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FINAL REPORT TO
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

**CASE FILE
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FOR RESEARCH ON
INSTRUCTIONAL STRATEGIES FOR OPTIMIZING THE LEARNING PROCESS
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In 1968, the Institute for Mathematical Studies in the Social Sciences undertook a three-year study of strategies for optimizing the presentation of stimulus material in learning situations. The work included both basic research in theoretical models of optimization methods and application of such principals to a practical course of instruction in the area of computer science.

Summary of Accomplishments

The theoretical work done in the course of this project has been reported in Atkinson (1967), Atkinson and Shiffrin (1968), Shiffrin (1968), and Shiffrin and Atkinson (1969).

Atkinson (1967) was later published in American Psychologist and a reprint is included with this report. A reprint of Shiffrin and Atkinson (1969) is also included.

The main effort of this project was the application of theoretical models of instructional strategies to the design and implementation of a computer-controlled instructional system and to the development of a practical course of instruction in computer programming. The instructional system and the course have been under continuous development for over two years and have existed in two major versions.

The first version of the instructional system was a single-user implementation for the Institute's PDP-1 computer system, and the first version of the programming course itself consisted of about 20 lessons. That first version was tested on about a dozen volunteer students, and a subsequent revision was based partially on the performance data collected then and on the comments of the students themselves. The PDP-1 version was discussed in considerable detail in semiannual status reports, and is now of interest only from a historical point of view. Thus, details of the first version are not repeated here.

The second major version of the instructional system and the course "Computer-assisted Instruction in Programming: AID" was designed as a time-sharing system for the PDP-10 computer. The primary documentation for the present version of the instruction system is found in Friend (1971). The course itself is described in detail in Friend and Atkinson (1971). Copies of both technical reports are included with this report, and together they provide a nearly complete description of the course and instructional system as they now exist. What is not included in the above-mentioned reports is a description of the data collection procedures and the performance data that has been collected to date. A brief description of data collection is given below.

The instructional system is now being used for five different curriculums in widely varied fields of study. The first application was the AID course described above, and the second was a closely related course in computer science, "Introduction to Programming: BASIC," a one-semester course in the fundamentals of programming for inner-city high school students with low reading

ability and no background in algebra. Third, the INSTRUCT system was modified slightly so that it could be used for "Language Arts for the Deaf," a program of grammar instruction designed for junior high school deaf students. Fourth, the U. S. Public Health Service used the INSTRUCT system in developing a set of review-test lessons in dental health for dental-assistant trainees at San Francisco City College. The fifth application is a course in high school algebra, now in the developmental testing stage at Peter Burnett School in San Jose,, California. Financial support for the curriculum applications has come from a variety of agencies, including National Aeronautics and Space Administration (for the AID course), National Science Foundation (for the BASIC course), the U. S. Office of Education (for the language course), and the U. S. Public Health Service (for the dental health course).

Data Collection Procedures

Late in 1970, data collection procedures were added to the instructional system so that detailed, accurate individual response histories could be collected in real time. These data are stored on magnetic tape for later analysis. Considerable effort has gone into insuring that these routines work perfectly so that there is no possibility of collecting "contaminated" or unmanageable data. This is a necessary effort in a project of this size, because the amount of individual response data that will eventually be collected will be enormous, and it would be impossible to sort or edit the data by hand if it were found at a later time that they were not perfectly clean. Each block of data, which is collected as the student works through the lessons, is of variable length depending upon the length of the student's response and contains the following information:

Student number
Date
Teletype number
Course identification
Identification of strand
Lesson number
Problem number
Subproblem number
Trial number
Number of preceding hint requests for current exercise
Answer request
Analysis value (positive for correct response, negative for
incorrect response)
Time of day (in hours, minutes and seconds)
Cumulative lesson score
Exact character-by-character response made by student.

This information is packed into 5 to 18 (36-bit) words of storage and is saved for later analysis. The only information not currently being recorded is the character-by-character response time. Such a precise time measure is ordinarily not used except in analysis of skill learning, and since we are concerned here with concept acquisition it was felt that the grosser time measure would suffice for our purposes.

Several data management programs have been written, including multiple-option sort programs. These programs are of no theoretical interest, but are necessary from an operational point-of-view. There has also been one data analysis program written, a simple item analysis program which gives, for each exercise, the number of students who did the exercise, the number who responded correctly on the first trial, and the computed percentage correct on first trial. A sample of the item analysis of the data collected for the first few lessons of the course is attached as an appendix. For cross-reference by exercise number, a listing of the exercises in these lessons is also included. An interpretation of this analysis has yet to be made, and no further analysis programs have been written.

Over 50 students were enrolled in the course in this past year, including some NASA personnel from the Ames Research Center at Moffett Field, California, and from the Manned Spacecraft Center in Houston, Texas, and some deaf students from Gallaudet College for the Deaf, Washington, D.C. In the interest of providing as wide a data base as possible, data from all of these students have been collected.

A smaller number of students (about 20) have been enrolled in the course "Computer-assisted Instruction in Programming: BASIC" and these data are also being collected for analysis.

References

- Atkinson, R. C. Computerized instruction and the learning process. Technical Report No. 122, September 13, 1967, Stanford University, Institute for Mathematical Studies in the Social Sciences. American Psychologist, 1968, 23, 225-239.
- Atkinson, R. C., and Shiffrin, R. M. Some speculations on storage and retrieval processes in long-term memory. Technical Report No. 127, February 2, 1968, Stanford University, Institute for Mathematical Studies in the Social Sciences.
- Friend, J. INSTRUCT Coders' Manual. Technical Report No. 172, May 1, 1971, Stanford University, Institute for Mathematical Studies in the Social Sciences.
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- Shiffrin, R. M. Search and retrieval processes in long-term memory. Technical Report No. 137, August 15, 1968, Stanford University, Institute for Mathematical Studies in the Social Sciences.
- Shiffrin, R. M., and Atkinson, R. C. Storage and retrieval processes in long-term memory. Psychological Review, 1969, 76, 179-193.

APPENDIX A
SAMPLE OF ITEM ANALYSIS I
LESSONS L1 TO L5

COMPUTER ASSISTED INSTRUCTION IN PROGRAMMING: AID

ITEM ANALYSIS I(1): FIRST RESPONSE DATA

7-DECEMBER-70 THROUGH 9-APRIL-71

LESSON: L 1

PROBLEM	% CORRECT FIRST TRY	TOTAL STUDENTS	FIRST TRY CORRECT	HINTS	TELLS
1	71.88	32	23	0	0
2	61.90	42	26	1	1
3	85.29	34	29	1	0
4	82.35	34	28	0	0
5	79.41	34	27	0	1
6	70.59	34	24	1	0
7	87.88	33	29	0	0
8	82.35	34	28	9	0
9	.00	36	0	0	35
10	94.59	37	35	0	0
11	67.57	37	25	0	0
11-1	.00	1	0	0	0
13	76.47	17	13	1	0
13-1	.00	30	0	0	0
14	100.00	2	2	0	0
15	76.92	13	10	0	0

COMPUTER ASSISTED INSTRUCTION IN PROGRAMMING: AID

ITEM ANALYSIS I(1): FIRST RESPONSE DATA

7-DECEMBER-70 THROUGH 5-APRIL-71

LESSON: L 2

PROBLEM	% CORRECT FIRST TRY	TOTAL STUDENTS	FIRST TRY CORRECT	HINTS	TELLS
1	85.71	14	12	0	0
2	82.61	23	19	0	0
3	96.67	30	29	0	0
3-1	80.65	31	25	1	0
4	.00	1	0	0	0
4-1	50.00	30	15	1	0
5	92.31	26	24	0	0
6	84.62	26	22	0	0
7	53.85	26	14	0	0
8	70.37	27	19	1	0
10	56.00	25	14	0	0
11	80.00	25	20	0	0
12	88.00	25	22	0	0
13	44.44	27	12	0	0
14	62.96	27	17	0	0
15	34.62	26	9	1	0
16-1	94.44	18	17	0	1
16-2	100.00	18	18	0	0
17	73.68	19	14	0	0
18	81.48	27	22	0	0
18-1	92.31	26	24	0	0
18-2	96.15	26	25	0	0
19	65.38	26	17	0	0
20	65.38	26	17	0	0
21-1	92.31	26	24	0	0
21-2	95.65	23	22	0	0
22	100.00	21	21	0	0
23	66.67	3	2	0	0
24	76.92	13	10	0	0

