#### 15-294 Rapid Prototyping Technologies:

#### **DXF** Files

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## The DXF File Format

- Drawing Interchange Format

   *or* –
   Drawing Exchange Format
- Proprietary file format, not an ANSI standard.
- Developed by AutoDesk in 1982 to allow their AutoCAD product to inter-operate with other programs.
- Partial specification now publicly available on AutoDesk's web site.

# Types of DXF File

- ASCII (human readable) or binary.
- DXF version number:
  - R14, R13, R12
  - 2010, 2007-2009, 2004-2006
- Later versions add new features such as complex curves and 3D shapes.
- When exporting to DXF for use with a laser cutter, ASCII R2010 is a safe choice.

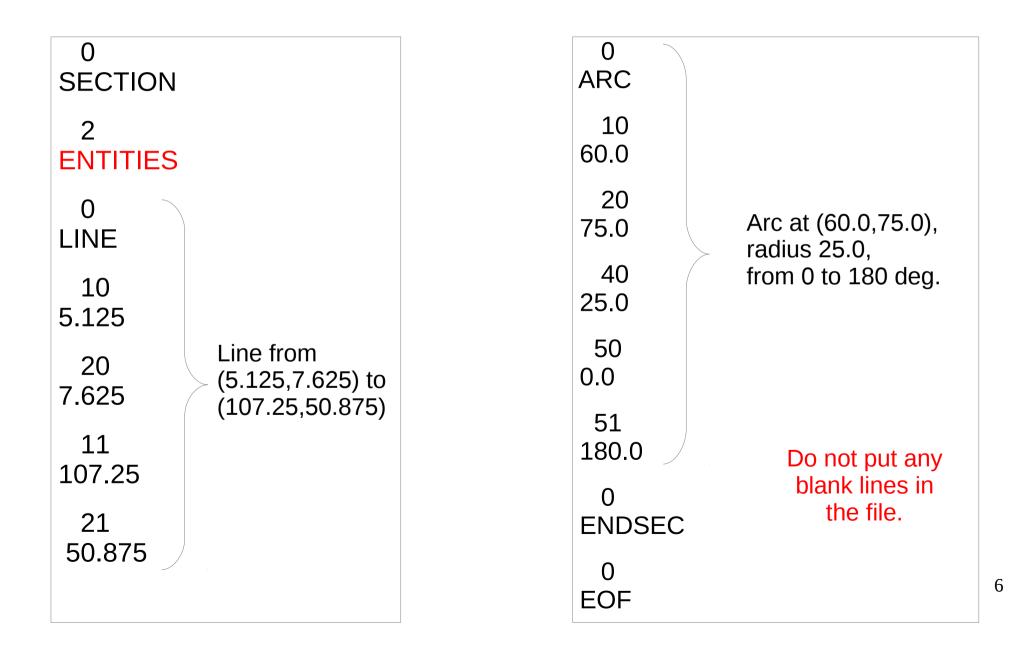
## Sections of a DXF File

- HEADER parameters such as units, min/max values
- CLASSES application-specific data
- TABLES line types, colors, layers, etc.
- BLOCKS macros for repeating entities
- **ENTITIES** where the lines and arcs are defined
- OBJECTS data for non-graphical objects
- THUMBNAILIMAGE
- END OF FILE

## Tagged Data Format

- Every element in a DXF file takes two lines:
  - Integer "group code" indicating the type of item
  - Value of the item (can be a number, string, etc.)
- Some common group codes:
  - 0: Entity type (string)
  - 2: Name of the entity (string)
  - 9: DXF variable name in header section (string)
  - 10, 20, 30: Primary X/Y/Z value (float)
  - 11, 21, 31: Secondary X/Y/Z value (float)
  - 40: radius

### DXF File: One Line and One Arc



## Python DXF Libraries

- Multiple DXF libraries exist for Python.
- **dxfwrite** is used in assignment #2:
  - Sets up reasonable header values and tables.
  - You can modify them if desired.
  - Provides primitives to make entities.
- **dxfgrabber** reads a DXF file and returns a Python structure with all the info.

### Using dxfwrite

from dxfwrite import DXFEngine as dxf
drawing = dxf.drawing('mypiece.dxf')

drawing.save()

## Graphics in Python

- Use Tkinter for simple on-screen graphics
- Create a Canvas widget, then add lines etc.
- Coordinates are in pixels; must be integers.
- Use mainloop() to have Tk render the canvas.

#### Drawing A Line With Tk

```
from Tkinter import *
master = Tk()
w = Canvas(master, width=800, height=800)
w.pack()
```

```
mainloop()
```

## Future Project: Vector Optimizer

- Drawing programs output vectors in seemingly random order.
- Laser cutting can go *much* faster if the vectors are ordered so as to minimize head motion with the laser off (not cutting = not useful).
- Many laser cutter drivers now include a vector optimizer, sometimes with user controls.
- Rabbit Laser's optimizer can be improved.