

creative

Tools for Graphics ...



Ariel Shamir

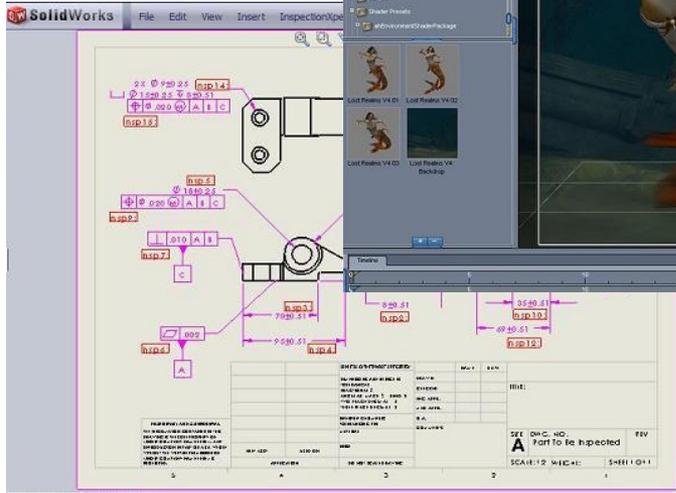
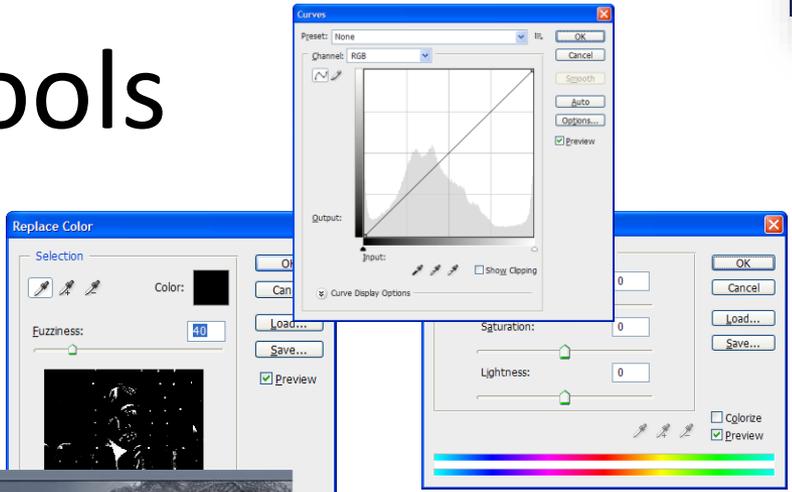
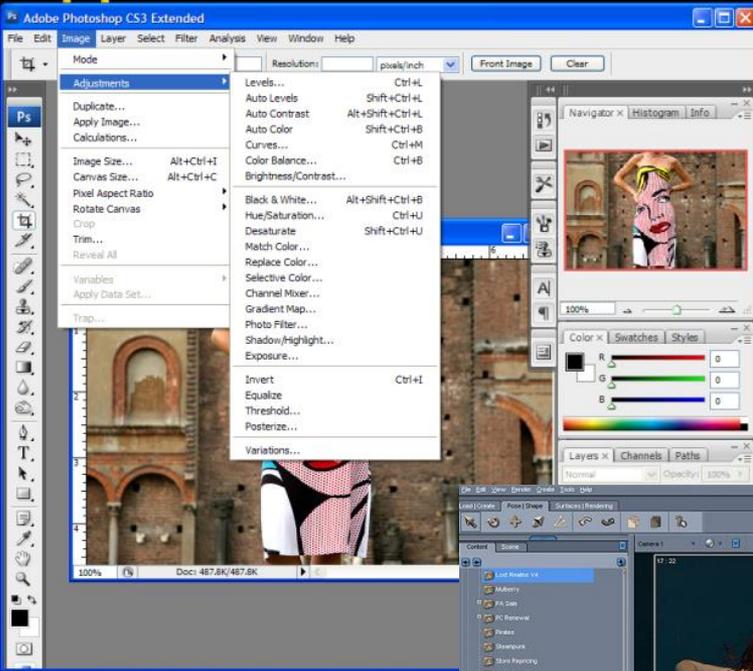
The Interdisciplinary Center,
Herzliya

With:



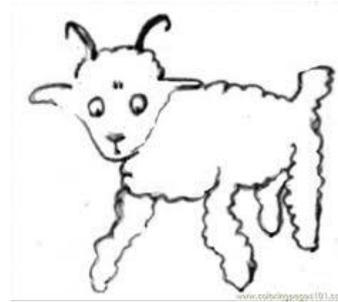


Tools



In the future...

"Draw me a sheep"



"Siri can you create a romantic image for me?"



"Siri, create me (a copy of) this chair!"

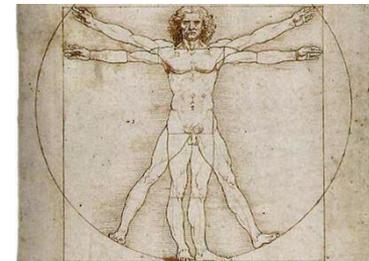


Vision and Graphics

- Challenging & Difficult tasks: image segmentation, image composition, object recognition, object reconstruction, 3D modeling...
- Difficult for who?



Computers



Humans

Possible Options

"Draw me a sheep"

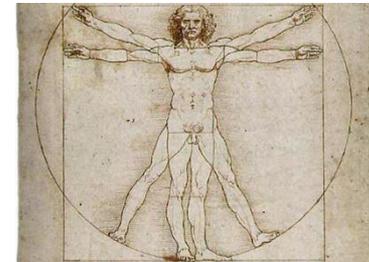
"Do it yourself"



Fully Automatic



All Manual



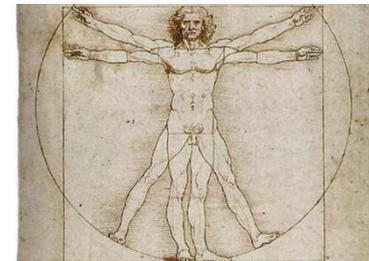
Computers (Electronic)

- Efficient in calculations
- Deterministic
- Fast

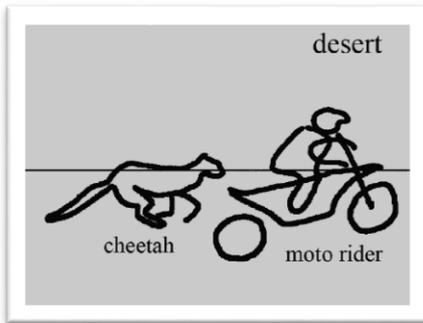


Humans (Most)

- Inconsistent
- Slow
- Still better at some tasks (many? which?)



Our Work



- Recast some of these problems and make them simpler using a “joint effort” approach

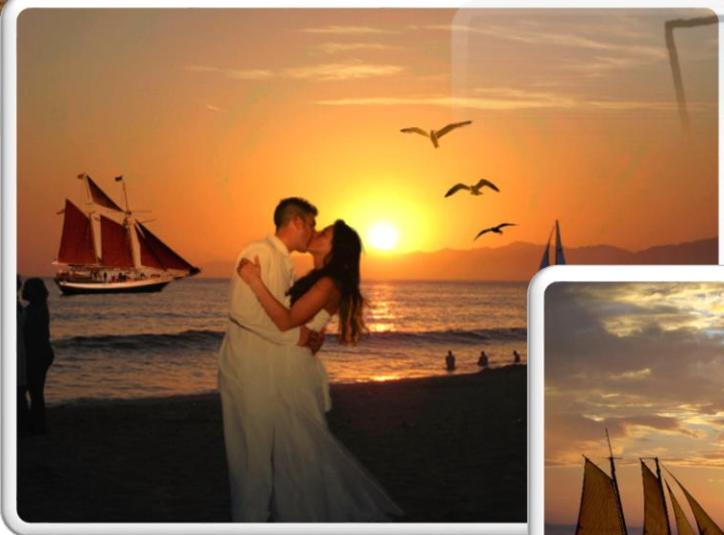
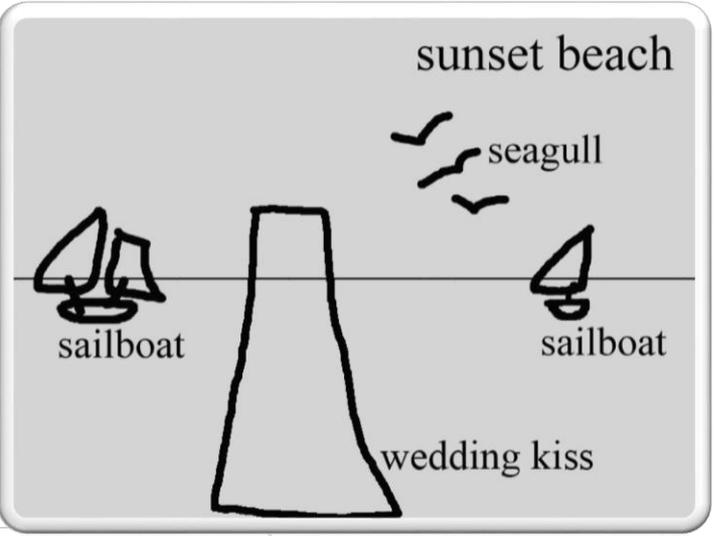
tree

man throw

dog jump

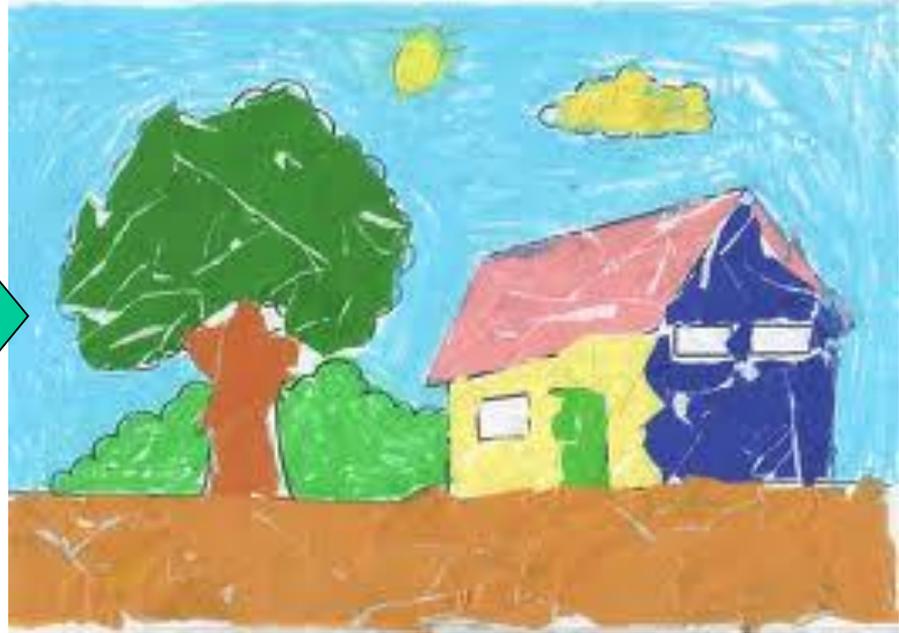
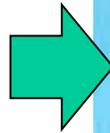
frisbee





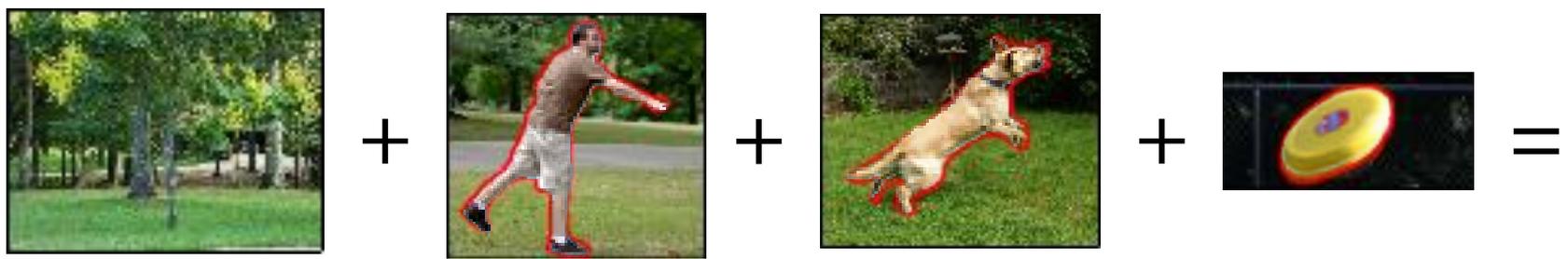


Collage





Find, Cut & Paste



Techniques Needed

- Image search
- Image segmentation
- Image composition



Very difficult problems in general!

