i s t a n b u l **t** e c h n i c a l **u** n i v e r s i t y
architectural **d**esign **c**omputing **g**raduate **p**rogram
dads 2011: a springtime venture

The Digital Shape or...
Mind the Gap Reloaded!

Lecture IV
Geometric Primitives and Transformations

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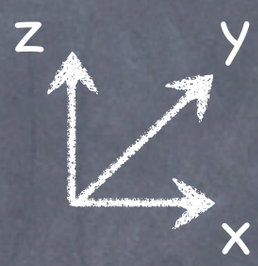
The story starts with a point...

2D

(Px, Py)

(Px, Py, Pz)



3D

A point in the N-D space is represented by an ordered N-tuple of numbers.

Any two points can be joined by a line segment.

The length of the segment is the shortest distance between the two points.

The line segment can be extended indefinitely on both sides... Doing so, one obtains a line.

There are many ways to represent a line.
[see whiteboard]

Lines can intersect...

... or can be parallel. How can you tell?
[see whiteboard]

A special case of intersection is perpendicularity, which occurs when lines meet at right angles.

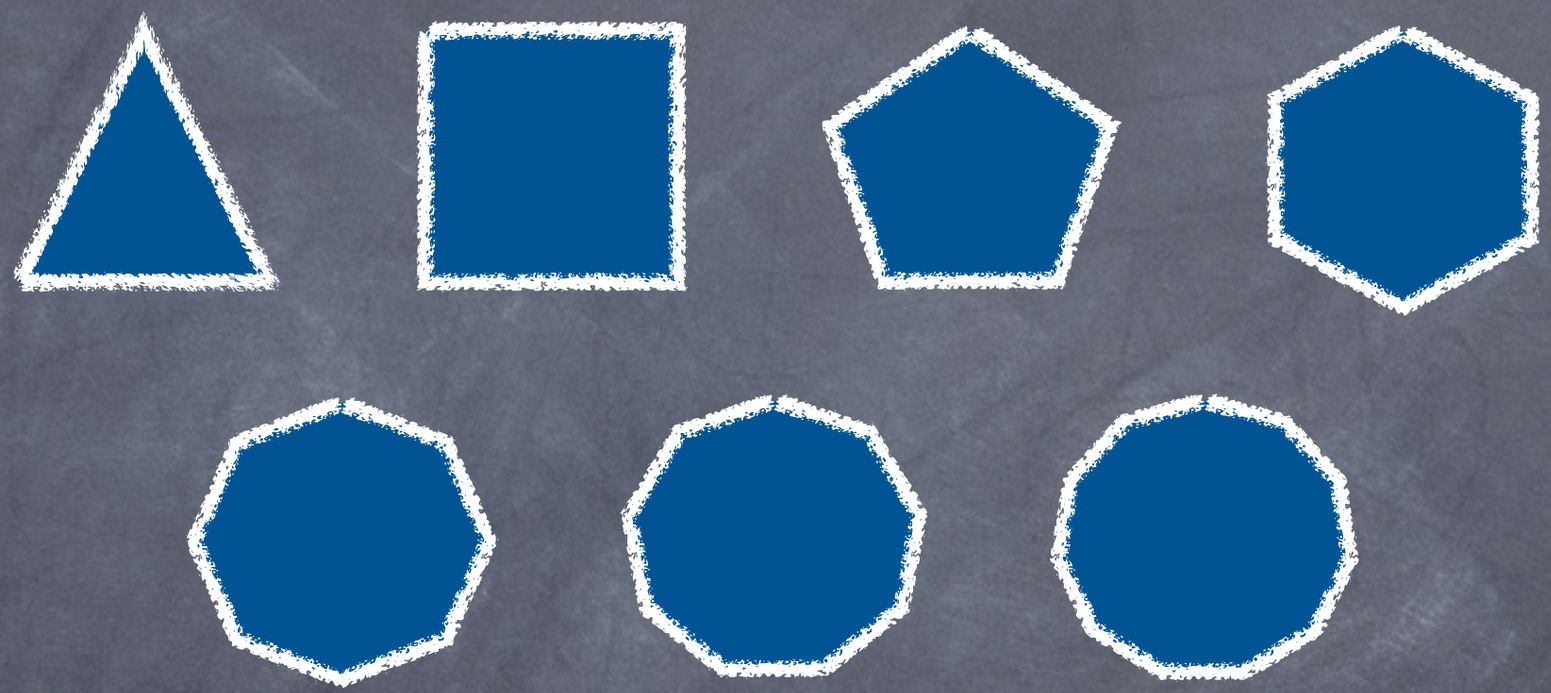
When a line is bent locally,
one obtains a curve.

Like a line, a curve is a set of points
satisfying a certain algebraic condition.

Take a circle for instance...
How would you represent a circle?

... or an ellipse?

