3 Important things to know about 3D GIS

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Esri

2018 Esri Mid-Atlantic User Conference

The 3 3D things

1. 3D data structure, storage
2. Creating 3D Data, editing
3. 3D Basemaps(Digital Twin)

Questions?

3D Data Structure and Storage

3D Thing to know #1

Fundamentals of 3D GIS data

There are two basic types of 3D GIS data:

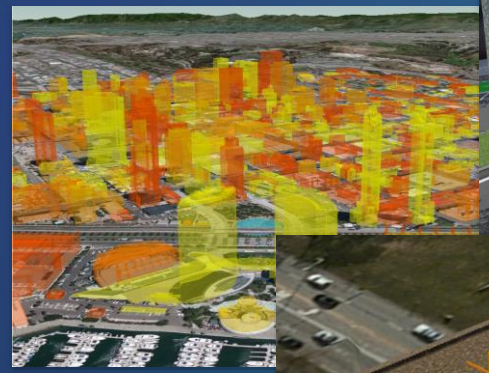
Feature data

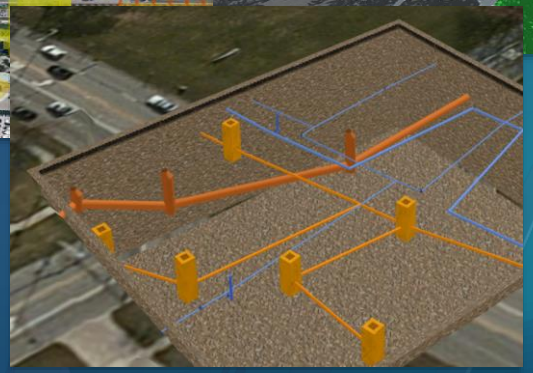
Surface data

Feature Data

Feature data represents discrete objects, and the 3D information for each object is stored in the feature's geometry.

X,Y, and Z stored in the SHAPE field.





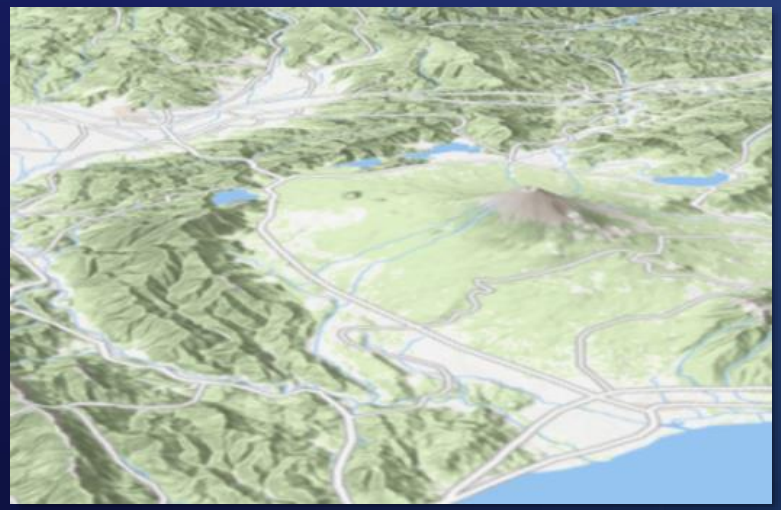
3D Feature data types

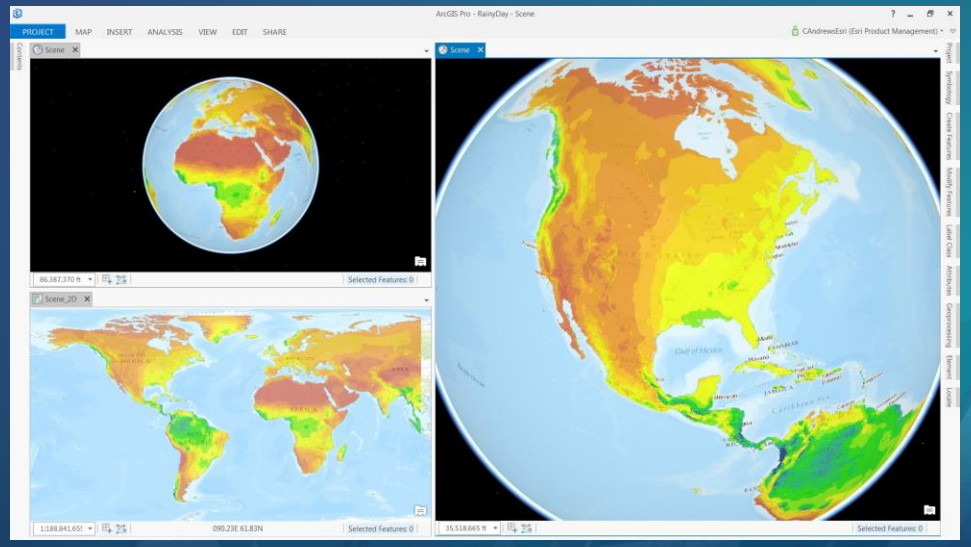
- PointZ
- LineZ
- PolygonZ
- Point Clouds
- 3D Mesh
- Multipatches

Surface Data

Surface data represents height values over an area, and the 3D information for each location within that area can be either stored as cell values or deduced from a triangulated network of 3D faces.

