

# Spatial Analysis

University of Maryland Libraries  
GIS and Spatial Data Center

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# GIS Services in the Libraries

- Workshops - 10 offerings available
  - Geospatial tools in R coming soon
- 1:1 consulting, collaboration
- Customized guest lectures/lab exercises
- Geospatial Researcher in Residence Program
- GIS lab in 4120 open for use during Library hours
- Access to free online tutorials and software trials
- See [www.lib.umd.edu/gis](http://www.lib.umd.edu/gis) for more information

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  - Proposals, ORAA requirements, presentations, etc.
- Data management
- Statistical consulting
- 3D scanning and printing; video editing
- Funding for open access publishing
- See [www.lib.umd.edu/rc](http://www.lib.umd.edu/rc) for more information

# Workshop Outline

1. Presentation

2. Exercises

1. Creating shapefiles

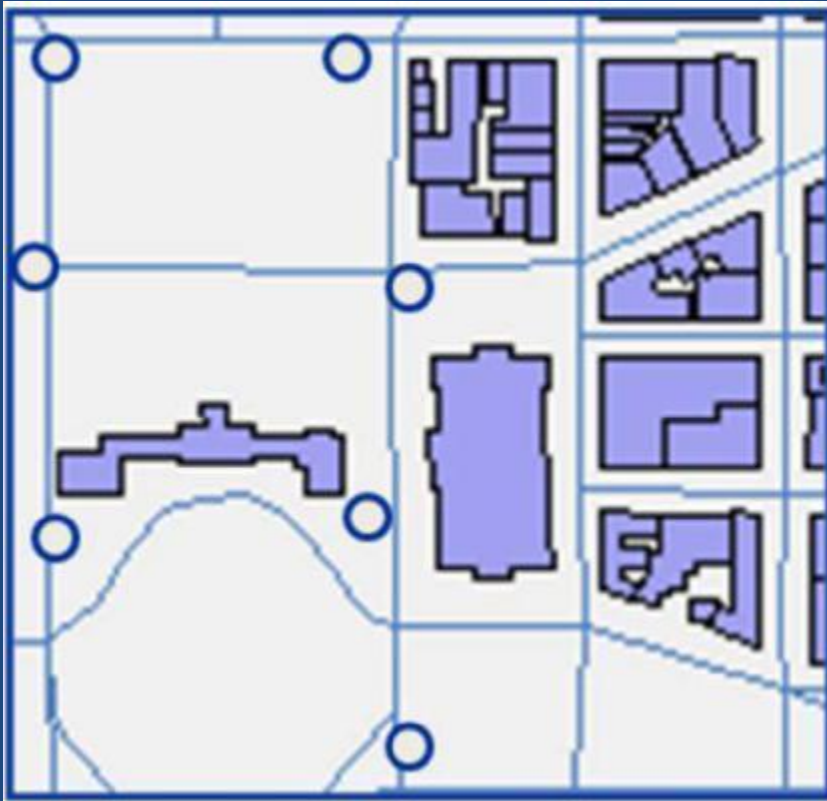
2. Five Common ArcToolbox Tools

3. Spatial Analysis with raster data

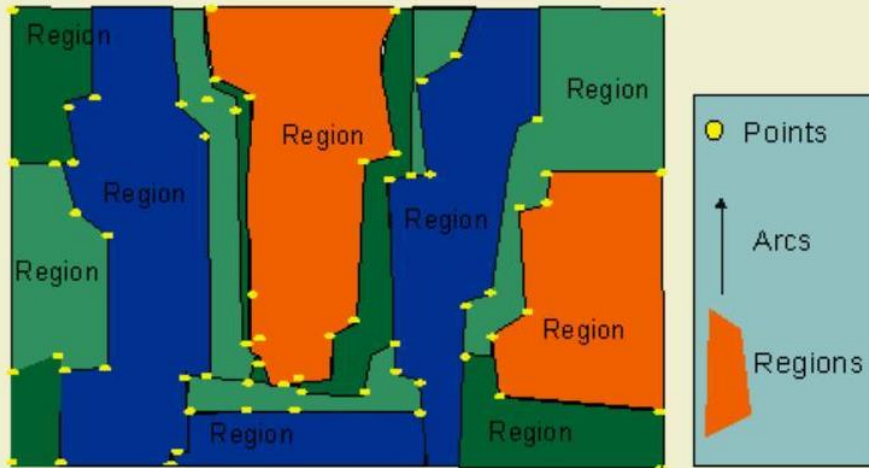
3. Questions and concerns?

