

Prototyping Interactive Systems

DES 206

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Prototyping Methods

Software based



- **Faster**
 - Several real life combined in one
 - Saves time required for physical prototyping
 - Simulations, analysis, modifications etc. can be done quickly
- **Cheaper ***
 - Saves material costs, process costs
 - Human resource can be easily trained (as compared to hand modelling which is almost a form of art and requires expert skills)
- **Iterative**
 - Modifications can be done easily at any stage

* One time costs of software licenses are associated in case of paid tools



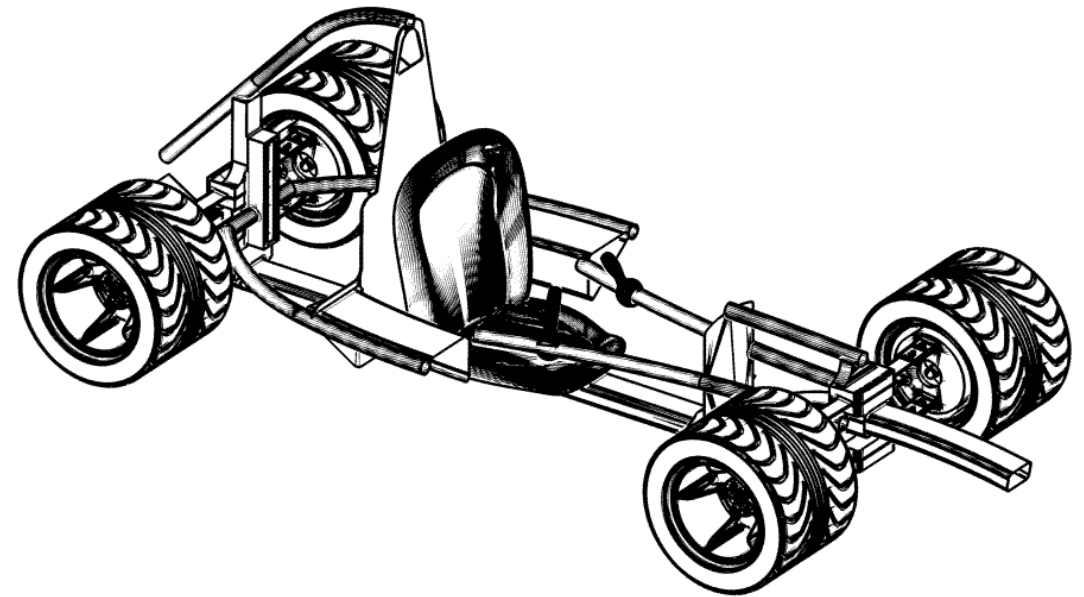
Computer Aided Design

Designing physical products in digital workspaces

CAD Benefits



- 2D and 3D visualization and design
- Enables exploration, development, modification and optimization of design
- Engineering, architecture, design
- Time and cost of physical prototyping saved
- Easy to learn
- Increased Productivity
- Allows easy sharing and collaborative work



- Patrick J. Hanratty
 - **PRONTO** – Program for Numerical Tooling and Operations in 1957
 - First **commercial CNC program**
- **Ivan Sutherland**
 - **SketchPad** – A Man-Machine Graphical Communication System in 1963
- Aerospace and Marine Design
- Architecture
- Industrial and Product Design



