


Government College of Engineering and Research  
Avasari, Pune

# SOLID MODELING AND DRAFTING

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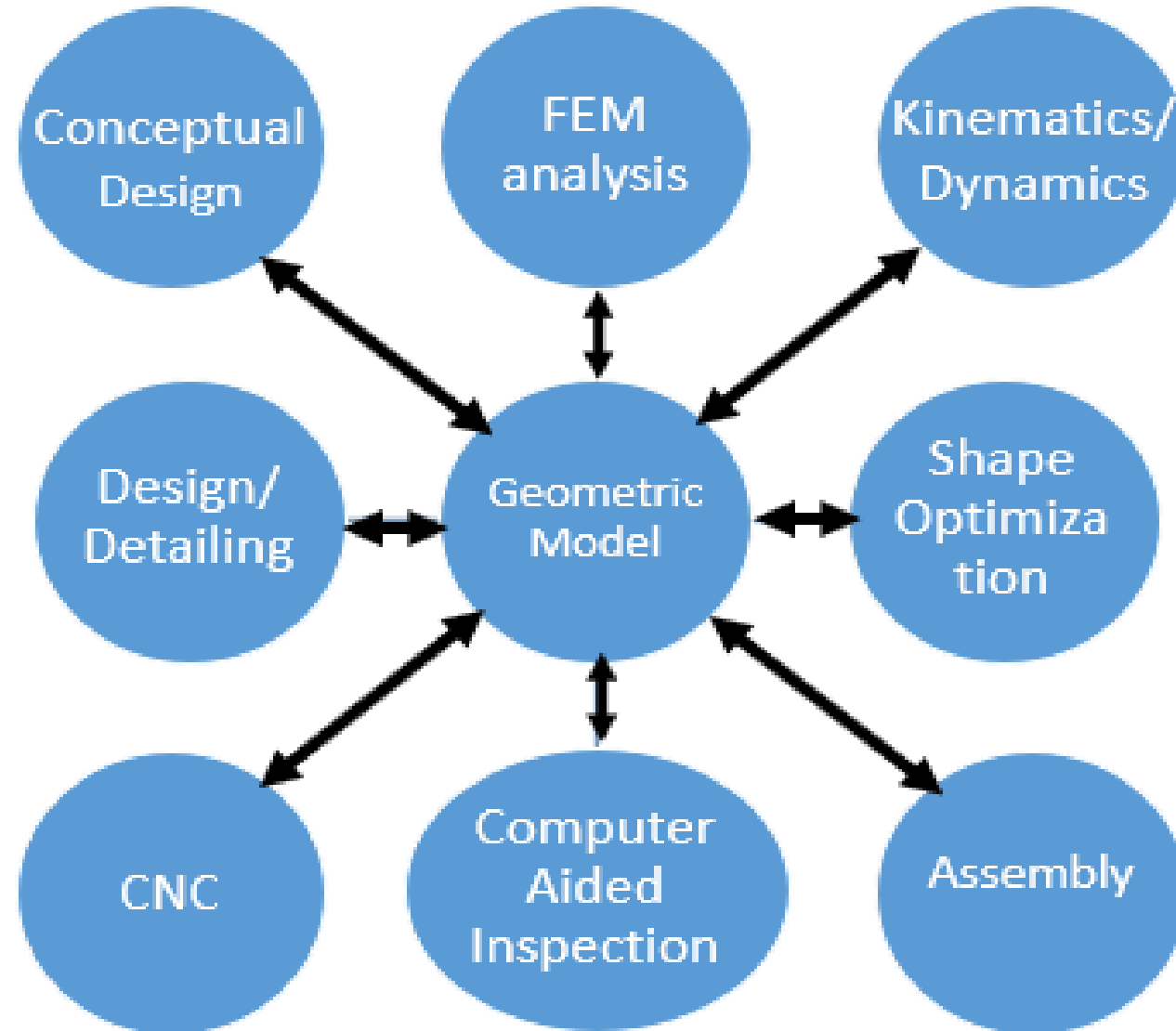
# Unit 5

## CAD Data Exchange

# Unit Outcome

USE CAD model data for various CAD based engineering applications viz. production drawings, 3D printing, FEA, CFD, MBD, CAE, CAM, etc.

# CAD Data Exchange



# CAD Data Exchange

- Geometric data exchange refers to conversion from one geometric data format to another.
- CAD CAM software developers use different proprietary formats to store the data.
- Fundamental incompatibilities among entity representations further complicate exchanging the modeling data.
- As such, the Geometry data format in which part geometry information is stored often varies from one CAD/CAM system to another and hence the format need not be unique one.

