ONLINE MAPPING

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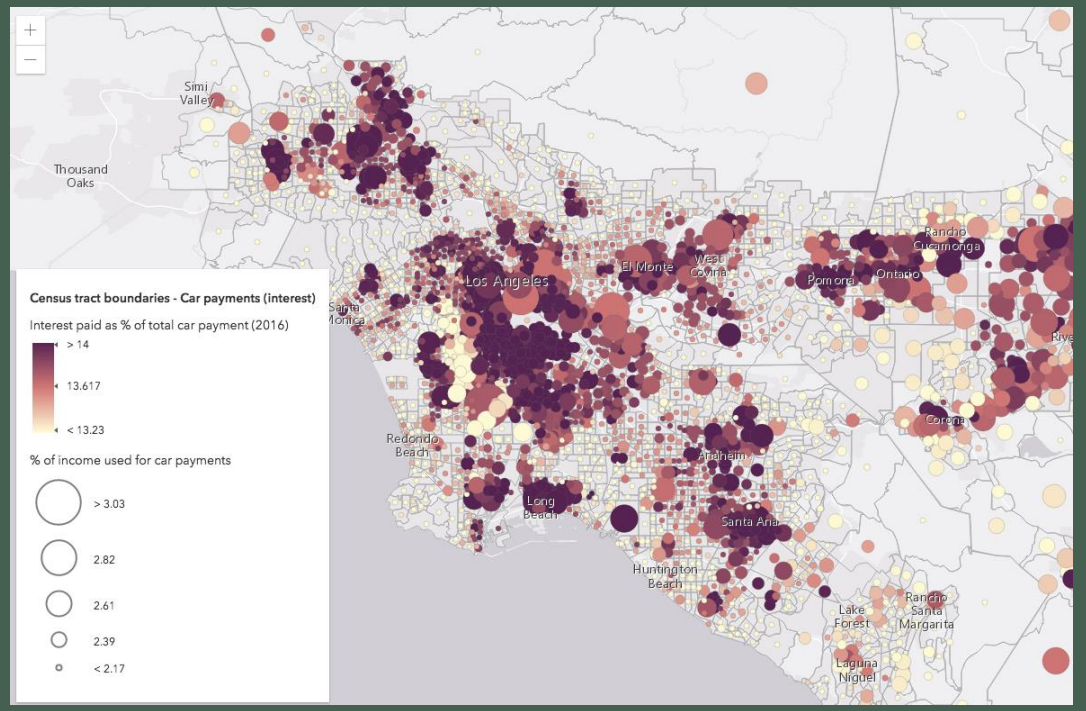
CONTINUING EDUCATION

INTRODUCTION

- Online mapping or Web mapping is a process of compiling and delivering geospatial data in the form of an interactive web application
- Allows users to visualize and interact with geographic and/or tabular data via internet
- An easy way to share geographic information with large audiences
- Comprises a server and a client



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COMPONENTS OF GIS ARCHITECTURE

Desktop GIS

- ArcGIS ArcMap
- ArcGIS Pro
- QGIS
- GRASS GIS
- SAGA GIS
- MapInfo
- …

Server GIS

- ArcGIS Server
- ArcGIS Online (AGOL)
- MapServer
- GeoServer
- …

Client Apps

- ArcGIS Online (AGOL)
- ArcGIS Web AppBuilder
- Collector for ArcGIS
- Explorer for ArcGIS
- Web APIs
- Mobile Apps and SDKs
- Open Layers
- Leaflet
- …

WEB GIS ARCHITECTURE

GIS Database Server

- Data (e.g. Shapefiles, rasters, geodatabases)

Web GIS Server

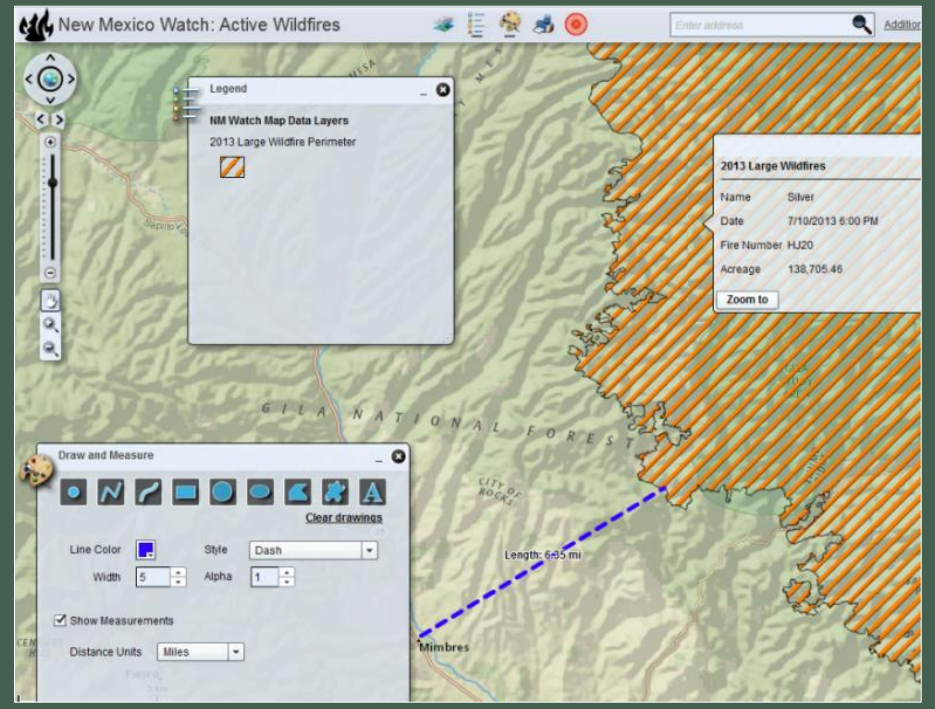
- Contents
- Functionality
- Capabilities

Web GIS Clients

- Content Delivery

COMPONENTS OF AN ONLINE MAPPING APPLICATION

- Basemap Layers
  - Streets, Imagery, Topographic, National Geographic, OpenStreetMap, etc.
- Operational Layers
  - Geospatial data layers created from shapefiles, CSV, TXT, GPX, map services, Web Map Service (WMS), Web Map Tile Service (WMTS), Web Feature Service (WFS), Web Coverage Service (WCS), KML, and GeoRSS formats, etc.
- Tools
  - Geocoding, routing, measurement, spatial analysis, etc.
  - User created tools
- Optional Features
  - Multimedia contents such as animation, images, video, text, etc.



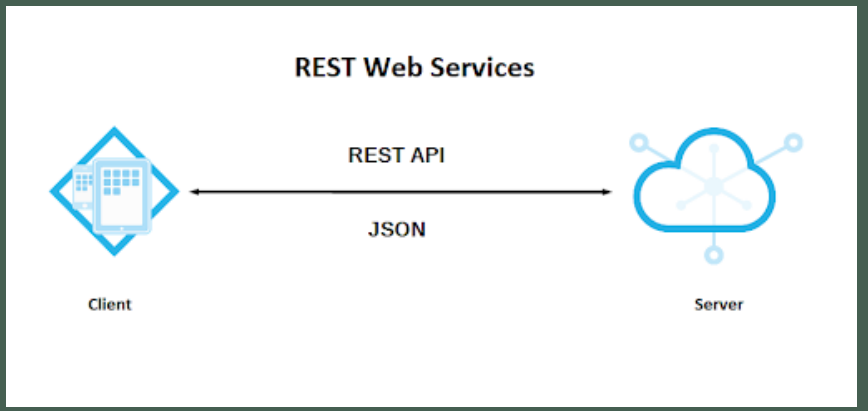
GIS WEB SERVICES

- Open Geospatial Consortium (OGC) standard services
  - WMS (Web Map Service), used for sharing both vector data and raster data as a picture of the data, it cannot query or edit the data
  - WMTS (Web Map Tile Service), used for sharing both vector data and raster data as picture of data in tiles, it cannot query or edit the data
  - WFS (Web Feature Service), used for sharing vector data, WFS-T can create, delete, and update features
  - WCS (Web Coverage Service), used for sharing raster datasets, it can query the data
  - GML (Geography Markup Language), describing GIS data in XML format, encoding geographic content for any application
  - KML (Keyhole Markup Language), XML form GIS data, used in Google Maps and Google Earth
  - …
- ArcGIS standard
  - REST Web Services (Representational State Transfer), which is a software architectural style used to create lightweight and scalable web services

OGC®

Making location count.

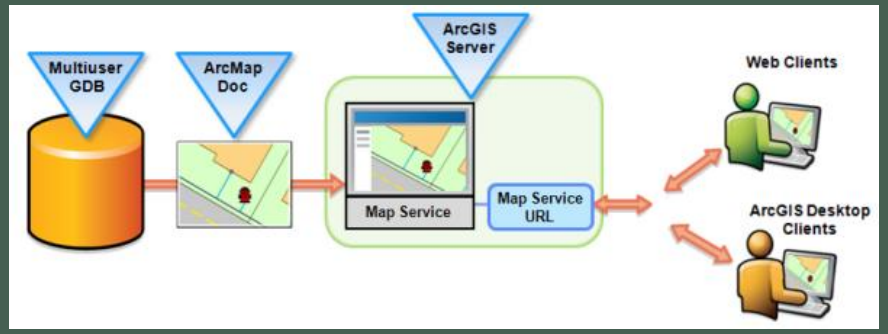
geospatialworld.net



isecurion.com

ARCGIS WEB SERVICES

- Map Services
  - Make maps, features, and attribute data available inside many types of client applications
  - Begin inside ArcMap, where you create your map and then publish it through ArcGIS Server
- Feature Services
  - Allow users to serve features over the internet and provide the symbology to use when displaying the features
  - Publish it through ArcGIS Server
- Image Services
  - Provide serving, processing, analysis, and extracting value from images, rasters, and other remotely sensed data
  - Publish it through ArcGIS Server



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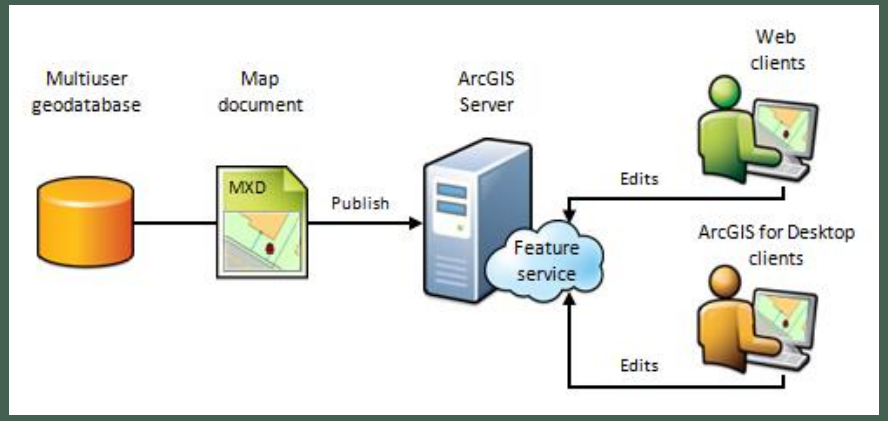

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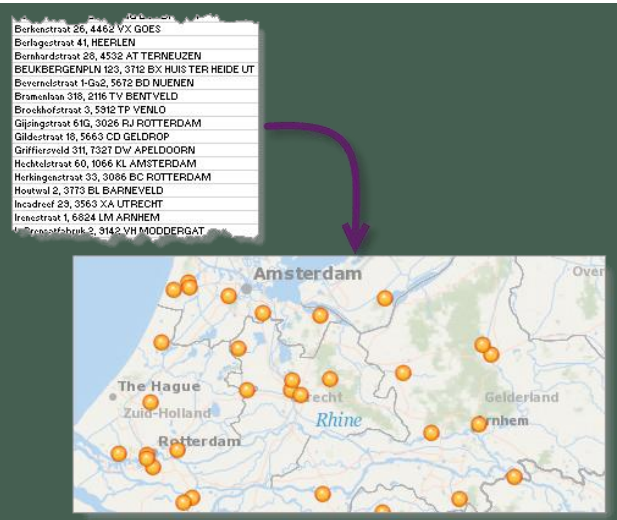
ARCGIS WEB SERVICES

- Geocoding Services
  - Can convert addresses and place names into x, y locations
- Geodata Services
  - Allows accessing to a geodatabase through a local area network or the internet using ArcGIS Server
- Geoprocessing Services
  - Shares the server's workflow and analysis functions with web clients, including printing
- Routing Services
  - Allows performing network analysis
- Geometry Services
  - Allows geometric calculations, simplifying, buffering, etc.



