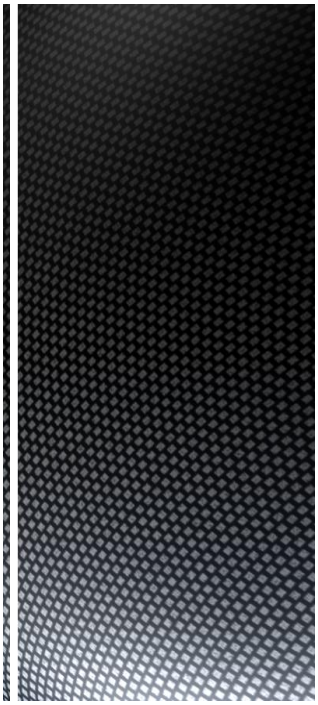


CAD/CAM (21-342)

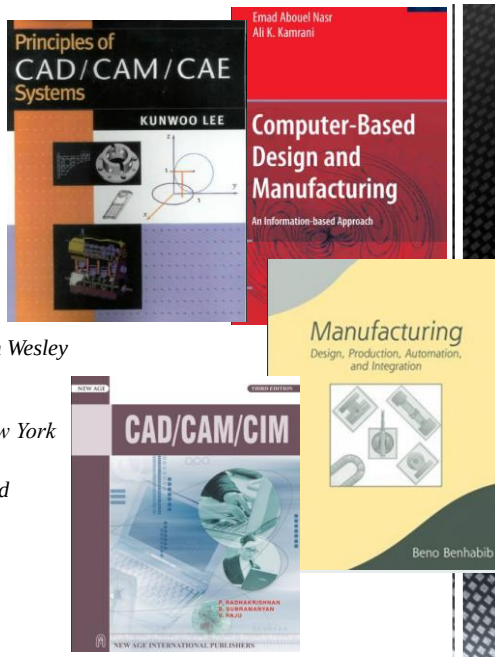
Advanced Manufacturing Laboratory
Department of Industrial Engineering
Sharif University of Technology

Session # 18

Course Description

- *Instructor*
  - *Omid Fatahi Valilai, Ph.D. Industrial Engineering Department, Sharif University of Technology*
  - *Email: FValilai@sharif.edu , Tel: 6616-5706*
  - *Website: Sharif.edu/~fvalilai*
- *Class time*
  - *Saturday- Monday* *10:30-12:00*
- *Course evaluation*
  - *Mid-term* *(25%)*
  - *Final exam* *(40%)*
  - *Quiz* *(5%)*
  - *Exercise* *(30%)*

Course Description *(Continued ...)*



- *Mid-term session:*
  - *Monday: 8th Ordibehesht 1393, 10:30 ~ 12:30*
- *Final Exam:*
  - *Saturday: 24th Khordad 1393, 15:00 ~ 17:30*
- *Reference:*
  - *Lee, Kunwoo; "Principles of CAD/CAM/CAE systems", 1999, Addsion Wesley*
  - *Abouel Nasr, Emad; Kamrani, Ali K.; "Computer-Based Design and Manufacturing: An Information-Based Approach", 2007, Springer, New York*
  - *Benhabib, Beno; "Manufacturing: Design, Production, CAD/CAM, and Integration", 2003, Marcel Dekker Inc, New York*
  - *Radhakrishnan, P.; Subramanian, S.; Raju, V.; "CAD/CAM/CIM", 3rd edition, 2005, New age international (P) limited publishers, New York*