Uses / Applications



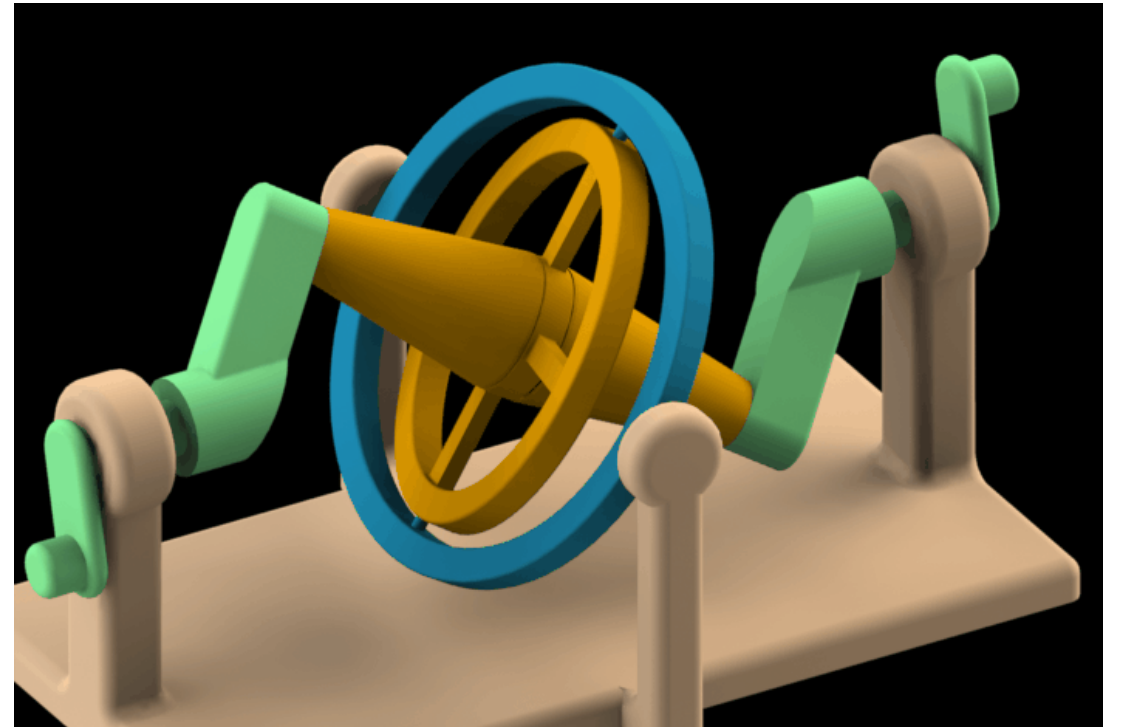
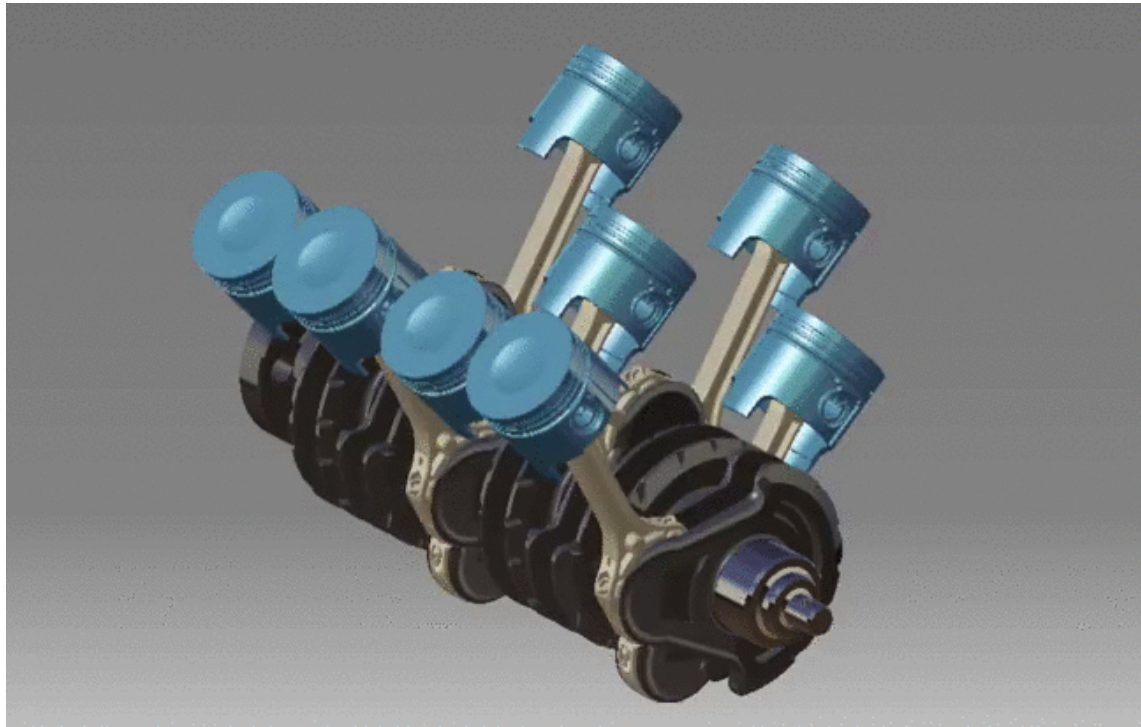
- Product Design – exploration and visualization



