

Automation (21-541)

*Advanced Manufacturing Laboratory
Department of Industrial Engineering
Sharif University of Technology*

Session # 8

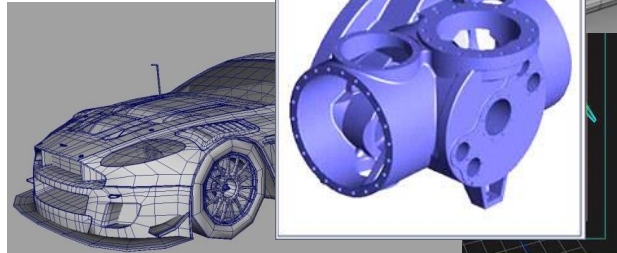


Session Schedule

- *Computer-Aided Design (CAD)*
 - *Geometric modeling*
 - *Geometric modeling techniques*
 - *Geometric data exchange*

Computer-Aided Design (CAD)

- **Geometric modeling :**
 - Computer representation of the geometry of a component using software is called a geometric model.
- Geometric modeling is done in three principal ways:
 - Wire frame modeling
 - Surface modeling
 - Solid modeling



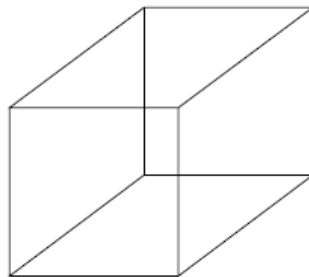
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Computer-Aided Design (CAD)

- **Geometric modeling :**
 - Wire frame modeling
 - In wire frame modeling the object is represented by its edges.
 - In the initial stages of CAD, wire frame models were in 2-D. Subsequently 3-D wire frame modeling software was introduced.



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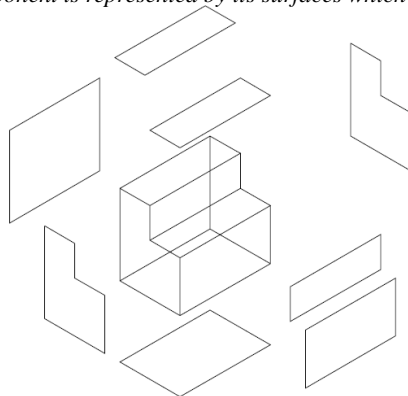
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Computer-Aided Design (CAD)

▪ Geometric modeling :

▪ Surface modeling

- In this approach, a component is represented by its surfaces which in turn are represented by their vertices and edges.



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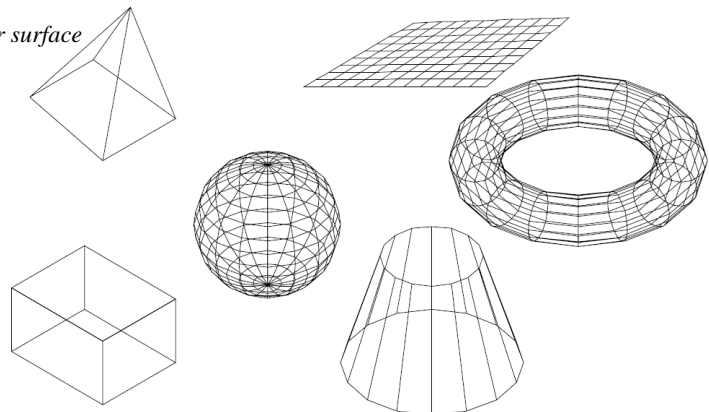
Computer-Aided Design (CAD)

▪ Geometric modeling :

▪ Surface modeling

- Standard surface types available for surface modeling:

- box,
- pyramid,
- wedge,
- dome,
- sphere,
- cone,
- torus,
- dish
- and mesh



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Homework : AT-G-04-#

- *Extend the simple program of HW2 for interpreting simple following objects. You should use your CIM data base structure to maintain the geometric data.*
 - *A simple interface can be applied to plot a cub and a sphere.*

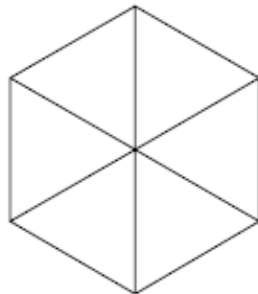
- *The HW should be sent to Evalilai@Sharif.edu till Monday, 15th of Ordibehesht (May, 6th, 2014)*
- *Email subject: "AT-G-04-#"*

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Computer-Aided Design (CAD)