# DATA TYPES

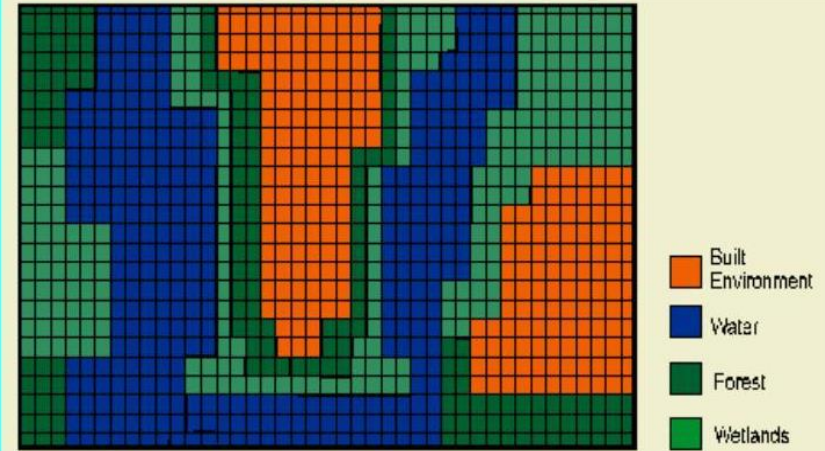
**What do you think are some differences between the two maps?**



# How about the difference between these maps?



The vector GIS builds a model of the real world from points, lines, and regions. Points are positioned according to a location reference system such as latitude-longitude, UTM, or SPC. The application determines the level of precision.



The Raster GIS references phenomena by grid cell location in a matrix. The grid cell is the smallest unit of resolution and may vary from centimeters to kilometers depending on the application.

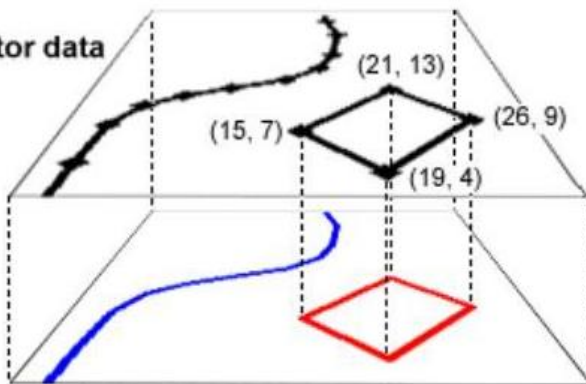
You have just identified the differences between Vector and Raster data types! Let's look at them in more detail.

# Data Types

## Vector

Uses geometric objects (points, lines and polygons) to represent real features on the earth's surface such as light poles, roads and buildings. Ideal for discrete themes with definite boundaries.

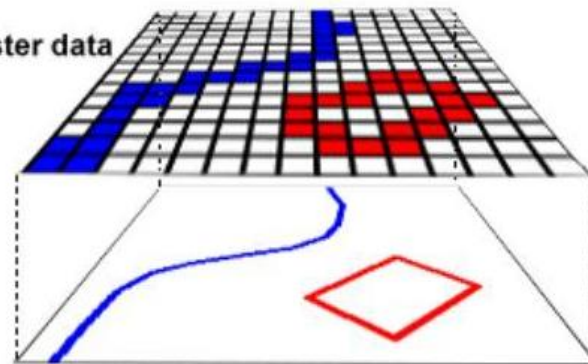
Vector data



## Raster

Is composed of a continuous grid of cells that represent a portion of the earth's surface. Ideal for continuous themes where there is lots of change.

