

As shape grammar makes its beginning first in education, is it still wise to take the slow by hand approach to teaching or say for example speed up the program at rigorous design schools to get people involved quicker and in quality numbers?

"Rules do not circumvent intuition, inspiration and so forth" - I agree with the argument that "the designs of rules involve intelligence and intuition, imagination, etc.", however can it not be considered that this type of design requires a different set of skills (more mathematical perhaps) than creating purely from / in an original kind of way?

It seems to me that architecture, art, and design are only minimally about shape, so how can a shape grammar take into consideration other design issues, including program and structure and even intention or message?

**rule**

**X → Y**

**shape rule:  $X \rightarrow Y$**

**design**

**A rule applies to a design:**

whenever there is a transformation  $t$  that makes the left-side  $X$   
a part of the design:  $t(X) \leq \text{design}$

**To apply the rule:**

first subtract the transformation  $t$  of the left-side  $X$  from the design,  
and then add the same transformation  $t$  of the right-side  $Y$  to the design.

**The result of applying the rule is a new design:**

new design =  $[\text{design} - t(X)] + t(Y)$

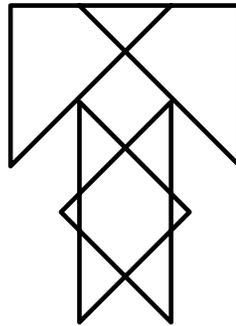
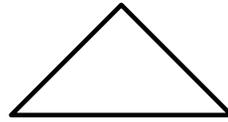
**rule**

**$X \rightarrow Y$**

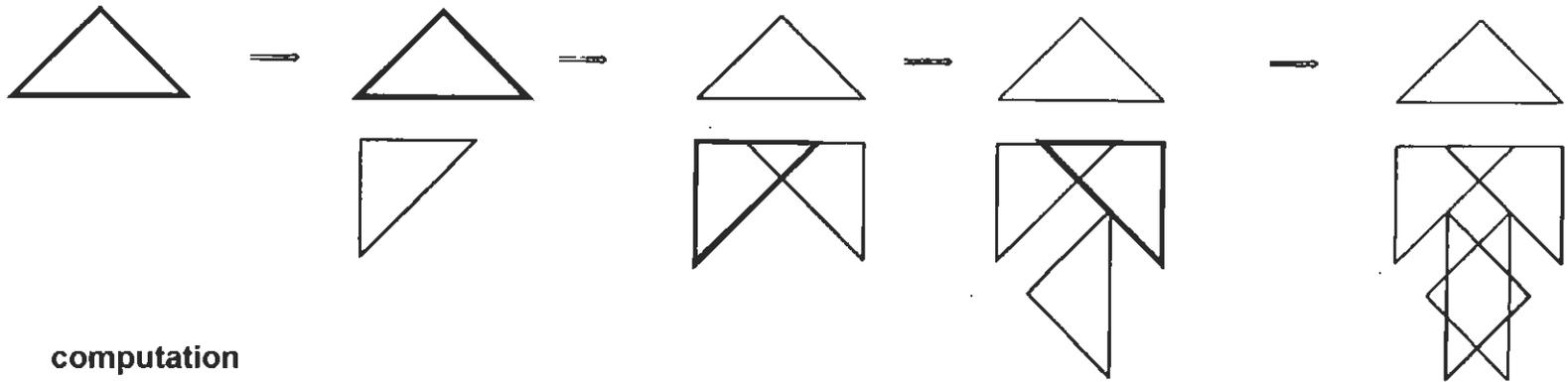
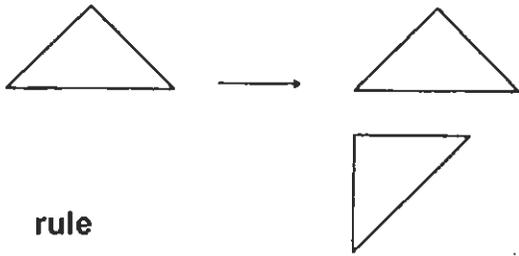
addition rule:  $X \leq Y$

