

CGA Shape grammar

C. Andujar

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CGA Shape grammar

P. Müller, P. Wonka, S. Haegler, A. Ulmer, L. Van Gool:

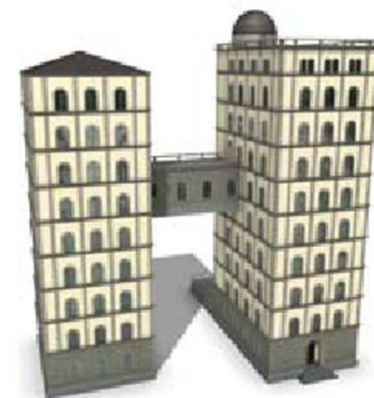
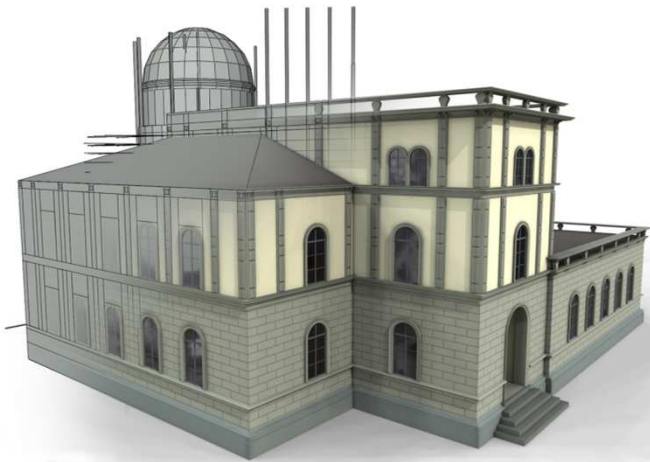
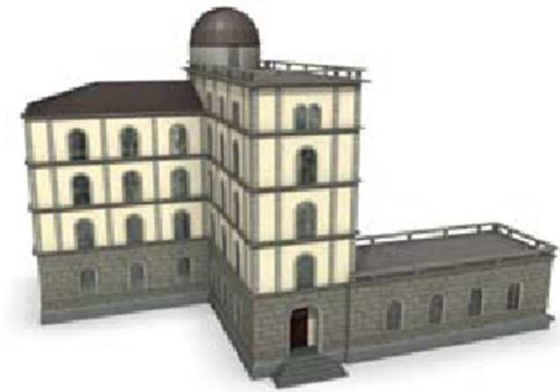
Procedural modeling of buildings

