

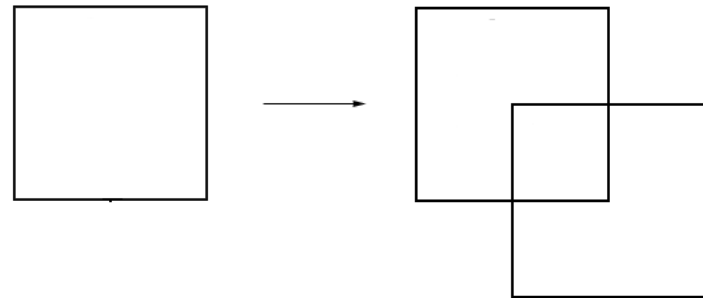
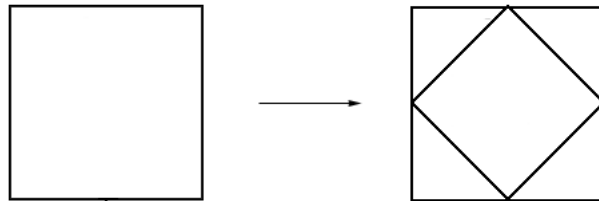
48-747 Shape Grammars

(Non Parametric and)

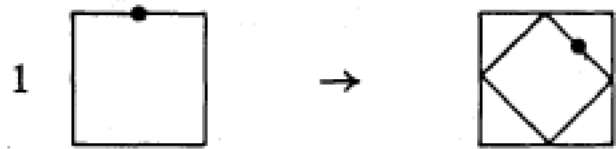
PARAMETRIC SHAPE GRAMMARS

george stiny

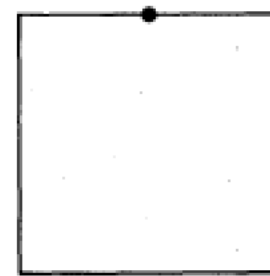
introduction to shape and shape grammars



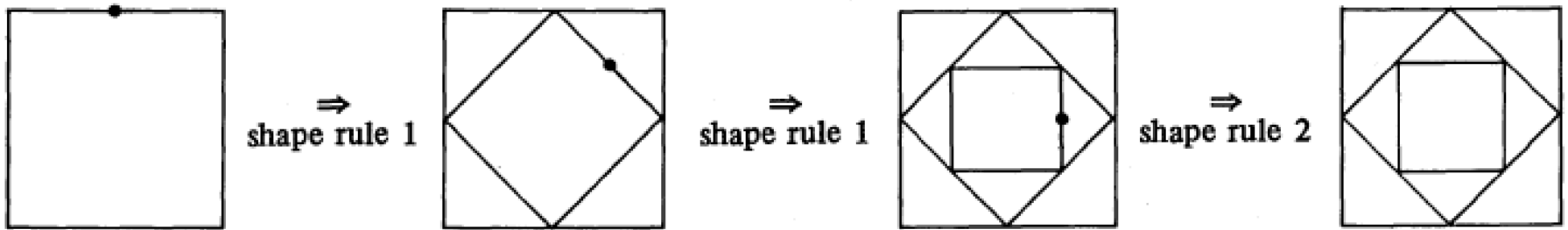
shape rules



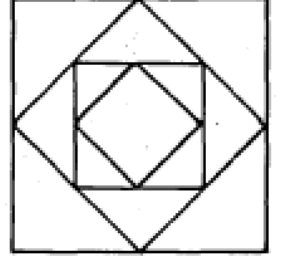
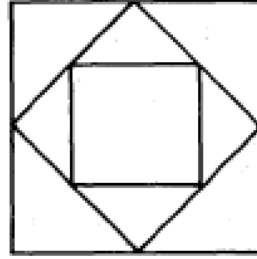
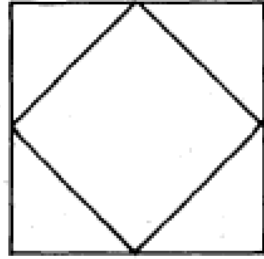
(a)