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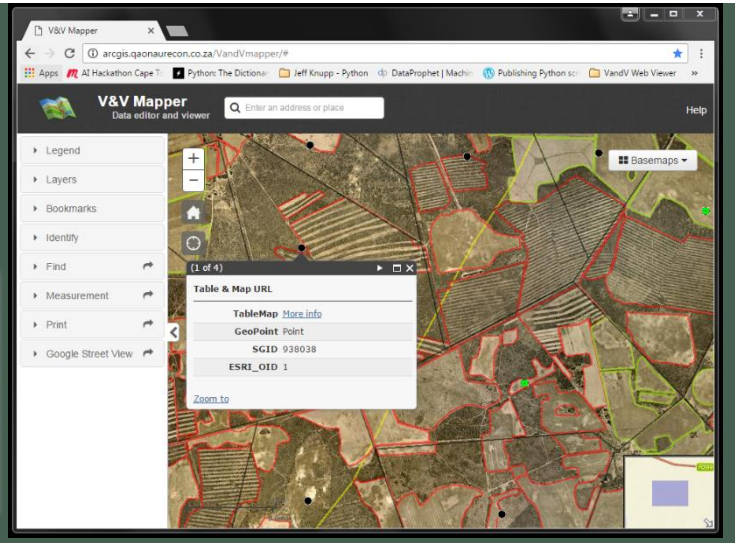

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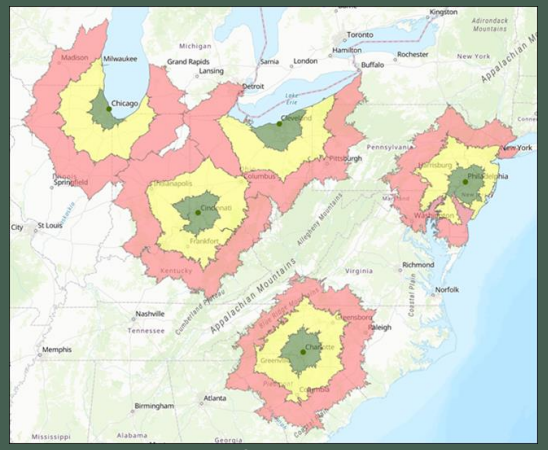

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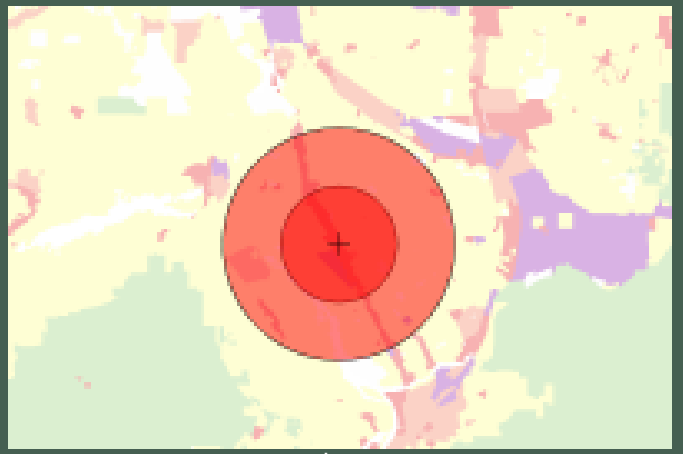
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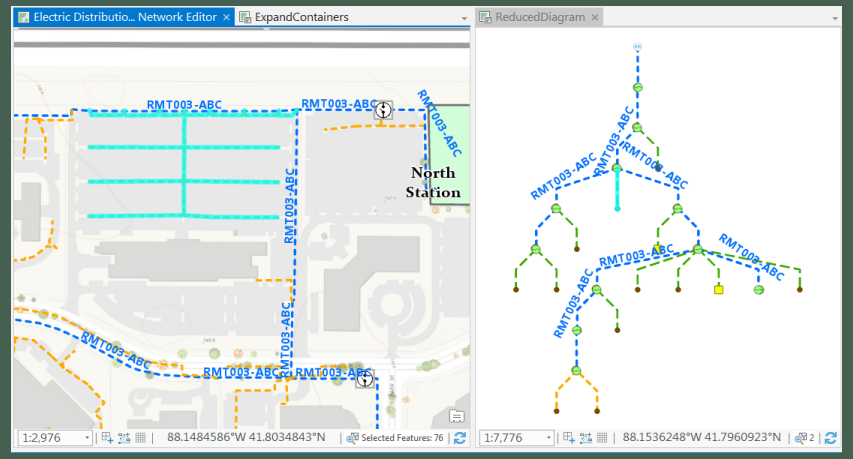
ARCGIS WEB SERVICES

- KML Services
  - Allows drawing points, lines, and polygons on maps and globes and share them with others
- OGC Services
  - Support WMS, WMTS, WFS, WCS, and WPS
- Schematics Services
  - Allows a web application to access schematic diagrams through a web service
- Utility Network Services
  - Support utility network workflows
- Scene Services
  - Allows web clients to request maps in 3D
- Cache Services
  - Make map, feature, image services run faster
- Stream Services
  - Allows low latency, real-time data dissemination
- Vector Tile Services
  - Enable sharing and consuming vector tiles
- Workflow Manager Services
  - Allow integrating existing business process with GIS workflow



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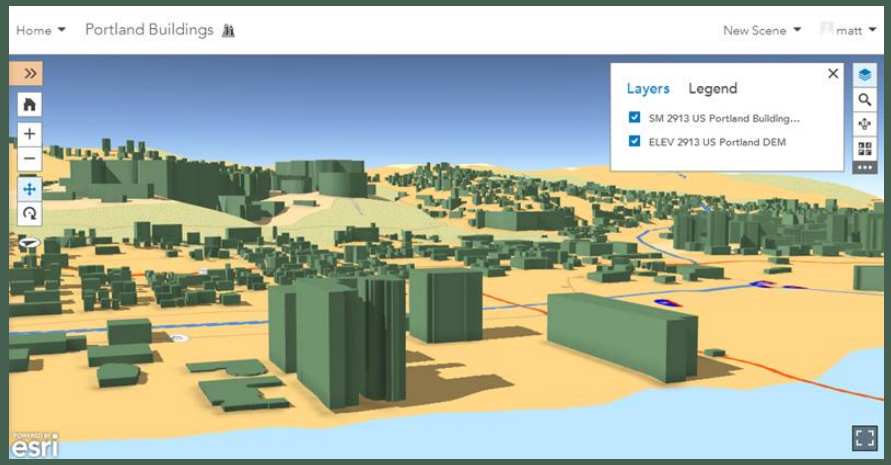

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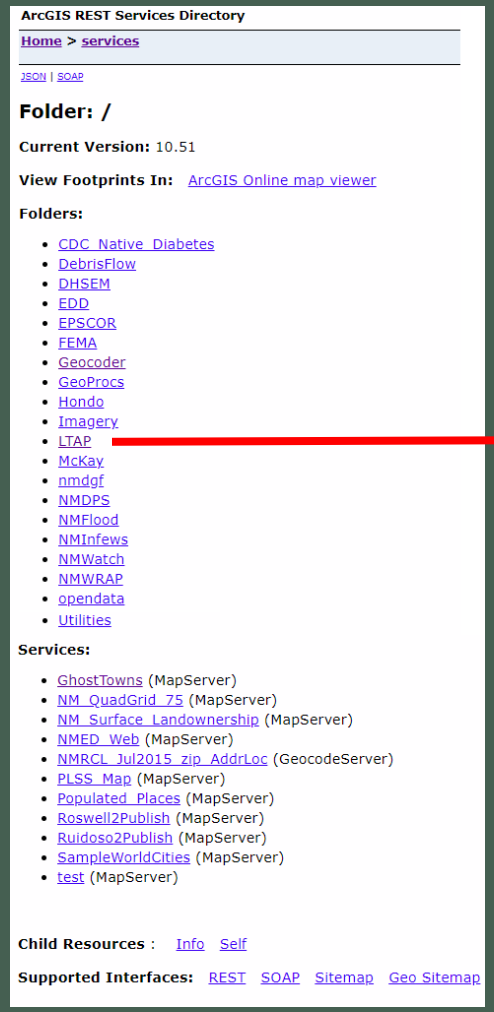
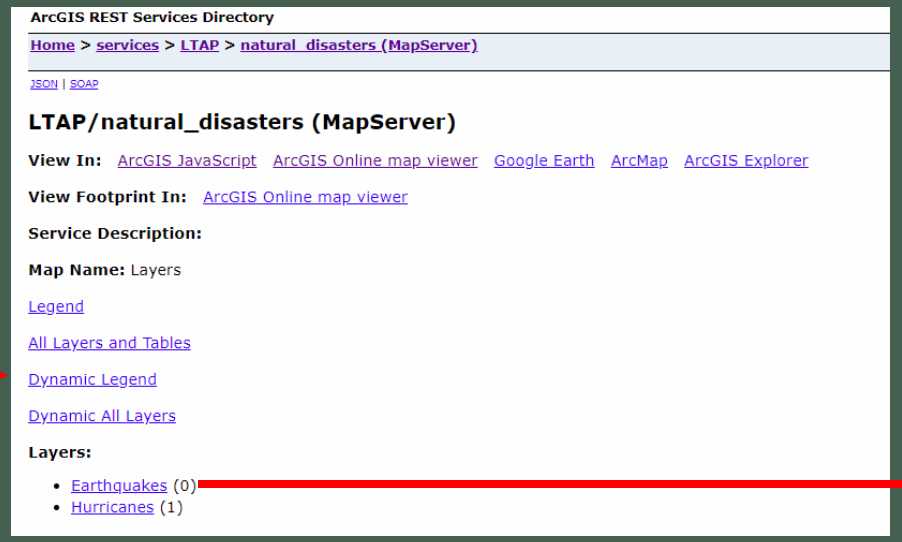
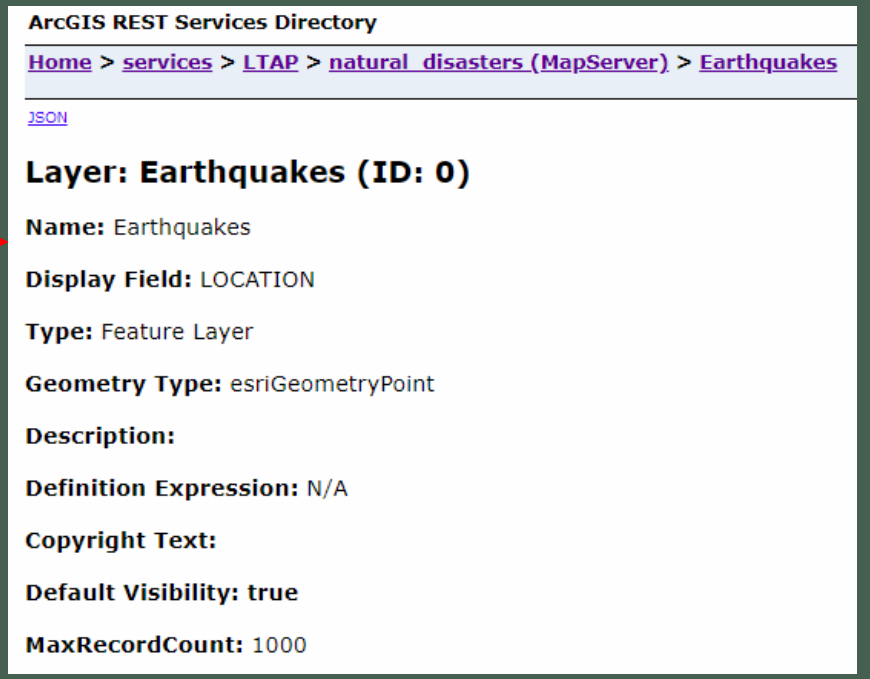
WEB SERVICES AND LAYERS

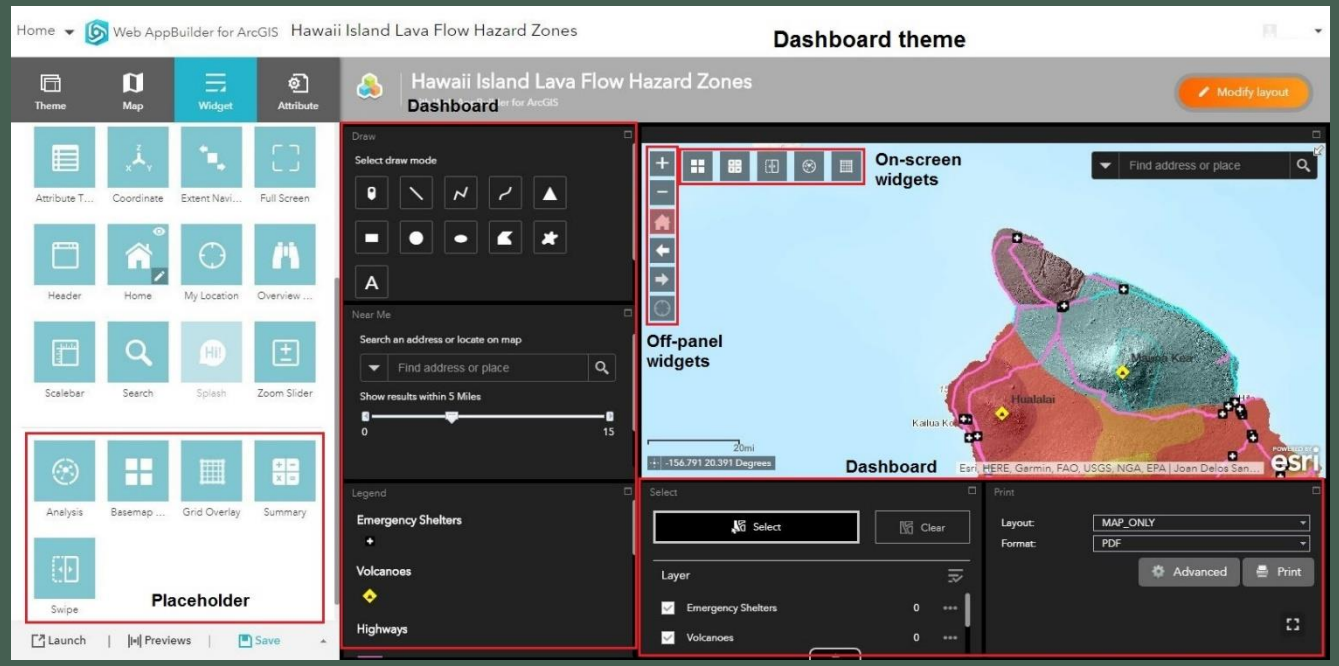






WEB APPLICATIONS

- Provide an interface to deliver data and tools to users via web.
- Application development using APIs or software technologies
- Proprietary Commercial-off-the-Shelf (COTS) applications
- Free and Open Source Software (FOSS) solutions
- Technologies: Python, JavaScript, HTML, Java, Objective C,…
- ArcGIS Online, ArcGIS AppBuilder, ArcGIS API for JavaScript, Mango Map, CARTO, GeoServer, MapGuide Open Source, MapFish, MapServer, OpenLayers, Leaflet, Google Maps API, Bing Maps API…