Uses / Applications



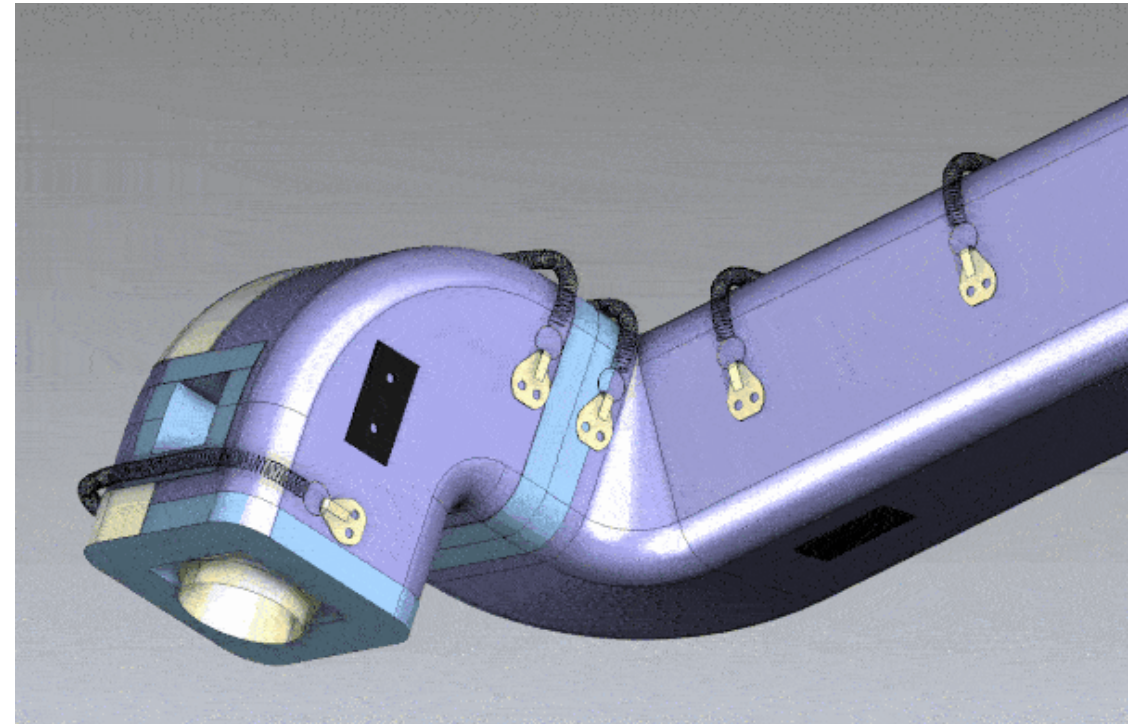
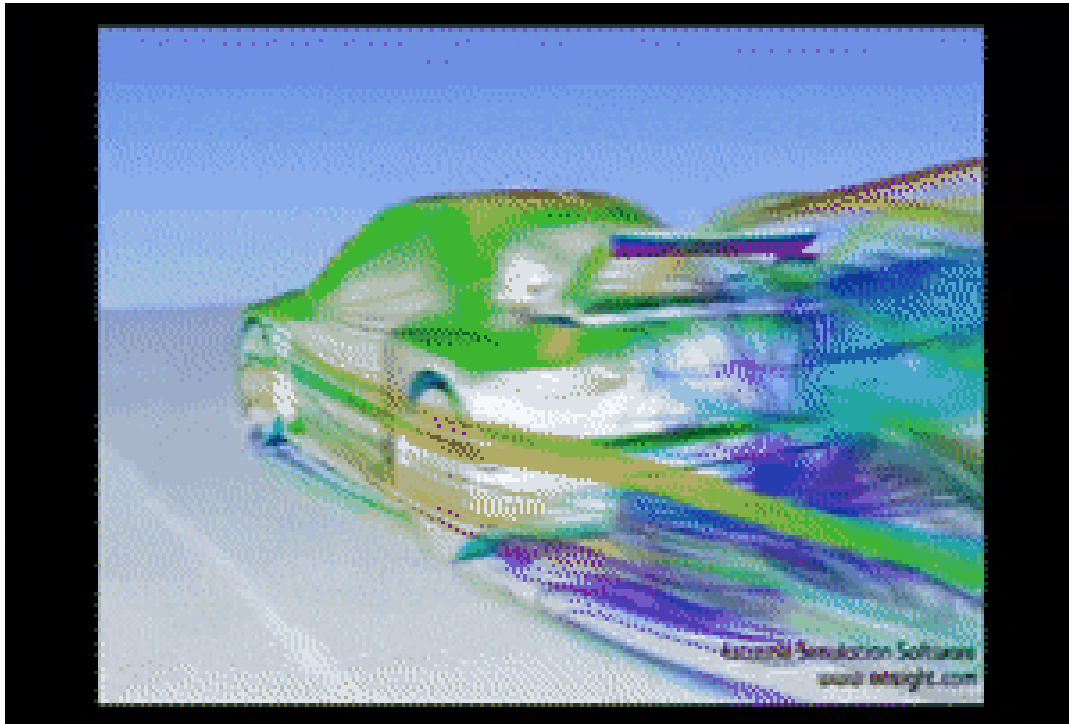
- Streamlining working mechanisms and movement