Many previous works... too many to mention

Key Idea

- Make the problem simpler by using simpler images:





Simple Images?



Search

[Photos](#) | [Groups](#) | [People](#)

Everyone's Uploads ▾

sailboat

SEARCH



From Clyde...



From MalNino



From Musical Mint



From ImranAnwar



From md91180



From roostercoupo...



From MalNino



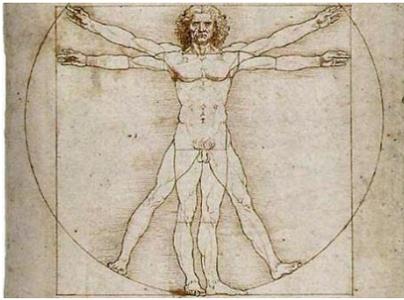
From Kevin4



From EdBob



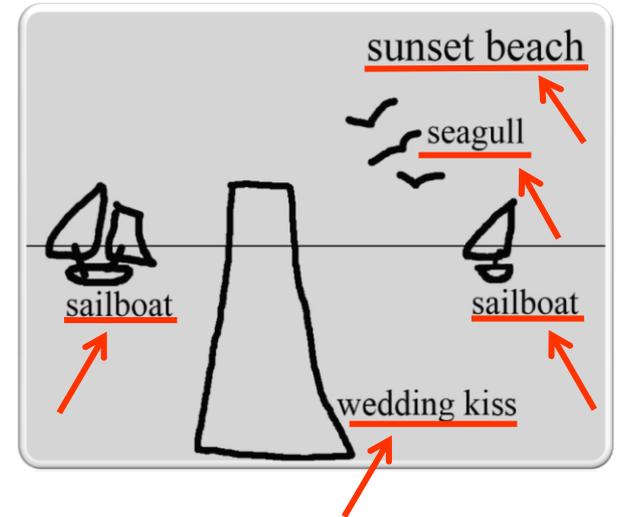
From msc-ρησθες...



Human

- Sketches the image
- Names the components
- Provides the composition
- Corrects in post processing

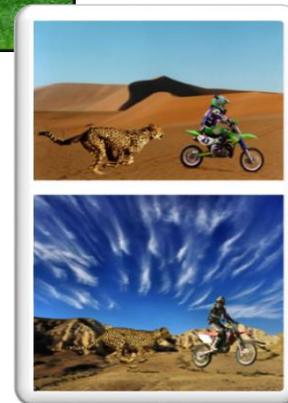
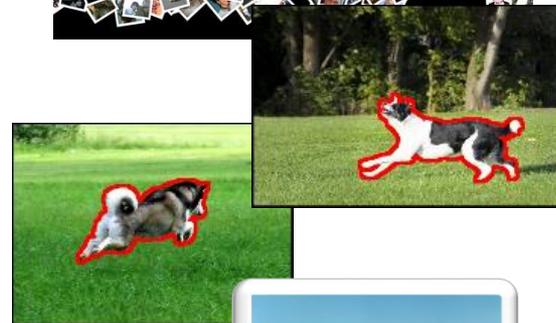
- No need for tedious precise drawing & positioning



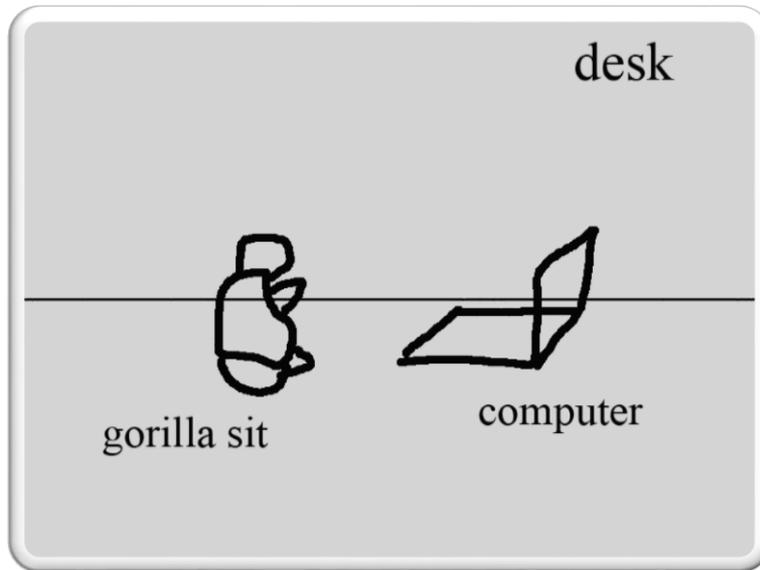


Computer

- Searches for images
- Filters images
- Segments & composes
- Rates results
- No need to solve complex segmentation & recognition problems



Not Always a Success





Takes Time...

desert

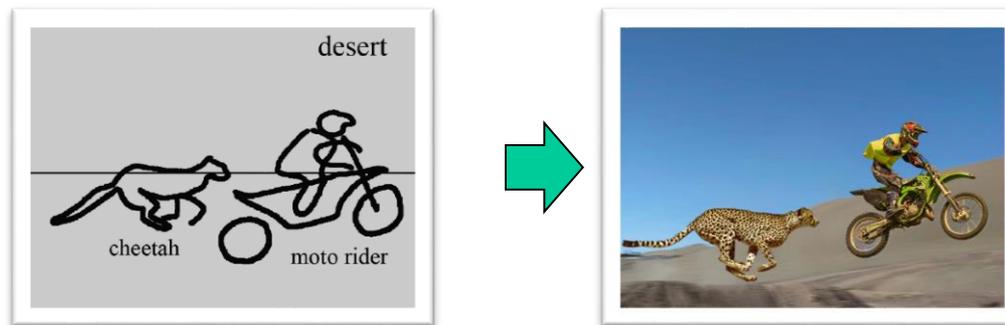
cheetah

moto rider



Going Physical?

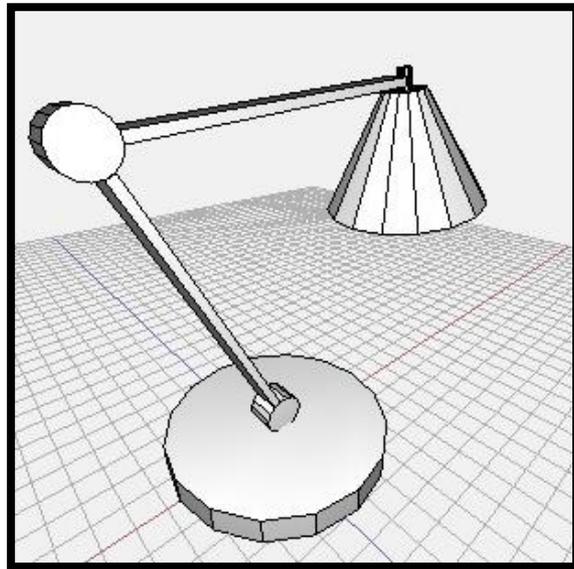
- We create images from sketches



- Can we create real things from sketches?

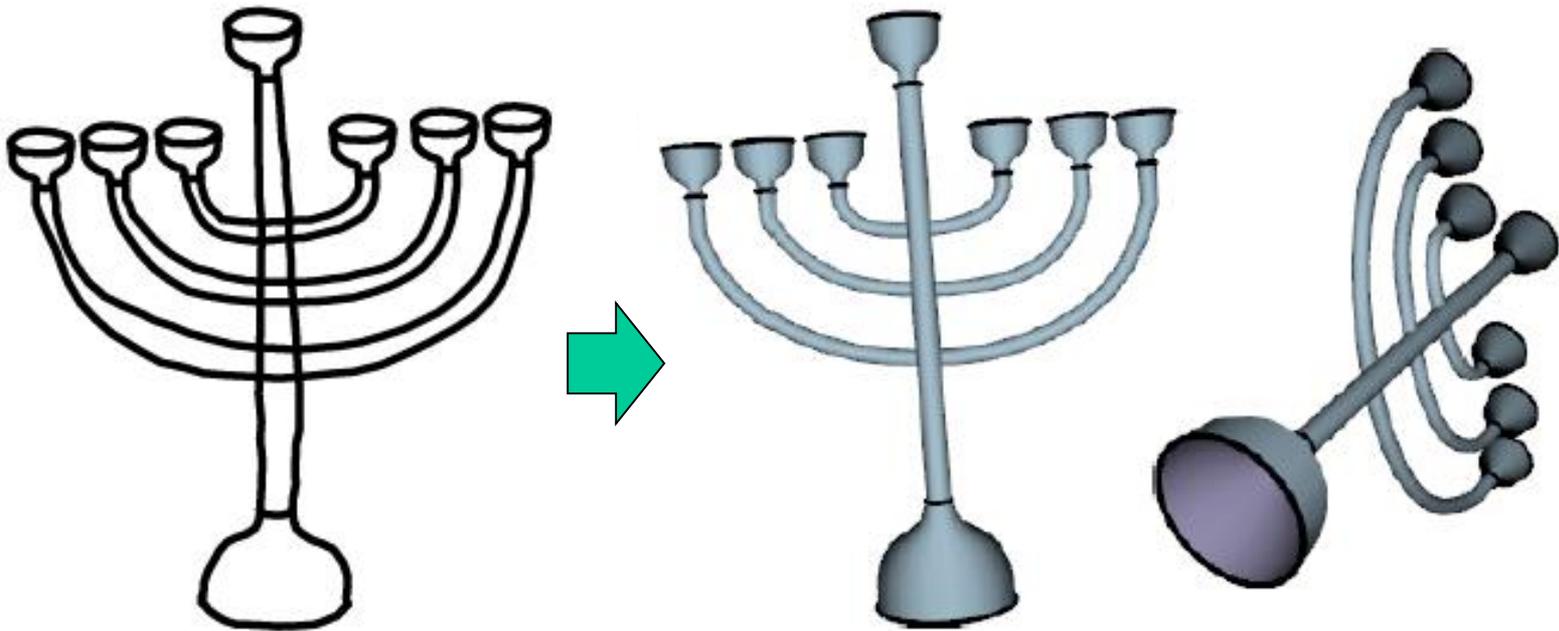
To Make Real Things You Have to **Model** them

- Modeling 3D objects is difficult for humans
- Even just crude objects!



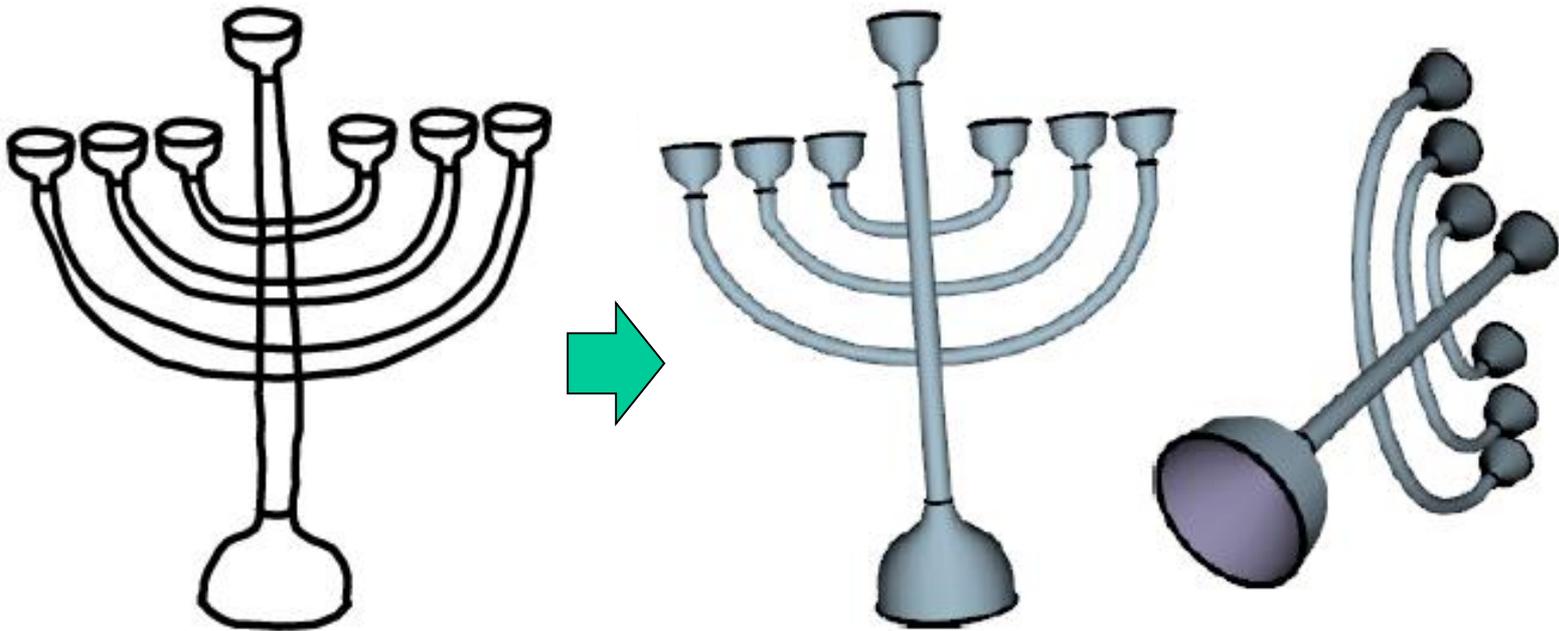
Sketching is Easier

- Can computers turn a sketch into a 3D model?

