Notes on CAD interchange formats

Paul Bourke
Auckland University Architecture School
March 1991

File formats for graphical information can be classified according to the following categories.

Type of information stored

A gross classification is whether the format is designed for bitmaps (raster) data or object orientated (geometric) data or both. The rest of these notes will focus on geometric data transfer however bitmap may become more important in the future as the printing technology becomes more able to handle such data more easily.

Designed for single or multiple hardware/software platforms

Many interchange formats are intended to be used on one hardware platform only, that is, to easily provide data transfer between applications on that platform. True interchange formats are designed not only to provide interapplication transfer on one machine but also to provide transfer between machines. This is usually what forces formats to be TEXT only (ASCII) files.

Most recent small computer systems have their own internal formats, the most notable example is the PICT format on the Macintosh.

Closed or open/extensible format

The description of a format can either be closed or it can be designed in such a way that functionality can be added for specialized fields and users. If a format is closed then the translation software is forced to describe the whole geometry in terms of the primitives available. For example if a format does not support Bezier smoothed polygons then the translator may need to generate a large number of line segments to describe a smoothed curve. The advantage with closed descriptions is that translators are generally easier to implement and are therefore more robust. Open formats allow the translator to add primitives usually in some simple programming language. This can make software to read the format very hard to write, PostScript is a good example of this.

2D and/or 3D

The dimension that can be handled is becoming more important as 3D modelling comes accessible on lower priced platforms. Since most of the popular exchange formats were designed for 2D transfer, 3D data interchange is generally more difficult.

2D exchange has been a requirement for quite a while and formats are therefore generally quite successful. The requirements are known: that is, it is necessary to be able to describe a small set of geometric primitives and a small number of attributes. A set of primitives might be lines, polygons, arcs, ovals, text, and possibly dimensions. Attributes for line based primitives might be the thickness, colour, and style. Attributes for text based primitives would include colour, typeface or font, size, and style.

3D transfer is much more problematic. The range of 3D modelling techniques range from the trivial (wireframe drawings), through to facet or solid modelling which have fundamentally different data structures, and finally the very complex descriptions needed for photorealistic scene descriptions. In the final case of rendering not just the geometry is needed but also lighting information, potentially complex and varied surface texture maps, and a camera model.

Quotes

Unfortunately the biggest problem is the CAD manager that believes the ONLY good translation is 100%

Standards are good, lets have lots of them!

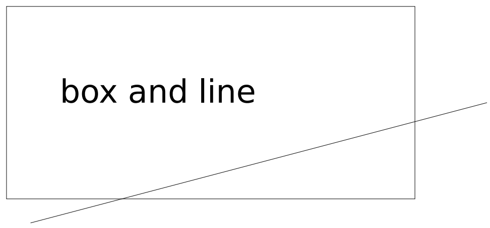
Personal preferences

The desirable characteristics for an interchange format are as follows:

1) the primitives should be as general as possible. A good example of non general primitives can be seen in those formats which provide three arc drawing definitions, namely, arc, oval, and circle. These can be combined into just one arc element with arguments of the start angle, stop angle, start radius, and stop radius.
2) The primitives should have a wide range of attributes. For example: one drawback in many formats is the restricted attributes for text elements. It is usually possible to define the size but often only in integer steps. Few formats support rotated text or styles such as underline, italics, etc.
3) it should store the data in a relatively efficient way. Files are often going to transfered between machines via relatively bandwidth limited channels so large files are undesirable.

One of the biggest drawbacks is the lack of a successful 3D format to describe the geometry of a model. DXF and IGES don't quite make it and the RIB format is not attempting to be a CAD format but rather a way of exporting to a RenderMan renderer. While with 2D data the attributes of the elements is quite important, the most important characteristic for people doing 3D model transfer is usually just the geometry.

A summary of some of the more common formats follow, where applicable the form of the file will be illustrated by using it to describe the following simple image which contains a rectangle, line and text made up of the words "box and line".



