

IME 100 Interdisciplinary Design and Manufacturing

STL file format – CAD behind 3D Printing

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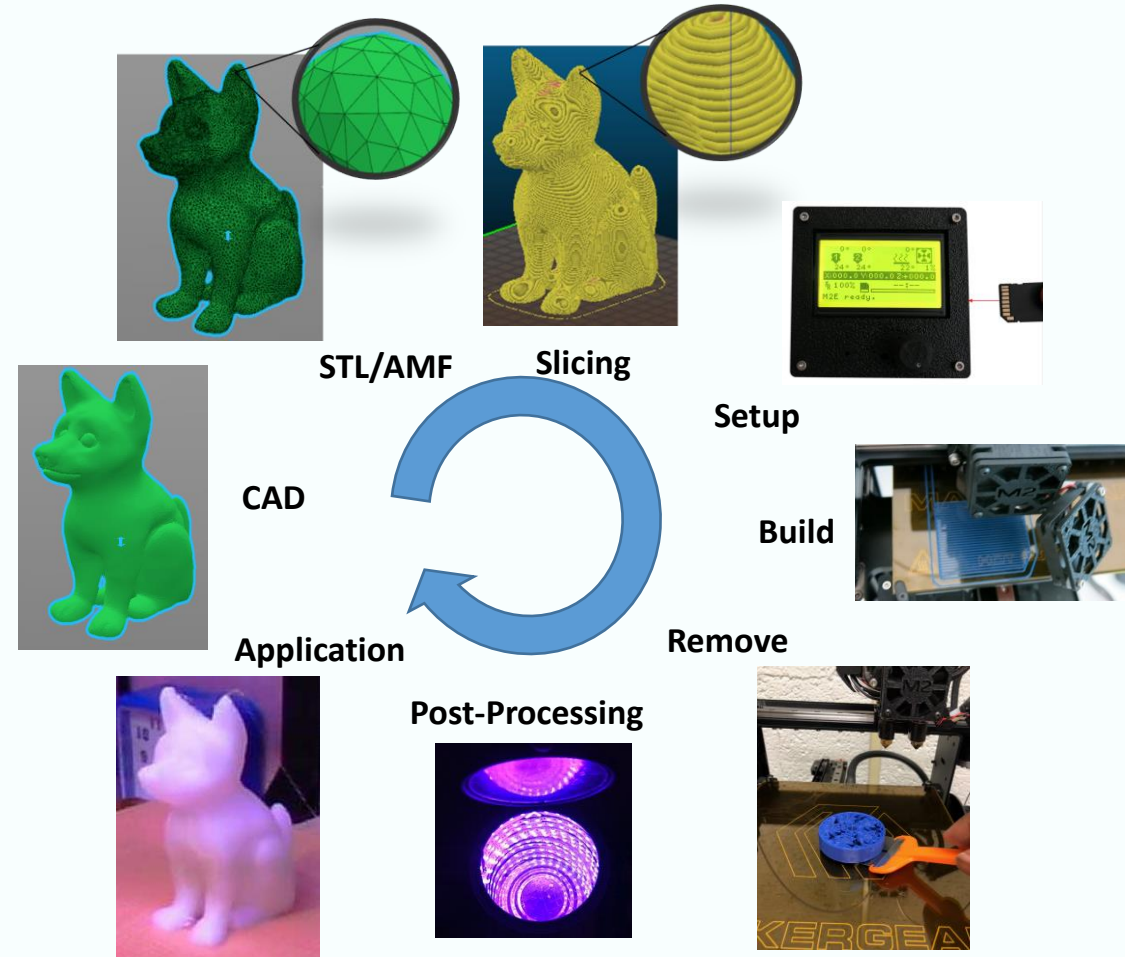


Announcements

- Toy deliverables are due on Friday
 - Website!
- Wednesday Lecture for **next week** we will have a visitor
 - Drop tests will be performed then for the toys (not today)



Additive Manufacturing Production Cycle

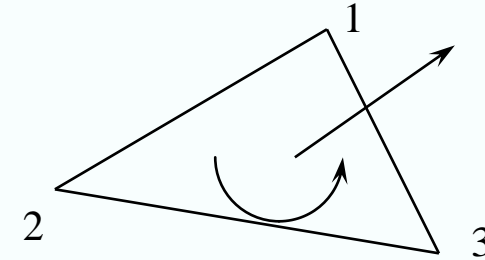


Additive Manufacturing Process Flow: CAD → STL/AMF → Slicing → Setup → Build (Print) → Remove → Post-Processing → Application
STL file source: www.thingiverse.com/thing:38493



STL Format

- STL, derived from StereoLithography. (or Standard Tessellation Language)
- Tessellated triangular facet model.