Raster data





# When to use Vector or Raster Data

## What would you use for...

- Determining where to put new hospitals?

## What would use for..

- Determining the elevation of land around the Chesapeake Bay?

Remember: either can be used, but one or the other will be better suited to certain kinds of data.

# Data Types (Layers)

- Raster/Grid

DEM Digital Elevation Model

Image (raster) where the pixel values represent the ground elevation above sea level

DTM Digital Terrain Model

Image (raster) a DTM is a DEM that has been altered by elements such as break lines and observations to correct for artifacts by using photogrammetrically derived line work introduced into a DEM surface.

DSM Digital Surface Model

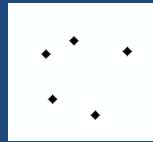
Image (raster) where the pixel values represent the elevations above sea level of the ground and all features on it. For example if there are buildings in the area, the DSM will include those building in the elevation values

# Data Types (Layers)

- Vector
  - Boundaries
  - Features
  - Geology
  - Hydrology
  - Demographic

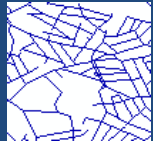
# Vector Data Review

point



attribute table

line



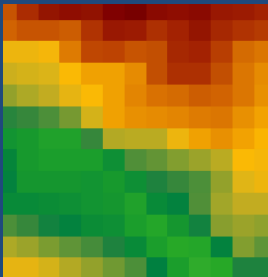
polygon



FID	Shape *	NAME	STATE_NAME	STATE_FIPS	CITY_FIPS	FIPS	AREA	POP1990	POP1999	POP90_00M	HOUSEHOLDS	MALES	FEMALES
1	Polygon	Lake of the Woods	Minnesota	27	077	27077	1794 0634	4076	4597	2	1476	2037	2039
2	Polygon	Ferry	Washington	53	019	53019	2202 2019	6295	7160	3	2247	3209	3015
3	Polygon	Stevens	Washington	53	065	53065	2529 9794	30948	39965	12	11241	15454	15494
4	Polygon	Okanogan	Washington	53	047	53047	5306 18	33350	39596	6	12654	16820	16522
5	Polygon	Pend Oreille	Washington	53	051	53051	1445 0208	8815	11788	6	3395	4426	4489
6	Polygon	Boundary	Idaho	16	001	16021	1279 2987	8332	8980	7	2997	4522	4090
7	Polygon	Lincoln	Montana	30	053	30053	3746 0908	17481	18681	5	6668	8777	8704
8	Polygon	Flathead	Montana	30	029	30029	5232 0306	95219	72498	11	22634	29319	29902
9	Polygon	Glaucus	Montana	30	035	30035	3124 4572	12121	12524	4	3916	5985	6136
10	Polygon	Liberty	Montana	30	051	30051	1489 9459	2295	2332	2	788	1120	1175
11	Polygon	Hill	Montana	30	041	30041	2917 3611	17654	17299	6	6426	9769	8996
12	Polygon	Sheridan	Montana	30	091	30091	1696 5627	4732	4228	3	1999	2322	2400
13	Polygon	Divide	North Dakota	38	023	38023	1279 9633	2899	2305	2	1193	1447	1452
14	Polygon	Burke	North Dakota	38	013	38013	1121 417	3002	2194	3	1252	1505	1496
15	Polygon	Beville	North Dakota	38	075	38075	883 772	3160	2779	4	1209	1560	1600
16	Polygon	Buttlesau	North Dakota	38	009	38009	1710 0691	8011	7113	5	3105	4030	3981
17	Polygon	Rosette	North Dakota	38	079	38079	943 6554	12772	14336	14	4190	6262	6510
18	Polygon	Towner	North Dakota	38	095	38095	1051 6148	3627	2980	3	1433	1617	1610