DXF

DXF is probably the most widespread data format in use on small computer CAD systems. It was developed by AutoCAD and has received its popularity from the high number of AutoCAD users. Most of the major CAD applications support DXF and do so quite well, at least for 2D data.

While DXF is the most widespread it is not due to it being a good data transfer medium. The structure is very inefficient and unwieldy for a program to interpret, basically it is showing its age.

DXF is primarily used for transfering 2D data but there have been some 3D primitives for quite a while and more are being added. Generally the 3D primitives are not powerful enough for most 3D modelers and most DXF interpreters do not even attempt to implement the simplest 3D primitives such as 3DLINE and 3DFACE.

```
0
SECTION
2
HEADER
9
$EXTMIN
10
1.123047
20
8.248047
9
$EXTMAX
10
3.626953
20
9.376953
9
$LIMMIN
10
0.000000
20
0.000000
9
$LIMMAX
10
8.000000
20
10.500000
9
$VIEWCTR
10
4.000000
20
7.583333
9
$VIEWSIZE
40
5.833333
9
$AXISMODE
70
0
9
$CHAMFERA
40
0.088388
9
$CHAMFERB
40
0.088388
9
$DIMALT
70
0
9
$DIMASZ
40
0.180000
9
$DIMCEN
40
0.250000
9
$DIMDLE
40
0.000000
9
$DIMDLI
40
0.250000
9
$DIMEXE
40
0.125000
9
$DIMEXO
40
0.062500
9
$DIMLIM
70
0
9
$DIMRND
40
0.000000
9
$DIMSCALE
40
1.000000
9
$DIMSE1
70
0
9
$DIMSE2
70
0
9
$DIMTAD
70
0
9
$DIMTIH
70
1
9
$DIMTM
40
-0.005000
9
$DIMTOH
70
1
9
$DIMTOL
70
0
9
$DIMTP
40
0.005000
9
$FILLETRAD
40
0.250000
9
$FILLMODE
70
1
9
$GRIDMODE
70
1
9
$LTSCALE
40
1.000000
9
$LUNITS
70
2
9
$LUPREC
70
3
9
$SNAPMODE
70
0
0
ENDSEC
0
SECTION
2
TABLES
0
TABLE
2
LTYPE
70
7
0
LTYPE
2
CONTINUOUS
70
0
3
Solid Line
72
65
73
0
40
0.000000
0
ENDTAB
0
TABLE
2
LAYER
70
1
0
LAYER
2
Layer_1
70
0
62
7
6
CONTINUOUS
0
ENDTAB
0
TABLE
2
STYLE
70
0
0
ENDTAB
0
TABLE
2
VIEW
70
0
0
ENDTAB
0
ENDSEC
0
SECTION
2
BLOCKS
0
BLOCK
8
0
2
CCADUNITCIRCLE
70
0
10
0.013889
20
0.013889
30
0.000000
0
CIRCLE
8
0
6
BYBLOCK
62
0
10
0.000000
20
0.000000
30
0.000000
40
1.000000
0
ENDBLK
0
BLOCK
8
0
2
CCADARROW1
70
0
10
0.000000
20
0.000000
30
0.000000
0
SOLID
8
0
6
BYBLOCK
62
0
10
-1.000000
20
-0.500000
30
0.000000
11
0.000000
21
0.000000
31
0.000000
12
-0.666667
22
0.000000
32
0.000000
13
-1.000000
23
0.500000
33
0.000000
0
ENDBLK
0
BLOCK
8
0
2
CCADARROW2
70
0
10
0.000000
20
0.000000
30
0.000000
```

```
0
SOLID
8
0
6
BYBLOCK
62
0
10
-1.000000
20
-0.500000
30
0.000000
11
0.000000
21
0.000000
31
0.000000
12
-1.000000
22
0.500000
32
0.000000
13
-1.000000
23
0.500000
33
0.000000
0
ENDBLK
0
BLOCK
8
0
2
CCADARROW3
70
0
10
0.000000
20
0.000000
30
0.000000
0
POLYLINE
8
0
6
BYBLOCK
62
0
66
1
40
0.010000
41
0.010000
70
0
0
VERTEX
8
0
10
-1.000000
20
-0.500000
30
0.000000
0
VERTEX
8
0
10
0.000000
20
0.000000
30
0.000000
0
VERTEX
8
0
10
-1.000000
20
0.500000
30
0.000000
0
SEQEND
0
ENDBLK
0
BLOCK
8
0
2
CCADARROW4
70
0
10
0.000000
20
0.000000
30
0.000000
0
POLYLINE
8
0
6
BYBLOCK
62
0
66
1
40
0.010000
41
0.010000
70
1
0
VERTEX
8
0
10
-1.000000
20
-0.500000
30
0.000000
0
VERTEX
8
0
10
0.000000
20
0.000000
30
0.000000
0
VERTEX
8
0
10
-1.000000
20
0.500000
30
0.000000
0
SEQEND
0
ENDBLK
0
BLOCK
8
0
2
CCADARROW5
70
0
10
0.000000
20
0.000000
30
0.000000
0
LINE
8
0
6
BYBLOCK
62
0
10
-0.500000
20
-0.500000
30
0.000000
11
0.500000
21
0.500000
31
0.000000
0
ENDBLK
0
BLOCK
8
0
2
CCADARROW6
70
0
10
0.000000
20
0.000000
30
0.000000
0
CIRCLE
8
0
6
BYBLOCK
62
0
20
0.000000
20
0.000000
30
0.000000
40
0.500000
0
ENDBLK
0
ENDSEC
0
SECTION
2
ENTITIES
0
POLYLINE
8
Layer_1
6
CONTINUOUS
62
7
66
1
40
0.010000
41
0.010000
70
1
0
VERTEX
8
Layer_1
10
1.125000
20
9.375000
30
0.000000
70
0
42
0.000000
0
VERTEX
8
Layer_1
10
3.250000
20
9.375000
30
0.000000
70
0
42
0.000000
0
VERTEX
8
Layer_1
10
3.250000
20
8.375000
30
0.000000
70
0
42
0.000000
0
VERTEX
8
Layer_1
10
1.125000
20
8.375000
30
0.000000
70
0
42
0.000000
0
SEQEND
0
LINE
8
Layer_1
6
CONTINUOUS
62
7
10
1.250000
20
8.250000
30
0.000000
11
3.625000
21
8.875000
31
0.000000
0
TEXT
8
Layer_1
62
7
10
1.388889
20
8.819444
30
0.000000
40
0.166667
1
box and line
0
ENDSEC
0
EOF
```

