

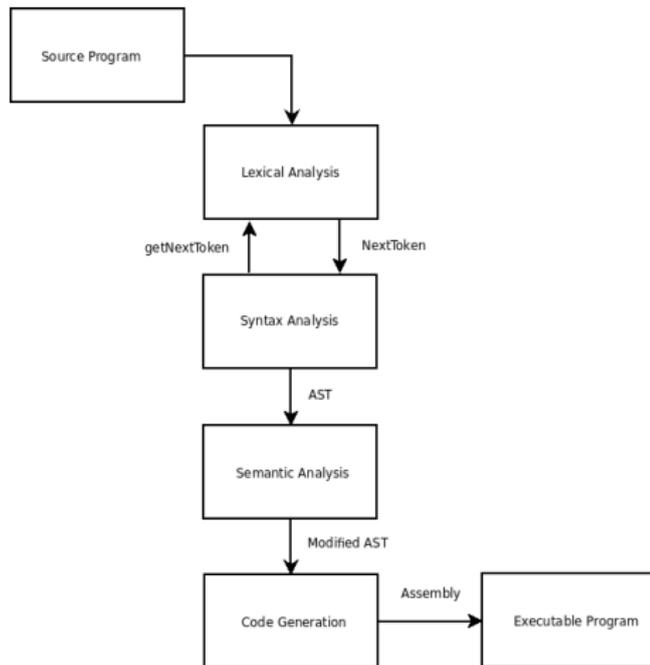
# Thing Compiler

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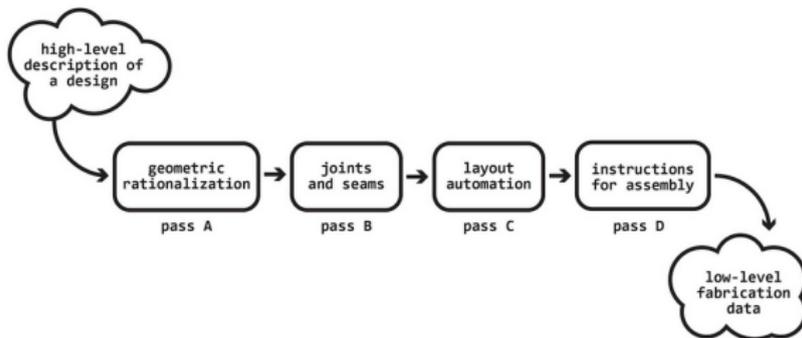
- goes
  - from program
  - to machine code
- involves many passes
  - lexing + parsing
  - optimization
  - backend



