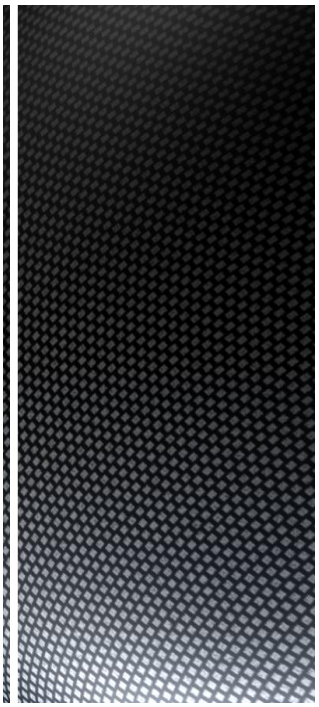
Automation (21-541)

Advanced Manufacturing Laboratory
Department of Industrial Engineering
Sharif University of Technology

Session # 10



Session Schedule

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

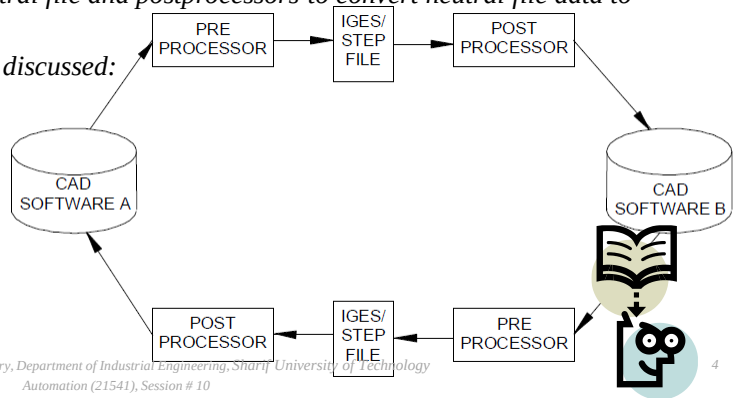
Computer-Aided Design (CAD)

- *Geometric data exchange*
  - *The heart of any CAD model is the component database.*

  This includes
  - *The graphics entities like points, lines, arcs, circles etc. and the co-ordinate points, which define the location of these entities.*
  - *This geometric data is used in all downstream applications of CAD, which include*
    - *Finite element modeling and analysis,*
    - *Process planning,*
    - *Estimation,*
    - *CNC programming,*
    - *Robot programming,*
    - *Programming of co-ordinate measuring machines,*
    - *ERP system programming and simulation.*

Computer-Aided Design (CAD)

- *Geometric data exchange*
  - *A solution to the problem of direct translators is to use neutral files.*
  - *These neutral files will have standard formats and software packages can have pre-processors to convert drawing data to neutral file and postprocessors to convert neutral file data to drawing file.*
  - *Three types of neutral files are discussed:*
    - *Drawing exchange files (DXF)*
    - *IGES files*
    - *STEP files*



Computer-Aided Design (CAD)

- *Geometric data exchange*
  - *Drawing exchange files/formats (DXF)*

  is a CAD data file format developed by Autodesk for enabling data interoperability between AutoCAD and other programs.

  - *The basic organization of a DXF file is as follows:*
    - *HEADER section*
    - *CLASSES section*
    - *TABLES section*
    - *BLOCK section*
    - *ENTITIES section*
    - *OBJECTS section*
    - *THUMBNAILIMAGE section*
    - *END OF FILE*

```
0
SECTION
2
HEADER
9
.
.
.
.
AcDbEntity
8
0
100
AcDbLine
10
.
.
.
.
LINE
5
12D
.
.
.
.
ENDSEC
0
EOF
```

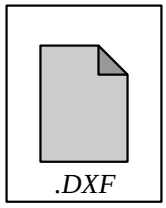
Computer-Aided Design (CAD)