The main reason for the apparently extreme size of this DXF file is that the most of it is just the header information used by the particular translator utility used. This header would not necessarily be any longer for large files.

A DXF file contains the following structure

HEADER section, general drawing info, eg: drawing bounds

TABLES section, definitions of special items, eg: line styles used

BLOCKS section, definition of geometric objects, eg: arrows

ENTITIES section, contains tha actual graphical elements

PICT

PICT is a company specific file format from Apple and is supported by the operating system and by ROM on all Macintosh computers. PICT is not a format for transfering between different machine types but rather for transfering between applications on the one machine, namely the Macintosh family of computers.

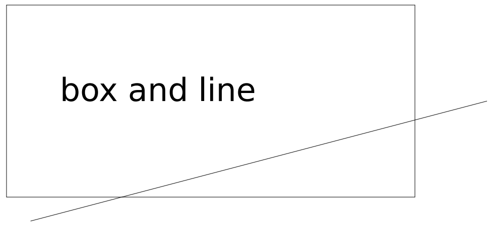
The graphical primitives in PICT are: text, lines, rectangles, round rectangles, arcs, ovals and circles, polygons, and regions (complex polygons, ie: with holes) On top of this it also provides support for bitmaps and what are known as picture comments which are a method for extending the capabilities of the format. For each primitive there are routines, generally in ROM, which draw the graphics on either the computer screen, printer, or to the PICT binary structure. Graphics drawn to the PICT structure can then be saved to a PICT file or PICT resource. To interpret a PICT file it is only necessary to read the file and pass the information to a ROM routine which analyses it.

