

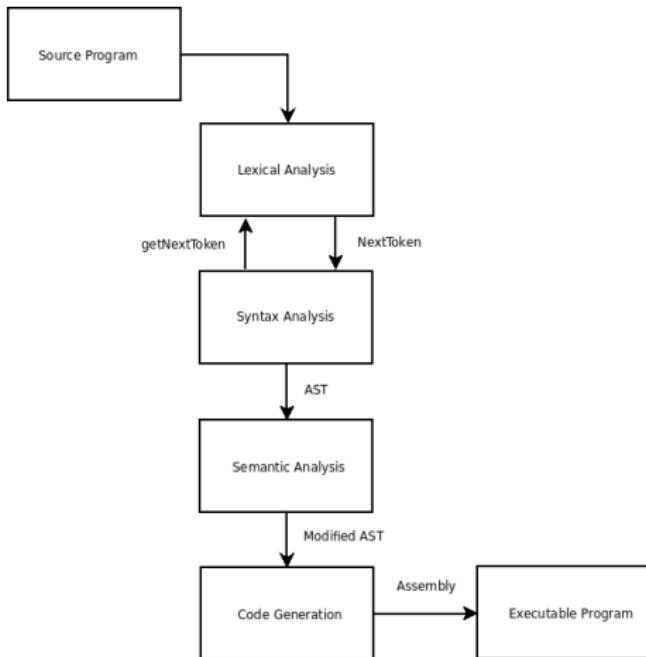
Thing Compiler

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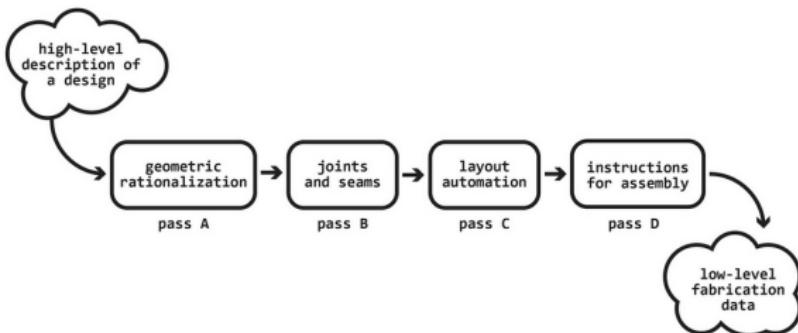
- goes
 - from program
 - to machine code
- involves many passes
 - lexing + parsing
 - optimization
 - backend



- shape
- color
- density
- joints
- ...

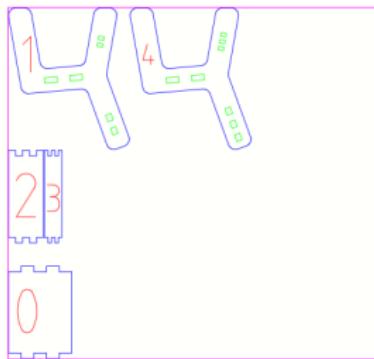
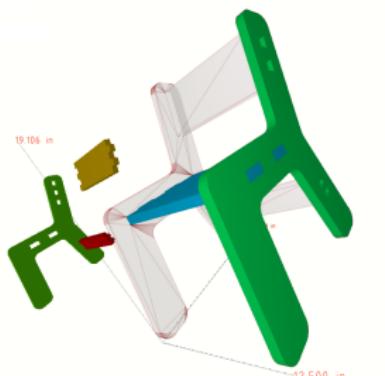
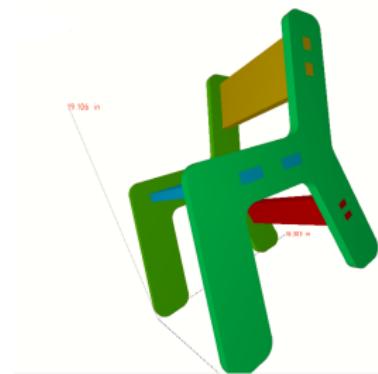
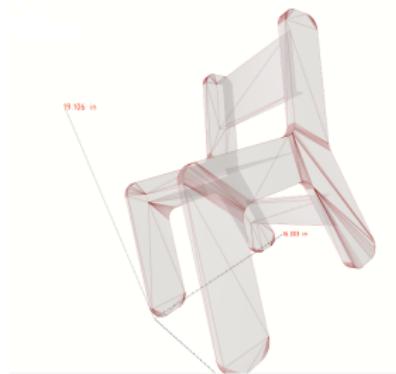
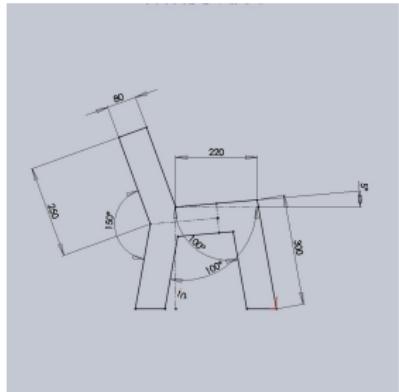


