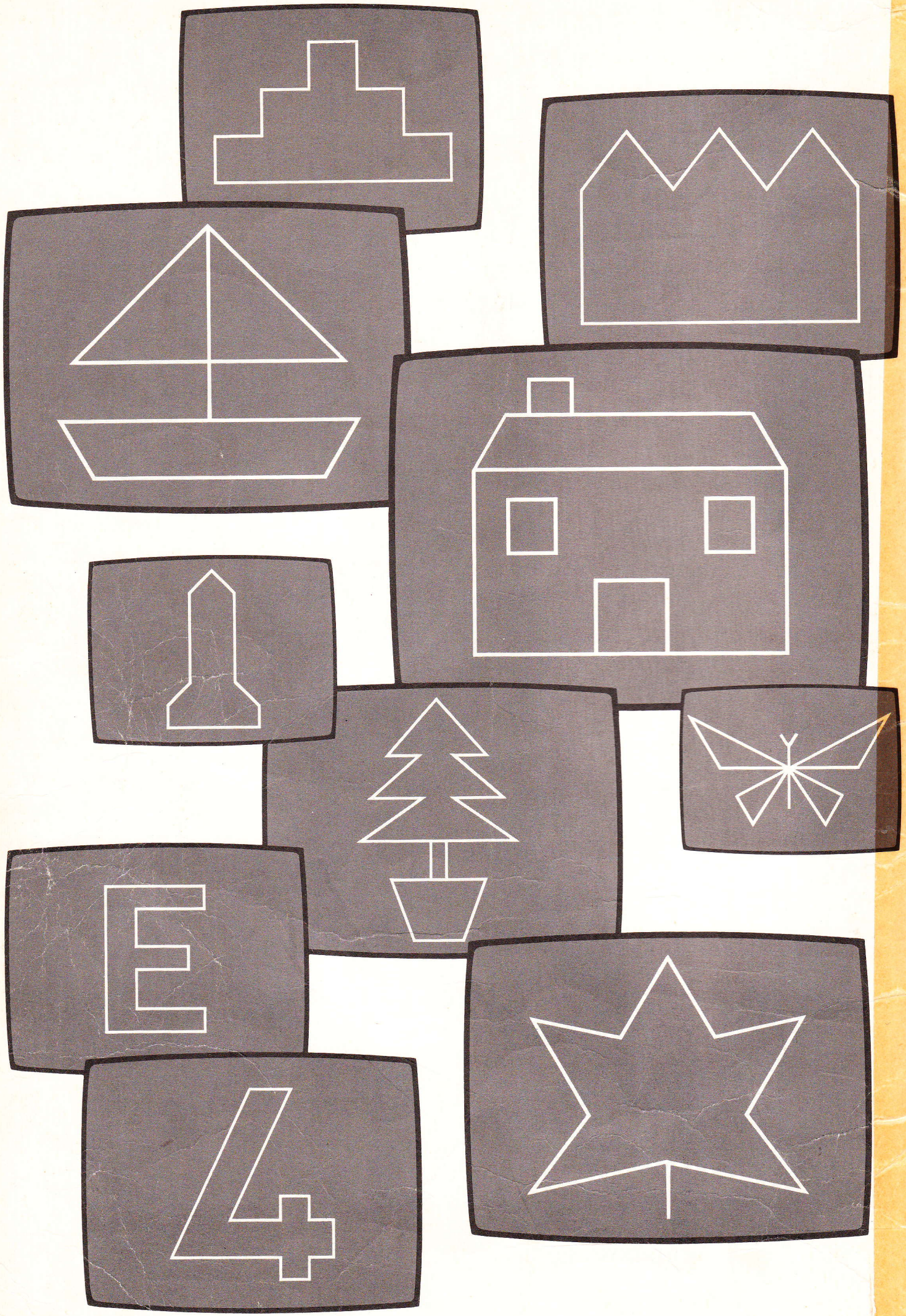
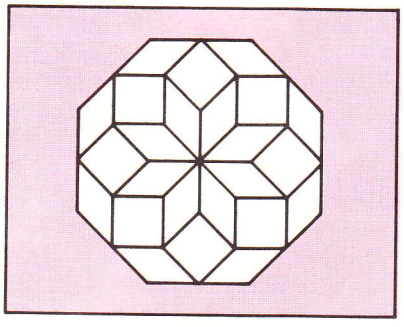


LOGO CHALLENGE

Heather Govier Malcolm Neave

Adviser Paul McGee

AVERY HILL COLLEGE
BEXLEY RD., ELTHAM SE9 2PQ



ADDISON-WESLEY PUBLISHERS
London ● Reading, Massachusetts ● Don Mills, Ontario ● Menlo Park, California ● Amsterdam ● Manila ● Sydney ● Singapore ● Tokyo

Addison-Wesley Computing
LOGO CHALLENGE

Materials available:

Pupil Book Pack - 5 copies
ISBN 201 18400 1

Teaching Packs (4 versions available)
Each pack includes Teacher's Guide, Pupil Book and Software.

BBC Acorn Model B (cassette)
ISBN 201 18401 X

RML 480Z (cassette)
ISBN 201 18402 8

RML 380Z (disk)
ISBN 201 18403 6

Sinclair ZX Spectrum (cassette)
ISBN 201 18404 4

Important notice

Addison-Wesley provides comprehensive support services, as follows.

Replacement copy service
Should your software be faulty, please return it to us within 21 days of receipt, indicating the nature of the fault plus the date of order and invoice number.

Accidental damage after purchase
In the event of accidental damage during use, you can purchase replacement software. Please write, stating the version to be replaced and quoting the ISBN and Serial Number printed on the label of your original cassette or disk.

© 1983 Addison-Wesley Publishers Limited
53 Bedford Square, London WC1B 3DZ

All rights reserved. No part of this publication, including computer software, may be reproduced, stored in a retrieval system, or transmitted in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without prior written permission of the publisher.

ISBN 201 18400 1 (pack of 5 books)

Design and illustrations by Sharp Print Management

Cover design by Jeff Carter

Printed in Great Britain by Thomson Litho Ltd, Scotland

ABCDEF 89876543

INTRODUCTION

This book is your guided tour of the world of LOGO CHALLENGE.
You should have it beside you as you work at the computer keyboard.

The book is really only an introduction. In fact, you will probably have lots of ideas of your own while you are working through it. Do not be afraid to leave the book and follow through your own ideas. Your ideas are what LOGO CHALLENGE is all about.

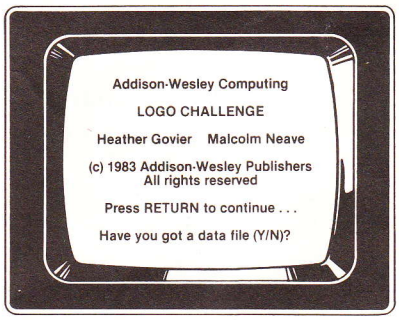
The book is divided into *Lessons* through which you will learn about what you can do with the program, and *Challenges* which are problems for you to solve.

The Challenges are really the most important part of the book, but those which you set for yourself or for your friends are even more important. All Challenges have a *Think!* cloud which has questions inside it. You should think about these questions before you start the Challenge. If you get stuck, read through the *Hint* section. This should give you some clues on how to solve the problem. You will find it useful to have a pencil and paper handy when you are working.

In this book all the words, numbers and keys that you type are written in red capital letters. After typing each instruction into the computer you must press the RETURN key. This tells the computer that you have finished what you want to say. All the numbers are on the top line of the keyboard and the number zero has a line through it (Ø) so that you will not confuse it with the letter O.

When the program is loaded you will see the title page. After pressing the RETURN key you will be asked:

"Have you got a data file (Y/N)?"



As you have no file yet, type N (for no) followed by RETURN to start the program. Later in this booklet you will be shown how to set up a file in your own name to store all your work.

You are now ready to start thinking LOGO CHALLENGE.
Enjoy yourself!

CONTENTS

Lesson A EXPLORING LOGO CHALLENGE (FORWARD, BACKWARD, CLEAR) page 6

Challenge 1
Draw a line from left to right going all the way across the screen

Lesson B TURNING THE PEN (LEFT, RIGHT, UNDO) page 8

Challenge 2
Draw a square corner or right angle

Challenge 3
Draw a square

Challenge 4
Draw a staircase

Lesson C LIFTING THE PEN (PENUP/PENDOWN) page 10

Challenge 5
Draw a large square

Challenge 6
Draw your initials

Challenge 7
Draw a clown

Lesson D SHORTER PROGRAMS (REPEAT/AGAIN) page 12

Challenge 8
Use a REPEAT/AGAIN loop to draw a square

Challenge 9
Use a REPEAT/AGAIN loop to draw a rectangle

Challenge 10
Draw an equilateral triangle

Extra Challenges
Using REPEAT/AGAIN loops

Lesson E STORING PROCEDURES (DEFINE/END, DELETE) page 18

Challenge 11
Store a procedure for an equilateral triangle

Challenge 12
Store a procedure for a staircase

Challenge 13
Store something else of your own choice

Lesson F — SAVING YOUR WORK (FINISH, LIST) — page 21

Challenge 14
Draw a house by using a square and a triangle

Challenge 15
Store HOUSE in the computer memory and on cassette or disk

Challenge 16
Draw and store a street of four houses

Extra Challenges
Using procedures

Lesson G — EDITING (EDIT, R (replace)) — page 26

Challenge 17
Edit TRIANGLE to make the sides 25 units long

Challenge 18
Edit HOUSE

Challenge 19
Edit STAIRCASE and explore the HELP file

Lesson H — INTRODUCING VARIABLES (SIZE) — page 30

Challenge 20
Edit HOUSE to make it variable

Challenge 21
Draw a well

Challenge 22
Draw the pyramids

Extra Challenges (HIDE/SHOW)
Regular polygons and circles

Lesson I — MORE VARIABLES (ANGLE, NUMBER) — page 34

Challenge 23
Use ARC to draw a flower

Challenge 24
Write a four-line program to draw any polygon

Challenge 25
Use the polygon program to draw a star

Lesson J — ARITHMETIC WITH VARIABLES — page 37

Challenge 26
Draw a street with perspective

Challenge 27
Draw a nest of concentric circles

Challenge 28
Draw a spiral

Extra Challenges
Elegant programming

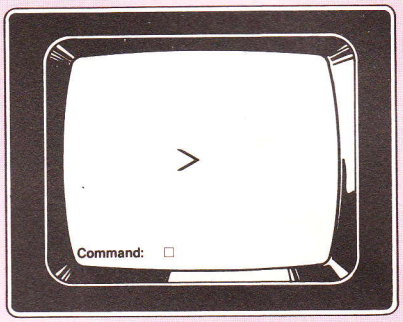
Make your own Challenge

Glossary — INDEX OF LOGO CHALLENGE COMMANDS — inside back cover

Lesson A

EXPLORING LOGO CHALLENGE

Let us begin by exploring what LOGO CHALLENGE can do. In the centre of the screen is an arrowhead. This marks the position of your "screen pen" and shows which way it is facing.