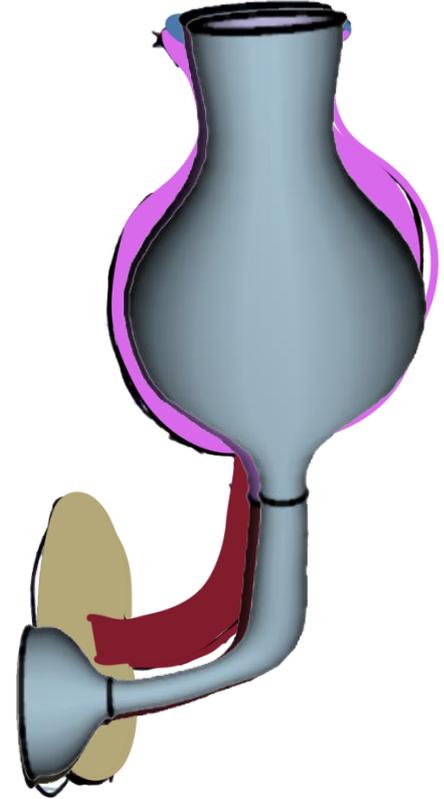
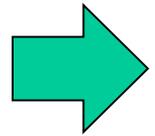
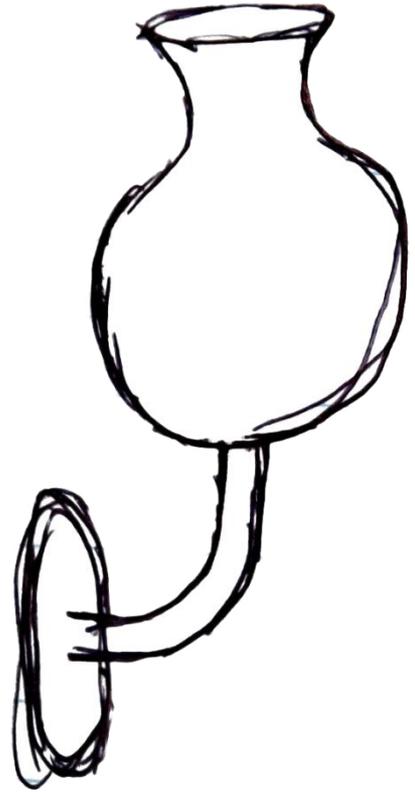


Sketching is Easier

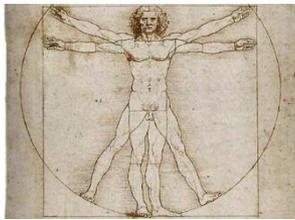
- Fully automatic methods for this are difficult!



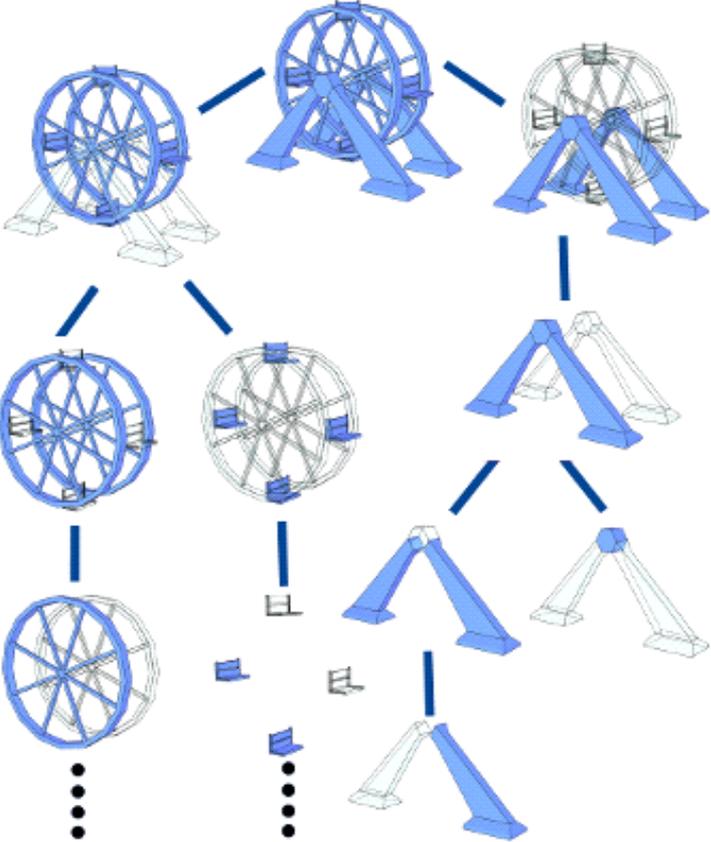
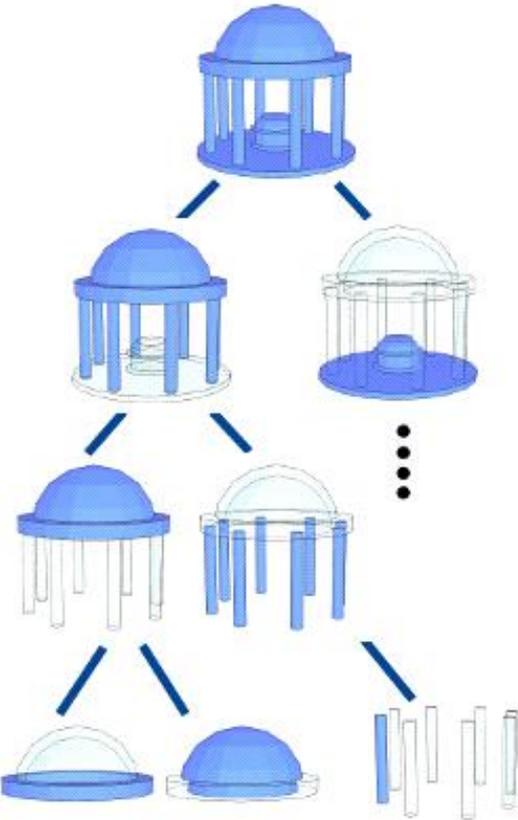
Challenges



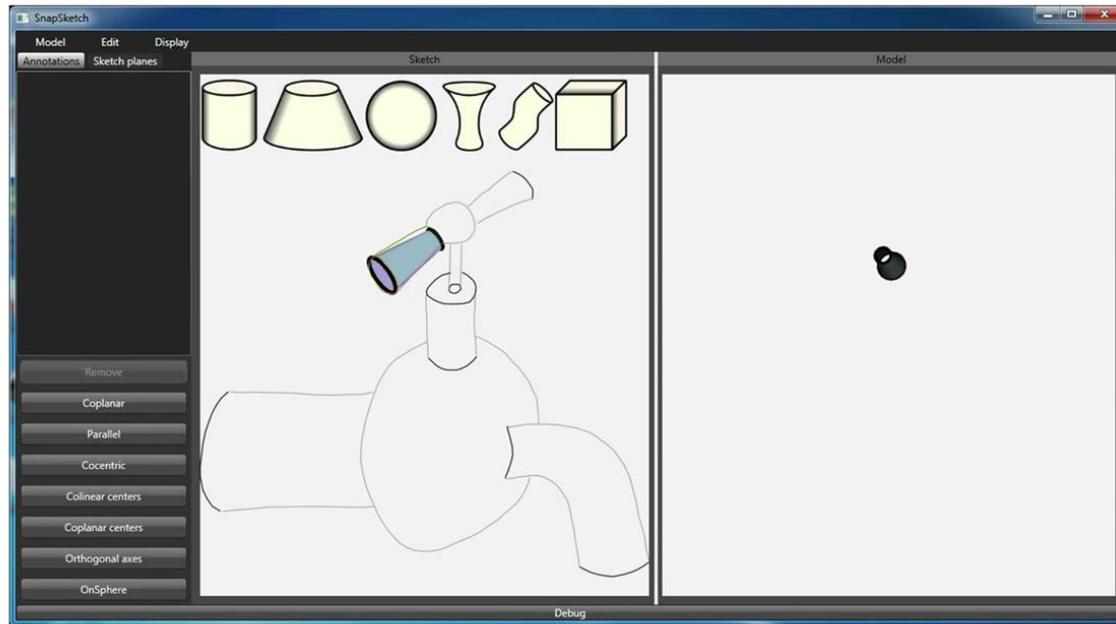
Interpretation
Segmentation
Positioning
Preserving Relations



Human Perception: Objects are a Composition of Parts



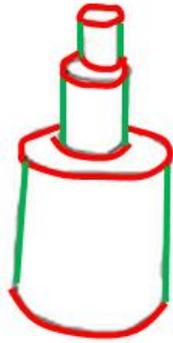
Demonstration



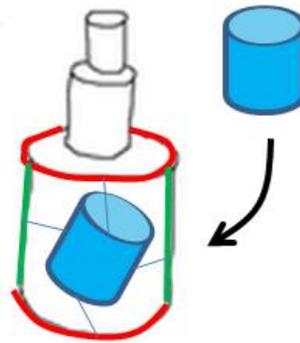
Overview



input sketch



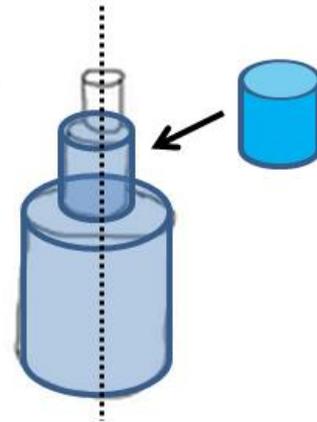
semantic classification



interactive matching



real-time snapping

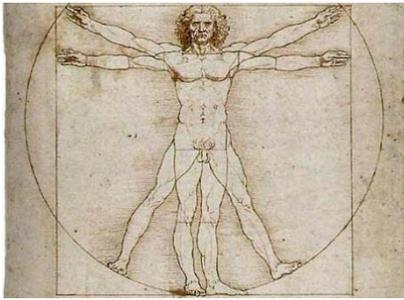


geosemantic snapping



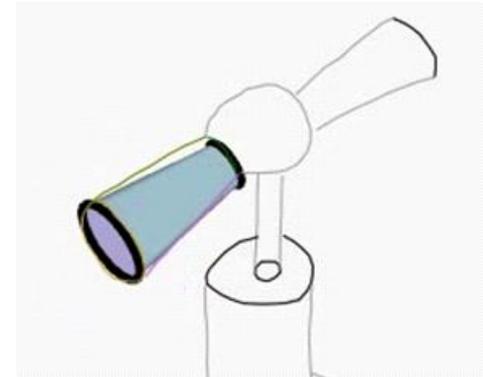
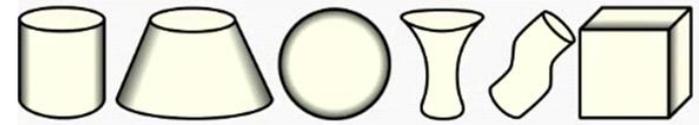
Computer

