One way to measure location: Degrees of latitude/longitude
Introduction to GIS:
What good are spatial data anyway?
Today’s Class: Thinking Spatially

- GIS is *not* just a digital mapmaker! It is a way of thinking and solving problems.

- Start thinking about the scope of problems for which GIS is useful.
Geographic Information Science

Input  \rightarrow Management  \rightarrow Analysis  \rightarrow Output
Geographic Information Science

Input → Management → Analysis → Output

Types of Spatial Data Available:

• Vector Data
• Raster Data
Geographic Information Science

Input ➔ Management ➔ Analysis ➔ Output

Types of Spatial Data Available:

• Vector Data – *also known as a ‘shapefile’*

• Raster Data – *also known as a ‘grid’*

ArcGIS specific terminology
Input → Management → Analysis → Output

Types of Spatial Data Available:

• Vector Data
  • Names
  • Attributes
  • Locations

• Raster Data
Geographic Information Science

Input → Management → Analysis → Output

Types of Spatial Data Available:

• Vector Data
  • Names
  • Attributes
  • Locations

• Raster Data

In ArcMap:
Geographic Information Science

Input ➔ Management ➔ Analysis ➔ Output

Types of Spatial Data Available:

- Vector Data
  - Names
  - Attributes
  - Locations
- Raster Data

In Windows explorer:
Geographic Information Science

Input  ➔ Management  ➔ Analysis  ➔ Output

Types of Spatial Data Available:

- Vector Data
- Raster Data
  - Images
  - Continuous
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Input ➔ Management ➔ Analysis ➔ Output

Types of Spatial Data Available:

• Vector Data
• Raster Data
  • Images
  • Continuous

In ArcMap:
Geographic Information Science

Input ➔ Management ➔ Analysis ➔ Output

Types of Spatial Data Available:

• Vector Data
• Raster Data
  • Images
  • Continuous

In Windows explorer:
Geographic Information Science

Input ➔ Management ➔ Analysis ➔ Output
Geographic Information Science

Input  ➔ Management  ➔ Analysis  ➔ Output

Sources of Spatial Data:

- Websites
- Purchased data (e.g., remotely sensed imagery)
- Faculty & graduate students
- Create your own!
Office of Geographic Information (MassGIS)

Through the Office of Geographic Information (MassGIS), the Commonwealth has created a comprehensive, statewide database of spatial information for mapping and analysis supporting emergency response, environmental planning and management, transportation planning, economic development, and transparency in state government operations.
Visualization
Visualization

World map (Robinson projection)
Visualization

Participants at the UN Climate Change Conference 2010
(COP 16 / CMP 6 in Cancun)

Map showing countries resized according to the number of delegates at the 2010 UN Climate Change Conference in Cancun / Mexico

Number of delegates at U.N. climate change conference
Landsat Satellite
True color image of New Haven, CT
Summer 1999
Landsat Satellite
False color image of
New Haven, CT
Summer 1999
Input → **Management** → Analysis → Output

Data Management:

- Spatial data rely on databases, so they require database management
- Currently lots of movement towards online and multi-user geodatabases

- *We will not spend any time on spatial data management in this class*
Geographic Information Science

Input → **Management** → Analysis → Output

What you need to know about data management:

• Spatial data often have metadata
**Ice_Rinks**

**Shapefile**

**Tags**

Ice, Rink, Arena, Skating, Massachusetts

**Summary**
The GIS Program mapped the location of these facilities for general planning and analysis purposes.

**Description**
This point datalayer containing all of the ice skating rinks and arenas in the Commonwealth of Massachusetts was created by the Center for Environmental Health (CEH), Massachusetts Department of Public Health (MDPH). The Community Sanitation Program (CSP) of the CEH, MDPH obtained the rink addresses and associated attributes. The CSP monitors skating rinks, as they are bound by the state sanitary code related to indoor air quality and ice making. The GIS Program mapped the location of these facilities for general planning and analysis purposes. Included in this layer are rinks both publicly and privately owned, as well as those located on school campuses.

MassGIS stores and distributes the layer as ICERINKS_PT.

**Credits**
None
What you need to know about data management:

• Spatial data often have metadata

• ALWAYS use ArcCatalog to move spatial data
Geographic Information Science

Input → Management → **Analysis** → Output

Analysis of Spatial Data is key in GIS

• Querying of data layers
• Links between data layers
• Statistical Analysis
• Spatial Modeling
Example: Selection Tools

How many public ice rinks are located in Boston?