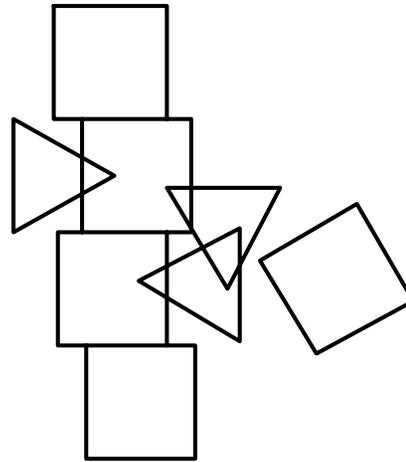
subtraction rule:  $Y \leq X$

add/subtract rule:  $X \not\leq Y$  and  $Y \not\leq X$

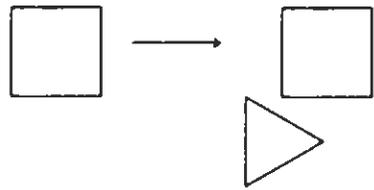


fellow

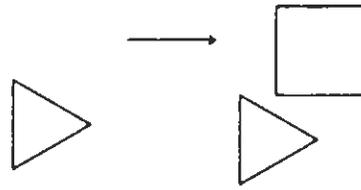




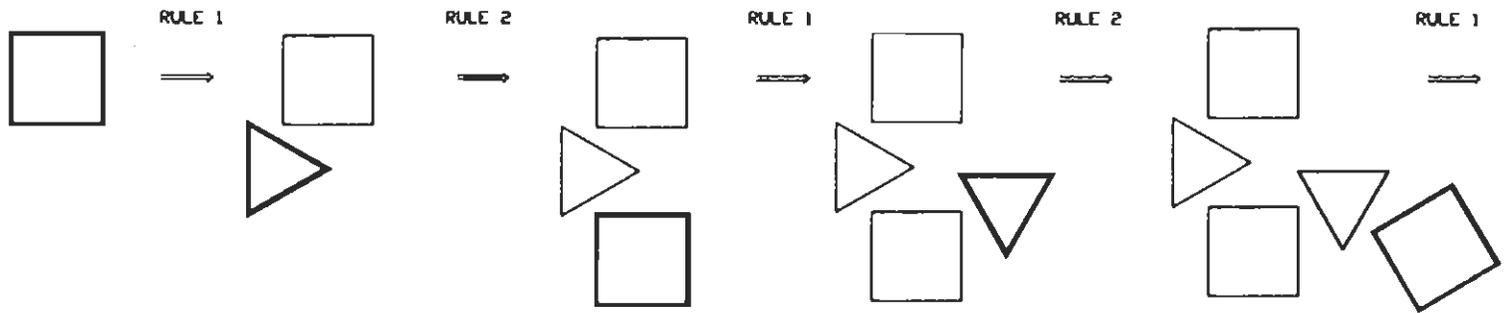
tumbling shapes



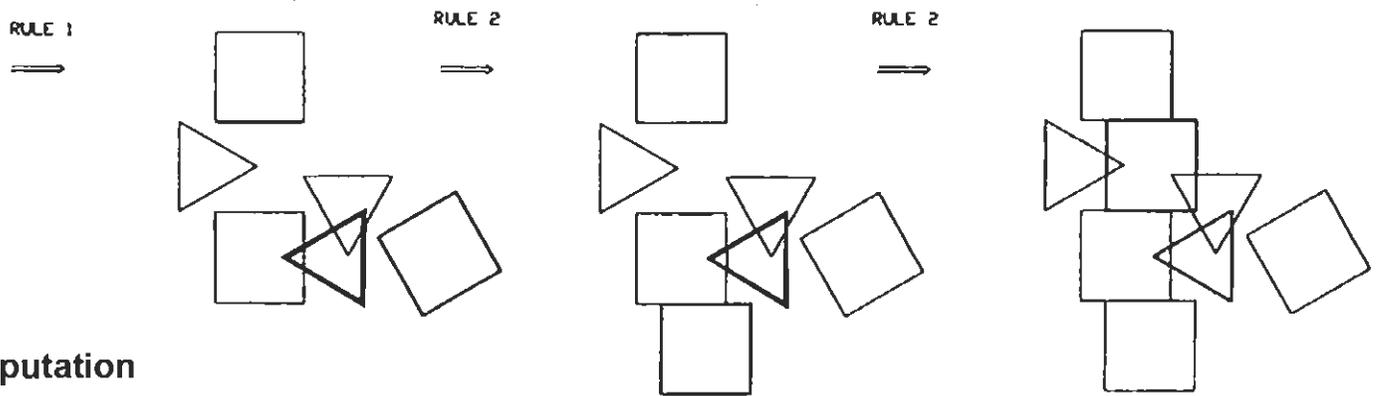
rule 1

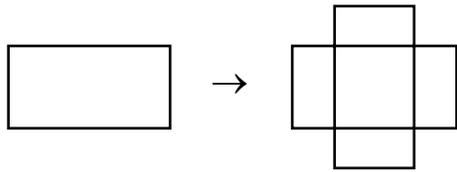


rule 2

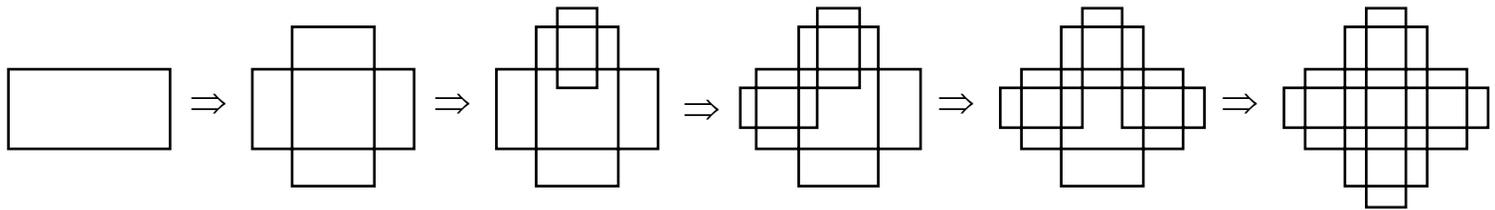


computation





rule



computation

## **nondeterminism**

choices of ways to apply rules

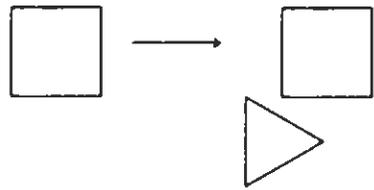
