

Purpose	(i) To learn about Production Systems (ii) To explore LSystems grammars and the shapes they produce.
Files Required	Octave
ILO Contribution	LO 4
Send to Me	nix
Homework	Read chapter 12 (WIP)

1. (a) Download and unzip the LSystems folder. Run the Octave script **runLSystem** and this will draw the plant CBP_Weed.

Select a depth of 3 and an angle of 20 degrees. Hit 0 when prompted to print the production strings or not

(b) Investigate other depths and angles.

2. (a) Now let's have some fun. Code the Axiom and Rule to produce Fig 1.24(c) from *The Algorithmic Beauty of Plants*

Axiom	F
Rule	$F \rightarrow FF[-F+F+F][+F-F-F]$

You will need to add code like this. The variables in the first three lines are strings; use single quotes around these. The fourth line has a float variable. Add a semicolon at the end of each line

```
grammar.name = 'anything you like';
grammar.axiom = 'axiom string';
grammar.rules = {'left side of rule' 'right side of rule'};
grammar.angle = degrees;
```

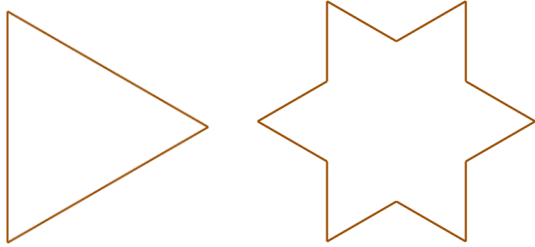
The authors' figure uses depth=4 and angle = 22.5 (degrees)

(b) Now experiment with various angles and depths and try to produce the most beautiful plant you can.

3. Consider the following grammar

Axiom	F++F++F
Rule	$F \rightarrow F-F++F-F$

Use this to explain (i) why the starting shape is a triangle (what is the specified angle), (ii) why the depth-1 production is a star



4. The following grammar

Axiom	F
Rule	$F \rightarrow F+F$

produces this graph with a depth of 1 (angle 90 degs)



Draw the shape with a depth of 2

5 From your answer to (4) work out what this grammar produces

Axiom	F
Rule	$F \rightarrow +F+F$

for depth 1 and depth 2 (angle 90 degs)

6. Koch Curve. Consider the following grammar

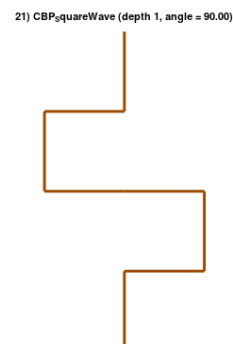
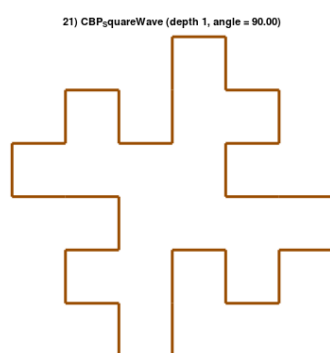
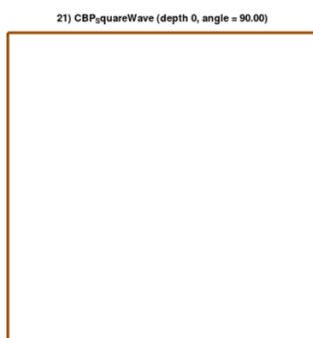
Axiom	F
Rule	$F \rightarrow F+F-F-F+F$

(a) Looking at the Rule, explain why the turtle emerges in the same direction it starts

(b) Sketch the first three productions of this grammar

(c) Code the grammar and investigate the resulting shapes

7. Look at the axiom drawn by the turtle (bottom left) and the depth-1 production (bottom right)
Work out the string representation for both the Axiom and the production Rule.



8. *Introducing X* Consider the following grammar

Axiom	X
Rule	$X \rightarrow F+F+X$

- (a) Write down the first three production strings
 (b) Draw the shape with angle = 45 degs. Remember the X is disregarded by the turtle

9. *Introducing 2-rules*

- (a) First consider this grammar and write down the production strings to depth = 3. Draw the curve for an angle of 45 degs

Axiom	X
Rule1	$X \rightarrow F+X$

- (b) Now repeat for this 2-rule system

Axiom	X
Rule1	$X \rightarrow F+X$
Rule2	$F \rightarrow FF$

10. Here are the first three plots for the grammar from *The Algorithmic Beauty of Plants Fig.1.24(d)*. The grammar is

Axiom	X
Rule1	$X \rightarrow F[+X]F[-X]+X$
Rule2	$F \rightarrow FF$

9) Figure 1.24 (d) (depth 1, angle = 20.00)



9) Figure 1.24 (d) (depth 2, angle = 20.00)



9) Figure 1.24 (d) (depth 3, angle = 20.00)



- (a) Use the grammar to derive the production strings for these three cases
 (b) Now code the rules and produce trees for greater depths

11. Consider the following grammar which will create a plant

Axiom	F
Rule1	$F \rightarrow F[-F]+F$

Use this to draw depth 1 and depth 2 plants for an angle of 30 degrees.
 Now code the grammar and check your results
 Generate plants for greater depths. You may want to reduce the angle.

12. **[Challenge]** Use what you have learned to invent your own grammar to make an interesting shape.