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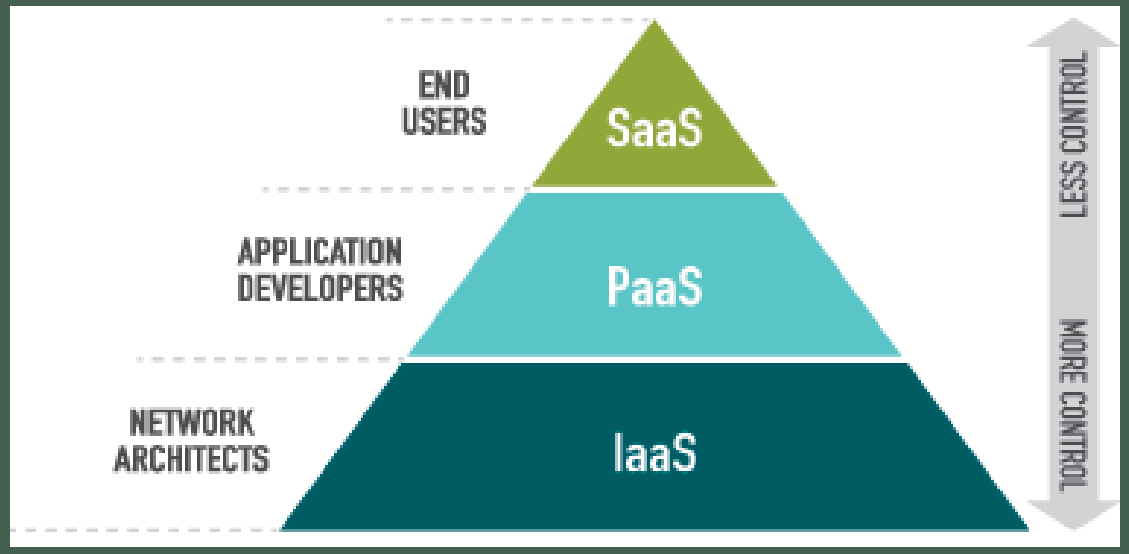
WEB GIS MODELS

- Infrastructure as a Service (IaaS)
  - a cloud computing service where enterprises rent or lease servers to perform GIS related computation and storage in the cloud
- Platform as a Service (Paas)
  - A cloud computing service where enterprises build GIS applications using a cloud based platform
- Software as a Service (SaaS)
  - Use map services or applications hosted on a cloud by other user communities to build GIS applications



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ARCGIS ONLINE

A cloud based GIS

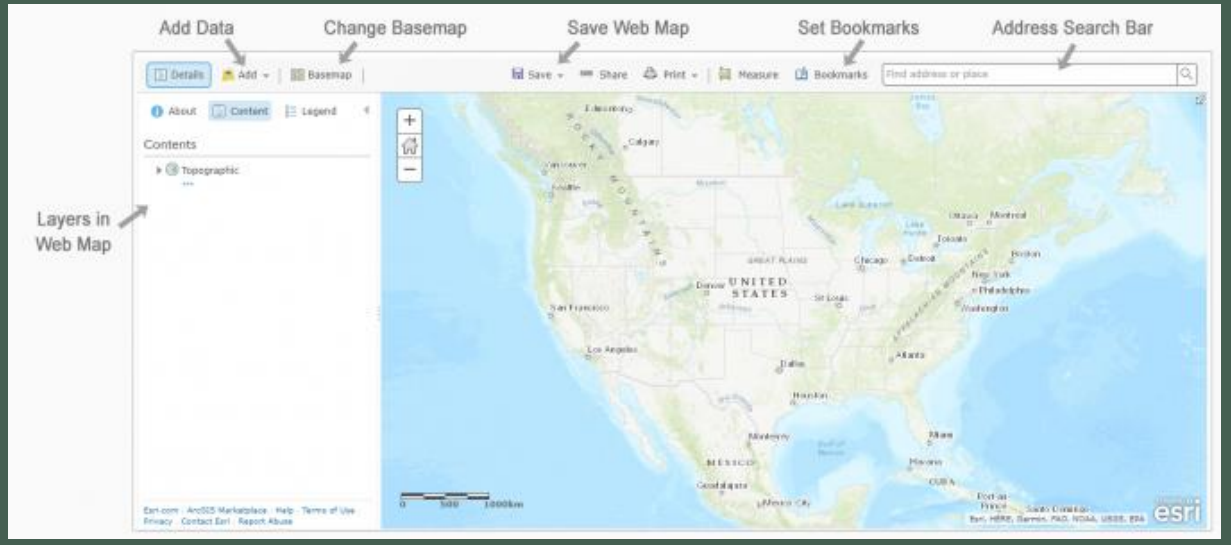
ARCGIS ONLINE

- An online mapping content management system
- Ability to extend capabilities of ArcGIS for Desktop, Server, Applications, APIs, and SDKs
- A subscription based service
- Consumes Service Credits*
  - Ex: Geocoding: 40 credits for 1,000 geocodes
  - https://www.esri.com/en-us/arcgis/products/arcgis-online/pricing/credits

arcgis.com/index.html

FEATURES

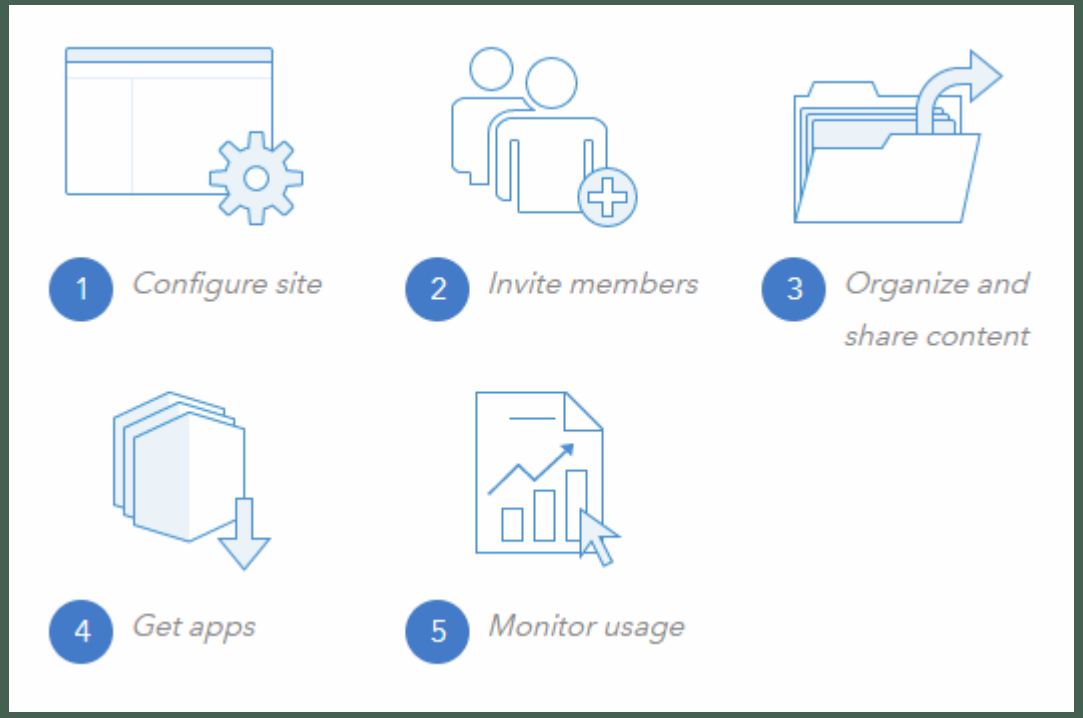
- Create Maps
  - An interactive map that displays geographic information
  - 2D environment
- Create Scenes
  - Dynamic scenes to visualize geospatial content
  - 3D environment
- Create Apps
  - Applications combining maps, scenes, or groups with text, multimedia
  - Share content with public
- Analysis Tools
  - Perform data analysis using ArcGIS Online tools
  - Limited compared to ArcGIS Desktop
- Host and Manage Data
  - Store, manage, and host spatial data in the form of files and web layers



gisgeography.com

FEATURES

- Administer ArcGIS Online Organizational Subscription

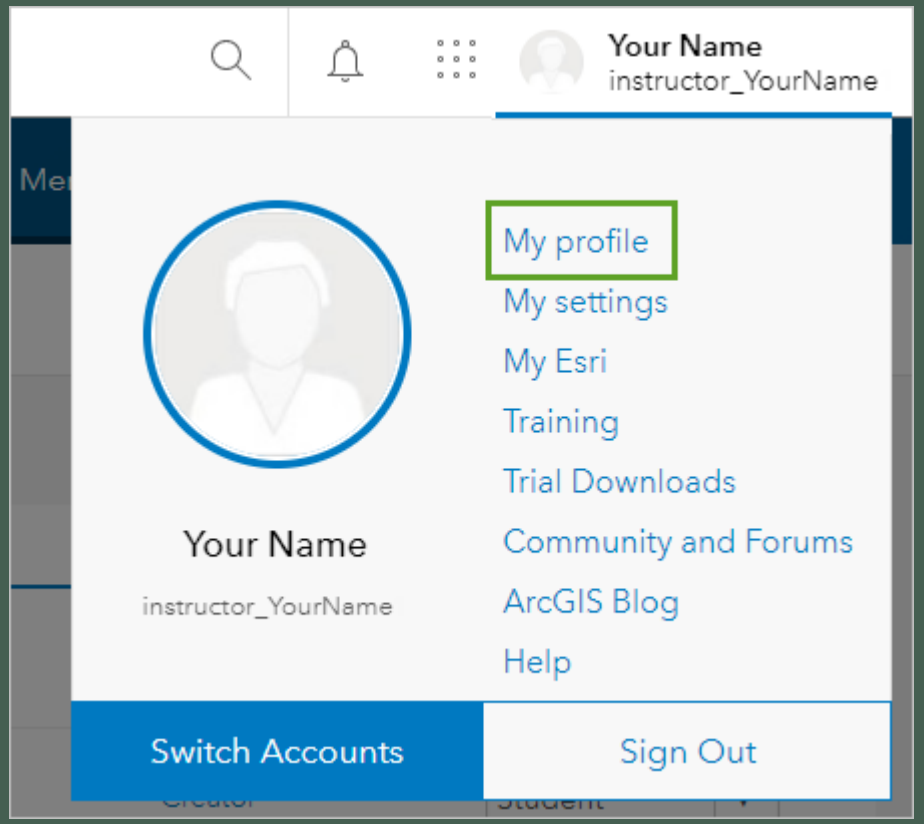


https://doc.arcgis.com/en/arcgis-online/administer/get-started-with-administration.htm

USER ACCOUNTS

- Public
  - Free, 2GB of storage, limited functionality
  - Personal, non-commercial use only
- Organizational
  - Allows to create a website for an organization to share customized content
  - Associated with ArcGIS licenses, 3 user accounts per license, option to purchase additional user accounts
  - Can be purchased separately
  - Roles: Viewer, Data Editor, User, Publisher, and Administrator

More information on ArcGIS Online User Roles and Privileges can be found at https://doc.arcgis.com/en/arcgis-online/reference/roles.htm



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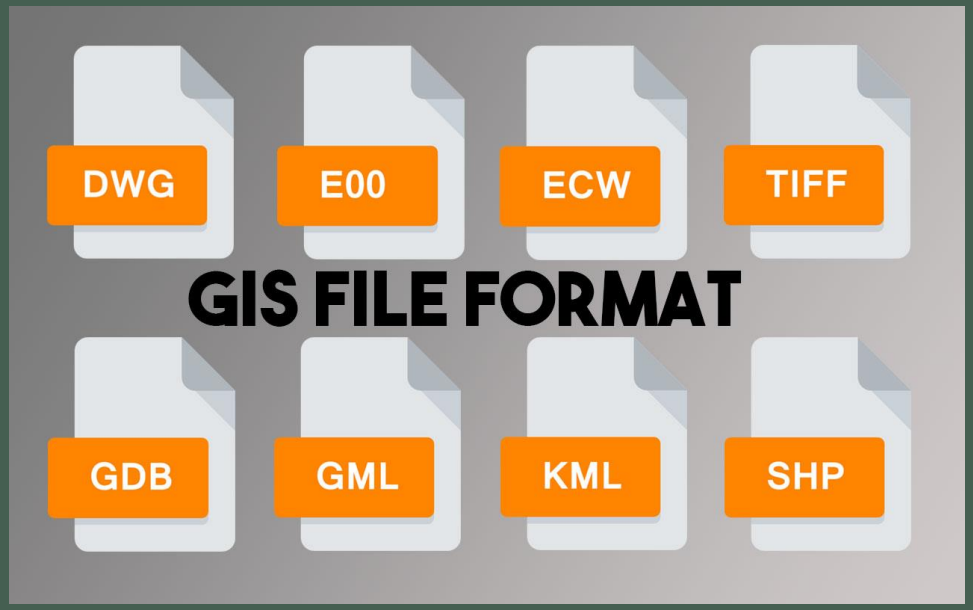
DATA FORMATS