shape grammars using labels



derivations



language

A *parametric shape* is a shape with *open terms*

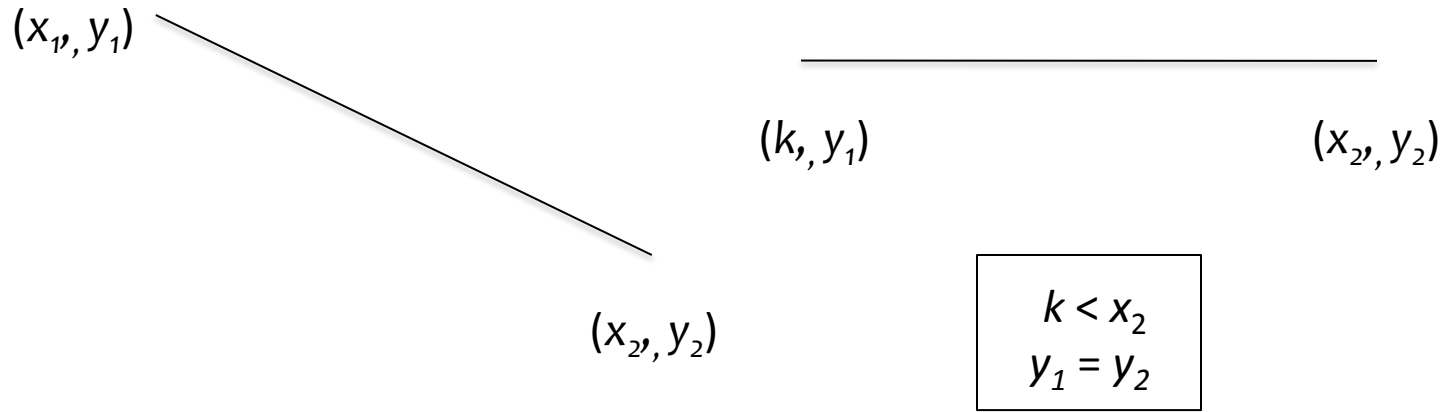
That is, certain points are specified in terms of *equations* or *constraints*

A parametric shape becomes a shape whenever we can find an assignment of real values to the points so that the constraints are satisfied

Example:

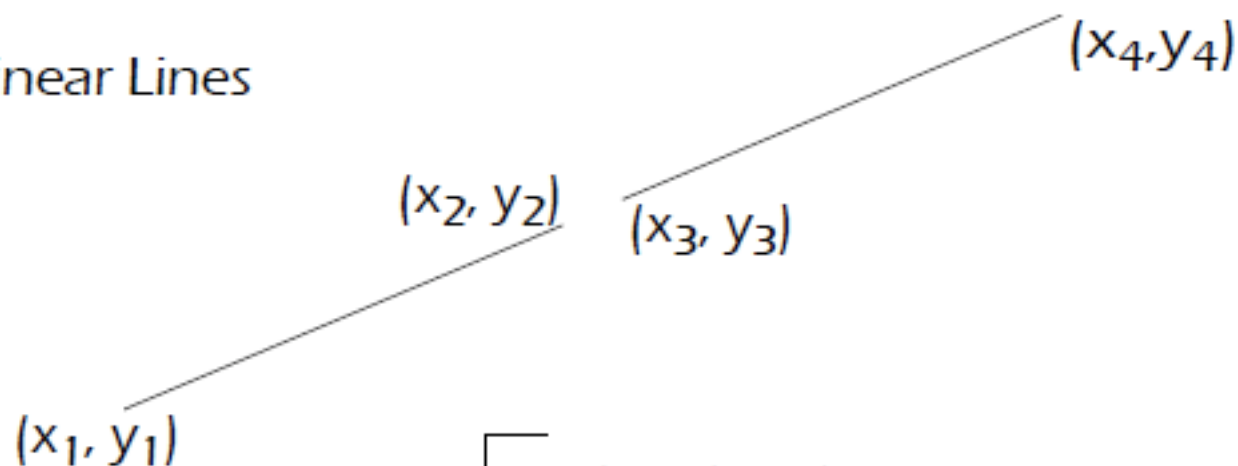
A square of given sides with one of its corners given fixed coordinates