There are many attributes for the graphical primitives such as line thickness, colour, area fill, text size, text style, and so on. One problem is that the units are all in integer point sizes which is 1/72 of an inch. This is a rather coarse unit for most CAD applications and highlights the fact that PICT was designed for graphics directed towards a monitor with 72 pixels/inch rather than being designed as a format for CAD applications, ie: PICT is essentially unitless.

This format has proven extremely successful on the Macintosh platform and almost all the data exchange between many diverse applications is handled by the PICT format. For example, the clipboard (a well known feature of Macintosh applications) uses the PICT format. To get PICT files to other platforms a translator is required, translators are now readily available to and from all the other formats mentioned here.

PICT is a 2D format only.

PICT files are not text files so an example is not possible, however the example used at the beginning of this section and redrawn below was created in a CAD package and pasted as PICT into this word processor.



HPGL

HPGL was designed by Hewlet Packard as a language to drive their line of plotters. As such it has been immensely popular and successful with most major plotter manufacturers supporting it even when they may also have their own plotter language. The only real competitor for plotter languages is Houston Instruments with their DMP language.

Because of its widespread acceptance as a plotter language it is often also used as file format especially by applications in the DOS world. It is generally a very poor interchange format due entirely to the fact that it was never designed to be one. For example: there is no method of defining the colour of a line. The closest thing is the SP instruction (Select Pen) which takes an argument from 1 to the number of pens available. While this makes sense to a plotter which may have various colour pens, it does not convey the pen colour information to a program attempting to interpret the drawing described by the HPGL file.

The graphical primitives that can be specified in HPGL are: arcs, circles, text, polygons including smooth polygons, rectangles, and of course lines.

HPGL is a 2D format only.

The general structure of a HPGL file is a two letter instruction in uppercase followed by any arguments. The arguments are separated by commas, the instructions can just follow from the next instruction or be separated by semicolons or linefeed. The only variation to this are text strings which are terminated by a special character not shown below, normally ASCII 3. In the following example the first line contains general plotter initialisation, the second line selects pen 1 (SP) which should be 0.3mm (PT). The third line drawns a rectangle, by moving with the pen up to the top left corner (PU) followed by the rectangle offsets (EA). The next three lines move to the appropriate coordinates and write the text. The second to last line draws the line. The last line deselects the pen (SP) and advances the page (PG)

```
INCA7CS0VS60;
SP1PT0.3
PU-4152,-1932EA-3144,218
PU-3648,-1664DI0,1SI0.144,0.34 Box
PU-3648,-1318SI0.144,0.34 and
PU-3648,-970SI0.145,0.34 line
PU-3012,-1808PD-3646,606PU
SPPG;
```

Of all the formats mentioned here, HPGL is the simplest for translators to read but because it is restricted to what plotters can do it can be a lot of work to represent certain forms. For example, since it has no concept of typeface it is usually necessary to create vector forms of a font. This not only greatly increases the amount of data but means that the interpreting program can no longer distinguish between text and other line segments.

PostScript

PostScript was designed as a page description language and is used primarily by LaserWriters. It is extremely powerful which means it is very difficult to write an interpreter for. They do exist however but mostly in the desktop publishing arena. many CAD packages are providing the facility to create PostScript files which can be transfered to other platforms or into desktop publishing applications for printing purposes.

The primitives supported by PostScript are almost infinite. Since it is a language, it can be added to by writing a PostScript program to implement any primitive one desires.

PostScript is almost always a 2D format but it does contain some 3D operators. PostScript can also support bitmap (raster) data.