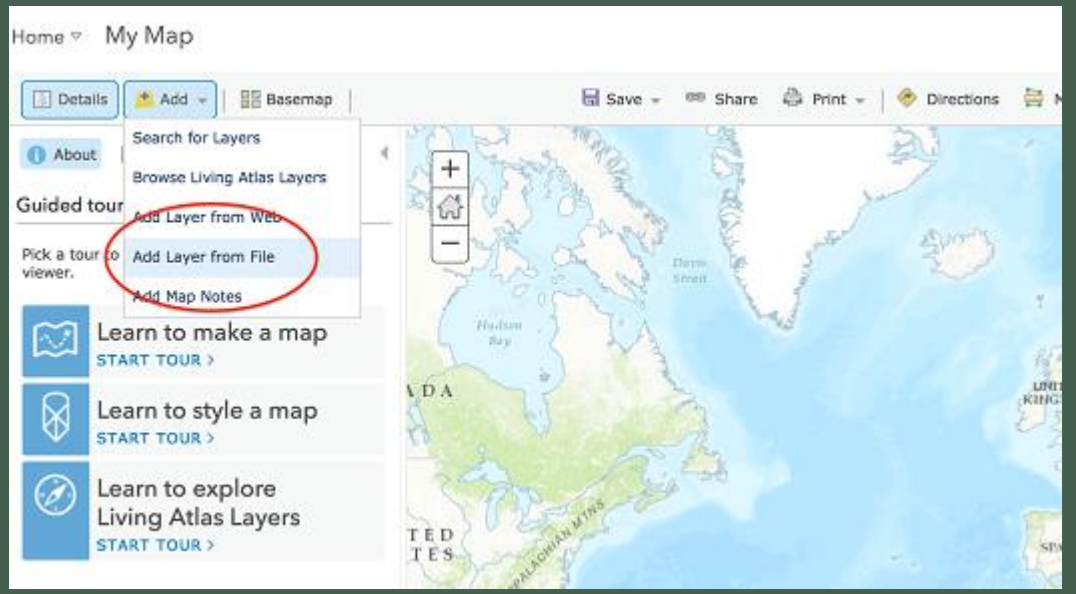
- CSV, TXT, and GPX formats
  - Organizational Account
    - ➢4000 rows (features) can be added directly to the map
    - ➢Geocoding consumes credits
  - Public Account
    - ➢A 250 feature limit for geocoding addresses or mapping
  - If data contains more than the limit…
    - ➢Needs to be broken into multiple files or
    - ➢Publish as a map service on ArcGIS Server or AGOL Hosted Feature Layer Using credits
  - Only point features can be uploaded in CSV or TXT formats
  - Polyline or polygon geometry types should be uploaded as zipped shapefiles



spatialpost.com

DATA FORMATS

- Shapefiles
  - Accepts only .zip file format for lines and polygons
  - Must contain valid geometry
  - Can have multiple shapefiles in a zip folder
  - Size of the shapefiles must be less than 10 MB
  - 4000 point features or 2000 line or polygon features
  - If data contains more than the limit, it needs to be broken into multiple files or can be published as a map service on ArcGIS Server or AGOL Hosted Feature Layer using credit
  - If files are large, choose generalize features option to improve web display*



e-education.psu.edu

DATA FORMATS

- GeoJSON
  - JavaScript Object Notation (JSON)
  - A open source format for encoding a variety of geographic data
  - GeoJSON supports the following geometry types:
    - Point, LineString, Polygon
    - Multipart collections of Point, LineString, Polygon
- Does not support raster files or geodatabases


```
{ "type": "FeatureCollection",
    "features": [
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        "geometry": {
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          "coordinates": [102.0, 0.5]
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          "properties": {
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          }
        },
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            ]
          },
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          "prop1": 0.0
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        },
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           "coordinates": [
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               [100.0, 1.0], [100.0, 0.0] ]
             ]
         },
         "properties": {
           "prop0": "value0",
           "prop1": {"this": "that"}
           }
         }
       ]
     }
```
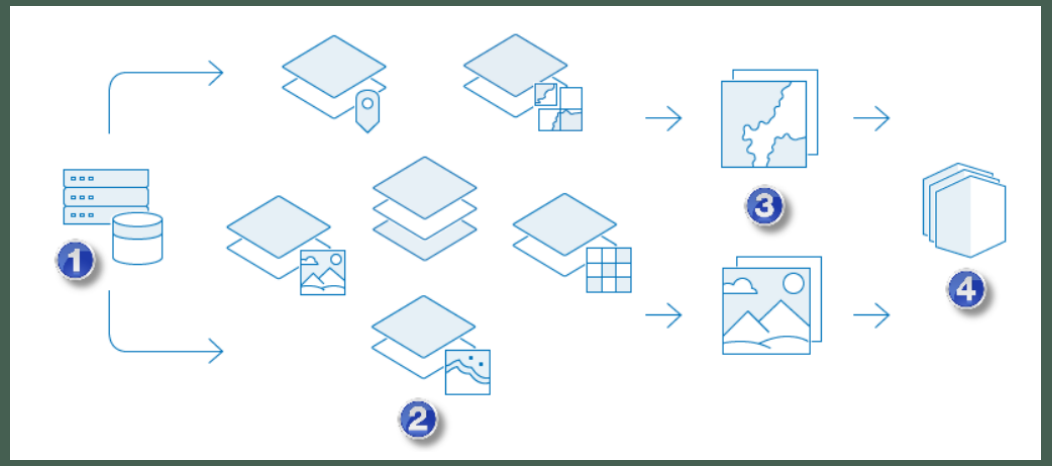

WEB LAYERS

How data are served?

TYPES OF WEB LAYERS

- Map image layer
  - Vector data includes points, lines, and polygons; Map image layers are dynamically rendered by server or from tiles
  - Supports map visualization and feature querying
- Feature layer
  - Features can be points, lines, or polygons
  - Supports editing, visualizing, and querying data and their attributes
  - It's a dependent layer to a map image layer
- Imagery layer
  - Imagery layers can be displayed dynamically or pre-rendered as cached image tiles
  - Supports visualization, metadata, mensuration, and image processing functions
- Tile layer
  - A set of web-accessible tiles that reside on a server. Tile layers include pre-rendered Tile map raster tiles or Vector tiles
  - Supports fast map visualization



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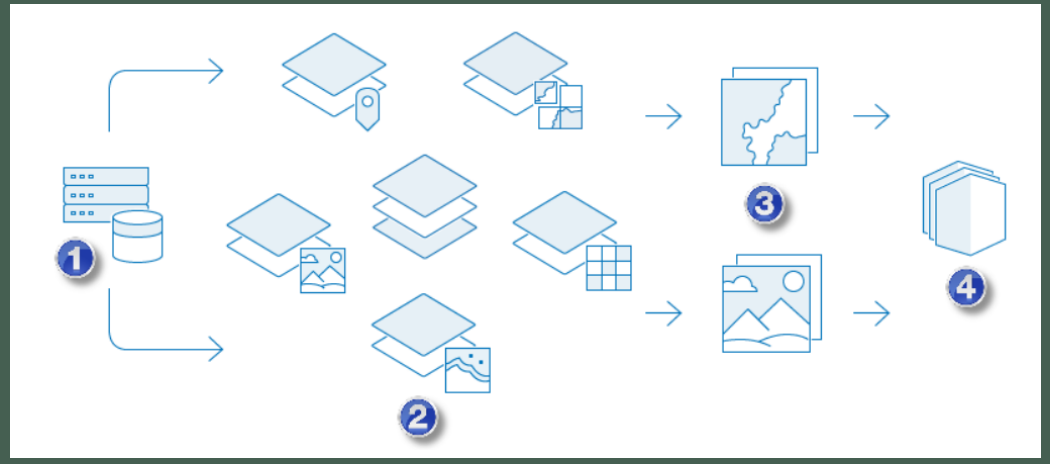
TYPES OF WEB LAYERS

- Vector tile layer
  - Displays pre-drawn vector tiles for fast visualization
  - Can adapt to resolution and be restyled easily
  - Does not support raster data
- Scene layer
  - Supports querying and visualization of point, 3D object, building and point cloud data
  - Can have an associated feature service that allows editing data on a scene layer
- Elevation layer
  - Supports visualization, metadata, mensuration, and image processing of elevation data sources in the ground surface of a scene
  - The elevation layer is used in web scenes to display 3D content on a custom elevation surface



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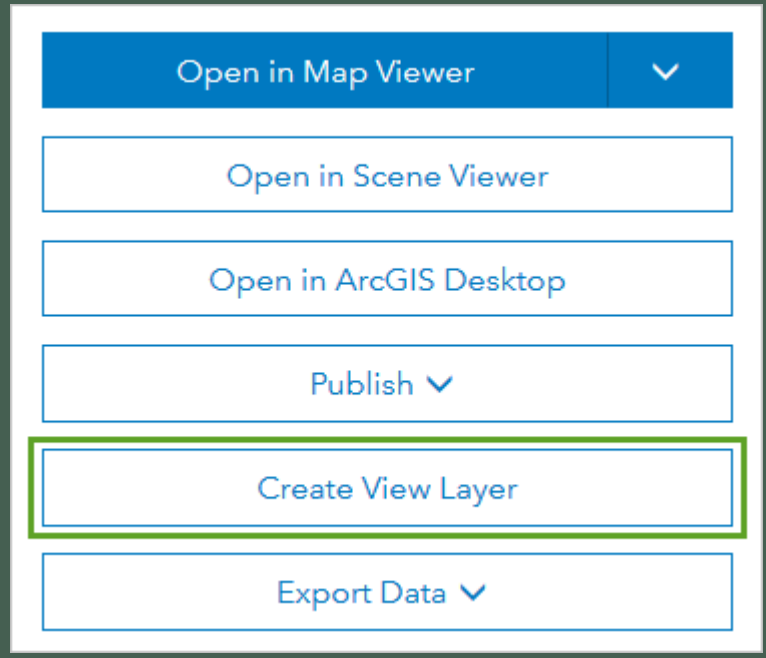
HOSTED FEATURE LAYERS

- Can publish maps and data as hosted layers to ArcGIS Online
- ArcGIS Online hosted layers are useful when you do not have your own ArcGIS Server site; or when ArcGIS Server site cannot be made public
- Requires an ArcGIS Online organization account
- Publish feature layers from any of the following formats:
  - Comma-separated values (CSV) files
  - Microsoft Excel files (.xlsx or .xls)
  - Google Sheets from Google Drive
  - GeoJSON files or zipped shapefiles
  - Feature collections
  - Zipped file geodatabases
  - Zipped collections of Georeferenced photos
  - ArcGIS Pro maps and ArcMap documents



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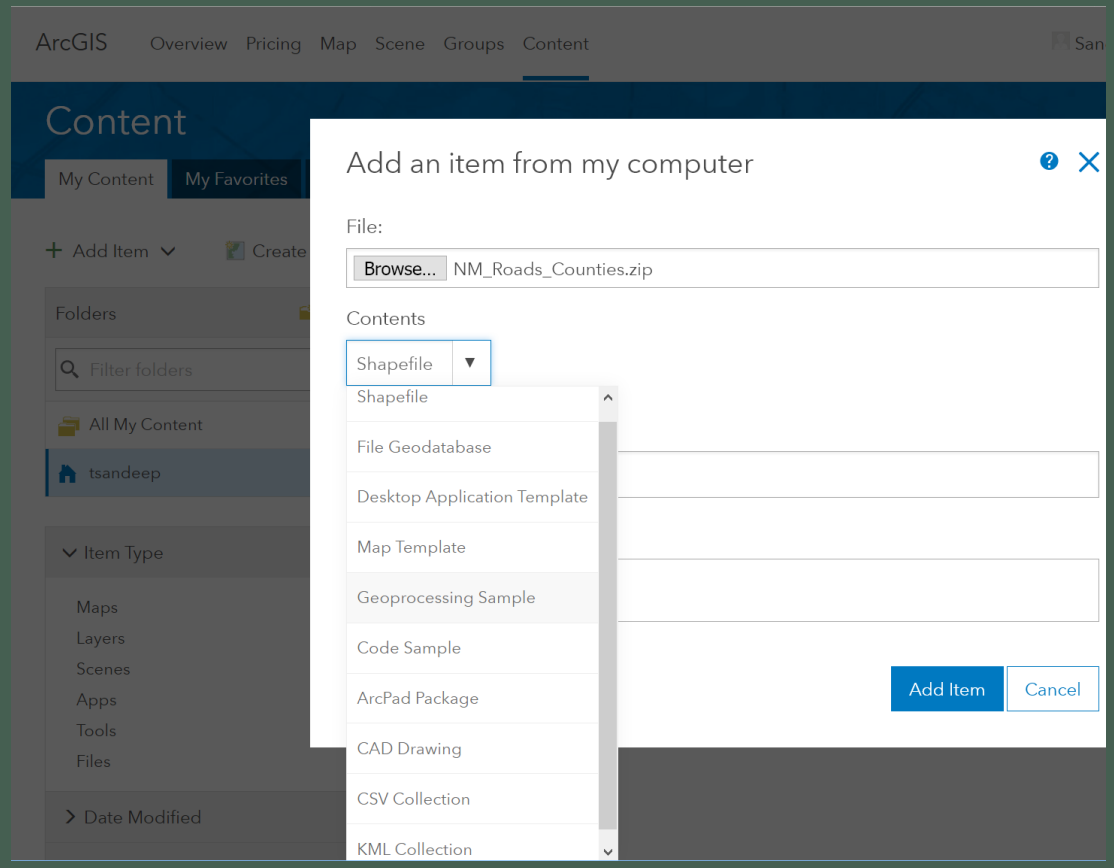
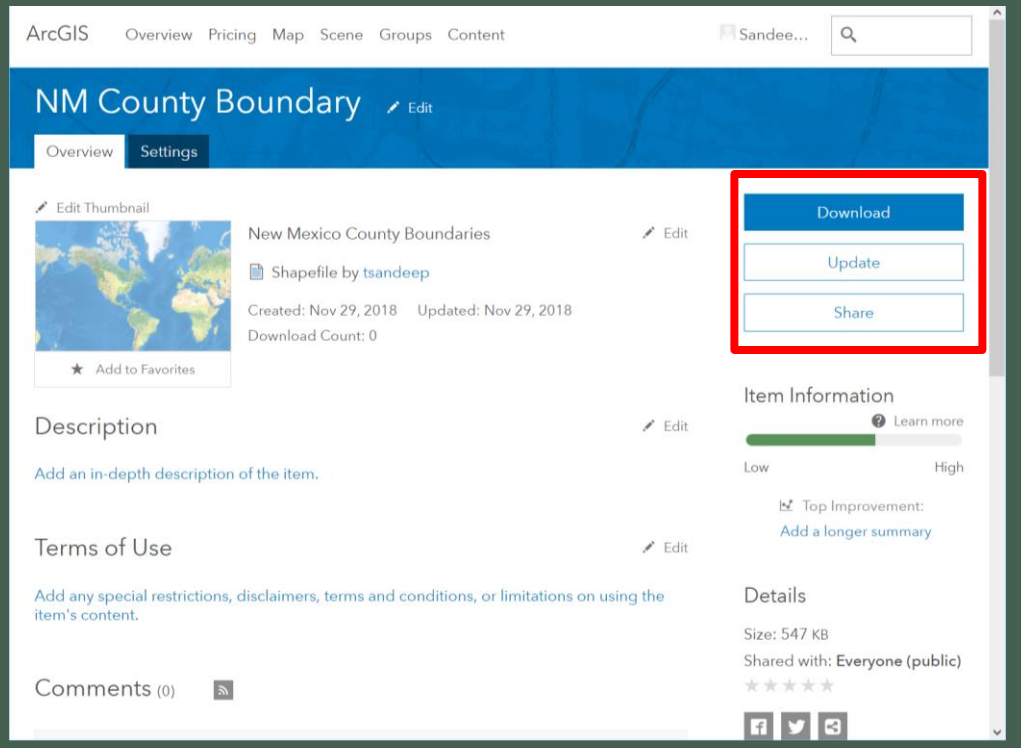
HOSTING AND MANAGING DATA

- ArcGIS Online allows users to upload and share datasets





DO YOU NEED TO EDIT DATA ONLINE?