parametric shapes



parametric shapes

Collinear Lines



(at a minimum)
is pictorially
equivalent
to the constraints

$$x_4 \geq x_3 \geq x_2 \geq x_1$$

$$y_4 > y_3 > y_2 > y_1$$

or

$$x_4 > x_3 > x_2 > x_1$$

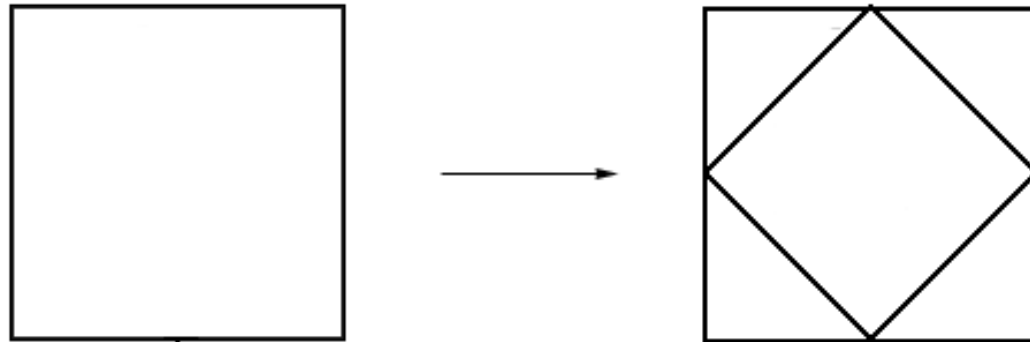
$$y_4 \geq y_3 \geq y_2 \geq y_1$$

and

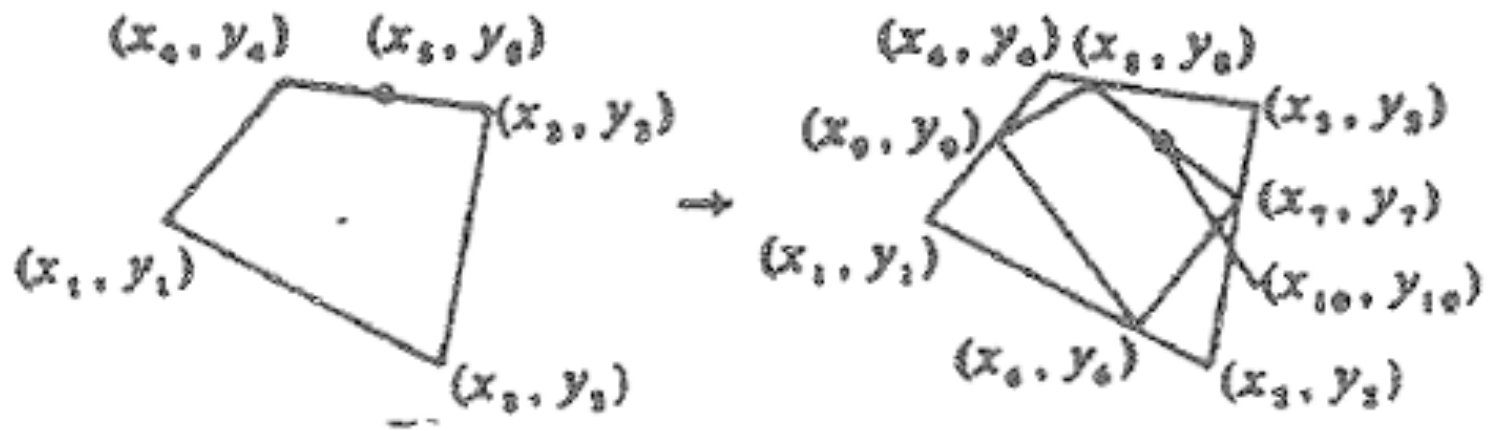
$$(y_2 - y_1)(x_4 - x_3) = (x_2 - x_1)(y_4 - y_3)$$