Note: many of the definitions used in a PostScript file may rely on what are called PREP files being transfered to the LaserWriter first. These PREP files possibly define a whole range of "special" operations and new drawing commands.

```
%!PS-Adobe-2.0
%%Title: “Box+line”-Layer#1
%%Creator: Claris CAD
%%CreationDate: Tuesday, March 5, 1991
%%PageBoundingBox: 120 125 2355 3382
%%EndComments
%%EndProlog
%%BeginDocumentSetup
md begin
T T 0 0 3257 2235 -125 -120 3382 2355 100 300 300 3 F F F F T T T F psu
(rob; document: \322Box+line\323-Layer#1)jn
0 mf
od
%%EndDocumentSetup
%%Page: ? 1
op
0 0 xl
1 1 pen
0 0 gm
(nc 0 0 3257 2235 6 rc)kp
338.5 338.5 638.5 975.5 0 rc
675 375 gm
488 1088 lin
480 418 gm
0 gr
T 1 setTxMode
0 fs
bu fc
{}mark T /Courier /|______Courier 0 rf
bn
50 fz
bu fc
2 F /|______Courier fnt
bn
(box and line)show
F T cp
%%Trailer
cd
end
%%Pages: 1 0
%%EOF
```

IGES

IGES stands for Initial Graphics Exchange Specification and was written by a panel for the National Bureau of Standards. The strongest argument for IGES is its high level of support by CAD packages running on the larger computer systems.

Most problems with IGES come from the fact that the standard is so robust that there is lots of room for personal discretion as to how the standard is applied.