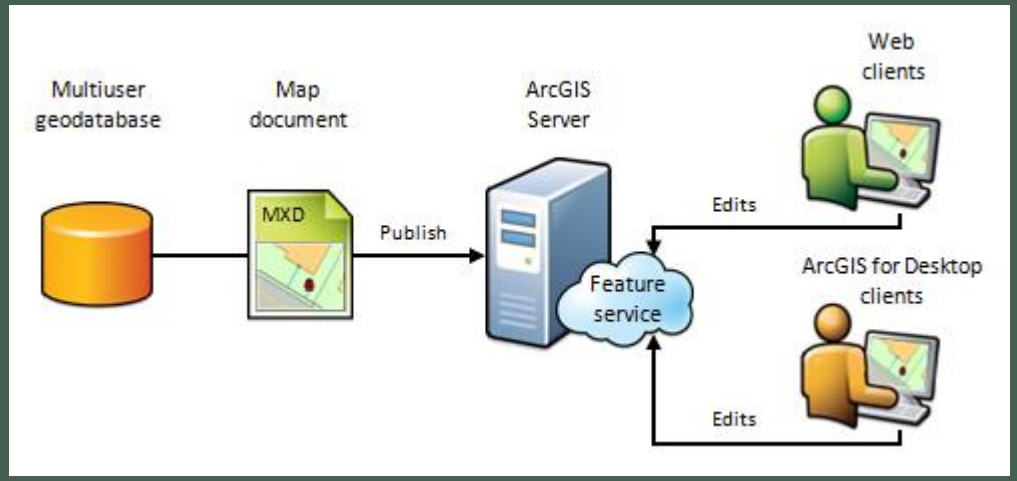
Map Service Layers vs Feature Layers

Functionality/Service Layer	Map Service Layer	Feature Layer
Geometry and attributes	Remain on server side	Downloaded to client side
Map drawn by	Server side	Client side
Scalability	More load on the server side; Handles large amounts of data	More load on the browser side; Less scalable for large data, except when using on-demand mode, scale dependency, vector tiling, or feature generalization
Responsiveness to mouse events	Less responsive	More responsive to user's mouse clicks

Source: Getting to know WebGIS, third edition

CREATING AND EDITING DATA ONLINE

- Feature Services support both read and write access
- Can be created or configured on ArcMap or ArcGIS Online
- For ArcGIS Online – Requires an organizational account
- For ArcGIS Server – Requires an Enterprise geodatabase
- Editor tracking and ownership-based editing capabilities
- Ability to include Attachments (images or other relevant files)
- Offline Editing Mode



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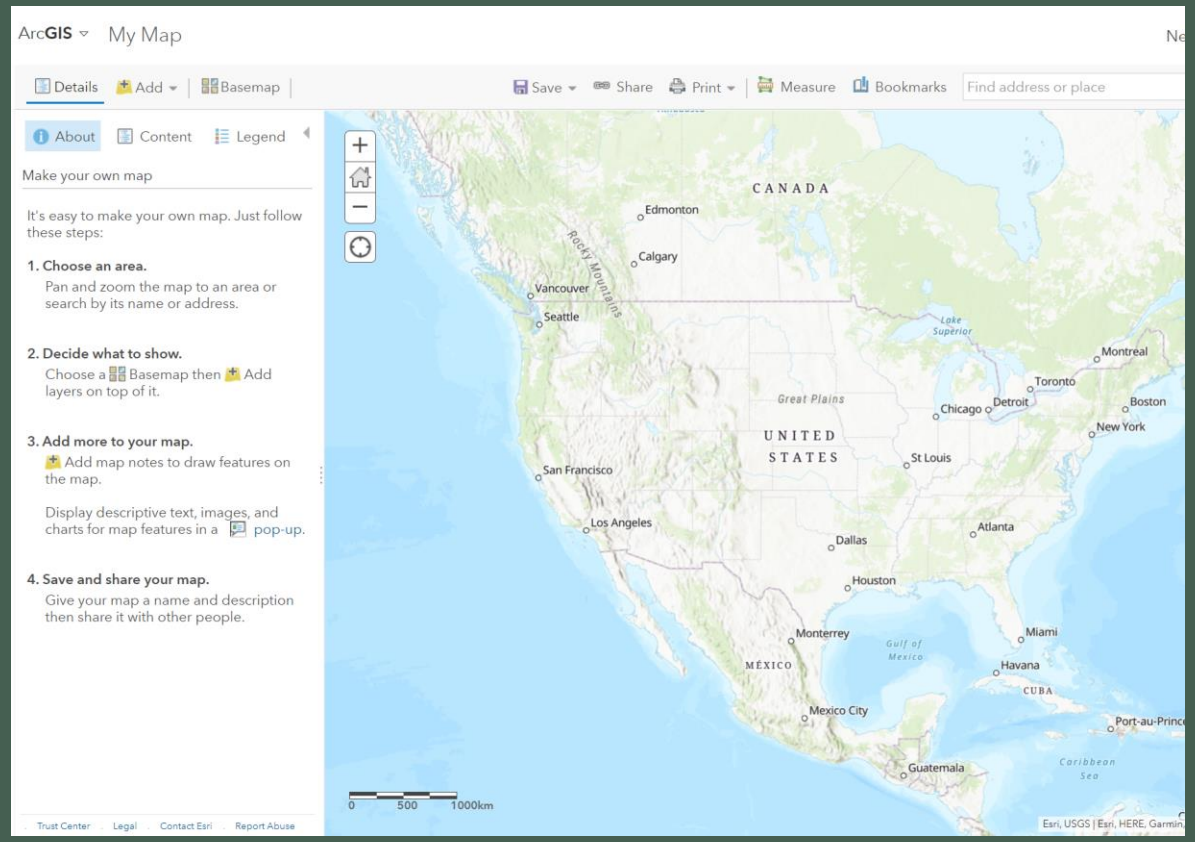
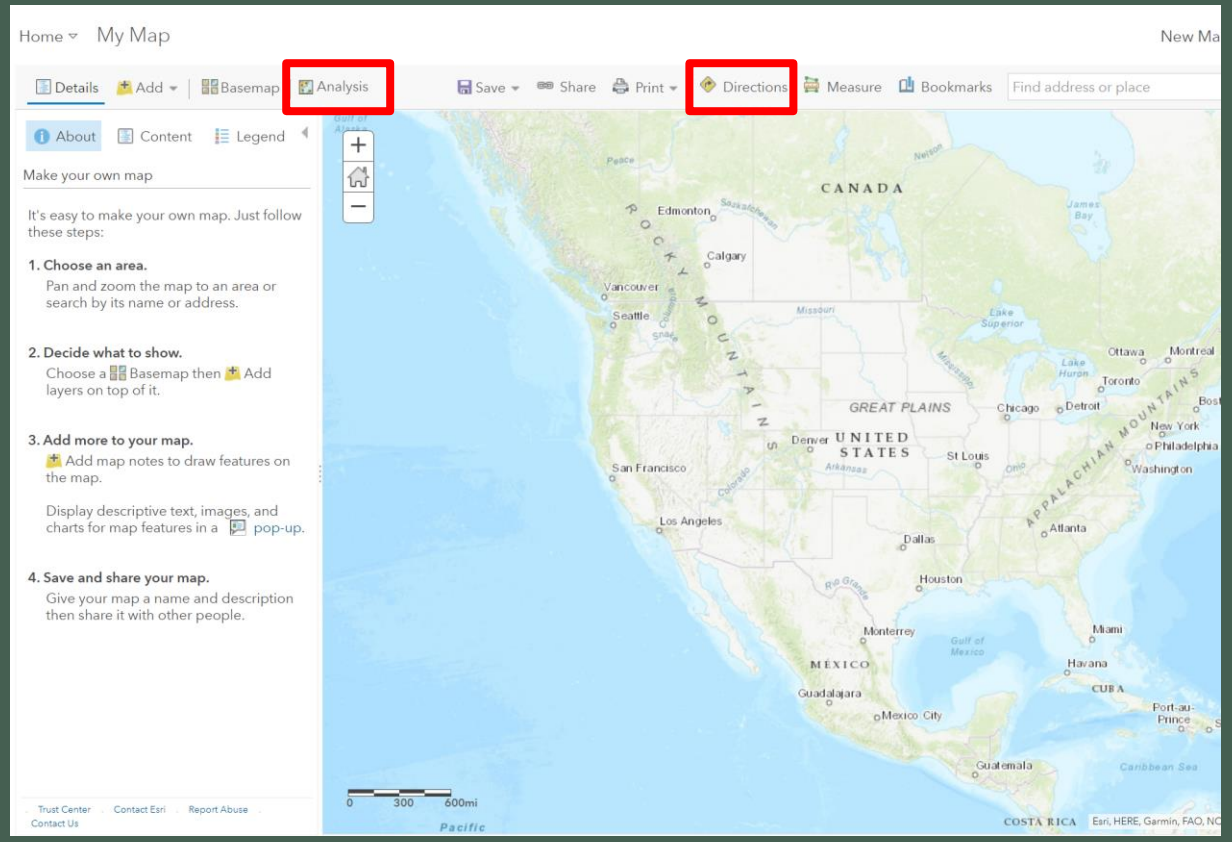
ARCGIS ONLINE – ANALYSIS TOOLS

- Public Account



- Organizational Account



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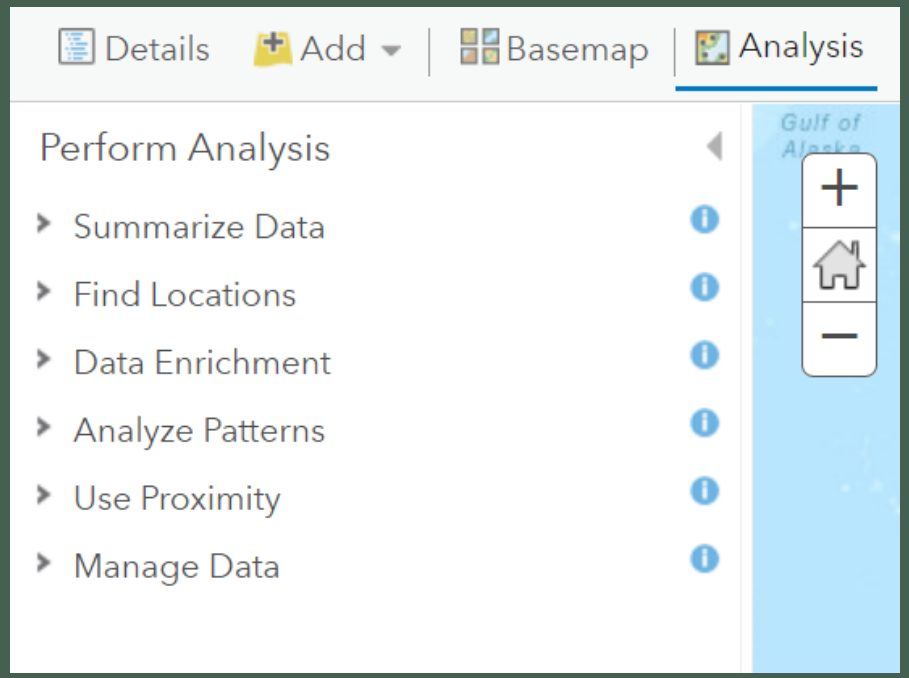
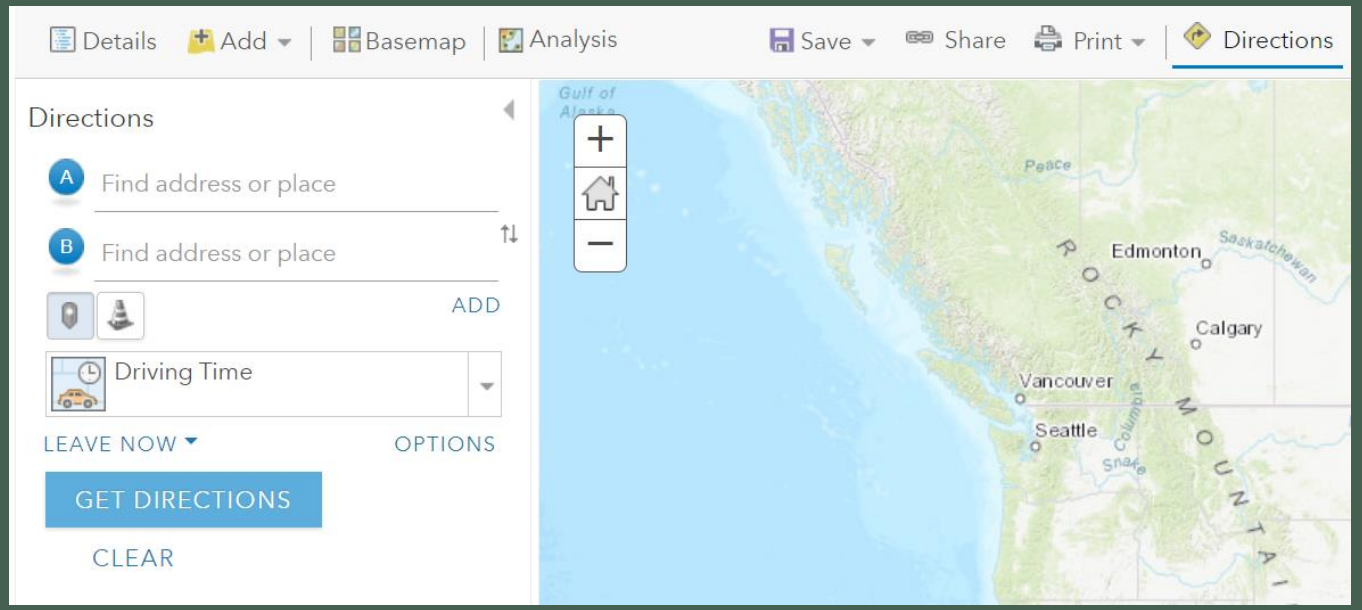
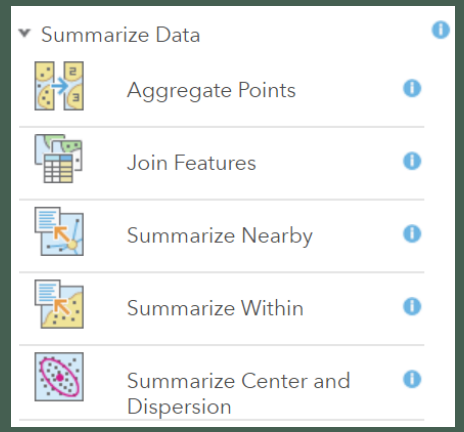