# Need for geometric data exchange

- **Heterogenous expertise in industry**

- In one organization expertise is available in one CAD package while in other organization people are more conversant with other package.
- This heterogeneity will always exist as long as number of alternative packages are available in market.
- That arises the need of data exchange.

- **Use of application specific packages**

- Single package may not satisfy all the requirements of design and manufacturing.
- Even if only one versatile comprehensive package is used for all CAD/CAM operations, still data exchange is needed from one module to another.

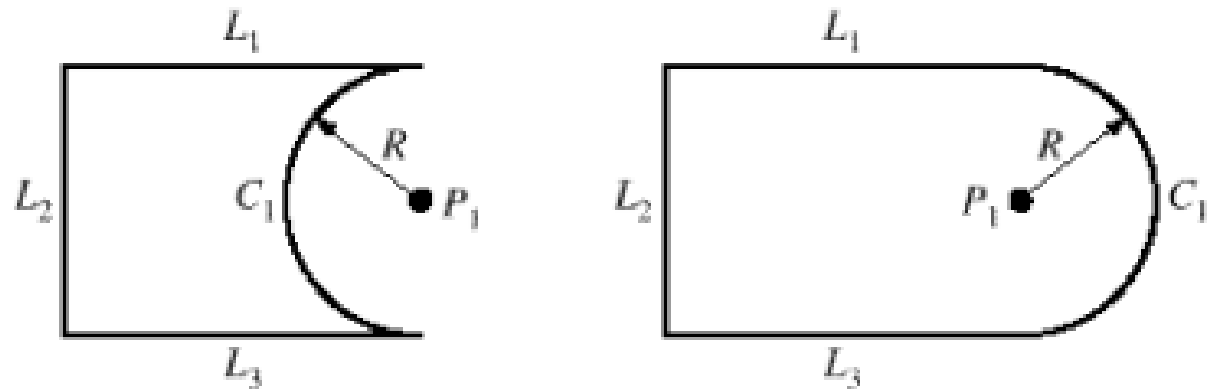
# Need for geometric data exchange contd.

- Migration from one system to another
  - May be because of availability of better package in the market.
  - Lack of technical support from the parent company.
  - Merger of two companies
- Data exchange with collaborators/ customers/suppliers
  - Because of technology transfer
  - Data exchange between developer and beneficiary
- Rapid pace of technological change

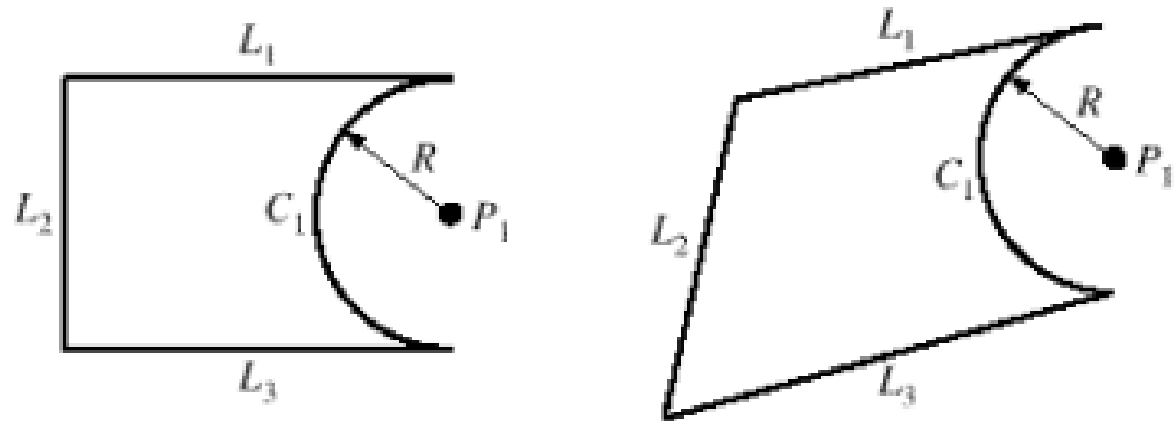
# Data that needs to be exchanged

- Shape data
  - Geometrical Information
  - Topological Information
  - Attributes such as font, colour, material
  - Annotations
- Non-shape data
  - It includes graphics data such as shaded images
  - Measuring units
  - Resolution