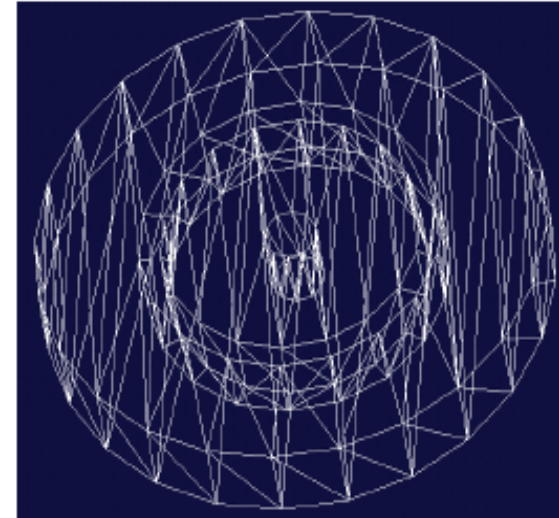
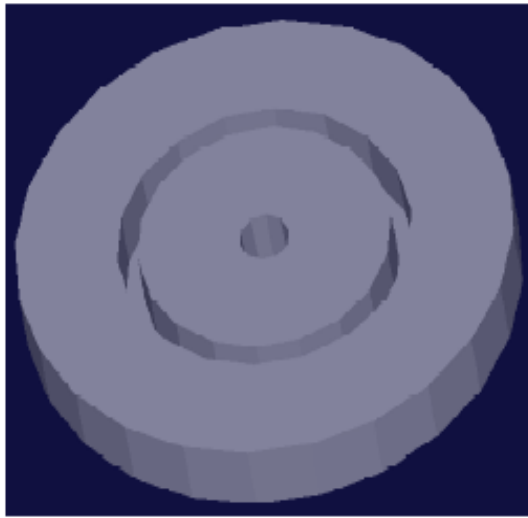


ASCII

```
solid name
    facet normal Ax Ay Az
        outer loop
            vertex x1 y1 z1
            vertex x2 y2 z2
            vertex x3 y3 z3
        endloop
    endfacet
endsolid name
```

Can be Binary as well





solid example

```
facet normal 6.89114779E-02 -9.96219337E-01 -5.28978631E-02
```

```
outer loop
```

```
vertex 2.73239994E+01 1.08957005E+01 4.57905006E+01
```

```
vertex 2.81019993E+01 1.09582005E+01 4.56250000E+01
```

```
vertex 2.75955009E+01 1.09116001E+01 4.58456993E+01
```

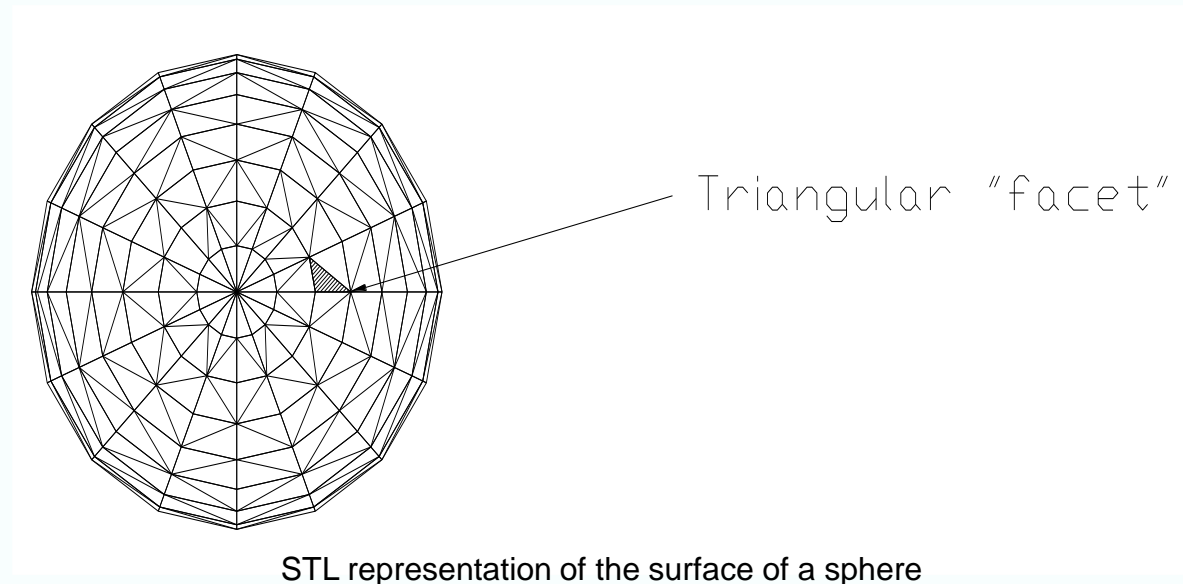
```
endloop
```

```
endfacet
```

```
:
```