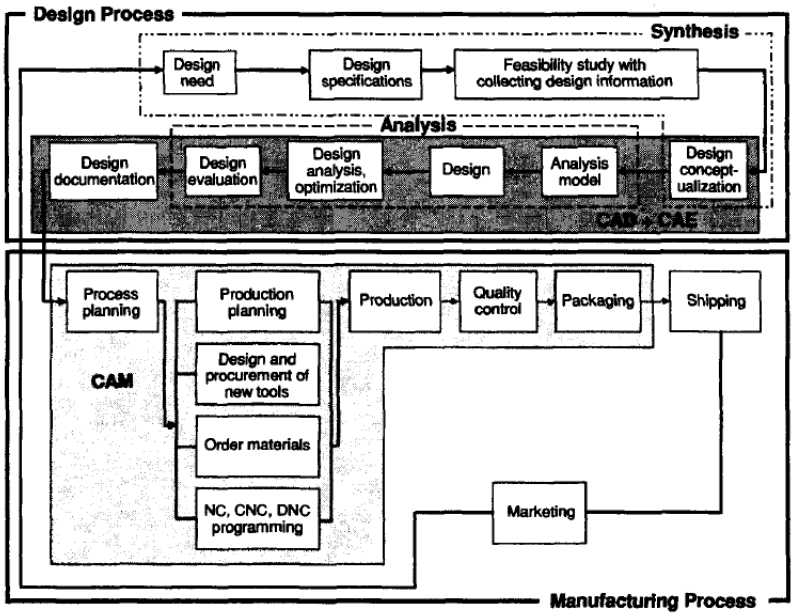
Course Description *(Continued..)*

- *Contents:*
  - *Introduction to CAD/CAM/CAE systems* *(5 sessions)*
  - *Components of CAD/CAM/CAE systems* *(2 sessions)*
  - *Geometric modeling systems* *(3 sessions)*
  - *Optimization in CAD* *(5 sessions)*
  - *Rapid prototyping and manufacturing* *(3 sessions)*
  - *Virtual engineering* *(2 sessions)*
  - *Product Life Cycle Cost Model* *(2 sessions)*
  - *Computer-Based Design and Features/Methodologies of Feature Representations* *(5 sessions)*
  - *Feature-Based Process Planning and Techniques* *(3 sessions)*
  - *Collaborative Engineering* *(2 sessions)*

Course Description *(Continued..)*

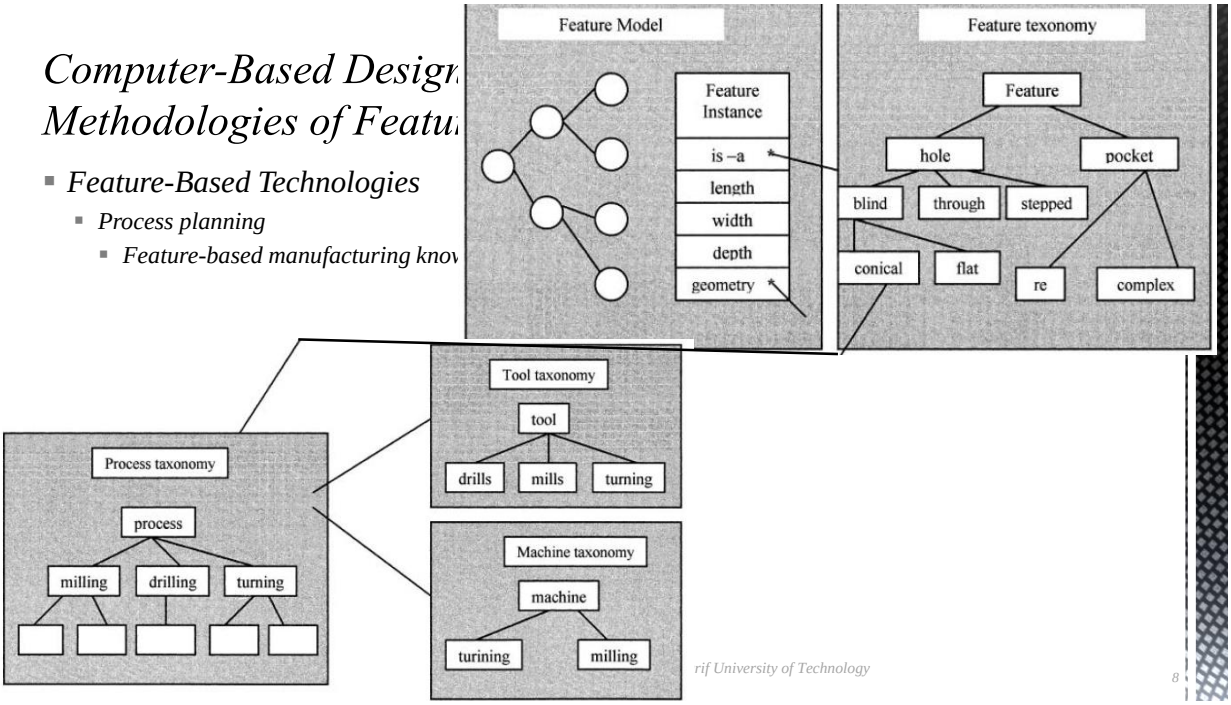
- *Contents:*
  - *Computer-Based Design and Features/Methodologies of Feature Representations* *(5 sessions)*
    - *Feature-Based Technologies*
    - *The New Methodology Objectives*
    - *Variant Process Planning (VPP)*
    - *Generative Process Planning (GPP)*
    - *Assembly Planning*

