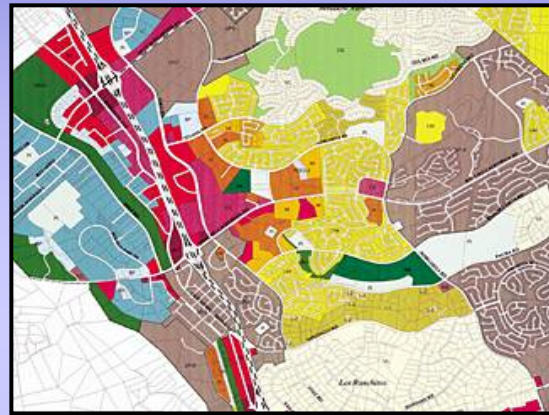


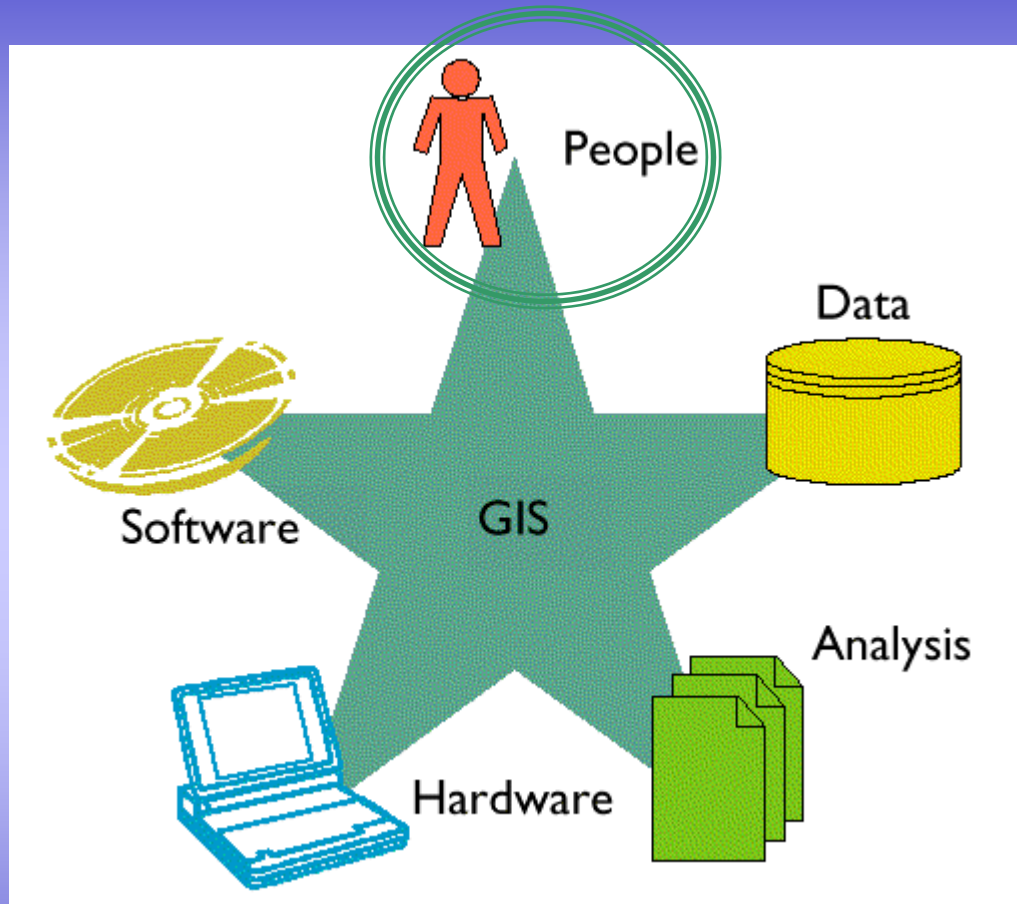
An introduction to Geographic Information Systems



William Shuart
Center for Environmental Studies
Virginia Commonwealth University



What is GIS?



A method to visualize, manipulate, analyze, and display spatial data

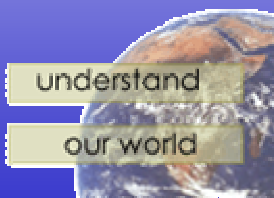
What is Not GIS???