SIGGRAPH 2006

<http://doi.acm.org/10.1145/1141911.1141931>



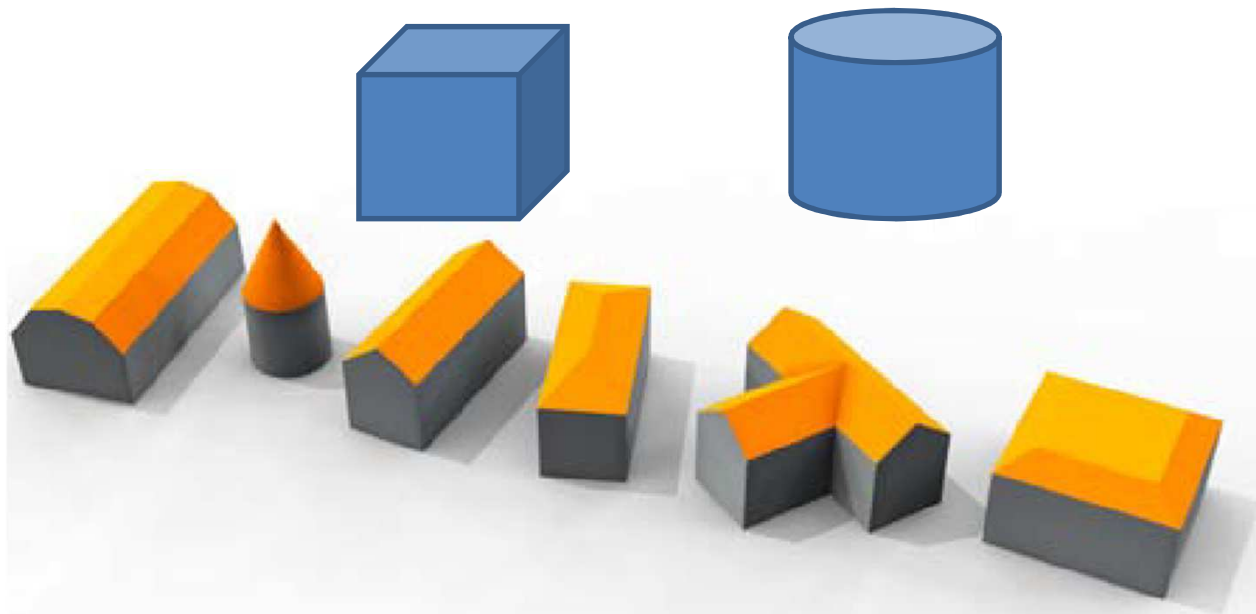
Examples



Basic shapes

- Cube
- Cylinder
- Predefined roof types

With labeled faces and edges

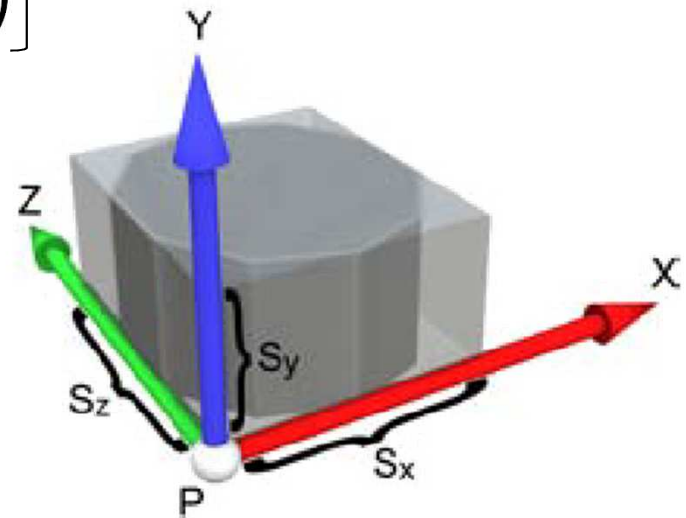


Shapes

Shape attributes

- Position $P = (p_x, p_y, p_z)$
- Size vector (s_x, s_y, s_z)
- Coordinate system (3 vectors)