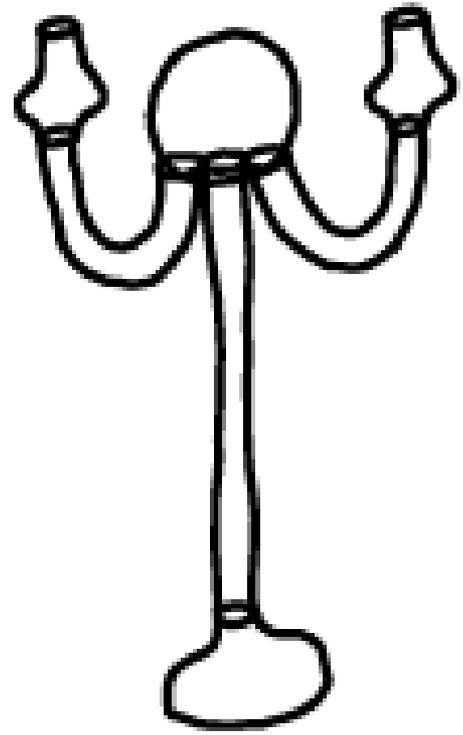
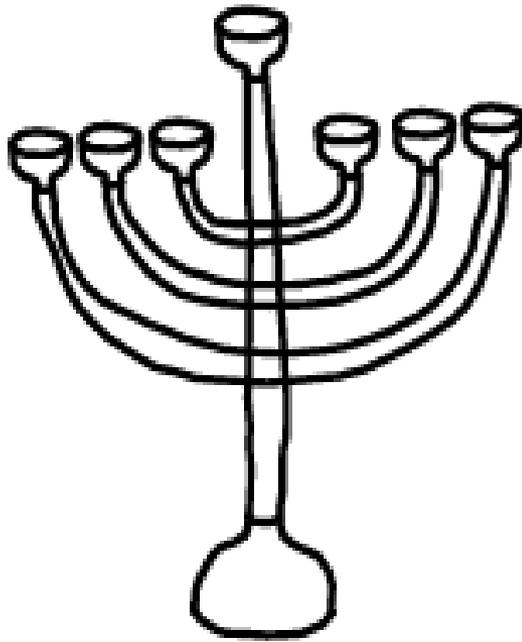
- Infers Geo-Semantic Constraints:
 - Almost relations are turned into exact
- Solves positioning while maintaining:
 - Parallelism
 - Orthogonality
 - Collinear centers (three or more)
 - Concentric axes
 - Coplanar elements

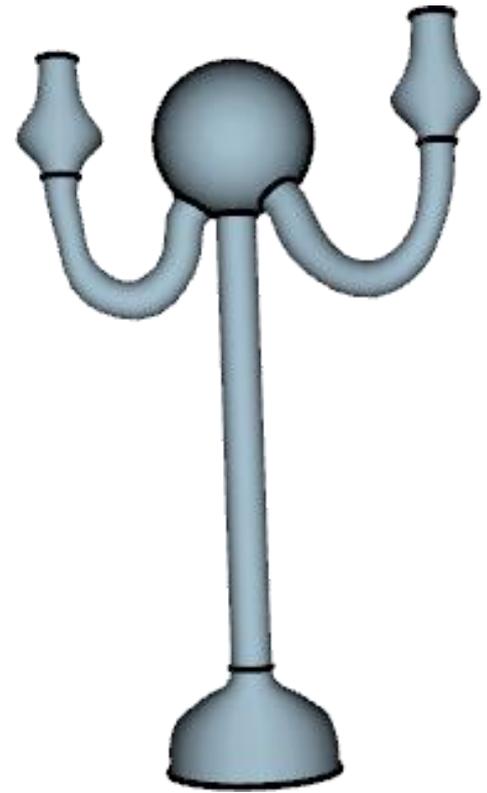
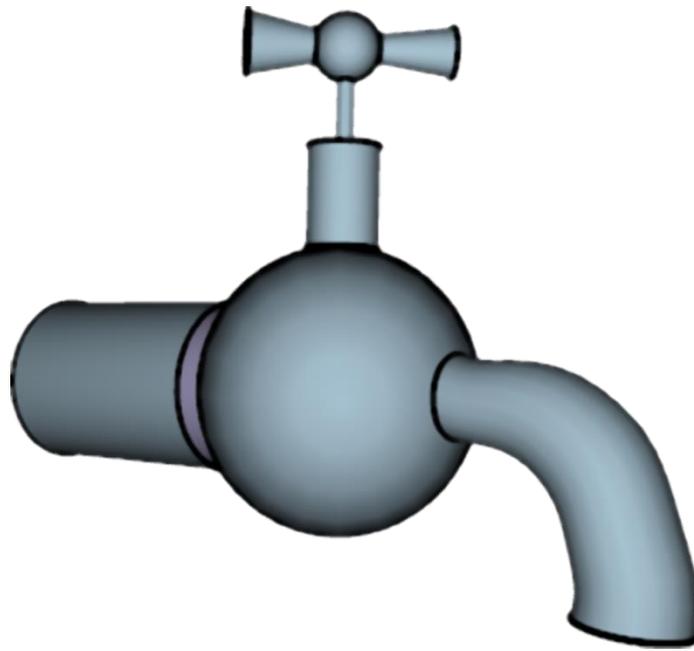
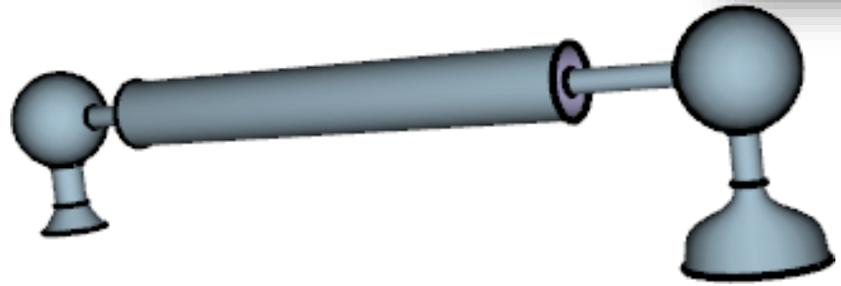
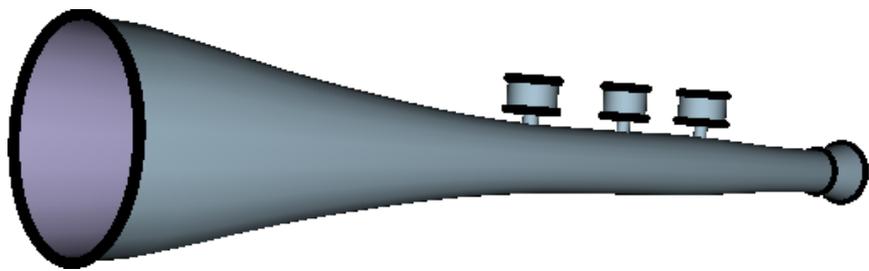


Human

- Sketch the parts of the object
- Choose correct type of primitive
- Position it correctly (good initial guess for solver)
- No need for tedious precise positioning & relations!







Limitations

- Need an initial good sketch
- Does not handle “out of plane” modeling (can be added)
- No textures
- Models are still very crude!

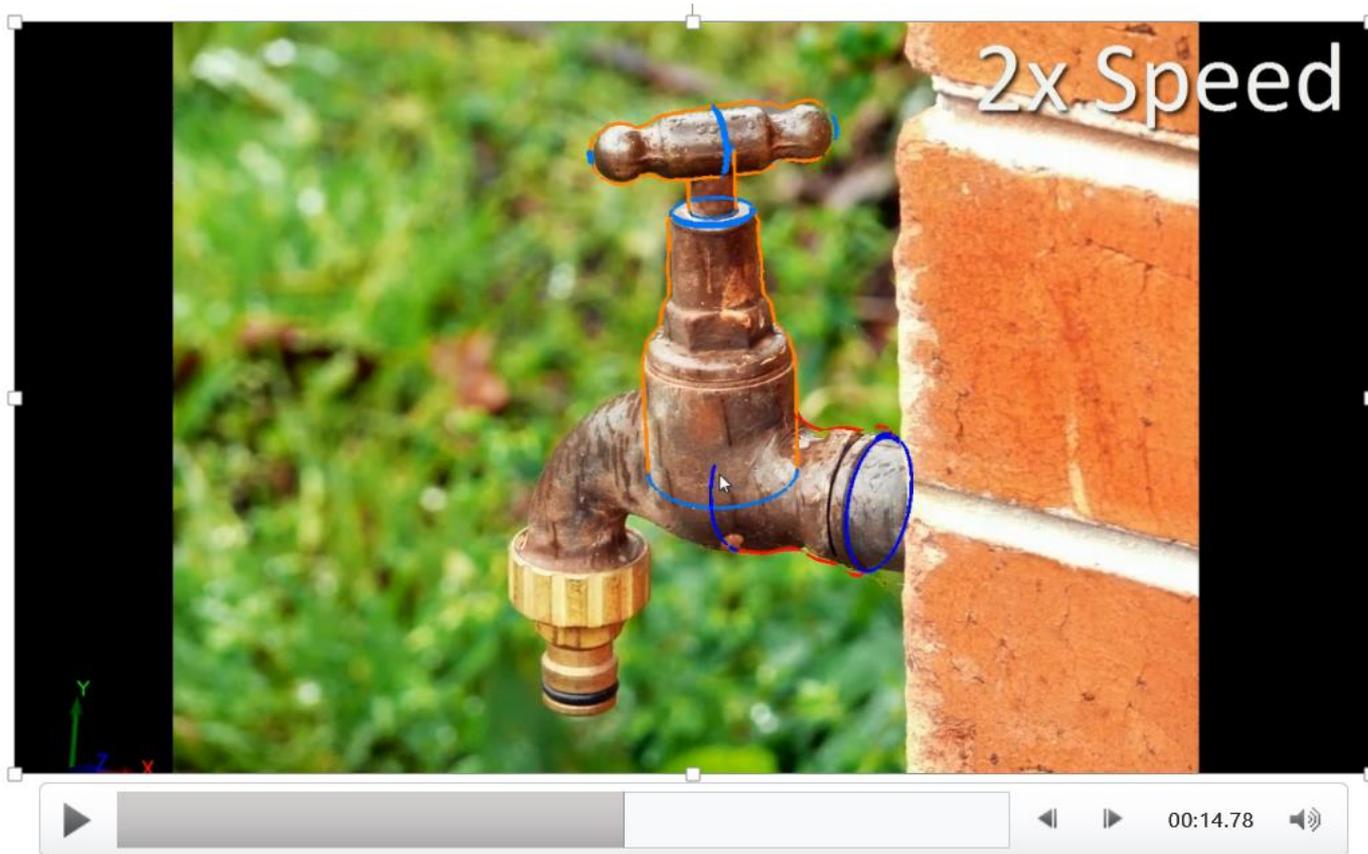
Next Step...

- Free the user from sketching
- Allow capturing textures, materials...

...3D from images?



Example



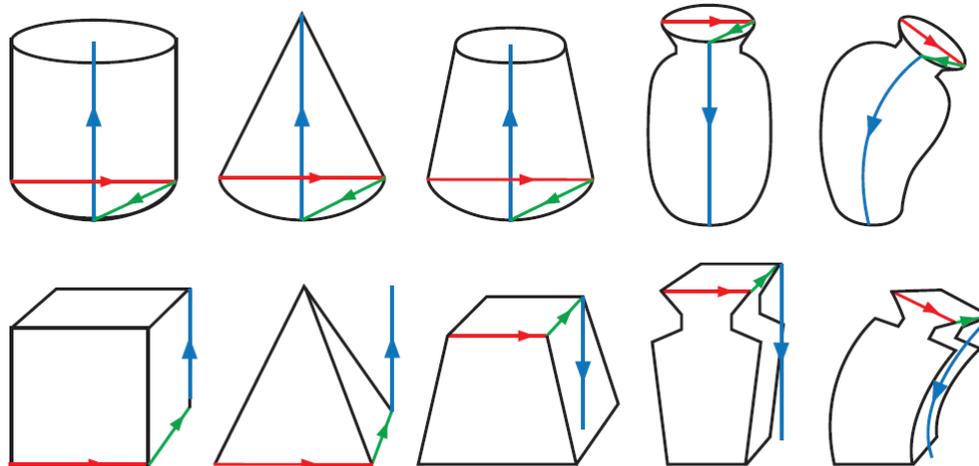
Challenges?