**which** rule to apply



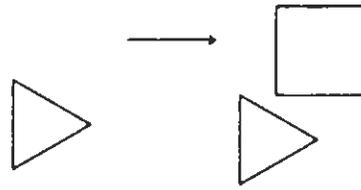
**where** to apply a rule



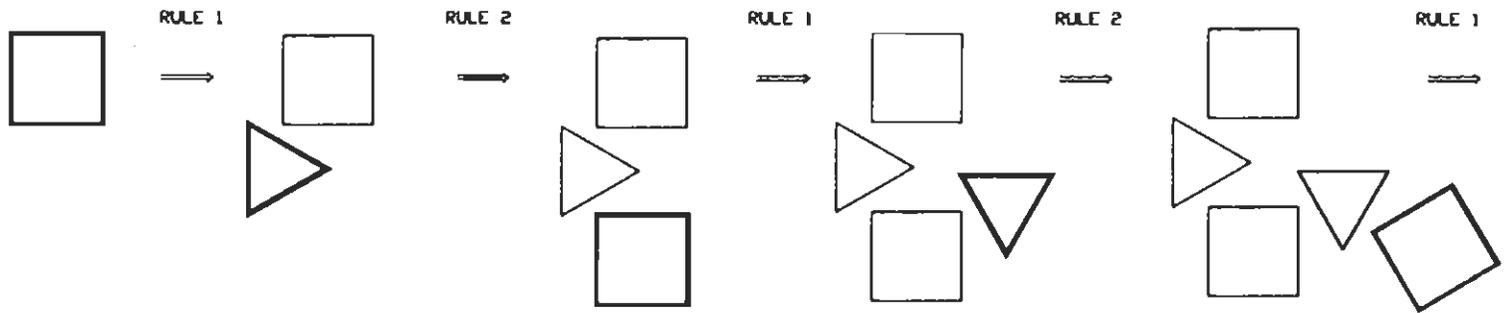
**how** to apply a rule



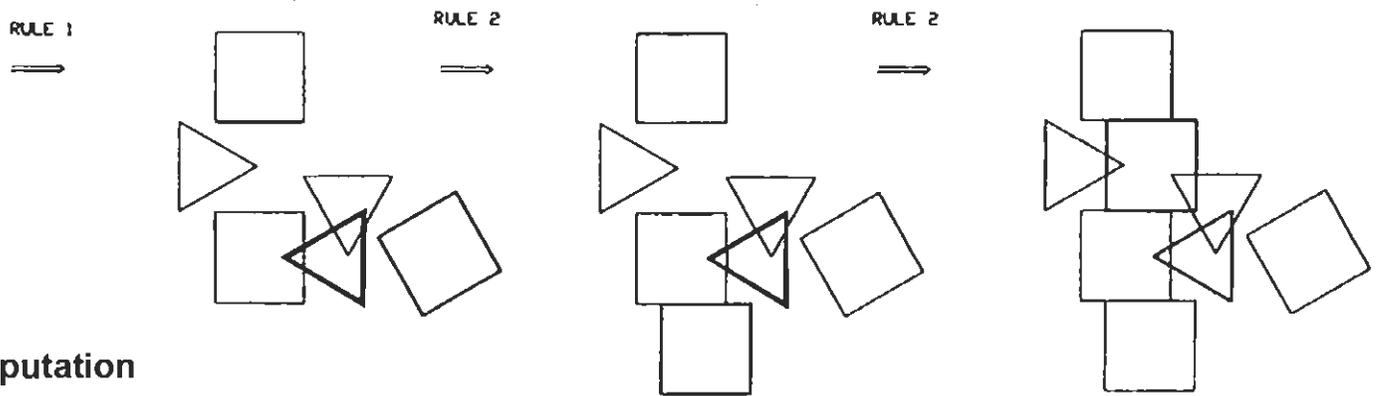
rule 1



rule 2



computation



**labels**

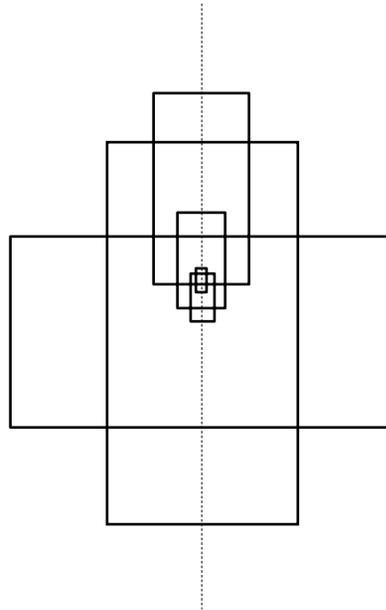
control rule applications

## **state labels**

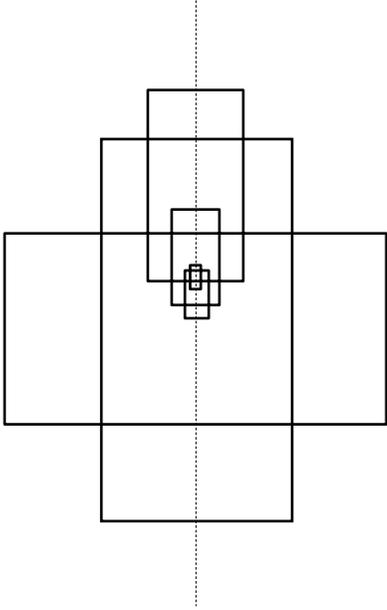
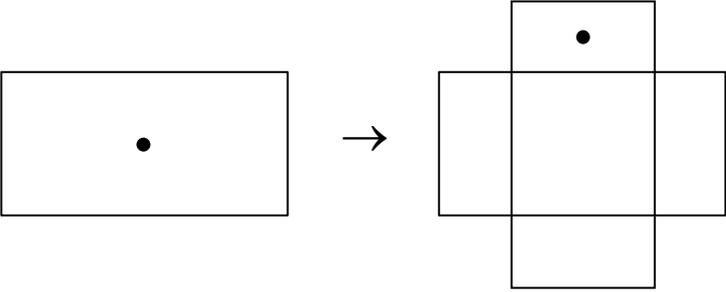
which rule to apply  
(when to apply a rule)

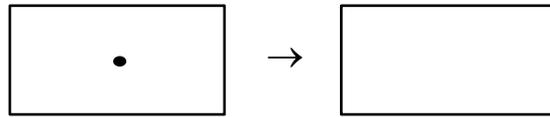
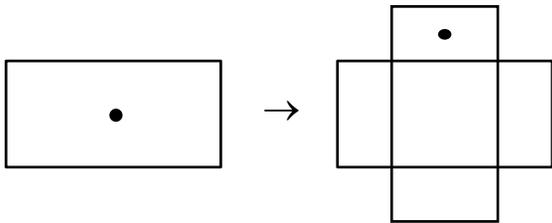
## **spatial labels**