and

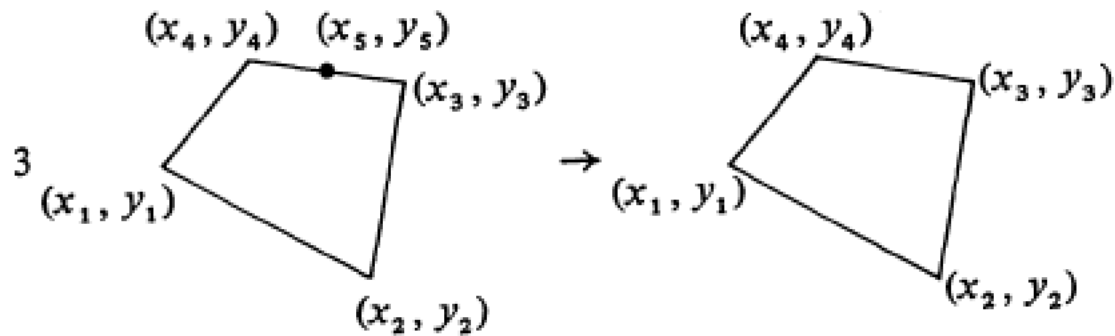
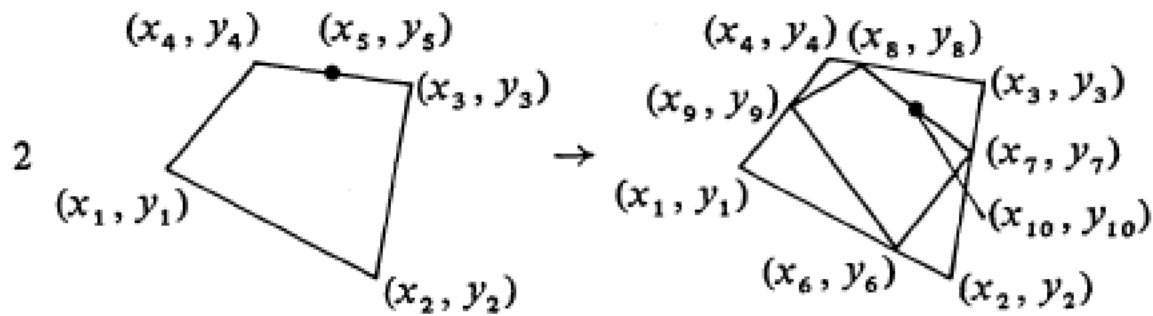
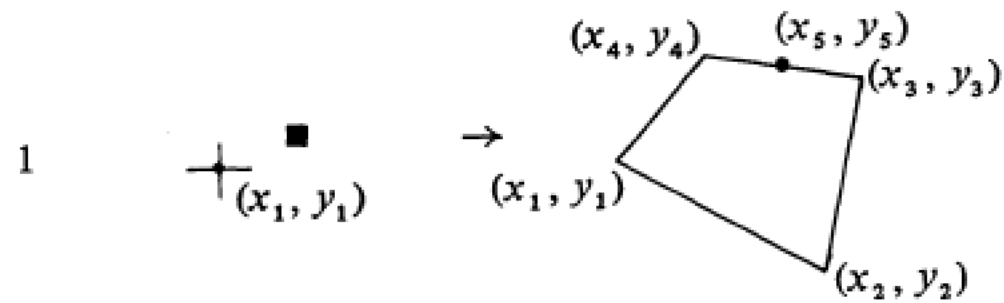
x_i, y_i are real numbers.