- 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

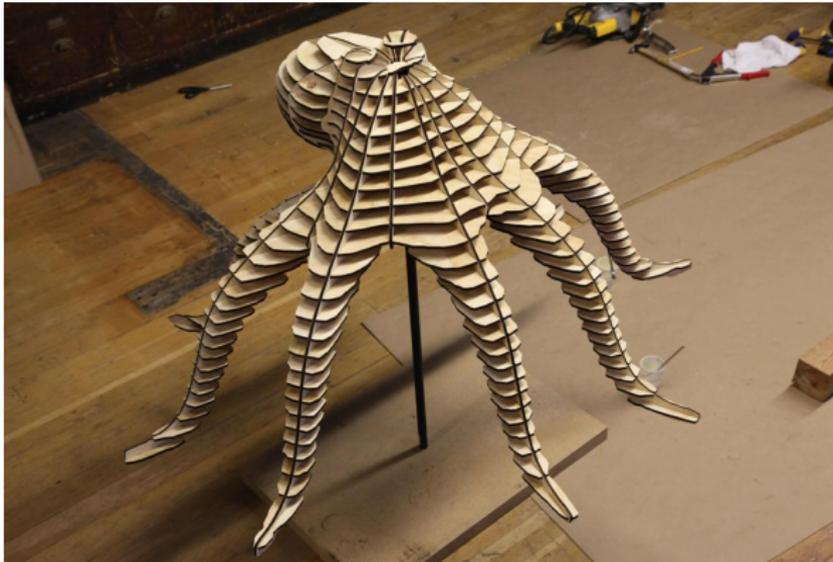




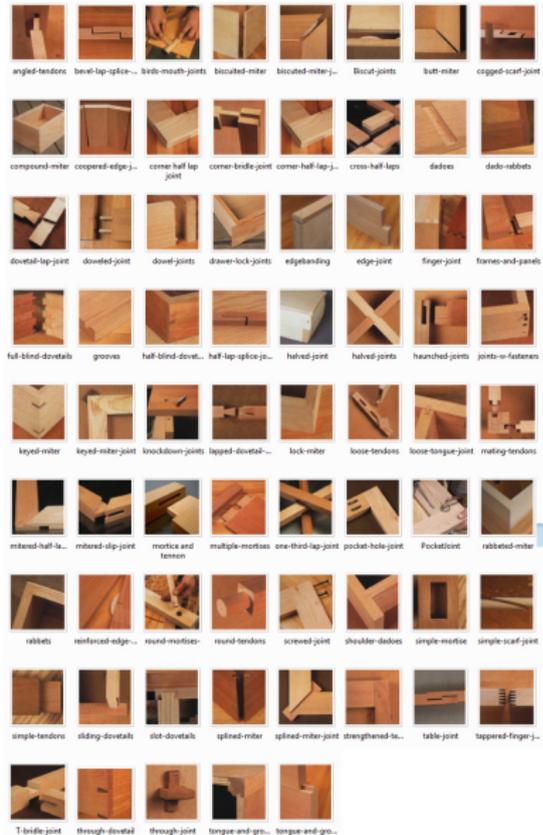
- break mesh into developable submeshes
- add joinery
- label and layout
- produce order and animation to show construction



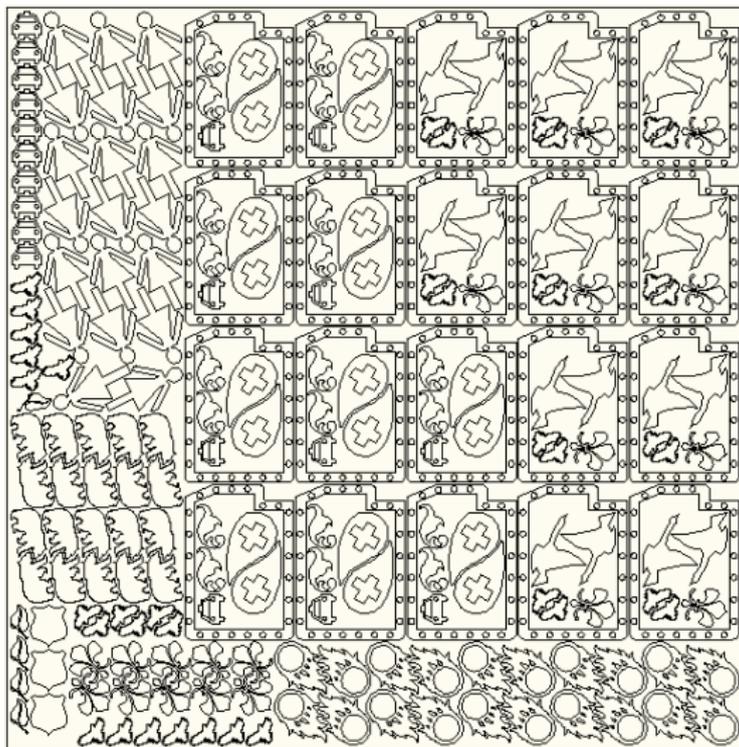
- Simplify input into cheap and easy to manufacture parts
- Example
  - origami
  - panelization
  - slicing
  - puzzle pieces



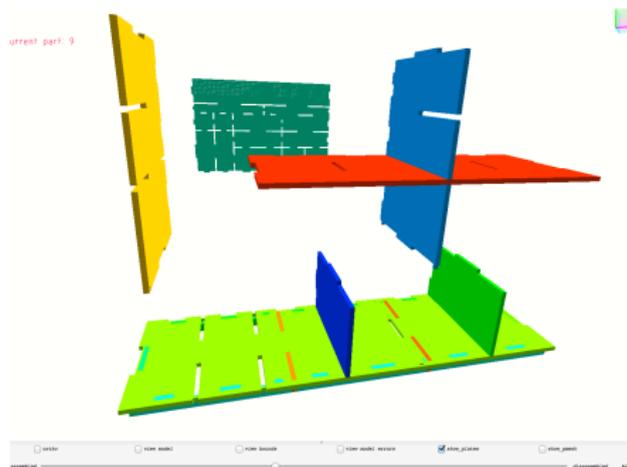
- provide connection
- joinery system
  - glue
  - zip ties
  - shoe laces
  - rivets
  - puzzle joinery
- joints
  - (living) hinge
  - bracket
  - perforated edge



