

Automation (21-541)

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

Session # 11



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.*

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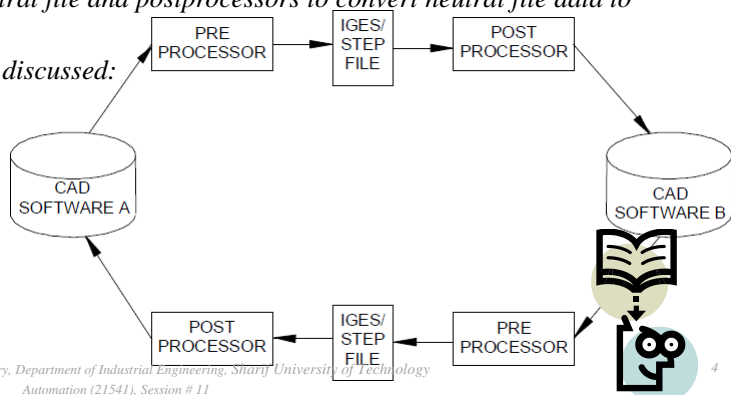


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Computer-Aided Design (CAD)

▪ 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*



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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*
 - *ENTITIES section*
 - *OBJECTS section*
 - *THUMBNAILIMAGE section*
 - *END OF FILE*

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```

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

```



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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.*

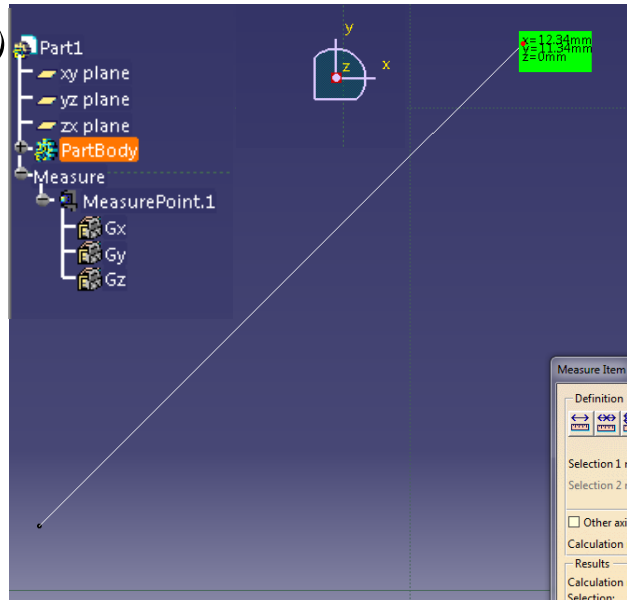
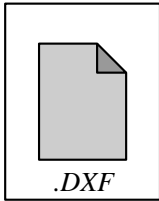
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Computer-Aided Design (CAD)

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



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Computer-Aided Design (CAD)

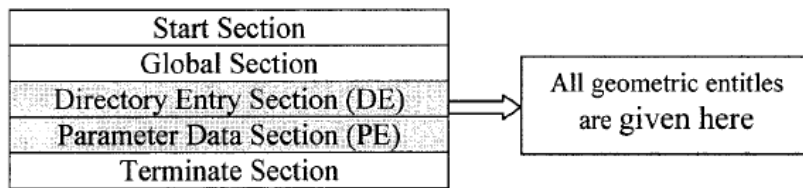
- Geometric data exchange
 - Initial Graphic Exchange Specification (IGES)

1H,,1H:,4HSLOT,37HS1\$DUA2:[IGESLIB.BDRAFT.B2I]SLOT.IGS; ,	S	1
17HBravo3 BravoDRAFT,31HBravo3->IGES V3.002 (02-Oct-87),32,38,6,38,15,	G	1
4HSLOT,1.,1,4HINCH,8,0.08,13H871006.192927,1.E-06,6.,	G	2
31HD. A. Harrod, Tel. 313/995-6333,24HAPPLICON - Ann Arbor, MI,4,0;	G	3
116 1 0 1 0 0 0 0 0	1D	4
116 1 5 1 0 0 0 0 0	1D	1
116 2 0 1 0 0 0 0 0	1D	2
116 1 5 1 0 0 0 0 0	1D	3
100 3 0 1 0 0 0 0 0	1D	4
100 1 2 1 0 0 0 0 0	1D	5
100 4 0 1 0 0 0 0 0	1D	6
100 1 2 1 0 0 0 0 0	1D	7
110 5 0 1 0 0 0 0 0	1D	8
110 1 3 1 0 0 0 0 0	1D	9
110 6 0 1 0 0 0 0 0	1D	10
110 1 3 1 0 0 0 0 0	1D	11
116,0.,0.,0.,0,0,0,0;	1D	12
116,5.,0.,0.,0,0,0,0;	1P	1
100,0.,0.,0.,0.,1.,0.,-1.,0,0;	3P	2
100,0.,5.,0.,5.,-1.,5.,1.,0,0;	5P	3
110,0.,-1.,0.,5.,-1.,0.,0,0;	7P	4
110,0.,1.,0.,5.,1.,0.,0,0;	9P	5
S 1G 4D 12P 6	11P	6
	T	1

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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.

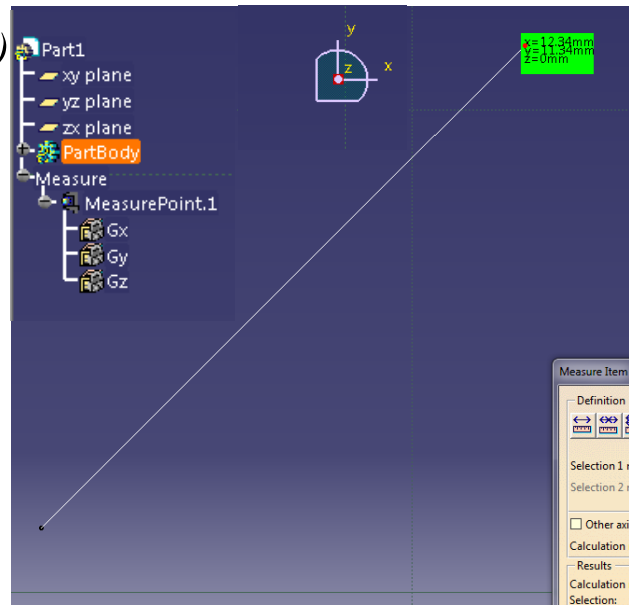
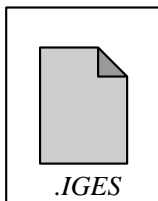


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Computer-Aided Design (CAD)

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



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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) CAD/CAM systems, and a brief description of the product being converted

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

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

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

Computer-Aided Design (CAD)

- 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.

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

Computer-Aided Design (CAD)

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

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

Column	1-8	9-16	17-24	25-32	33-40	41-48	49-56	57-64	65-72	73-80
Line 1	Entity Type	Parameter Entry Pointer					Transformation Matrix		Visible Entity Switch	Sequence Number
Line 2	Entity Type									Sequence Number

Computer-Aided Design (CAD)

- 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.

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

Computer-Aided Design (CAD)

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

Field	1	2	3	4	5	6	7	8	..	73-80
Circle	100	Z	X	Y	X ₁	Y ₁	X ₂	Y ₂		Sequence Number
Line	110	X ₁	Y ₁	Z ₁	X ₂	Y ₂				Sequence Number
						Z ₂				

- 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.

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

Homework # 10

- *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 omidf@ie.sharif.edu till Saturday, 23rd of Azar (Dec, 14th, 2013)*
- *Email subject: "HW10:GroupCode"*

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('00001', '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;

```

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Initial STEP Architecture