Uses / Applications



- Engineering Design – Analysis and optimization



Tools / Platforms



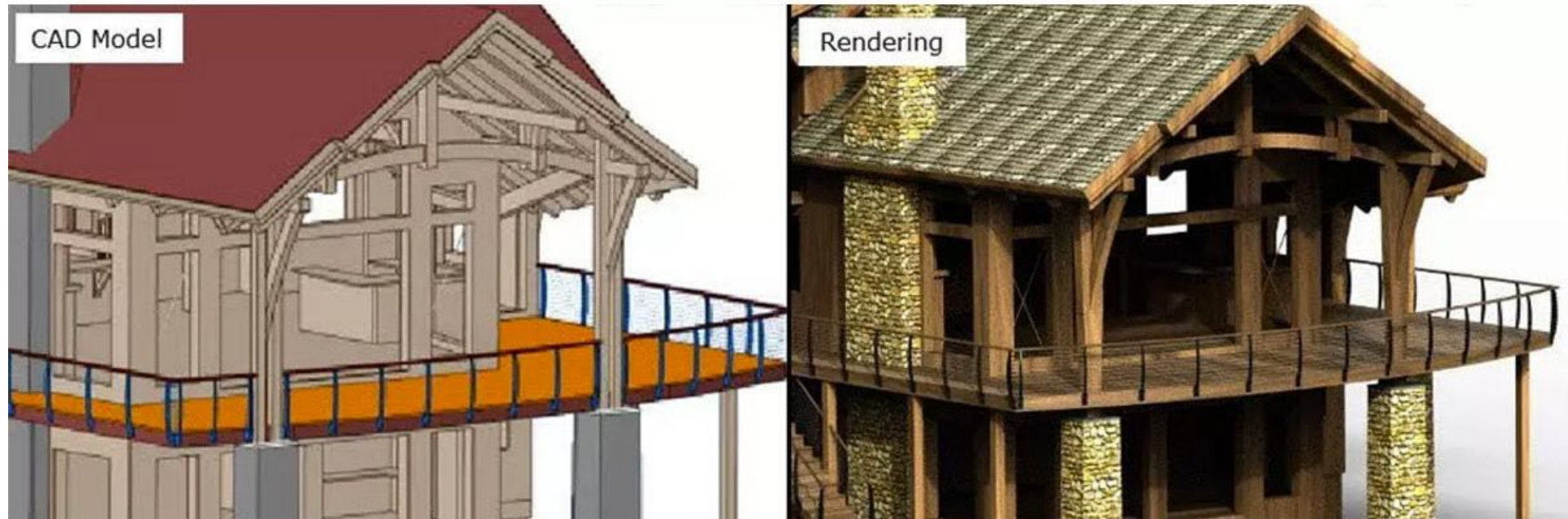
Tools / Platforms in this course



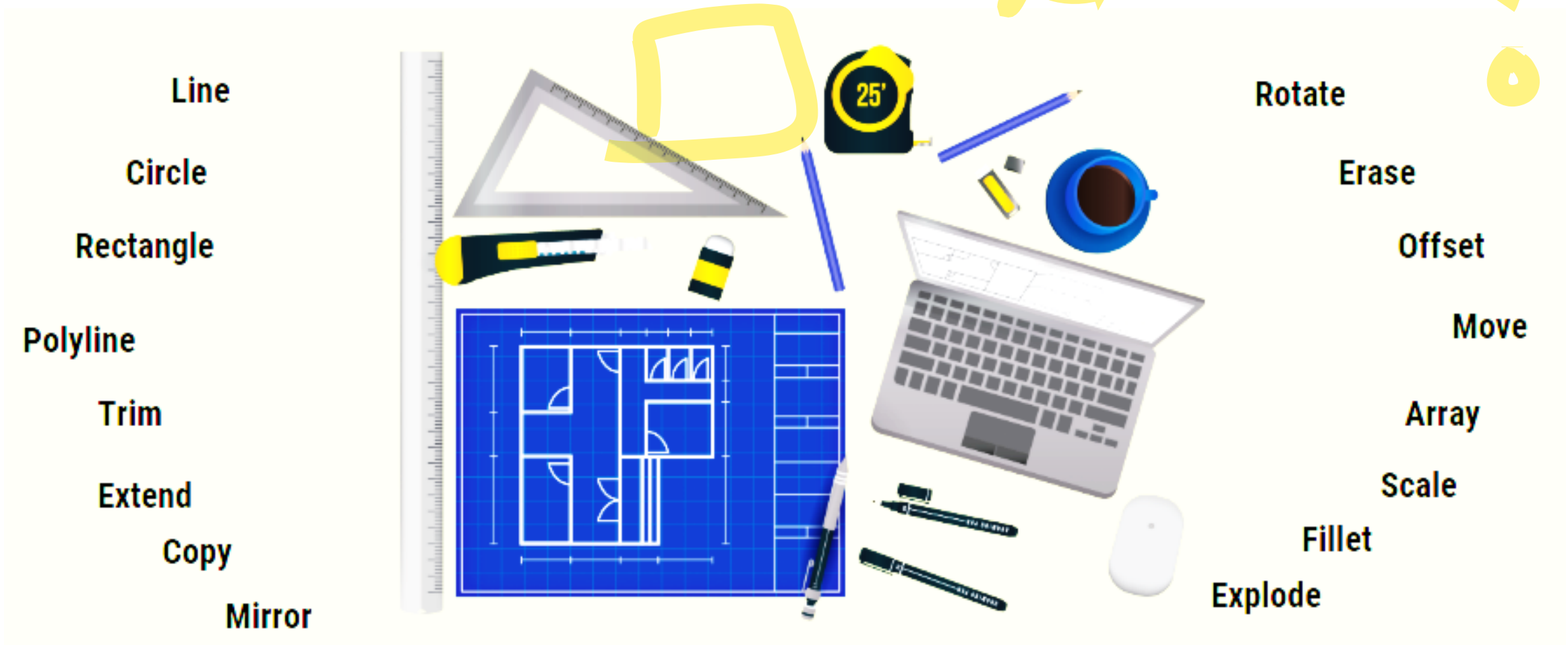
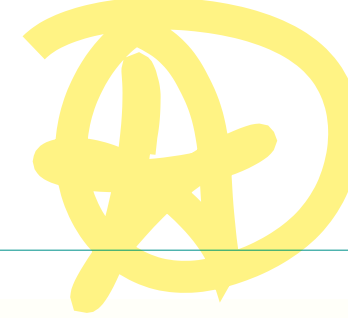
- Popular in animation, gaming and ARVR
- More free flowing
- High quality rendering possible



- Popular in product design and manufacturing
- More mathematical/parametric
- Analysis – structural, material, movement, surface etc. possible