X,Y and (Value) are stored in the cell or vetices of triangles

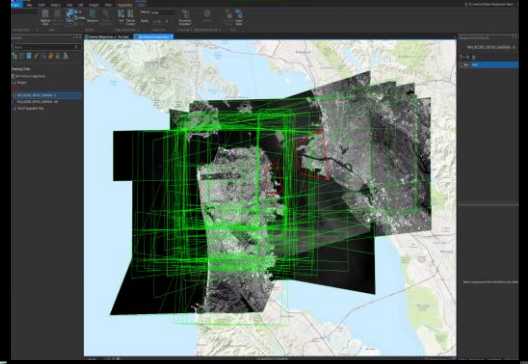




3D Surface data types

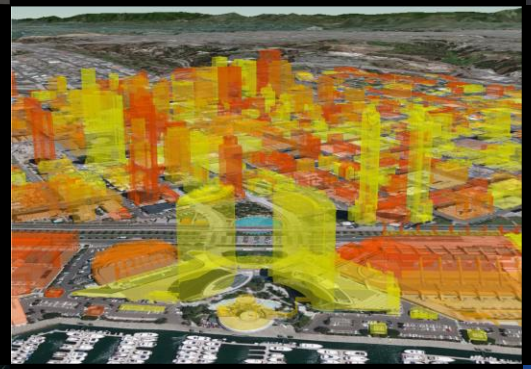
- Raster
- TIN – Triangular Irregular Network
- LAS Dataset
- Terrain Dataset

Lidar



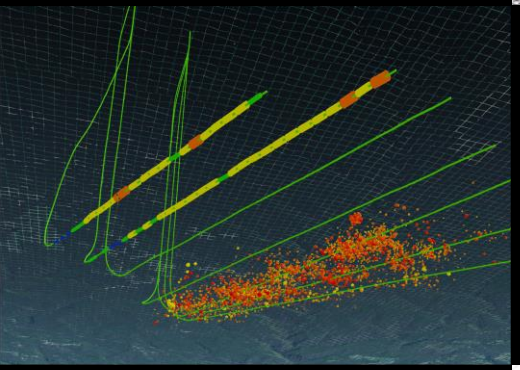
Oblique photogrammetry

BIM



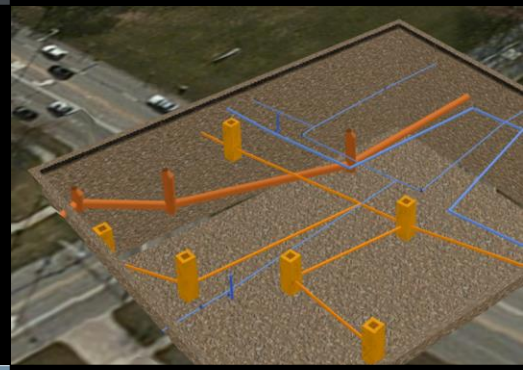
Indoor & subsurface scanning

Real-time (4D)



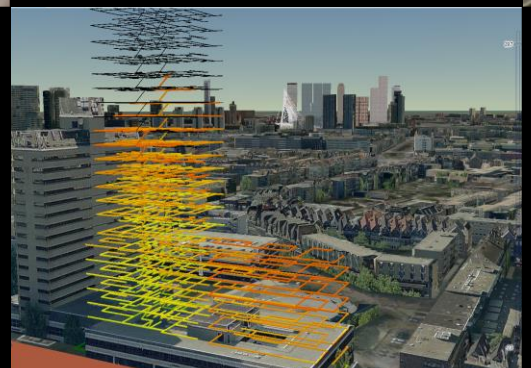
IoT

Textured Meshes



FMV

Spherical & panoramic imagery



UAV

What are 3D point features?

A point feature is a GIS object that stores its geographic representation—an X and Y coordinate pair—as one of its properties (or fields) in the row in the database.

3D point features embed their z-coordinates inside the geometry, or Shape field, of their feature class.

This means that z-values are automatically included with every new point feature, allowing it to represent any 3D position in space—regardless of whether that point is on, above, or below the ground.

What are 3D polyline features?

A line feature is a GIS object that stores its geographic representation—a series of x and y coordinate pairs—as one of its properties (or fields) in the row in the database.

3D line features embed their z-values inside the geometry, or Shape field, of their feature class.

This means that z-values are automatically included with every new vertex created for the 3D line, allowing it to connect any two points together, regardless of whether they are on, above, or below the ground.

What are 3D polygon features?

A polygon feature is a GIS object that stores its geographic representation—a series of x and y coordinate pairs that enclose an area—as one of its properties (or fields) in the row in the database.

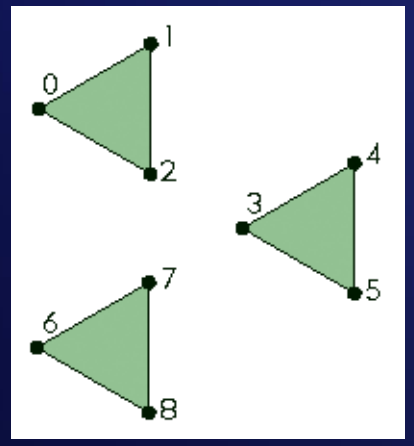
3D polygon features store z-coordinates embedded inside their feature geometry, or Shape field, of their feature class.

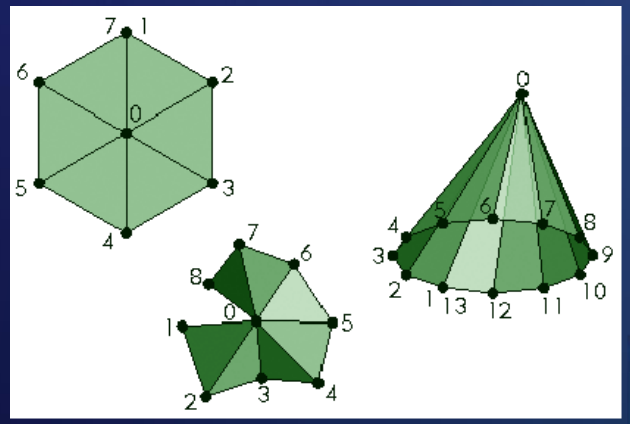
This means that z-values are automatically included with every new vertex created for the 3D polygon, allowing its perimeter to connect any two points together—regardless of whether they are on, above, or below the ground.

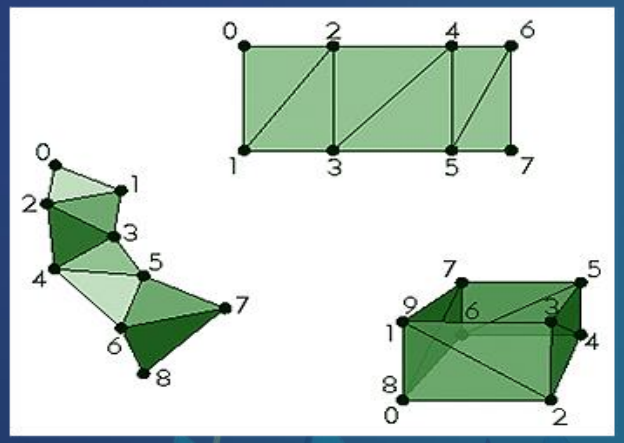
What are multipatch features?

