795 PRINT"LISTED, CHANGED IN VALUE OR HAVE THE ASC VALUES OF A"
1800 PRINT"STRING INSERTED STARTING AT A SPECIFIED LOCATION WITH"
1805 PRINT"THE STRING LENGTH INSERTED BEFORE THE STRING. THIS IS"
1810 PRINT"USED TO INPUT STRING OPERANDS FOR OP CODES THAT REQUIRE"
1815 PRINT"THEM. ANY OPERANDS REQUIRED BY AN OP CODE MUST FOLLOW"
1820 PRINT"THAT OP CODE IN THE INSTRUCTION SPACE. HERE ARE THE OP"
1825 PRINT"CODES AND THEIR OPERAND REQUIREMENTS-"
1830 INPUT"HIT ENTER TO CONTINUE";V$:CLS
1835 PRINT"OP CODE-NAME, OPERANDS (S-STRING, N-NUMERIC FIELD, R-STRING"
1840 PRINT"FIELD, I-NUMERIC STRING, L-LABEL NUMBER)"
1845 PRINT"0-NOP 1-CLS 2-LET, R, S 3-LET, N, I 4-IF, R, R 5-IF, N, N 6-POKE, N, N"
1850 PRINT"7-PEEK, N, N 8-ADD, N, N 9-SUBTRACT, N, N 10-MULTIPLY, N, N"
1855 PRINT"11-DIVIDE, N, N 12-L, N, N 13-#+, R, R 14-INT, N, N"
1860 PRINT"15-SIN, N, N 16-COS, N, N 17-TAN, N, N 18-ATN, N, N 19-VAL, N, R"
1865 PRINT"20-STR$, R, N 21-STRING$, R, N, R 22-LPRINT, R 23-INKEY$, R"
1870 PRINT"24-JUMP TO LABEL, L 25-ABS, N, N 26-INP, N, N 27-PRINT, R"
1875 PRINT"28-PRINT$, N, R 29-INPUT, R 30-INPUT N-1, R 31-PRINT N-1, R"
1880 PRINT"32-LEFT$, R, R, N 33-RIGHT$, R, R, N 34-MID$, R, R, N, N 35-MOVE, N, N"
1885 PRINT"36-MOVE, R, R 37-EXP, N, N 38-LOG, N, N 39-JUMP IF =, L"
1890 PRINT"40-JUMP IF >, L 41-JUMP IF <, L 42-ASC, N, R 43-CHR$, R, N"
1895 PRINT"44-LEN, N, R 45-SQR, N, N 46-RETURN 47-PRINT$, N 48-SET, N, N"
1900 PRINT"49-RESET, N, N 50-POINT, N, N, N 51-OUT, N, N 52-RND(0), N"
1902 INPUT"HIT ENTER TO CONTINUE";V$:CLS
1905 PRINT"53-INSTR, R, R, N 54-END 55-GOSUB, L 999-LABEL, L"
1910 PRINT"MOST OP CODES AND THEIR OPERANDS OPERATE LIKE THEIR BASIC"
1915 PRINT"COUNTERPARTS WITH THE FIRST OPERAND BEING THE RESULT FIELD."
1920 PRINT"POINT AND INSTR PUT 1 IN THE RESULT NUMERIC FIELD WITH"
1925 PRINT"THE FIRST OPERAND OF INSTR BEING THE LARGER STRING IN THE"
1930 PRINT"SEARCH. A JUMP SHOULD FOLLOW AN IF INSTRUCTION."
1935 PRINT"YOU SHOULD NOT ATTEMPT TO PROGRAM A VERB PROCEDURE UNLESS"
1940 PRINT"YOU ARE EXPERIENCED IN LEVEL 2 BASIC PROGRAMMING!"