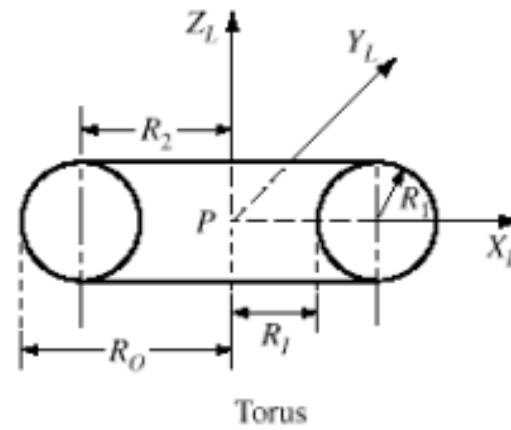
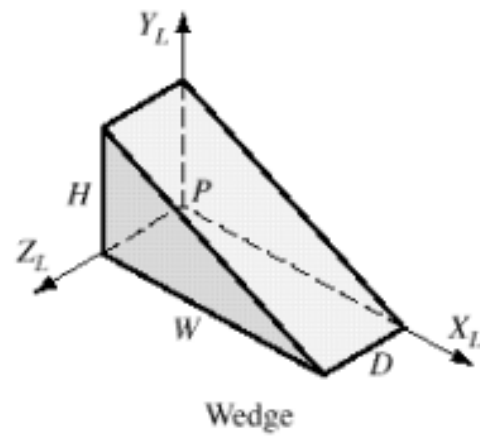
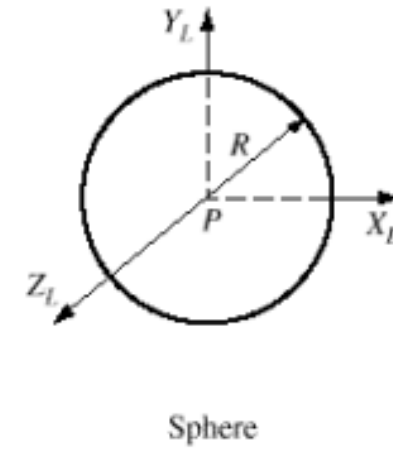
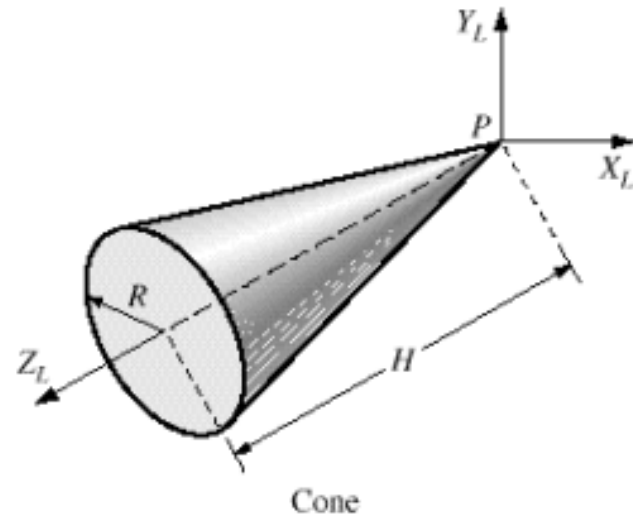




(a) Same geometry but different topology



(b) Same topology but different geometry



# Data that needs to be exchanged contd.

- Design data
  - Information that designers generate from geometric models for analysis purpose
  - Mass property and finite element mesh data belong to this type of data.
- Manufacturing data
  - It consists of information as tooling, NC tool path,
  - Tolerancing, process planning, tool design and bill of materials

- Having understood the need for CAD data exchange and the types of data to be transferred
- Question is: What are the ways to transfer?
- It has two solutions
  - **Direct**
  - **Indirect**

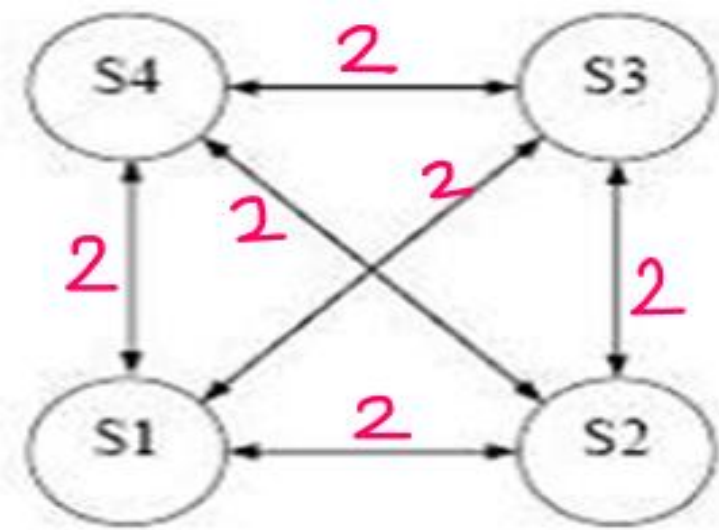
Note: Though it is desired for a data format to address the complete product description, it is not always feasible to design and implement such a format.