- Images are more complex than sketches
- Parts are not separated in complex objects

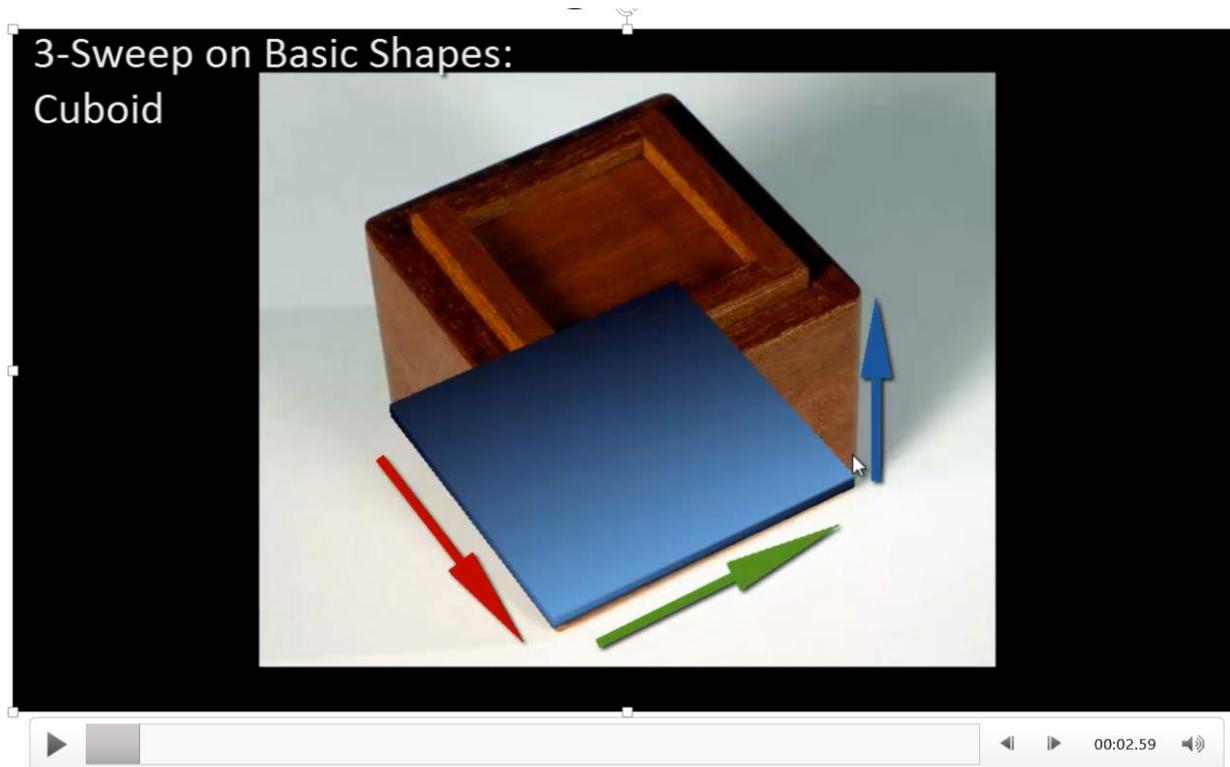


3-Sweep

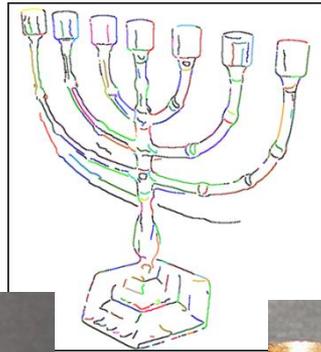
- A simple intuitive method to define 3D primitives using 3 mouse sweeps



Modeling a Primitive



“Behind the Scene”

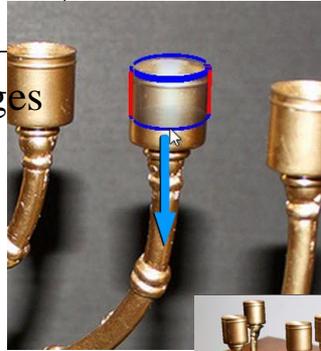


Pre-Processing

Input image



Extracted edges



3-Sweep Modeling Primitives

Drawing two strokes to form the profile of a primitive



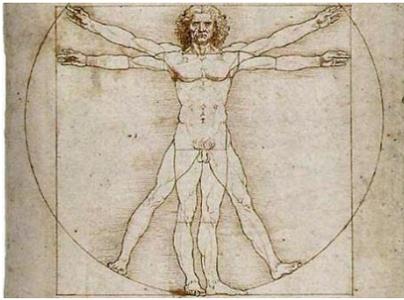
Sweep to form 3D model of a primitive



Optimization

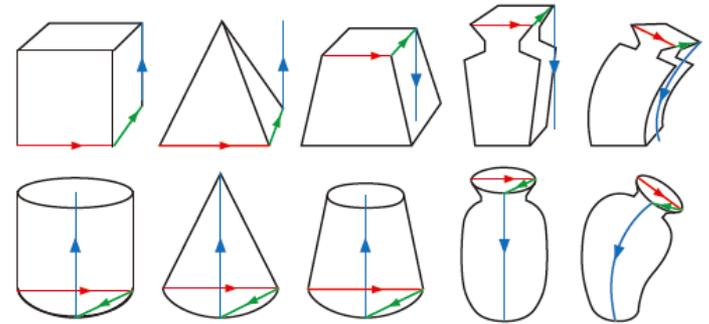
Applying geo-semantic constraint to achieve final model

Editing and pasting the object



Human

- Defines parts implicitly
- Defines position implicitly



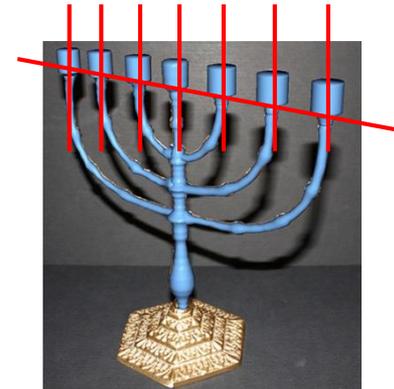
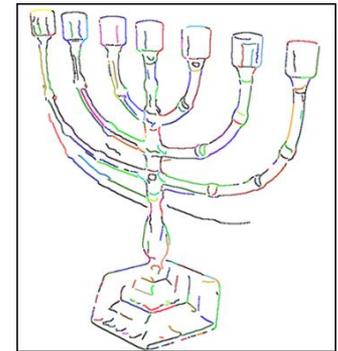
- No need for tedious precise drawing or positioning





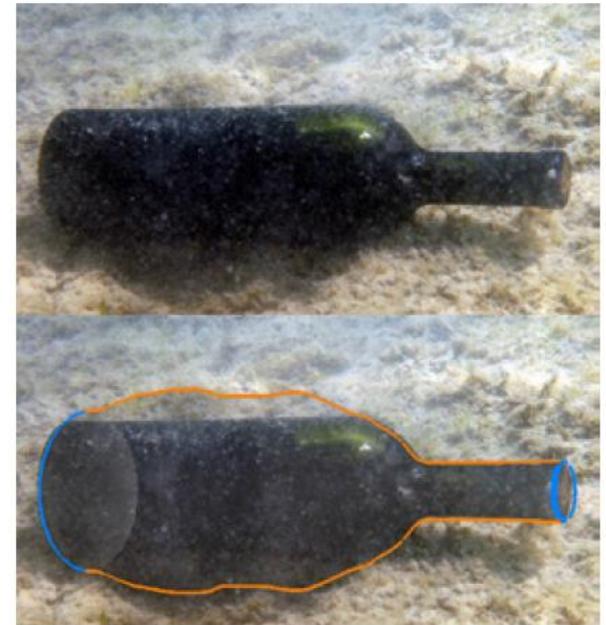
Computer

- Defines initial edges
- Snaps primitive to image edges
- Infers Geo-Semantic Constraints:
 - Almost relations are turned into exact
- Solves positioning while maintaining the constraints

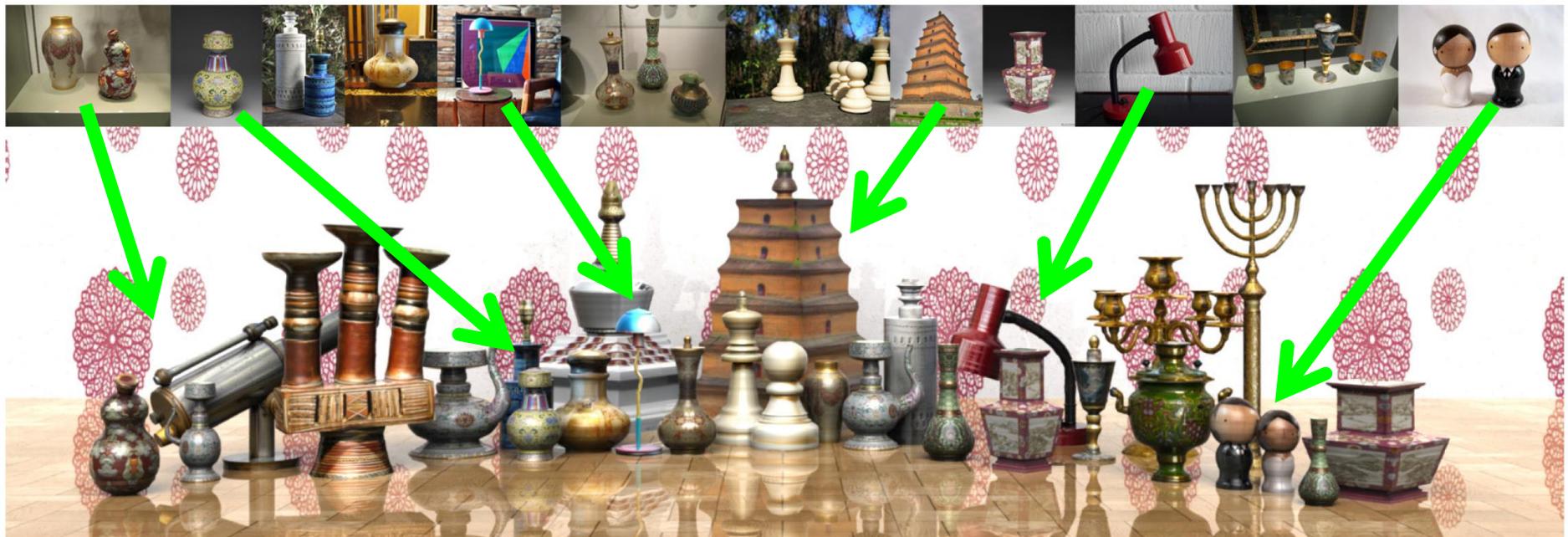


Failure Cases

- Non-ideal perspective projection
- Assumption of uniformly scaling profiles
- Ill-defined edge



Still ... Many Objects Can be Modeled



More Limitations and Future Directions

- Many objects cannot be decomposed into generalized cylinders and cuboids
- Cannot generate non-planar extrusions or non uniform profiles
- Cannot deal with:
 - Object that extrudes towards screen
 - Object that is very small in image
 - Hollow objects
- Cannot handle shadow

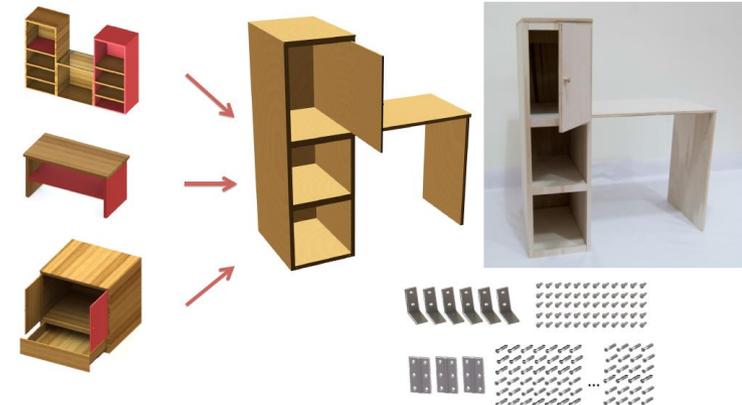
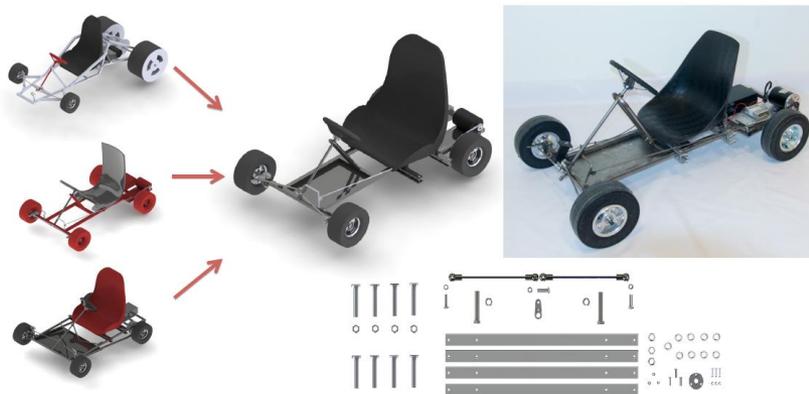
Closing the Loop?

- Designing objects that can be really fabricated?