where to apply a rule  
how to apply a rule

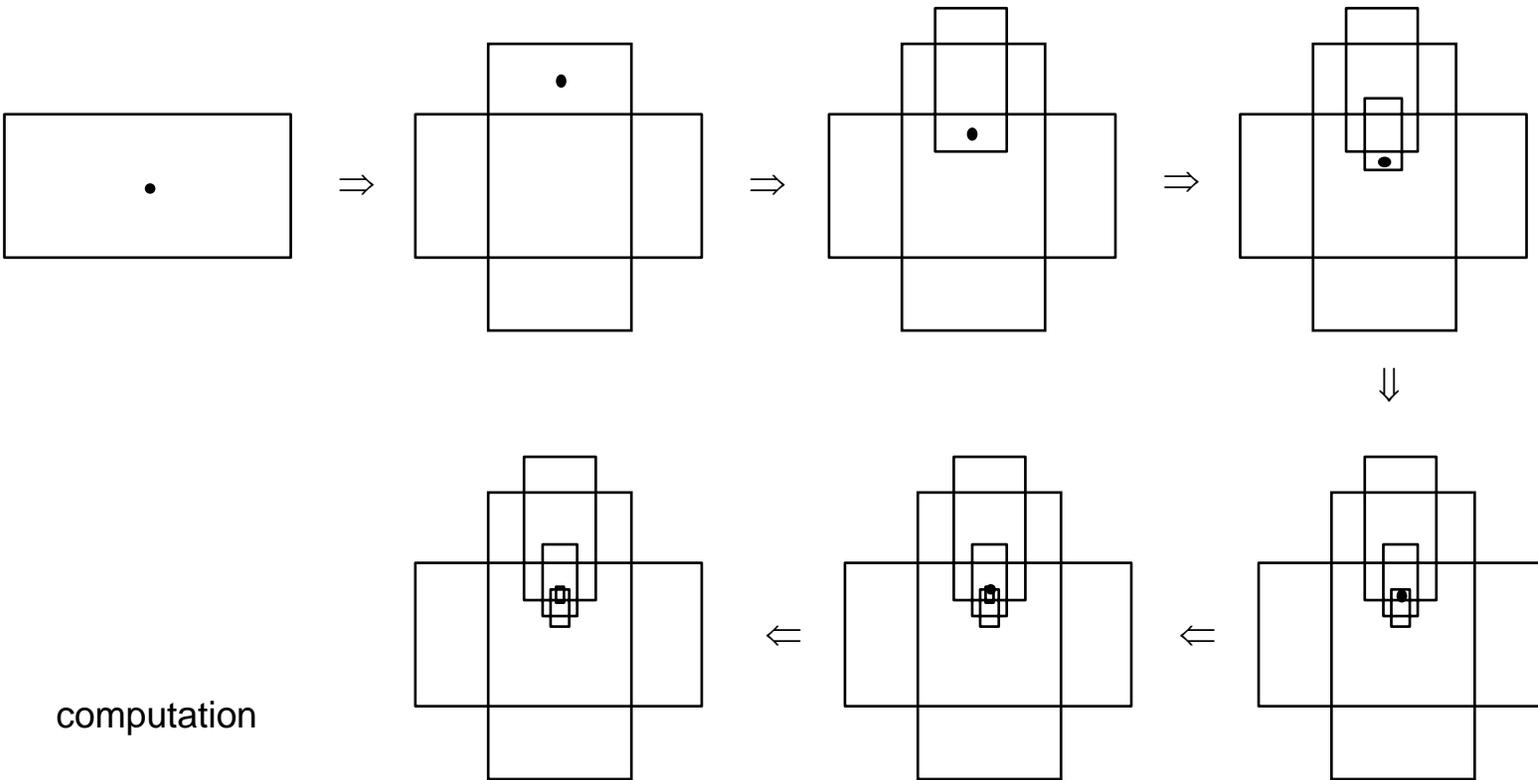


**rule?**

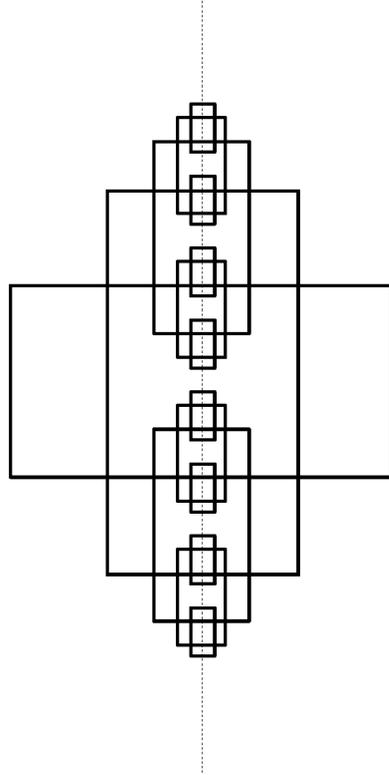


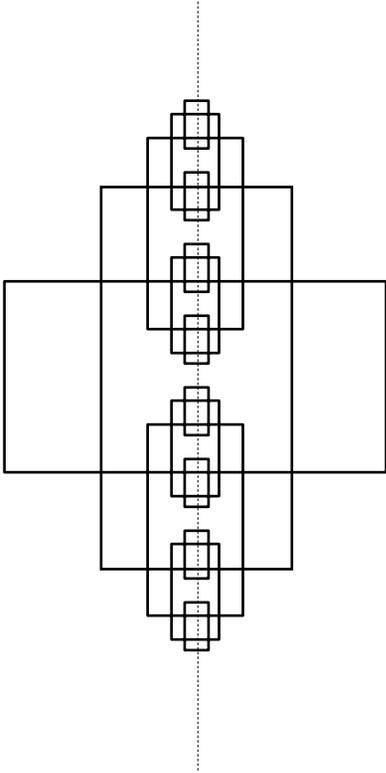
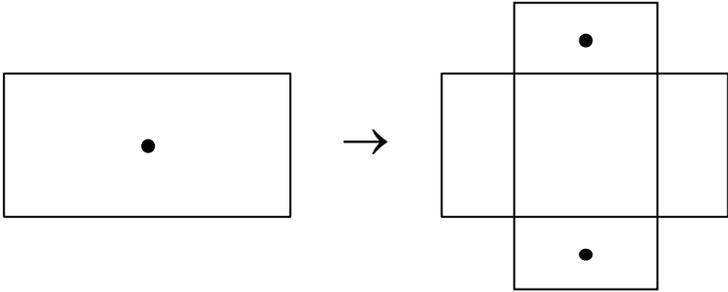


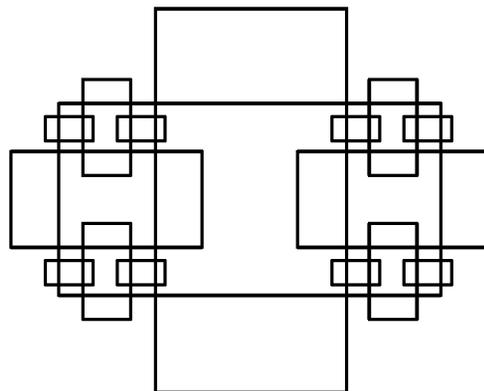
erasing rule

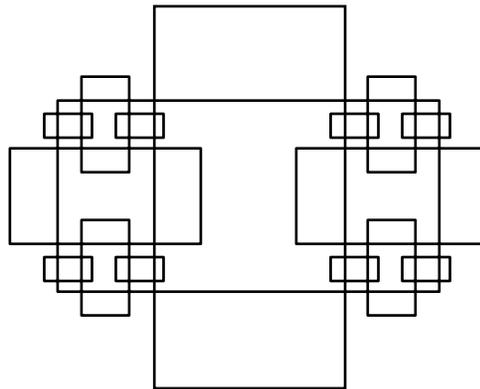
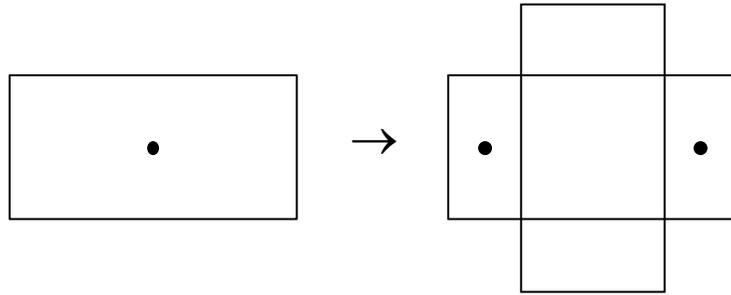


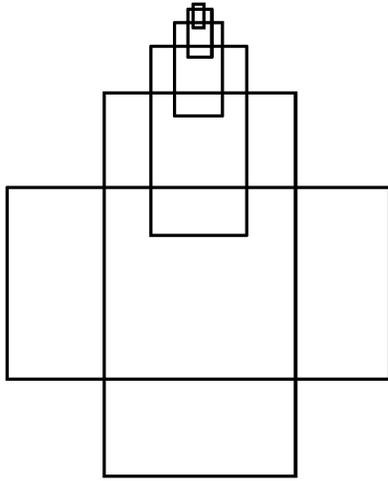
computation

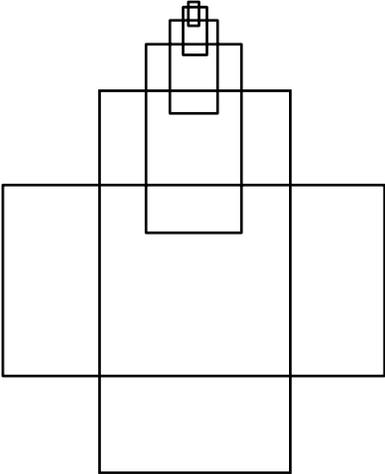
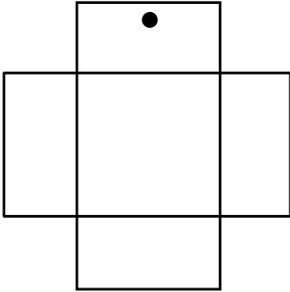
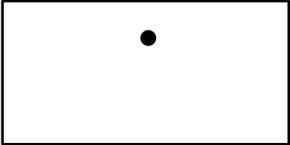


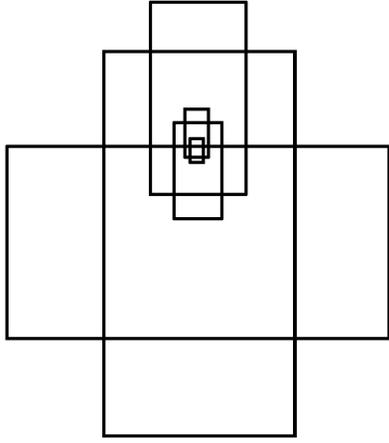


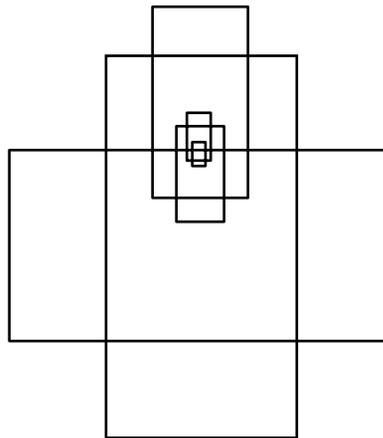
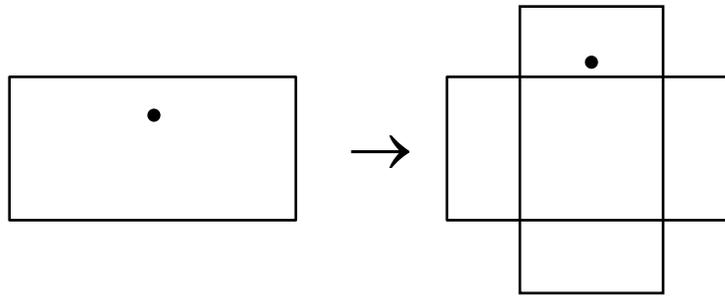