Introduction to CAD/CAM/CAE systems



Computer-Based Desig
Methodologies of Featu

- *Feature-Based Technologies*
  - *Process planning*
    - *Feature-based manufacturing knov*



Computer-Based Design and Features Methodologies of Feature Representations

- *Feature-Based Technologies*
  - *Process planning*
    - *Generative Process Planning*
      - *In the generative process planning (GPP) approach, the planning system seeks to synthesize the process plan directly*
      - *For machine-designed objects, the distinctive approach is to perform the planning on the basis of a feature by feature methodology by retrieving candidate processes from*

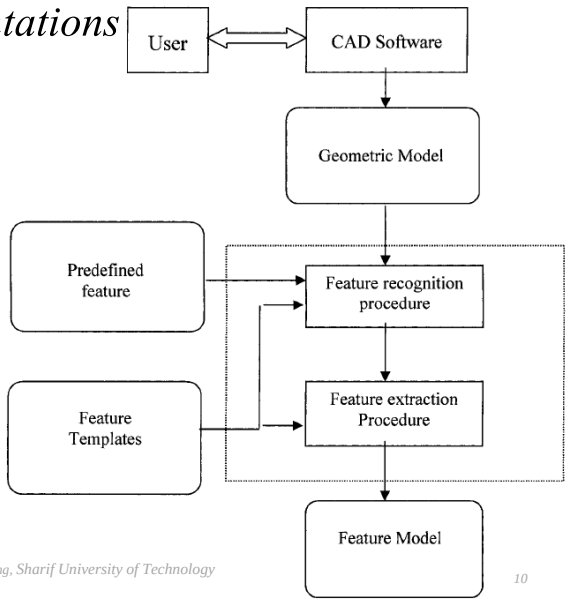
the manufacturing knowledge repository,

selecting the practical processes on the basis of geometric and manufacturing information of the designed objects,

and merging the selected processes in a proper sequence.

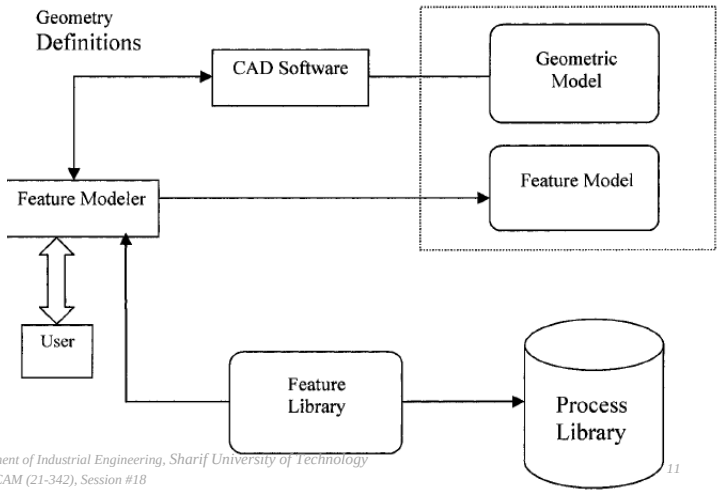
Computer-Based Design and Features Methodologies of Feature Representations

- *Feature-Based Technologies*
  - *Feature recognition*
    - *Feature recognition involves the identification and grouping of feature entities from a geometric model.*



Computer-Based Design and Features Methodologies of Feature Representations

- *Feature-Based Technologies*
  - *Feature recognition*
    - *Design by features, or the so-called feature-based design (FBD), uses a library of 2D or 3D features as design primitives on the product modeling level.*
    - *Features allow the capability of providing additional information useful for process planning.*
    - *Since features reflect specific manufacturing processes, they assure the parts can be produced*



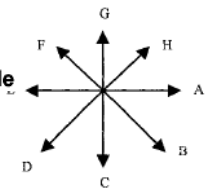
Computer-Based Design and Features Methodologies of Feature Representations

- *Feature-Based Technologies*
  - *Feature Recognition Techniques*
  - *The feature recognition algorithms can be classified by their approaches to the problems as follows:*
    - *1. The syntactic pattern recognition approach*
    - *2. Logic-based approach*
    - *3. Graph-based approach*
    - *4. Expert system/artificial intelligence approach*
    - *5. Volume decomposition and composition approach*
    - *6. 3D feature recognition from 2D features approach*