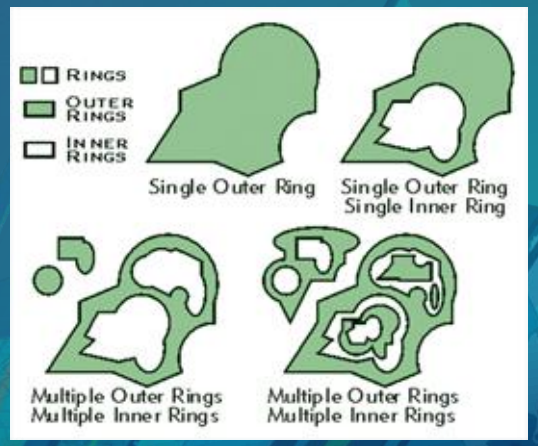
A multipatch feature is a GIS object that stores a collection of patches to represent the boundary of a 3D object as a single row in a database.

Patches store texture, color, transparency, and geometric information representing parts of a feature. The geometric information stored in a patch may be triangles, triangle fans, triangle strips, or rings.









Math Alert !

Only 3 slides ☺

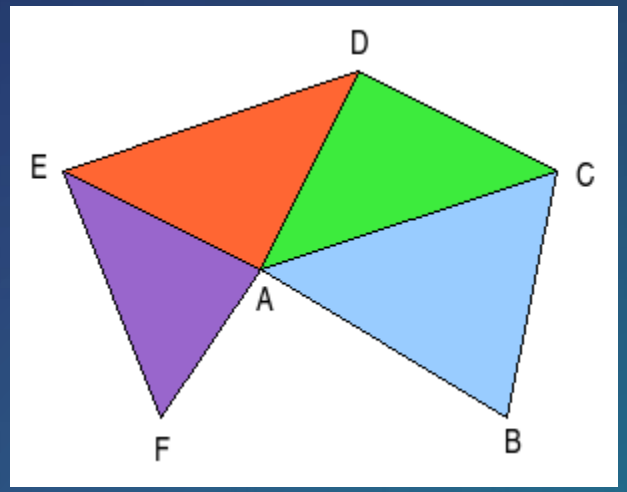
Triangle Fan

From Wikipedia, the free encyclopedia

A **triangle fan** is a primitive in 3D computer graphics that saves on storage and processing time.

It describes a set of connected triangles **that share one central vertex** (unlike the triangle strip that connects the next vertex point to the last two used vertices to form a triangle). If N is the number of triangles in the fan, the number of vertices describing it is N+2. This is a considerable improvement over the 3N vertices that are necessary to describe the triangles separately.

The graphics pipeline can take advantage by only performing the viewing transformations and lighting calculations once per vertex.



Set of connected triangles described by vertices A through F.

Triangle Strip

From Wikipedia, the free encyclopedia

A **triangle strip** is a series of connected triangles, sharing vertices, allowing for more efficient memory usage for computer graphics.

They are more efficient than triangle lists without indexing, but usually equally fast or slower than indexed triangle lists.[1][2] The primary reason to use triangle strips is to reduce the amount of data needed to create a series of triangles.

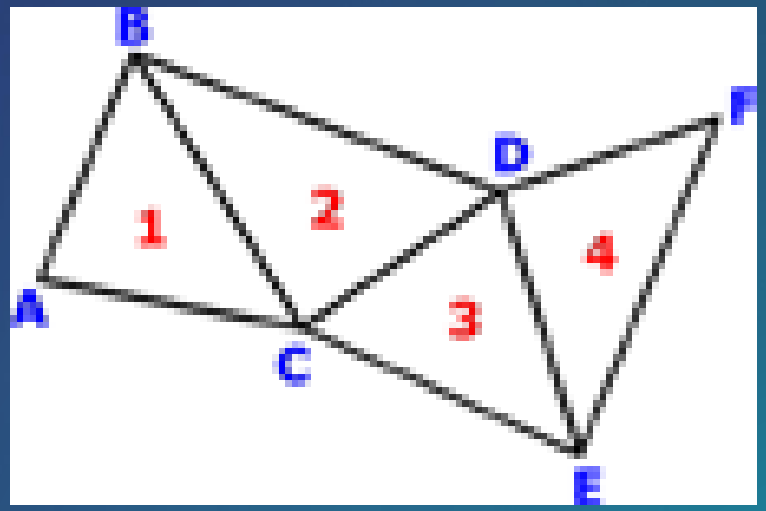


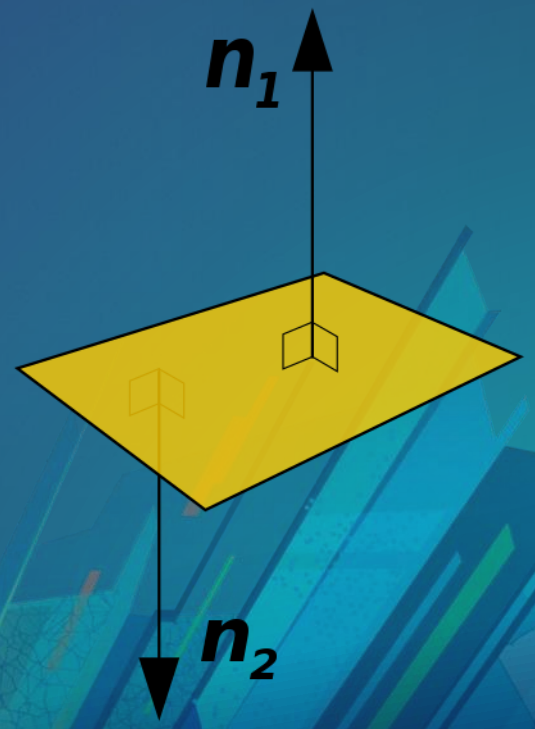
Diagram of four triangles, 1, 2, 3, and 4, with vertices A, B, C, D, E, and F.