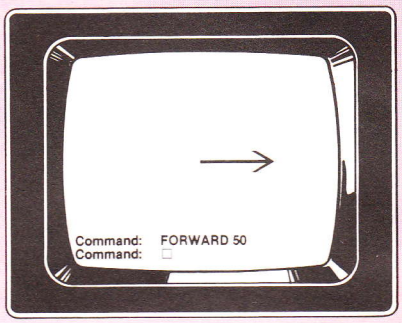
At the bottom of the screen is the word:

"Command:"

This means that the computer is waiting for you to give it instructions. You must tell the pen which way to move and how far to move.

Type:

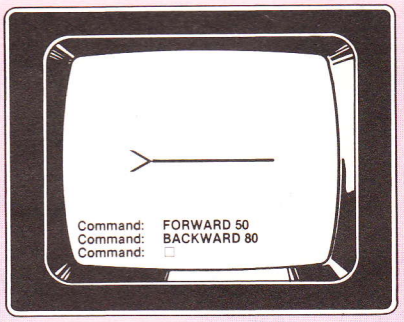
FORWARD 50 RETURN



(*Remember:* **After typing every instruction in LOGO CHALLENGE you should press the RETURN key.)**

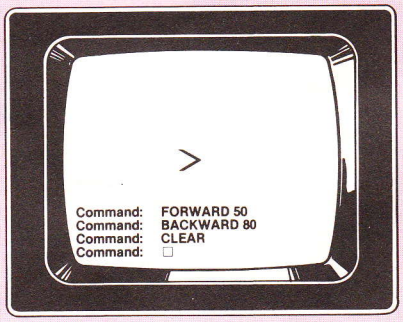
Type:

BACKWARD 80 RETURN



Did you notice that your instructions appear at the bottom of the screen as you type them?

If you make a mistake in your typing you can "rub out" by using the DELETE key (on some keyboards this may be labelled DELT).



Now type:

CLEAR RETURN

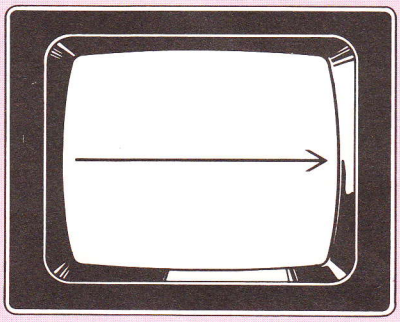
This will clear the screen of all your drawing and reset the pen to its starting place.

Challenge 1

Draw a line from left to right going all the way across the screen.

Think! **Which way will the pen move first, FORWARD or BACKWARD?**

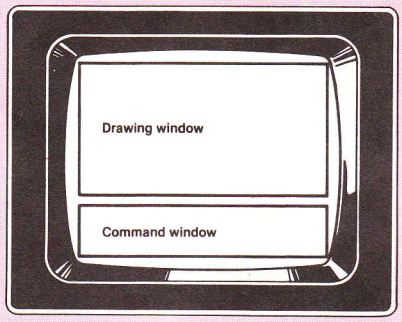
Hint: **FORWARD and BACKWARD commands must always be followed by a number.**



How far is it from one side of the screen to the other in LOGO CHALLENGE steps?

Did you manage to end with your arrowhead just on the right edge of the screen, as shown in the picture?

What happens if you go FORWARD further?



You will have found out that the line does not quite go from one edge of the screen to the other. All the LOGO CHALLENGE drawings are made on a "window" which does not quite fill the screen. Another "window" at the bottom of the screen shows your typed commands.

Remember to keep your pictures inside the drawing "window".

Lesson B

TURNING THE PEN

To draw pictures rather than just lines you need to turn the pen. You can do this by typing LEFT or RIGHT, followed by a number to show how much to turn.

Type:

CLEAR

to clear the screen.

Now type:

FORWARD 40
LEFT 60
FORWARD 40

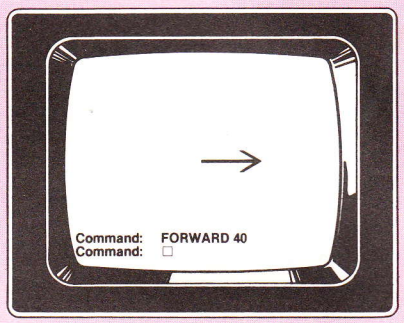
Notice what happens as you type each line. LEFT 60 turns the pen, but as it does not move forward it does not draw anything.

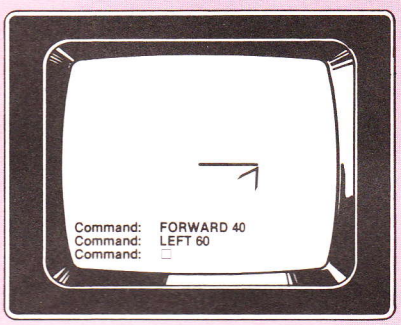
Type:

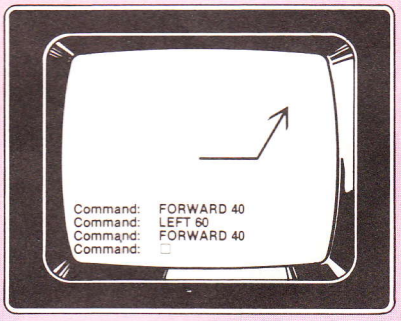
UNDO

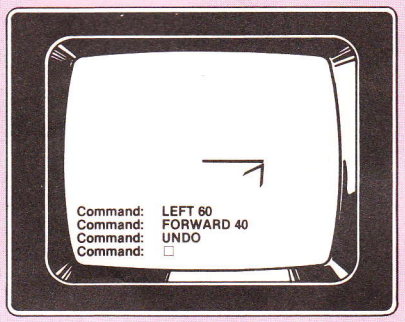
Did you see what happened?

UNDO can be used to make corrections as it will undo the last instruction that you typed.









Challenge 2

Draw a square corner or right angle.

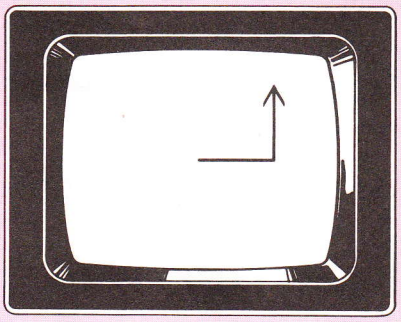
Think! **What number must you use after LEFT or RIGHT to make a right-angle turn?**

Hint: **Remember FORWARD, BACKWARD, LEFT and RIGHT commands must all be followed by a number.**

Always remember to type:

CLEAR

to clear the screen before you start each new Challenge.

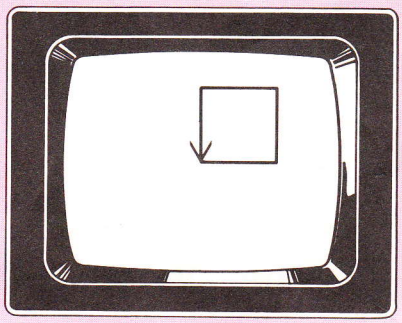


Challenge 3

Draw a square.

Think! **How long will you make the sides?**
How much will you turn the pen?
Will the pen turn LEFT or RIGHT?

Hint: **Remember you can use the DELETE key to correct typing mistakes by rubbing out backwards. If you make a mistake in your program by giving the wrong instruction, you can type UNDO to rub out the last step in your drawing.**

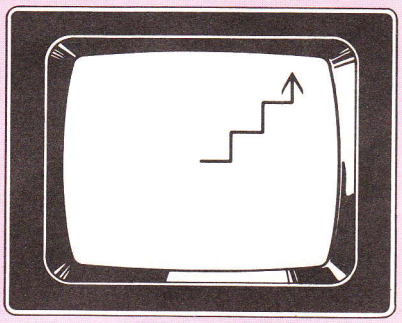


Challenge 4

Draw a staircase.

Think! **How long will each step be?**
Through what angle will you turn the pen?
Will you turn it LEFT or RIGHT?

Hint: **The commands you have learned so far are: FORWARD, BACKWARD, LEFT, RIGHT, CLEAR, UNDO.**



It is not necessary to type the whole word each time. Instead, most LOGO CHALLENGE instructions have two-letter abbreviations, as follows. All the abbreviations are listed inside the back cover.

FD for FORWARD
BD for BACKWARD
LT for LEFT
RT for RIGHT
CL for CLEAR

Lesson C

LIFTING THE PEN

If you want to draw something which begins at the bottom of the screen, you must move the pen down the screen before you start.

To move the pen without drawing a line you can type:

PENUP

before you move and:

PENDOWN

after you have moved.

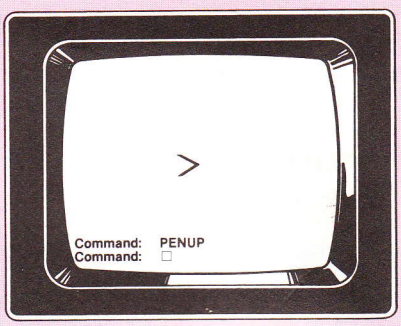
After clearing the screen type:

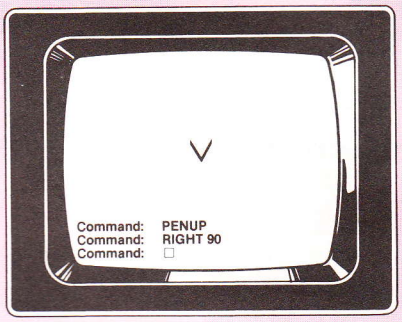
PENUP
RIGHT 90
FORWARD 50
LEFT 90
PENDOWN

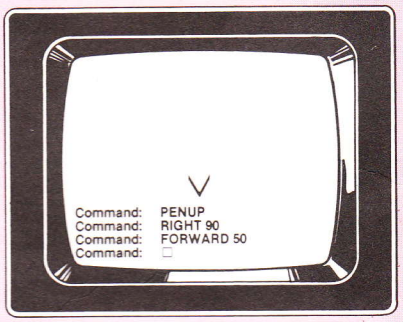
What has happened?