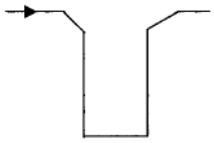
Computer-Based Design and Features Methodologies of Feature Representations

- *Feature-Based Technologies*
  - *Feature Recognition Techniques*
  - *The feature recognition algorithms can be classified by their approaches to the problems as follows:*
    - *1. The syntactic pattern recognition approach*
      - *The syntactic pattern recognition approach uses the semantic primitives for part analysis.*
      - *The main components of the syntactic pattern recognition method are an input string, a pattern grammar, and a parser.*

IF **the input sting is ABCAGHA**
THEN **the feature is a countersink hole**



A. Pattern primitives



B. Countersink hole

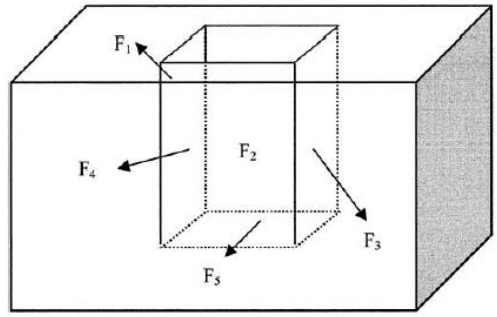
ABCAGHA

C. Input string

Computer-Based Design and Features Methodologies of Feature Representations

- *Feature-Based Technologies*
  - *Feature Recognition Techniques*
  - *The feature recognition algorithms can be classified by their approaches to the problems as follows:*
    - *2. Logic-based approach*
      - *The logic rules are used with the B-rep representation modeling and the CSG representation modeling approaches for feature recognition.*
      - *Each feature can be recognized by a separate rule.*

IF face F_1 is adjacent to face F_2 and
face F_2 is adjacent to face F_3 and
face F_3 is adjacent to face F_4 and
face F_5 is adjacent to faces F_1 F_2 F_3 F_4 and
angle between F_1 and F_2 is < 180 (concave),
and
angle between F_3 and F_4 is < 180 (concave)
THEN faces F_1, F_2, F_3, F_4, and F_5 form a pocket feature



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Computer-Based Design and Features Methodologies of Feature Representations

- *Feature-Based Technologies*
  - *Feature Recognition Techniques*
  - *The feature recognition algorithms can be classified by their approaches to the problems as follows:*
    - *2. Logic-based approach*
      - *The logic rules are used with the B-rep representation modeling and the CSG representation modeling approaches for feature recognition.*
      - *Each feature can be recognized by a separate rule.*

IF the Boolean operation is Subtraction,
and the dimensions of the subtracted solid primitive are less than the solid model
and the subtracted solid primitive is a cylinder
THEN the feature is a hole

Computer-Based Design and Features Methodologies of Feature Representations

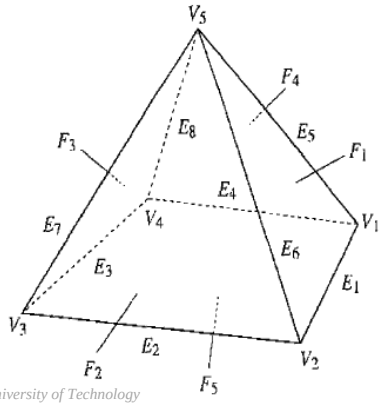
- *Feature-Based Technologies*
  - *Feature Recognition Techniques*
  - *The feature recognition algorithms can be classified by their approaches to the problems as follows:*
    - *3. Graph-based approach*

Vertices	
	V1
Neighbor Vertices	V2, V5, V4
Intersecting Edges	E1, E4, E5
Intersecting faces	F1, F4, F5

Edges	
	E1
Neighbor Edges	E2, E4, E5, E6
Boundary Vertices	V1, V2
Intersecting Faces	F1, F5

Faces	
	F1
Boundary Edges	E1, E4, E5
Boundary Vertices	V1, V2, V5
Neighbor faces	F2, F3, F4, F5

Figure 5-4. Representation of vertices, edges, and faces



	F_1	F_2	F_3	F4	F_5
F_1	0	1	1	1	1
F_2	1	0	1	1	1
F_3	1	1	0	1	1
F_4	1	1	1	0	1
F_5	1	1	1	1	0