Define an OBB called **scope**



Push/Pop example

1: A →

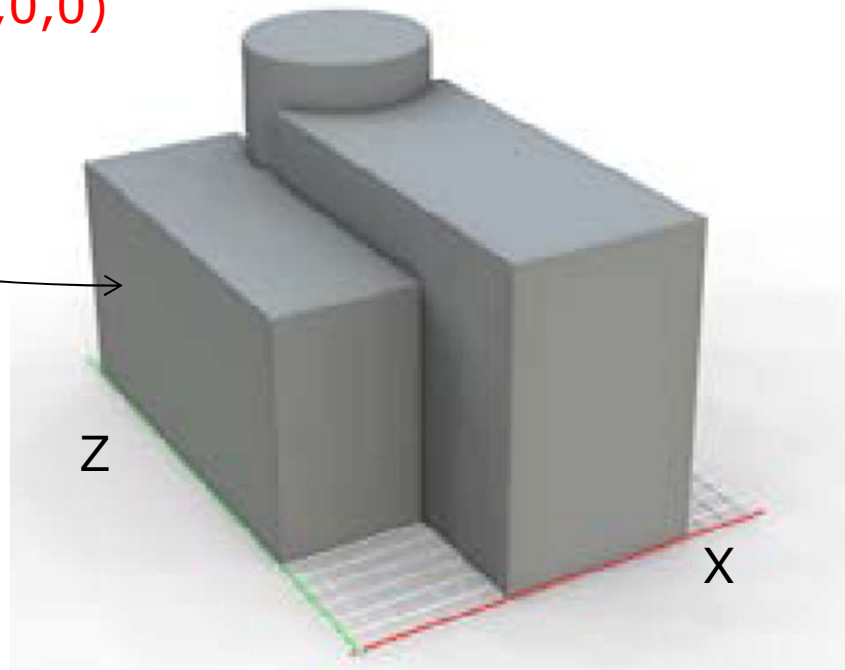
$P=(0,0,6)$

[T(0,0,6) S(8,10,18) I("cube")]

T(6,0,0) S(7,13,18) I("cube") T(0,0,16) S(8,15,8)

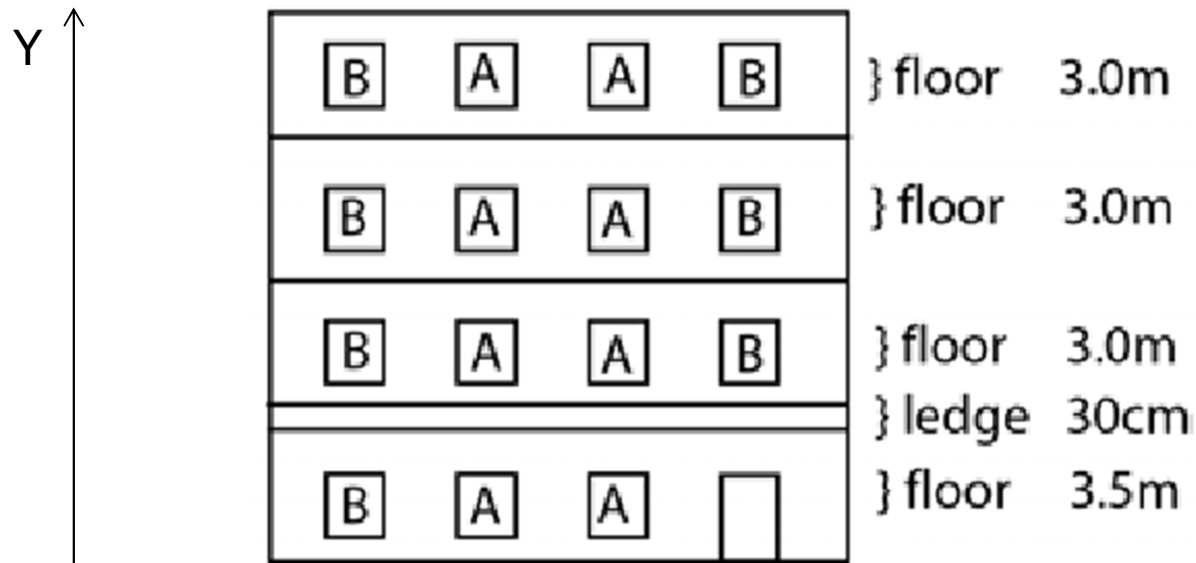
I("cylinder") $P=(6,0,0)$

$P=(6,0,16)$



Subdivision example

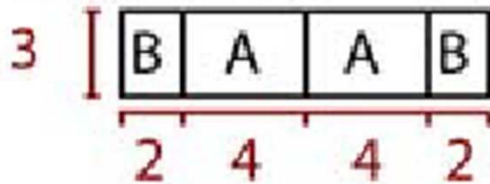
1: fac \rightsquigarrow Subdiv("Y",3.5,0.3,3,3,3){ floor | ledge | floor | floor | floor }