1945 INPUT"HIT ENTER TO CONTINUE";V$:CLS:RETURN
2000 P=P+SR-1:IFN=2P1:P+1
2001 IFN<520=N:ZE=K
2002 IFN=2P2=Z1
2010 GOTO1170
2020 IFZ=10R20<00R0#<0 "THEN2222
2025 IFK=920=5
2030 IFK=120=1
2040 IFK=220=2
2050 IFK=320=3
2060 IFK=420=4
2070 IFK=520=6

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2000 IFK=620-7
2005 IFZ0=7ANDZ8=1THEN2222
    ) GOT02000
    ) GOSUB3000:C2=C2+1:A2*(C2,1)=M1$:A2*(C2,2)=M2$:A2*(C2,3)=M3$:A2*(C2,4)=M4$:A
2*(C2,5)=M5$:A2*(C2,6)=M7$:A2*(C2,7)=M5$:A2*(C2,8)=Z0$:A9(C2)=ZZ:Z2=0:Z0$=" "
2155 M1$=" ":M2$=" ":M3$=" ":M4$=" ":M5$=" ":M6$=" ":M7$=" ":RETURN
2222 PRINT"I DO NOT UNDERSTAND THIS SENTENCE!":GOT01140
3000 FORI6=1TOC1:IFM7$=A0$(I6)THENI7=A1(I6,3):M7$=A0$(I7)
3010 NEXTI6:RETURN
3070 IFZ1=5M5$+M5$+ "/" +D$
3075 IFZ1=5M6$+M6$+ "/" +D$
3080 IFZ1=2M2$+M2$+ "/" +D$
3090 IFZ1=3M3$+M3$+ "/" +D$
3100 IFZ1=4M4$+M4$+ "/" +D$
3110 D$=" ":RETURN
3180 IFM7$=" "THENM7$=C$ELSEM7$=M7$+" "+C$
3190 ZH=N:ZI=K:RETURN
4100 IFN=10RN=5THEN1344
4110 IFZ4=9ANDN=4ZH=3:GOT01344
4120 GOT02222
4300 ZR=ZP+1:IFK=1M1$+M1$+ "/" +C$
4320 IFK=2M2$+M2$+ "/" +C$
4330 IFK=4M4$+M4$+ "/" +C$
    ) RETURN
    ) S1$=S3$:S2$=S4$:V1=V3:V2=V4:X1=X3:X2=X4:S3$=" ":S4$=" ":V3=0:V4=0:X3=0:X4=0
:RETURN
4700 S3$=E$:V3=T:X3=XN:GOSUB4900:RETURN
4800 S4$=E$:V4=T:X4=XN:GOSUB4900:RETURN
4900 IFS1$<>" "F$=S1$:F1=V1:F2=X1:GOSUB5000
4910 IFS2$<>" "F$=S2$:F1=V2:F2=X2:GOSUB5000
4920 RETURN
5000 IFM6$<>" "ORM3$<>" "ORM5$<>" "RETURN
5001 IFF2=1ANDXM=1:RETURN
5002 IFZ0=0:RETURN
5005 C3=C3+1:A3*(C3,1)=F$:A3*(C3,2)=E$:A4(C3,1)=F2:A4(C3,2)=XM
5010 A0!(C3,1)=F1:A0!(C3,2)=T:RETURN
6000 IFQ$<>" "M6$+M6$+ "/" +0$
6001 IFZH=9THENGOSUB3070
6002 IFZ0=0THEN6200
6005 IFM7$=" "THEN2222ELSEGOSUB2135:GOT01140
6200 IFZ0=7THEN7000ELSEL=1:P=0
6205 IFC1<1THEN6210
6206 FORI8=1TOC1:IFLEN(M7$)<OLEN(A0$(I8))ORM7$(I8)<M7$THEN6200
6207 B2=A1(I8,3):IFB2=0THENM7$=A0$(B2)
    ) NEXTI8
6210 L=1:P=0
6220 IFC2<1THEN6700
6230 FORI8=1TOC2
6300 IFM1$=" "THEN6320
6310 M6$=A2$(I8,1):M6$=M1$:GOSUB9700:IFM6=0THEN6600
6320 IFM2$=" "THEN6340