# Direct Solution Vs Indirect Solution

- Direct Solution: (Features, advantages, drawbacks etc.)
  - Calls for translating the modeling data directly from one CAD/CAM system to another
  - Usually in one step.
  - Direct translators run more quickly
  - Data files are compact and smaller in size
  - Not recommended for large number of CAD/CAM systems
  - They are system based and can work only for given system

# Direct Solution Vs Indirect Solution

- Indirect Solution: (Features, advantages, drawbacks etc.)
  - More general
  - Adopts philosophy of creating a neutral database which is independent of any existing or future CAD/CAM system
  - It is most useful when there are large number of CAD CAM systems.
  - It is system independent
  - Because of its generality nature, the size of the neutral database is larger and its access speed is slower.
  - It is suitable only for smaller number of CAD/CAM systems



(a) Direct translators  
(Total 12)

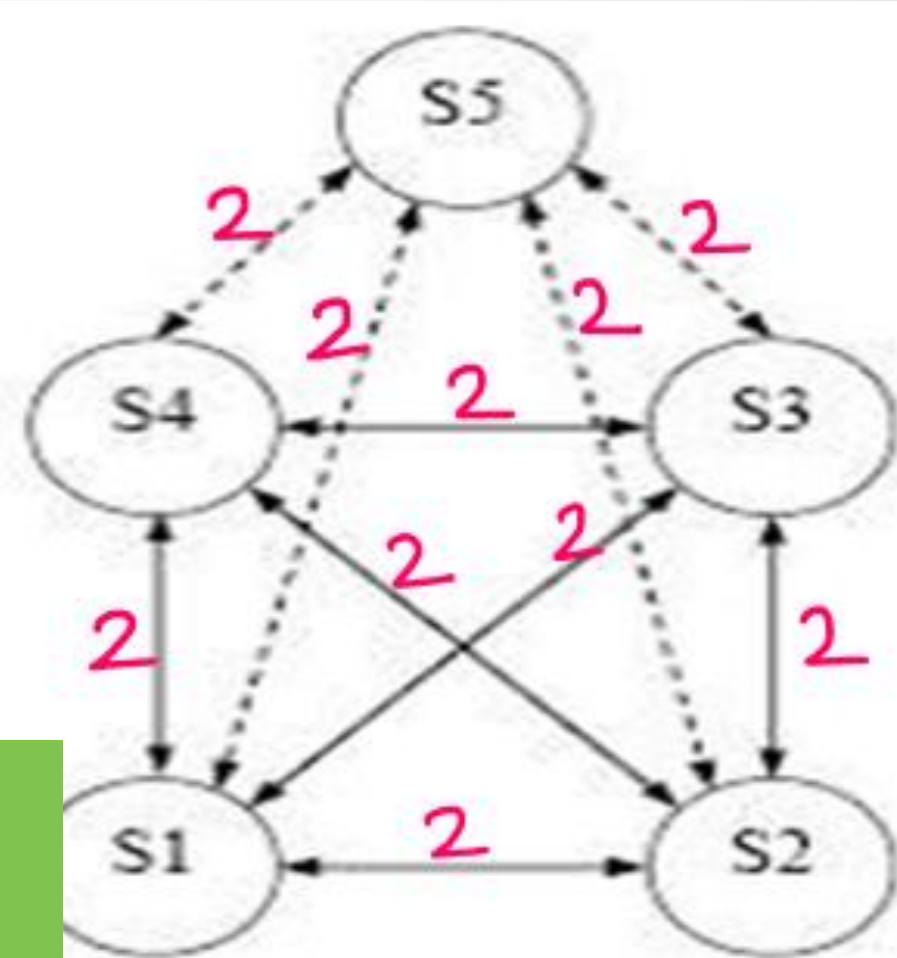
For 4 CAD/CAM systems, total no. of direct translators required are 10