COMPUTER ASSISTED INSTRUCTION IN PROGRAMMING: AID

ITEM ANALYSIS I(1): FIRST RESPONSE DATA
 7-DECEMBER-70 THROUGH 5-APRIL-71
 LESSON: L 3

PROBLEM	% CORRECT FIRST TRY	TOTAL STUDENTS	FIRST TRY CORRECT	HINTS	TELLS
2	92.00	25	23	0	0
2-1	100.00	1	1	0	0
3	84.62	26	22	0	0
4	88.46	26	23	1	0
4-1	66.67	3	2	0	0
4-2	100.00	3	3	0	0
4-4	100.00	3	3	0	0
4-5	66.67	3	2	0	0
4-6	66.67	3	2	0	0
5	81.48	27	22	0	0
5-1	50.00	2	1	0	0
6	100.00	27	27	0	0
7	44.44	27	12	0	0
8	85.19	27	23	1	0
8-1	100.00	4	4	0	0
8-2	100.00	4	4	0	0
9	74.07	27	20	0	0
10-1	94.74	19	18	0	0
11	88.89	18	16	0	0
11-1	66.67	18	12	0	0
12	94.44	18	17	0	0
12-1	.00	1	0	0	0
12-2	.00	1	0	0	0
13	100.00	1	1	0	0
14	100.00	19	19	0	0
15	90.00	20	18	0	0
16	90.91	22	20	0	0
17	72.73	22	16	0	0
18	77.27	22	17	0	0
19	70.83	24	17	0	0
20	80.00	25	20	0	1
20-1	40.00	5	2	0	1
20-2	25.00	4	1	0	1
21	.00	5	0	0	0
22	41.67	24	10	1	0
23	70.83	24	17	0	1
24	.00	1	0	0	0
24-1	95.83	24	23	0	0
24-2	100.00	24	24	0	0

24-3	100.00	24	24	0	0
25	100.00	20	20	0	0
26	100.00	6	6	0	0
27	81.82	11	9	0	0

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COMPUTER ASSISTED INSTRUCTION IN PROGRAMMING: AID

ITEM ANALYSIS I(1): FIRST RESPONSE DATA

7-DECEMBER-70 THROUGH 9-APRIL-71

LESSON: L 4

PROBLEM	% CORRECT FIRST TRY	TOTAL STUDENTS	FIRST TRY CORRECT	HINTS	TELLS
1	90.91	22	20	0	0
1-1	50.00	2	1	0	0
2	90.91	22	20	0	0
2-1	100.00	21	21	0	0
2-2	100.00	21	21	0	0
3	95.24	21	20	0	0
4	73.91	23	17	0	0
5	95.65	23	22	0	0
5-1	86.96	23	20	0	0
6	95.65	23	22	0	0
6-1	.00	1	0	0	0
6-2	100.00	1	1	0	0
6-3	100.00	1	1	0	0
6-4	100.00	1	1	0	0
6-5	100.00	1	1	0	0
7	100.00	23	23	0	0
8	87.50	24	21	0	0
9	95.83	24	23	0	0
9-1	100.00	1	1	0	0
10	60.00	25	15	0	0
10-1	54.17	24	13	0	0
11	73.91	23	17	0	0
12-1	95.45	22	21	0	0
12-2	95.24	21	20	0	0
12-3	85.71	21	18	0	0
13	95.45	22	21	0	0
14	59.09	22	13	0	0
15	95.24	21	20	0	0
16	61.90	21	13	0	1
17	95.00	20	19	0	0
17-1	100.00	1	1	0	0
17-2	100.00	1	1	0	0
18	95.00	20	19	0	0
19	86.36	22	19	0	0
20	68.18	22	15	0	0
20-1	85.71	21	18	0	0
21	86.36	22	19	0	0
22-1	100.00	14	14	0	0
22-2	100.00	2	2	0	0

23	84.21	19	16	0	0
23-1	100.00	2	2	0	0
23-2	100.00	2	2	0	0
24	90.00	20	18	0	0
24-1	78.95	19	15	0	0
25	95.24	21	20	0	0
25-1	95.24	21	20	0	0
26	85.00	20	17	0	0
26-1	85.00	20	17	0	0
26-2	80.00	20	16	0	0
27-1	80.00	20	16	0	0
28	100.00	18	18	0	0
29	50.00	4	2	0	0
30	85.71	7	6	0	0

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COMPUTER ASSISTED INSTRUCTION IN PROGRAMMING: AID

ITEM ANALYSIS I(1): FIRST RESPONSE DATA
 7-DECEMBER-70 THROUGH 19-APRIL-71
 LESSON: L 5

PROBLEM	% CORRECT FIRST TRY	TOTAL STUDENTS	FIRST TRY CORRECT	HINTS	TELLS
1	84.62	13	11	0	0
2	84.62	13	11	0	0
3	92.31	13	12	0	0
4	80.00	15	12	0	0
5	80.00	15	12	1	0
5-1	100.00	15	15	1	0
6	42.86	14	6	0	0
7	87.50	16	14	0	0
7-1	100.00	16	16	0	0
7-2	93.75	16	15	0	0
8	76.47	17	13	0	1
9	70.59	17	12	0	0
10	57.89	19	11	0	1
11	100.00	18	18	0	0
11-1	94.44	18	17	0	0
11-2	94.44	18	17	0	0
12-1	94.44	18	17	0	0
13-1	100.00	18	18	0	0
13-2	88.89	18	16	0	0
14-1	100.00	18	18	0	0
15-1	100.00	17	17	0	0
16-1	81.25	16	13	0	1
17-1	100.00	13	13	0	0
18	86.67	15	13	0	0
18-1	53.33	15	8	0	0
18-2	80.00	15	12	0	0
19	100.00	14	14	0	0
19-1	100.00	14	14	0	0
19-2	78.57	14	11	0	0
20	92.86	14	13	0	0
20-1	92.86	14	13	0	0
21	100.00	14	14	0	0
21-1	100.00	14	14	0	0
21-2	100.00	14	14	0	0
22	87.50	16	14	0	0
23	75.00	16	12	0	0
23-1	75.00	4	3	0	0
24	100.00	16	16	0	0
25	81.25	16	13	0	0

26	93.33	15	14	0	0
27	93.75	16	15	0	0
27-1	93.75	16	15	0	0
28	.00	17	0	0	0
29-1	82.35	17	14	0	0
29-2	87.50	16	14	0	0
29-3	81.25	16	13	0	0
30-1	94.12	17	16	0	0
30-2	100.00	17	17	0	0
30-3	94.12	17	16	0	0
31-1	56.25	16	9	0	2
31-2	70.59	17	12	0	1
32	93.75	16	15	0	0
34	80.00	5	4	0	0

APPENDIX B

SAMPLE OF TEXT OF EXERCISES

LESSONS L1 TO L5

LESSON L1

(L1-1-0)

INTRODUCTION TO PROGRAMMING
BY JAMESINE E. FRIEND

IN THE FIRST LESSON YOU WILL LEARN HOW TO USE THIS PROGRAM.
AFTER YOU TYPE YOUR ANSWERS YOU MUST PRESS THE RETURN KEY.
CAN YOU FIND THE RETURN KEY?

(L1-2-0)

WRONG ANSWERS ARE NOT COUNTED. YOU ALWAYS GET ANOTHER
CHANCE IF YOUR ANSWER IS WRONG.

WHAT DOES THE COMPUTER PRINT WHEN IT IS READY FOR YOUR ANSWER?
A. AN EXCLAMATION POINT !
B. A QUESTION MARK ?
C. AN ASTERISK *

TYPE "A", "B", OR "C". (DON'T FORGET THE RETURN KEY.)

(L1-3-0)

IF MULTIPLE CHOICE PROBLEMS HAVE MORE THAN ONE CORRECT
ANSWER, YOU CAN LIST THE CORRECT CHOICES IN ANY ORDER.

SUPPOSE B, C, AND D ARE THE CORRECT CHOICES FOR A PROBLEM.
WHICH OF THESE WOULD BE CORRECT WAYS TO ANSWER?

- A. D, B, C, A
- B. B, D, C
- C. B, C, D
- D. D, B, C

(L1-4-0)

YOU CAN USE COMMAS AND SPACES BETWEEN THE LETTERS

IF YOU WISH, BUT YOU DON'T HAVE TO USE ANYTHING.

WHICH OF THESE ARE CORRECT WAYS TO ANSWER A MULTIPLE CHOICE PROBLEM?

- A. A,B,C,D
- B. B A C D
- C. ACBD
- D. A, B, C, D

(L1-5-0)

IF YOU MAKE A MISTAKE WHILE YOU ARE TYPING, YOU CAN
"ERASE" THE LINE:

HOLD DOWN THE CTRL KEY WHILE YOU TYPE THE LETTER "U".

("U" STANDS FOR "UNDO THIS LINE")

THE COMPUTER WILL IGNORE THE ENTIRE LINE AND WILL GIVE YOU A
NEW LINE FOR YOUR ANSWER.

NOW FOR PRACTICE:

TYPE "UP", ERASE IT WITH CTRL-U,
AND THEN TYPE "DOWN".

(L1-6-0)

WHICH OF THE FOLLOWING ANSWERS WILL BE RECORDED AS
"YES"?

- A. NO ...ERASED
YE.S
- B. YES ...ERASED
NO
- C. ANYTHING ...ERASED
ELSE ...ERASED
YES
- D. NO ...ERASED
YES ...ERASED
NO ...ERASED
NEVER

(LI-7-0)

YOU DON'T HAVE TO ERASE THE ENTIRE LINE.
TO ERASE ONE CHARACTER, TYPE THE "RUBOUT" KEY.
IF YOU TYPE "RUBOUT" TWICE, YOU WILL ERASE THE
LAST TWO CHARACTERS, ETC.