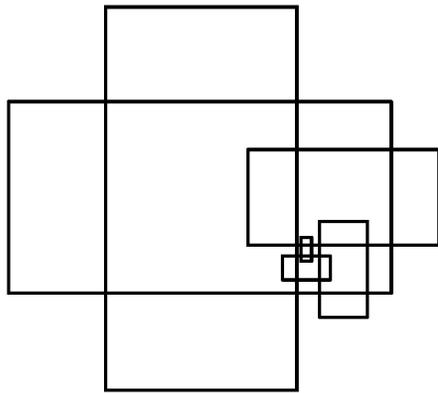


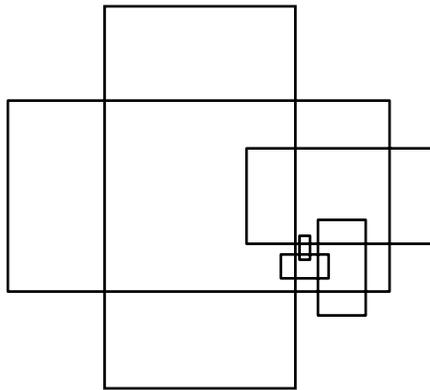
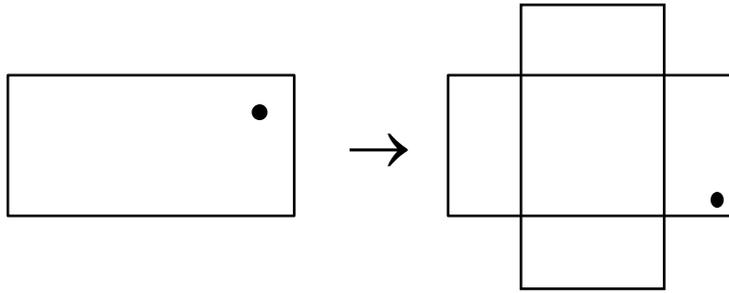


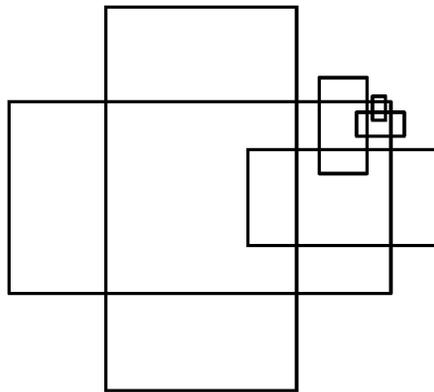


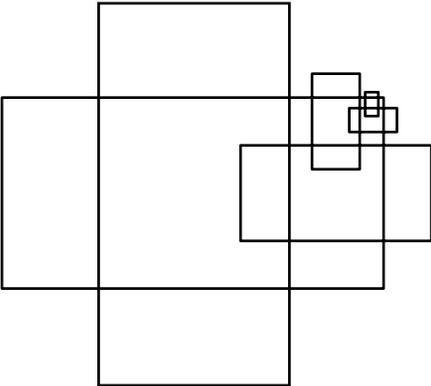
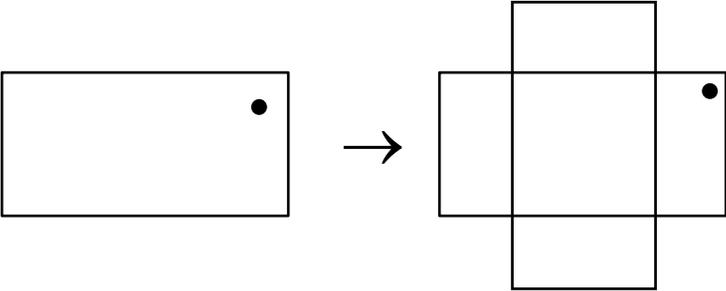








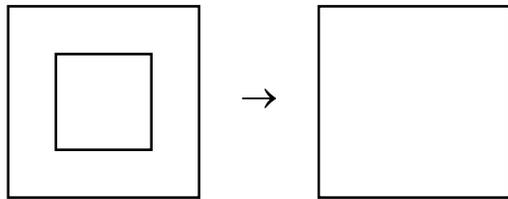
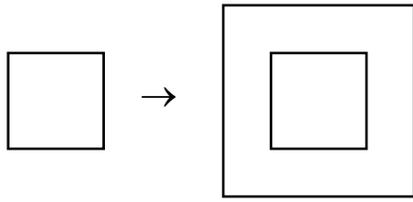




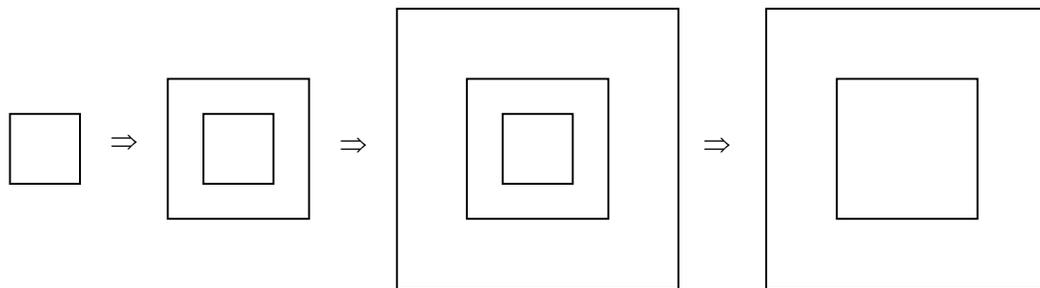
## **state labels**

which rule to apply  
(when to apply a rule)

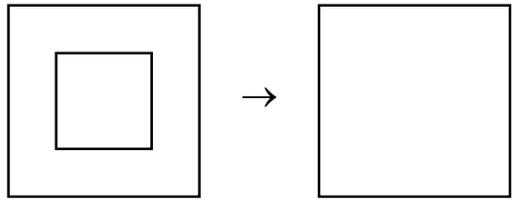
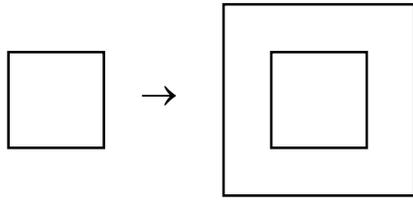
- sequence of rule applications
- repetition of rule applications



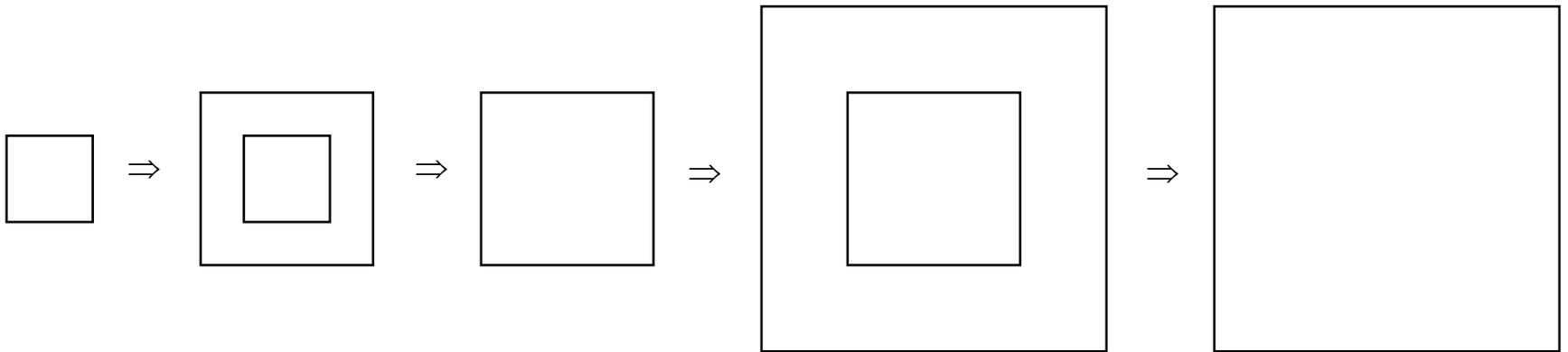
rules



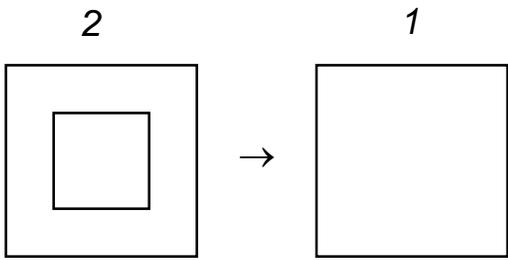
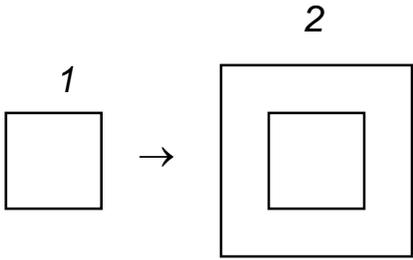
computation