Normal(geometry)

From Wikipedia, the free encyclopedia

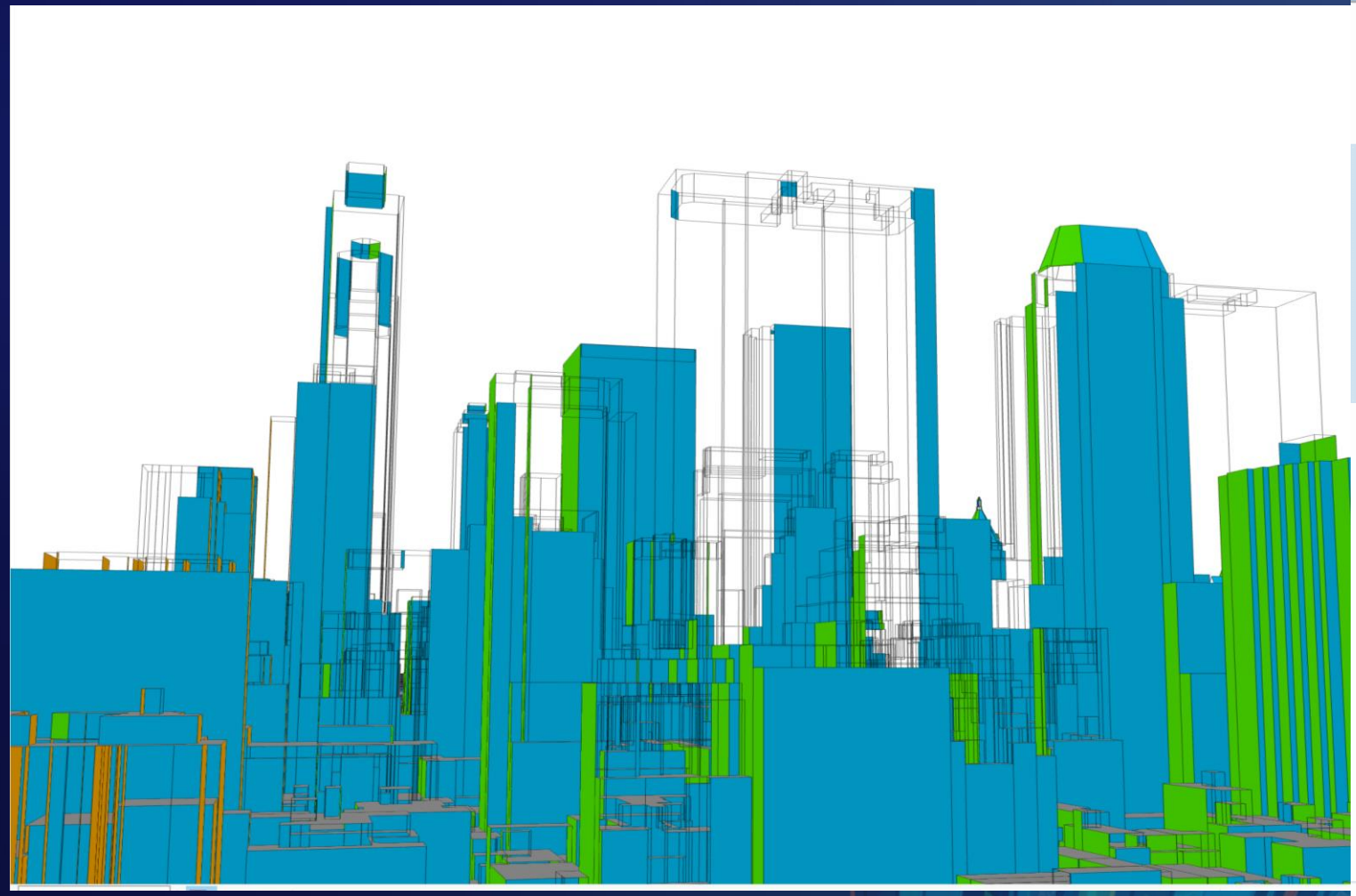
In geometry, a **normal** is an object such as a line or vector that is perpendicular to a given object.

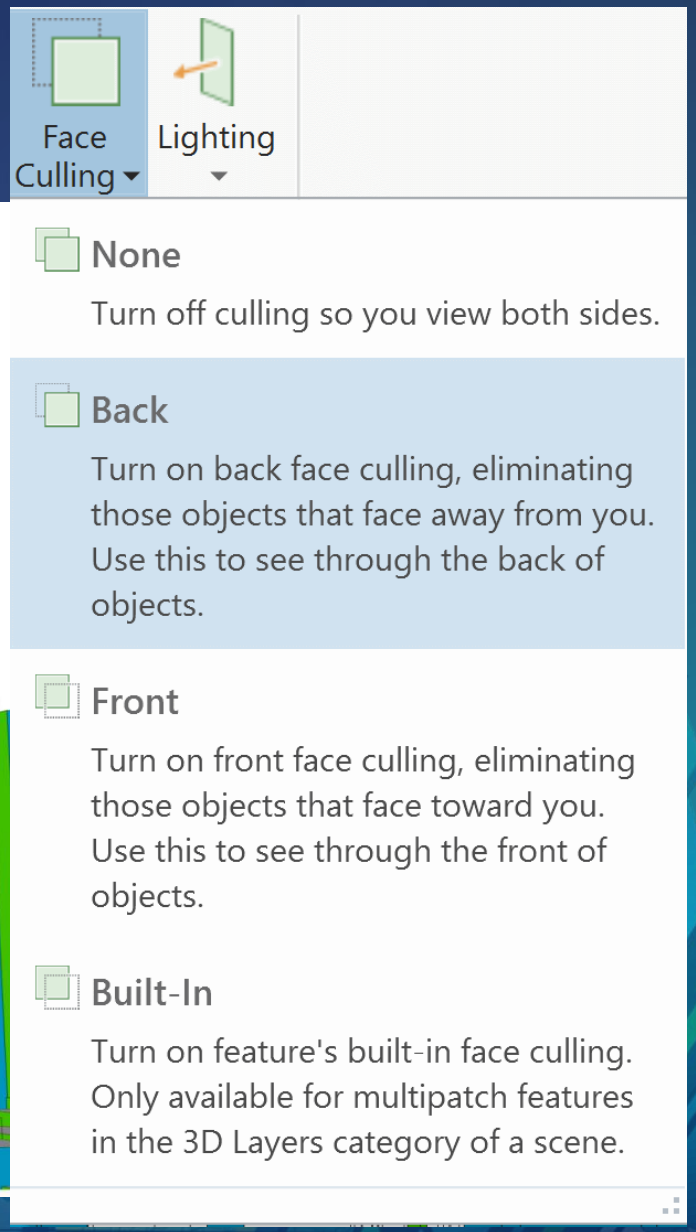
The normal is often used in computer graphics to determine a surface's orientation toward a light source for flat shading, or the orientation of each of the corners (vertices) to mimic a curved surface with Phong shading.