6330 M6$=A2$(I8,2):M6$=M2$:GOSUB9700:IFM6=0THEN6600
6340 IFM3$=" "THEN6360
6350 M6$=A$(L+3):M6$=M3$:GOSUB9700:IFM6=0THEN6600
6360 IFM4$=" "THEN6380
6370 M6$=A2$(I8,4):M6$=M4$:GOSUB9700:IFM6=0THEN6600
6380 IFM5$=" "THEN6400
6390 M6$=A2$(I8,7):M6$=M5$:GOSUB9700:IFM6=0THEN6600
6400 IFM6$=" "THEN6420
6410 M6$=A2$(I8,5):M6$=M6$:GOSUB9700:IFM6=0THEN6600
6420 IFM7$=A2$(I8,6)THEN6400ELSE6600
6450 M6$=A2$(I8,3):M6$=M3$:GOSUB9700:IFM6=0THEN6600
6460 P=I8
6600 NEXTI8
6700 IFZ0<9ANDP=0THEN7920
6705 IFZ0=8ANDP=0PRINT"NO":GOT01140
6720 IFZ0=A9(P)THENPRINTA2$(P,8):GOT01140
6730 IFZ0=1ANDR2$(P,1)<>" "THENPRINTA2$(P,1):GOT01140
6740 IFZ0=3ANDR2$(P,2)<>" "THENPRINTA2$(P,2):GOT01140
6750 IFZ0=3ANDR2$(P,3)<>" "THENPRINTA2$(P,3):GOT01140
6760 IFZ0=4ANDR2$(P,4)<>" "THENPRINTA2$(P,4):GOT01140
6770 IFZ0=5ANDR2$(P,7)<>" "THENPRINTA2$(P,7):GOT01140
6780 IFZ0=6ANDR2$(P,5)<>" "THENPRINTA2$(P,5):GOT01140
6800 IFZ0=8PRINT"YES":GOT01140
6810 GOT07920
7000 IFX1=10RV<0ORX3=10RZY<20RM3$<>" "ORM5$<>" "ORM6$<>" "ORS1$=" "ORS3$=" "THE
N2222
7001 IK=10:IL=4
7002 L=1:FORN=1TOIK:FORK=1TOIL:H(N,K)=0:NEXTK:NEXTN:KI=0:N=0:ZD=0
7003 IFC3<1THEN7920
7004 L=0
7015 GOSUB7900
7020 IFSR=9THEN7060
7022 P=0:J=0
7025 IFR3$(L,1)=S3$THENP=2:J=1
7026 IFR3$(L,2)=S3$THENP=1:J=2
7030 IFF=0ORJ=0THEN7015
7031 IFR4(L,P)=10RPA(L,J)=1THEN7015
7032 IFR0!(L,J)>1THEN7015
7035 IFKI=0THEN7043

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7037 T=0
7039 T=T+1:Z=H(T,1):Z0=H(T,4):IFA3*(Z0,Z)=A3*(L,P)THEN7044
7041 IF T<K THEN7039
7043 KI=KI+1:T=KI
7044 IF KI>J THEN7025
7045 Z=AB!(L,P):IF Z=0 THEN Z=1
7047 H(T,1)=P:H(T,2)=Z:H(T,4)=L:IFA3*(L,P)=S1 THEN N=1
7049 GOTO7015
7060 IF N=0 OR KI=0 THEN7020
7062 ZI=N:Z=H(N,2):IF Z=0 THEN7030
7064 IF Z=0 THEN7020
7066 FOR P=1 TO KI: T=H(P,1):Z=H(P,4):IF H(P,2)>0 THEN7115 ELSE7260
7068 Z=0:FOR N=1 TO KI:K=H(N,1):K3=H(N,4):IF N=P THEN7250 ELSE H(N,3)=0
7070 L=0
7072 GOSUB7900:Z=0:Z0=0:IF S=9 THEN7240
7074 IFA3*(Z0,T)=A3*(L,1) THEN Z=1:Z0=2
7076 IFA3*(Z0,T)=A3*(L,2) THEN Z=2:Z0=1
7078 IF Z=0 THEN7140
7080 IFA3*(L,Z0)=A3*(K3,K) THEN7200 ELSE7140