STL representation

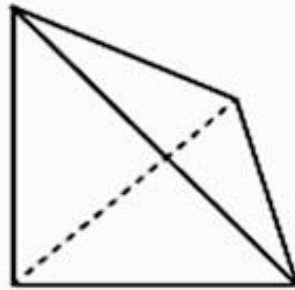


STL is the standard for AM industry. The success stems from its simplicity and sufficiency. It describes a solid using B-rep technique. An STL file format represents an object as a collection of triangular facets. For each facet, a normal vector is needed to indicate the outer surface of the model.



STL of a Triangular Pyramid

```
solid triangular_pyramid
  facet normal 0.0 -1.0 0.0
    outer loop
      vertex 0.0 0.0 0.0
      vertex 1.0 0.0 0.0
      vertex 0.0 0.0 1.0
    endloop
  endfacet
  facet normal 0.0 0.0 -1.0
    outer loop
      vertex 0.0 0.0 0.0
      vertex 0.0 1.0 0.0
      vertex 1.0 0.0 0.0
    endloop
  endfacet
  facet normal 0.0 0.0 -1.0
    outer loop
      vertex 0.0 0.0 0.0
      vertex 0.0 0.0 1.0
      vertex 0.0 1.0 0.0
    endloop
  endfacet
  facet normal 0.577 0.577 0.577
    outer loop
      vertex 1.0 0.0 0.0
      vertex 0.0 1.0 0.0
      vertex 0.0 0.0 1.0
    endloop
  endfacet
endsolid
```