- **GPS** – Global Positioning System
- A **static map** – paper or digital
 - Maps are often a “product” of a GIS
 - A way to visualize the analysis
- A **software** package



Spatial Data

- Estimates are that 80% of all data has a *spatial* component
 - Data from most sciences can be analyzed “spatially”



Databases

- Not easy to interpret
 - Attribute values

Attributes of czhydrography

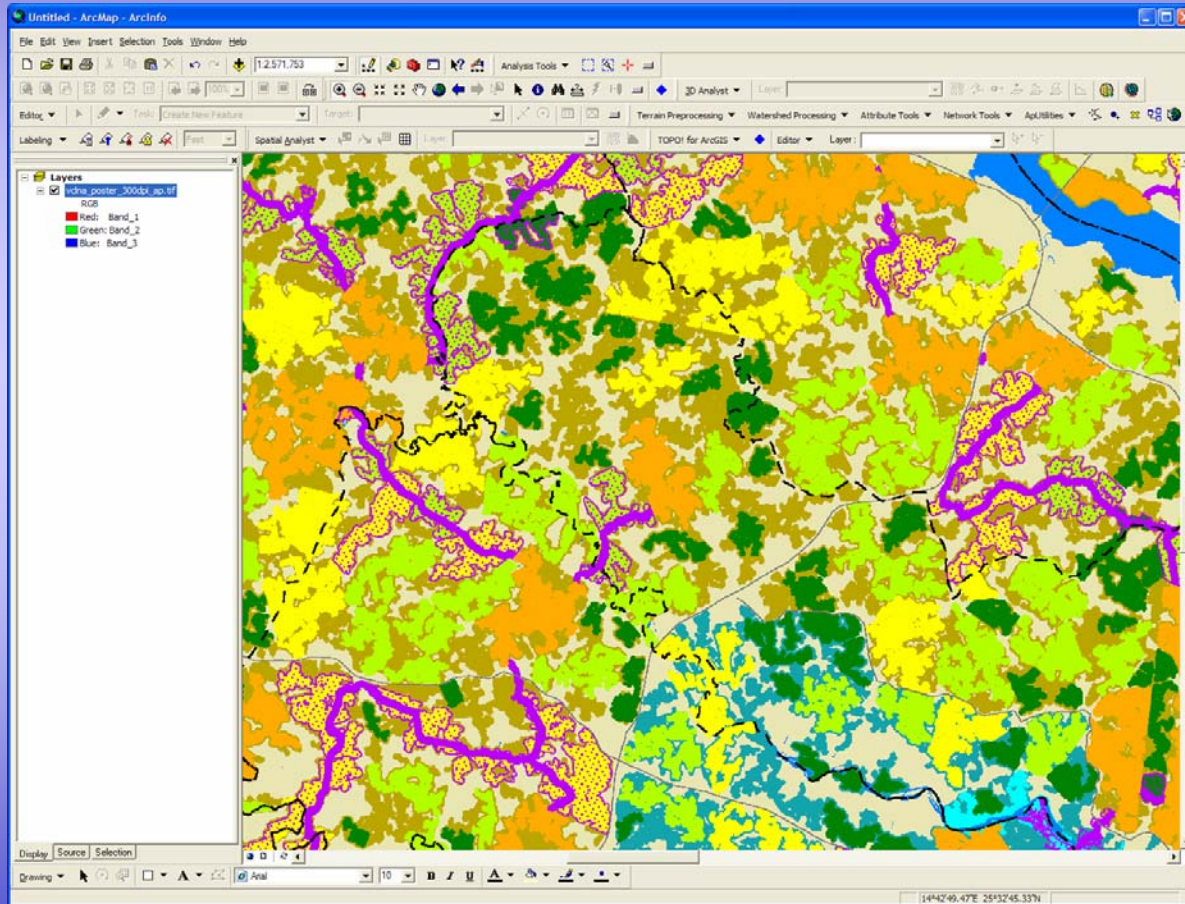
| FID | Shape | TLID | FNODE | TNODE | LENGTH | FEDIRP | FENAME | FETYPE | FEDIRS | CFCC |
|-------|----------|-----------|-------|-------|---------|--------|---------------|--------|--------|------|
| 37654 | Polyline | 168197125 | 232 | 230 | 0.00795 | | Zion Branch | | | H11 |
| 37660 | Polyline | 168197136 | 172 | 228 | 0.07053 | | Zion Branch | | | H11 |
| 38556 | Polyline | 168204496 | 172 | 154 | 0.02655 | | Zion Branch | | | H11 |
| 19291 | Polyline | 76512302 | 516 | 486 | 0.04992 | | Youngs Branch | | | H11 |
| 19292 | Polyline | 76512316 | 486 | 474 | 0.00849 | | Youngs Branch | | | H11 |
| 43699 | Polyline | 21875585 | 711 | 726 | 0.03063 | | Yorkers Swamp | | | H11 |
| 43700 | Polyline | 21875586 | 726 | 719 | 0.06595 | | Yorkers Swamp | | | H11 |
| 43704 | Polyline | 21875592 | 708 | 710 | 0.02356 | | Yorkers Swamp | | | H11 |
| 43705 | Polyline | 21875593 | 710 | 711 | 0.00291 | | Yorkers Swamp | | | H11 |
| 43711 | Polyline | 21875600 | 706 | 703 | 0.0073 | | Yorkers Swamp | | | H11 |
| 9784 | Polyline | 103751555 | 214 | 212 | 0.00237 | | Yoder Pond | | | H12 |
| 23894 | Polyline | 199467988 | 1020 | 1083 | 0.02086 | | Yearlys Creek | | | H11 |