Elements and Operations



Line

Circle

Rectangle

Polyline

Trim

Extend

Copy

Mirror

Rotate

Erase

Offset

Move

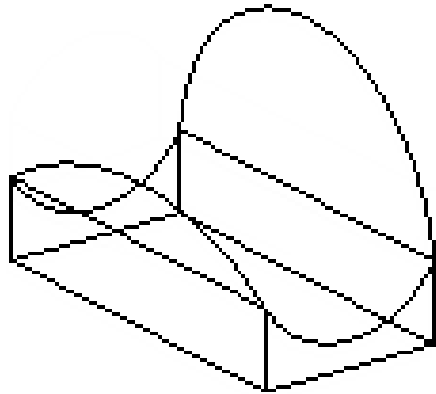
Array

Scale

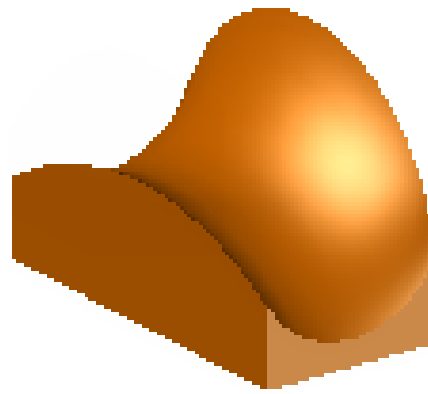
Fillet

Explode

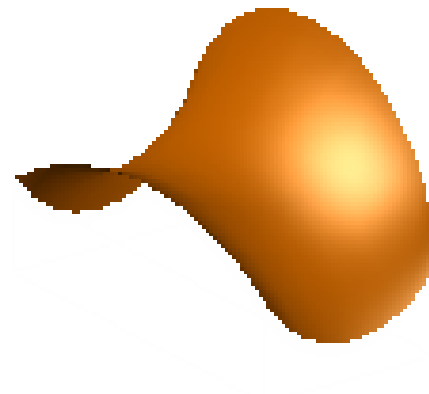
Types of CAD modelling



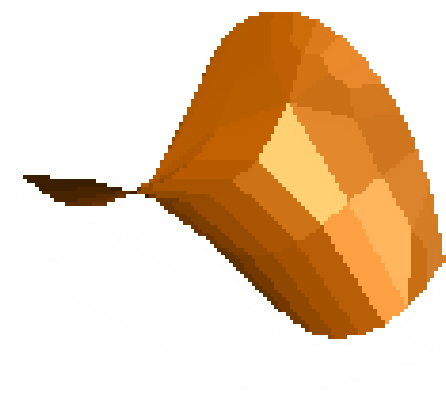
3D Wireframe



3D Solid

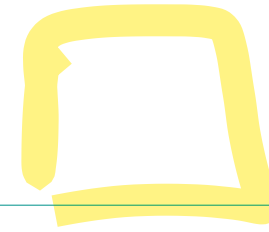


3D Surface

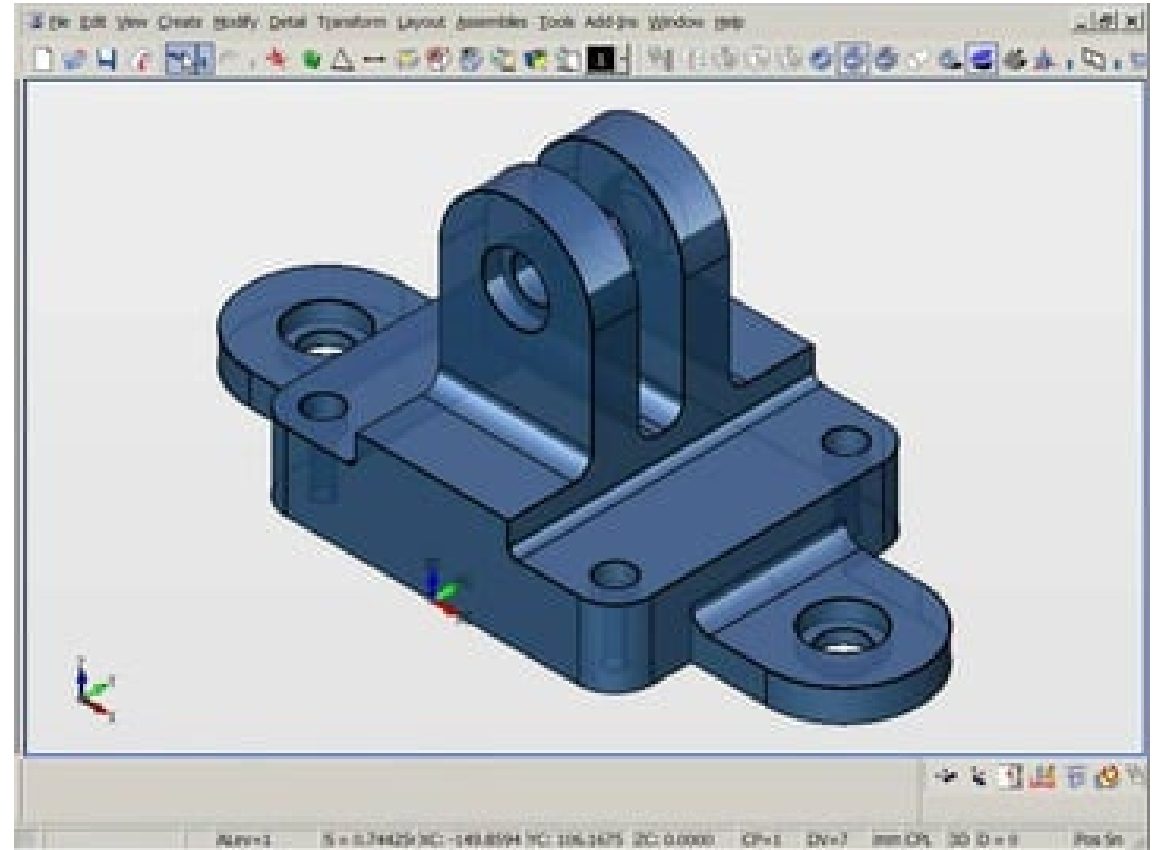


3D Mesh

Solid Modelling



- Works with three-dimensional primitive shapes
- The shapes may vary, but they act together like building blocks
- Some start with 2D sketches that are then extruded to produce a three-dimensional figure
- Some programs can use modifiers, working with the solids as if you were physically milling it in a workshop. Others add solid over solid in order to produce more complex figures.
- Entry-level - Tinkercad and FreeCAD
- Advanced - SketchUp, SolidWorks, and Fusion 360