19	Polygon	Cavalier	North Dakota	38	019	38019	1593 6905	6064	4896	4	2375	3032	3032
20	Polygon	Pembina	North Dakota	38	067	38067	1111 7749	9238	8375	8	3655	4577	4661
21	Polygon	Kittson	Minnesota	27	069	27069	1095 0149	5767	5279	5	2274	2833	2934
22	Polygon	Ryanus	Minnesota	27	135	27135	1670 997	15026	18222	9	5415	7995	7331
23	Polygon	Blaine	Montana	30	005	30005	4226 2541	6720	7174	2	2379	3359	3370
24	Polygon	Phelps	Montana	30	071	30071	5197 3383	5163	4744	1	1931	2537	2626
25	Polygon	Valley	Montana	30	085	30085	5955 5539	6239	6138	2	3268	4110	4129
26	Polygon	Daniels	Montana	30	019	30019	1421 8024	2266	1959	2	919	1115	1131
27	Polygon	Whitcomb	Washington	53	073	53073	2170 2019	12780	159383	59	48543	62848	64332
28	Polygon	Bonner	Idaho	16	017	16017	1902 8247	26222	35991	14	10259	13231	13591
29	Polygon	Ward	North Dakota	38	101	38101	2943 6348	5762	69569	28	21495	28824	29937
30	Polygon	Koochiching	Minnesota	27	071	27071	3141 6325	16299	15420	5	6025	8440	7859
31	Polygon	Shaght	Washington	53	057	53057	1765 1474	79555	101320	45	30673	39205	40390
32	Polygon	Williams	North Dakota	38	105	38105	2175 6933	21129	20035	10	6941	10366	10743
33	Polygon	McHenry	North Dakota	38	049	38049	1874 8398	6528	6024	3	2591	3309	3219
34	Polygon	St. Louis	Minnesota	27	137	27137	6750 4944	199213	162998	29	78901	98435	101778
35	Polygon	San Juan	Washington	53	095	53095	59 9162	10039	12738	179	4392	4867	5998
36	Polygon	Roosevelt	Montana	30	085	30085	2391 1697	10999	10936	5	3694	5374	6525
37	Polygon	Mountral	North Dakota	38	061	38061	1944 771	7021	6590	4	2587	3469	3552
38	Polygon	Marshall	Minnesota	27	089	27089	1819 1567	10983	10190	6	4194	5566	5427

# Raster Data Review

cells



attribute table  
(or not)

raster properties

Layer Properties

General Source Extent Display Symbology Fields Joins & Relates

Property	Value
<input checked="" type="checkbox"/> <b>Raster Information</b>	
Columns and Rows	1082, 884
Number of Bands	1
Cellsize (X, Y)	0.000277777778, 0.000277777778
Uncompressed Size	3.65 MB
Format	GRID
Source Type	continuous
Pixel Type	floating point
Pixel Depth	32 Bit

# Analysis in GIS

- With vector data, the GIS uses values from fields in the attribute table

OBJECTID	SHAPE	Name of Building	Size of Building	Operational Hours	Access
1	Polygon	Gym	1768.992398	8:30am-5:00pm	Emp
2	Polygon	Gym	1043.515552	8:30am-5:00pm	Emp
3	Polygon	J	3834.247963	8:30am-5:00pm	Emp
4	Polygon	OA	14550.305355	8:30am-5:00pm	Emp
5	Polygon	G	11507.921772	8:30am-5:00pm	Emp
6	Polygon	S	2690.197171	8:30am-5:00pm	Emp
7	Polygon	L	11246.731494	8:30am-5:00pm	Emp
8	Polygon	E	10625.150848	8:30am-5:00pm	Emp
9	Polygon	F	4913.179712	8:30am-5:00pm	Emp
10	Polygon	O	25929.942586	8:30am-5:00pm	Emp

- With raster data, the GIS uses values from individual cells, or performs calculations based on zones and/or regions.