- *Geometric modeling :*
 - *Solid modeling*
 - *The representation of solid models uses the fundamental idea that a physical object divides the 3-D Euclidean space into two regions, one exterior and one interior, separated by the boundary of the solid.*

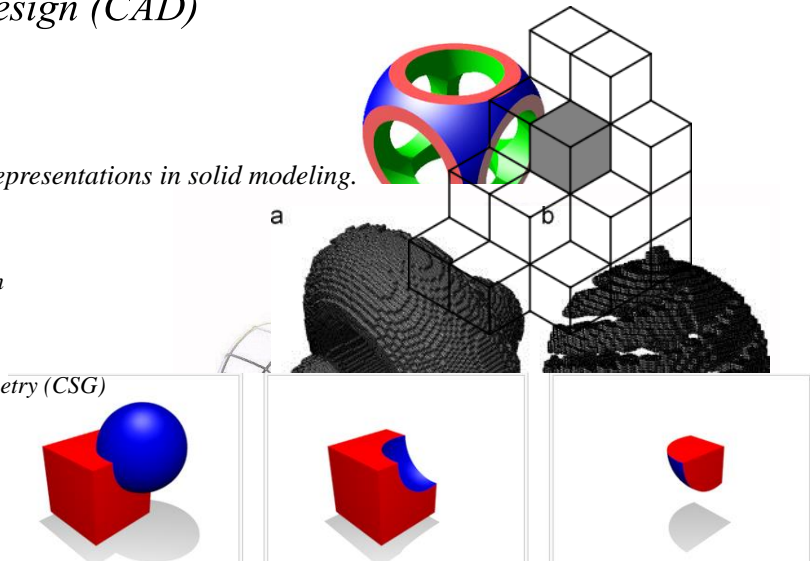


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Computer-Aided Design (CAD)

- **Geometric modeling :**
 - Solid modeling
 - There are six common representations in solid modeling.
 - Spatial Enumeration
 - Cell Decomposition
 - Boundary Representation
 - Sweep Methods
 - Primitive Instancing
 - Constructive Solid Geometry (CSG)

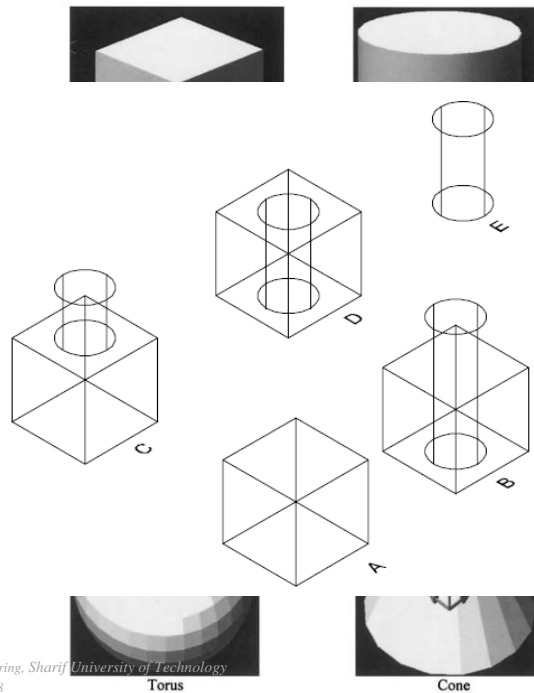


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Computer-Aided Design (CAD)

- **Geometric modeling :**
 - Solid modeling
 - Constructive Solid Geometry (CSG)
 - In a CSG model, physical objects are created by combining basic elementary shapes known as primitives like blocks, cylinders, cones, pyramids and spheres.
 - The Boolean operations like union (\cup), difference ($-$) and intersection \cap are used to carry out this task.



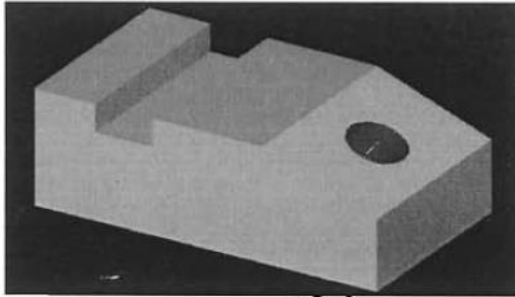
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Torus

Cone

Homework:

- Consider the following solid model. Use the CSG method and draw the CSG tree model based on the CSG primitive objects and operators.