7082 Z=AB!(L,Z):Z0=AB!(L,Z0):IF Z=0 AND Z0=0 THEN7230 ELSE7140
7084 H(N,3)=Z:GOTO7140
7086 IF H(N,3)>0 THEN Z=Z+1
7088 NEXT N:IF Z=KI-1 THEN7270
7090 NEXT P:GOTO7020
7092 FOR N=1 TO KI:IF P=N THEN7290
7094 IF H(N,2)>0 THEN H(N,2)=H(N,2)+H(N,3) ELSE H(N,2)=H(N,3)
7096 H(N,3)=0:NEXT N
7098 FOR N=1 TO KI:IF N=P THEN7400 ELSE H(N,1)
7100 Z=H(N,4)
7102 FOR K=1 TO KI:IF K=P OR K=N THEN7410
7104 L=1:Z=H(K,1)
7106 L=0
7108 K3=H(K,4)
7110 GOSUB7900:Z=0:Z0=0
7112 IF S=9 THEN7410
7114 IFA3*(Z0,T)=A3*(L,1) THEN Z=1:Z0=2
7116 IFA3*(Z0,T)=A3*(L,2) THEN Z=2:Z0=1
7118 IF Z=0 THEN7030
7120 IFA3*(K3,Z)=A3*(L,Z) THEN7030 ELSE7030
7122 IFA4(L,1)=1 OR A4(L,2)=1 THEN7400 ELSE7030
7124 H(N,2)=AB!(L,Z):H(K,3)=AB!(L,Z):GOTO7030
7126 NEXT K
7128 NEXT N
7130 FOR N=1 TO KI:IF N=P THEN7450
7132 IF H(N,3)>0 H(N,2)=H(N,2)+H(N,3)
7450 NEXT N
7460 T=0:FOR N=1 TO KI:IF N<OPTHE N=T+H(N,2):NEXT N
7470 Z=H(P,2)/T:IF H(21,3)>0 THEN Z=Z+H(21,3)
7480 GOTO7030
7500 IF C1<1 THEN RETURN
7502 M#=" ":P=0:B=0
7504 INPUT"VERB PHRASE":M#
7506 FOR I=1 TO C1:IFA0*(I)=M# THEN7520
7508 NEXT I:PRINT"UNKNOWN!":RETURN
7510 I7=A1(I,4):IF I7=0 THEN7540
7512 IFA1(I,1)<2 THEN PRINT"NOT A VERB!":RETURN
7514 PRINT"NEW ACTION VERB PROC"
7516 B3=C9+1:IF B3>219 THEN PRINT"OUT OF MEMORY":END
7518 C9=B3:I7=B3:A1(I,4)=B3
7520 B4=0:INPUT"# INSTRUCTION SPACES":B4:IFA4<2 THEN7432
7522 IFC9+B4-1>19 THEN PRINT"INSUFFICIENT MEMORY":GOTO7030
7524 A7(I7)=B4-1:B6=I7:FOR B5=1 TO B4-1:B6=B6+1:A7(B6)=0:NEXT B5:PRINT"INITIALIZED 1
0 NOP5"
7526 C9=C9+B4-1
7528 INPUT"L=LIST,C=CHANGE,S=STRING,E=END":M#
7530 IF M#="E" THEN RETURN
7532 IF M#="S" THEN7530
7534 INPUT"FROM TO LOCATIONS":B1,B2:IF B1>82 OR B1<10 OR B2>A7(I7) THEN7550
7536 IF M#="C" THEN7565
7538 FOR B3=81 TO B2:PRINT"LOC ":B3:" CONTENTS ":A7(I7+B3)
7540 IFA7(I7+B3)>0 AND A7(I7+B3)<255 THEN PRINT"ASC ":CHR$(A7(I7+B3)) ELSE PRINT" "
7542 NEXT B3:GOTO7540
7544 FOR B3=81 TO B2:PRINT"LOC ":B3:" WBS ":A7(I7+B3)
7546 IFA7(I7+B3)>0 AND A7(I7+B3)<255 THEN PRINT"ASC ":CHR$(A7(I7+B3)) ELSE PRINT" "
7548 INPUT"NOW":A7(I7+B3)
7550 NEXT B3:GOTO7540