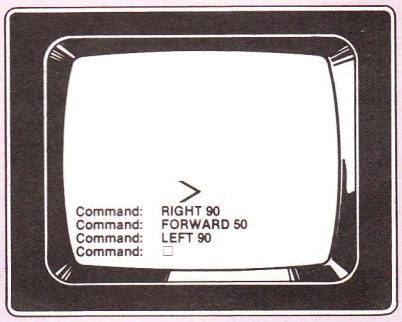
Now draw a staircase which begins at the bottom of the screen and climbs right to the top.

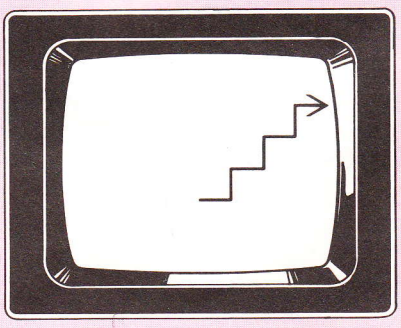
PENUP can also be used if you want to move the pen in the middle of a drawing without leaving a trace.









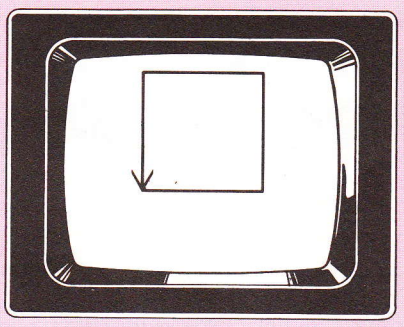


Challenge 5

Draw a large square.

Think! **Where will you start your drawing?**
How will you move the pen to the start position without leaving a trace?

Hint: **PENUP can be shortened to PU, PENDOWN can be abbreviated to PD.**

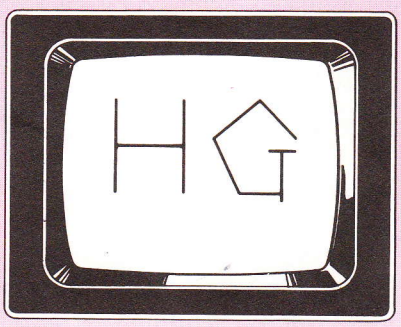


Challenge 6

Draw your initials.

Think! **Where will you start your drawing?**
How will you move the pen between the letters?

Hint: **You will have to make your letters out of straight lines as you do not yet know how to draw curves. It might help to design the letters on paper first.**



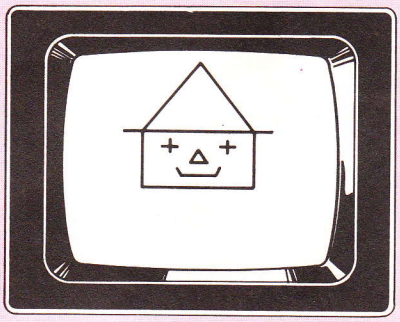


Challenge 7

Draw a clown.

Think! **Where will you start your drawing?**
How big will it be?
How will you draw the eyes, nose and mouth?

Hint: **Remember you can use UNDO if you make a mistake.**



Now try some drawings of your own.

If you need ideas, look at the inside front cover of this book.

Lesson D

SHORTER PROGRAMS

When you drew the staircase and the square you had to type the same commands over and over again. For example, your staircase program might have been something like:

```
FORWARD 30
LEFT 90
FORWARD 30
RIGHT 90
FORWARD 30
LEFT 90
FORWARD 30
RIGHT 90
FORWARD 30
LEFT 90
FORWARD 30
RIGHT 90
```

The first four lines are repeated three times. The brackets have been drawn in to show this. Instead of typing these four lines over and over again, you could use the REPEAT command.

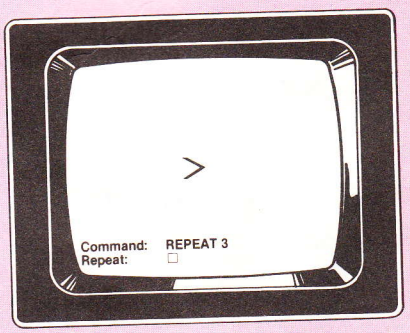
To clear the screen type:

CLEAR

Now type:

REPEAT 3

because you want to repeat the lines three times.

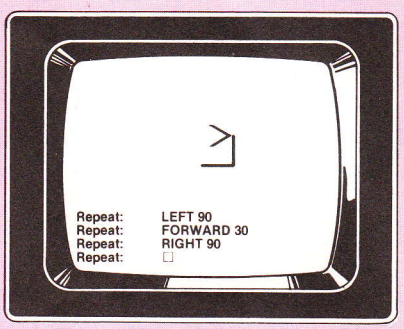


Did you notice that after you typed REPEAT 3 the cue word changed from "Command:" to "Repeat:"?

This is to remind you that you are inside a REPEAT/AGAIN loop and that everything you are typing is to be repeated.

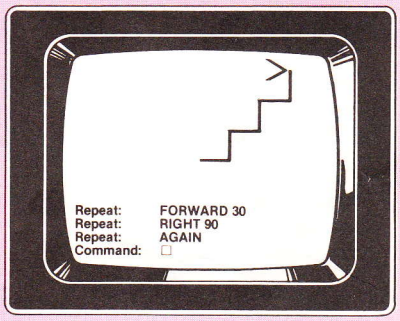
Now type the lines you want repeated:

FORWARD 30
LEFT 90
FORWARD 30
RIGHT 90



Lastly, to tell the program that you now want it to start the repeating, type:

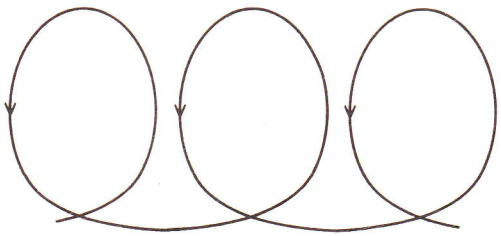
AGAIN



Watch what happens at every step.

Your complete staircase program should be:

REPEAT 3
FORWARD 30
LEFT 90
FORWARD 30
RIGHT 90
AGAIN



The lines that you want repeated go in between the words REPEAT and AGAIN.

We can call this a REPEAT/AGAIN loop because the instructions are carried out over and over again.

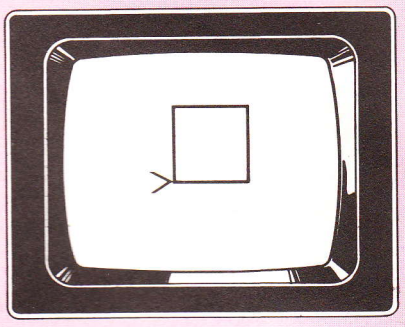
REPEAT/AGAIN loops can be very useful when you want to draw more complicated shapes without too much typing.

Challenge 8

Use a REPEAT/AGAIN loop to draw a square.

Think! **What number will you use after REPEAT?**
How many lines will be inside the REPEAT/AGAIN loop?

Hint: **Remember to type AGAIN at the end of your list of instructions.**



What is the difference between this square and the one you drew without using REPEAT? (Clue—look at the arrowhead.)

Is there any other way that you could have drawn the square?

Now draw a smaller square and then a larger one.

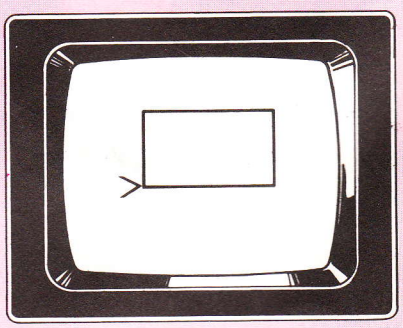
Think! **Which instructions will be the same each time?**
Which will be different?

Challenge 9

Use a REPEAT/AGAIN loop to draw a rectangle.

Think! **What is being repeated this time?**
What number will you use after REPEAT?
How many lines will be inside the REPEAT/AGAIN loop?
Which instructions will be the same as the ones you wrote for SQUARE?
Which will be different?

Hint: **RP is short for REPEAT and AG is short for AGAIN.**



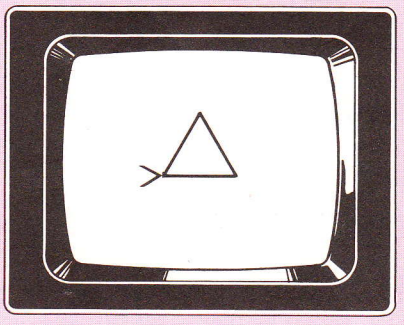
Remember you can type UNDO if you make a mistake.

Challenge 10

Draw a triangle with all its sides the same length (an equilateral triangle).

Think! **What number will you use after REPEAT here?**
How many lines will be inside the REPEAT/AGAIN loop?
How much will the pen turn at each corner?

Hint: **Think carefully about how much to turn the pen. Try walking in a triangle, thinking about what you are doing. It may take several attempts to solve this one. Do not worry. You can use UNDO if you make mistakes.**



If you get really stuck, talk about the problem with your friend or with the teacher.