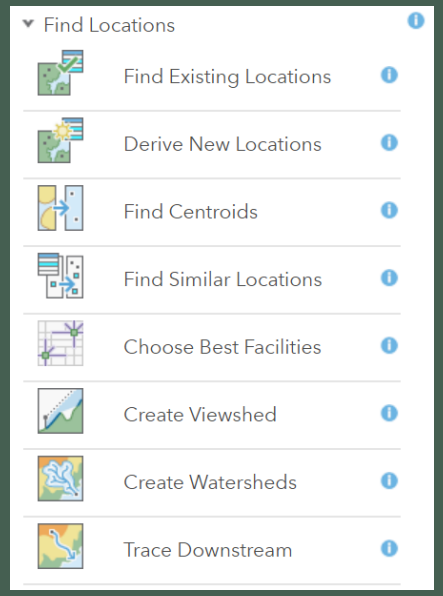
Analysis Tools

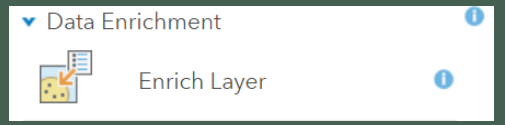


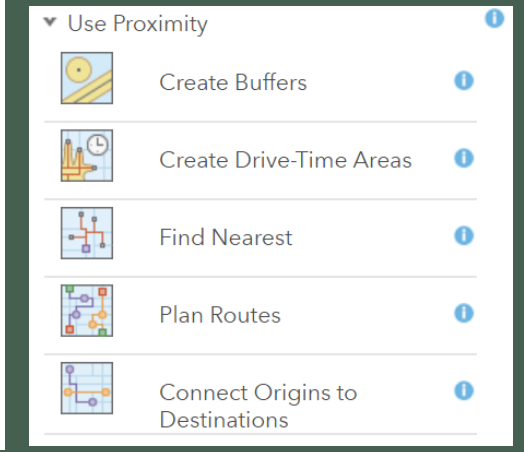
Directions

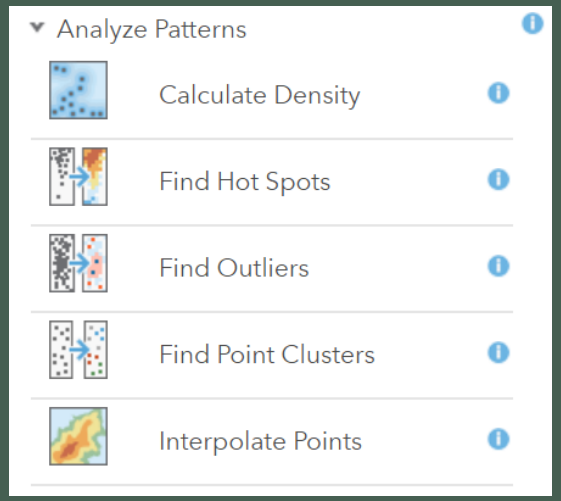
ANALYSIS & DIRECTION TOOLS

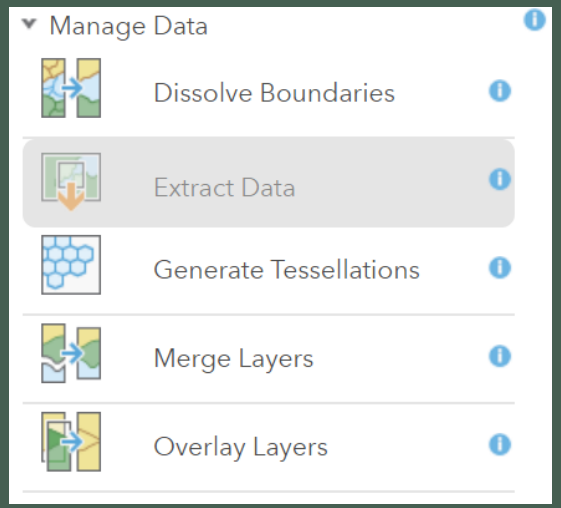


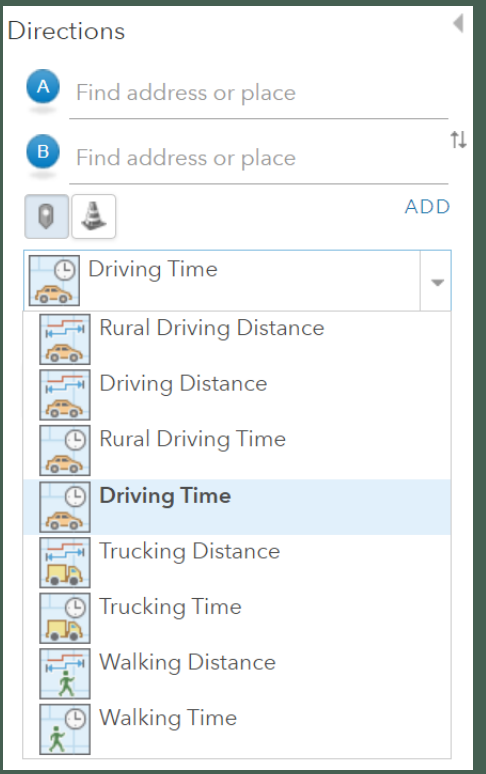












https://doc.arcgis.com/en/arcgis-online/analyze/perform-analysis.htm
https://doc.arcgis.com/en/arcgis-online/get-started/get-directions.htm

DEMO & EXERCISES

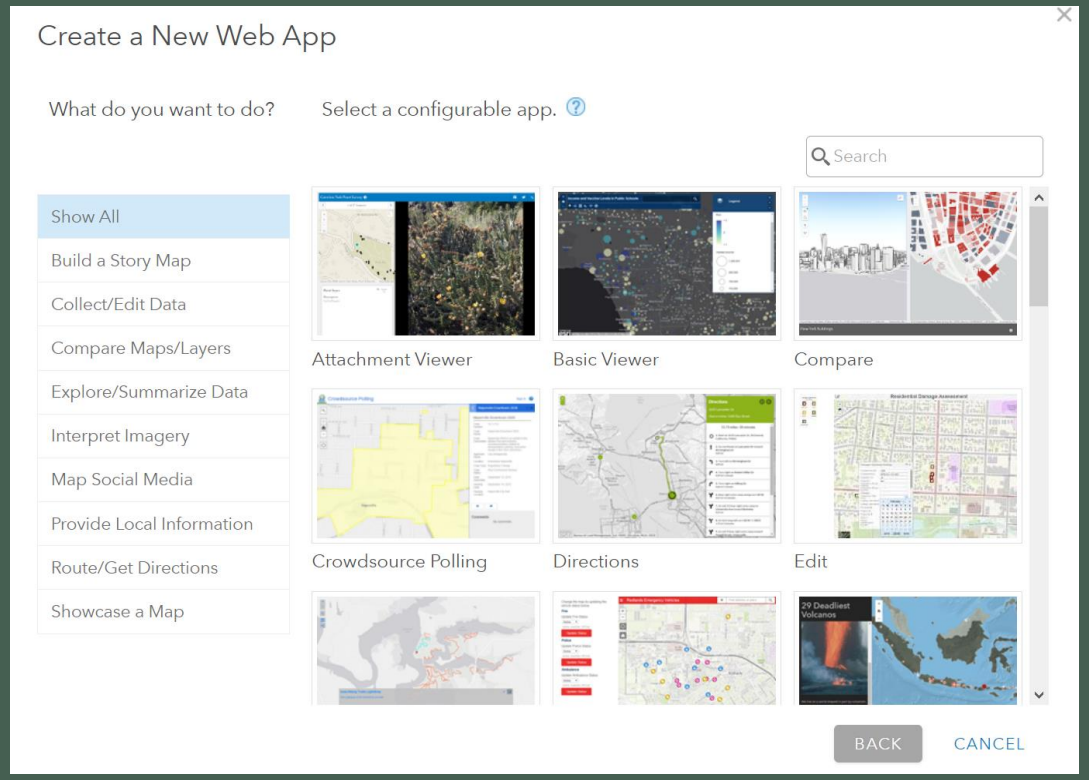
- Exercise 1: create a web map
  - Map a spreadsheet (CSV file) with coordinates
  - Map a spreadsheet (CSV file) by Geocoding
  - Map a line/polygon data set by uploading a shapefile
  - Map a layer by search
  - Map a layer from ArcGIS Server
- Exercise 2: Customize Data
  - Edit Data
  - Symbology
  - Pop-up
  - Add images and charts

WEB APPLICATIONS

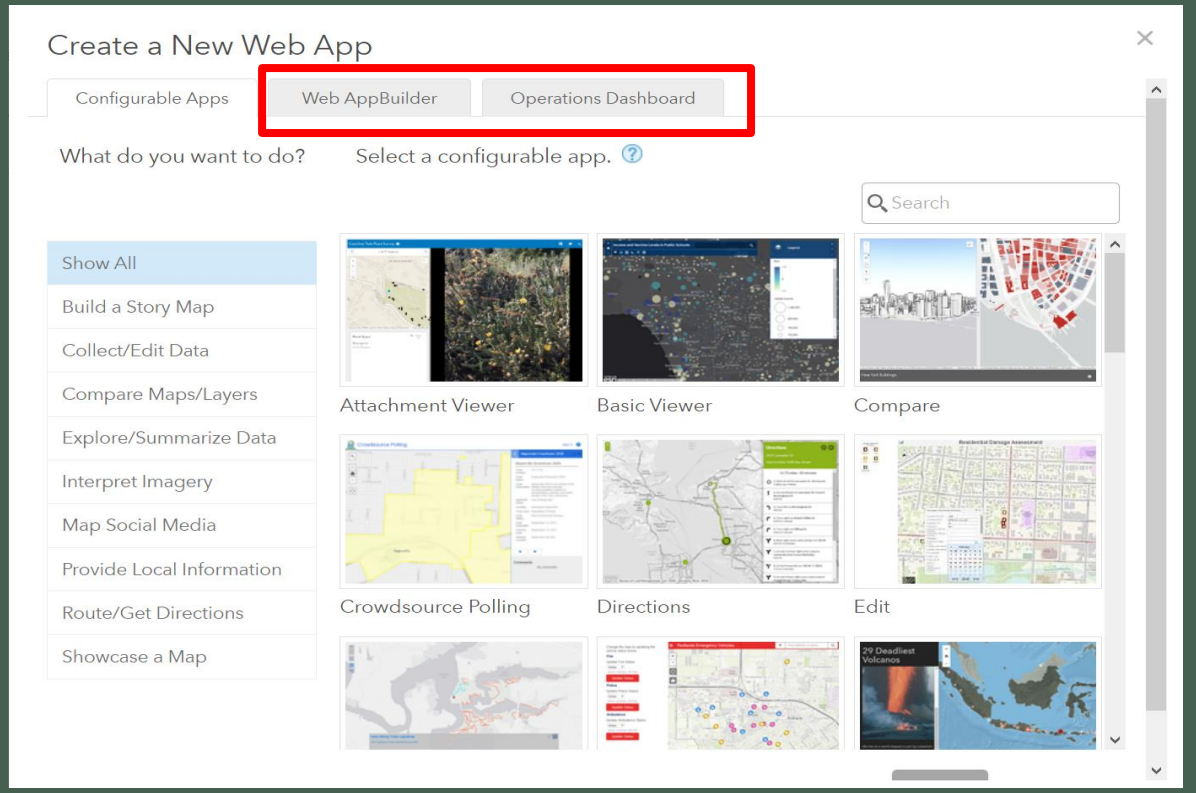
Customizing pre-built apps or Build apps from scratch?