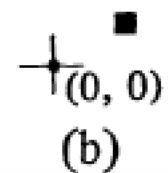
shape rule



shape schema



(a)

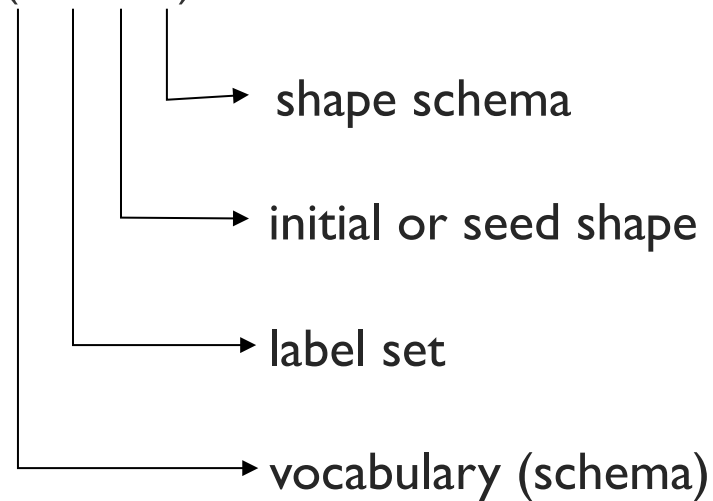


(b)

parametric shape grammar

parametric shape grammar $G = (S, L, I, R)$

initial (seed) shape belongs to the *universe* of labeled shapes made up of schemas in S and labels in L



R contain schemas of the form $a \rightarrow b$ where **a** and **b** belong to the universe of labeled shape schemas made of schemas in S and labels in L except **a** cannot be empty

formally: a parametric shape grammar is

A shape schema is **applicable** to the *current shape*

which is either the initial shape

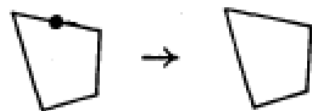
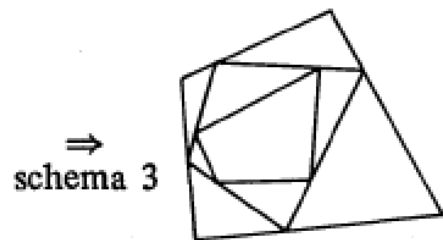
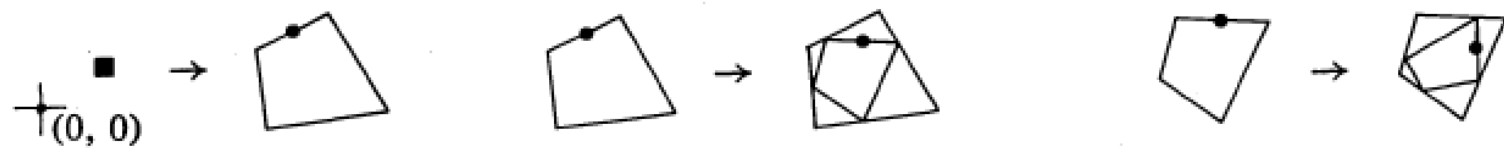
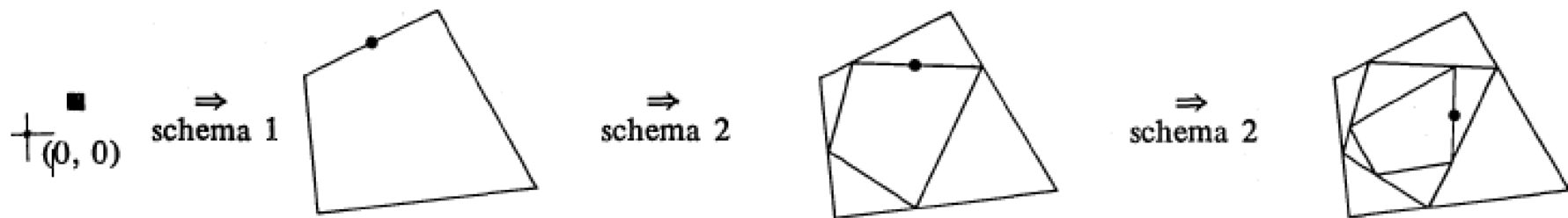
or a shape produced from the initial shape