- design is input
- machine + human are targets
- passes
 - rationalization – design -> parts
 - seams + joinery – parts -> parts
 - layout – parts -> polygons
 - instructions – parts -> doc/viz



Chair Example

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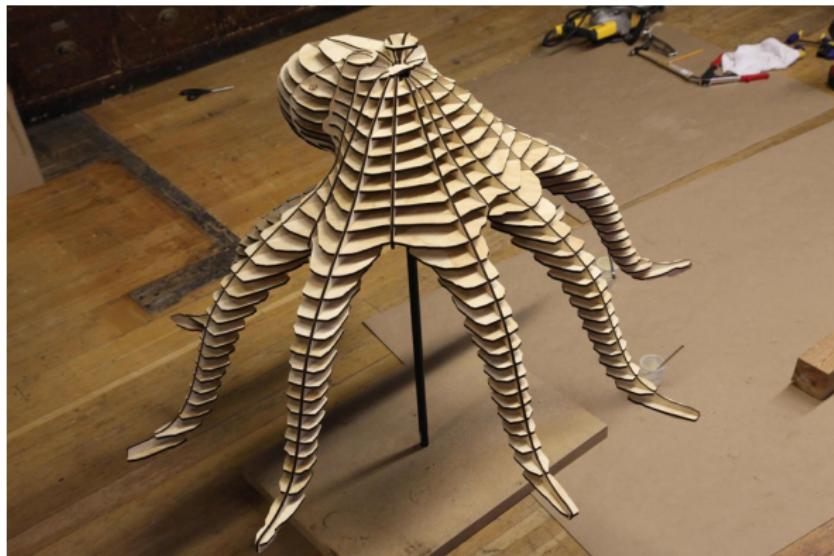
Mesh Example

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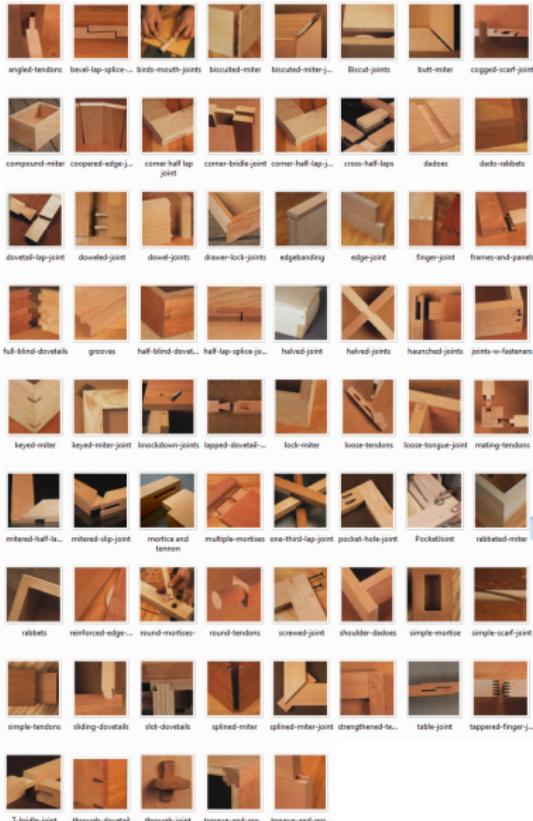
- break mesh into developable submeshes
- add joinery
- label and layout
- produce order and animation to show construction



- Simplify input into cheap and easy to manufacture parts
- Example
 - origami
 - panelization
 - slicing
 - puzzle pieces



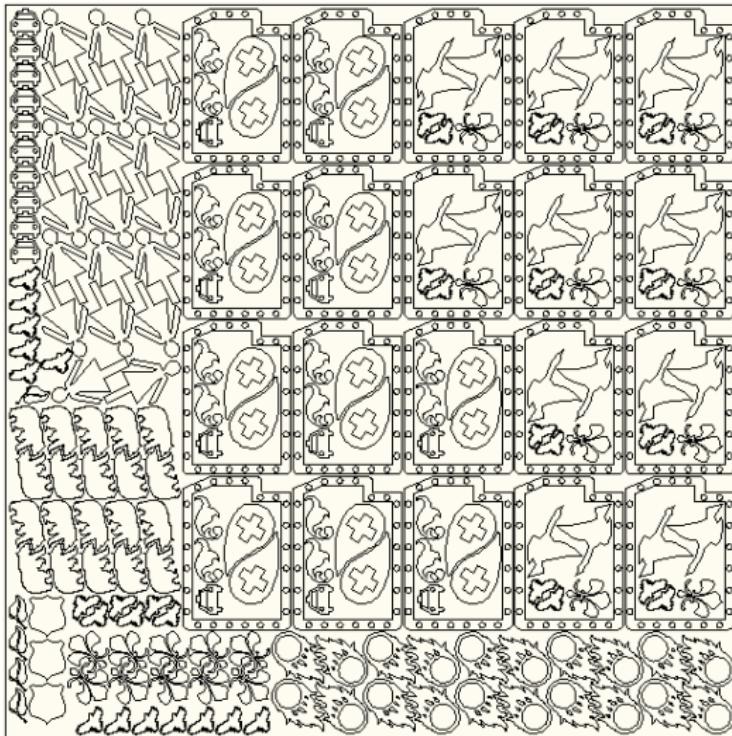
- provide connection
- joinery system
 - glue
 - zip ties
 - shoe laces
 - rivets
 - puzzle joinery
- joints
 - (living) hinge
 - bracket
 - perforated edge