Solid Modelling

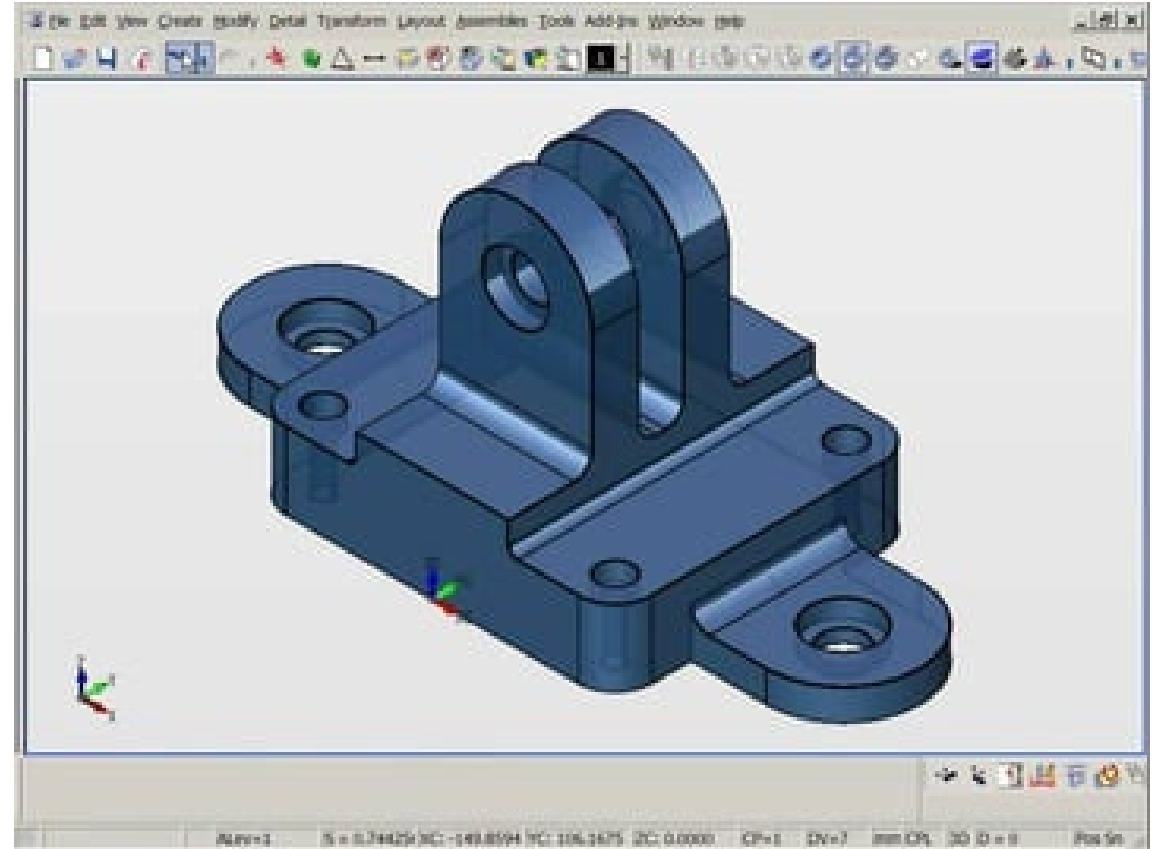


ADVANTAGES

- Tools are easy to understand and work with; the user doesn't require extensive training
- Computational requirements are lower since the computer isn't working with thousands of triangles
- The final pieces are always mathematically correct in the sense that the model is possible in the real world

DISADVANTAGES

- High realism in the representation of organic shapes is almost impossible to achieve



Wireframe Modelling



- Used in cases where the surface is complex and curved
- Wireframe modeling provides the finesse for more complex forms
- Many wireframe modeling tools use triangles as their basic elements, and the more triangles use, the higher the realism
- “polygon count”, the total number of triangles contained within the wireframe of a model
- Nowadays, it's not uncommon for shapes to reach millions of polygons!!
- Blender, Maya, and Daz 3D



Wireframe Modelling



ADVANTAGES

- It's possible to achieve more complex surfaces and curves compared to solid modeling

DISADVANTAGES

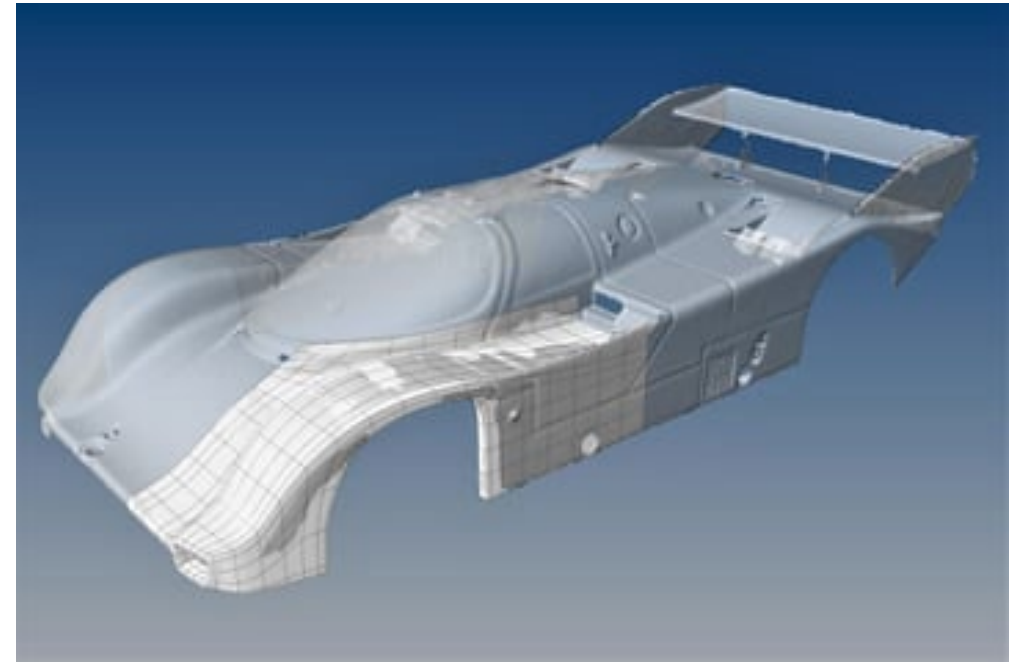
- Users require more training for developing complex organic forms
- High resolution will require millions of polygons and computational needs will be higher