Face culling

Get your normals normal





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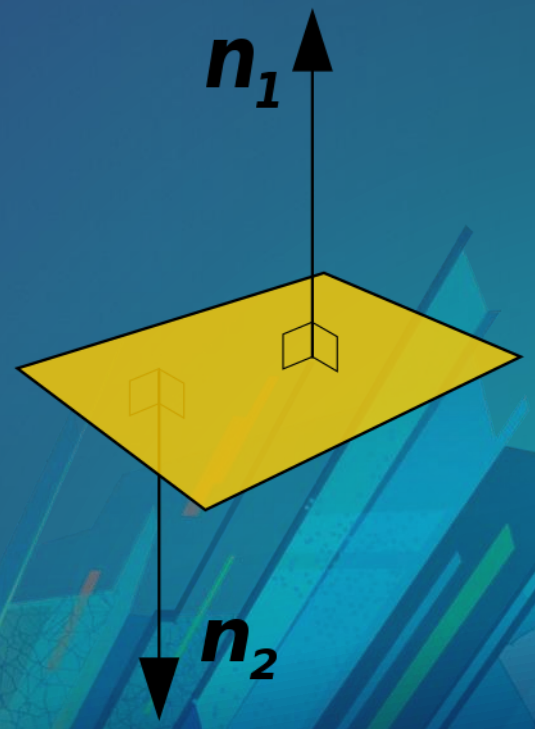


Creating 3D Data, editing

3D Thing to know #2

How do I create 3D point, line or polygon features?

Create z-enabled point feature class

Edit Tab→ Create Feature

Select in Edit toolbar where z’s are coming from

Select template tool and click location, digitize line, or create polygon.

Run Feature to 3D by attribute on a 2D point feature class

How do I create multipatch features?

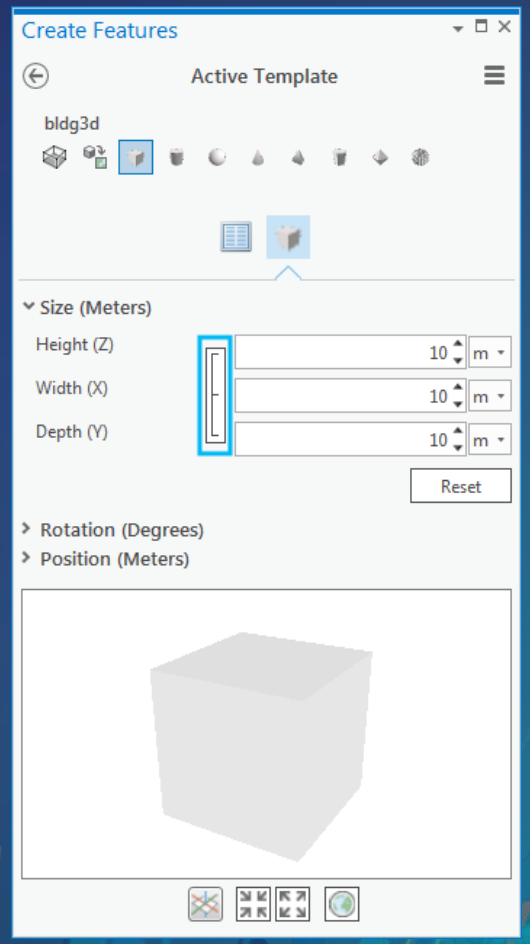
Multipatch features can be created by importing existing 3D models into ArcGIS using geoprocessing tools or manual 3D editing tools.

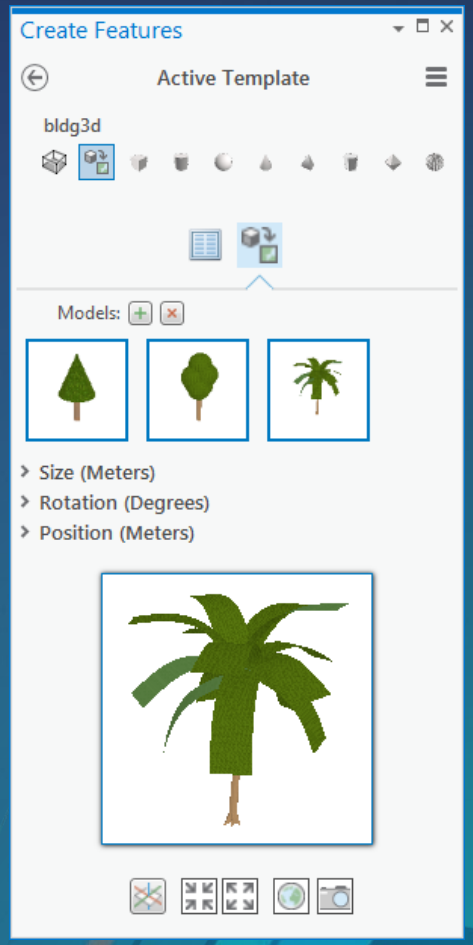
- In the Create Features pane, the Model File will allow you to add a model to a scene, the model is imported to the target geodatabase multipatch feature class.
- The Layer 3D To Feature Class geoprocessing tool will convert points symbolized by a variety of model formats (such as SketchUp, OpenFlight, 3ds, or COLLADA) to a multipatch feature class.
- The Import 3D Files geoprocessing tool will do the same but provides more import format options such as VRML.
- Multipatch features can be constructed programmatically using ArcObjects

Create multipatch features manually

Construction tools that enable you to create multipatch features from standard predefined 3D shapes, or by directly loading 3D models and placing them in the scene.