CAUTION: SPACES ARE CHARACTERS JUST LIKE LETTERS AND
NUMBERS. IF YOU TYPE A RUBOUT AFTER A SPACE, THE SPACE
IS ERASED!

FOR PRACTICE, TYPE "YES" THIS WAY:
YEL(RUBOUT)S

(LI-8-0)

YOU CAN GET A HINT ANY TIME YOU WANT. JUST TYPE A
QUESTION MARK (?). NOW... DO YOU KNOW HOW TO GET A HINT?

(LI-9-0)

TO GET THE ANSWER TO A PROBLEM, HOLD DOWN THE CTRL
KEY WHILE YOU TYPE THE LETTER "T". ("CTRL" STANDS FOR
"CONTROL". CONTROL COMMANDS LIKE CTRL-T ARE GIVEN BY HOLDING
DOWN THE CTRL KEY WHILE YOU TYPE THE LETTER.)

SHOW ME HOW TO USE CTRL-T TO GET THE ANSWER.

(LI-10-0)

CTRL-G IS THE THIRD CONTROL COMMAND. IT ALLOWS YOU
TO MOVE AROUND WITHIN THE TEACHING PROGRAM. IT WORKS LIKE THIS:

1. WHEN YOU TYPE CTRL-G, IT MEANS "GO".
2. THE COMPUTER WILL SAY
WHERE TO?
3. YOU TELL IT WHAT LESSON OR PROBLEM YOU WANT. FOR EXAMPLE:
TO CONTINUE WITH YOUR
LAST PROBLEM TYPE THE RETURN KEY
TO GO TO LESSON 5 TYPE "L 5"
TO GO TO LESSON 2, PROBLEM 3 TYPE "L 2-3"

IF YOU HAD TYPED CTRL-G, WHICH WOULD YOU TYPE TO GO
TO LESSON 7, PROBLEM 18?

- A. L 1
- B. L 7-18
- C. LESSON 8, PROBLEM 17
- D. L 18-7
- E. LESSON 18-PROBLEM 7

(L1-11-0)

WOULD YOU LIKE TO PRACTICE USING CTRL-G TO GET FROM ONE PROBLEM TO ANOTHER?

(L1-11-1)

O.K. FOLLOW THESE INSTRUCTIONS TO GO BACK TO PROBLEM 2 AND THEN GO TO PROBLEM 12:

FIRST, TYPE CTRL-G AND WAIT FOR THE COMPUTER TO TYPE "WHERE TO?"

SECOND, TYPE "L 1-2" FOR LESSON 1, PROBLEM 2, AND WAIT UNTIL PROBLEM 2 IS PRINTED.

THIRD, TYPE CTRL-G AND WAIT UNTIL THE COMPUTER TYPES "WHERE TO?"

FOURTH, TYPE "L 1-12" FOR LESSON 1, PROBLEM 12.

(L1-12-0)

YOU CAN USE CTRL-G TO GET FROM ONE PROBLEM TO ANOTHER. YOU CAN ALSO USE CTRL-G TO GET SUMMARIES OF LESSONS AND REVIEWS OF LESSONS.

IF YOU WANT:

TYPE CTRL-G, THEN TYPE:

-----	-----
SUMMARY OF LESSON 4	S4
REVIEW OF LESSON 2	R2
LIST OF LESSONS	LIST

FOR PRACTICE, GET A SUMMARY OF THIS LESSON:

FIRST, TYPE CTRL-G AND WAIT FOR THE COMPUTER TO TYPE "WHERE TO?"

SECOND, TYPE "S1" FOR SUMMARY OF LESSON 1.

(LI-13-0)

THE FOURTH CONTROL COMMAND IS CTRL-C. CTRL-C CAUSES THE TEACHING PROGRAM TO STOP. YOU WILL USE CTRL-C TO STOP THIS PROGRAM WHEN YOU WANT TO QUIT FOR TODAY.

TO SIGN OFF:

FIRST, TYPE CTRL-C

SECOND, TYPE THE LETTER K (FOR "KILL"). WAIT FOR THE SIGN-OFF MESSAGE (ABOUT 10 SECONDS).

BEFORE YOU PRACTICE SIGNING OFF - DO YOU REMEMBER HOW TO SIGN ON AGAIN?

(LI-13-1)

DO YOU WANT TO PRACTICE SIGNING OFF AND ON?

†

(LI-13-2)

OK. GO AHEAD.

(LI-14-0)

DON'T FORGET TO SIGN OFF WHEN YOU ARE THROUGH TODAY. YOU MUST SIGN OFF AFTER EACH SESSION.

SUMMARY OF CONTROL COMMANDS IN THE TEACHING PROGRAM:

COMMAND	NAME	MEANING
-----	-----	-----
CTRL-U	UNDO	ERASE THIS LINE
CTRL-T	TELL	TELL ME THE ANSWER
CTRL-G	GO	GO TO A DIFFERENT PROBLEM
CTRL-C	HALT	STOP THE TEACHING PROGRAM

FROM LESSON 1, YOU SHOULD HAVE LEARNED HOW TO SIGN ON AND OFF, HOW TO START AND STOP THE TEACHING PROGRAM, HOW TO GET A HINT, AND HOW TO USE CTRL-G.

DO YOU WANT TO REVIEW ANY OF THESE TOPICS?

(L1-15-0)

DO YOU WANT TO GO ON TO LESSON 2 NOW?

LESSON L2

(L2-1-0)

LESSON 2 USING AID FOR ARITHMETIC

IN THIS COURSE YOU WILL USE TWO DIFFERENT PROGRAMS:

1. THE TEACHING PROGRAM. YOU ARE USING THE TEACHING PROGRAM NOW. THE TEACHING PROGRAM WILL TEACH YOU TO WRITE PROGRAMS USING THE AID LANGUAGE.

2. THE AID INTERPRETER. AFTER YOU LEARN TO WRITE AID PROGRAMS, YOU WILL USE THE AID INTERPRETER TO TRY OUT YOUR PROGRAMS.

YOU WILL ONLY BE ABLE TO USE ONE OF THE PROGRAMS AT A TIME SO YOU HAVE TO KNOW HOW TO STOP A PROGRAM AND START ANOTHER.

WHICH PROGRAM ARE YOU USING NOW?

(L2-2-0)

HOW TO START THE AID INTERPRETER:

FIRST, STOP THE TEACHING PROGRAM (TYPE CTRL-C).
SECOND, TYPE "L AID" AND THE RETURN KEY.

HOW TO STOP THE AID INTERPRETER:

TYPE CTRL-C.

AFTER THE TEACHING PROGRAM IS STOPPED, WHAT SHOULD YOU TYPE TO START THE AID INTERPRETER?

(L2-3-0)

WHICH COMMAND WILL STOP THE AID INTERPRETER?

A. CTRL-H

- B. CTRL-T
- C. CTRL-C
- D. CTRL-G

(L2-3-1)

ANY PROGRAM CAN BE STOPPED BY TYPING CTRL-C. TO START A PROGRAM YOU MUST TYPE THE LETTER "L", A SPACE, AND THEN THE NAME OF THE PROGRAM.

YOU SHOULD TYPE "L AID" TO START THE AID INTERPRETER PROGRAM. WHAT WOULD YOU TYPE TO START THE TEACHING PROGRAM?

(L2-4-0)

FOR PRACTICE, START THE AID INTERPRETER, STOP IT, AND START THE TEACHING PROGRAM AGAIN.

(IF YOU WANT MORE DETAIL, TYPE A QUESTION MARK.)

(L2-4-1)

WHEN YOU STARTED THE AID INTERPRETER, WHAT DID THE COMPUTER TYPE?

(L2-5-0)

THE PROGRAMMING LANGUAGE AID IS EASY TO USE FOR ARITHMETIC AND ALGEBRA ("AID" STANDS FOR "ALGEBRAIC INTERPRETIVE DIALOGUE", WHICH MEANS, AS NEARLY AS I CAN FIGURE IT OUT, THAT IT INTERPRETS YOUR ALGEBRA AND THEN TALKS BACK).

TO GET AID TO EVALUATE

$$4.5 + 6.9 - 3.2$$

YOU WILL USE THE COMMAND

TYPE 4.5 + 6.9 - 3.2

AID WILL THEN DO THE ARITHMETIC AND TYPE THE ANSWER.
NOTICE THAT THE WORD "TYPE" IS FOLLOWED BY A SPACE.

TO EVALUATE

$$1.5 + 1.5 + 1.037$$

WHICH COMMAND DO YOU USE?

A. TYPE 2.5 + 1.7.

B. PRINT 1.5 + 1.5 + 1.037

C. 1.5 + 1.5 + 1.037

D. TYPE 1.5 + 1.5 + 1.037

(12-6-0)

IF YOU WANTED AID TO EVALUATE

$$6349 - 2968$$

WHAT COMMAND WOULD YOU USE?

(12-7-0)

WHICH ARE VALID AID COMMANDS?

A. EVALUATE (17 - 15) + 3

B. PRINT (17 - 15) + 3

C. TYPE (17 - 15) + 3

N. NONE OF THE ABOVE

(12-8-0)

RULES ABOUT AID COMMANDS:

1. WAIT FOR AID TO PRINT AN ASTERISK, *.

2. TYPE AN AID COMMAND.

3. TYPE THE RETURN KEY.

TYPE THE COMMAND WHICH WOULD CAUSE AID TO SUBTRACT 17.65
FROM 45.01.