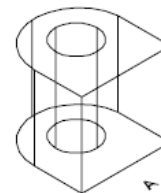
- The HW should be sent to FValilai@sharif.edu till Saturday, 20th of Ordibehesht (May, 10th, 2014)
- Email subject: "AT-I-**-StudentNumber"

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Computer-Aided Design (CAD)

- Geometric modeling :
 - Solid modeling
 - Boundary Representation (B-rep)
 - Boundary representation is built on the concept that a physical object is enclosed by a set of faces which themselves are closed and oriented surfaces.
 - Geometric entities -- Topological entities
 - Point -- Vertex
 - Curve, line -- Edge
 - Surface -- Face



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Computer-Aided Design (CAD)

- *Geometric modeling :*
 - *Solid modeling*
 - *Solid models differ from wire frame and surface models in the kind of geometric information they provide.*
 - *Wire frame models only show the edge geometry of an object. They say nothing about what is inside an object.*
 - *Surface models provide surface information, but they too lack information about an object's internal structure. Solid models provide complete geometric descriptions of objects.*

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Computer-Aided Design (CAD)

- *Geometric modeling :*
 - *Solid modeling*
 - *Solid models can be used for quick and reliable design analysis.*
 - *Solid models apart from geometric information provide important data such as volume, mass, mass properties and center of gravity.*
 - *The designer can also export models created to other applications like*
 - *finite element analysis (FEA),*
 - *Rapid prototyping and other special engineering applications*

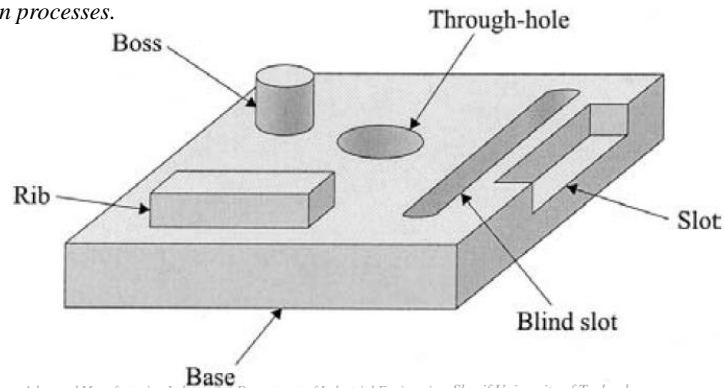
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Computer-Aided Design (CAD)

- *Geometric modeling :*

- *Feature-Based Design*

- *Features can be seen as specific geometric shapes on a part that can be associated with certain fabrication processes.*



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Computer-Aided Design (CAD)

- *Geometric modeling :*

- *Feature-Based Design*

- *Features have been commonly classified as*

- *Form,*
 - *Material,*
 - *Precision,*
 - *and technological features.*

- *It has been long advocated that if these features were highlighted during the modeling phase of a product's design process, in the subsequent*

production-planning phases, engineers could take advantage of this information in accessing historical data regarding the production of these features.

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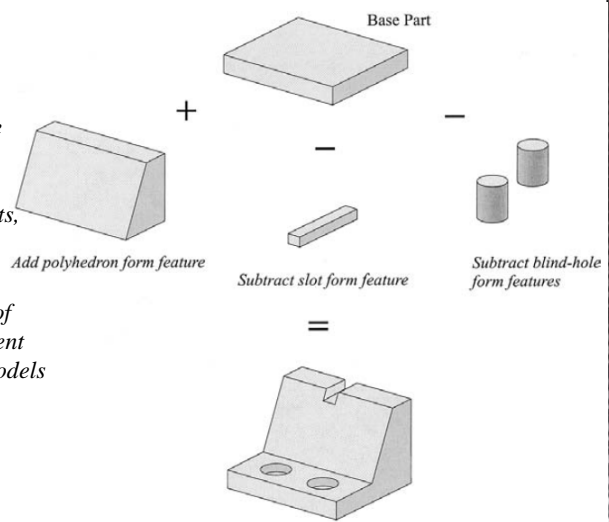
Computer-Aided Design (CAD)

- **Geometric modeling :**
 - **Feature-Based Design**
 - *The objective of design by features is :*
 - *To increase the efficiency of the designer during the geometric-modeling phase*
 - *To provide a bridge (mapping) to engineering-analysis and process-planning phases of product development.*

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Computer-Aided Design (CAD)

- **Geometric modeling :**
 - **Feature-Based Design**
 - *In feature-based design, parts' solid models are configured through a sequence of form-feature attachments (subtractions and additions) to the primary (base stock) representations of the parts, which can be as simple as a rectangular box.*
 - *These features could be chosen from a library of predefined (and sometimes application dependent) features or could be extracted from the solid models of earlier designs.*



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