IGES is both a 2D and 3D format.

```
IGES Start section created by Claris Graphics Translator v1.0          S      1
1H,,1H;,12Hbox+line.IGS,12Hbox+line.IGS,8HCGT v1.0,8HIGES 3.0,16,8,24,8,G      1
24,12Hbox+line.IGS,1.0,1,4HINCH,32000,1.6,13H910305.183439,,,3HIBB,3HWCPG      2
,4,0;                                                                  G      3
     124       1       1       0       0       0       0       0 0 0 0 0D      1
     124       0       0       1       0       0       0               D      2
     124       2       1       0       0       0       0       0 0 1 1 0D      3
     124       0       0       1       0       0       0               D      4
     410       3       1       1       0       0       3       0 0 2 2 0D      5
     410       0       0       1       0       0       0               D      6
     124       4       1       0       0       0       0       0 0 0 0 0D      7
     124       0       0       1       0       0       0               D      8
     124       5       1       0       0       0       0       0 0 1 1 0D      9
     124       0       0       1       0       0       0               D     10
     410       6       1       1       0       0       9       0 0 2 2 0D     11
     410       0       0       1       0       0       0               D     12
     124       7       1       0       0       0       0       0 0 0 0 0D     13
     124       0       0       1       0       0       0               D     14
     124       8       1       0       0       0       0       0 0 1 1 0D     15
     124       0       0       1       0       0       0               D     16
     410       9       1       1       0       0      15       0 0 2 2 0D     17
     410       0       0       1       0       0       0               D     18
     124      10       1       0       0       0       0       0 0 0 0 0D     19
     124       0       0       1       0       0       0               D     20
     124      11       1       0       0       0       0       0 0 1 1 0D     21
     124       0       0       1       0       0       0               D     22
     410      12       1       1       0       0      21       0 0 2 2 0D     23
     410       0       0       1       0       0       0               D     24
     124      13       1       0       0       0       0       0 0 0 0 0D     25
     124       0       0       1       0       0       0               D     26
     124      14       1       0       0       0       0       0 0 1 1 0D     27
     124       0       0       1       0       0       0               D     28
     410      15       1       1       0       0      27       0 0 2 2 0D     29
     410       0       0       1       0       0       0               D     30
     124      16       1       0       0       0       0       0 0 0 0 0D     31
     124       0       0       1       0       0       0               D     32
     124      17       1       0       0       0       0       0 0 1 1 0D     33
     124       0       0       1       0       0       0               D     34
     410      18       1       1       0       0      33       0 0 2 2 0D     35
     410       0       0       1       0       0       0               D     36
     124      19       1       0       0       0       0       0 0 0 0 0D     37
     124       0       0       1       0       0       0               D     38
     124      20       1       0       0       0       0       0 0 1 1 0D     39
     124       0       0       1       0       0       0               D     40
     410      21       1       1       0       0      39       0 0 2 2 0D     41
     410       0       0       1       0       0       0               D     42
     304      22       1       1       0       0       0       0 0 1 0 0D     43
     304       0       0       1       2       0       0               D     44
     304      23       1       1       0       0       0       0 0 1 0 0D     45
     304       0       0       1       2       0       0               D     46
     304      24       1       1       0       0       0       0 0 1 0 0D     47
     304       0       0       2       2       0       0               D     48
     304      26       1       1       0       0       0       0 0 1 0 0D     49
     304       0       0       1       2       0       0               D     50
     304      27       1       1       0       0       0       0 0 1 0 0D     51
```

```
     304       0       0       1       2       0       0               D     52
     304      28       1       1       0       0       0       0 0 1 0 0D     53
     304       0       0       1       2       0       0               D     54
     110      29       1       1       1       5       1       0 0 0 0 0D     55
     110      78       1       1       0       0       0               D     56
     110      30       1       1       1       5       1       0 0 0 0 0D     57
     110      78       1       1       0       0       0               D     58
     110      31       1       1       1       5       1       0 0 0 0 0D     59
     110      78       1       1       0       0       0               D     60
     110      32       1       1       1       5       1       0 0 0 0 0D     61
     110      78       1       1       0       0       0               D     62
     110      33       1       1       1       5       1       0 0 0 0 0D     63
     110      78       1       1       0       0       0               D     64
     212      34       1       1       1      41      37       0 0 0 0 0D     65
     212       0       1       2       0       0       0               D     66
     406      36       1       0       0       0       0       0 0 1 2 0D     67
     406       0       0       1      16       0       0               D     68
     404      37       1       0       0       0       0       0 0 0 2 0D     69
     404       0       0       2       0       0       0               D     70
124,1.0,0.0,0.0,0.0,0.0,1.0,0.0,0.0,0.0,0.0,1.0,0.0;                   1P      1
124,1.0,0.0,0.0,0.0,0.0,1.0,0.0,0.0,0.0,0.0,1.0,0.0;                   3P      2
410,2,1.0,0,0,0,0,0,0,0;                                               5P      3
124,1.0,0.0,0.0,0.0,0.0,1.0,0.0,0.0,0.0,0.0,1.0,0.0;                   7P      4
124,1.0,0.0,0.0,0.0,0.0,1.0,0.0,0.0,0.0,0.0,1.0,0.0;                   9P      5
410,3,1.0,0,0,0,0,0,0,0;                                              11P      6
124,1.0,0.0,0.0,0.0,0.0,1.0,0.0,0.0,0.0,0.0,1.0,0.0;                  13P      7
124,1.0,0.0,0.0,0.0,0.0,1.0,0.0,0.0,0.0,0.0,1.0,0.0;                  15P      8
410,4,2.0833333E-2,0,0,0,0,0,0,0;                                     17P      9
124,1.0,0.0,0.0,0.0,0.0,1.0,0.0,0.0,0.0,0.0,1.0,0.0;                  19P     10
124,1.0,0.0,0.0,0.0,0.0,1.0,0.0,0.0,0.0,0.0,1.0,0.0;                  21P     11
410,5,1.9999999E-2,0,0,0,0,0,0,0;                                     23P     12
124,1.0,0.0,0.0,0.0,0.0,1.0,0.0,0.0,0.0,0.0,1.0,0.0;                  25P     13
124,1.0,0.0,0.0,0.0,0.0,1.0,0.0,0.0,0.0,0.0,1.0,0.0;                  27P     14
410,6,2.0,0,0,0,0,0,0,0;                                              29P     15
124,1.0,0.0,0.0,0.0,0.0,1.0,0.0,0.0,0.0,0.0,1.0,0.0;                  31P     16
124,1.0,0.0,0.0,0.0,0.0,1.0,0.0,0.0,0.0,0.0,1.0,0.0;                  33P     17
410,7,1.0,0,0,0,0,0,0,0;                                              35P     18
124,1.0,0.0,0.0,0.0,0.0,1.0,0.0,0.0,0.0,0.0,1.0,0.0;                  37P     19
124,1.0,0.0,0.0,0.0,0.0,1.0,0.0,0.0,0.0,0.0,1.0,0.0;                  39P     20
410,8,1.0,0,0,0,0,0,0,0;                                              41P     21
304,2,1.25E-1,4.1666667E-2,1H2;                                       43P     22
304,4,1.0,6.9444447E-2,1.25E-1,6.9444447E-2,1HA;                      45P     23
304,6,1.0,6.9444447E-2,1.25E-1,6.9444447E-2,1.25E-1,                  47P     24
6.9444447E-2,2H2A;                                                    47P     25
304,2,1.25E-1,1.25E-1,1H2;                                            49P     26
304,2,6.9444447E-2,5.5555555E-2,1H2;                                  51P     27
304,2,2.5E-1,6.9444447E-2,1H2;                                        53P     28
110,1.125,9.375,0.0,3.25,9.375,0.0;                                   55P     29
110,3.25,9.375,0.0,3.25,8.375,0.0;                                    57P     30
110,3.25,8.375,0.0,1.125,8.375,0.0;                                   59P     31
110,1.125,8.375,0.0,1.125,9.375,0.0;                                  61P     32
110,1.25,8.25,0.0,3.625,8.875,0.0;                                    63P     33
212,1,12,1.0555555,1.6666667E-1,1,1.5707963,0.0,0,0,1.3888888,        65P     34
8.875,0.0,12Hbox and line;                                            65P     35
406,2,8.0,1.05E1;                                                     67P     36
404,7,5,0.0,0.0,11,0.0,0.0,17,0.0,0.0,23,0.0,0.0,29,0.0,0.0,35,       69P     37
0.0,0.0,41,0.0,0.0,0,0,1,67;                                          69P     38
S      1G      3D     70P     38                                        T      1
```