<table>
<thead>
<tr>
<th>FID</th>
<th>Shape *</th>
<th>OBJECTID</th>
<th>FACIL_NAME</th>
<th>CITY_TOWN</th>
<th>FACIL_TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Point</td>
<td>584</td>
<td>McVann-O'Keefe Memorial Skating Rink</td>
<td>Peabody</td>
<td>DCRP</td>
</tr>
<tr>
<td>1</td>
<td>Point</td>
<td>585</td>
<td>Hobomock Arena Rink I</td>
<td>Pembroke</td>
<td>Public</td>
</tr>
<tr>
<td>2</td>
<td>Point</td>
<td>586</td>
<td>Hobomock Arena Rink II</td>
<td>Pembroke</td>
<td>Public</td>
</tr>
<tr>
<td>3</td>
<td>Point</td>
<td>587</td>
<td>Boys &amp; Girls Club</td>
<td>Pittsfield</td>
<td>Public</td>
</tr>
<tr>
<td>4</td>
<td>Point</td>
<td>588</td>
<td>John A. Armstrong Memorial Skating Rink</td>
<td>Plymouth</td>
<td>DCRP</td>
</tr>
<tr>
<td>5</td>
<td>Point</td>
<td>589</td>
<td>Shea Memorial Rink</td>
<td>Quincy</td>
<td>DCR</td>
</tr>
<tr>
<td>6</td>
<td>Point</td>
<td>590</td>
<td>Quincy Youth Arena</td>
<td>Quincy</td>
<td>Public</td>
</tr>
<tr>
<td>7</td>
<td>Point</td>
<td>591</td>
<td>Joseph Zapustas Arena</td>
<td>Randolph</td>
<td>Public</td>
</tr>
<tr>
<td>8</td>
<td>Point</td>
<td>592</td>
<td>CDL Arena</td>
<td>Raynham</td>
<td>Public</td>
</tr>
<tr>
<td>9</td>
<td>Point</td>
<td>593</td>
<td>Burbank Area</td>
<td>Reading</td>
<td>Public</td>
</tr>
<tr>
<td>10</td>
<td>Point</td>
<td>594</td>
<td>Cronin Memorial Rink</td>
<td>Revere</td>
<td>DCRP</td>
</tr>
<tr>
<td>11</td>
<td>Point</td>
<td>595</td>
<td>Rockland Rink</td>
<td>Rockland</td>
<td>Public</td>
</tr>
<tr>
<td>12</td>
<td>Point</td>
<td>596</td>
<td>Massports Club, Bavis Arena</td>
<td>Rockland</td>
<td>Public</td>
</tr>
<tr>
<td>13</td>
<td>Point</td>
<td>597</td>
<td>Massports Club, Mini Rink</td>
<td>Rockland</td>
<td>Public</td>
</tr>
<tr>
<td>14</td>
<td>Point</td>
<td>598</td>
<td>Salem State College, Rockett Arena</td>
<td>Salem</td>
<td>School</td>
</tr>
<tr>
<td>15</td>
<td>Point</td>
<td>599</td>
<td>Hockeystick USA South Rink</td>
<td>Saugus</td>
<td>Public</td>
</tr>
<tr>
<td>16</td>
<td>Point</td>
<td>600</td>
<td>Hockeystick USA North Rink</td>
<td>Saugus</td>
<td>Public</td>
</tr>
<tr>
<td>17</td>
<td>Point</td>
<td>601</td>
<td>Kanaguchi Memorial Arena</td>
<td>Saugus</td>
<td>Public</td>
</tr>
</tbody>
</table>
Example: Selection Tools

How many public ice rinks are located in Boston?
Example: Selection Tools

How many ice rinks are located in Essex County?
Example: Selection Tools

How many ice rinks are located in Essex County?
Example: Statistical Analysis

What are the elevation ranges and means for these 7 study sites?
### Table: Mean Elevation

<table>
<thead>
<tr>
<th>VALUE</th>
<th>MIN</th>
<th>MAX</th>
<th>RANGE</th>
<th>MEAN</th>
<th>STD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>641.924011</td>
<td>846.934021</td>
<td>205.009995</td>
<td>710.749023</td>
<td>60.061798</td>
</tr>
<tr>
<td>2</td>
<td>757.830017</td>
<td>1000.190002</td>
<td>242.363998</td>
<td>878.716980</td>
<td>53.556702</td>
</tr>
<tr>
<td>3</td>
<td>688.664001</td>
<td>730.526001</td>
<td>41.862202</td>
<td>706.921997</td>
<td>10.757700</td>
</tr>
<tr>
<td>4</td>
<td>495.661011</td>
<td>545.869019</td>
<td>50.207901</td>
<td>506.815002</td>
<td>8.815210</td>
</tr>
<tr>
<td>5</td>
<td>585.768982</td>
<td>595.671997</td>
<td>9.903140</td>
<td>590.843018</td>
<td>2.373770</td>
</tr>
<tr>
<td>6</td>
<td>610.671997</td>
<td>630.543030</td>
<td>19.871201</td>
<td>621.702026</td>
<td>3.698090</td>
</tr>
<tr>
<td>7</td>
<td>468.274994</td>
<td>680.870972</td>
<td>212.595993</td>
<td>551.622009</td>
<td>50.438999</td>
</tr>
</tbody>
</table>

### Bar Chart: Mean Elevation

- **Study Site**
  - Site 1
  - Site 2: High elevation
  - Site 3
  - Site 4: Low elevation
  - Site 5
  - Site 6
  - Site 7
Example: Suitability Analysis
Example: Suitability Analysis

- soils
- irrigation rates
- groundwater levels
- slope
- land cover

...and/or any other spatially-explicit parameter
Example: Suitability Analysis

[Image of a turtle and a map with color-coded suitability analysis]
Doggie Daycare Suitability

After combining Customer Suitability, Distance Suitability and parcel criteria, you end up with a map of potential properties that meet all of your requirements.
Geographic Information Science

Input  ➔ Management  ➔ Analysis  ➔ Output

GIS Output at its best is:

• Information rich

• Understandable (Intuitive!)

• We’ll talk more about cartography at the start of lab this week
Cartography matters!
Cartography matters!
Interesting map for the day
What areas on your map might be good candidates for biodiversity conservation? Why?

What other information not on your map would help you make this decision?