7552 INPUT"LENGTH POINTER LOCATION":B1:IFA1<10 OR B1>A7(I7) THEN7575
7554 M#=" ":INPUT"STRING VALUE":M#:B2=LEN(M#):IF B2<10 OR B2+B1>A7(I7) THEN7580
7556 A7(I7+B1)=B2
7558 FOR B3=1 TO B2:A7(I7+B1+B3)=ASC(MID$(M#,B3,1)):NEXT B3:GOTO7540
7560 L=L+1:IF L>C3 THEN S=9:L=0 ELSE S=0
7562 RETURN
7564 PRINT"UNKNOWN":GOTO1140
7566 PRINT"TOO COMPLEX":GOTO1140
7568 IF Y3=0 THEN Z=Z+Y3
7570 PRINT Z:GOTO1140
8000 IFC1>0 OR C2>0 OR C3>0 OR C9>0 THEN8005 ELSE END
8005 INPUT"STORE DATA BASE ON TAPE (Y/N)":Y
8010 IF Y<>"Y" THEN END
8020 B4=INT(C9/I7)+1

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8022 PRINT#-1,C1,C2,C3,BH
8025 IFC1<1THEN8035
8030 FORI6=1TOC1
8035 PRINT#-1,A0$(I6),A1(I6,1),A1(I6,2),A1(I6,3),A1(I6,4)
8038 NEXTI6
8040 IFC2<1THEN8045
8045 FORI6=1TOC2
8050 PRINT#-1,A2$(I6,1),A2$(I6,2),A2$(I6,3),A2$(I6,4),A2$(I6,5),A2$(I6,6),A2$(I6,7),A2$(I6,8),A2$(I6,9)
8053 NEXTI6
8055 IFC3<1THEN8055
8060 FORI6=1TOC3
8065 PRINT#-1,A3$(I6,1),A3$(I6,2),A4(I6,1),A4(I6,2),A8!(I6,1),A8!(I6,2)
8068 NEXTI6
8070 IFB#K1THENEND
8075 FORI6=1TOBH
8080 I7=0
8085 B0=-1:I7=I7+1:IFI7<=C9THENB0=A7(I7)
8090 B1=-1:I7=I7+1:IFI7<=C9THENB1=A7(I7)
8095 B2=-1:I7=I7+1:IFI7<=C9THENB2=A7(I7)
8100 B3=-1:I7=I7+1:IFI7<=C9THENB3=A7(I7)
8105 B4=-1:I7=I7+1:IFI7<=C9THENB4=A7(I7)
8110 B5=-1:I7=I7+1:IFI7<=C9THENB5=A7(I7)
8115 B6=-1:I7=I7+1:IFI7<=C9THENB6=A7(I7)
8120 B7=-1:I7=I7+1:IFI7<=C9THENB7=A7(I7)
8125 B8=-1:I7=I7+1:IFI7<=C9THENB8=A7(I7)
8130 B9=-1:I7=I7+1:IFI7<=C9THENB9=A7(I7)
8135 BA=-1:I7=I7+1:IFI7<=C9THENBA=A7(I7)
8140 BB=-1:I7=I7+1:IFI7<=C9THENBB=A7(I7)
8145 BC=-1:I7=I7+1:IFI7<=C9THENBC=A7(I7)
8150 BD=-1:I7=I7+1:IFI7<=C9THENBD=A7(I7)
8155 BE=-1:I7=I7+1:IFI7<=C9THENBE=A7(I7)
8155 NEXTI6:END
8500 IFC2<1THENRETURN
8502 FORI6=1TOC2:CL5:PRINT"WHEN-";A2$(I6,3):PRINT"WHY-";A2$(I6,7)
8505 PRINT"WHO-";A2$(I6,1):PRINT"WHAT-";A2$(I6,2):PRINT"WHERE-";A2$(I6,4)
8510 PRINT"VERB-";A2$(I6,6):PRINT"HOW-";A2$(I6,5):PRINT"OBJ CLAUSE-";A2$(I6,8)
8515 INPUT"HIT ENTER TO CONTINUE";V$
8520 NEXTI6:RETURN
9700 MG=0:IFLEN(MB$)<LEN(MB$)RETURN
9705 ILEFT$(MB$,2)=" /"MB$=MID$(MB$,3,LEN(MB$)-2)