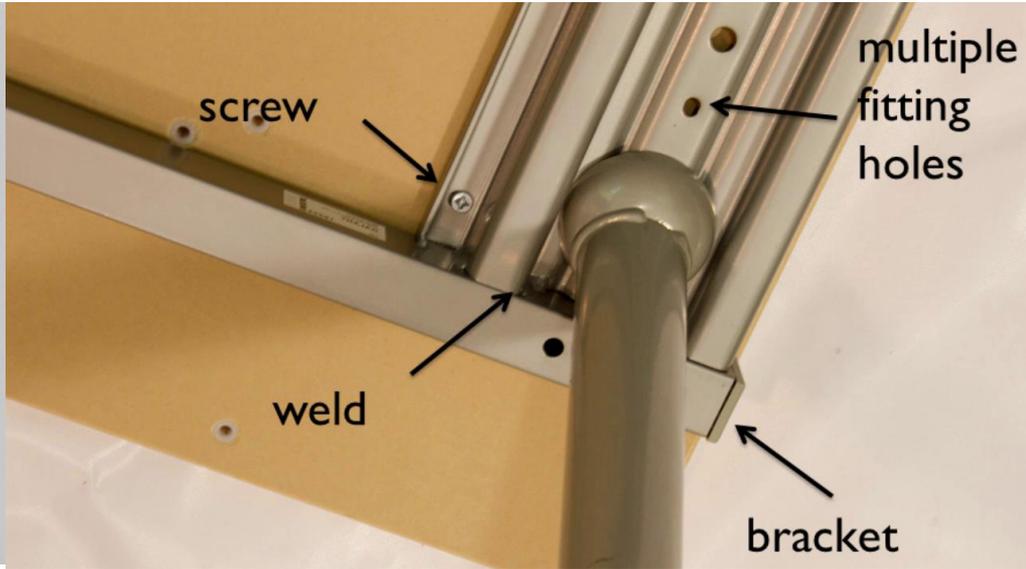
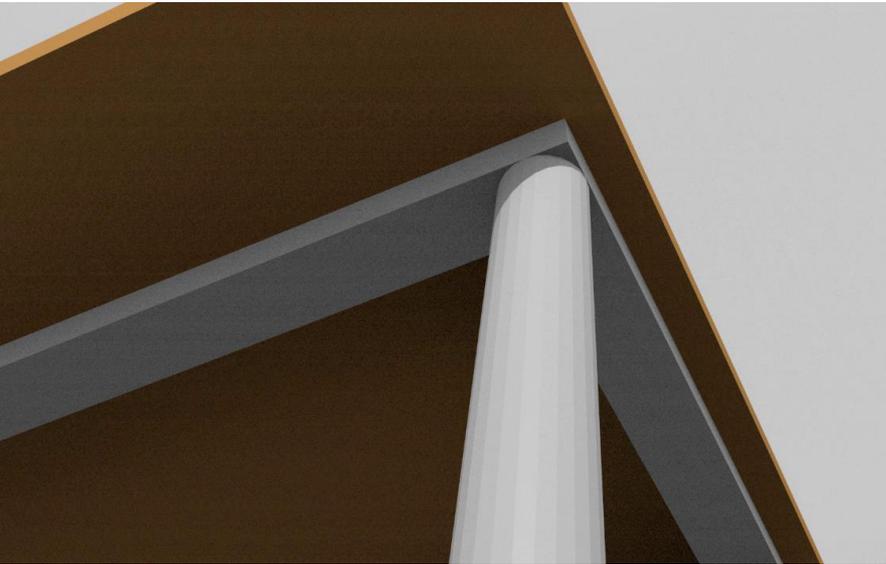


Challenges

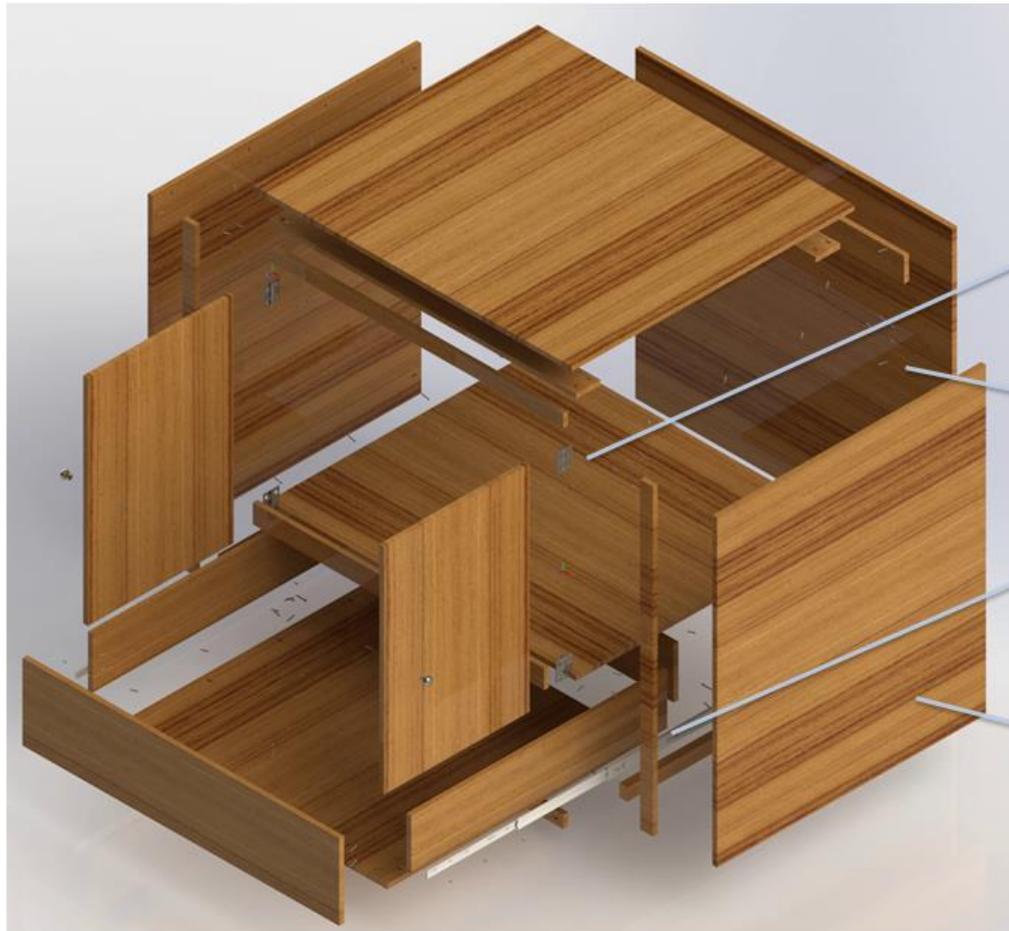
- Many small details
- How to connect parts?
- Fabricability (materials, physics...)



Virtual vs. Real



Many Parts (~300)



Items Catalog



Ref# 1789A25
\$5.69



Ref# 90198A105
\$7.38/100

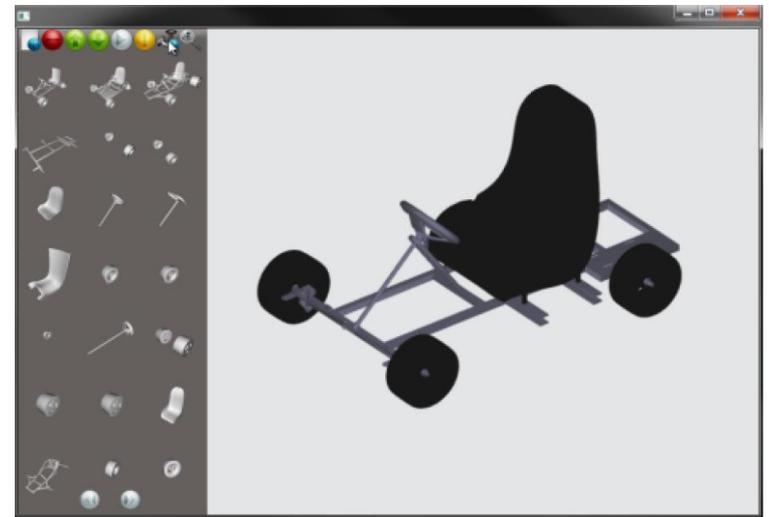


Ref# 1057A51
\$25.61



Ref# 90198A105
12"X12": \$7.38
12"X24": \$13.54
24"x24": \$24.62

Fabrication By Example

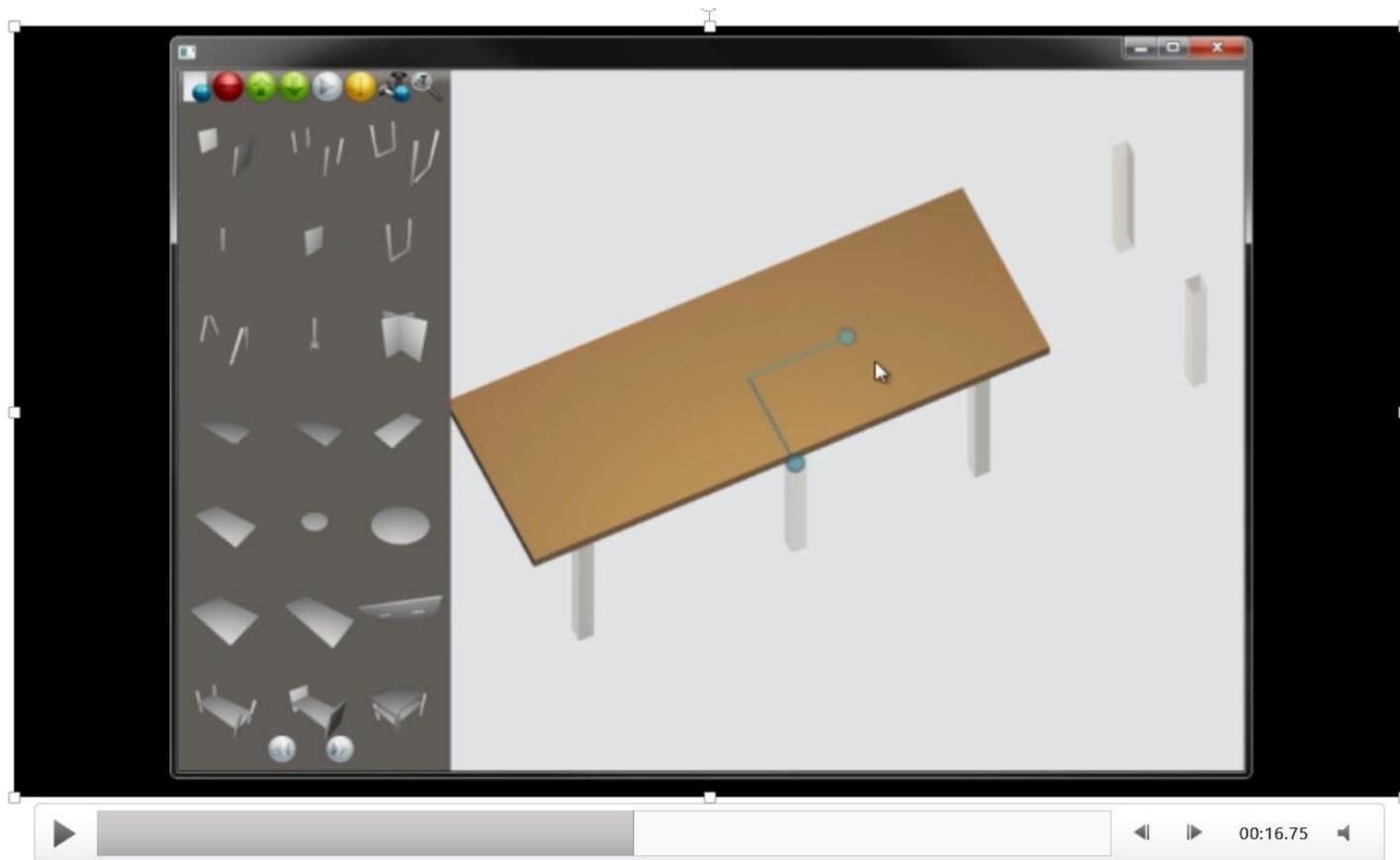


Database of hierarchical
parametric objects (templates)