RIB

RenderMan is supposed to be (or become) the PostScript of the 3D world. Its history started with Loren Carpenter at Lucasfilm in 1981 and the most popular version is now available on many platforms from PIXAR.

RenderMan is primarily a scene description language, that is, a way of describing objects, scenes, lights, and cameras so that a computer program can create realistic images from them. As such RIB files are not so much a general interchange format but rather a means of transfering data to a specific application, namely an implementation of RenderMan. The aim of RenderMan is to create computer generated photorealistic images of a scene.

RenderMan offers a small but powerful set of primitive surfaces, hierarchical modelling, constructive solid modelling, hierarchical geometry, a camera model, powerful shading attributes, and above all it is extensible.

RIB files are inherently 3D.

A simple example RIB file that renders some of the quadratic primitives is shown below.

```
##
## Quadratic primitives
##
Projection "perspective" "fov" 60
Translate 0 0 4

WorldBegin
      LightSource "ambientlight" 0 "intensity" .5
      Rotate -90 1 0 0

      ## A sphere
      color 1 0 0
      Translate -1.2 0 0.6
      Sphere 0.5 -0.5 0.5 360
      ## A cone
      color 0 1 0
      Translate 1.2 0 -0.5
      Cone 1 0.5 360
      ## A cylinder
      color 0 0 1
      Translate 1.2 0 0.5
      Cylinder 0.5 -0.5 0.5 360
      ## A hyperboloid
      color 1 1 0
      Translate -2.4 0 -1.2
      Hyperboloid 0.4 -0.4 -0.4 0.4 0.4 0.4 360
      ## A paraboloid
      color 1 0 1
      Translate 1.2 0 -0.5
      Paraboloid 0.5 0 0.9 360
      ## A torus
      color 0 1 1
      Translate 1.2 0 0.5
      Torus .4 .15 0 360 360
      ## A disk is a special case of a cone with no height (height now = z axis)
      color 0 1 0
      Translate -1.2 0 2
      Disk 0 .5 360
WorldEnd
```