9710 FORMF=1TOLEN(MB$)-LEN(MB$)+1

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9720 IFMB$=MID$(MB$,MF,LEN(MB$))MG=1:RETURN
9730 NEXTMF:RETURN
9800 FORL=0TOI4:A6$(L)=" ":A5!(L)=0:NEXTL:A6$(0)=V$:GT=0:LT=0:E0=0:RT=0
9801 I7=A1(S9,4):P=I7
9802 I6=A7(I7)
9803 I7=I7+1:L=A7(I7)
9804 IFL=0THEN9803
9806 IFL=1THENC15:GOTO9803
9807 IFL=2THENGOSUB9970:V$="":FORK=1TOSR:I7=I7+1:N=A7(I7):V$=V$+CHR$(N):NEXTK:A6$(L)=V$:GOTO9803
9808 IFL=3THENGOSUB9970:V$="":FORK=1TOSR:I7=I7+1:N=A7(I7):V$=V$+CHR$(N):NEXTK:A5!(L)=VAL(V$):GOTO9803
9809 IFL<4THEN9815
9810 GOSUB9970:GT=0:LT=0:E0=0
9811 IFA6$(L)=A6$(SR)THENG0=1
9812 IFA6$(L)>A6$(SR)THENG1=1
9813 IFA6$(L)<A6$(SR)THENLT=1
9814 GOTO9803
9815 IFL<5THEN9821
9816 GOSUB9970:GT=0:LT=0:E0=0
9817 IFA5!(L)=A5!(SR)THENG0=1
9818 IFA5!(L)>A5!(SR)THENG1=1
9819 IFA5!(L)<A5!(SR)THENLT=1
9820 GOTO9803
9821 IFL=6THENGOSUB9970:N=A5!(L):K=A5!(SR):POKEK,K:GOTO9803
9822 IFL=7THENGOSUB9970:A5!(L)=PEEK(A5!(SR)):GOTO9803
9823 IFL=8THENGOSUB9970:A5!(L)=A5!(L)+A5!(SR):GOTO9803
9824 IFL=9THENGOSUB9970:A5!(L)=A5!(L)-A5!(SR):GOTO9803
9825 IFL=10THENGOSUB9970:A5!(L)=A5!(L)*A5!(SR):GOTO9803
9826 IFL=11THENGOSUB9970:A5!(L)=A5!(L)/A5!(SR):GOTO9803
9827 IFL=12THENGOSUB9970:A5!(L)=A5!(L)I A5!(SR):GOTO9803
9828 IFL=13THENGOSUB9970:A6$(L)=A6$(L)+A6$(SR):GOTO9803
9829 IFL=14THENGOSUB9970:N=INT(A5!(SR)):A5!(L)=N:GOTO9803
9830 IFL=15THENGOSUB9970:A5!(L)=SIN(A5!(SR)):GOTO9803
9831 IFL=16THENGOSUB9970:A5!(L)=COS(A5!(SR)):GOTO9803
9832 IFL=17THENGOSUB9970:A5!(L)=TAN(A5!(SR)):GOTO9803
9833 IFL=18THENGOSUB9970:A5!(L)=ATN(A5!(SR)):GOTO9803
9834 IFL=19THENGOSUB9970:A5!(L)=VAL(A6$(SR)):GOTO9803
9835 IFL=20THENGOSUB9970:A6$(L)=STR$(A5!(SR)):GOTO9803
9836 IFL=21THENGOSUB9968:A6$(K)=STRING$(A5!(L),A6$(SR)):GOTO9803
9837 IFL=22THENGOSUB9972:LPRINTA6$(SR):GOTO9803
9838 IFL=23THENGOSUB9972:A6$(SR)=INKEY$:GOTO9803
9839 IFL<24THEN9845
9840 GOSUB9972:I7=P:FORN=1TOI6
9841 I7=I7+1:IFA7(I7)<>999THEN9844

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9042 I7=I7+1:IFA7(I7)<5RTHEN9044
9043 GOTO9003
9044 NEXTN:PRINT"INVALID TAG ";SR:GOTO1140