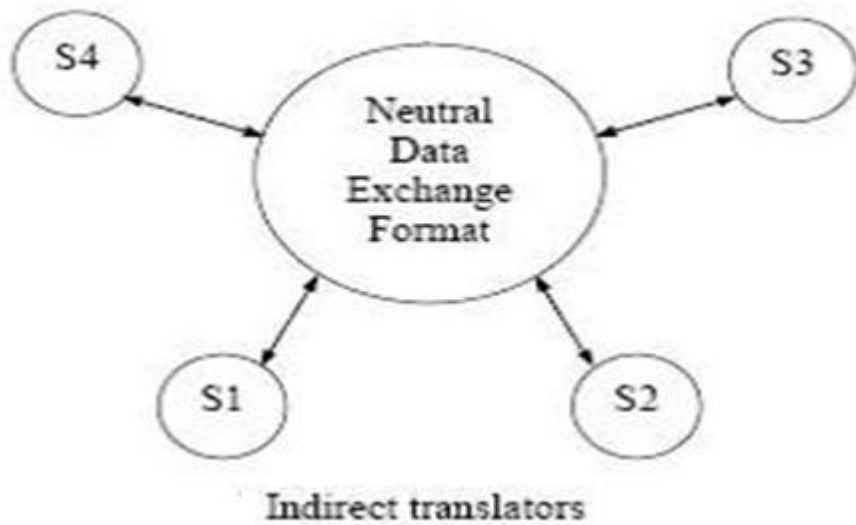
$$\text{i.e. } N = n(n - 1) \\ = 4 \times 3 = 12$$

For 5 CAD/CAM systems, total no. of direct translators required are 20

$$\text{i.e. } N = n(n - 1) = 5 \times 4 = 20$$

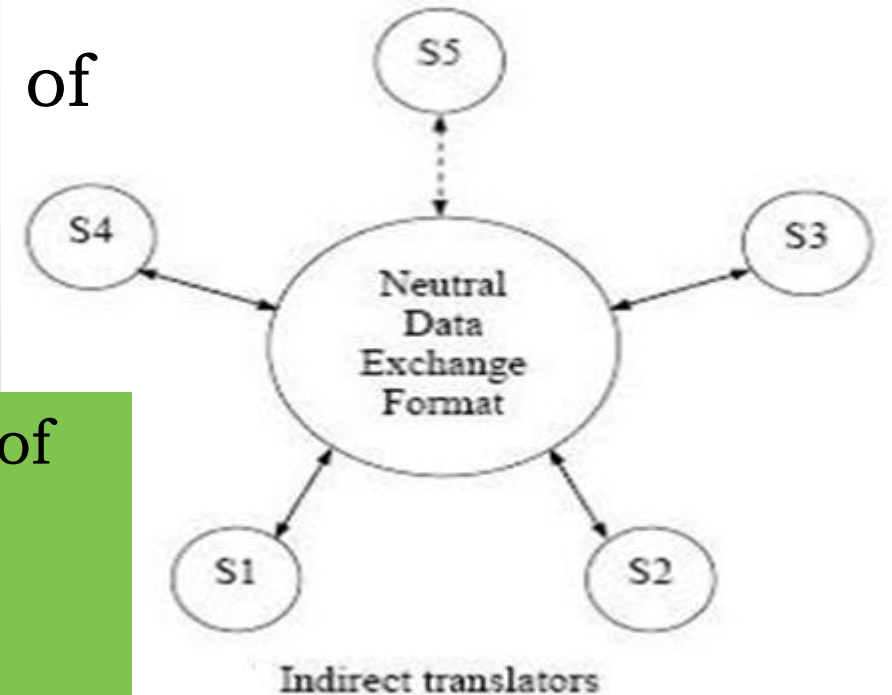
- In general for  $n$  CAD/CAM systems, total no. of direct translators required are-  
i.e.  $N = n(n - 1)$
- Adding 1 system in the existing  $n$  systems we require  $2n$  additional translators.





For 4 CAD/CAM systems, total no. of direct translators required are 8  
 i.e.  $N = 2n$   
 $= 4 \times 2 = 8$

For 5 CAD/CAM systems, total no. of direct translators required are 10  
 i.e.  $N = 2n$   
 $= 5 \times 2 = 10$



- In general for  $n$  CAD/CAM systems, total no. of direct translators required are-  
 i.e.  $N = 2n$
- Adding 1 system in the existing  $n$  systems we require 2 additional translators.



# Options available for data exchange

- Native format
- Neutral format
- Standard format
- Binary format
- ASCII format

# Options available for data exchange

- **Native Format:**
  - This is Company's own format
  - Generally not disclosed
  - Always with some specific extension.
  - File can be read only by the same package.
  - It is not a standard.
  - It is not opened by another package unless there is a translator.