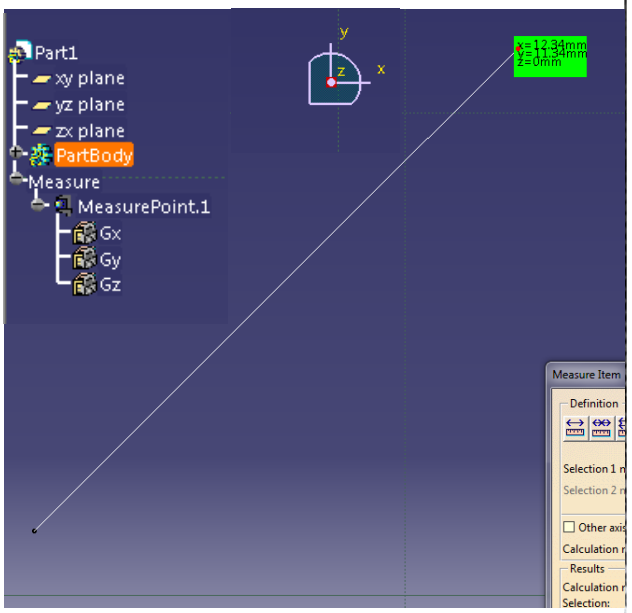
- *Geometric data exchange*
  - *Drawing exchange files/formats (DXF) structures:*

    - *BLOCKS section – This section contains Block Definition entities describing the entities comprising each Block in the drawing.*
    - *ENTITIES section – This section contains the drawing entities, including any Block References.*
    - *OBJECTS section – Contains the data that apply to nongraphical objects, used by AutoLISP and ObjectARX applications.*
    - *THUMBNAILIMAGE section – Contains the preview image for the DXF file.*

Computer-Aided Design (CAD)

- *Geometric data exchange*
  - *Drawing exchange files/formats (DXF):*





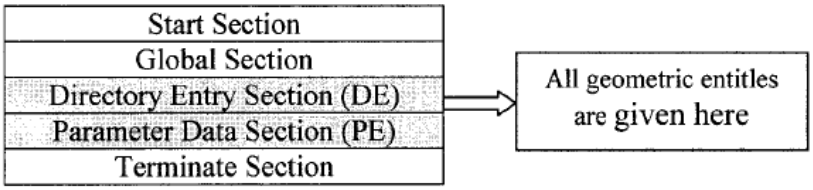
Computer-Aided Design (CAD)

- *Geometric data exchange*
  - *Initial Graphic Exchange Specification (IGES)*

```
                                                                        S      1
1H,,1H;,4HSLOT,37H$1$DUA2:[IGESLIB.BDRAFT.B2I]SLOT.IGS;,                G      1
17HBravo3 BravoDRAFT,31HBravo3->IGES V3.002 (02-Oct-87),32,38,6,38,15,  G      2
4HSLOT,1.,1,4HINCH,8,0.08,13H871006.192927,1.E-06,6.,                   G      3
31HD. A. Harrod, Tel. 313/995-6333,24HAPPLICON - Ann Arbor, MI,4,0;     G      4
     116       1       0       1       0       0       0       0      1D      1
     116       1       5       1       0                              0D      2
     116       2       0       1       0       0       0       0      1D      3
     116       1       5       1       0                              0D      4
     100       3       0       1       0       0       0       0      1D      5
     100       1       2       1       0                              0D      6
     100       4       0       1       0       0       0       0      1D      7
     100       1       2       1       0                              0D      8
     110       5       0       1       0       0       0       0      1D      9
     110       1       3       1       0                              0D     10
     110       6       0       1       0       0       0       0      1D     11
     110       1       3       1       0                              0D     12
116,0.,0.,0.,0,0,0;                                                     1P      1
116,5.,0.,0.,0,0,0;                                                     3P      2
100,0.,0.,0.,0.,1.,0.,-1.,0,0;                                          5P      3
100,0.,5.,0.,5.,-1.,5.,1.,0,0;                                          7P      4
110,0.,-1.,0.,5.,-1.,0.,0,0;                                            9P      5
110,0.,1.,0.,5.,1.,0.,0,0;                                             11P      6
S      1G      4D     12P      6                                       T      1
```

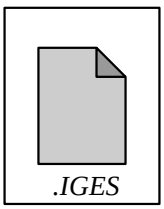
Computer-Aided Design (CAD)