- pack parts to maximize of stock use

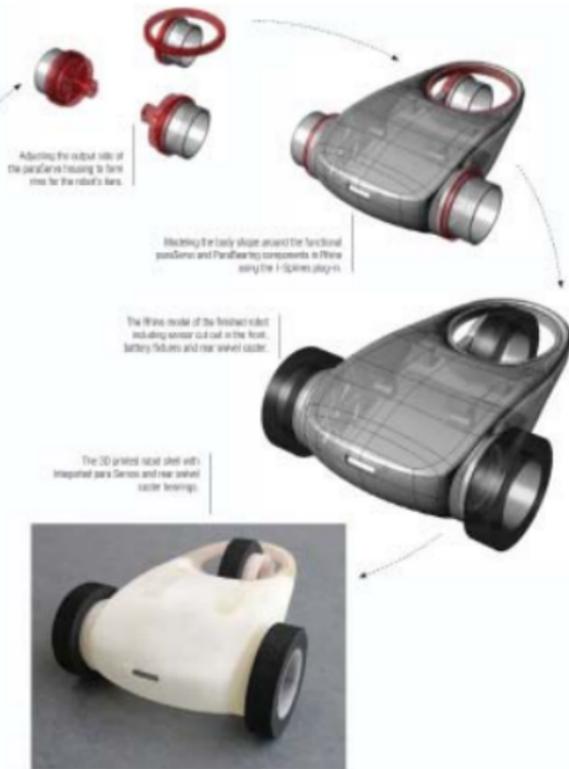
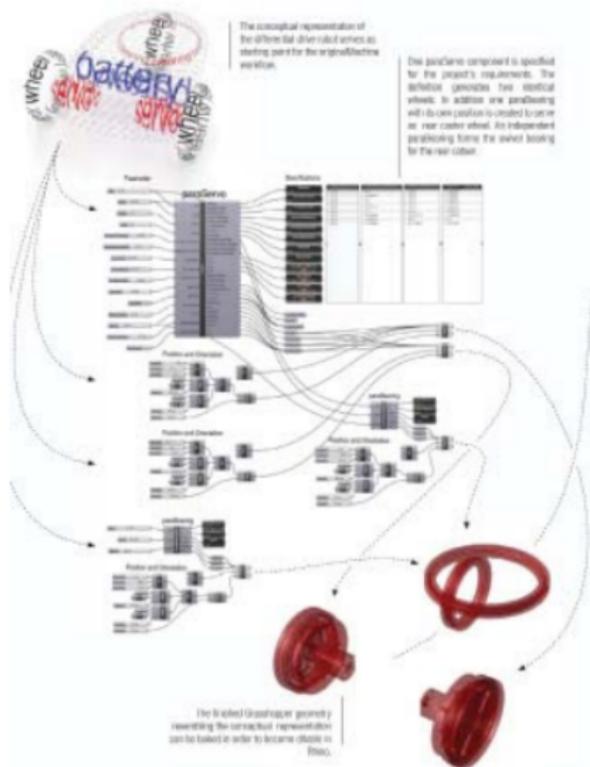


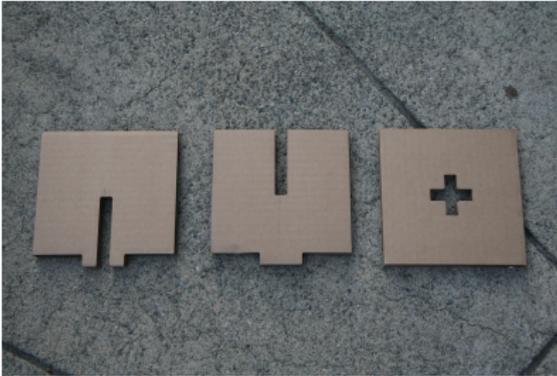
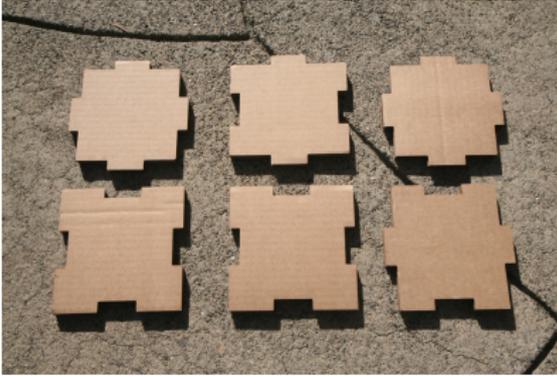
- don't have a robotic assembler
- human is another machine target
- eventually robot will do assembly
- several ways to communicate assembly instructions