| 8817 | Polyline | 103824736 | 23 | 26 | 0.00702 | | Wythe Creek | | | H11 |
| 8818 | Polyline | 103824737 | 26 | 52 | 0.03706 | | Wythe Creek | | | H11 |
| 10695 | Polyline | 103798763 | 83 | 95 | 0.03706 | | Wythe Creek | | | H11 |
| 10696 | Polyline | 103798764 | 82 | 83 | 0.00702 | | Wythe Creek | | | H11 |
| 10697 | Polyline | 103798766 | 76 | 74 | 0.06175 | | Wythe Creek | | | H11 |
| 10754 | Polyline | 103802439 | 48 | 50 | 0.00736 | | Wythe Creek | | | H11 |
| 10755 | Polyline | 103802440 | 50 | 57 | 0.02246 | | Wythe Creek | | | H11 |
| 10757 | Polyline | 103802615 | 57 | 67 | 0.00861 | | Wythe Creek | | | H11 |
| 10758 | Polyline | 103802616 | 67 | 76 | 0.0138 | | Wythe Creek | | | H11 |
| 10805 | Polyline | 103802794 | 74 | 80 | 0.02321 | | Wythe Creek | | | H11 |
| 10806 | Polyline | 103802795 | 80 | 82 | 0.00418 | | Wythe Creek | | | H11 |
| 10818 | Polyline | 103802821 | 95 | 96 | 0.00394 | | Wythe Creek | | | H01 |
| 10819 | Polyline | 103802822 | 96 | 93 | 0.00275 | | Wythe Creek | | | H01 |
| 12373 | Polyline | 103785951 | 569 | 567 | 0.06175 | | Wythe Creek | | | H11 |
| 12521 | Polyline | 103790287 | 511 | 521 | 0.00736 | | Wythe Creek | | | H11 |
| 12522 | Polyline | 103790288 | 521 | 550 | 0.02246 | | Wythe Creek | | | H11 |
| 12525 | Polyline | 103790340 | 550 | 556 | 0.00861 | | Wythe Creek | | | H11 |
| 12526 | Polyline | 103790341 | 556 | 569 | 0.0138 | | Wythe Creek | | | H11 |
| 12551 | Polyline | 103790590 | 567 | 584 | 0.02321 | | Wythe Creek | | | H11 |
| 12552 | Polyline | 103790591 | 584 | 587 | 0.00418 | | Wythe Creek | | | H11 |