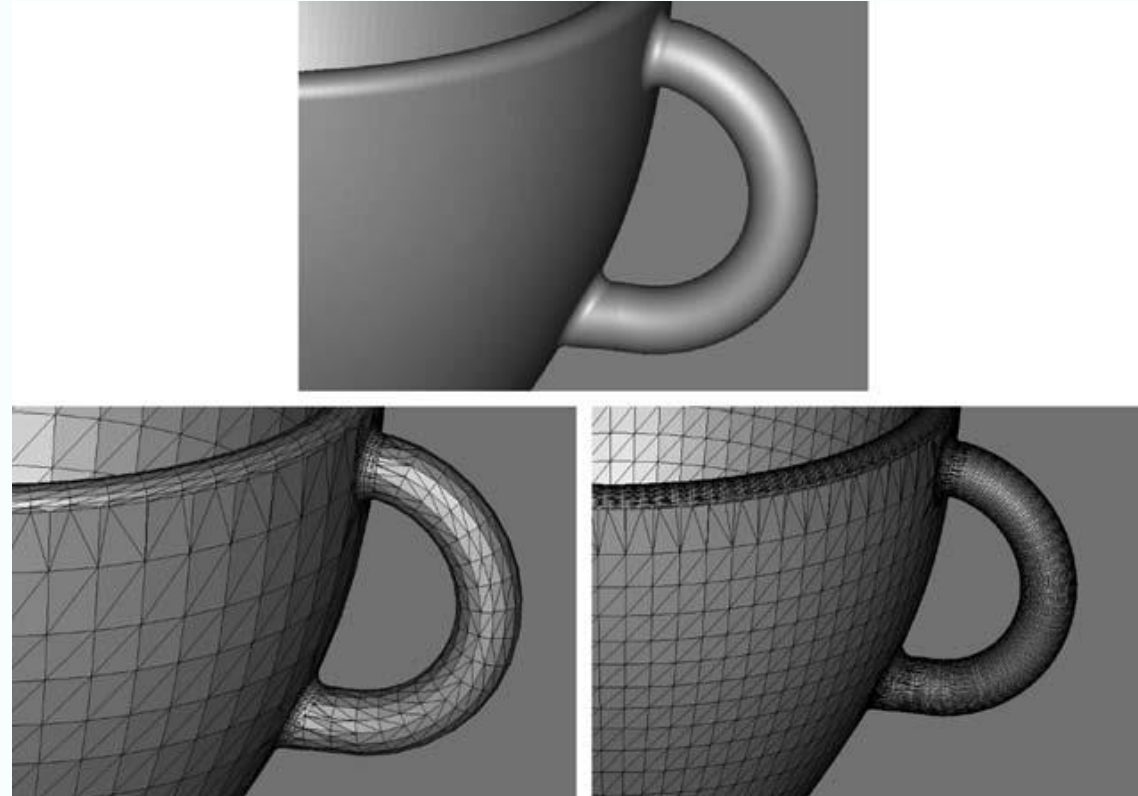


Binary STL File

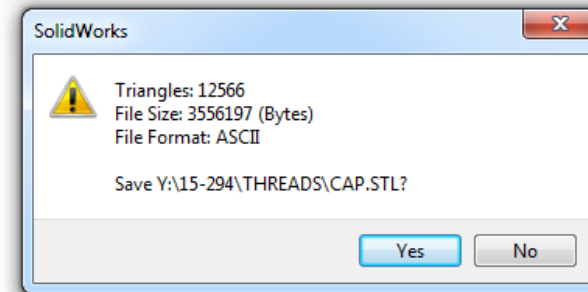
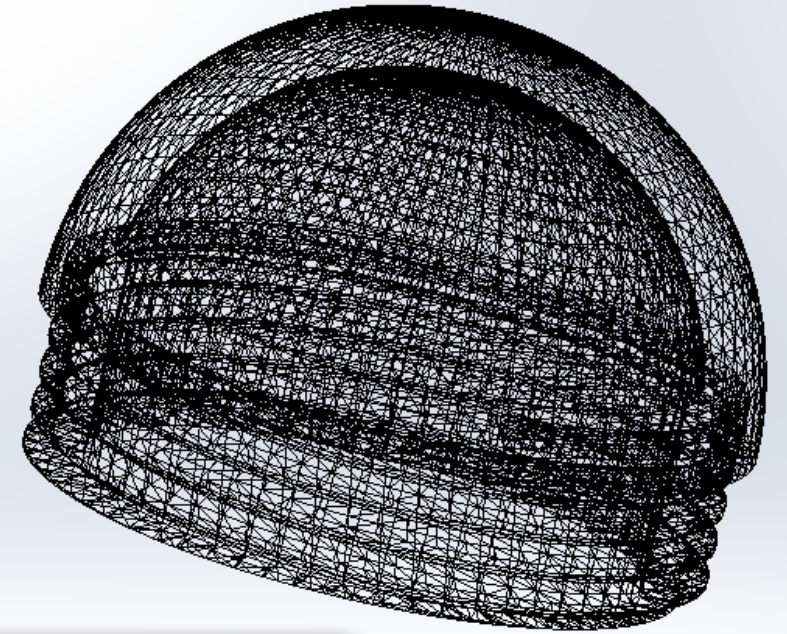
- ASCII files consume more storage
- Binary version is more efficient
 - Header:
 - – An 80-byte ASCII header that can be used to describe the part
 - – A 4 byte unsigned long integer that indicates the number of facets in the object
 - – A list of facet records, each 50 bytes long
 - The facet record :
 - – 3 floating values of 4 bytes each to describe the normal vector
 - – 3 floating values of 4 bytes each to describe the first vertex
 - – 3 floating values of 4 bytes each to describe the second vertex
 - – 3 floating values of 4 bytes each to describe the third vertex
 - – One unsigned integer of 2 bytes, that should be zero, used for checking