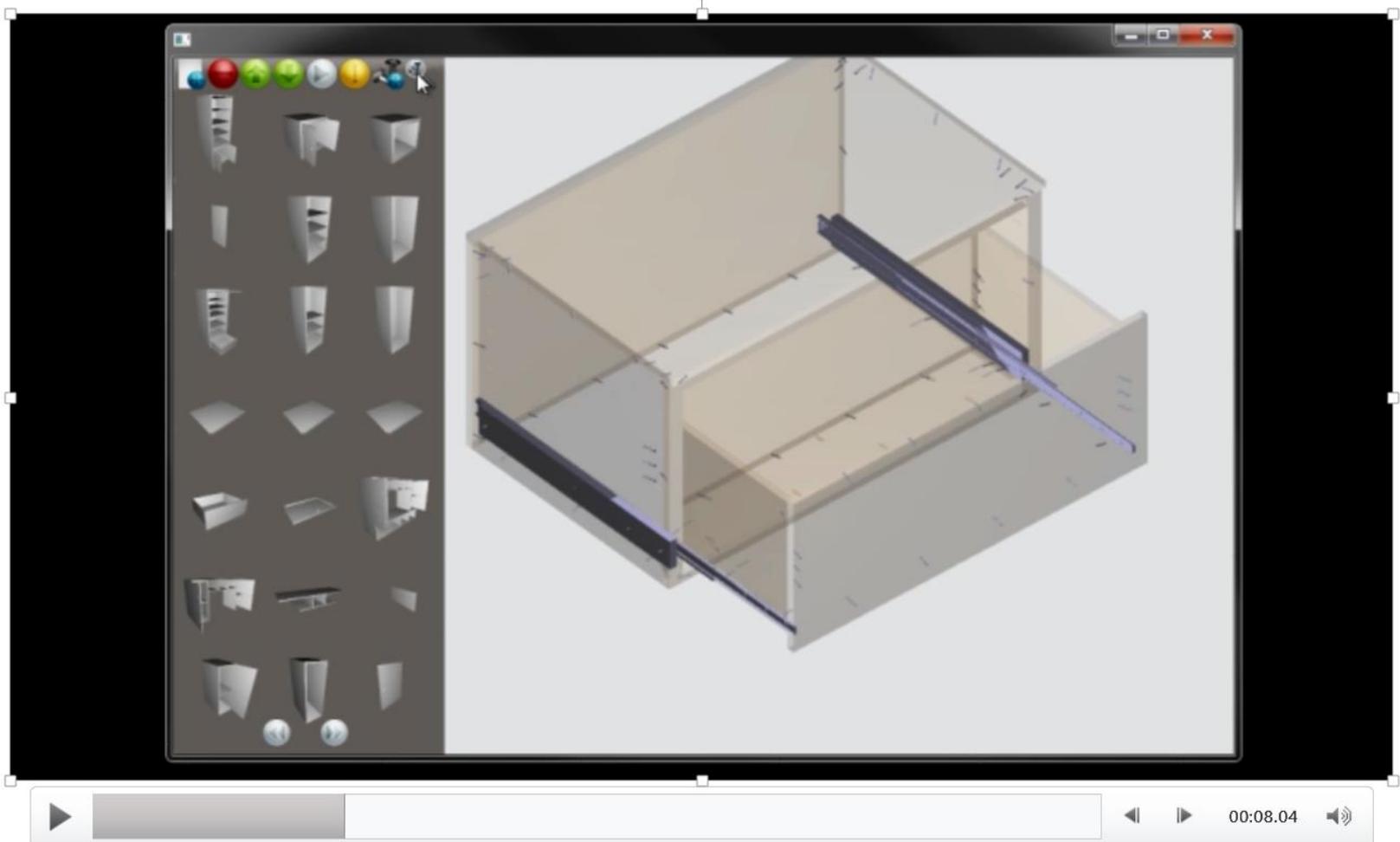
Parameters & Constraints



Part Based Modeling



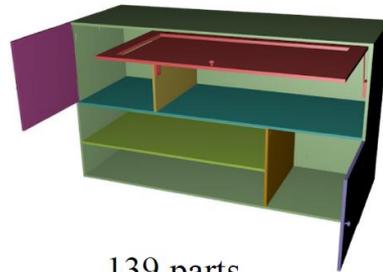
Connectors



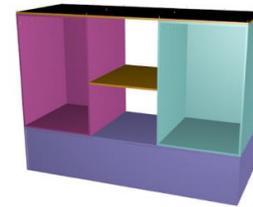
Examples



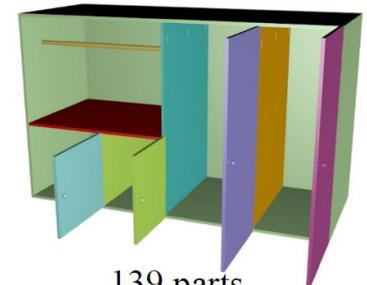
179 parts
(163 connectors)



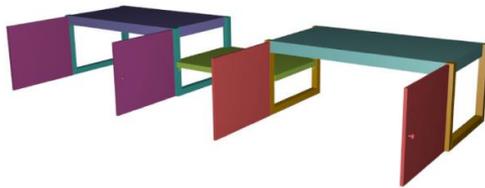
139 parts
(122 connectors)



217 parts
(197 connectors)



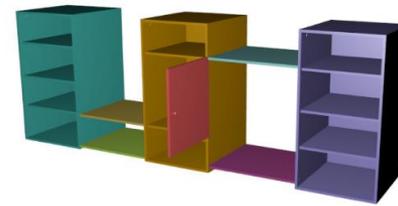
139 parts
(121 connectors)



147 parts
(124 connectors)



156 parts
(140 connectors)



128 parts
(99 connectors)

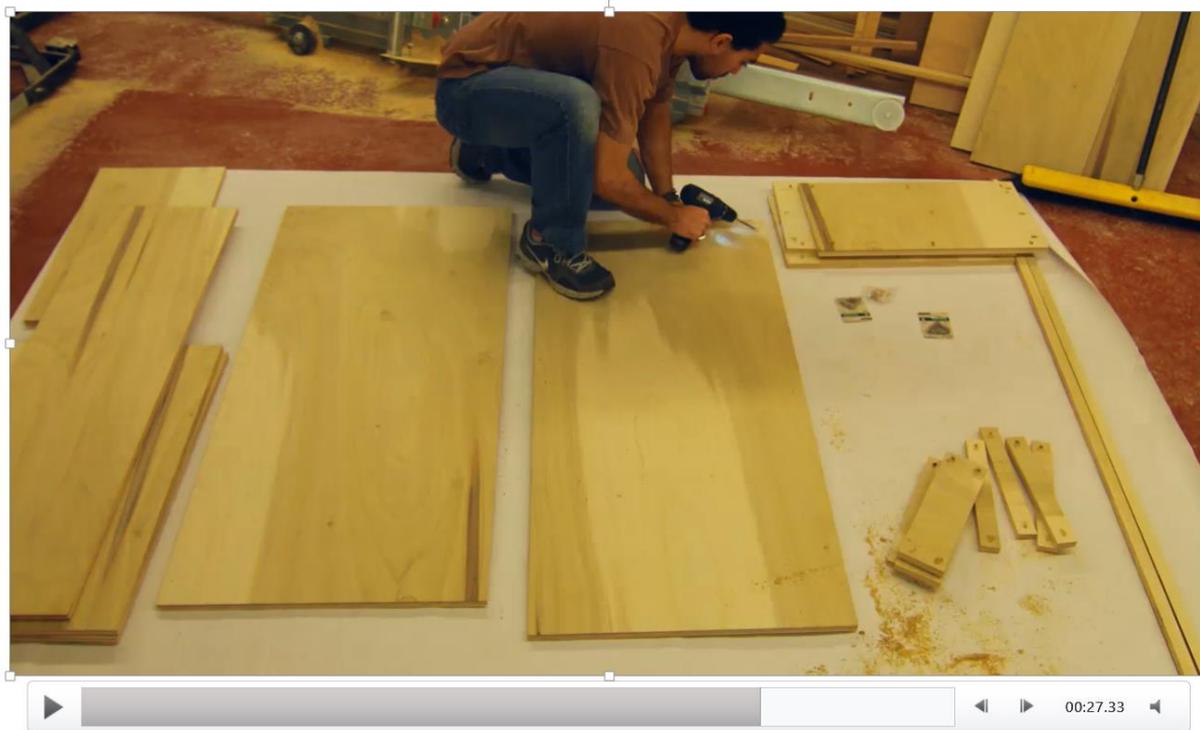


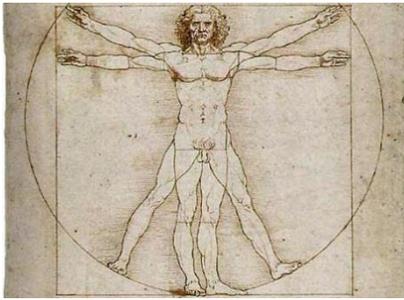
101 parts
(90 connectors)

Examples



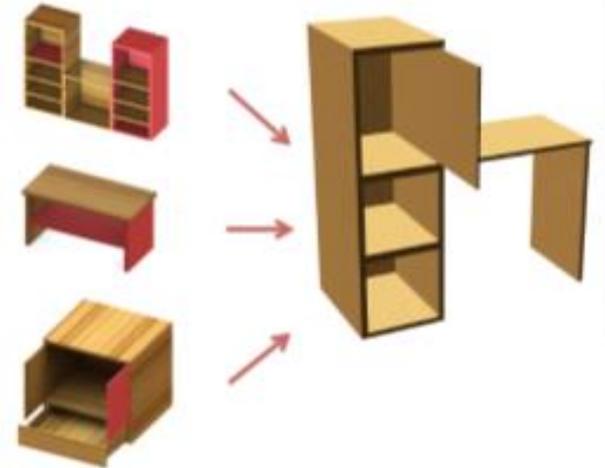
Example Modeling Session





Human

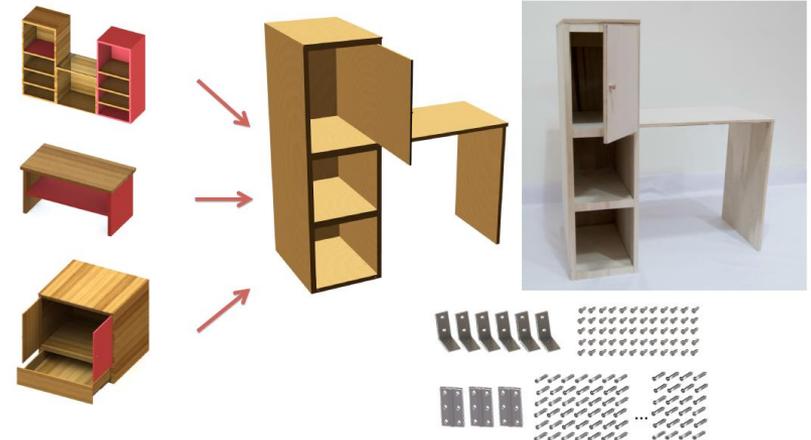
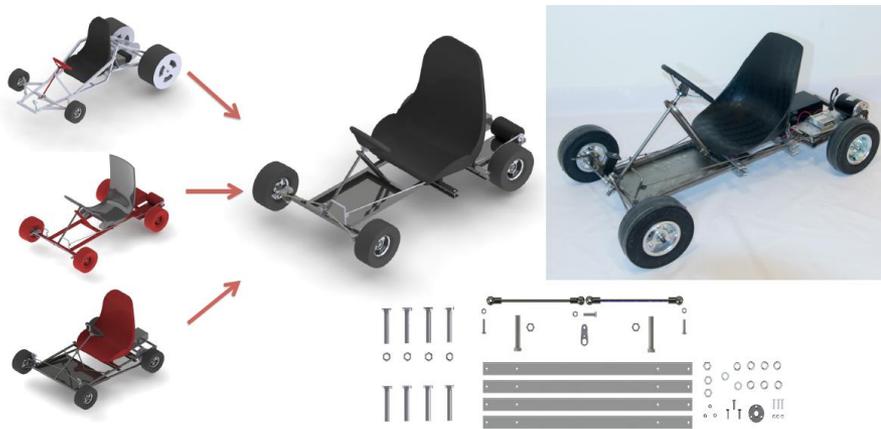
- Uses given parts
 - Defines composition
 - Changes parameters
-
- Allows exploration of different shapes
 - No need for tedious precise positioning
 - No need to define connectors





Computer

- Preserves relations and constraints
- Snaps parts to each other
- Copies and adds connectors



Boxelization

Convert this...



