

Design Tools for Robots

- **Project Plato**
 - interactive tool and workflow for designing *families* of objects
 - each family exports free parameters and contains code for creating a (printable) *family member* given parameter values
- **Fabrication *a Lavoisier***
 - interactive system for designing fabricable models from existing template collections
 - the user creates a new models by recomposing parts of existing templates

Project Plato

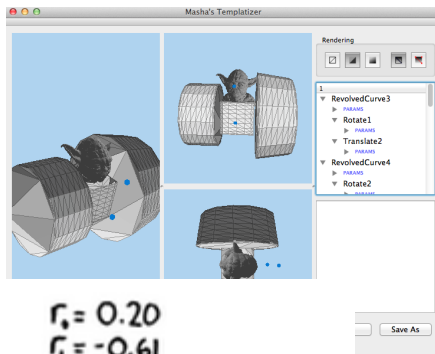
design for mass customization

General Idea

Engineer designs a *family* of objects

System compiles it into an efficient *program*

Casual user interactively *customizes* it

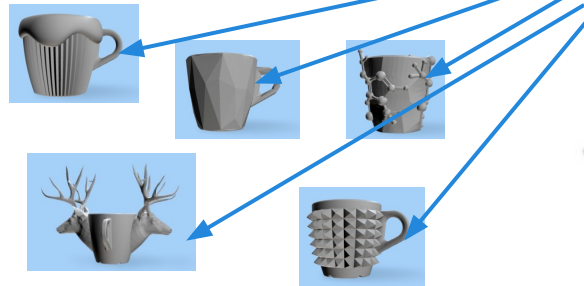
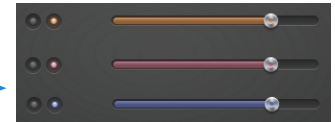


$r_1 = 0.20$
 $r_2 = -0.61$
 $r_3 = -0.83$



Engineer

Compiler /
Optimizer



Customized printable objects



Casual User

Engineer's Tool

- inherently parameterized design
- supports basic CAD operations
- supports more expressive operations
 - e.g visual design
- built to be extensible (e.g. can link in a new elementary or composite procedure “CreateWheel”)
- supports low and high level constraints

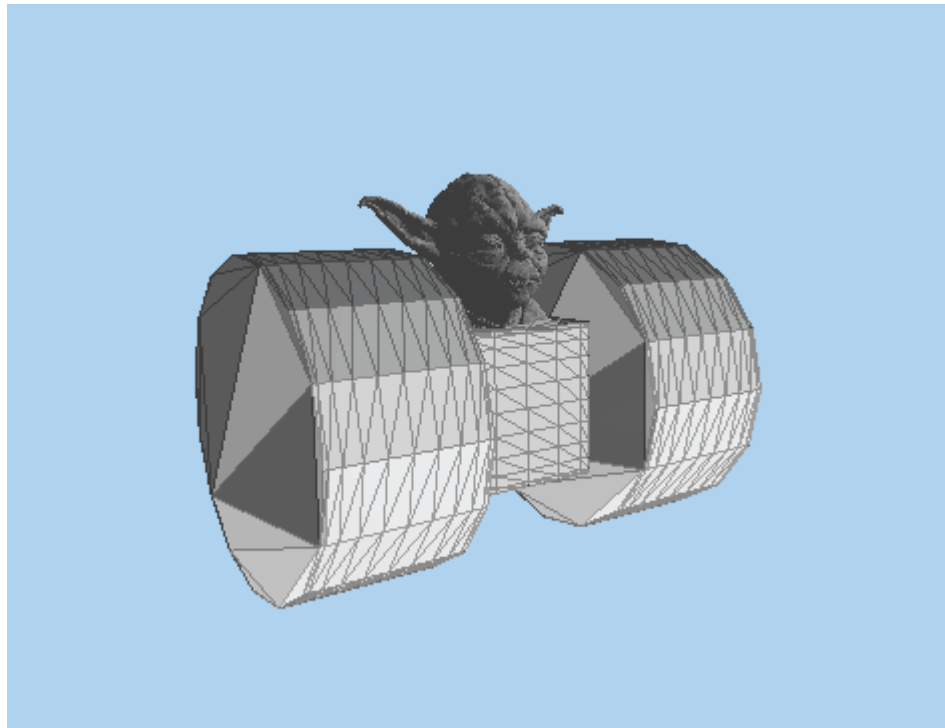
Object Family: Operation Tree

Compile a template into a tree of operations on 3D geometry of types:

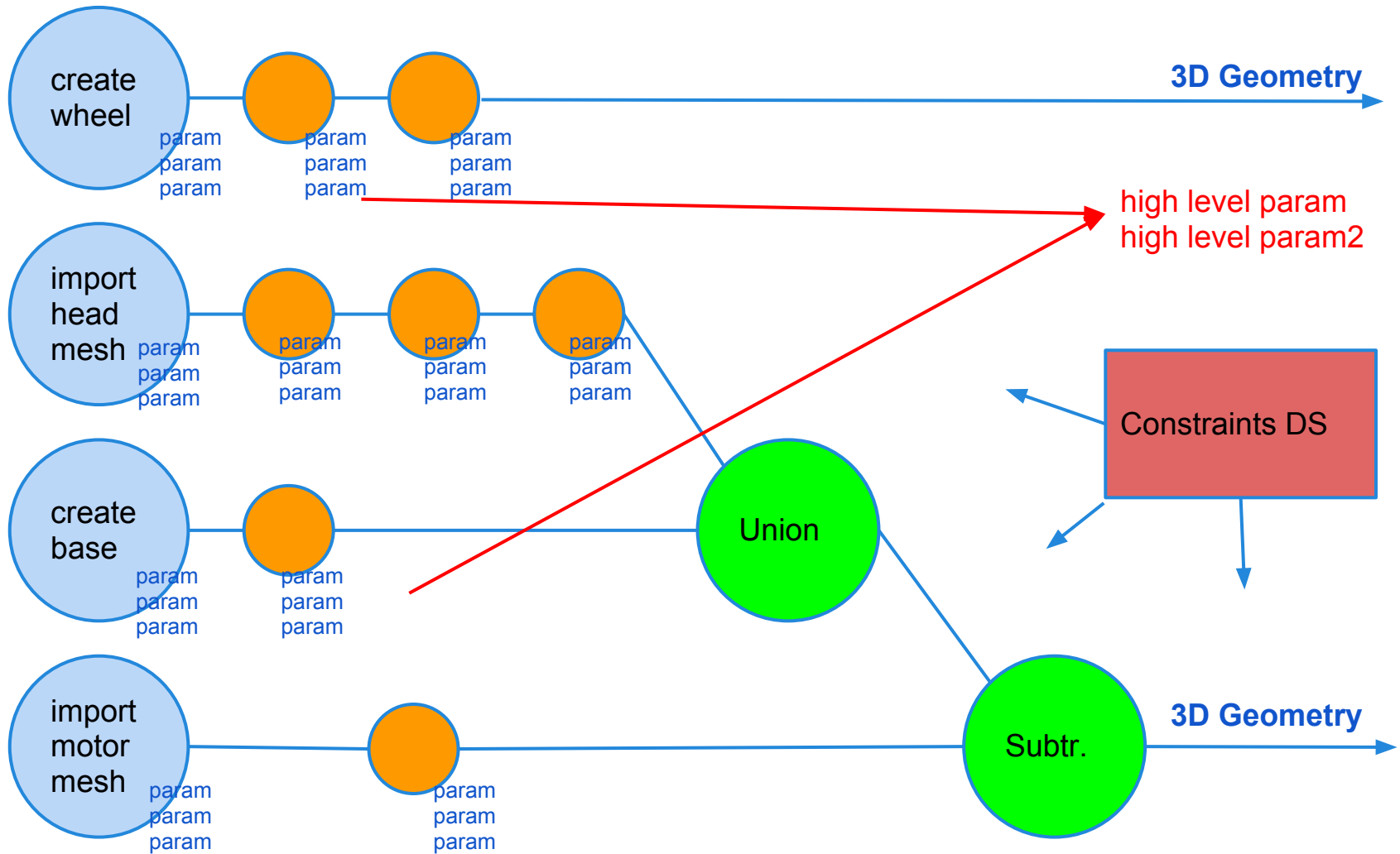
- **CreateShapeOperation**
 - e.g. CreateBox, ImportMesh, ExtrudeCurve
- **ModifyShapeOperation**
 - e.g. Scale, Translate, DisplacementMap, LaplacianMeshDeform
- **CombineShapesOperation**
 - e.g. RelativePosition, CSGUnion
- **DuplicateShapeOperation**
 - actual copy is only created on demand

Object Family: Operation Tree

Example:



Object Family: Operations Tree



Customization / Interaction

UI like shapeways customizer apps, but:

- very fast preview
- only valid parameter ranges
- custom UI is built automatically based on template parameters

UROP Project:

- client / server architecture