(12-9-0)

FOR PRACTICE, START THE AID INTERPRETER AND TYPE THE FOLLOWING AID COMMANDS (WAIT FOR AID TO ANSWER AFTER YOU TYPE EACH COMMAND):

TYPE 2 + 3

TYPE 16.001 - 16

TYPE 15/3

YOU CAN MAKE UP SOME PROBLEMS OF YOUR OWN IF YOU WANT TO TRY MORE. AFTER YOU ARE THROUGH, START THE TEACHING PROGRAM AGAIN.

(12-10-0)

AID SYMBOLS FOR ARITHMETIC OPERATIONS:

+ ADDITION
- SUBTRACTION
* MULTIPLICATION
/ DIVISION

WHICH COMMANDS WILL CAUSE AID TO MULTIPLY 3 BY 4?

- A. TYPE (3)(4)
- B. TYPE 3 X 4
- C. TYPE 3 * 4
- D. TYPE 3/4
- E. TYPE 3*4

(12-11-0)

WHICH COMMAND WILL CAUSE AID TO MULTIPLY 25 BY 5 AND DIVIDE BY 3?

- A. TYPE 25 X 5/3
- B. TYPE 25 * 5/3
- C. TYPE 25(5/3)
- N. NONE OF THE ABOVE

(12-12-0)

WHICH WILL CAUSE AID TO SUBTRACT 27 FROM THE PRODUCT OF 6 AND .75?

- A. TYPE 6 X .75 - 27

- B. TYPE $6/.75 - 27$
- C. TYPE $6(.75) - 27$
- N. NONE OF THE ABOVE

(L2-13-0)

WHICH ARE VALID AID COMMANDS?

- A. TYPE $(17.01)/32.765$
- B. TYPE $1/2 + .1785 - (12/16)$
- C. TYPE $2(10) + 3(10) + 4(10)$
- D. TYPE $1/2 + (7 * 3/2)$
- N. NONE OF THE ABOVE

(L2-14-0)

WHICH ARE VALID AID COMMANDS?

- A. TYPE $-2 + 3$
- B. TYPE $(3 * 2) + 7$
- C. TYPE $18/36 + 1.5$
- D. TYPE $(1/2 + 1/4 + 1/8)/2$
- E. TYPE $2(.5 + 3/2)$
- N. NONE OF THE ABOVE

(L2-15-0)

WHICH ARE VALID COMMANDS?

- A. TYPE $1.33 * 10(-1)$
- B. TYPE $3.1416*4.3$
- C. TYPE 7.5
- D. TYPE $7 + 0.5$
- N. NONE OF THE ABOVE

(L2-16-0)

START AID AND USE "TYPE" COMMANDS TO DO THESE PROBLEMS:

1. MULTIPLY 1.23456 BY 6.54321
2. DIVIDE 1.23456 BY 6.54321
3. SUBTRACT 11.221122 DIVIDED BY 55.665566 FROM 33.443344
4. MULTIPLY .123 BY .321 AND ADD .456 DIVIDED BY .654

WHEN YOU ARE THROUGH, START THE TEACHING PROGRAM AGAIN.

(L2-16-1)

WHAT ANSWER DID YOU GET FOR THE FIRST PART OF PROBLEM L2-16?

(L2-16-2)

HERE ARE THE SOLUTIONS TO THE OTHER PARTS OF PROBLEM L2-16:

TYPE 1.23456/6.54321
(AID ANSWERS .188678034)

TYPE 33.443344-11.221122/55.665566
(AID ANSWERS 33.241763)

TYPE .123*.321+.456/.654
(AID ANSWERS .736730706)

DID YOU GET THEM ALL RIGHT?

(L2-17-0)

WHAT WOULD AID ANSWER TO THIS COMMAND:

TYPE 72/12

(L2-18-0)

AID WILL NOT GIVE FRACTIONS AS ANSWERS. IF YOU GAVE
THE COMMAND
TYPE 2/4
AID WOULD ANSWER
.5

IF YOU TYPED
TYPE 5/25
WHAT WOULD AID ANSWER?

(L2-18-1)

TYPE 14/56
WHAT WOULD AID ANSWER?

(L2-18-2)

TYPE 3 * 1/4
WHAT WOULD AID ANSWER?

(L2-19-0)

	SUMMARY OF HOW TO USE:	
	AID INTERPRETER	TEACHING PROGRAM
	-----	-----

START:	L AID	L INST
STOP:	CTRL-C	CTRL-C
ERASE A LINE:	CTRL-U	CTRL-U
GET A HINT:	NO HINTS	TYPE A QUESTION MARK.
GET THE		

ANSWER: NO ANSWERS CTRL-T

GO TO ANOTHER
LESSON OR
PROBLEM: NO LESSONS CTRL-G
OR PROBLEMS

WHICH ARE THE SAME IN BOTH THE TEACHING PROGRAM AND AID?

- A. STARTING THE PROGRAM
- B. GETTING A HINT
- C. ERASING
- D. STOPPING THE PROGRAM

(12-20-0)

WHICH ARE TEACHING PROGRAM COMMANDS?

- A. CTRL-C
- B. OFF
- C. TYPE
- D. CTRL-H
- E. CTRL-G
- F. L AID

(12-21-0)

USE AID TO DO THESE PROBLEMS:

1. FIND THE AREA OF A RECTANGLE WITH WIDTH 1.72375 AND LENGTH 12.001325.
2. SUPPOSE A SQUARE OF WIDTH .637825 IS CUT FROM THE ABOVE RECTANGLE. FIND THE AREA OF THE SQUARE.
3. FIND THE AREA OF THE REMAINING PART OF THE RECTANGLE.

WHEN YOU ARE THROUGH START THE TEACHING PROGRAM AGAIN.

(12-21-1)

WHAT WAS THE AREA OF THE UNCUT RECTANGLE?

(L2-21-2)

WHAT WAS THE AREA OF THE RECTANGLE AFTER THE SQUARE WAS REMOVED?

(L2-22-0)

DO YOU WANT A SUMMARY OF LESSON 2?

(L2-23-0)

IN LESSON 2 YOU SHOULD HAVE LEARNED THE DIFFERENCE BETWEEN THE TEACHING PROGRAM AND THE AID INTERPRETER. YOU SHOULD KNOW HOW TO START AND STOP THE AID INTERPRETER, AND HOW TO USE THE "TYPE" COMMAND. YOU SHOULD ALSO KNOW THE SYMBOLS TO USE FOR ADDITION, SUBTRACTION, MULTIPLICATION AND DIVISION.

DO YOU WANT TO REVIEW ANY OF THESE TOPICS?

(L2-24-0)

READY FOR LESSON 3?

LESSON L3

(L3-1-0)

LESSON 3
ORDER OF ARITHMETIC OPERATIONS

START AID AND TYPE THESE COMMANDS:

TYPE $(16 - 4) - 3$

TYPE $16 - (4 - 3)$

THEN START THE TEACHING PROGRAM AGAIN.

DO YOU REMEMBER HOW TO GET AID STARTED AND STOPPED?

†

(L3-2-0)

AID EVALUATES EXPRESSIONS INSIDE PARENTHESES FIRST.

TYPE $7 * (3 + 2)$

WHAT WILL AID ANSWER?

(L3-2-1)

THE COMMAND

TYPE $7 * (3 + 2)$

WILL CAUSE AID TO

FIRST, ADD 3 AND 2

SECOND, MULTIPLY THAT SUM BY 7.

WHAT WILL AID ANSWER?

(L3-3-0)

WHAT WILL AID ANSWER TO THIS COMMAND?

TYPE $(7 * 3) + 2$

(L3-4-0)

WHAT WILL AID ANSWER TO THIS COMMAND?

TYPE 12/(6 - 2)

(L3-4-1)

WHICH EXPRESSION WILL AID EVALUATE FIRST IN THIS COMMAND?

TYPE 12/(6 - 2)

- A. 12/6
- B. 6 - 2
- C. 2/6

(L3-4-2)

AND WHAT WILL AID ANSWER TO THE ABOVE COMMAND?

(L3-4-3)

TYPE (18/6) - 2

WHICH EXPRESSION WILL AID EVALUATE FIRST?

- A. 18/4
- B. 6 - 2
- C. 18/6

(L3-4-4)

.....AND THE ANSWER TO THE COMMAND?

(L3-4-5)

WHAT WILL AID ANSWER TO THE FOLLOWING COMMANDS?

TYPE (16 - 4) - 2

(L3-4-6)

TYPE 16 - (4 - 2)

(L3-5-0)

WHAT WILL AID ANSWER TO THIS COMMAND?
TYPE 1/(100/10)

;

(L3-5-1)

TYPE 33/(77/7)

(L3-6-0)

WHAT WILL AID ANSWER?
TYPE 27 - (5 * 4)

(L3-7-0)

IF YOU WERE USING AID, WHAT COMMAND WOULD YOU USE
TO GET AID TO
FIRST SUBTRACT 4 FROM 7
THEN DIVIDE THAT QUANTITY BY 11?