ARCGIS ONLINE – WEB APPS

- Public Account

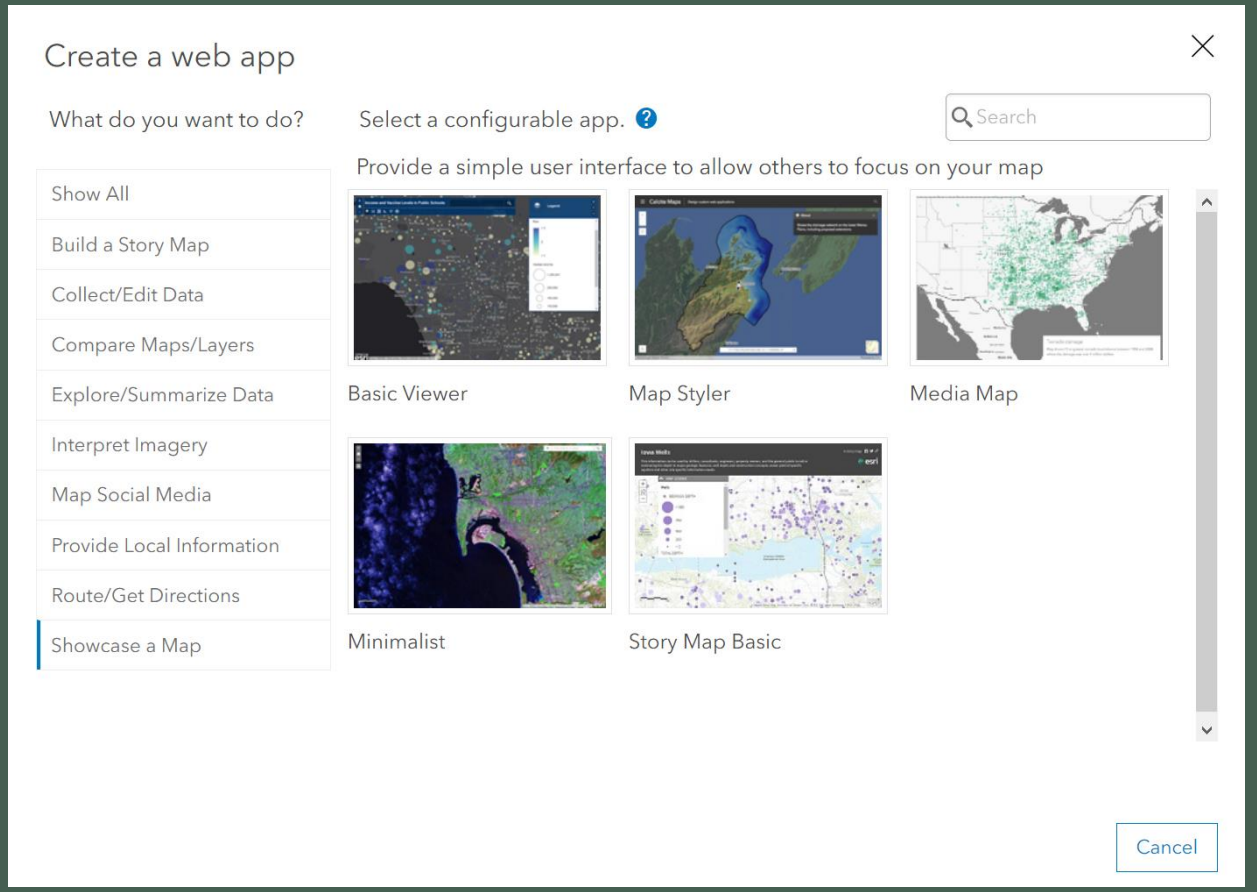


- Organizational Account



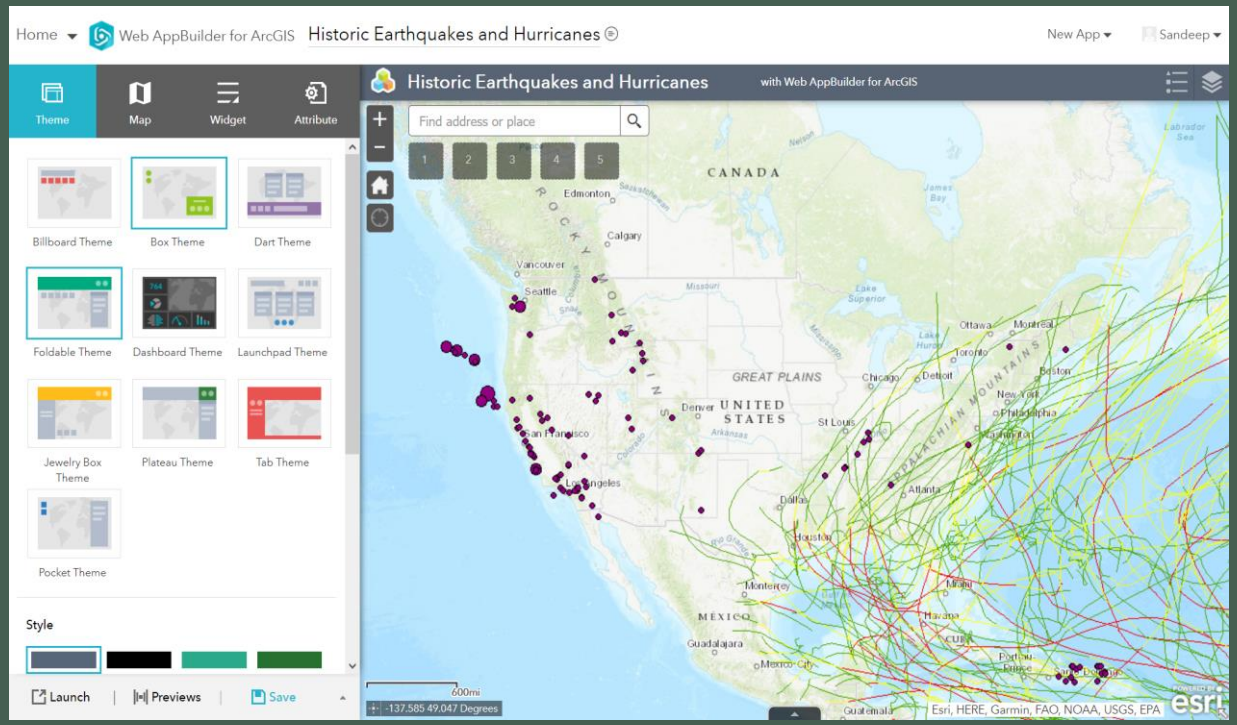
CONFIGURABLE APPS

- Prebuilt web application templates
- A selection of templates based on themes: Story Maps, Collect/Edit Data, Compare Maps/Layers, etc.
- Requires no coding and are customizable
- Perfect for creating a web application faster



WEB APPBUILDER FOR ARCGIS

- Create web mapping applications without programming
- Built on HTML5 and ArcGIS API for JavaScript
- No plug-ins required (as the case with Flex API)
- WYSIWYG (what-you-see-is-what-you-get) application
- Developer Edition is available
- Cross device compatibility
- Pre-built widgets
- Supports 2D and 3D web apps
- Requires ArcGIS Online Organizational Account



WEB APPBUILDER FOR ARCGIS (DEVELOPER EDITION)

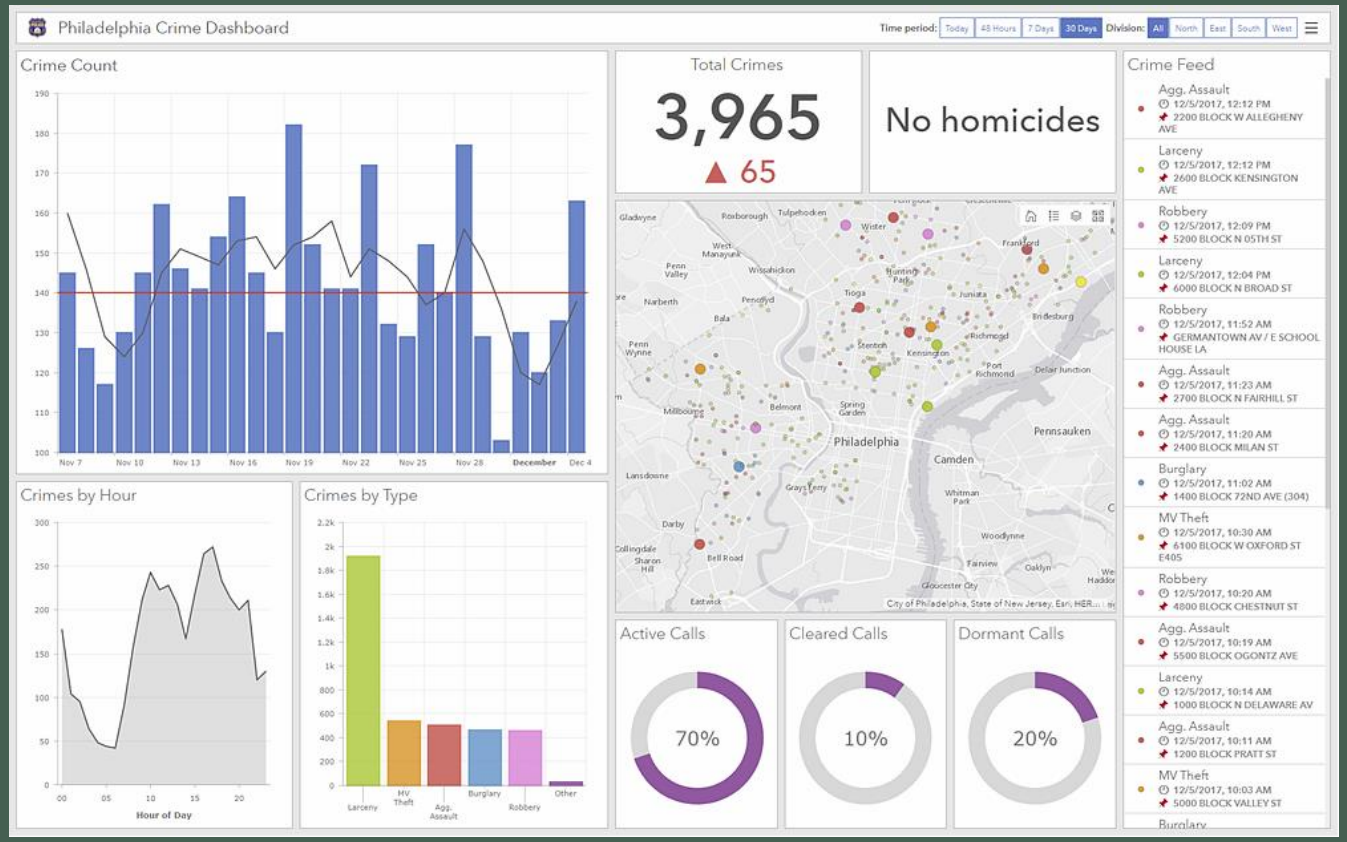
- Similar capabilities as of ArcGIS Online version*
- Create custom widgets, themes and app templates
- Host web app on a local server
- Customized web app URL
- Latest SDK: Version 2.19

ArcGIS Web AppBuilder (Developer Edition)

https://developers.arcgis.com/web-appbuilder/

OPERATIONS DASHBOARD

- Allows to monitor events or activities
- Multiple data visualizations on a single screen
- Dashboard elements include maps, lists, charts, gauges, and indicators



https://doc.arcgis.com/en/operations-dashboard/help/what-is-a-dashboard.htm

STORY MAPS

- A simple web app that combine interactive maps, multimedia content, and user experiences to tell your story
- No coding needed, easy to configure
- Cross device compatibility

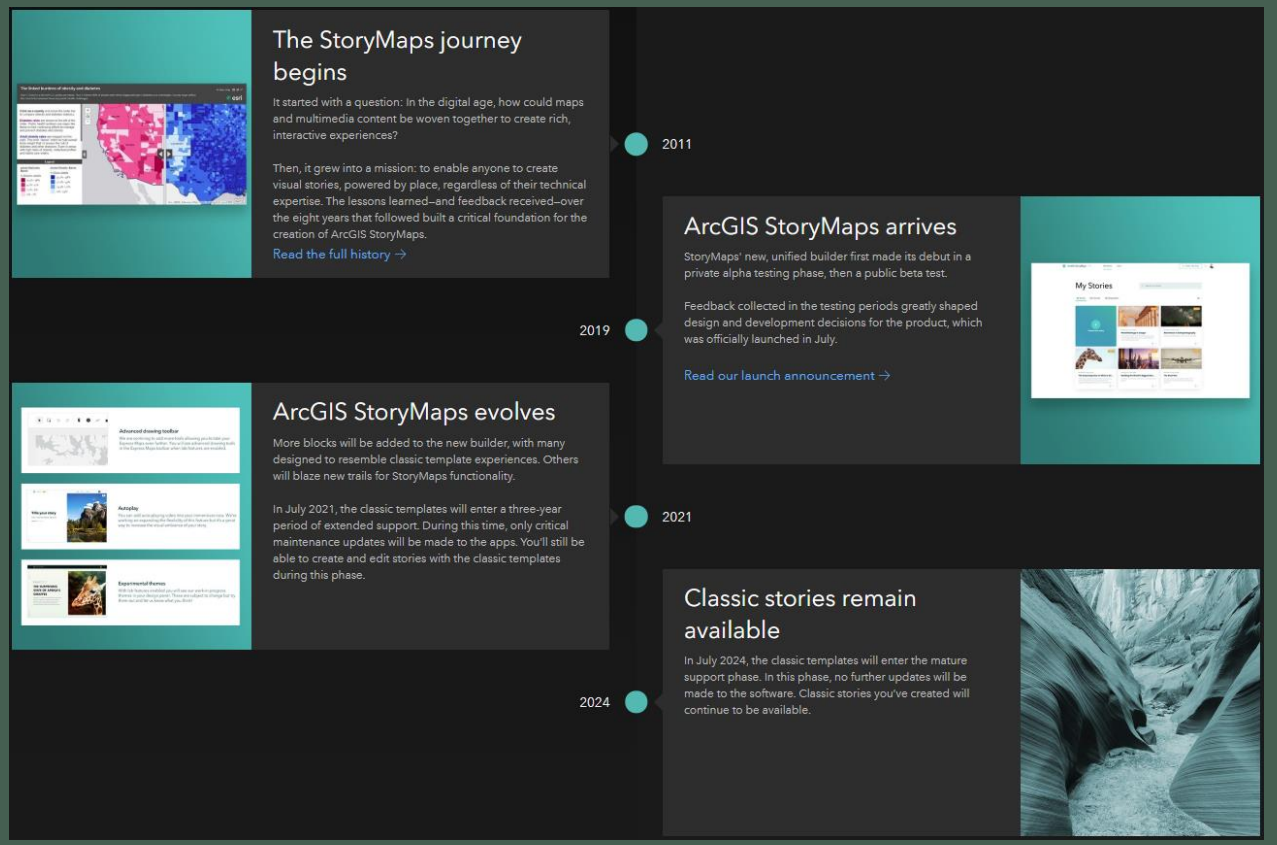
Idea! → Choose a template → Build your story → Share your Story