Here are all the commands that you have learned so far:

FORWARD (FD)
BACKWARD (BD)
LEFT (LT)
RIGHT (RT)
CLEAR (CL)
UNDO
PENUP (PU)
PENDOWN (PD)
REPEAT (RP)
AGAIN (AG)

Extra Challenges

USING REPEAT/ AGAIN LOOPS

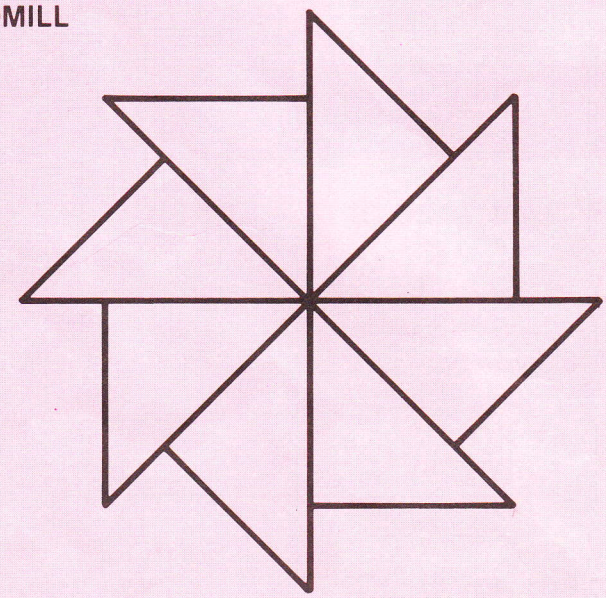
These two pages are filled with pictures for you to draw as extra Challenges. There is no need to tackle them in order nor to do all of them. Just choose the ones that you are interested in.

Before you start drawing read through the Think! clouds and think carefully about what you will do. You may find it helpful to draw out the picture on squared paper first, and to use a protractor to measure the angles. Perhaps you could be planning your work while someone else is using the computer.

Think! **Where will the drawing start?**
How long will each line be?
How much will you turn the pen at each corner?

Think! **Can you use a REPEAT/AGAIN loop to draw the picture?**
What will be repeated?
What number will you use after REPEAT?
How many lines will be inside the REPEAT/AGAIN loop?

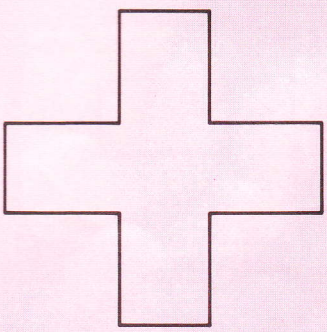
WINDMILL



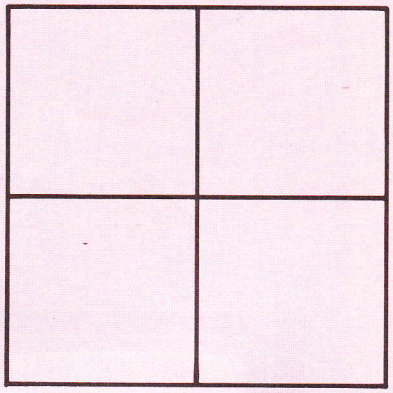
MOUNTAINS



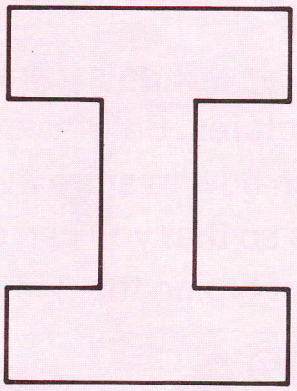
PLUS



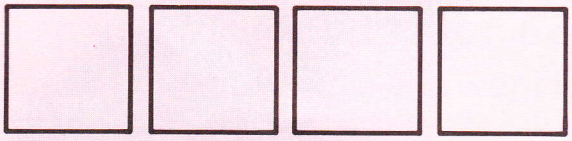
WINDOW



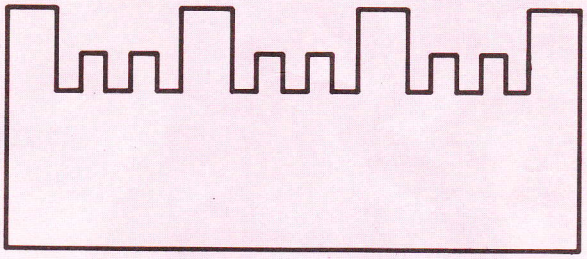
CORRIDORS



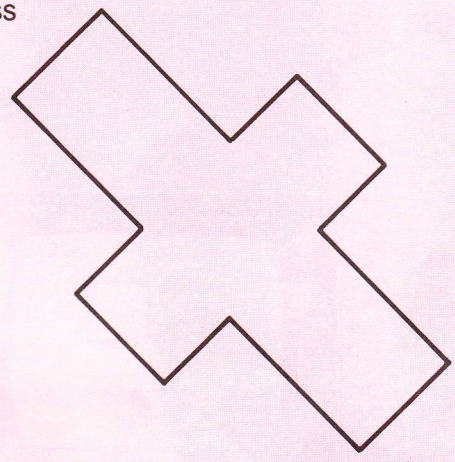
ALLSQUARE



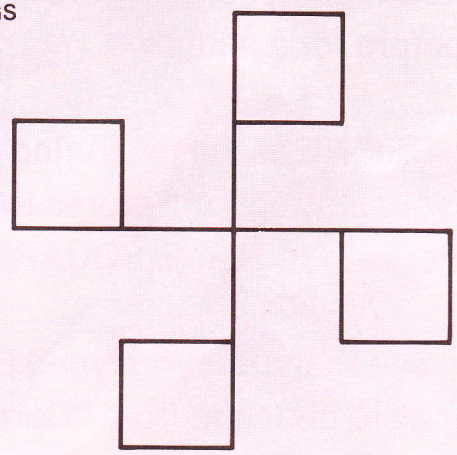
BATTLEMENTS



CROSS



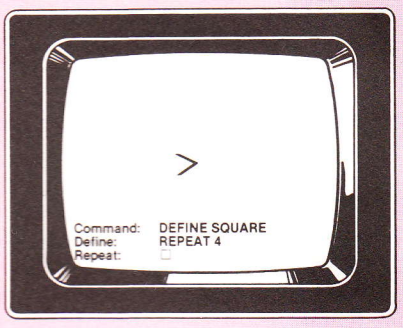
FLAGS



Lesson E

STORING PROCEDURES

You have now written several programs to draw different pictures. Before you write any more, you should learn how to store the programs or procedures so that you can call them up at any time without typing them in full each time.

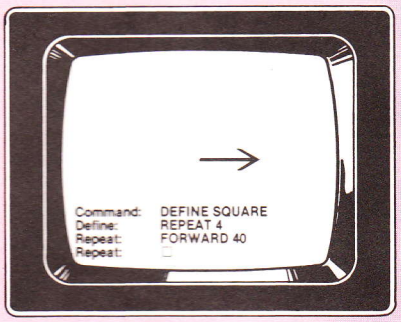


To do this you can use DEFINE/END.

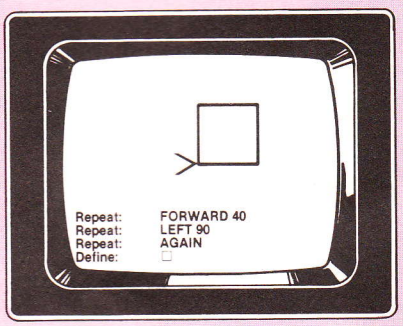
This is how to store a square in the program.

Type:

```
DEFINE SQUARE
REPEAT 4
FORWARD 40
LEFT 90
AGAIN
END
```



As you type the instructions the square will be drawn, just as it was before. The four lines bracketed together are like the instructions you typed before for a square.



Putting DEFINE at the beginning and END at the end of your instructions stores them in the computer with the name SQUARE.

Did you see that after you typed DEFINE SQUARE the cue word changed from "Command:" to "Define:"?

This is to remind you that everything you type is part of the procedure which you are defining (if you use REPEAT in your definition the cue word changes again to "Repeat:" to remind you that you are inside a REPEAT/AGAIN loop).

Now type:

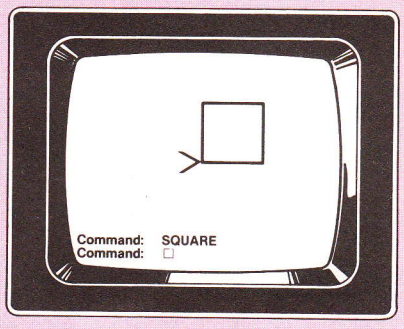
CLEAR

to clear the screen.

Now type:

SQUARE

What happens?



If you make mistakes when you are storing procedures, you can still use the DELETE key for typing errors or type UNDO to rub out the last piece of your drawing. If you want to start all over again first type:

END

You can then rub out the whole procedure from the computer's memory by typing:

DELETE

followed by the name of the procedure.

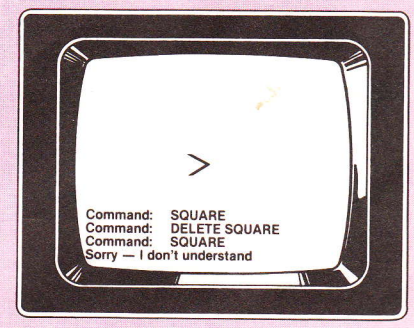
Type:

DELETE SQUARE

Now type:

SQUARE

What happens?

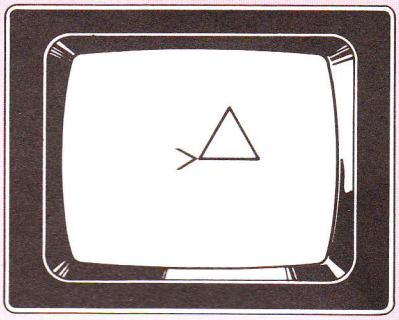


The procedure for SQUARE has been deleted (or rubbed out) from the computer's memory.

Follow the instructions at the beginning of the Lesson and store a procedure for SQUARE again.

Challenge 11

Store a procedure for an equilateral triangle with sides 40 units long.



Think! **What will be the first line of your instructions?**
How did you draw a triangle before?
How will you make each side of your triangle 40 units long?
How will you end the list of instructions?