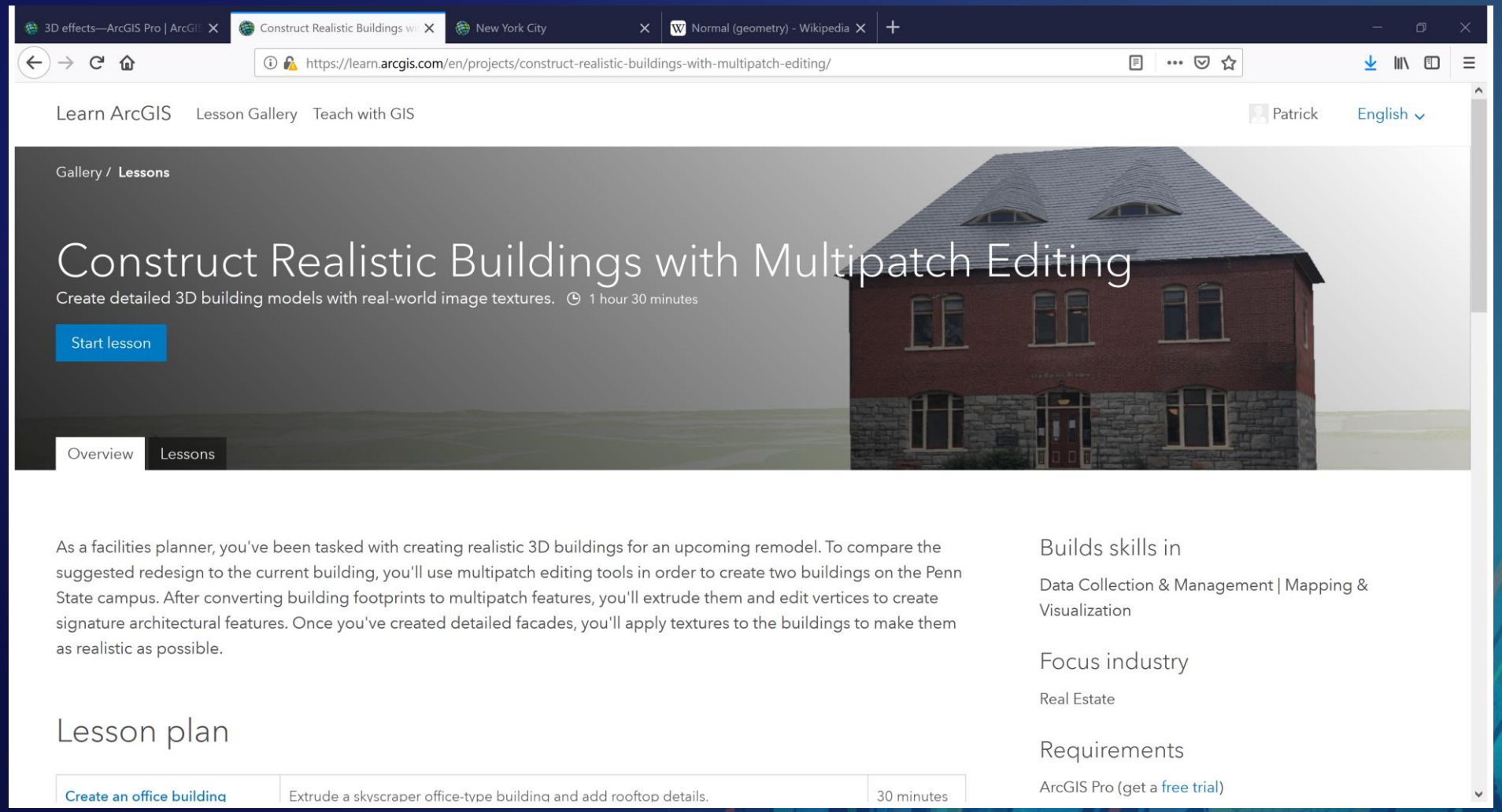
Start with a single 3D face and develop your feature using an additive workflow.





Homework

- **https://learn.arcgis.com/en/projects/construct-realistic-buildings-with-multipatch-editing/**