https://storymaps.arcgis.com/

esri.com

ARCGIS STORY MAPS

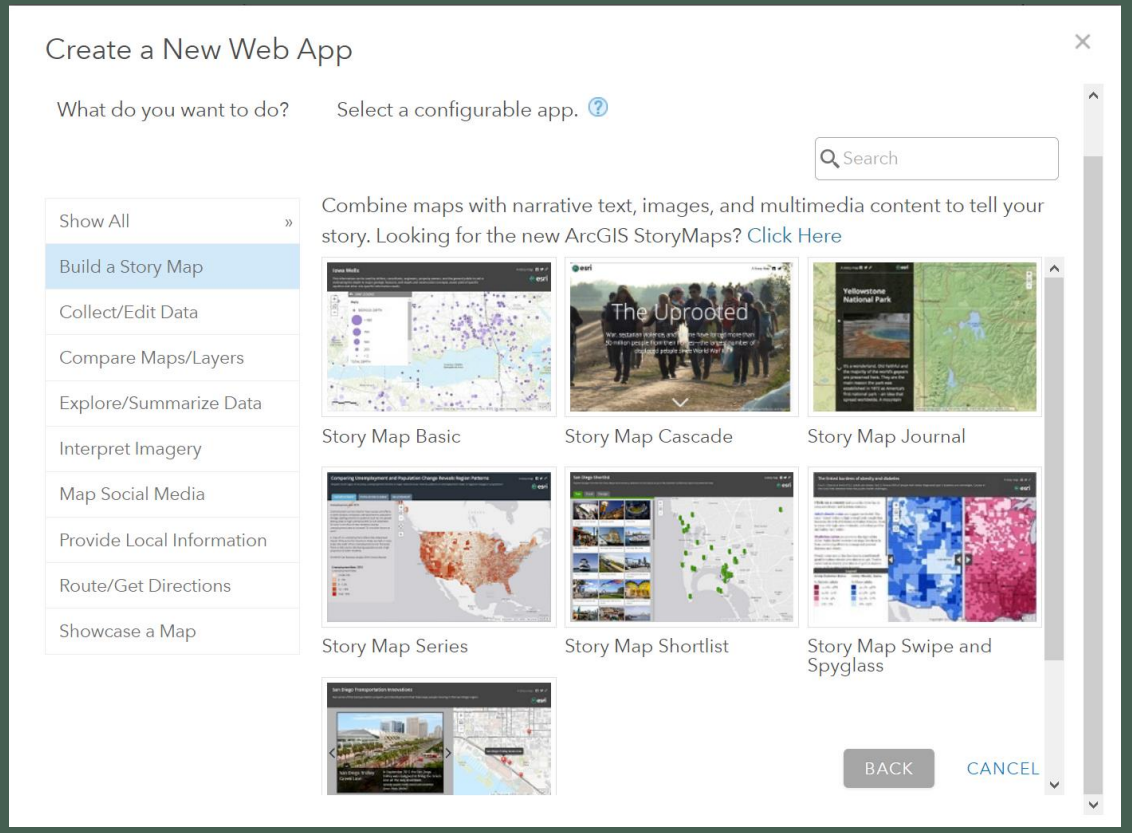
- Renamed as ArcGIS Story Maps
- The classic ESRI Story Maps templates are available until mid-2020 and existing stories can be edited until 2024
- After that time, stories created using the classic version can only be viewed and shared, with limited support
- Unfortunately, story maps created in the classic version cannot be migrated to the new version



https://www.esri.com/en-us/arcgis/products/arcgis-storymaps/product-road-map

CLASSIC STORY MAPS

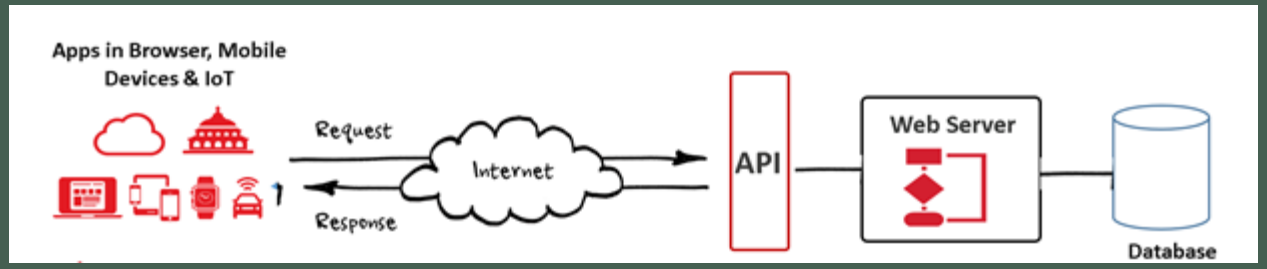
- Integrated into ArcGIS Online
- Build a Story Map (as a Web App) using the web map created in AGOL
- Prebuilt templates



CLASSIC STORY MAPS – TEMPLATES

- Can also be accessed directly at https://storymaps-classic.arcgis.com/en/

ARCGIS API

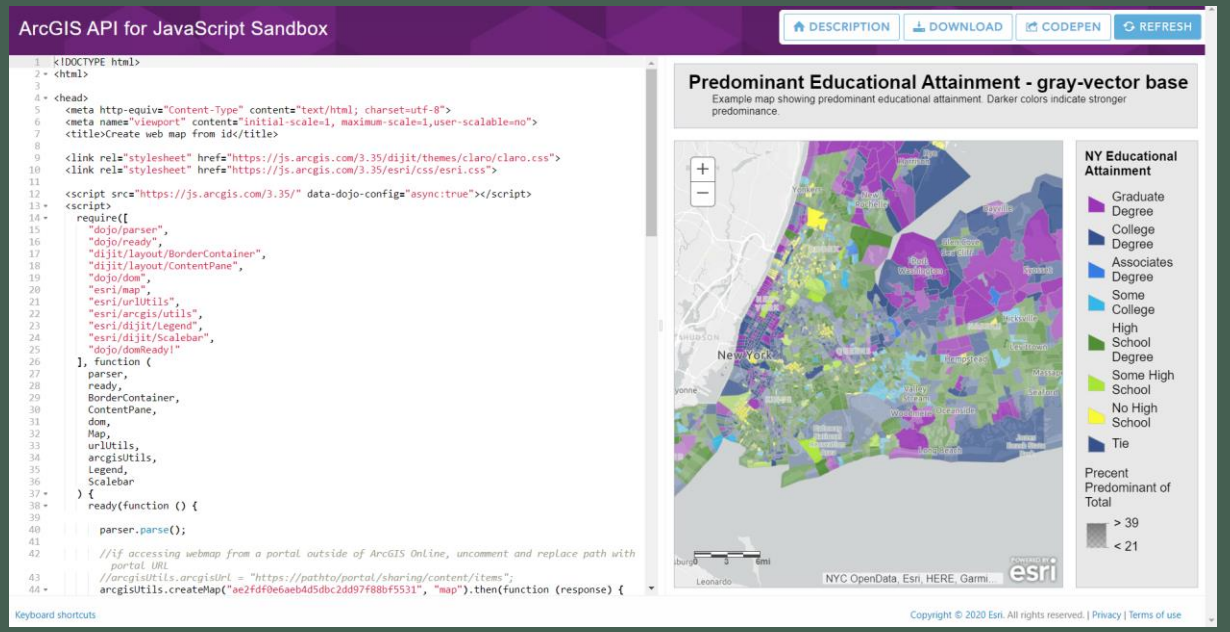


apifriends.com

All Products	JavaScript	Android	iOS	NET	Qt
Java	macOS	ArcGIS Online	REST API	Python	Pro SDK

ARCGIS API FOR JAVASCRIPT

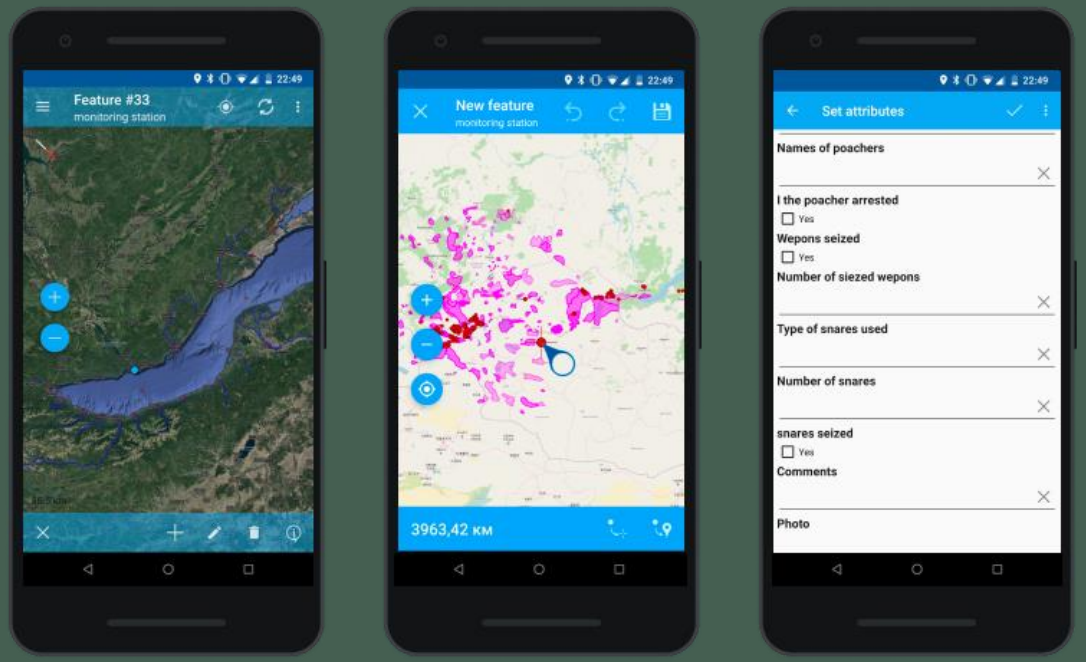
- For developers
- JavaScript is a widely used programming language
- All browsers support JavaScript
- Cross-platform capabilities 9desktop and mobile0
- Any text editor can be used to write code
- Requires basic knowledge of HTML and CSS



arcgis.com

MOBILE GIS

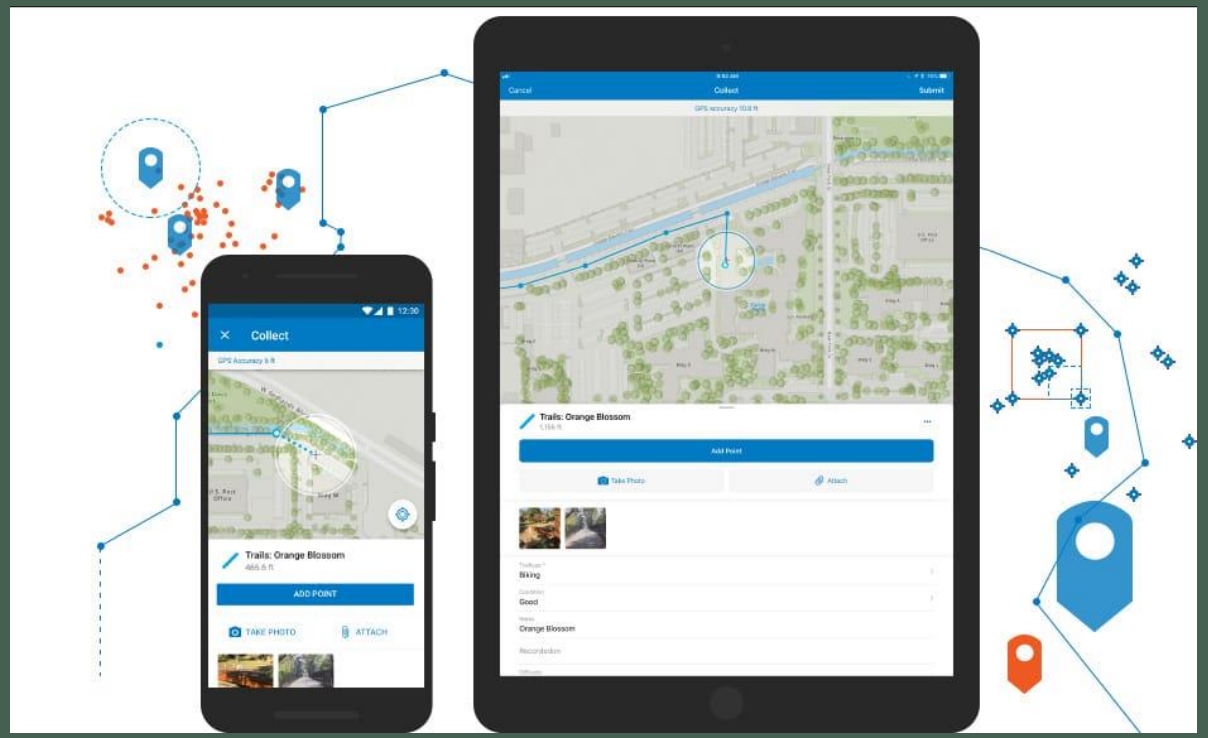
- Browser based, Native-app based, and hybrid based
- Provides rapid data collection and seamless data integration
- Decreases task redundancy and keep data more current
- Improves efficiency and accuracy of field operations
- Allows to make accurate, real-time business decisions
- Replaces paper based workflows



nextgis.com

MOBILE GIS APPLICATIONS

- ArcPad
- ArcGIS for Collector
- ArcGIS for Smartphones and Tablets (Discontinued)
- ArcGIS Companion (New)
- Collector for ArcGIS
- Explorer for ArcGIS
- Workforce for ArcGIS
- Navigator for ArcGIS
- Survey123 for ArcGIS
- AppStudio Player for ArcGIS



esri.com

BENEFITS OF MOBILE GIS

- Mobility
- Location awareness
- Multiple user accessibility
- Versatile means of communication
- Sharing more current information

geocortex.com