Surface Modelling



- Highly professional applications demand smooth surfaces and seamless integration
- It relies on guiding lines to define the shape and curvature of a part. The software then calculates a smooth surface that connects the guiding lines
- Used in automotive, aerospace etc.
- Since the seamless integration of all elements is necessary, surface modeling is the best way to approach these challenges
- Most solid modelling tools can handle this type of modelling also e.g. Catia, FreeCAD, Inventor, and SolidWorks



Surface Modelling

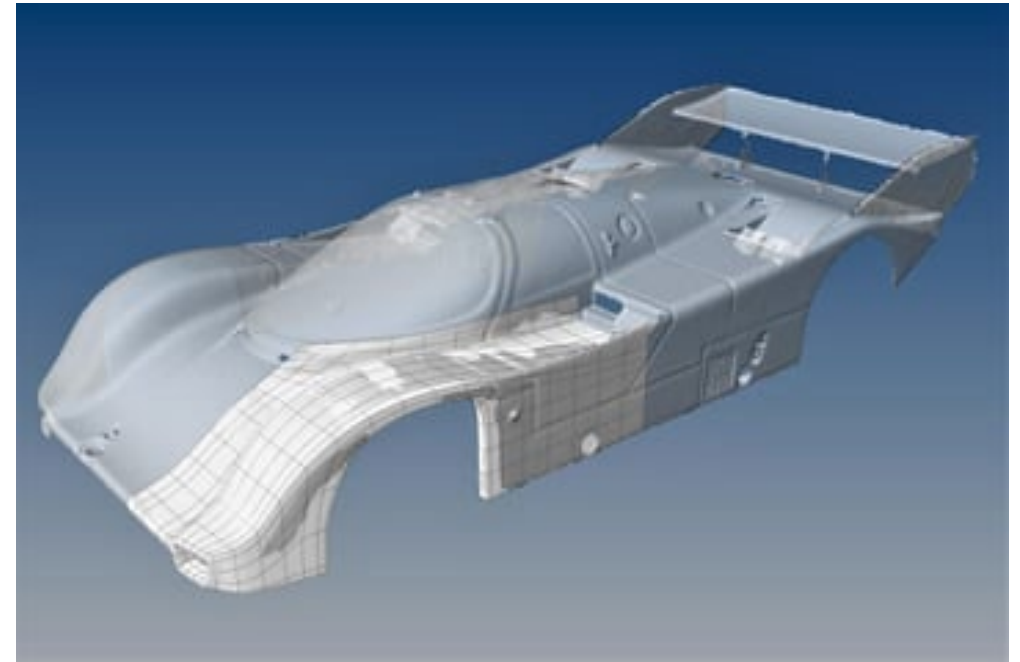


ADVANTAGES

- It's possible to produce complex surfaces
- Facilitates surface related analysis such as aerodynamic analysis in cars and aircrafts

DISADVANTAGES

- This technique is more complex and requires more advanced programs
- More advanced programs will demand far more training and experience from the designer