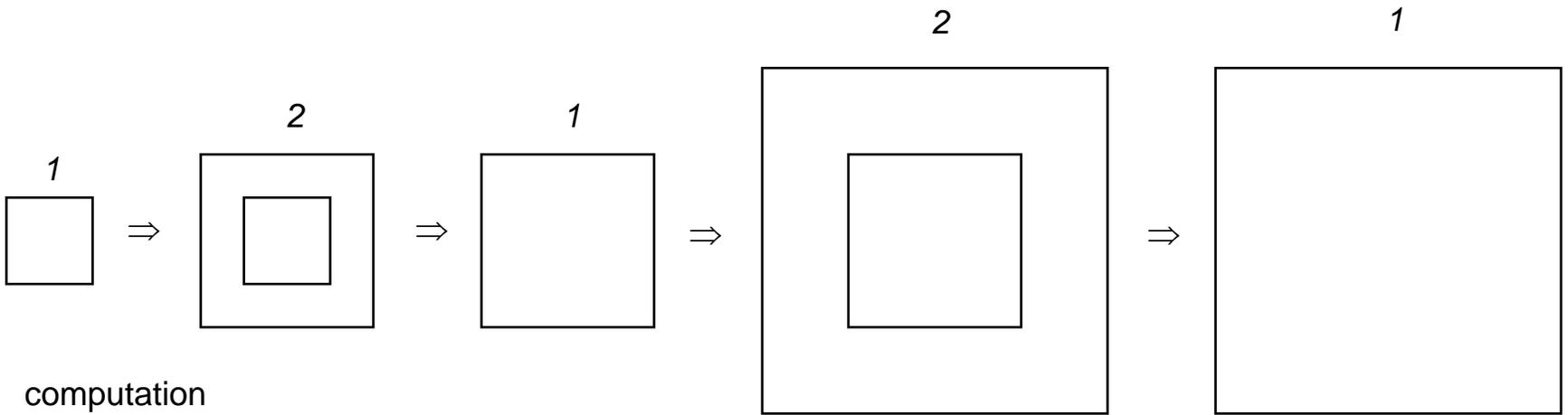
rules



computation

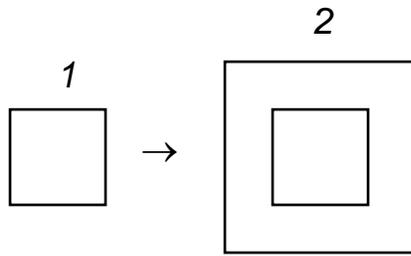


rules

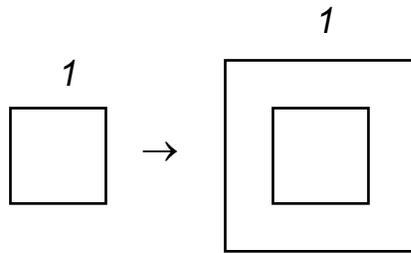
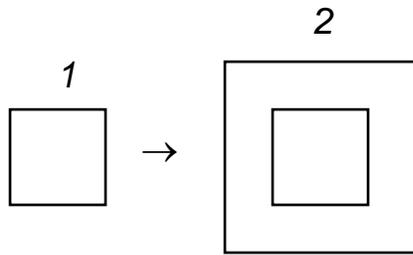


computation

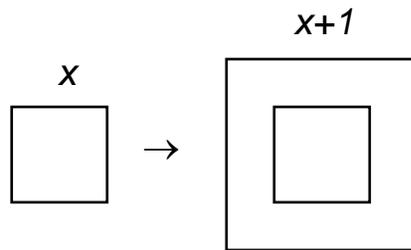
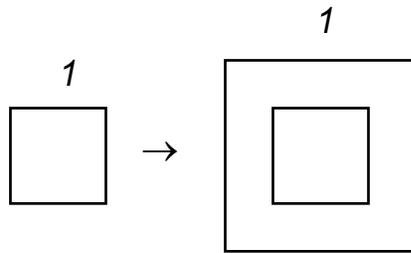
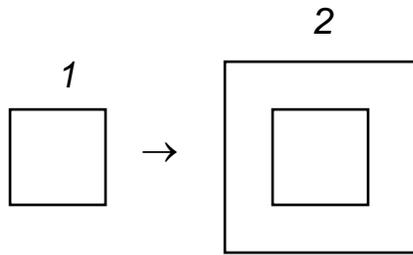
state labels: sequence



**state labels: repetition**



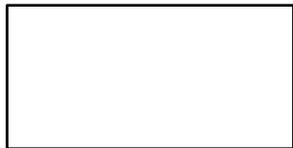
**state labels: repetition**



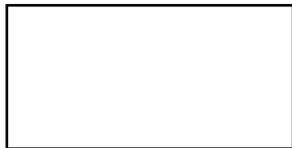
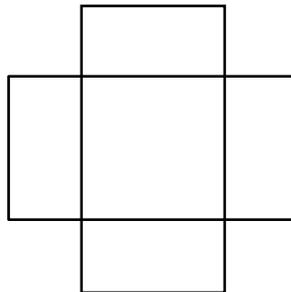
**state labels: repetition**

**initial shape**

starting condition

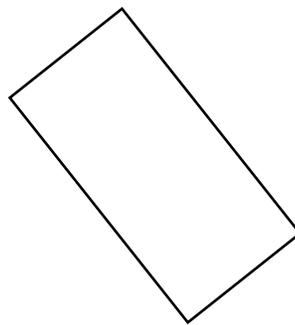


rule



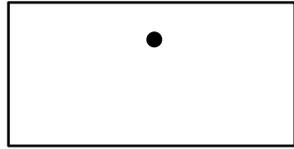
initial shape

designs?

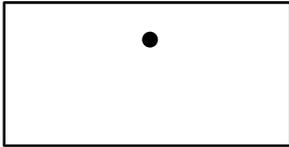
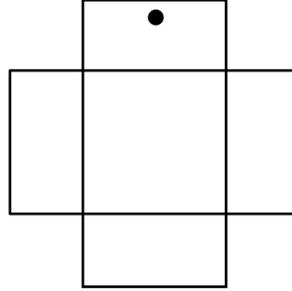


initial shape

designs?

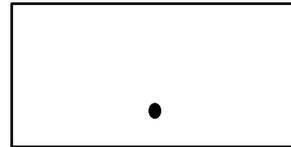


rule



initial shape

designs?