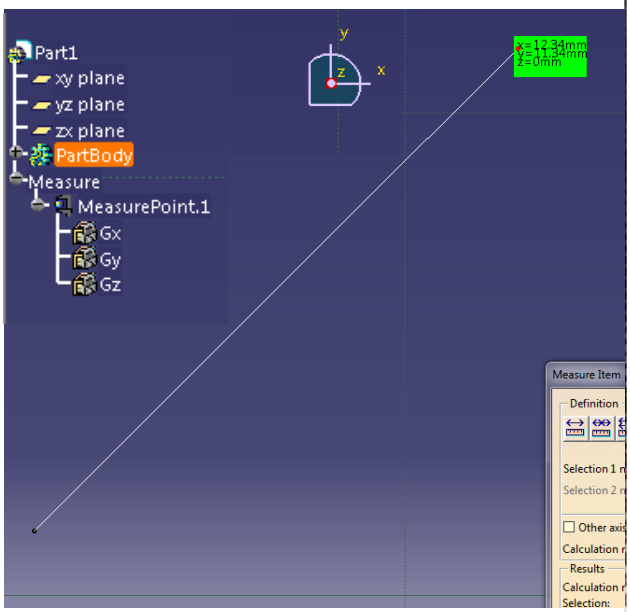
- *Geometric data exchange*
  - *Initial Graphic Exchange Specification (IGES):*
    - *The IGES committee was established in the year 1979.*
    - *The CAD/CAM Integrated Information Network (CIIN) of Boeing served as the preliminary basis of IGES.*



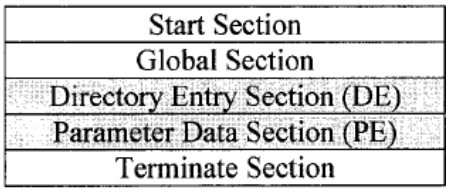
Computer-Aided Design (CAD)

- *Geometric data exchange*
  - *Initial Graphic Exchange Specification (IGES)*





Computer-Aided Design (CAD)



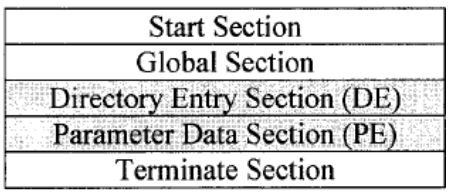
- *Geometric data exchange*
  - *Initial Graphic Exchange Specification (IGES):*
    - *Start Section*

    The Start section is a human readable introduction to the file.

    It is commonly described as a "prologue" to the IGES file.

    This section contains information such as the names of the sending (source) and receiving (target) CADICAM systems, and a brief description of the product being converted

Computer-Aided Design (CAD)



- *Geometric data exchange*
  - *Initial Graphic Exchange Specification (IGES):*
    - *Global Section*

    The Global section includes information that describe the preprocessor and information needed by the postprocessor to interpret the file.
      - *Characters used as delimiters between individual entries and between records (usually commas and semicolons respectively)*
      - *The name of the IGES file itself, Vendor and software version of sending (source) system,*
      - *Date and time of file generation,*
      - *Model space scale,*
      - *Model units,*
      - *Minimum resolution and maximum coordinate values,*
      - *Name of the author of IGES file*

Computer-Aided Design (CAD)

Start Section
Global Section
Directory Entry Section (DE)
Parameter Data Section (PE)
Terminate Section

- *Geometric data exchange*
  - *Initial Graphic Exchange Specification (IGES):*
    - *Directory Entry Section (DE)*
      - *The DE section is a list of all the entities defined in the IGES file together with certain attributes associated with them.*
      - *The entry for each entity occupies two 80-character records which are divided into a total of twenty 8-character fields*
      - *The first and the eleventh (beginning of the second record of any given entity) fields contain the entity type number such as 100 for circle, 110 for lines, etc.*
      - *The second field contains a pointer to the parameter data entry for the entity in the PD section.*

Computer-Aided Design (CAD)

Start Section
Global Section
Directory Entry Section (DE)
Parameter Data Section (PE)
Terminate Section

- *Geometric data exchange*
  - *Initial Graphic Exchange Specification (IGES):*
    - *Directory Entry Section (DE)*