A 4x4 grid representing raster data. The cells contain numerical values and are colored based on their values. The values are: Row 1: (1,1)=1, (1,2)=1, (1,3)=2, (1,4)=3; Row 2: (2,1)=1, (2,2)=4, (2,3)=2, (2,4)=1; Row 3: (3,1)=3, (3,2)=2, (3,3)=1, (3,4)=2; Row 4: (4,1)=3, (4,2)=1, (4,3)=1, (4,4)=4. The colors are: 1 is white, 2 is blue, 3 is green, and 4 is orange.

1	1	2	3
1	4	2	1
3	2	1	2
3	1	1	4

# More on Raster Data

- Two types of raster data:
  - Thematic
    - A measured quantity or a classification
    - Ex: 5=elevation in feet
    - Ex: 5=water; 3=forest
  - Image
    - Reflected or emitted light
    - Ex: Pixel scale from 0 to 255  
where 0 is black and 255 is white

5	5	3
5	5	3
5	3	3

0	50	229
50	125	73
123	86	140



# Raster Datasets

- Usually **represent a single theme** (elevation, land use, etc.) – so you need several to show an area
- Are made up of **individual cells** – cells either have a value or have no data

# Raster Datasets – Cells

- Cells can be any size, but every cell in the dataset is the same size.
- The smaller the cell size, the greater the resolution.
- Cells are arranged in rows and columns, so each one has a specific address.

# More on Cells

## Zones

- formed by two or more cells with the same value (connected or disconnected)