Hint: **Your instructions must begin with:**

DEFINE TRIANGLE

and end with:

END

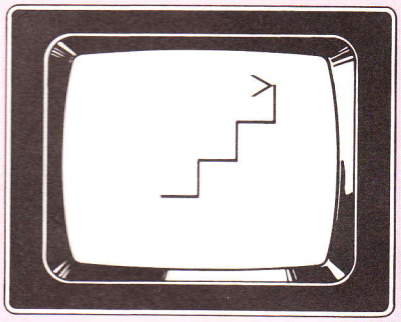
In fact you can call your triangle anything you like. If you start by typing:

DEFINE TRI

your triangle will be called TRI and to call it up later you should type TRI instead of TRIANGLE.

Challenge 12

Store a procedure for a staircase.



Think! **What will be the first line of your instructions?**
Where will you start the drawing?
Can you use a REPEAT/AGAIN loop?
What will be the last line of your instructions?

Hint: **Remember you must type:**

END

at the end of your procedure.

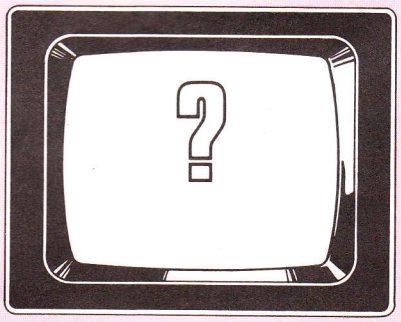
Now clear the screen and call up:

SQUARE, TRIANGLE or STAIRCASE

to check that they have been stored.

Challenge 13

Store some of the other pictures that you know how to draw.



Think! **Have you planned carefully what you will do?**
Will it help to draw the picture on paper first?

Hint: **If you make a mistake you can still use UNDO to correct it.**

Lesson F

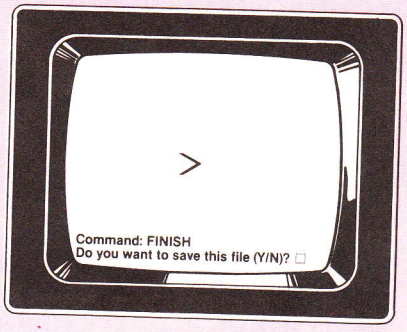
SAVING YOUR WORK

You have now stored SQUARE, TRIANGLE, STAIRCASE and some things of your own in the computer but not on your disk or cassette. If you turn the computer off you will lose your drawings.

To store the procedures permanently you must finish using the program.

Type:

FINISH



You will get a message asking whether you want to save the file you have made.

Type:

Y

for yes.

The computer now asks what you wish to call the file. It might be a good idea to call the file by your own name so that you will remember the name easily next time you need to use it.



Type YOUR NAME.

If you are using a computer which has programs stored on cassette tape, you will now get a message telling you how to store your procedures

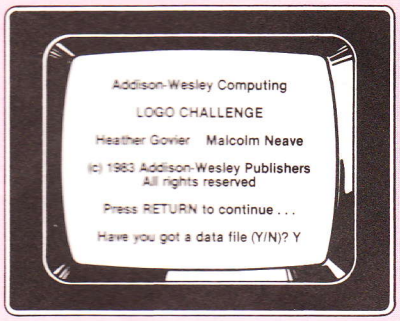
on your cassette. It is a good idea to have a separate blank cassette with your name on it for this purpose.

If you are working with a computer which uses disks, your work will be stored automatically on the back of the disk.

Watch what happens to the light on the disk drive.

Next time you come to use LOGO CHALLENGE, when you load and press:

RETURN

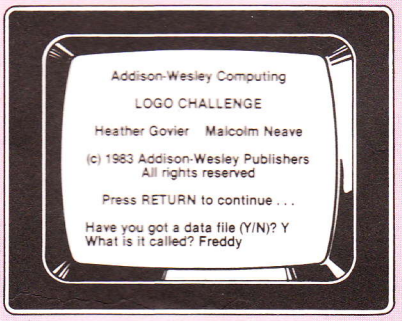


you will be asked whether you have a file that you wish to load.

If you type:

Y

you will be asked for the name of the file. If you are using cassettes you will then be given instructions about how to load your file from cassette.



If your file is stored on disk it will be loaded automatically.

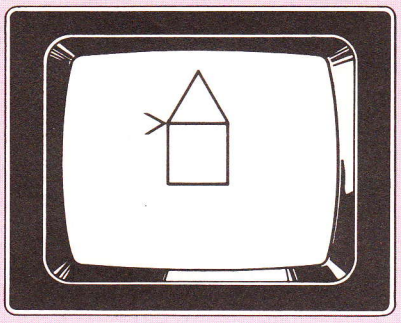
You can check that all your drawings are still there by typing:

LIST

What happens?

Challenge 14

Draw a house by using a square and a triangle.



Think! **Try typing:**

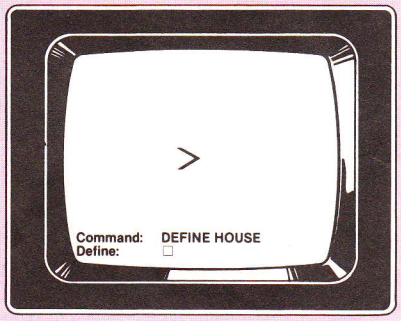
SQUARE
TRIANGLE

Why does this not give a house?
How can you put in extra commands to make a house like the one in the picture?

Hint: **You will need to move the pen between SQUARE and TRIANGLE.**

Challenge 15

Store your house in the computer memory and on cassette or disk.



Think! **What will be the first instruction?**
How will you end the list of instructions?
What instructions will go in between?

Hint: **You will have to type:**

DEFINE HOUSE

followed by the list of HOUSE commands.

Do not forget to type:

END

at the end of the list of commands.

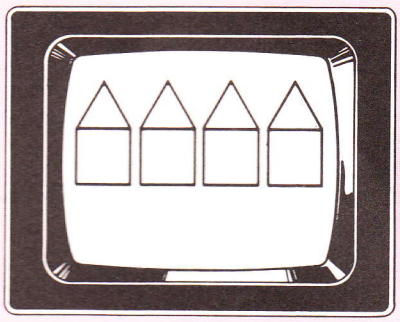
To store the house on the disk or cassette use:

FINISH

Look back over Lesson E and Lesson F if you get stuck.

Challenge 16

Draw and store a street or four houses.



Think! **Where will you start drawing?**
Can you use REPEAT/AGAIN?
What happens if you type:

REPEAT 4
HOUSE
AGAIN

Why does this not give a street?
What else will have to go inside the REPEAT/AGAIN loop?
Do you want detached houses or a terrace?

Hint: **Don't forget PENUP/PENDOWN will move the pen without making a line.**

Do not forget to store your street using DEFINE STREET/END. Look back over Lesson E and Lesson F if you get stuck.

Here are all the commands that you have learned so far. If you forget any of them, they are all listed in the glossary, inside the back cover.

FORWARD (FD)
BACKWARD (BD)
LEFT (LT)
RIGHT (RT)
CLEAR (CL)
UNDO
PENUP (PU)
PENDOWN (PD)
REPEAT (RP)
AGAIN (AG)
DEFINE (DF)
END (EN)
DELETE (DL)
FINISH
LIST (LS)

Extra Challenges

USING PROCEDURES

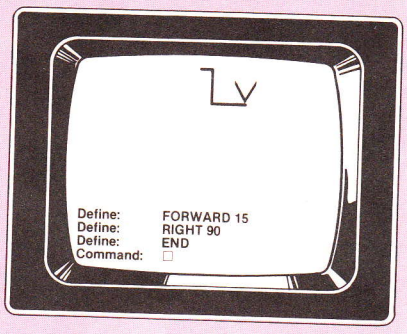
Just as HOUSE is built up from the procedures SQUARE and TRIANGLE, you could build up many of the pictures on pages 16 and 17 from smaller blocks.

Look at the plus sign on page 16. Starting from the top, three lines and three turns make the repeated block.

You could write a procedure for these lines called BLOCK.

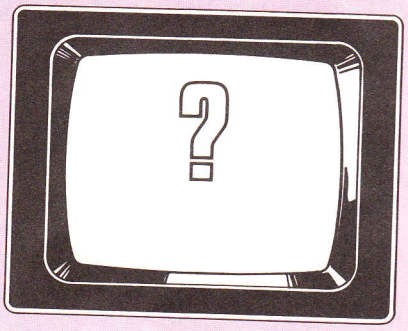
Type:

```
DEFINE BLOCK
FORWARD 5
RIGHT 90
FORWARD 15
LEFT 90
FORWARD 15
RIGHT 90
END
```



Now clear the screen and type:

```
REPEAT 4
BLOCK
AGAIN
```



What happens?

Most of the pictures on pages 16 and 17 could be drawn in this way.

This makes your sets of instructions much simpler to understand and use.

Choose one of the pictures from pages 16 or 17 and rewrite the instructions for it, using procedures.

If you have already stored the picture you will need to DELETE it first, or if you like just call it by a different name.

Lesson G

EDITING

If you had tried to draw a street of eight houses you would have found that your HOUSE was too big to do this. It would be very useful if you could change the size of your drawings without having to DEFINE them all over again.

To learn how to do this, think about the set of instructions you used to draw a square using a REPEAT/AGAIN loop. They were something like:

REPEAT 4
FORWARD 60
LEFT 90
AGAIN

You may not have FORWARD 60 in your list but all the other instructions should be the same.

If you want a smaller square, all you need to change is the line FORWARD 60.

If you put FORWARD 25 instead, you will get a smaller square.

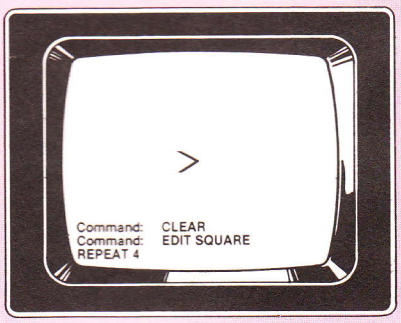
To change part of the program without rewriting it we use the EDIT mode.

Type:

EDIT SQUARE

You will see that the first line of the SQUARE program appears. The rest of the screen is automatically cleared, ready to start editing.

The first line is:
REPEAT 4



You do not wish to change this line so just press the RETURN key. Now the next line of SQUARE has appeared:

FORWARD 60

This is the line that you want to change so do not press the RETURN key this time.

You want to replace it with FORWARD 25.

Type: R for replace.

The screen will now say: "Replace:"

This means that the computer is waiting for you to type what you want to put instead of FORWARD 60.