;

(L3-8-0)

WHAT COMMAND WOULD YOU USE TO GET AID TO

FIRST SUBTRACT 3 FROM 30, THEN DIVIDE BY 9?

(L3-8-1)

(L3-8-2)

WHAT COMMAND WOULD YOU USE TO GET AID TO
FIRST SUBTRACT 4 FROM 10, THEN SUBTRACT 3?

(L3-9-0)

WHAT COMMAND YOU USE TO GET AID TO ADD 778 AND 921
AND THEN MULTIPLY BY 607?

(L3-10-0)

LOOK AT THESE THREE COMMANDS. AID WILL GIVE
THE SAME ANSWER TO TWO OF THEM. WHICH TWO?

TYPE $3 + (2 * 4)$

TYPE $(3 + 2) * 4$

TYPE $3 + 2 * 4$

START AID AND TRY THE THREE COMMANDS.

(L3-10-1)

DID AID GIVE THE ANSWERS YOU EXPECTED?

(L3-10-2)

WHICH TWO OF THESE COMMANDS WOULD HAVE THE SAME ANSWER?

TYPE $42/(3/12)$

TYPE $42/3/12$

TYPE $(42/3)/12$

START AID AND TRY THEM.

(L3-11-0)

WHEN YOU DON'T USE PARENTHESES, AID HAS ITS OWN RULES FOR DOING ARITHMETIC. THEY ARE:

1. DO ALL MULTIPLICATION AND DIVISION FIRST, STARTING AT THE LEFT, AND WORKING TOWARDS THE RIGHT.
2. DO ADDITION AND SUBTRACTION NEXT, STARTING AT THE LEFT, AND WORKING TOWARDS THE RIGHT.

THUS THE COMMAND

TYPE $1/4 + 3 * 2$

IS DONE IN THE FOLLOWING WAY:

FIRST, AID STARTS AT THE LEFT, DIVIDES 1 BY 4 AND GETS .25.

SECOND, AID MULTIPLIES 3 BY 2 AND GETS 6.

THIRD, AID RETURNS TO THE LEFT, AND ADDS .25 AND 6.

TYPE $2 + 7 * 3 - 1$

WHICH OPERATION WILL AID DO FIRST?

- A. ADDITION
- B. SUBTRACTION
- C. MULTIPLICATION
- D. DIVISION

(L3-11-1)

AID DOES THE MULTIPLICATION FIRST, SO

$2 + 7 * 3 - 1$

$= 2 + 21 - 1$

$= ???$

(L3-12-0)

WHAT WILL AID ANSWER?

TYPE 16 - 6/2 + 4

(L3-12-1)

TYPE 16 - 6/2 + 4

WHEN AID EVALUATES THIS COMMAND,
WHICH OPERATION WILL BE DONE FIRST?

- A. ADDITION
- B. SUBTRACTION
- C. MULTIPLICATION
- D. DIVISION

†

(L3-12-2)

WHAT WILL AID ANSWER TO THE ABOVE COMMAND?

(L3-13-0)

WHAT ANSWER WILL AID GIVE?

TYPE 14 + 8 * 2/4

(L3-13-1)

TYPE 14 + 8 * 2/4

WHICH EXPRESSION WILL AID EVALUATE FIRST?

- A. 14 + 8
- B. 8 * 2
- C. 2/4

(L3-13-2)

AID DOES THE MULTIPLICATION FIRST BECAUSE THE * IS TO THE LEFT OF THE / . AFTER AID MULTIPLIES $8*2$ IT WILL DO THE DIVISION, THEN START LOOKING FOR ADDITION OR SUBTRACTION. WHAT ANSWER WILL AID GET?

(L3-14-0)

WHAT WILL AID ANSWER TO THIS COMMAND?
TYPE $2 * 3 - 1/2$

(L3-15-0)

WHAT WILL AID ANSWER?
TYPE $100/10/2$

(L3-16-0)

WHAT ANSWER WILL AID GIVE?
TYPE $6 + 9/3 * 4 - 1$

(L3-17-0)

PUT PARENTHESES AROUND NEGATIVE NUMBERS.
FOR EXAMPLE, THE COMMAND TO AID TO MULTIPLY 3 BY NEGATIVE 2 IS WRITTEN
TYPE $3 * (-2)$
TYPE THE COMMAND WHICH WILL CAUSE AID TO EVALUATE 20 DIVIDED BY NEGATIVE 4.

(L3-18-0)

WHAT WILL AID ANSWER?
TYPE $4 + (-2)$

(L3-19-0)

WHAT COMMAND WILL CAUSE AID TO ADD NEGATIVE 5 AND NEGATIVE 6?

(L3-20-0)

YOU CAN USE PARENTHESES WHENEVER YOU WANT TO TO MAKE EXPRESSIONS EASIER TO READ.

WHICH OF THESE WILL CAUSE AID TO FIRST MULTIPLY 3 BY 12, THEN ADD 5?

- A. TYPE $(3*12) + 5$
- B. TYPE $3 * 12+5$
- C. TYPE $3*(12 + 5)$
- D. TYPE $(3*12) + (5)$
- N. NONE

(L3-20-1)

WHICH OF THESE WILL CAUSE AID TO FIRST DIVIDE 225 BY 15, AND THEN SUBTRACT 11.

- A. TYPE $225/(15 - 11)$
- B. TYPE $((225)/(15)) - 11$
- C. TYPE $(225/15) - 11$
- D. TYPE $225/15 - 11$
- N. NONE

(L3-20-2)

...ADD 3 TIMES NEGATIVE 5 TO 64 DIVIDED BY 8.

- A. TYPE $(3 * (-5)) + 64/8$
- B. TYPE $3 * -5 + 64/8$
- C. TYPE $3 * ((-5) + 64)/8$
- D. TYPE TYPE $(3 * (-5) + (64/8))$
- N. NONE

(L3-21-0)

TYPE $2 * \frac{3}{6} - \frac{1}{2}$
MEANS THE SAME AS
A. TYPE $(2 * \frac{3}{6}) - (\frac{1}{2})$
B. TYPE $2 * (\frac{3}{6} - \frac{1}{2})$
C. TYPE $(2 * \frac{3}{6}) - \frac{1}{2}$
N. NONE

(L3-22-0)

TYPE $100/10/10/2$
COULD BE WRITTEN
A. TYPE $(100/10)/(10/2)$
B. TYPE $(100/(10/10))/2$
C. TYPE $(100/(10/10/2))$
N. NONE

(L3-23-0)

TYPE $10/7 - 5 - 2$
COULD BE WRITTEN
A. TYPE $10/(7 - 5) - 2$
B. TYPE $(10/7) - (5 - 2)$
C. TYPE $(10/7) - 5 - 2$
N. NONE

(L3-24-0)

USE AID TO FIND THE ANSWERS TO THESE PROBLEMS:
1. MULTIPLY THE SUM OF 47.3 AND 3.5 BY NEGATIVE 4.29.
2. SUBTRACT 1117 DIVIDED BY 22 FROM 161.
3. DIVIDE 43 DIVIDED BY 3.4 BY 56.

(L3-24-1)

WHAT ANSWER DID AID GIVE FOR PART 1 OF PROBLEM L3-24?

(L3-24-2)

PART 2?

(L3-24-3)

PART 3?

(L3-25-0)
DO YOU WANT A SUMMARY OF LESSON 3?

(L3-26-0)
IN LESSON 3 YOU SHOULD HAVE LEARNED HOW TO USE
PARENTHESES IN AID COMMANDS. YOU SHOULD ALSO HAVE LEARNED
THE ORDER IN WHICH AID WILL DO ARITHMETIC OPERATIONS IF
THERE ARE NO PARENTHESES.

DO YOU WANT TO REVIEW LESSON 3?

(L3-27-0)
READY FOR LESSON 4?

LESSON L4

(L4-1-0)

LESSON 4
EXPONENTS, SCIENTIFIC NOTATION

EXPONENTS ARE USUALLY WRITTEN AS LITTLE NUMBERS TO THE RIGHT AND SLIGHTLY ABOVE THE BASE SOMETHING LIKE THIS:

$$4^3$$

BECAUSE THIS IS HARD TO TYPE AND DIFFICULT FOR THE COMPUTER TO UNDERSTAND, WE WILL USE AN UP-ARROW:

$$4\uparrow 3$$

EXAMPLES:

$4\uparrow 3$ MEANS $4*4*4$ (WHICH IS 64)

$7\uparrow 2$ MEANS $7*7$ (WHICH IS 49)

THE COMMAND

TYPE $5\uparrow 2$

MEANS THE SAME AS

A. TYPE $5*2$

B. TYPE $5*5$

C. TYPE $5*5*5$

N. NONE

(L4-1-1)

TYPE $6\uparrow 4$

MEANS THE SAME AS

A. TYPE $6*6*6*6$

B. TYPE $6*4$

C. TYPE $6*6*6*6$

N. NONE

(L4-2-0)

WHAT WOULD AID ANSWER TO THIS COMMAND?
TYPE 2↑3

(L4-2-1)

WHAT WILL AID ANSWER?
TYPE 6↑2

(L4-2-2)

WHAT WILL AID ANSWER TO THIS COMMAND?
TYPE 10↑3

(L4-2-3)

TYPE 10↑4
WHAT WILL AID ANSWER?