9045 IFL=25THENGOSUB9970:AS!(L)=ABS(AS!(SR)):GOTO9003
9046 IFL=26THENGOSUB9970:AS!(L)=INP(AS!(SR)):GOTO9003
9047 IFL=27THENGOSUB9972:PRINTA$(SR):GOTO9003
9048 IFL=28THENGOSUB9970:PRINTA$(L),A$(SR):GOTO9003
9049 IFL=29THENGOSUB9972:INPUTA$(SR):GOTO9003
9050 IFL=30THENGOSUB9972:INPUT#-1,A$(SR):GOTO9003
9051 IFL=31THENGOSUB9972:PRINT#-1,CHR$(34)+A$(SR)+CHR$(34):GOTO9003
9052 IFL=32THENGOSUB9968:A$(K)=LEFT$(A$(L),AS!(SR)):GOTO9003
9053 IFL=33THENGOSUB9968:A$(K)=RIGHT$(A$(L),AS!(SR)):GOTO9003
9054 IFL=34THENGOSUB9966:A$(N)=MID$(A$(K),AS!(L),AS!(SR)):GOTO9003
9055 IFL=35THENGOSUB9970:AS!(L)=AS!(SR):GOTO9003
9056 IFL=36THENGOSUB9970:A$(L)=A$(SR):GOTO9003
9057 IFL=37THENGOSUB9970:AS!(L)=EXP(AS!(SR)):GOTO9003
9058 IFL=38THENGOSUB9970:AS!(L)=LOG(AS!(SR)):GOTO9003
9059 IFL<>39THENG003
9060 IFE0=1THEN9040
9061 I7=I7+1:GOTO9003
9062 IFL<>40THEN9065
9063 IF01=1THEN9040ELSE9062
9064 IFL<>41THENG067
9065 IFLT=1THEN9040ELSE9062
9066 IFL=42THENGOSUB9970:AS!(L)=ASC(A$(SR)):GOTO9003
9067 IFL=43THENGOSUB9970:A$(L)=CHR$(AS!(SR)):GOTO9003
9068 IFL=44THENGOSUB9970:AS!(L)=LEN(A$(SR)):GOTO9003
9069 IFL=45THENGOSUB9970:AS!(L)=SQR(AS!(SR)):GOTO9003
9070 IFL=46THENI7=RT:RT=0:GOTO9003
9071 IFL=47THENGOSUB9970:PRINTA$(L),AS!(SR):GOTO9003
9072 IFL=48THENGOSUB9970:N=AS!(L):K=AS!(SR):SET(N,K):GOTO9003
9073 IFL=49THENGOSUB9970:N=AS!(L):K=AS!(SR):RESET(N,K):GOTO9003
9074 IFL=50THENGOSUB9970:N=AS!(L):K=AS!(SR):OUTN,K:GOTO9003
9075 IFL=51THENGOSUB9970:N=AS!(L):K=AS!(SR):GOTO9003
9076 IFL=52THENGOSUB9972:AS!(SR)=AND(0):GOTO9003
9077 IFL<>53THENG065
9078 GOSUB9968:N=AS!(SR):AA$=A$(K):AB$=A$(L)
9079 GOSUB9968:AS!(N)=MG
9080 GOTO9003
9081 IFL=54THEN1140
9082 IFL=55THENRT=I7+1:GOTO9040
9083 IFL<>56THENG080
9084 GOSUB9968:N=AS!(L):SL=AS!(SR):IFPOINT(N,SL)THENAS!(K)=1ELSEAS!(K)=0
9085 GOTO9003
9086 IFL=999THENI7=I7+1:GOTO9003
9087 PRINT"INVALID OP":N=I7-P:PRINT"LOC ";N;" CODE ";L
9088 GOTO1140
9089 I7=I7+1:N=A7(I7)
9090 I7=I7+1:K=A7(I7)
9091 I7=I7+1:L=A7(I7)
9092 I7=I7+1:SR=A7(I7)
9093 RETURN

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