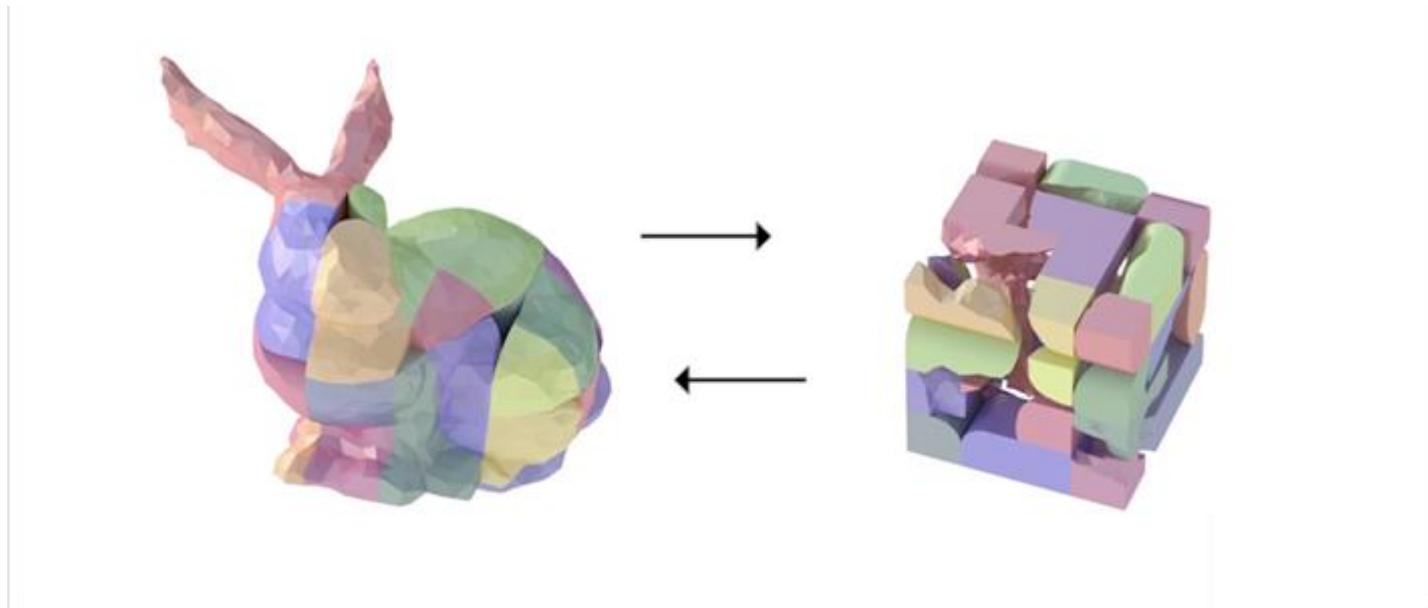
...to this



Boxelization

Convert this...

...to this

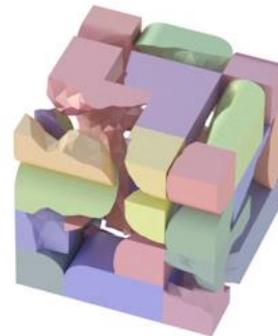


In One Piece...

Boxelization: transform



to and from this



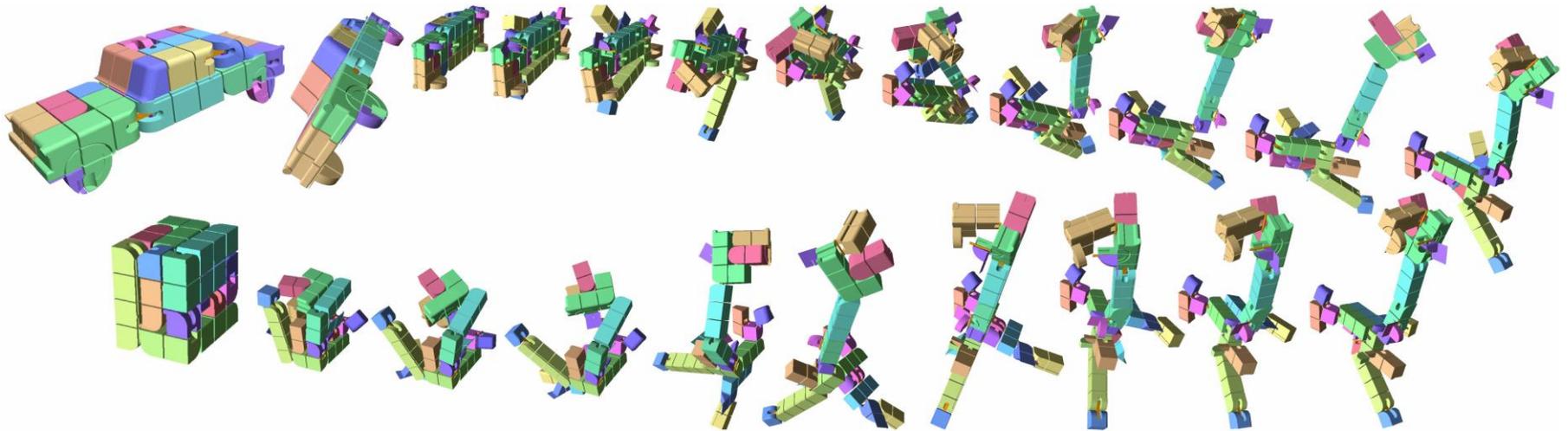
© Disney

...and Really Fabricate It



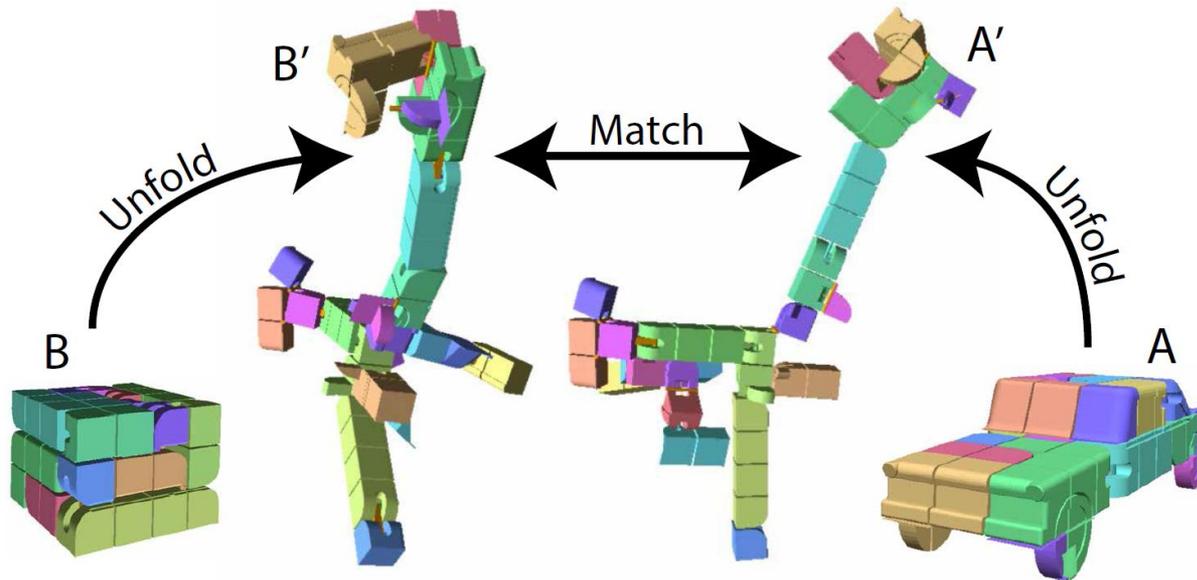
Challenges

- Finding the partitioning & configuration
- Finding a folding sequence (no intersection)



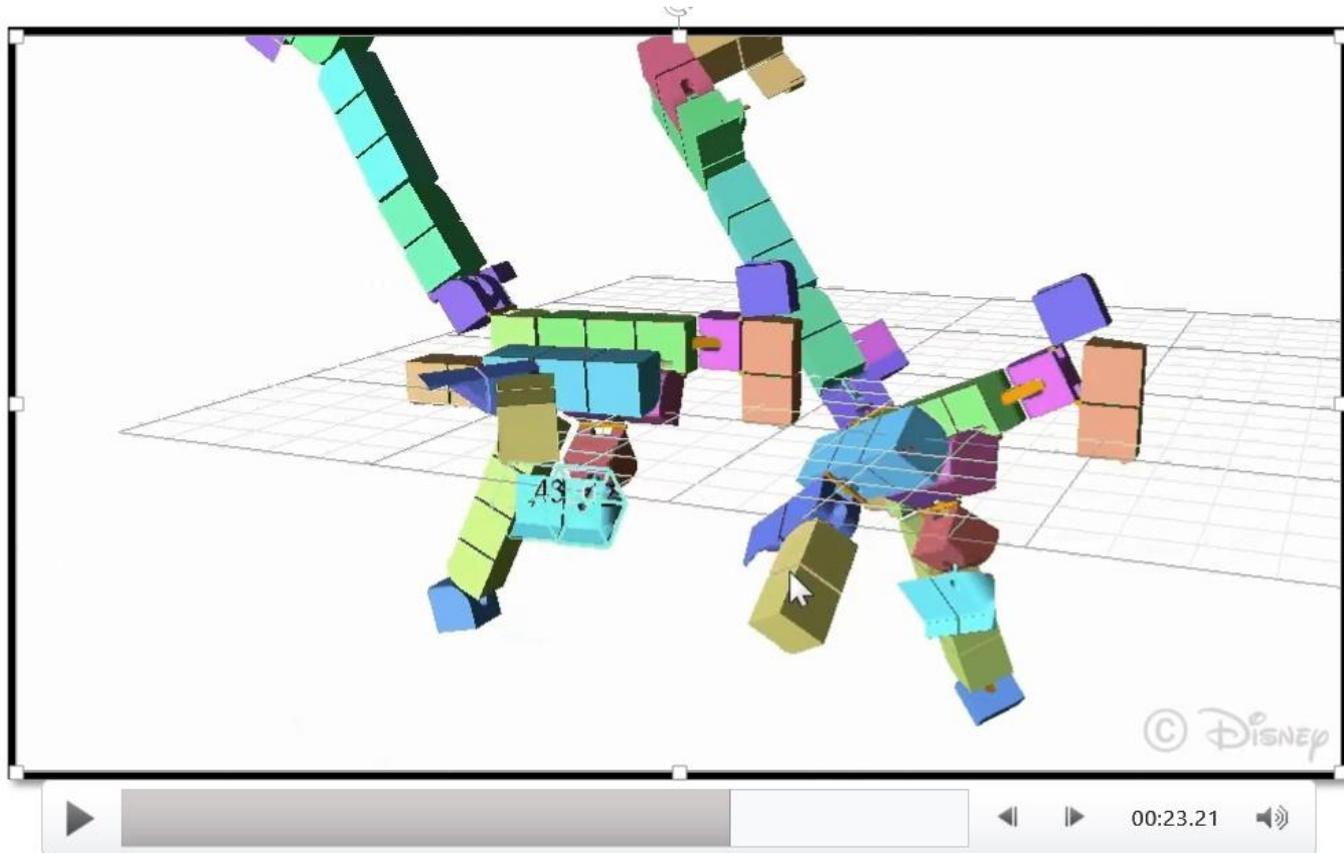
Key Insight

- Unfolding is much simpler than folding



- Still difficult for humans...
- We you use physics & interaction

Interactive Physics Unfolding



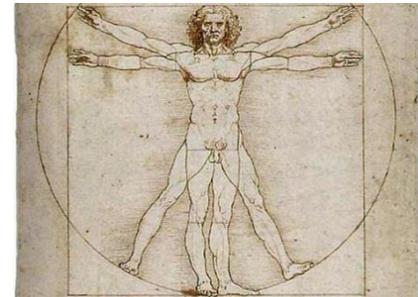
Computer

- Runs a physics simulation



Human

- Assists when it gets stuck & guides

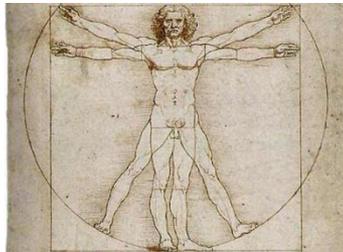


Example Folding



Summary

1. View the computer as a tool (HCI) and not as an independent entity (AI)
2. Make hard problems simpler using collaboration (sometimes it is all that is needed)
3. Each “participant” does what it is best at:

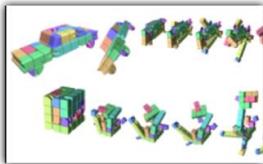


Human (semantics)

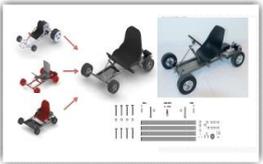


Machine (computation)

Papers & Colleagues:



Yahan Zhou · Shinjiro Sueda · Wojciech Matusik · Ariel Shamir
Boxelization: Folding 3D Objects Into Boxes
To appear: SIGGRAPH 2014



Adriana Shultz · Wojciech Matusik · David Levin · Pitchaya Sitthi-Amorn · Ariel Shamir
Design and Fabrication by Example
To appear: SIGGRAPH 2014



Tao Chen · Zhe Zhu · Ariel Shamir · Shi-Min Hu · Daniel Cohen-Or
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Sketch2Photo: Internet Image Montage
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Thank You