Column	1-8	9-16	.	49-56		65-72	73-80
Line 1	Entity Type	Parameter Entry Pointer		Transformat -ion Matrix		Visible Entity Switch	Sequence Number
Line 2	Entity Type						Sequence Number

Computer-Aided Design (CAD)

Start Section
Global Section
Directory Entry Section (DE)
Parameter Data Section (PE)
Terminate Section

- *Geometric data exchange*
  - *Initial Graphic Exchange Specification (IGES):*
    - *Parameter Data Section (PE)*
      - *The PD section contains the actual data defining each entity listed in the DE section*
        - *A straight line entity is defined by the six coordinates of its two endpoints*
      - *Each entity has always two records in the DE section,*
        - *The number of records required for each entity in the PD section varies from one entity to another (the minimum is one record) and depends on the amount of data.*
      - *Parameter data are placed in free format in columns 1 through 64.*

Computer-Aided Design (CAD)

Start Section
Global Section
Directory Entry Section (DE)
Parameter Data Section (PE)
Terminate Section

- *Geometric data exchange*
  - *Initial Graphic Exchange Specification (IGES):*

Field	1	2 3 4	5 6	7 8	..	73-80
Circle	100	Z X Y (center of circle)	X_1 Y_1 (start point)	X_2 Y_2 (end point)		Sequence Number
Line	110	X_1 Y_1 Z_1 (start point)	X_2 Y_2 Z_2 (end point)			Sequence Number

  - *Termination Section*
    - *The Terminate section contains a single record which specifies the number of records in each of the four preceding sections for checking purposes.*

Homework : AT:G:07:#

- *In this HW you will try the direct translation of geometric data related to your group format to a simple IGES format.*
  - *Given a simple .IGES file you should find the LINE (110) entities.*
  - *You should map the line data into your designed CIM database.*

- *The HW should be sent to Fvalilai@Sharif.edu till Sunday, 16th of Azar (Dec, 7th ,2014)*
- *Email subject: "AT:G:07:#"*

Computer-Aided Design (CAD)

- *Geometric data exchange*
  - *Standard for the Exchange of Product data (STEP, ISO 10303):*
    - *The STEP is the enabler for seamless exchange of product data which is critical to CAD/CAM/CAE systems.*
    - *STEP itself is the basis for Product Data Management System (PDM).*
    - *It covers border functionalities. It includes methods of representing all critical product specifications such as*
      - *Shape information,*
      - *Materials,*
      - *Tolerances,*
      - *Finishes and*
      - *Product structure.*

Computer-Aided Design (CAD)

- *Geometric data exchange*
  - *Standard for the Exchange of Product data (STEP, ISO 10303):*

```
ISO-10303-21;
HEADER;
FILE_DESCRIPTION(
/* description */ ('A minimal AP214 example with a single part'),
/* implementation_level */ '2;1');
FILE_NAME(
/* name */ 'demo',
/* time_stamp */ '2003-12-27T11:57:53',
/* author */ ('Lothar Klein'),
/* organization */ ('LKSoft'),
/* preprocessor_version */ ' ',
/* originating_system */ 'IDA-STEP',
/* authorization */ ' ');
FILE_SCHEMA (('AUTOMOTIVE_DESIGN { 1 0 10303 214 2 1 1}'))
ENDSEC;
DATA;
#10=ORGANIZATION('O0001','LKSoft','company');
#11=PRODUCT_DEFINITION_CONTEXT('part definition',#12,'manufacturing');
#12=APPLICATION_CONTEXT('mechanical design');
#13=APPLICATION_PROTOCOL_DEFINITION(,'automotive_design',2003,#12);
#14=PRODUCT_DEFINITION('0',$,#15,#11);
#15=PRODUCT_DEFINITION_FORMATION('1',$,#16);
#16=PRODUCT('A0001','Test Part 1','',(#18));
#17=PRODUCT_RELATED_PRODUCT_CATEGORY('part',$,(#16));
#18=PRODUCT_CONTEXT('',#12,'');
#19=APPLIED_ORGANIZATION_ASSIGNMENT(#10,#20,(#16));
#20=ORGANIZATION_ROLE('id owner');
ENDSEC;
END-ISO-10303-21;
```