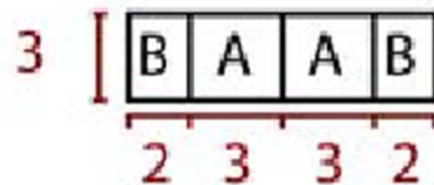
Relative size values

1: floor \rightsquigarrow Subdiv("X",2,1r,1r,2){ B | A | A | B }

S(12, 3) floor \rightarrow

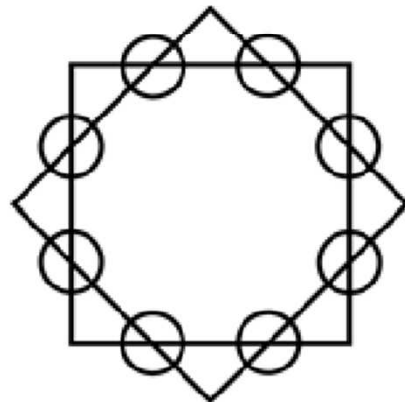
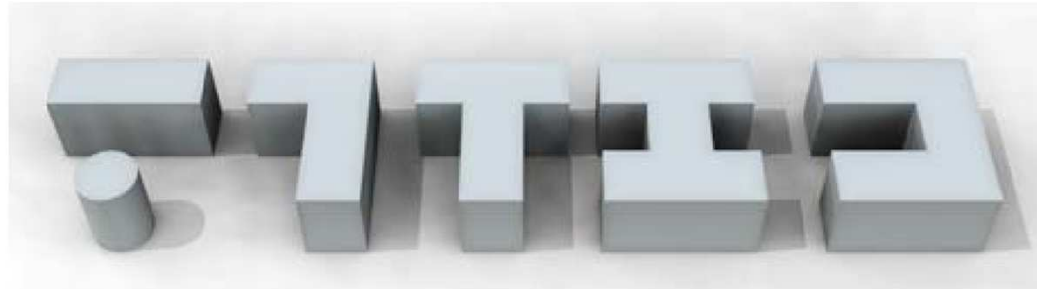