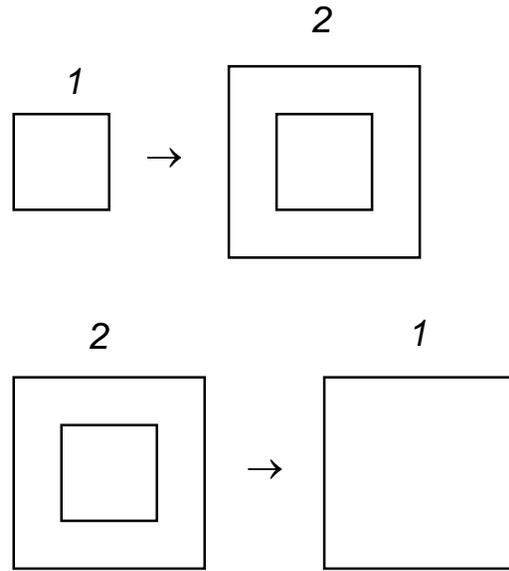


initial shape

designs?

**(optional) final state**

stopping condition



rules

final state: 1

final state: 2

designs?

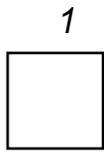
designs?

## **shape grammar**

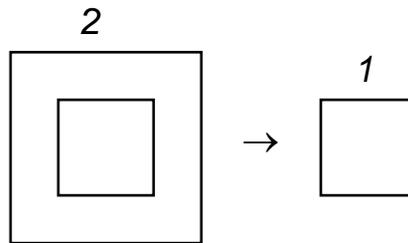
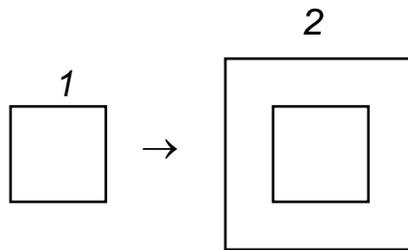
initial shape

rules

(final state)



initial shape



rules

final states: 1 or 2

## **parametric design**

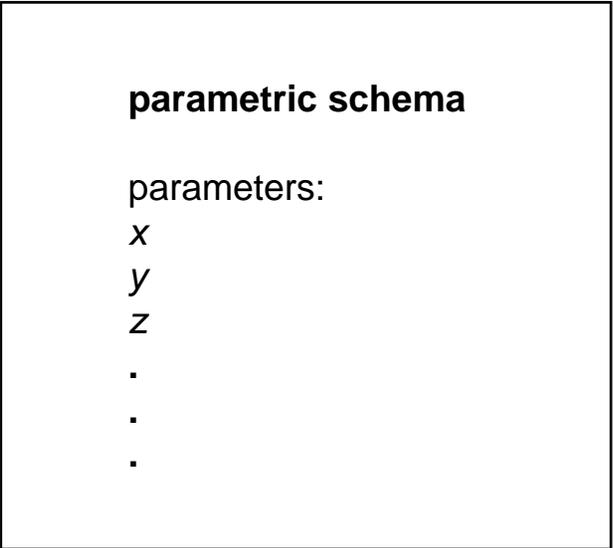
schema or type of design

some properties fixed

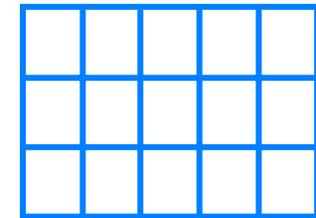
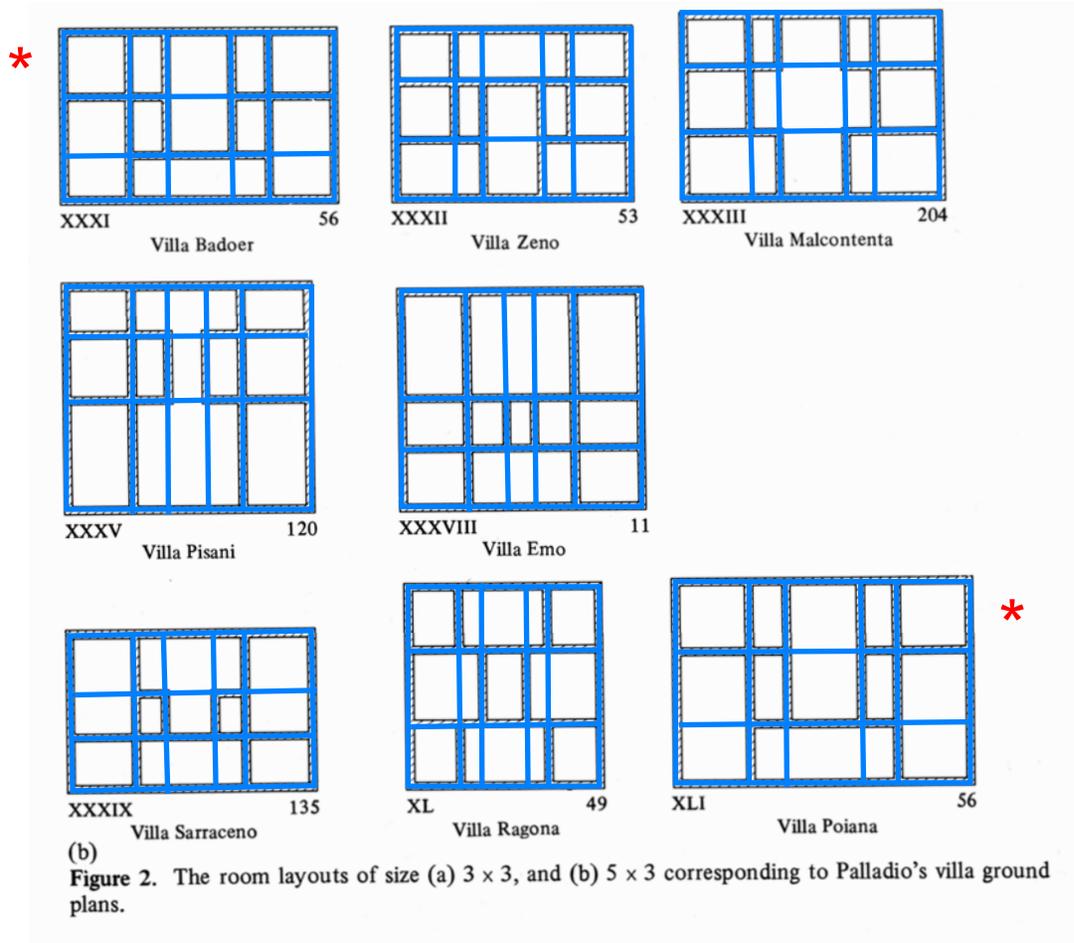
some properties vary

values assigned  
to variables

$x = 5$   
 $y = 15$   
 $z = 1.45$

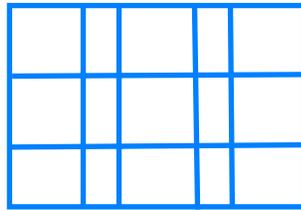
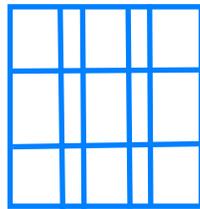
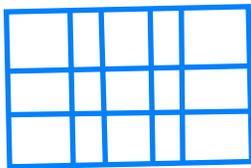
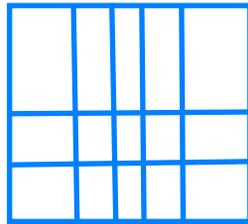
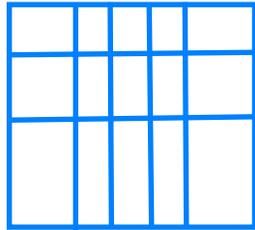
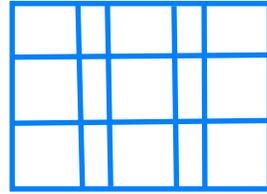
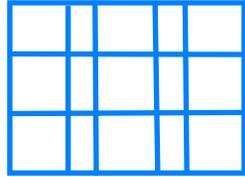
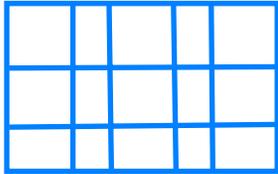