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



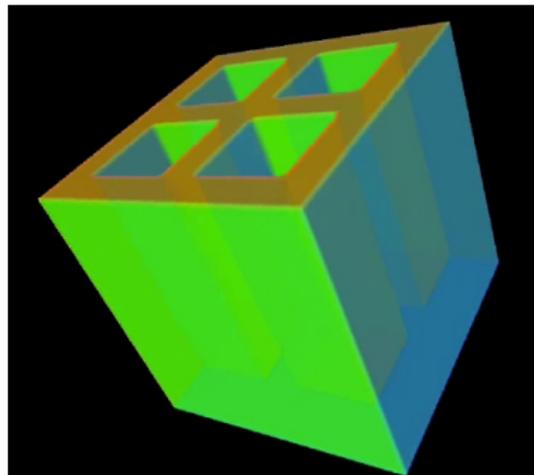


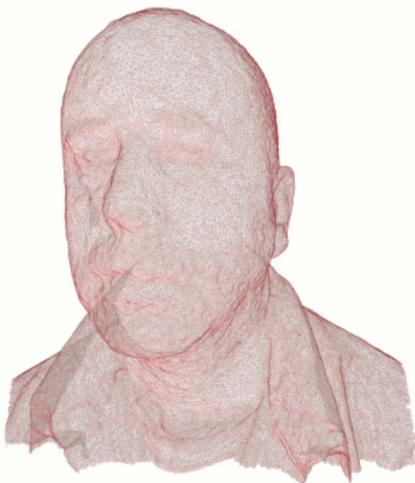


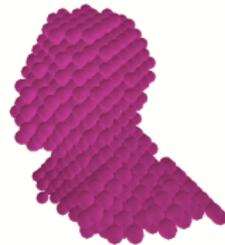
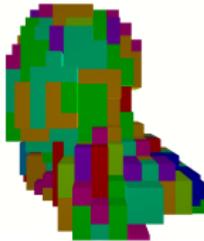
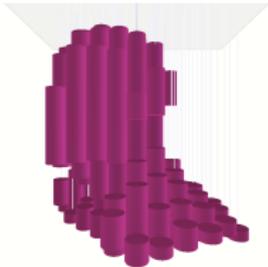
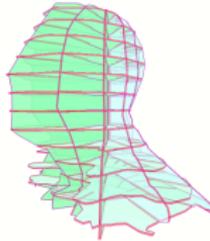
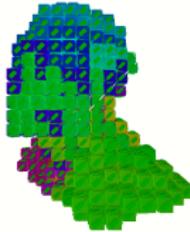
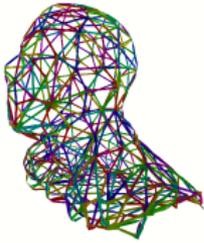
- material – sheet steel, leather, plaster
- fabrication – cutting, casting, milling
- joinery – jointing, glueing, stacking
- rationalization – panelization, slicing, subdividing



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



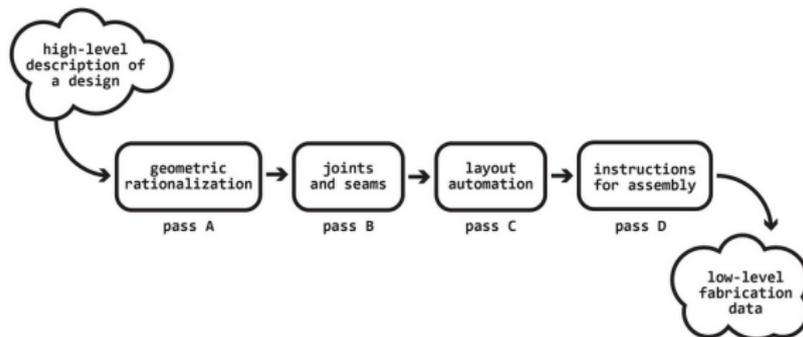




- plate movie
- otherfab examples

- mesh
  - mesh = list of triangles
  - triangle = three points
  - points = three coordinates
  - obeys winding order
- polygon
  - polygon = tree of polylines
  - polyline = list of points

| 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