Accuracy Control

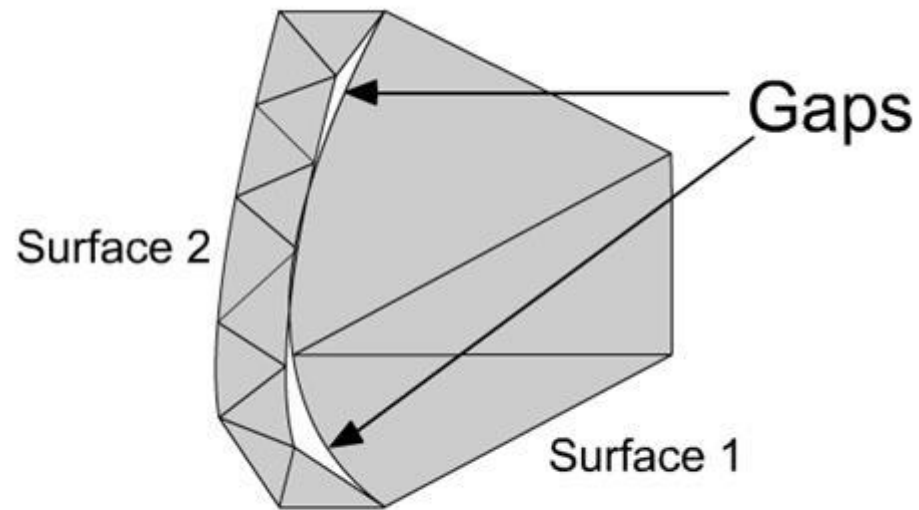


Solidworks – Save as STL

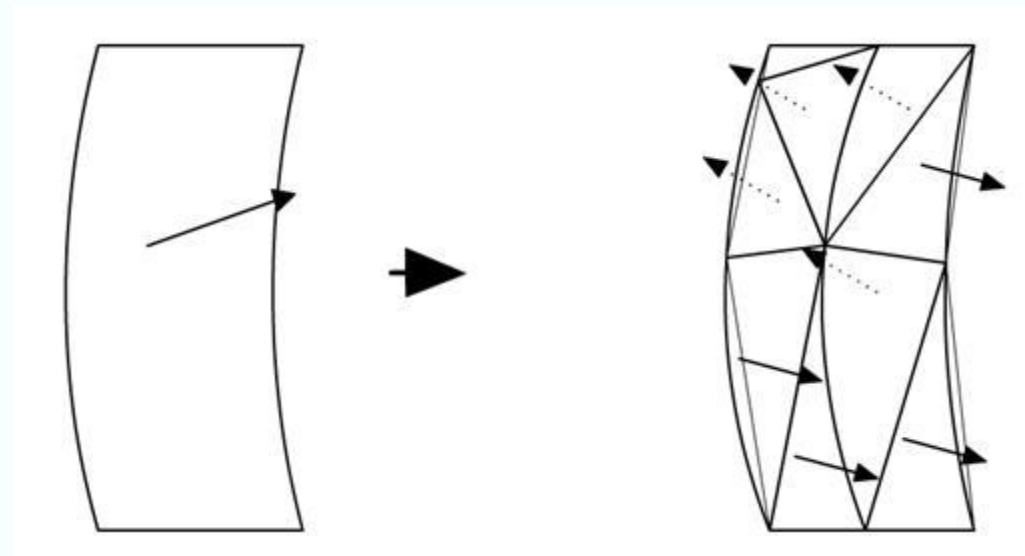


Problems with STL File Format

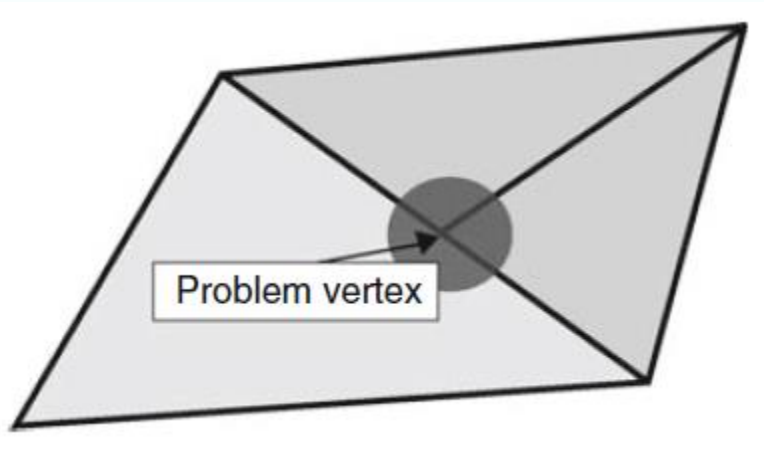
- **Problem 1: Gaps created in STL conversion**



- **Problem 2: Inconsistent normals**



- Problem 3: Strict vertex to vertex rule



Adjacent faces should share the same two vertices



Class Activity



Class Activity

- Create an **ascii** STL for the ASTM dogbone file modeled by you shown
- You may use Fusion to create the Binary STL file and then convert it to ascii on Cura. Or directly convert the file by right clicking the body and exporting as an ascii stl file
- You may use notepad or any word processor to then open the file
- Replace the term ASCII in the STL text with your name.
- This will be due for **class participation points** for today's lecture. Submit the revised file at the link provided in week 8 page on blackboard