3D Data: Structure and Editing

Demo

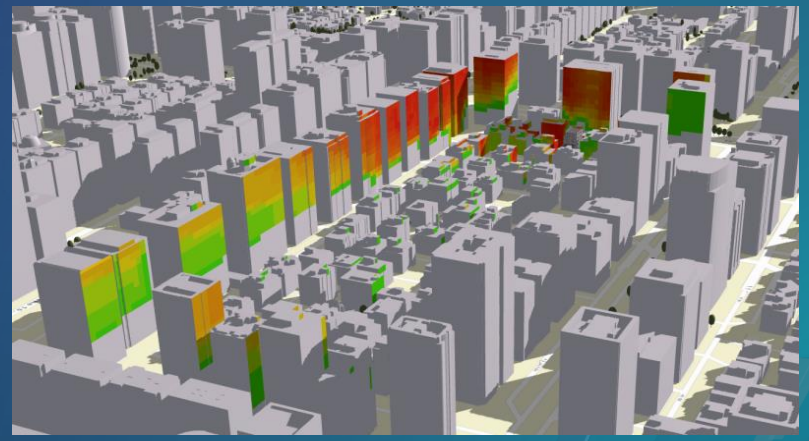
3D Basemaps / Digital Twin

3D Thing to know #3

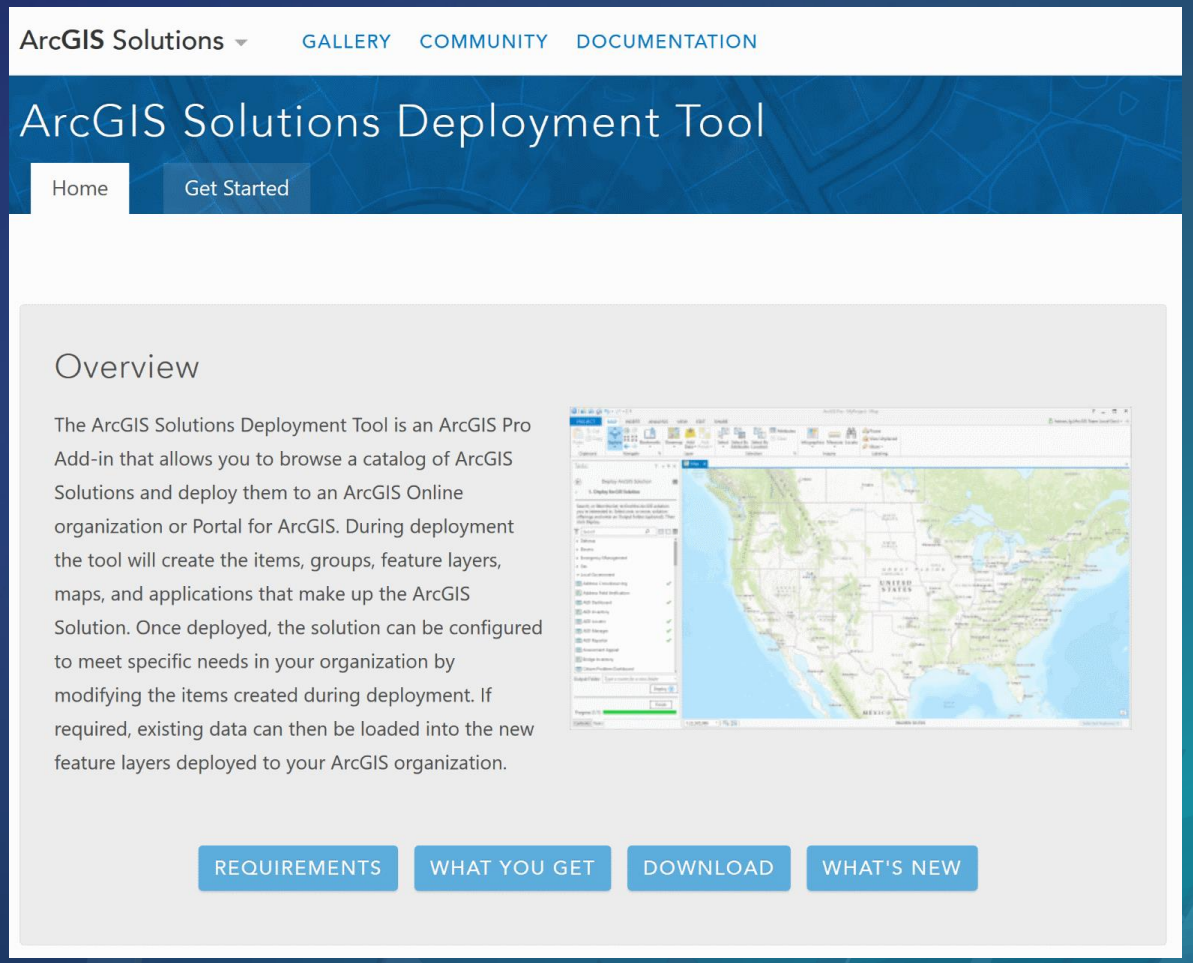
3D in Solutions

- **December 2015**
  - **Local Government scenes (LOD1)**

- **February – May 2016**
  - **Local Government base scenes (LOD2 / LOD3)**
  - **Review proposed development**
    - **Visualize development in context**
    - **Analyze shadow, visibility, solar exposure**
    - **Assess zoning compliance**
    - **Receive feedback**