whenever the left hand side of the rule 'occurs' in the object

in which case

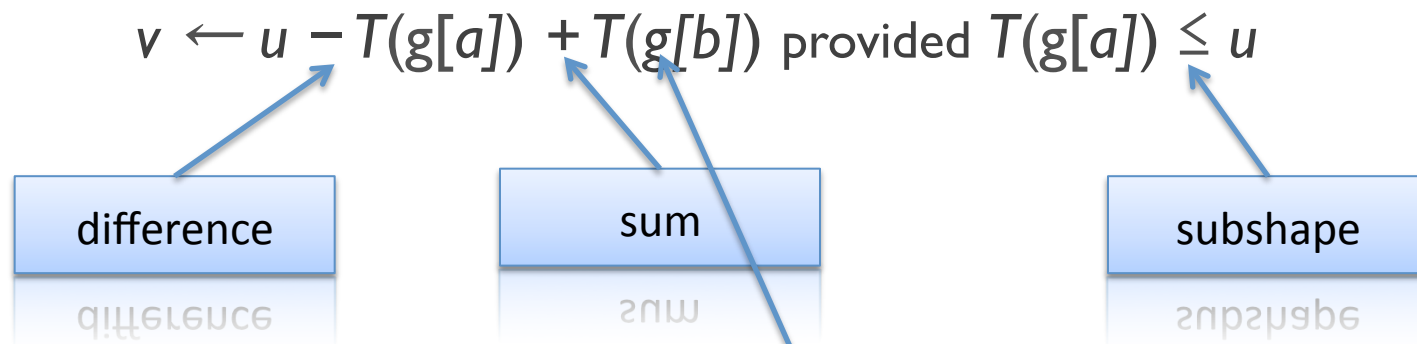
it is **replaced** by the right hand side of the rule under rule application

shape schema application

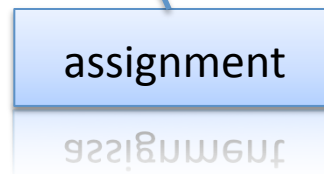


A schema $a \rightarrow b$ is applied only if a 'occurs' in the given shape u under some 'transformation' T and an assignment g in which case $T(g[a])$ is substituted by $T(g[b])$ in the current shape

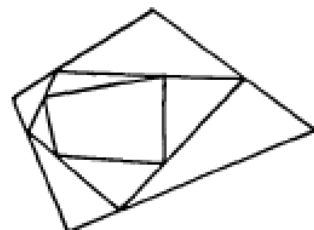
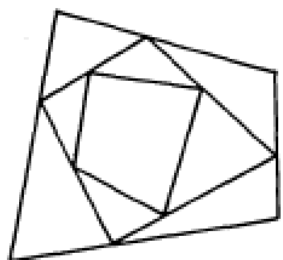
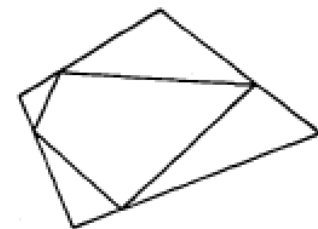
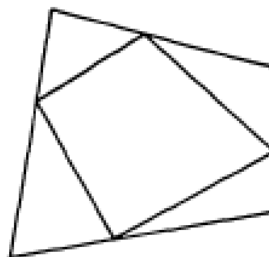
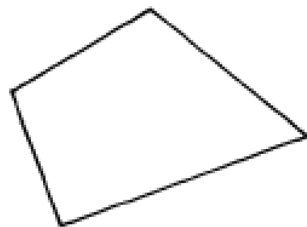
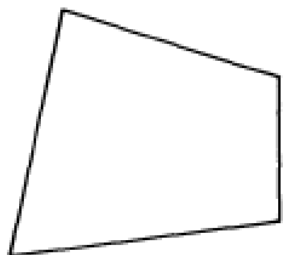
Rule application



We describe this as $u \Rightarrow v$



rule application



language

go to some grammar examples