# Options available for data exchange

- **Neutral format:**
  - package gives an optional format which can be very easily interpreted by the outside world.
  - Generally it comes with all information like what type of data is stored , what is the order of information etc...
  - It may come with manual wherein everything is mentioned about how data is stored.
- **Standard format:**
  - Accepted by national or international standard.

# Options available for data exchange

## Binary format

- A binary file is a computer file that is not a text file.

## ASCII format

- American *Standard Code for Information Interchange*
- It is a standard encoding for alphanumeric characters used in computers and related devices.
- ASCII was introduced by the United States of America Standards Institute (USASI) now known as the American National Standards Institute.

Note: Generally neutral and standard format are in ASCII format whereas Native format is of binary format, because input and output becomes faster

DECIMAL	BINARY	OCTAL	HEXA- DECIMAL
0	0	0	0
1	1	1	1
2	10	2	2
3	11	3	3
4	100	4	4
5	101	5	5
6	110	6	6
7	111	7	7
8	1000	10	8

## ASCII - Binary Character Table

<b>Letter</b>	<b>ASCII Code</b>	<b>Binary</b>
A	065	01000001
B	066	01000010
C	067	01000011
D	068	01000100

# Different formats

Some standard available formats are-

- IGES, DXF, STL, STEP, PDES, ACIS, Parasolid
- DXF- Drawing Exchange Format
- IGES- Initial Graphics Exchange Format
- STL- Standard Triangular Language
- STEP- Standard for Exchange of Products data

# IGES format

- Early attempts to design data format focused on CAD to CAD exchange where primarily shape and non-shape data were to be transferred from one system to another.
- E.g. IGES format

# IGES (Initial Graphics Exchange Specification) format

- It is the first standard exchange format
- IGES has been revised a few times since its version 1.0 was released in 1980.
- The various IGES versions share common characteristics.
- Each version must remain upwards compatible with previous version.
- This means that a processor that is fully conforming to the latest version can correctly interpret IGES files written in accordance with prior versions.



# IGES (Initial Graphics Exchange Specification) format

- CAD/CAM vendors or companies specialized in database transfer must write software to translate from their systems to IGES format and vice versa.
- The software that translates from the native database format of a given CAD/CAM system to the IGES format is called a preprocessor.
- The software that translates in a opposite way (from IGES to a CAD CAM system) is called as postprocessor.
- The preprocessors and postprocessors are also called as translators

# IGES (Initial Graphics Exchange Specification) format

- IGES is a text-based format.
- The IGES file has five sections: Start, General, Directory, Parameters, Termination (some says 6)
  - Flag
  - Start.....1
  - Global (or General)....2
  - Directory.....3
  - Parameters.....4
  - Termination.....5

# IGES (Initial Graphics Exchange Specification) format

- The sections are indicated by the characters S, G, D, P, or T in column 73.
- Each line is 80 characters long. Some sections using tabulated representation.
- Each entity type has a type-id (type number) and optional sub-type id (form number). For instance a line is 110 Form 0 and B-Spline surface is 128.