1	1	2	3
1	4	2	1
3	2	1	2
3	1	1	4

Zone 1 consists of 7 cells

## Regions

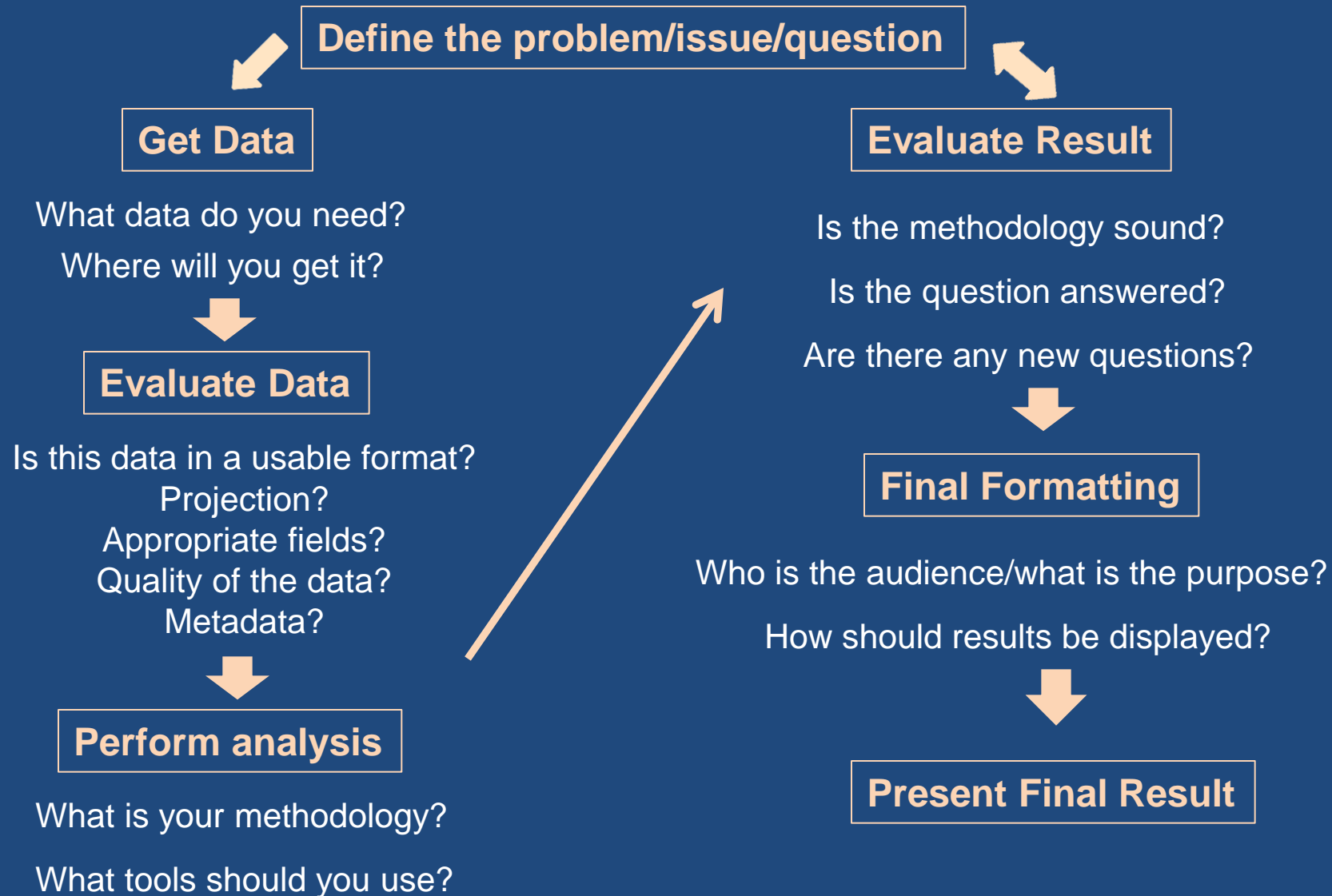
- group of connected cells in a zone

1	1	2	3
1	4	2	1
3	2	1	2
3	1	1	4

Zone 1 has 2 regions

# GIS Process

# GIS Analysis – A Process



# GIS is just a tool

- Quality of your data
- Quality of your modeling process
- Quality of your analysis
- Aesthetics

# ArcGIS Pro

The screenshot displays the ArcGIS Pro software interface. The main window shows a map titled "NAD\_1983\_UTM\_Zone\_11N" with a Raster Layer. The map displays various geographical features, including fire stations (e.g., Palm Springs Fire Station 3, Palm Springs Fire Station 4, Palm Desert Fire Station 71, Palm Desert Fire Station 33, Garman Valley Fire Station 53, Toro Peak 2650 M, Anza SW) and schools (e.g., Rio Vista Elementary, Della S. Lindley Elementary, Cathedral City Elementary, Benjamin Franklin School, La Quinta Fire Station 70, Coachella Valley High School, Valle del Sol Elementary, Desert Mirage High School). The map is overlaid on a topographic background.

The interface includes a ribbon menu at the top with tabs for Project, Map, Insert, Analysis, View, Edit, Imagery, Share, Appearance, and Data. The Share tab is currently active, showing options for Project, Map, Layer, Geoprocessing, Web Map, Web Layer, Locator, Web Tool, Jobs, Project Template, Map File, Layer File, Task File, Map, and Export.

On the left side, the Contents pane shows the Drawing Order for the map. The layers are:

- CREWS Points
  - Site\_Type
    - Fire Station (red triangle)
    - School (blue triangle)
    - Proposed (purple triangle)
    - Sensor only (green triangle)
- Study Area (red outline)
- hish\_30 (value range: High: 254, Low: 0)
- Topography, 30 M (value range: High: 3298.07, Low: -65.7923)
- Basemap
  - World\_Imagery
  - Basemap
  - World\_Topo\_Map

On the right side, the Share As Web Map pane is open, showing the configuration for the web map. The Name is "NAD\_1983\_UTM\_Zone\_11N". The Item Description is "Topography". The Sharing Options are set to "My Content". The Finish Sharing buttons are "Analyze", "Share", and "Jobs".

Let's Go!

ArcGIS Exercises

[lib.umd.edu/gis/workshops](http://lib.umd.edu/gis/workshops)