So type:

FORWARD 25

and then press the RETURN key.

The next line of the SQUARE program has now appeared at the bottom of the screen.

LEFT 90

You do not wish to change this line so press the RETURN key again. This gives:

AGAIN

You do not wish to change AGAIN so press the RETURN key. This was the last line of your procedure. The screen will now show:

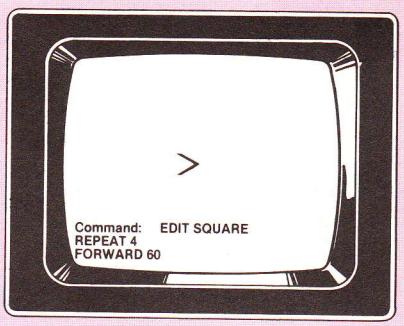
"Any more (Y/N)?"

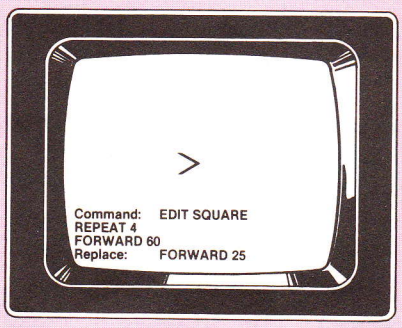
This is to ask if you want to add any extra lines to the procedure. As you do not, type:

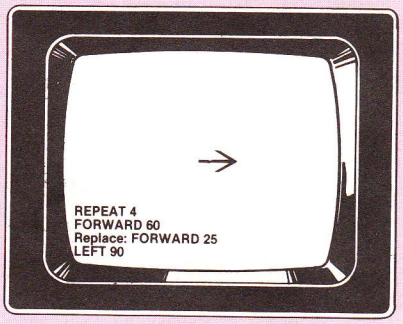
N for no.

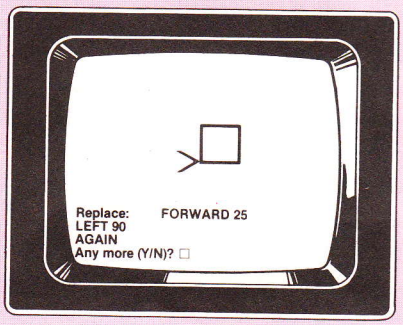
The computer will respond with "End of Edit" and return to "Command:" mode.

What size SQUARE have you drawn this time?





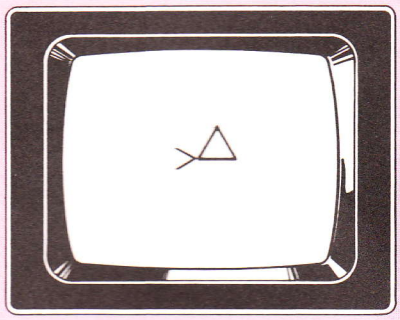




Challenge 17

Edit TRIANGLE to make the sides 25 units long.

Think! **What instructions did you type before to define a triangle? Which lines will stay the same in your smaller triangle? Which will change?**



Hint: **Start with EDIT TRIANGLE.**

Remember that the RETURN key is used to say "no change". R means that you want to replace a line.

Read through Lesson G again carefully if you get stuck.

When you have edited TRIANGLE, CLEAR the screen and then type:

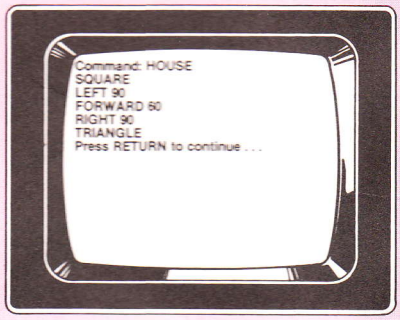
HOUSE

What happens? Why?

Challenge 18

Edit HOUSE.

Think! **Did HOUSE go wrong? If so why?**



Hint: **If you want to see all the instructions you wrote for HOUSE, type:**

LIST HOUSE

Can you see which line will have to be changed?

The LIST command used in this way is very useful if you want to remind yourself about how you wrote your programs.

In Lesson F you discovered what happened if you typed LIST on its own. Look back to Lesson F if you have forgotten.

Typing LIST followed by the name of one of your drawings does something rather different. Try:

LIST TRIANGLE

or: LIST STAIRCASE

What happens?

What happens if you type:

LIST MARMALADE

Why?

Challenge 19

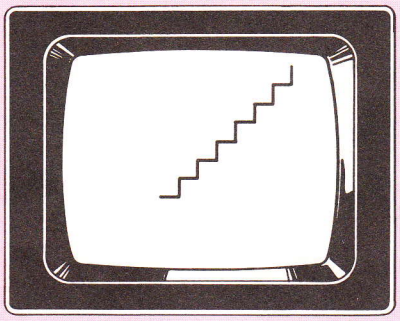
Edit STAIRCASE and explore the HELP file.

Think! **How could you make a staircase with a greater number of smaller steps?**

Type:

LIST STAIRCASE

What will you change?
What will stay the same?



Hint: **You now know most of the commands that you can use in** LOGO CHALLENGE. **If you forget any of them type:**

HELP

You may have to wait for a while.

You should know most of the commands listed in the HELP file.

Try to find out more about some of the ones that you do not recognise. What does WHERE do, for example?

What happens if you type:

HELP FORWARD

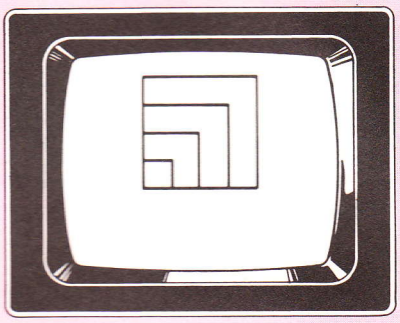
or

HELP LIST

(When you are editing you can put lines in or take them out. If you would like to learn how to do this, ask your teacher.)

Lesson H

INTRODUCING VARIABLES



The picture on the right is made up of four squares of different sizes. We could draw the picture by editing SQUARE four times, giving different numbers for the FORWARD instruction. However, this would take quite a long time. It would be very useful to be able to say:

```
SIZE 20          Then:   SIZE 30
SQUARE                   SQUARE
```

and so on, without doing lots of editing. To do this we need to edit SQUARE one more time.

Remember the instructions for SQUARE (type LIST SQUARE to see them on the screen):

```
REPEAT 4
FORWARD 25
LEFT 90
AGAIN
```

This time, instead of changing 25 to another number we really want to leave a blank space where we can put any number we like. We want to say FORWARD "something-or-other".

This "something-or-other" is called a variable because we can vary (or change) it whenever we like.

Instead of "something-or-other", in LOGO CHALLENGE we use the word SIZE.

Now edit SQUARE, changing the line FORWARD 25 to:

FORWARD SIZE

When you press the RETURN key the program will say:

"SIZE not set—how big should it be?"

It is asking for a SIZE to draw this particular square.

Type: 50

then complete the editing as you did before.

Now CLEAR the screen and type:

SIZE 10
SQUARE

What happens?

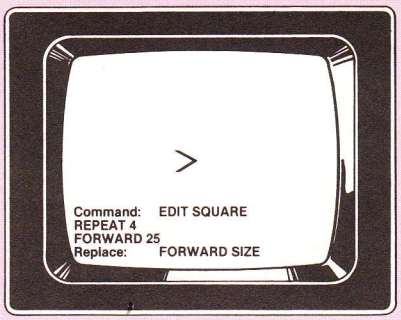
Now type:

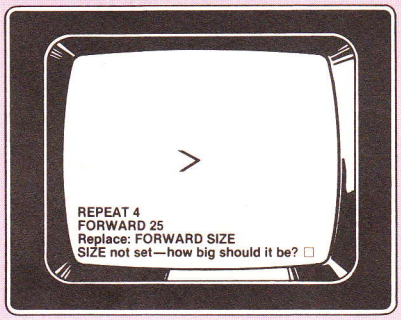
SIZE 30
SQUARE

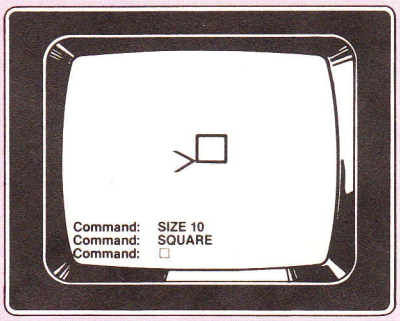
What happens?

Can you now draw a picture like the one at the start of this Lesson?

Remember that you can correct typing mistakes by using the DELETE key, and "rub out" the last step in your drawing by typing UNDO.





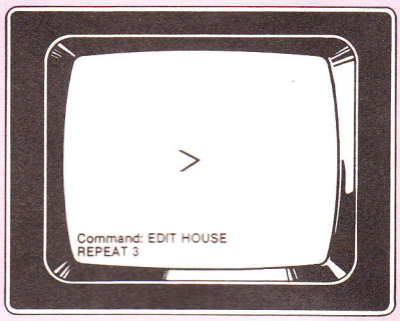


Challenge 20

Edit HOUSE to make it variable.

Think! **What instructions make up your HOUSE procedure?**
What will need to be changed?
What will stay the same?

Hint: **You will have to put a variable into TRIANGLE too.**

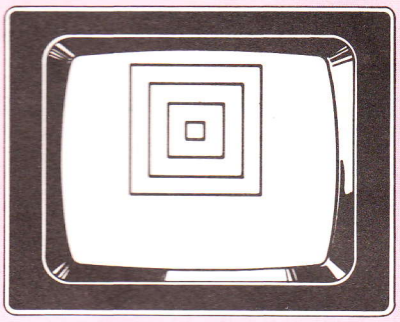


Challenge 21

Draw a well.

Think! **How is this different from the picture you drew for Lesson H?**
What extra instructions will you use?

Hint: **Remember PENUP and PENDOWN.**

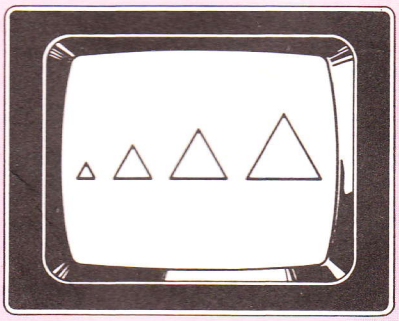


Challenge 22

Draw the pyramids.