Nesting

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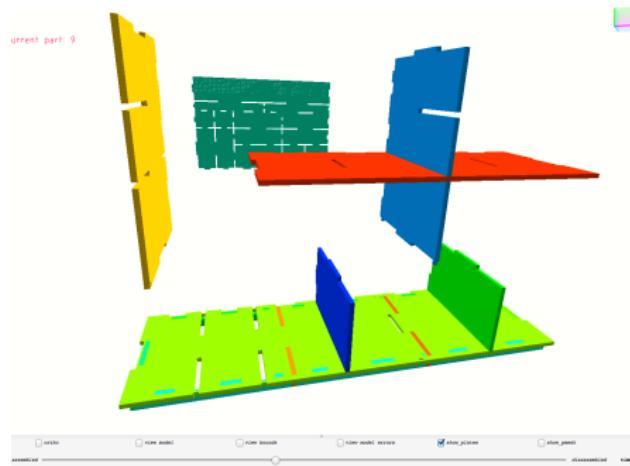
- pack parts to maximize of stock use



Instructions

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- don't have a robotic assembler
- human is another machine target
- eventually robot will do assembly
- several ways to communicate assembly instructions



- supporting all possible meshes is hard
- limiting set of shapes
 - makes writing compiler easier
 - makes support specific fabrication machine easier
 - correct by construction



Original Machines – Peter Schmidt

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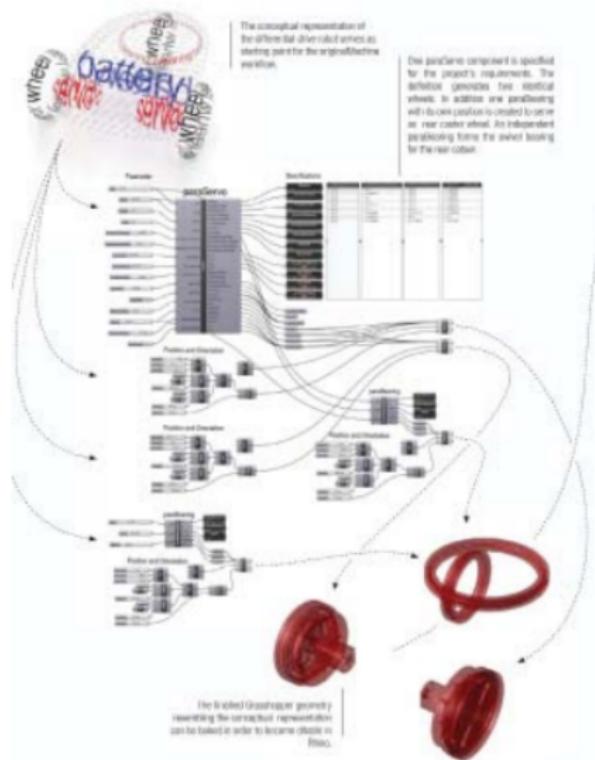
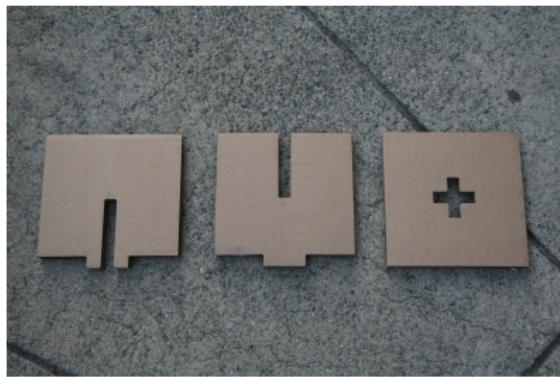
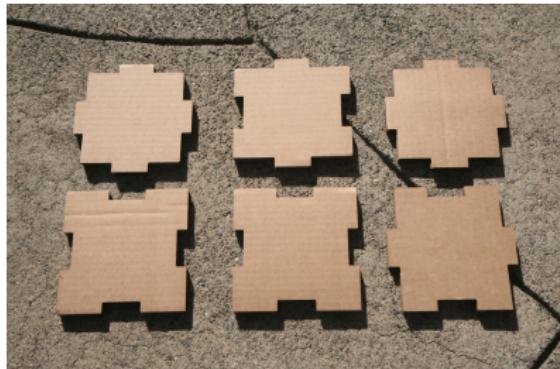