(L4-3-0)
WHAT WILL AID ANSWER?
TYPE 17↑1

(L4-4-0)
WHAT WILL AID ANSWER?
TYPE 17↑0

(L4-5-0)

IN AN EXPONENTIAL EXPRESSION THE NUMBER ON THE LEFT
OF THE ARROW IS CALLED THE "BASE". THE NUMBER ON THE RIGHT
OF THE ARROW IS CALLED THE "EXPONENT". IN THE EXPRESSION
 $43 \uparrow 5$

WHAT NUMBER IS THE BASE?

(L4-5-1)

IN THE EXPRESSION $(-4) \uparrow 7$, THE NUMBER 7 IS CALLED WHAT?

†

(L4-6-0)

AID WILL DO EXPONENTIATION BEFORE IT DOES
MULTIPLICATION, DIVISION, ADDITION OR SUBTRACTION.

WHAT WOULD AID ANSWER?

TYPE $5 * 2 \uparrow 3$

(L4-6-1)

LET'S GO THROUGH A PROBLEM STEP-BY-STEP.
WHICH EXPRESSION IS EVALUATED FIRST IN THIS COMMAND?

TYPE $32 / 4 \uparrow 2$

- A. $4 * 2$
- B. $32 / 4$
- C. $4 \uparrow 2$
- N. NONE

(L4-6-2)

...AND WHAT IS THE VALUE OF 4^2 ?

(L4-6-3)

SO THE VALUE OF $32/4^2$ IS THE SAME AS THE VALUE OF $32/???$

(L4-6-4)

THEN WHAT WOULD AID ANSWER TO THIS COMMAND?
TYPE $32/4^2$

(L4-6-5)

WHAT WOULD AID ANSWER TO THIS COMMAND?
TYPE $10^3 * 2$

(L4-6-6)

THERE IS AN EASY WAY TO DO PROBLEMS THAT HAVE EXPONENTIATION AND ALSO SOME OTHER OPERATION: IMAGINE THAT THERE ARE PARENTHESES AROUND THE TERM WITH THE EXPONENTIATION.

FOR EXAMPLE,

TO DO	$3^4 + 2$	DO	$(3^4) + 2$
TO DO	$625/5^2$	DO	$625/(5^2)$
TO DO	$4^2 + 2^4$	DO	$(4^2) + (2^4)$

WHAT IS THE VALUE OF $5^2/2$?

(L4-6-7)

WHAT WOULD AID ANSWER?
TYPE $10^{\uparrow 3} / 10^{\uparrow 2}$

(L4-6-8)

WHAT WOULD AID ANSWER?
TYPE $10^{\uparrow 3} - 10^{\uparrow 2}$

†

(L4-7-0)
WHAT WILL AID ANSWER?
TYPE $12 * 10^{\uparrow 2}$

(L4-8-0)
WHAT WILL AID ANSWER?
TYPE $2 * 10^{\uparrow 0} + 7$

(L4-9-0)
USE PARENTHESES IF YOU WANT AID TO DO THE ARITHMETIC
OPERATIONS IN AN UNUSUAL ORDER. FOR EXAMPLE, IF YOU WANT AID
TO ADD BEFORE IT DOES EXPONENTIATION USE PARENTHESES LIKE
THIS:
TYPE $(5+3)^{\uparrow 2}$
WHAT WILL AID ANSWER?

(L4-9-1)

TYPE $(2*5)^{\uparrow 3}$

(L4-10-0)

TYPE $2*3^{\uparrow 2}/5$

MEANS THE SAME AS

- A. TYPE $((2*3)^{\uparrow 2})/5$
- B. TYPE $(2*3)^{\uparrow (2/5)}$
- C. TYPE $2*(3^{\uparrow 2})/5$
- D. TYPE $2*(3^{\uparrow (2/5)})$
- N. NONE

(L4-10-1) ' ,

TYPE $(4/6)^{\uparrow 2}+10^{\uparrow 4}$

MEANS THE SAME AS

- A. TYPE $(4/6^{\uparrow 2})+(10^{\uparrow 4})$
- B. TYPE $4/(6^{\uparrow 2})+10^{\uparrow 4}$
- C. TYPE $4/6^{\uparrow 2}+10^{\uparrow 4}$
- N. NONE

(L4-11-0)

TYPE $3^{\uparrow 2}*5/(7-4)^{\uparrow 3}$

MEANS THE SAME AS

- A. TYPE $3^{\uparrow (2*5)}/7-4^{\uparrow 3}$
- B. TYPE $(3^{\uparrow 2}*5)/(7-4)^{\uparrow 3}$
- C. TYPE $(3^{\uparrow 2}*5)/((7-4)^{\uparrow 3})$
- N. NONE

(L4-12-0)

USE AID TO EVALUATE EACH OF THE FOLLOWING. USE EXPONENTIATION WHEREVER POSSIBLE.

1. 4 SQUARED TIMES 3.1416
2. THE SUM OF 4 CUBED AND 6

3. THE SUM OF THE SQUARES OF 1, 2, 3, 4, 5, 6, 7 AND 8

(L4-12-1)

WHAT ANSWER DID AID GIVE FOR PART 1 OF PROBLEM L4-12?

(L4-12-2)

WHAT ANSWER DID AID GIVE FOR PART 2?

(L4-12-3)

WHAT ANSWER DID YOU GET FOR PART 3?

(L4-13-0)

FRACTIONAL EXPONENTS ARE USED FOR ROOTS.
 $9^{1/2}$ MEANS THE SQUARE ROOT OF 9
 $9^{1/3}$ MEANS THE CUBE ROOT OF 9
ETC.

WHAT WILL AID ANSWER TO THIS COMMAND?
TYPE $16^{1/2}$

(L4-14-0)

WHAT AID COMMAND WOULD YOU USE TO FIND THE SQUARE
ROOT OF 17?

(L4-15-0)
WHAT WILL AID ANSWER?
TYPE $10 + 9^{1/2}$

(L4-16-0)
NEGATIVE EXPONENTS ARE USED TO MEAN THE RECIPROCAL,
FOR EXAMPLE
 5^{-2} MEANS $1/(5^2) = 1/25 = .04$
 5^{-3} MEANS $1/(5^3) = 1/125 = .008$

WHAT WILL AID ANSWER?
TYPE 10^{-2}

(L4-17-0)
WHAT WILL AID ANSWER?
TYPE 2^{-2}

(L4-17-1)

TYPE 10^{-3}

(L4-17-2)

TYPE 17^{-6}
IS THE SAME AS
A. TYPE $(17-6)^{-1}$
B. TYPE $(17^6)^{-1}$
C. TYPE $1/(6^17)$
D. TYPE $1/(17^6)$
N. NONE

(L4-18-0)
WHAT WILL AID ANSWER?
TYPE $5 \uparrow (-1)$

(L4-19-0)
WHAT WILL AID ANSWER?
TYPE $10 \uparrow (-1)$

(L4-20-0)
WHAT WILL AID ANSWER?
TYPE $5 \uparrow (-2) + 1$

(L4-20-1)

TYPE $3 * 10 \uparrow (-3)$

(L4-21-0)
WHAT WILL AID ANSWER?
TYPE $3.5 * 10 \uparrow (-2)$

(L4-22-0)
USE AID TO EVALUATE EACH OF THESE EXPRESSIONS:
1. THE SQUARE ROOT OF 2.25
2. 1.5 SQUARED
3. 10 TIMES 10 TIMES 10 TIMES 10 (IS THERE MORE THAN ONE WAY TO WRITE THIS COMMAND?)
4. THE SQUARE ROOT OF THE SUM OF 14 SQUARED AND 5 SQUARED

(L4-22-1)

HERE ARE THE ANSWERS FOR PROBLEM L4-22

1. 1.5
2. 2.25
3. 100000
4. 14.8660687

DID YOU GET THEM ALL RIGHT?

(L4-22-2)

DO YOU WANT ME TO SHOW YOU THE CORRECT COMMANDS?

†

(L4-22-3)

THE CORRECT COMMANDS FOR PROBLEM L4-22 ARE

1. TYPE $2.25 \uparrow (1/2)$
2. TYPE $1.5 \uparrow 2$
3. TYPE $10 * 10 * 10 * 10 * 10$
TYPE $10 \uparrow 5$
4. TYPE $(14 \uparrow 2 + 5 \uparrow 2) \uparrow (1/2)$

DO YOU WANT TO START AID AND TRY THEM AGAIN?

(L4-23-0)

SCIENTIFIC NOTATION IS SOMETIMES USED TO WRITE LARGE NUMBERS.

SCIENTIFIC NOTATION	DECIMAL FORM
-----	-----
$3.0 * 10 \uparrow 4$	30000
$4.56 * 10 \uparrow 6$	4560000

WHAT IS THE DECIMAL FORM OF $1.6 * 10 \uparrow 3$?