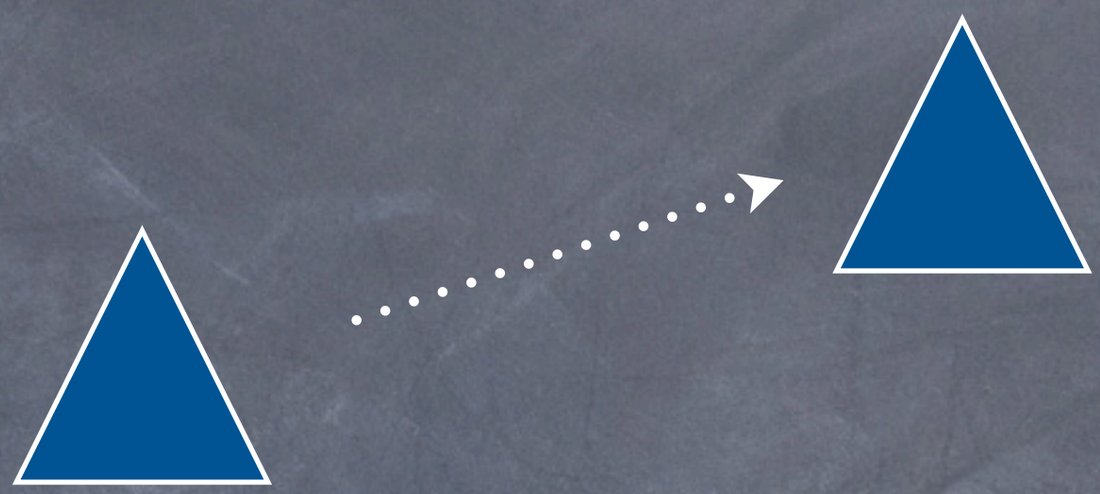
When you fill in a closed curve, you obtain a region.
What does “filling in” mean?



Inside of polygons are well known examples.

In the limit, a polygon becomes a disc.

Certain regions are convex... certain aren't.



Objects can be translated.

They can be rotated.

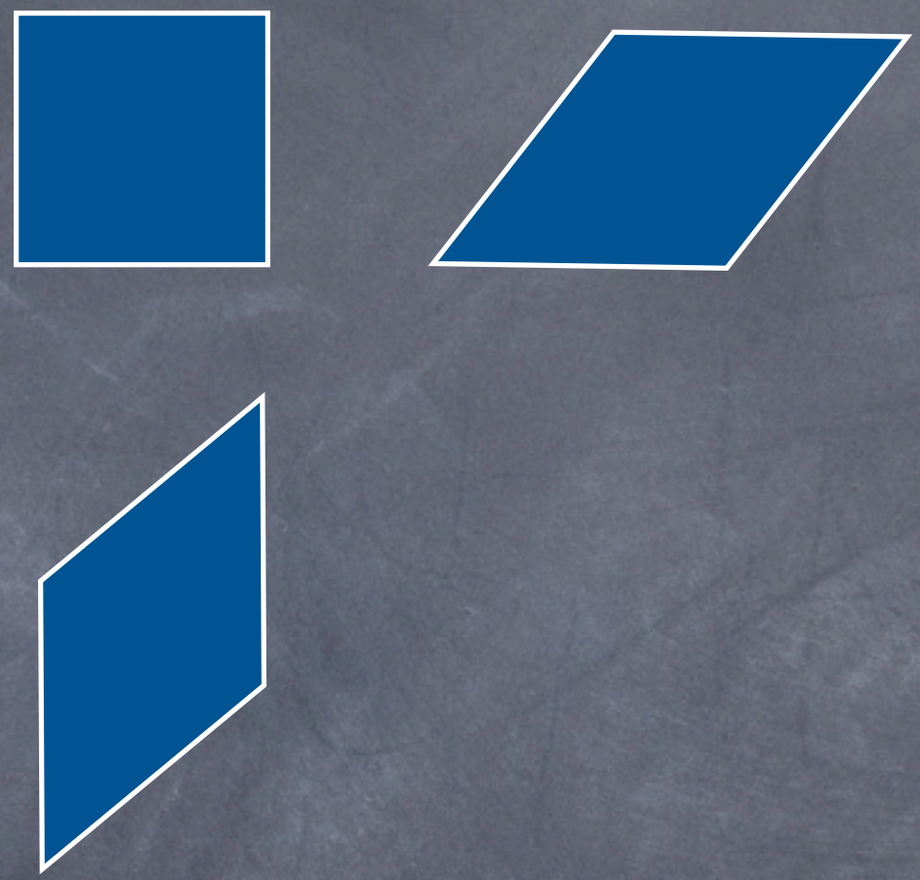
Objects can be translated then rotated.

Such movements are Euclidean Motions.

Euclidean Motions don’t alter shape.

Objects can be scaled isotropically

... or anisotropically!



Shear is another type of transformation...
it significantly alters shape!

Objects can be translated, rotated, then isotropically scaled.

Such operations are Similarity Transformations.

If size is not an intrinsic property of shape, then Similarity Transformations don’t alter shape neither.

Objects can be reflected.

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Whether reflections alter shape or not
is a matter of semantic context.

Summary of Transformations

Transformation	Class	Invariance
Translation Rotation	Euclidean	length, angle, parallelism
+Isotropic scaling	Similarity	angle, parallelism
+Anisotropic scaling +Shear	Affine	parallelism