Plate Example

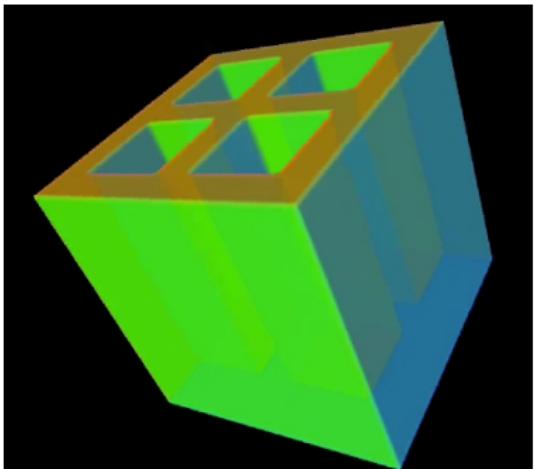
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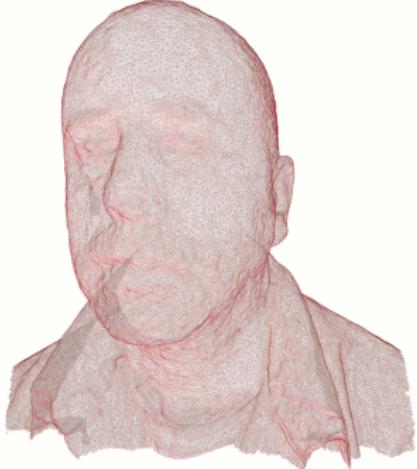


- material – sheet steel, leather, plaster
- fabrication – cutting, casting, milling
- joinery – jointing, glueing, stacking
- rationalization – panelization, slicing, subdividing



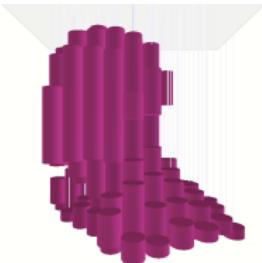
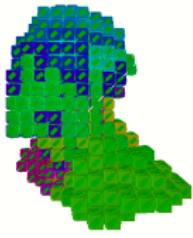
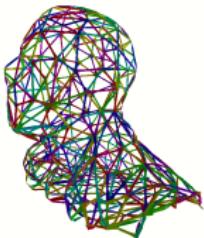
- limited design
 - overlapping thin plates
 - at least one orthogonal angles
- alternative is to union of plates meshes





Space of Compilers

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- plate movie
- otherfab examples

- mesh

- mesh = list of triangles
- triangle = three points
- points = three coordinates
- obeys winding order

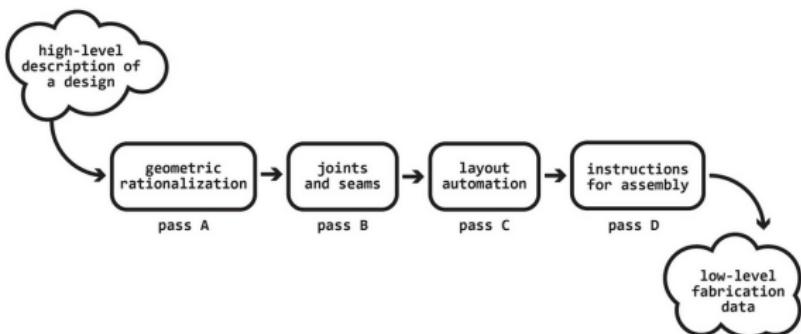
- polygon

- polygon = tree of polylines
- polyline = list of points

Intermediate Representations

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name	input	output
rationalization	mesh	polygons
joinery	polygons	polygons
layout	polygons	pdf
instructions	mesh + polygons	pdf



name	description
rat	break into 3d parts
seams	puzzle joinery
labeling	adjacency
instructions	assembly ordering

name	description
rat	create slices
seams	slots
labeling	xy order
instructions	assembly ordering

name	description
rat	mesh to flat parts
seams	bends and attachments
labeling	neighbors
instructions	assembly ordering

name	description
rat	break into plates
seams	dove tail joinery
labeling	neighbors
instructions	assembly ordering

name	description
rat	break into edges
seams	crimp and holes + angles
labeling	neighbors
instructions	assembly ordering + crimp instructions

- LLVM is compiler toolkit for software compilers
- promotes reuse
- allows writing transformation passes