S(10, 3) floor \rightarrow

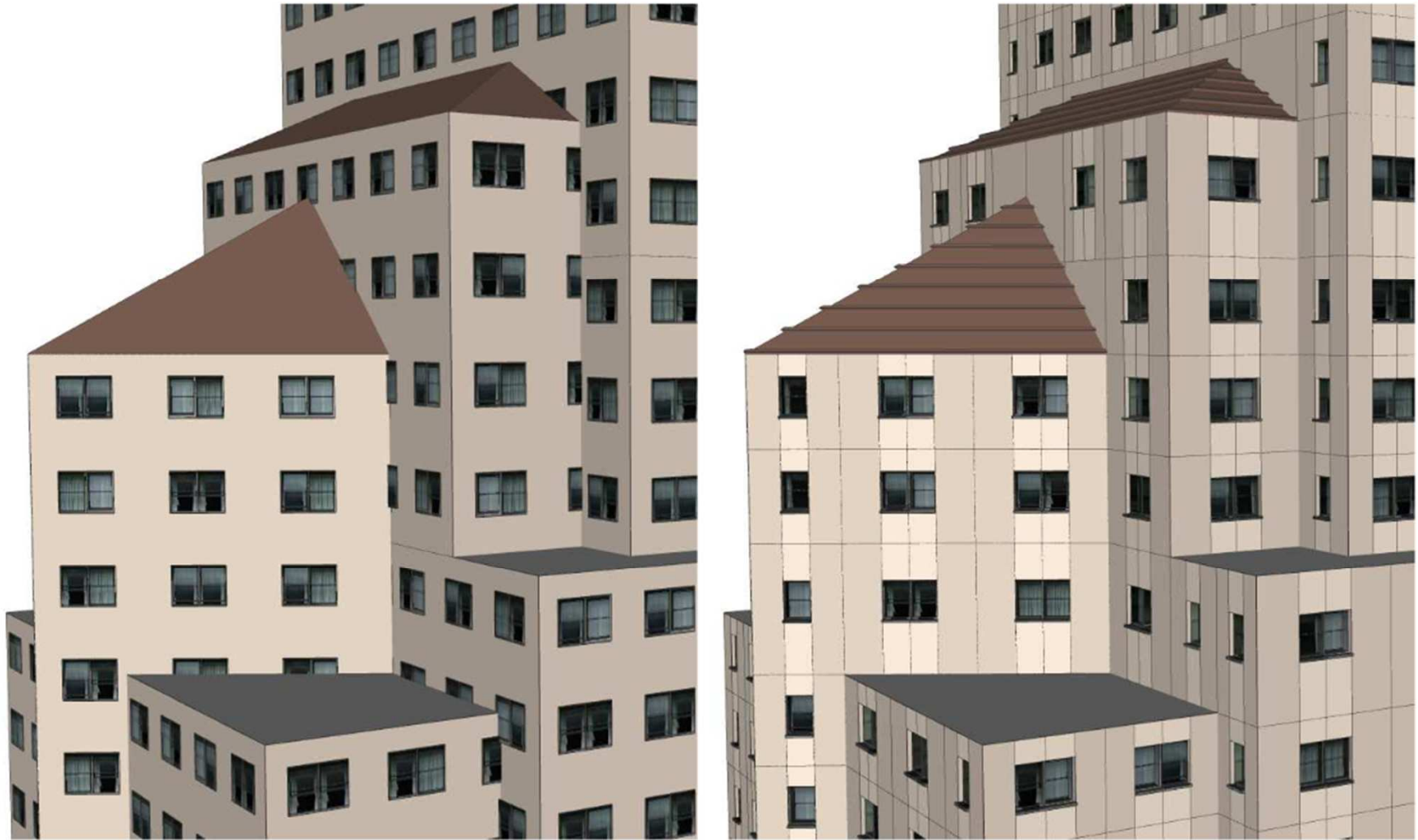


Assembling solids

- Union of basic 3D shapes
- Extrusion of a building footprint



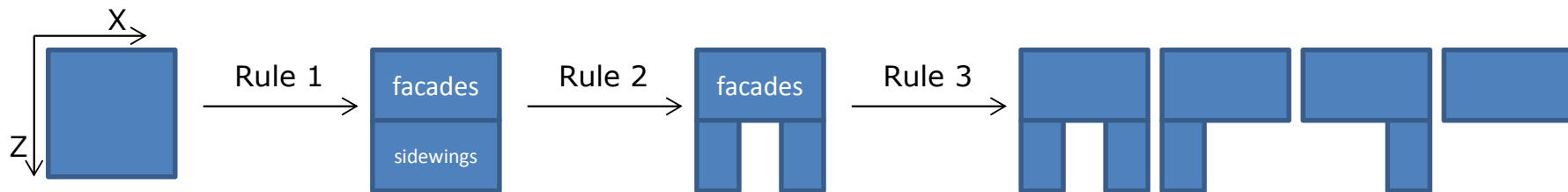
Occlusion tests



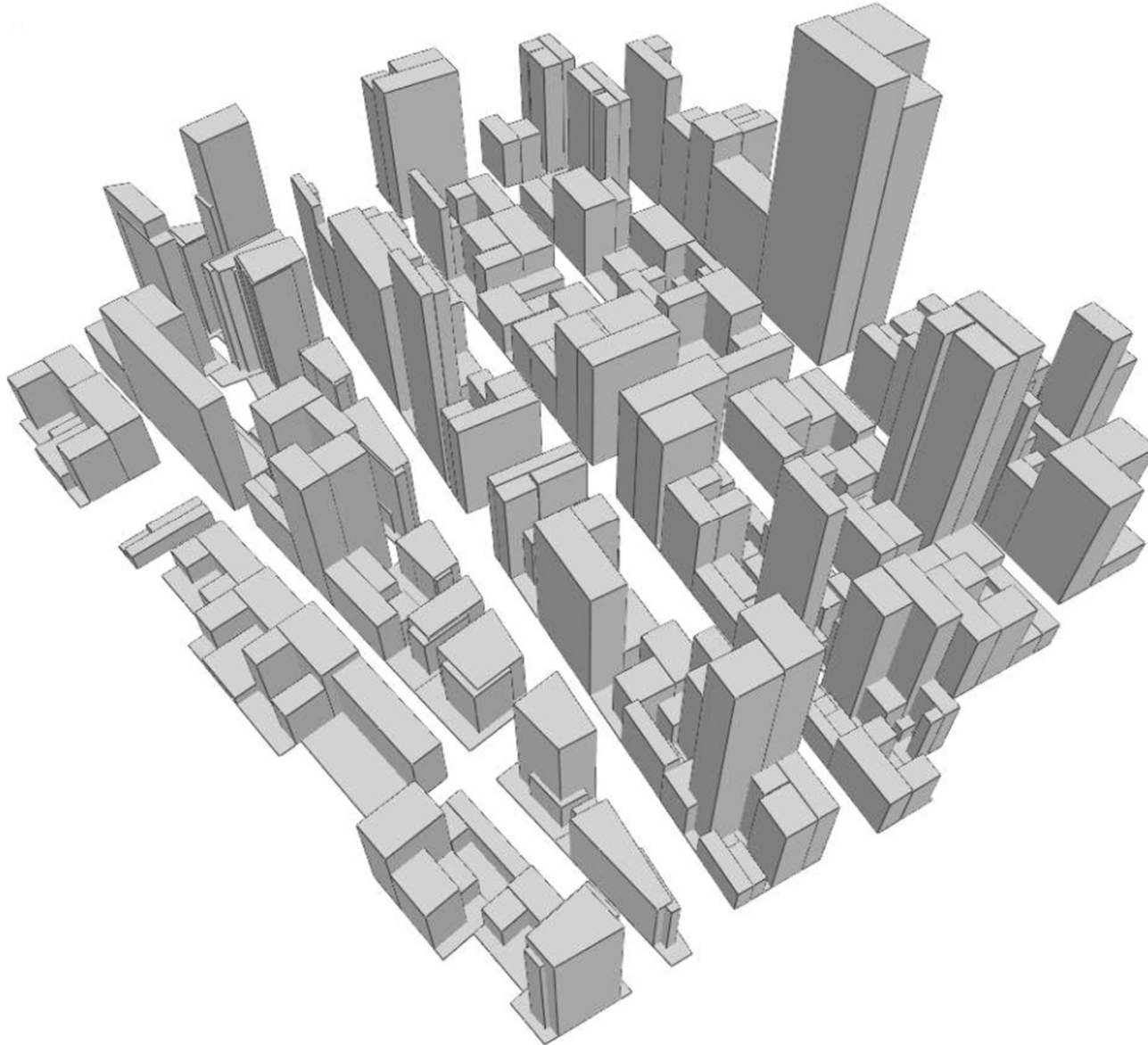
Example: office building

PRIORITY 1:

- 1: lot \rightsquigarrow $S(1r, \text{building_height}, 1r)$
Subdiv("Z", $\text{Scope.sz} * \text{rand}(0.3, 0.5)$, $1r$) { facades | sidewings }
- 2: sidewings \rightsquigarrow
Subdiv("X", $\text{Scope.sx} * \text{rand}(0.2, 0.6)$, $1r$) { siding | ϵ }
Subdiv("X", $1r$, $\text{Scope.sx} * \text{rand}(0.2, 0.6)$) { ϵ | siding }
- 3: siding
 \rightsquigarrow $S(1r, 1r, \text{Scope.sz} * \text{rand}(0.4, 1.0))$ facades : 0.5
 \rightsquigarrow $S(1r, \text{Scope.sy} * \text{rand}(0.2, 0.9), \text{Scope.sz} * \text{rand}(0.4, 1.0))$
facades : 0.3
 \rightsquigarrow ϵ : 0.2
- 4: facades \rightsquigarrow Comp("sidefaces") { facade }



Example: office building



See paper for more examples



Homes



Results



Figure 19: This figure shows a modern city model which was created from scratch in two days only.

150 rules





190 rules