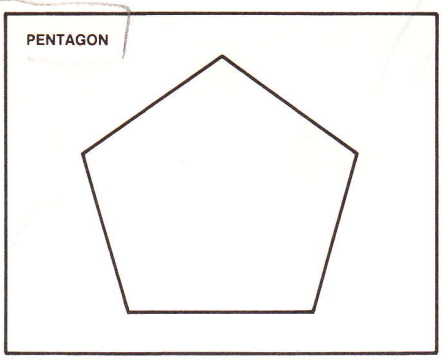
Think! **Where will you start?**
How much will you change the size of the triangle each time?
How much space will you leave between the triangles?

Hint: **Remember how far it is from one side of the screen to the other. If you have forgotten, how can you find out?**



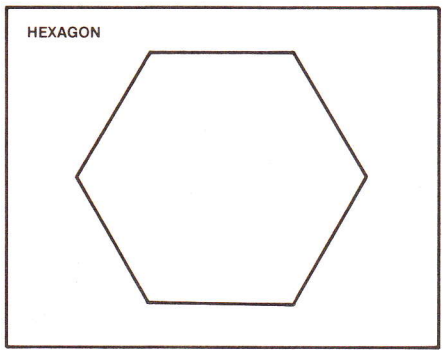
Extra Challenges

POLYGONS AND CIRCLES

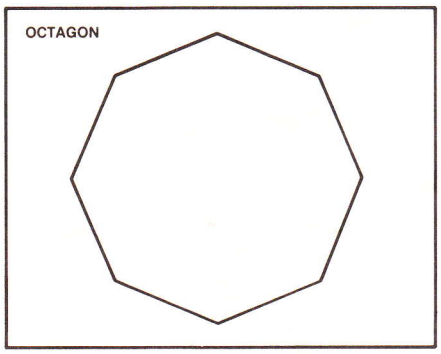


You have already drawn a three-sided polygon (a triangle) and a four-sided polygon (a square). Can you now draw a polygon with five sides? Or six sides? What about a polygon with twelve sides?

Think! **What turn will be needed at each corner?**
What is the total amount of turn needed to bring the pen back to where it started?



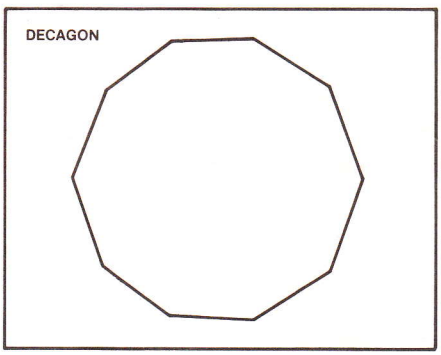
When you have worked out what is needed, store a procedure for a hexagon, and a few of the other regular polygons shown here.



All the shapes you have drawn so far have been straight-sided. How will you draw a circle?

Think! **How did you draw the polygons?**
Have you tried walking in a circle thinking about what you are doing?
How much do you turn altogether?
What number will you use after REPEAT?

When you have stored a procedure for a circle, draw and store a smaller circle.



Think! **Try walking in a smaller circle.**
Do you turn more or less? Do you walk as far?
What is your total amount of turn?

Circle drawing can be a bit slow. You can make it faster if you HIDE the arrowhead first. Type:

HIDE

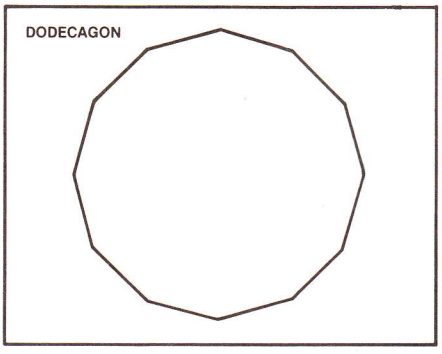
What happens? To bring the arrowhead back, type:

SHOW

What happens? Now type:

HIDE
CIRCLE

Your circle will now be drawn more quickly.



Lesson I

MORE VARIABLES

In Lesson H you learned how to vary the SIZE of your drawings but you may wish to vary other things about them. Here are two sets of instructions for a circle:

```
REPEAT 360
FORWARD 1
LEFT 1
AGAIN
```

```
REPEAT 72
FORWARD 1
LEFT 5
AGAIN
```

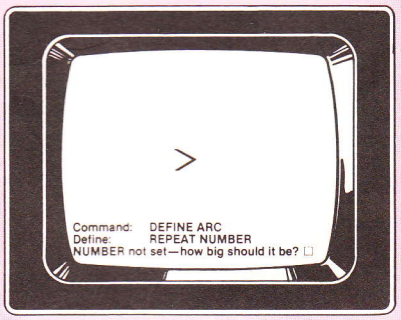
Which produces the larger circle?

In these two programs the FORWARD instruction stays the same. It is the NUMBER of repeats and the ANGLE of turn which vary.

Just as we used SIZE as a variable we can also use ANGLE and NUMBER.

CLEAR the screen and then type:

```
DEFINE ARC
REPEAT NUMBER
```



The computer will respond with:

"NUMBER not set — how big should it be?"

Type:

```
36
```

then:

FORWARD 1
LEFT ANGLE

You will get the message:

"ANGLE not set — how big should it be?"

Type:

10
AGAIN
END

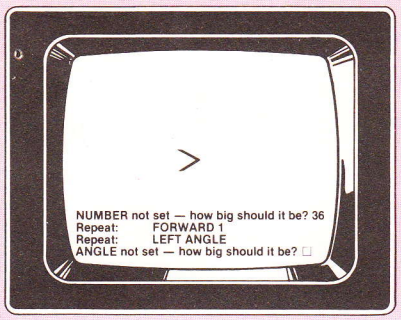
What happens?

Now type:

NUMBER 36
ANGLE 5
ARC

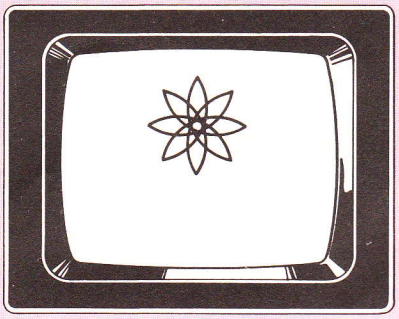
What happens?

What else can you do with your ARC program?



Challenge 23

Use ARC to draw a flower.



Think! **What NUMBER and ANGLE setting will you need?
Can you use a REPEAT/AGAIN loop?
What is the building block?
Would it be simpler to store a procedure for a petal first?**

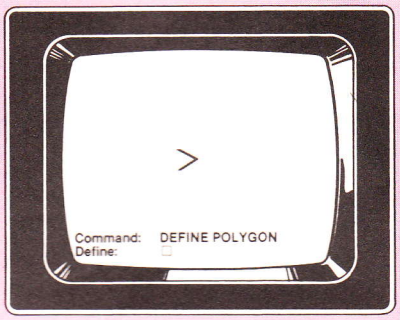
Hint: **Always think of the building blocks. Your first problem is to work out how to draw a petal. When you have done that the flower should be easy.**

Challenge 24

Write a four-line program to draw any polygon.

Think! **Think about all the polygons that you worked on before.
What was the same for all of them?
What changed?**

Hint: **Use DEFINE POLYGON/END. You will need to use all three variables NUMBER, SIZE and ANGLE in your instructions.**



What shape will you get when you type:

NUMBER 5
SIZE 20
ANGLE 72
POLYGON

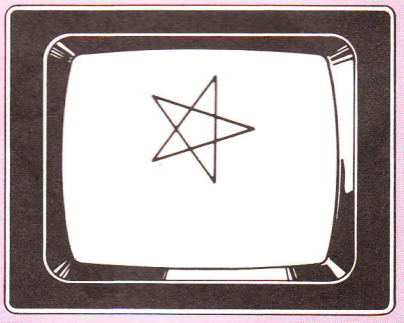
What settings for NUMBER, SIZE and ANGLE will you need to draw a hexagon or a square?

Challenge 25

Use the polygon program to draw a star.

Think! **What settings of NUMBER, SIZE and ANGLE will you need to draw a star like the one in the picture?
Could you draw a different kind of star?**

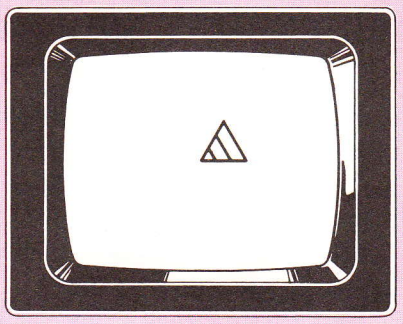
Hint: **You may find it helpful to draw the star on paper first and measure the angles with a protractor.**



Lesson J

ARITHMETIC WITH VARIABLES

To draw a nest of triangles which get bigger and bigger we need to use the TRIANGLE program with variable SIZE.



We could type:

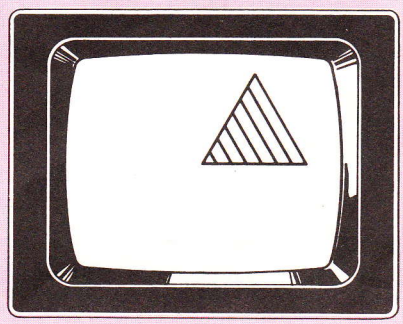
```
SIZE 10
TRIANGLE
SIZE 20
TRIANGLE
SIZE 30
TRIANGLE
```

and so on.

We are adding an extra 10 to the SIZE of the triangle each time. It would be easier to do this using a REPEAT/AGAIN loop if we did not have to keep changing the SIZE instruction.

We can in fact get the computer to do this adding for us.

Look at this list of instructions:



```
DEFINE NEST
SIZE 10
REPEAT 6
SIZE = SIZE + 10
TRIANGLE
AGAIN
END
```

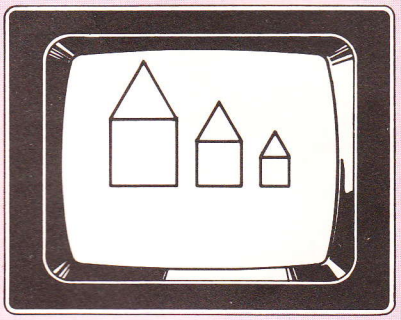
Type it in and watch what happens? Can you see how the REPEAT/AGAIN loop is working?