Elements and Operations

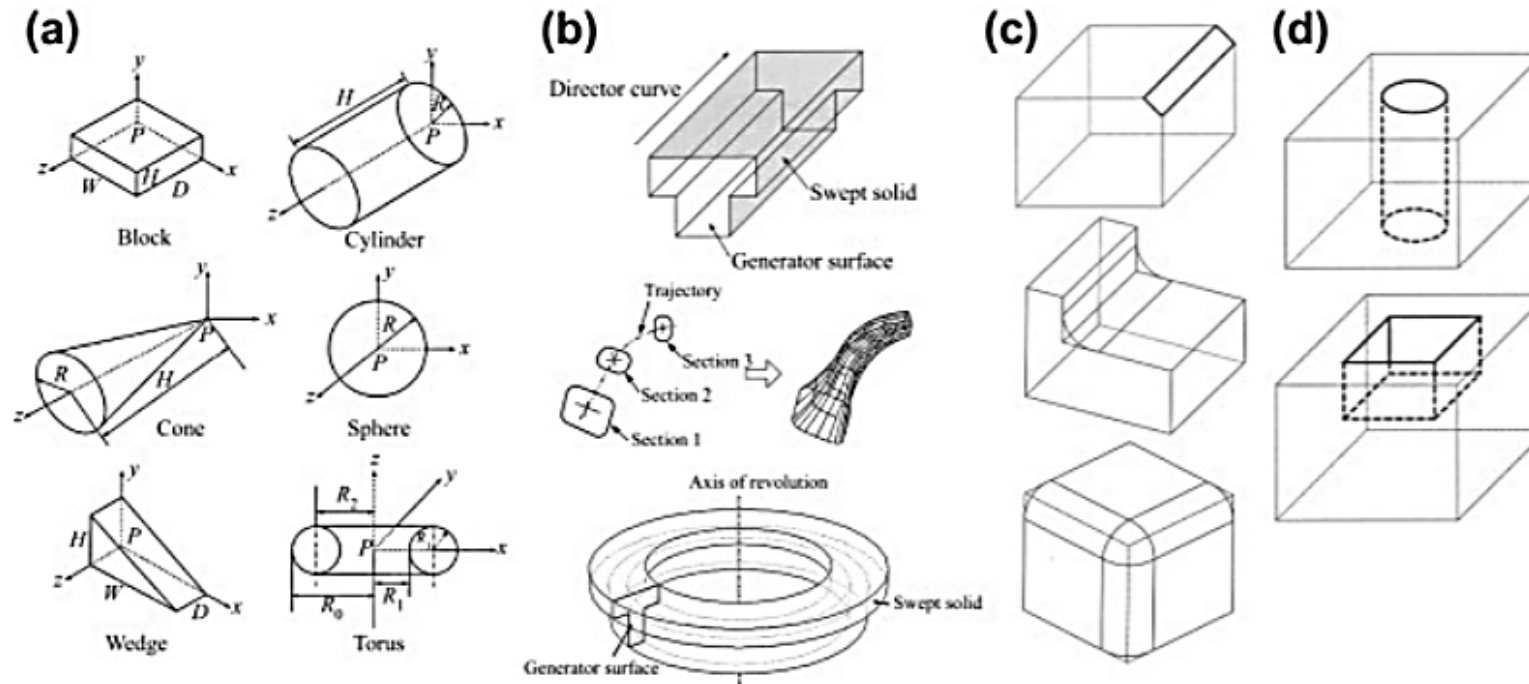


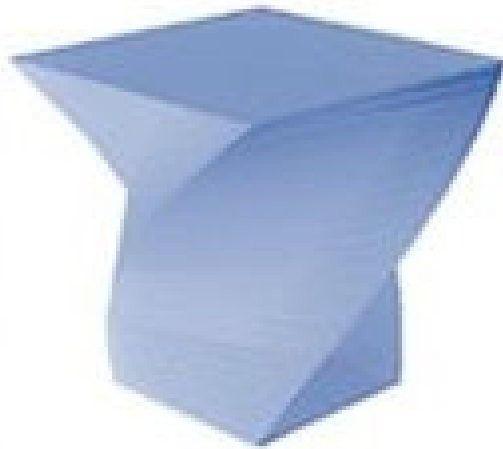
Figure 3.4. Solid model construction methods. (a) Primitives and Boolean operations. (b) Protrusion operations. (c) Pick-and-place. (d) Feature operations (Lee, 1999).

Simple solid modelling



(b)

3D Simple



Vase

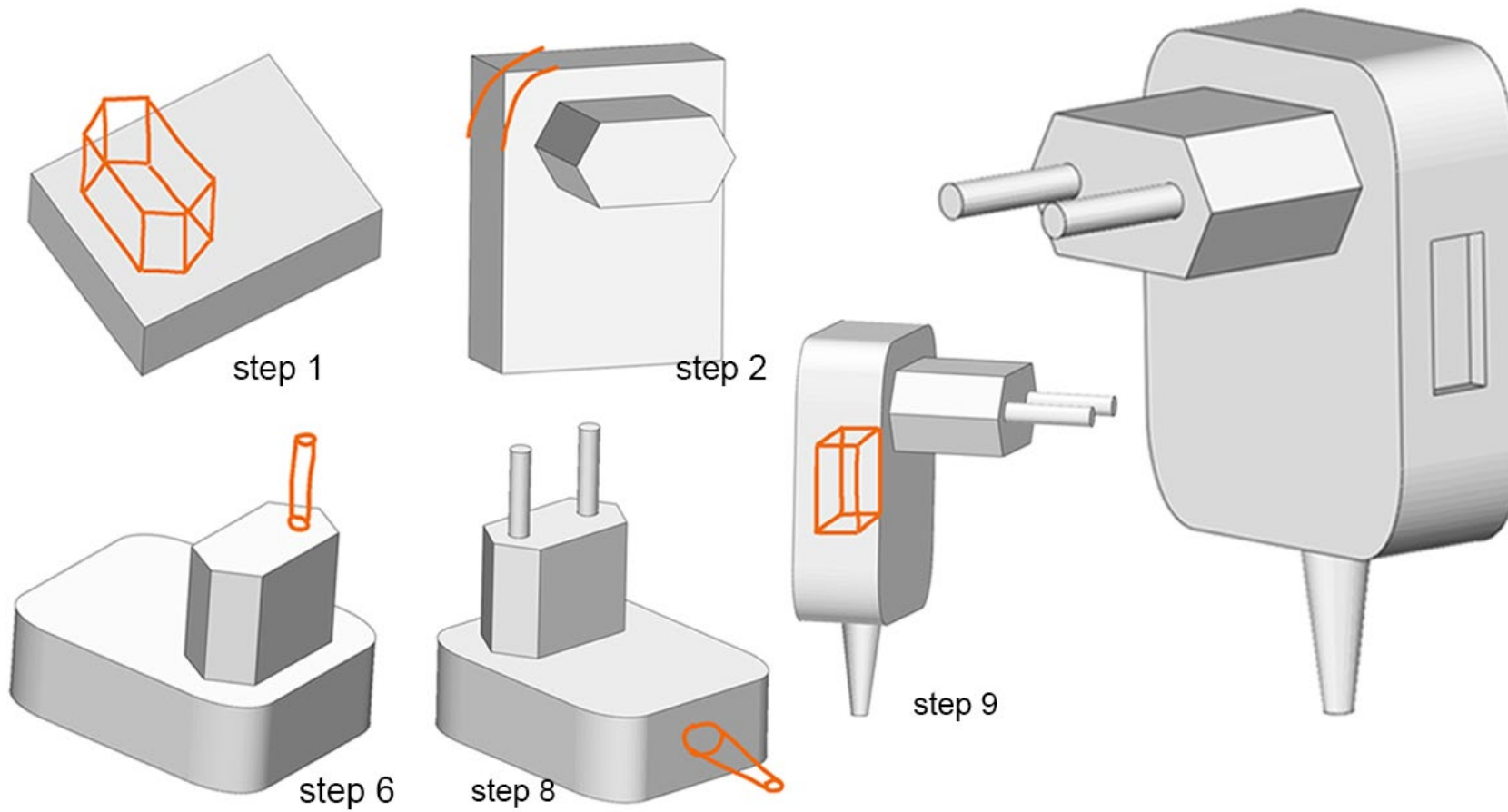


Tree



Hourglass

Lets try to make this adapter



Lets try to make this



Solid Modelling using Boolean