design

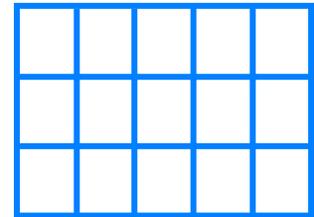


3 x 5 grid

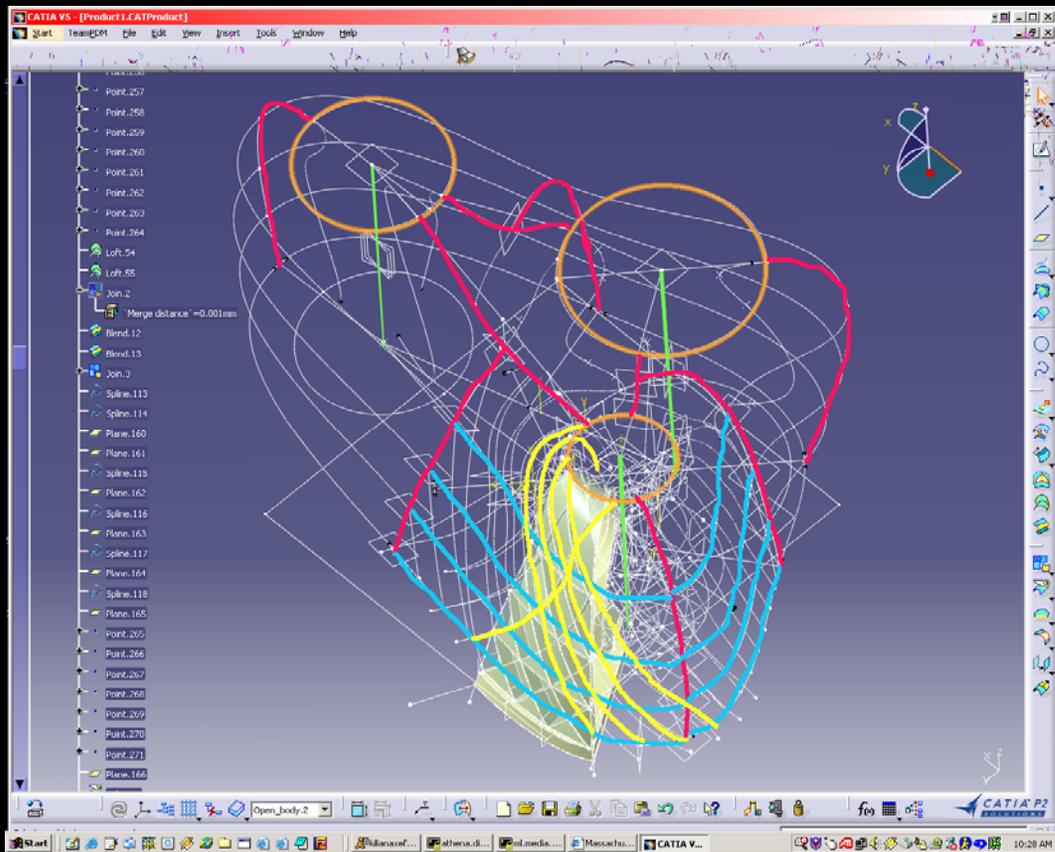
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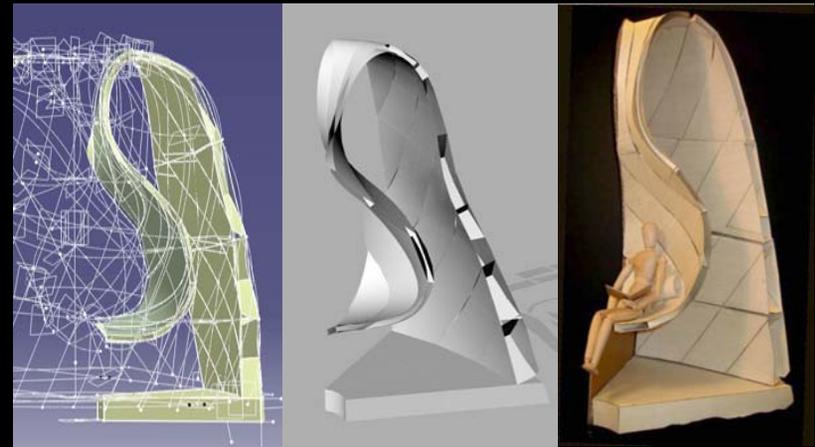
\*



3 x 5 grid



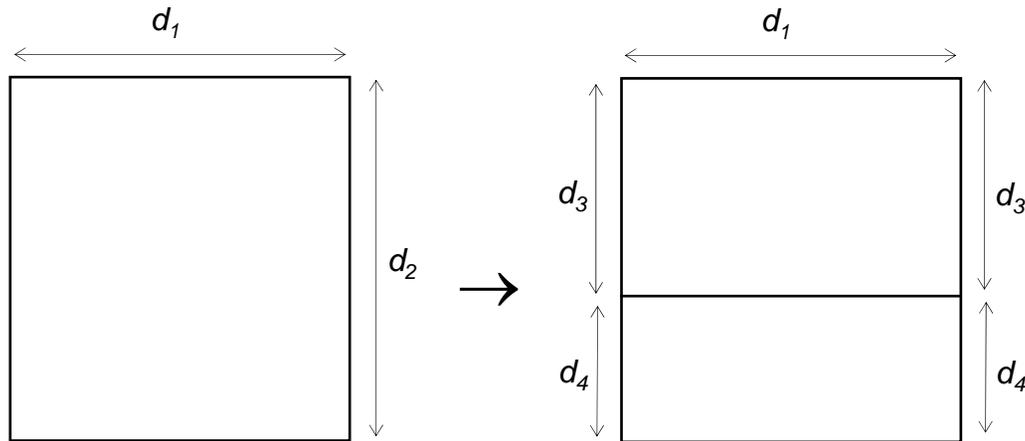
parametric design with CATIA  
(Reading Room: Barrios, Kilian, Morshead)



## **parametric shape grammars**

rules and initial shape are  
parametric shapes

## parametric rule



**parameters:**  $d_1, d_2, d_3, d_4$

**conditions on parameters:**

$d_1$  and  $d_2$  are the sides of a rectangle

$$d_3 + d_4 = d_2$$

**parametric shape rule:  $X \rightarrow Y$**

**design**

**A parametric rule applies to a design:**

whenever there is an assignment  $g$  of values to variables in the rule  
and a transformation  $t$  that makes the left-side  $X$  a part of the design:  
 $t(g(X)) \leq \text{design}$

**To apply the rule:**

first subtract  $t(g(X))$  from the design, and then add  $t(g(Y))$

**The result of applying the rule is a new design:**

$\text{new design} = [\text{design} - t(g(X))] + t(g(Y))$