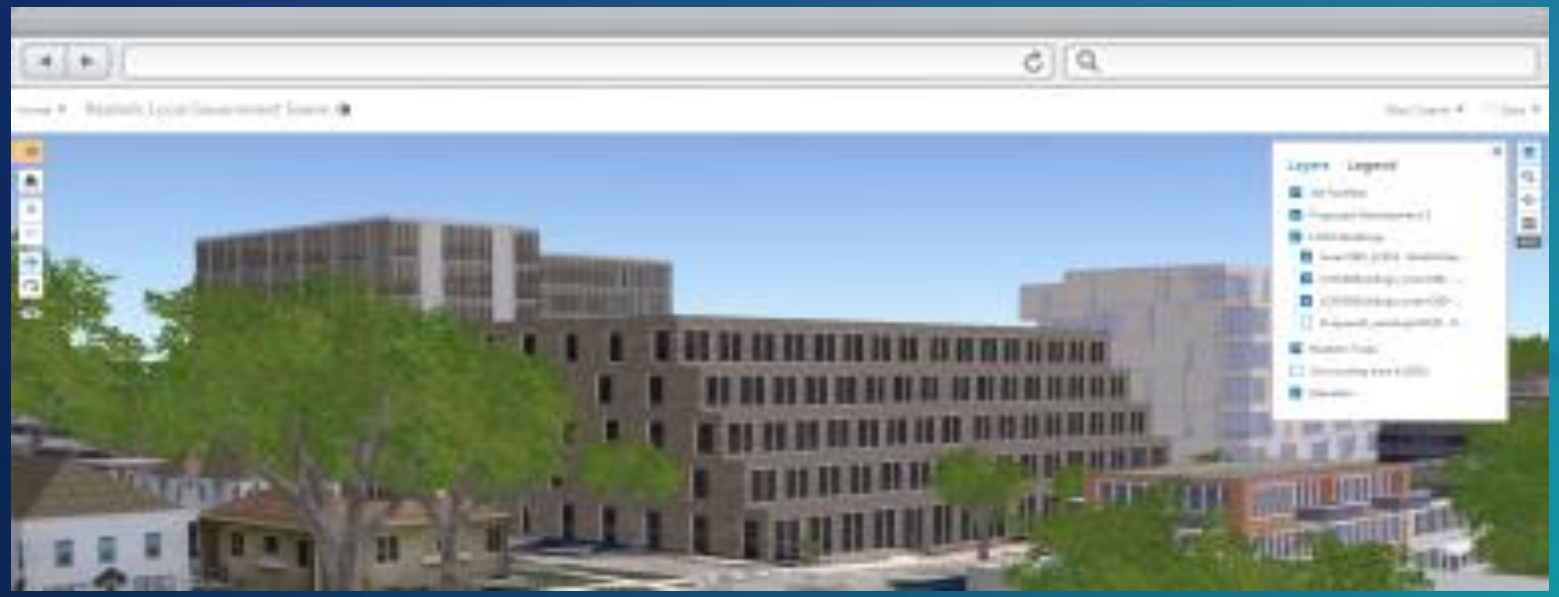


ArcGIS Solutions Deployment Tool



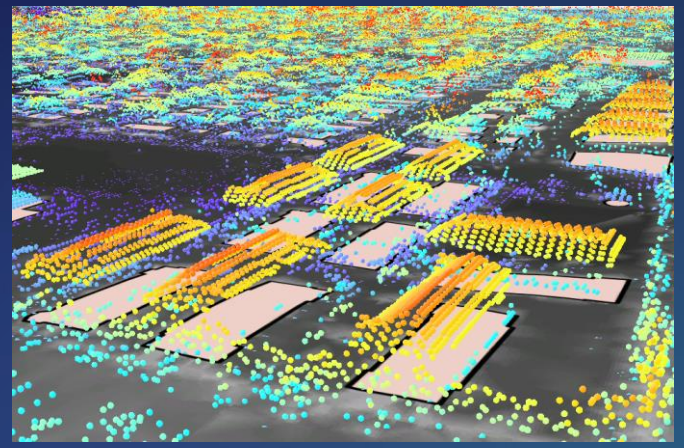
3D Basemap Solution

Publish 3D Basemaps
A collection of local government 3D basemaps that serve as a foundation for desktop, mobile and web mapping applications

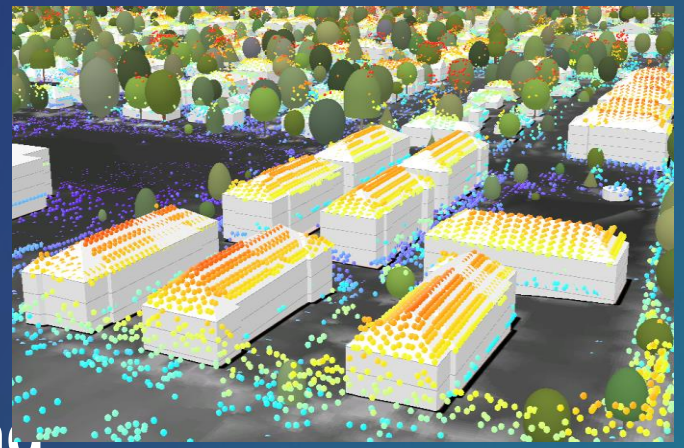


Example 3D Solutions User Story

- **Create the Scene**
  - Elevation layer
  - LOD2 buildings with floor information
  - Simple trees
  - Zoning volumes
- **Publish Scene to Portal for consumption in ArcGIS Pro and web scene**
- **Author the Scene in the Web Scene Viewer**



Building footprints
+ Lidar



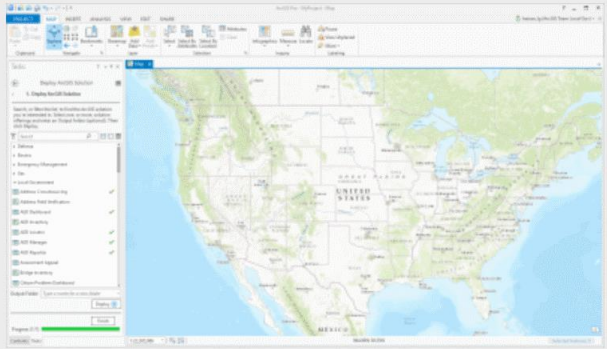
LOD2 Buildings
+ Schematic Trees

Schematic Local
Government Scene

Home | Get Started

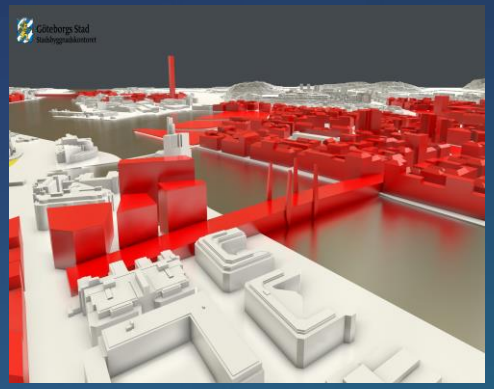
Overview

The ArcGIS Solutions Deployment Tool is an ArcGIS Pro Add-in that allows you to browse a catalog of ArcGIS Solutions and deploy them to an ArcGIS Online organization or Portal for ArcGIS. During deployment the tool will create the items, groups, feature layers, maps, and applications that make up the ArcGIS Solution. Once deployed, the solution can be configured to meet specific needs in your organization by modifying the items created during deployment. If required, existing data can then be loaded into the new feature layers deployed to your ArcGIS organization.

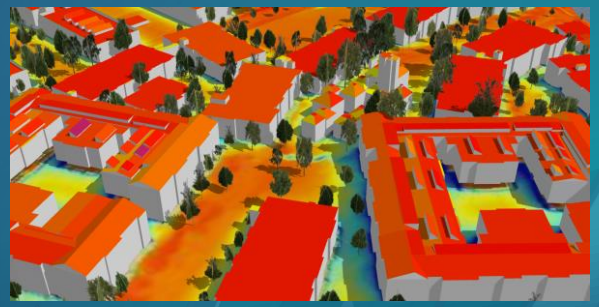


Solutions Deployment Tool and 3D Basemaps

Where to find out more about Esri 3D



- Sample scenes in the ArcGIS Online gallery
- 3D in Esri Story Maps
- Esri 3D landing page
- ArcGIS Earth landing page
- ArcGIS Earth intro blog
- I3S open specification (for data providers)
- 3D Mapping space on GeoNet
- Message in a Bottle JS example



Questions?

Thank you for attending!

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