(L4-23-1)

TO EVALUATE 1.6×10^3 MOVE THE DECIMAL POINT IN 1.6
3 PLACES TO THE RIGHT. TRY AGAIN.

(L4-23-2)

WHAT IS THE VALUE OF 1.31×10^5 ?

(L4-24-0)

THE SCIENTIFIC NOTATION FOR 9300 IS
 9.3×10^3

WHAT IS THE SCIENTIFIC NOTATION FOR 93000000?

(L4-24-1)

GIVE THE SCIENTIFIC NOTATION FOR 780100

(L4-25-0)

SCIENTIFIC NOTATION IS ALSO USED TO WRITE SMALL
NUMBERS. FOR EXAMPLE,

SCIENTIFIC NOTATION	DECIMAL FORM
2.5×10^{-3}	.0025
7.1×10^{-7}	.0000071

WHAT IS THE DECIMAL FORM OF 3.4×10^{-4} ?

(L4-25-1)

WHAT IS THE VALUE OF 4.302×10^{-3} ?

(L4-26-0)

GIVE THE SCIENTIFIC NOTATION FOR .00894

(L4-26-1)

GIVE THE SCIENTIFIC NOTATION FOR .002.

(L4-26-2)

WHAT IS THE SCIENTIFIC NOTATION FOR .0000101

(L4-27-0)

AID SOMETIMES GIVES ANSWERS IN DECIMAL FORM, SOMETIMES
IN SCIENTIFIC NOTATION DEPENDING UPON THE SIZE OF THE NUMBER.
IF YOU USE THE COMMAND

TYPE 10×10

AID WILL GIVE THE ANSWER, 100, IN DECIMAL FORM.

IF YOU USE THE COMMAND

TYPE $10 \times 10 \times 10 \times 10 \times 10 \times 10$

AID WILL GIVE THE ANSWER, 1×10^6 , IN SCIENTIFIC NOTATION.

START AID AND EXPERIMENT TO FIND OUT WHAT RULES AID USES
TO DECIDE WHETHER TO USE DECIMAL FORM OR SCIENTIFIC NOTATION.

(L4-27-1)

IF YOU USED THIS COMMAND

TYPE 1/100

WOULD AID GIVE THE ANSWER IN DECIMAL FORM OR IN SCIENTIFIC NOTATION?

(L4-28-0)

FROM NOW ON, YOU CAN WRITE NUMBERS IN EITHER DECIMAL FORM OR IN SCIENTIFIC NOTATION, WHICHEVER YOU PREFER.

WOULD YOU LIKE A SUMMARY OF LESSON 4?

(L4-29-0)

IN THIS LESSON YOU SHOULD HAVE LEARNED ABOUT EXPONENTIATION AND ABOUT THE ORDER IN WHICH AID DOES ARITHMETIC IF THERE IS EXPONENTIATION IN THE EXPRESSION. YOU SHOULD ALSO HAVE LEARNED HOW TO READ AND WRITE NUMBERS IN SCIENTIFIC NOTATION.

DO YOU WANT TO REVIEW ANY OF THE TOPICS FROM THIS LESSON?

(L4-30-0)

READY FOR LESSON 5?

LESSON L5

(L5-1-0)

LESSON 5
THE "SET" COMMAND. THE "DELETE" COMMAND.

SO FAR, THE ONLY AID COMMAND YOU HAVE USED IS THE "TYPE" COMMAND. THERE ARE MANY MORE AID COMMANDS; IN THIS LESSON YOU WILL LEARN ABOUT THE "SET" COMMAND AND THE "DELETE" COMMAND.

THE COMMAND

SET X = 5.25

CAUSES THE VALUE OF X TO BECOME 5.25. WHAT WILL BE THE VALUE OF Y AFTER THIS COMMAND:

SET Y = 17.01

(L5-2-0)

THE AID VARIABLES ARE SINGLE LETTERS A, B, C, . . . , Z.
HOW MANY VARIABLES DOES AID HAVE?

(L5-3-0)

THESE TWO COMMANDS

SET N = 350

TYPE 2*N

WILL CAUSE AID TO GIVE 700 AS THE ANSWER.
WHAT WILL AID ANSWER AFTER THESE COMMANDS?

SET B = 1.5

TYPE 3*B

(L5-4-0)

WHAT WILL AID ANSWER?

SET C = 0.5
TYPE 1/2 + 3*C

(L5-5-0)
TYPE CORRECTLY THE COMMAND WHICH IS WRONG.
SET P=3
SETQ=5
TYPE P*10-Q

(L5-5-1) ,

WHAT ANSWER WILL AID GIVE AFTER THE ABOVE COMMANDS?

(L5-6-0)
WHICH COMMANDS WILL CAUSE AID TO ANSWER 0?
A. SET M = 5
SET N = 10
SET P = 2
SET R = -25
TYPE M+N*P+R
B. SET A = 1
SET B=2
SET C=3
SET D=4
TYPE A+B-C

(L5-7-0)
FOR EACH OF THE FOLLOWING, GIVE THE VALUE OF X.
SET X=-35/7

(L5-7-1)

SET M = 12
SET N = 4
SET X = M/N

(L5-7-2)

SET R = 3
SET S = 12 - R
SET X = R*S

(L5-8-0)

RULES ABOUT THE "SET" COMMAND:

1. THERE MUST BE A SPACE AFTER THE WORD "SET". (OTHER SPACES ARE OPTIONAL.)
2. THERE MUST BE AN EQUAL SIGN.
3. THE VARIABLE MUST BE A SINGLE LETTER.
4. YOU CAN USE A VARIABLE TO THE RIGHT OF THE EQUAL SIGN IF IT HAS A VALUE ALREADY. FOR EXAMPLE, YOU MAY USE:
SET X = Y+2
IF Y WAS GIVEN A VALUE IN A PREVIOUS COMMAND.

WHICH ARE CORRECT AID COMMANDS?

- A. SET X-2
- B. SETX=2
- C. SET X=2*3
- D. SET PI = 3.1416
- N. NONE

(L5-9-0)

WHICH ARE VALID AID COMMANDS?

- A. SETX=2+3+4
- B. SET Y TO 2+3.1416+2
- C. SET VAR=-10
- D. SET B=9
- N. NONE

(L5-10-0)

GIVE THE AID COMMAND WHICH WILL GIVE THE
VALUE -7.14 TO THE VARIABLE D.

(L5-11-0)

TYPE THE COMMAND TO MAKE 3 THE VALUE OF S.

(L5-11-1)

WHAT COMMAND WILL CAUSE AID TO SET M EQUAL TO S PLUS 9?
(ASSUME S ALREADY HAS A VALUE.)

(L5-11-2)

GIVE THE COMMAND WHICH WILL CAUSE L TO BE EQUAL TO
M DIVIDED BY S.

(L5-12-0)

START AID AND TYPE THESE COMMANDS.

SET X = 5 (WAIT UNTIL AID TYPES AN ASTERISK)

TYPE 6 + X (WAIT UNTIL AID TYPES THE ANSWER)

THEN START THE TEACHING PROGRAM AGAIN.

(L5-12-1)

DID AID GIVE THE RIGHT ANSWER?

(L5-13-0)

START AID AND TYPE THESE COMMANDS. (P STANDS FOR PI)

SET P=3.14159265

TYPE P↑2

TYPE P↑3

TYPE P↑4

TYPE P↑5

(L5-13-1) †

WHAT VALUE DID AID GIVE FOR P↑2 ?

(L5-13-2)

WHAT VALUE DID AID GIVE FOR P↑3?

(L5-14-0)

SUPPOSE THE LENGTH OF A RECTANGLE IS 9.3 AND ITS WIDTH IS 4.7. THESE COMMANDS WILL CALCULATE ITS AREA:

SET L = 9.3

SET W = 4.7

TYPE L*W

START AID AND USE THESE COMMANDS TO CALCULATE THE AREA OF THE RECTANGLE.

(L5-14-1)

WHAT IS THE AREA OF THE RECTANGLE ACCORDING TO AID?

(L5-15-0)

SUPPOSE YOU WANT TO FIND THE VALUE OF THIS LONG EXPRESSION:

$$((5+34/73)^2 + (42-50^2)/19)/(5+34/73)$$

USING THE "SET" COMMAND WILL SIMPLIFY IT FOR YOU:

SET A=5+34/73

SET B=(42-50^2)/19

TYPE (A^2+B)/A

START AID AND USE THE COMMANDS ABOVE TO FIND THE VALUE OF THE EXPRESSION.

(L5-15-1)

WHAT ANSWER DID AID GIVE?

(L5-16-0)

WHAT IS THE VALUE OF THIS EXPRESSION?

$$(13+(-2)+65)^3/(29.1-7/1.03+13+(-2)+65)$$

START AID AND TRY TO FIND THE ANSWER, USING THE "SET" COMMAND TO SIMPLIFY IT.

(L5-16-1)

WHAT SOLUTION DID AID GIVE FOR THE VALUE OF
THE PREVIOUS EXPRESSION?