# IGES (Initial Graphics Exchange Specification) format

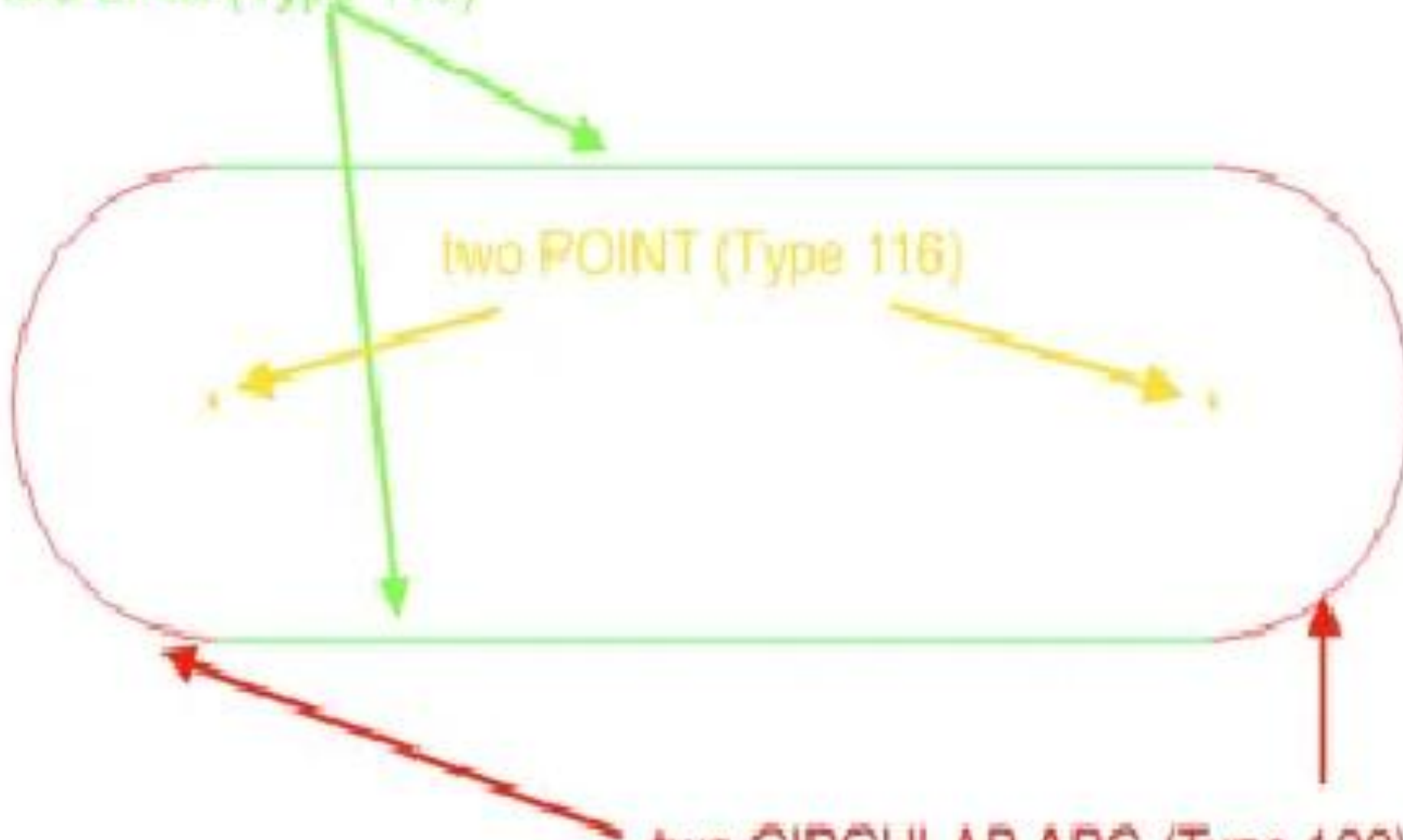
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# IGES (Initial Graphics Exchange Specification) format

two LINE (Type 110)

two POINT (Type 116)

two CIRCULAR ARC (Type 100)



# IGES (Initial Graphics Exchange Specification) format

```
1H,,1H;,4HSLOT,37H$1$DUA2:[IGESLIB,BDRAFT,B2I]SLOT.IGS;
17HBravo3 BravodRAFT,31HBravo3->IGES V3.002 (02-Oct-87),32,38,6,38,15,
4HSLOT,1.,1,4HINCH,8,0.08,13HB71006.192927,1.E-06,6.,
31HD. A. Harrod, Tel. 313/995-6333,2-4HAPPLICON - Ann Arbor, MI,4,0;
```

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.,0,0;
116,5.,0.,0.,0.,0.,0,0;
100,0.,0.,0.,0.,1.,0.,-1.,0,0;
100,0.,5.,0.,5.,-1.,5.,1.,0,0;
110,0.,-1.,0.,5.,-1.,0.,0,0;
110,0.,1.,0.,5.,1.,0.,0,0;
```

```
6      1G      4D      12P      6
```

S	1
G	1
G	2
G	3
G	4
1D	1
0D	2
1D	3
0D	4
1D	5
0D	6
1D	7
0D	8
1D	9
0D	10
1D	11
0D	12
1P	1
3P	2
5P	3
7P	4
9P	5
11P	6
T	1

Start  
Global  
Directory  
Entry  
Parameter  
Data  
Terminale

```

prt0001_out.log.1 - Notepad
File Edit Format View Help
Pro/ENGINEER IGES pre-processor log file
IGES output for Part PRT0001, into file prt0001.igs.