Each time the instructions are carried out an extra 10 units are added to the SIZE instruction.

If we wish we can also use subtraction (–), multiplication (use the * key) and division (use the / key) with our variables.

Challenge 26

Draw a street with perspective.



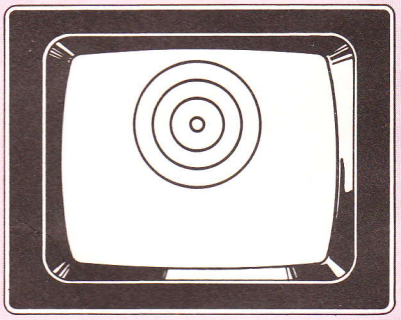
Think! **Where must the pen start?**
Can you use a REPEAT/AGAIN loop?

Hint: **The shortest way of doing this is to use arithmetic with your variables, but there are other ways. If you found Lesson J difficult to follow, try to think of a method of your own.**

Think! **Could you have done this Challenge by editing your original STREET program?**

Challenge 27

Draw a nest of concentric circles.

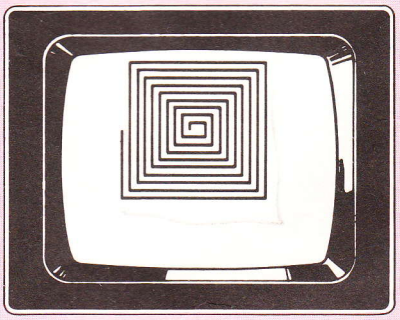


Think! **What will change as the circles get larger?**

Hint: **Plan your work first.**

Challenge 28

Draw a spiral.



Think! **What changes?**
What stays the same?
How could you make use of the arithmetic?

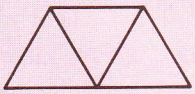
Hint: **There are many different kinds of spiral that you could draw. Yours may not look exactly like the one in the picture.**

Extra Challenges

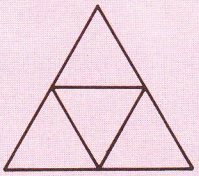
ELEGANT PROGRAMMING

Once you have mastered all the LOGO CHALLENGE commands you should be able to draw and store procedures for almost anything.
The Challenge now is to try and keep all your lists of instructions short and readable. Each of the Challenges given on this page has a number. You should be able to produce the drawing using a program of no more than that number of lines. It will be necessary to use procedures as you did on page 25.

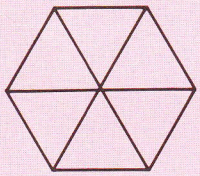
TRAPEZIUM (4)



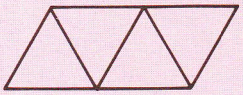
BIGTRI (5)



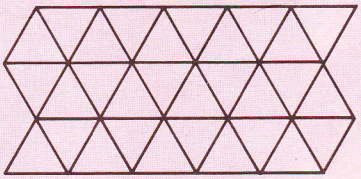
BIGHEX (4)



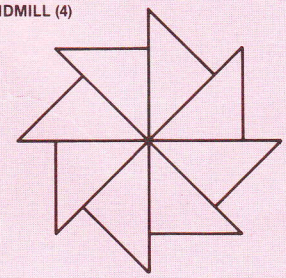
PARALLELOGRAM (4)



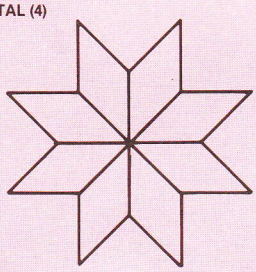
TESSELLATION (6)



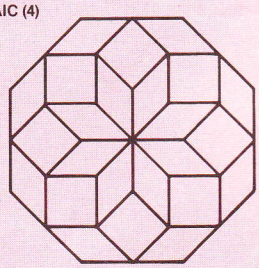
WINDMILL (4)



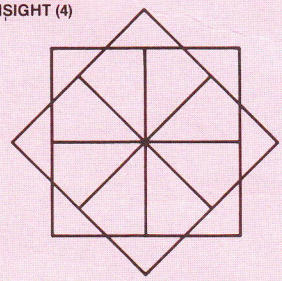
CRYSTAL (4)



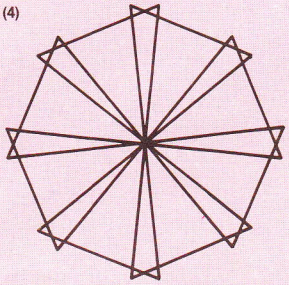
MOSAIC (4)



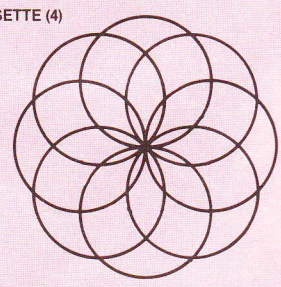
GUNSIGHT (4)



FAN (4)

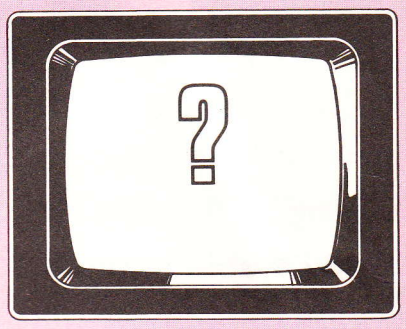


ROSETTE (4)



And Finally...

MAKE YOUR OWN CHALLENGE



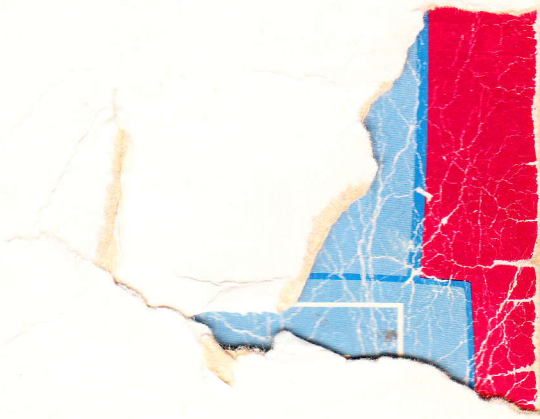
You are now on your own! You may have found the last ten Challenges pretty difficult but we hope that you enjoyed thinking about them. Now it is your turn to set Challenges for yourself, your friends, your teacher, or even us. (To challenge us, write, care of the publisher.)

In order for a Challenge to be meaningful you must be able to solve it yourself before you ask others to do it. Problem posers must be problem solvers first!

Glossary

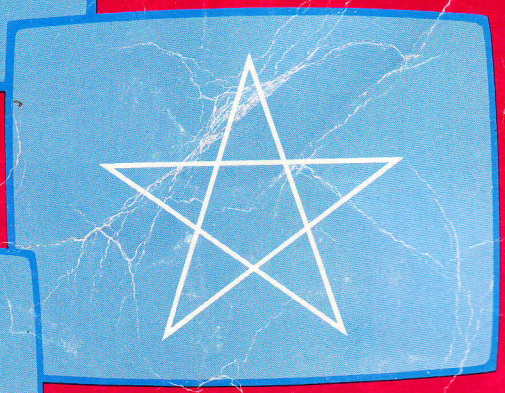
INDEX OF LOGO CHALLENGE COMMANDS

FORWARD (FD)	page 6
BACKWARD (BD)	6
CLEAR (CL)	6
LEFT (LT)	8
RIGHT (RT)	8
UNDO	8
PENUP (PU)	10
PENDOWN (PD)	10
REPEAT (RP) AGAIN (AG)	12
DEFINE (DF) END (EN)	18
DELETE (DL)	19
FINISH	21
LIST (LI)	22 and 28
EDIT (ED)	26
HELP	29
SIZE	30
HIDE (HD) SHOW (SH)	33
NUMBER/ANGLE	34

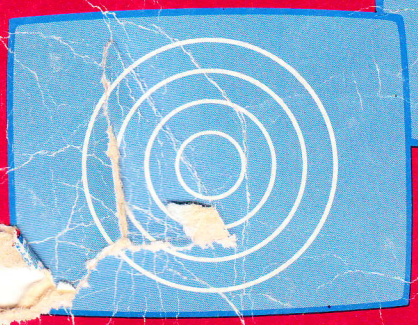


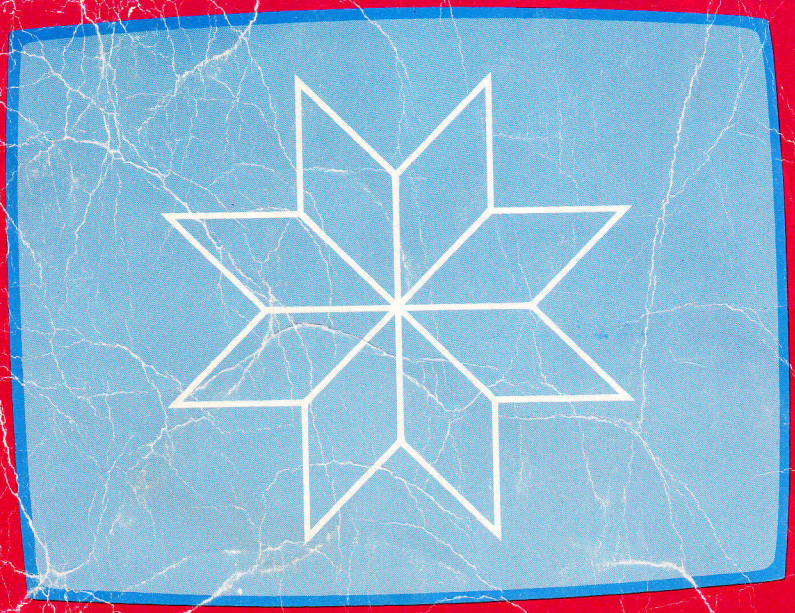
LOGO CHALLENGE





m
oth
solve





ISBN 201 18400 1

Addison-Wesley Publishers