(L5-17-0)

AN ACCOUNTANT FOR AN INTERNATIONAL COMPANY MUST
CALCULATE THE TOTAL MILEAGE EACH COMPANY CAR IS DRIVEN
PER WEEK. MANY OF THE CARS ARE EUROPEAN AND THEIR
ODOMETERS GIVE DISTANCE IN KILOMETERS RATHER THAN MILES.
IMAGINE YOU ARE DOING THESE CALCULATIONS AND MUST CONVERT
KILOMETERS TO MILES USING THE CONVERSION:

1 KILOMETER = 0.6214 MILES.

ONE CAR WAS DRIVEN 693 KILOMETERS IN THE PAST WEEK.
START AID AND FIND HOW MANY MILES IT WAS DRIVEN,

• USING THE FOLLOWING COMMANDS:

SET C = 0.6214

SET K = 693

TYPE C*K

(L5-17-1)

HOW MANY MILES WAS THE CAR DRIVEN ACCORDING
TO AID?

(L5-18-0)

IN THE COMPUTER MEMORY THERE ARE 26 AID STORAGE
LOCATIONS ARE LABELLED "A", "B", "C", ..., "Z". WHEN A "SET"
COMMAND IS USED, AID DOES THE FOLLOWING:

1. AID CALCULATES THE VALUE OF THE
EXPRESSION FOLLOWING THE EQUAL SIGN.
2. AID FINDS THE STORAGE LOCATION GIVEN
BY THE LETTER ON THE LEFT OF THE EQUAL
SIGN. IF NO STORAGE LOCATION IS ALREADY
NAMED BY THAT LETTER, THEN AID NAMES
AN EMPTY ONE WITH THAT LETTER.
3. AID WRITES THE NEW VALUE OF THE VARIABLE
INTO ITS STORAGE LOCATION AND WIPES OUT

ANY OLD CONTENTS OF THAT LOCATION. THIS MEANS THAT YOU CAN CHANGE THE VALUE OF A VARIABLE, (RE-DEFINE IT) BY USING THE "SET" COMMAND A SECOND TIME.

LOOK AT THESE THREE "SET" COMMANDS:

```
SET R = 4
SET S = 3.5
SET R = S*2
```

WHAT IS THE VALUE OF R AFTER THE FIRST COMMAND?

(L5-18-1)

WHAT IS THE VALUE OF R AFTER THE SECOND COMMAND?

(L5-18-2)

WHAT IS THE VALUE OF R AFTER THE THIRD COMMAND?

(L5-19-0)

WHAT WILL BE THE VALUE OF Y AFTER THE FIRST OF THESE COMMANDS?

```
SET Y = 3
SET X = Y+2
SET Y = X*10
```

(L5-19-1)

WHAT WILL BE THE VALUE OF Y AFTER THE
SECOND COMMAND?

(L5-19-2)

WHAT IS Y AFTER THE THIRD COMMAND?

(L5-20-0)

WHAT IS M EQUAL TO AFTER THE FIRST COMMAND
BELOW?

SET M = 2
SET M = M+1

(L5-20-1)

WHAT IS THE VALUE OF M AFTER THE SECOND COMMAND?

(L5-21-0)

WHAT IS THE VALUE OF A AFTER THE FIRST COMMAND
BELOW?

SET A = 5
SET B = 10
SET A = A+B

(L5-21-1)

WHAT IS A AFTER THE SECOND COMMAND?

(L5-21-2)

WHAT IS A AFTER THE THIRD COMMAND?

(L5-22-0)

THE AID COMMAND:

DELETE A

REMOVES THE VALUE OF A AND ITS LABEL FROM THE STORAGE LOCATION IT HAD BEEN ASSIGNED. AS FAR AS AID IS CONCERNED, THERE IS NO VALUE OR LOCATION CORRESPONDING TO A ANYMORE.

SUPPOSE YOU NO LONGER NEED THE VARIABLE X IN A CALCULATION. WHAT COMMAND WOULD YOU GIVE AID TO REMOVE X AND ITS VALUE FROM THE COMPUTER'S MEMORY?

(L5-23-0)

"DELETE" MUST BE FOLLOWED BY A SPACE.
WHICH OF THE FOLLOWING ARE CORRECT?

- A. DELETE X
- B. DELETE 2
- C. DELETEDB
- D. DELETE M
- N. NONE

(L5-23-1)

A AND D ARE CORRECT IN THE ABOVE PROBLEM.
B SHOULD USE A LETTER VARIABLE, NOT A NUMBER.

C NEEDS SOMETHING. REWRITE C CORRECTLY.

(L5-24-0)

WHICH ARE VALID AID COMMANDS?

- A. DELETED
- B. DELETE P1
- C. DELETE W

(L5-25-0)

YOU MAY USE THE "DELETE" COMMAND TO DELETE SEVERAL VARIABLES AT ONCE. FOR EXAMPLE:

DELETE A,B,C

A SPACE AFTER "DELETE", AND COMMAS BETWEEN THE VARIABLES ARE REQUIRED.

SUPPOSE YOU HAVE BEEN USING M,P,T AND W AS VARIABLES. AFTER THE COMMAND:

DELETE W,P

WHICH VARIABLES WILL AID STILL HAVE AVAILABLE?

(L5-26-0)

TYPE A SINGLE COMMAND WHICH WILL ELIMINATE THE VARIABLES K AND Y FROM AID STORAGE.

(L5-27-0)

THE "TYPE" COMMAND, LIKE THE "DELETE" COMMAND, MAY ALSO BE USED WITH SEVERAL EXPRESSIONS SEPARATED BY COMMAS AS BELOW:

TYPE 1/16,2/16,3/16

THIS COMMAND WILL CAUSE AID TO TYPE:

1/16 = .0625
2/16 = .125

$$3/16 = .1875$$

SUPPOSE THE FOLLOWING COMMANDS ARE GIVEN:

SET L=4

SET W=7

TYPE L*W,2*(L+W)

AID WILL PRINT TWO ANSWERS. WHAT WILL THE FIRST ANSWER BE?

(L5-27-1)

WHAT IS THE SECOND RESULT THAT AID WILL TYPE?

†

(L5-28-0)

WHICH ARE VALID AID COMMANDS?

A. TYPE .3+X, .4+X

B. TYPE M*N AND M*N/2

C. TYPE A-B-C; B-A-C; C-A-B

D. TYPE 3*X, (3*X) †2 N

N. NONE

(L5-29-0)

CAUTION: YOU CANNOT COMBINE SEVERAL "SET" COMMANDS THE WAY YOU CAN COMBINE "DELETE" OR "TYPE" COMMANDS.

THESE COMMANDS WILL CALCULATE THE AREA AND CIRCUMFERENCE OF A CIRCLE OF RADIUS 3:

SET P=3.1416

SET R=3

TYPE P*R†2

TYPE 2*P*R

USE AID TO DO THE CALCULATION BUT TRY TO DO IT WITH ONE "TYPE" COMMAND INSTEAD OF TWO.

(L5-29-1)

WHAT "TYPE" COMMAND DID YOU USE TO
COMBINE BOTH TYPE COMMANDS ABOVE?

(L5-29-2)

WHAT IS THE AREA OF THE CIRCLE ACCORDING TO
AID?

(L5-29-3)

WHAT IS THE CIRCUMFERENCE GIVEN BY AID?

(L5-30-0)

1 CENTIMETER = .3937 INCHES. SIGN ON
TO AID AND CONVERT THE FOLLOWING LENGTHS TO
CENTIMETERS:

6.9 INCHES

7.445 INCHES

23.9753 INCHES

(L5-30-1)

FROM THE ABOVE CALCULATIONS,
6.9 INCHES = ??? CENTIMETERS.

(L5-30-2)

7.445 INCHES = ??? CENTIMETERS.

(L5-30-3)

23.975 INCHES = ??? CENTIMETERS.

†

(L5-31-0)

TO FIND THE NEW AMOUNT IN A SAVINGS ACCOUNT, CALCULATE THE INTEREST AND ADD IT TO THE LAST BALANCE. START AID AND CALCULATE THE INTEREST AND THE NEW BALANCE AFTER ONE YEAR FOR AN ACCOUNT WITH AN INTEREST RATE OF 4.5 PERCENT PER YEAR AND A PREVIOUS BALANCE OF \$3274.86. (ASK FOR A HINT IF YOU NEED ONE.)

(L5-31-1)

WHAT IS THE INTEREST ON THE ABOVE ACCOUNT TO THE NEAREST PENNY?

(L5-31-2)

WHAT IS THE NEW BALANCE IN THE ACCOUNT?

(L5-32-0)

DO YOU WANT TO SEE A SUMMARY OF THIS
LESSON?

(L5-33-0)

IN THIS LESSON YOU SHOULD HAVE LEARNED ABOUT THE
VARIABLES AND USES, HOW TO SET THE VALUE OF A VARIABLE
BY USING THE "SET" COMMAND, AND HOW TO DELETE VARIABLES.
YOU SHOULD ALSO HAVE LEARNED HOW TO COMBINE SEVERAL
"TYPE" OR "DELETE" COMMANDS INTO ONE COMMAND.

DO YOU WANT TO REVIEW ANY OF LESSON 5?

†

(L5-34-0)

DO YOU WANT TO GO ON TO LESSON SIX?