Contents of IGES start section:
  PTC IGES file: prt0001.igs

Contents of IGES global section:
Parameter delimiter      ,
Record delimiter        ;
Sender's product id     PRT0001
File name                prt0001.
System id                Pro/ENGI
Corporation
Preprocessor version     2009440
Number of bits/integer  32
Maximum power of 10 for a float  38
Number of digits per float  7
Maximum power of 10 for a double float  38
Number of digits per double float  15
Receiver's product id   PRT0001

```



Types and quantities of IGES entities created:

Type	Form	Count	Name
100	0	6	Circular Arc
102	0	1	Composite Curve
110	0	7	Line
120	0	2	Surface of Revolution
124	0	6	Transformation Matrix
128	0	2	Rational B-Spline Surface
186	0	1	Manifold Solid B-Rep Object
314	0	11	Color Definition
402	7	3	Associativity Instance
406	15	4	Property
502	1	1	Vertex
504	1	1	Edge



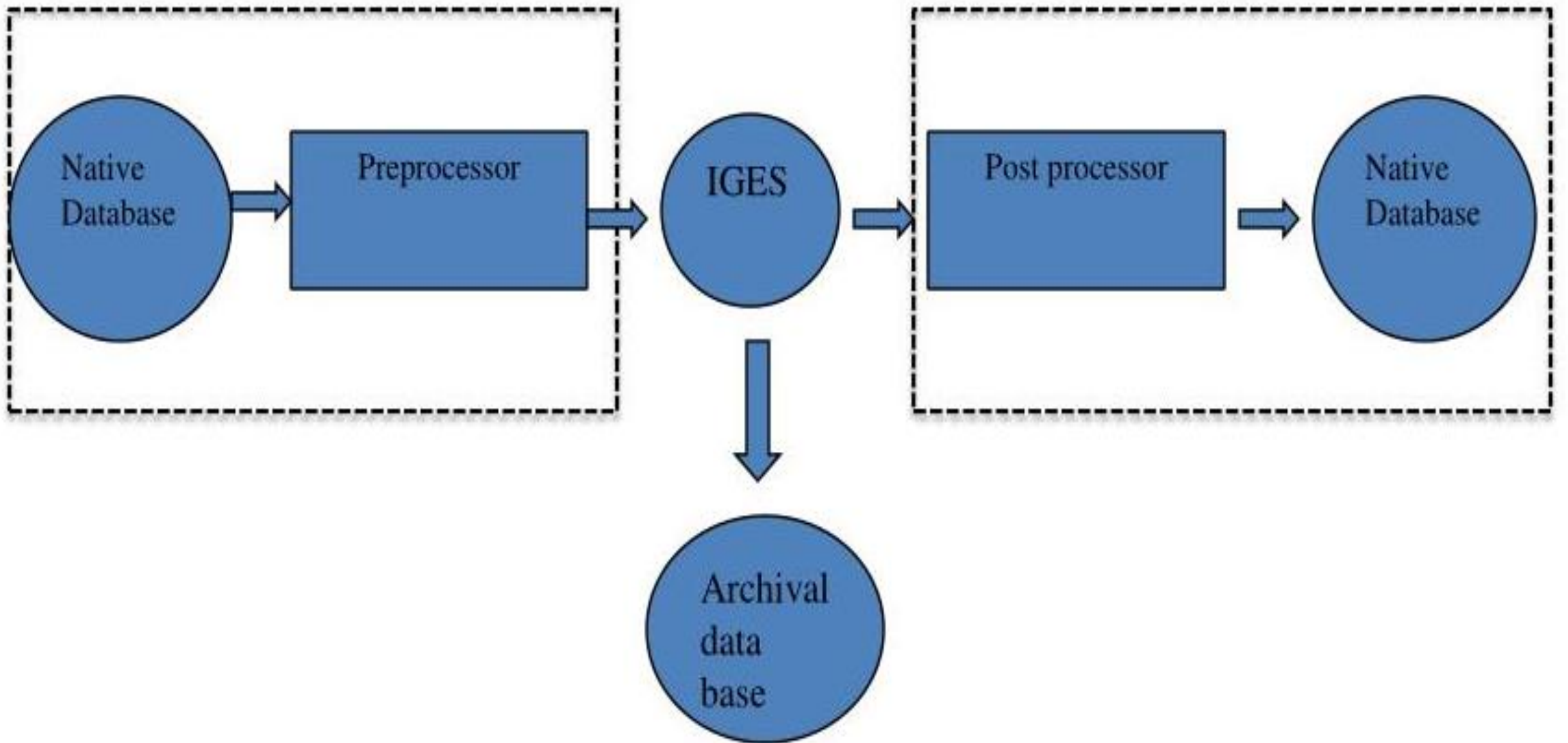


Fig. Database exchange using IGES





Thank You  
For Your Attention