Record: 1 Show: All Selected Records (0 out of 47401 Selected.) Options



Visualization

- A picture is worth a thousand words



GIS Functions

Capture

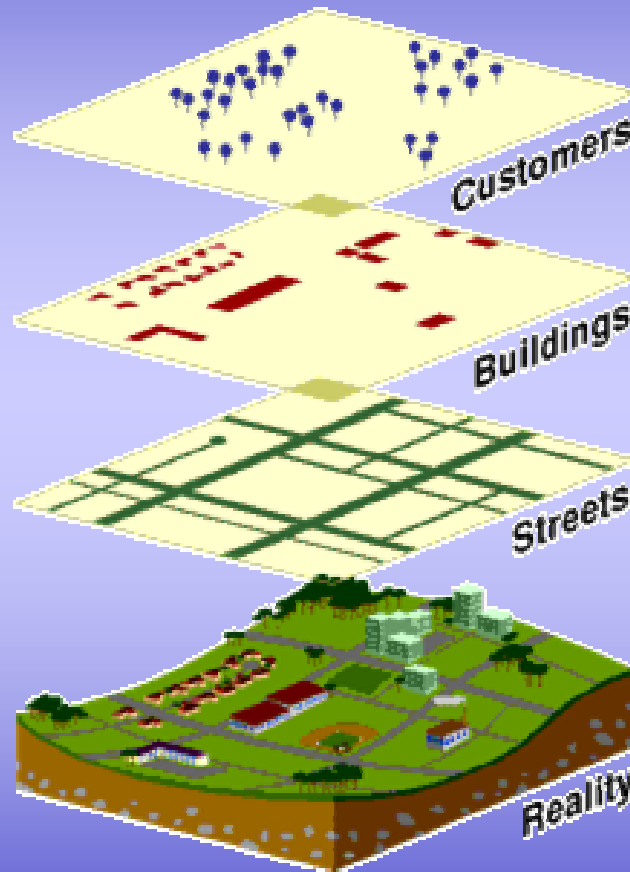
Analyze

Store

Display

Query

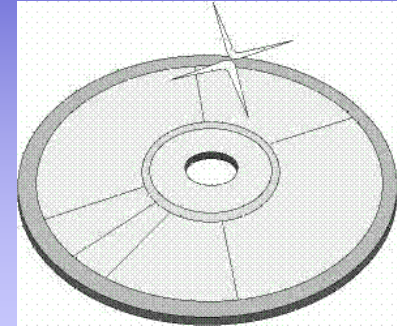
Output



Capturing data



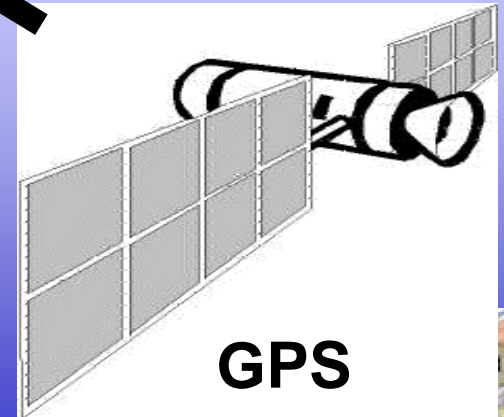
Paper maps



Digital data

480585.5, 3769234
483194.1, 3768432
485285.8, 3768391
484327.3, 3768565
483874.7, 3769823

Coordinates

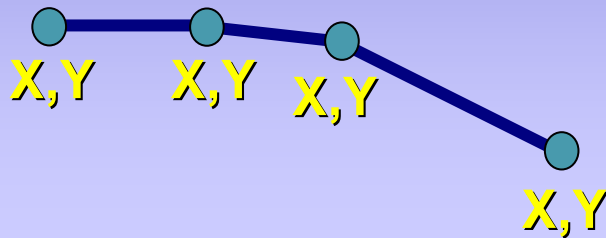


GPS

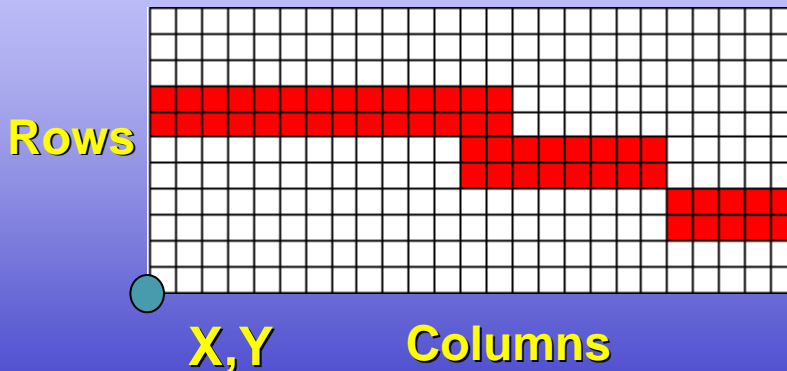


Storing data

- Vector formats
 - Discrete representations of reality



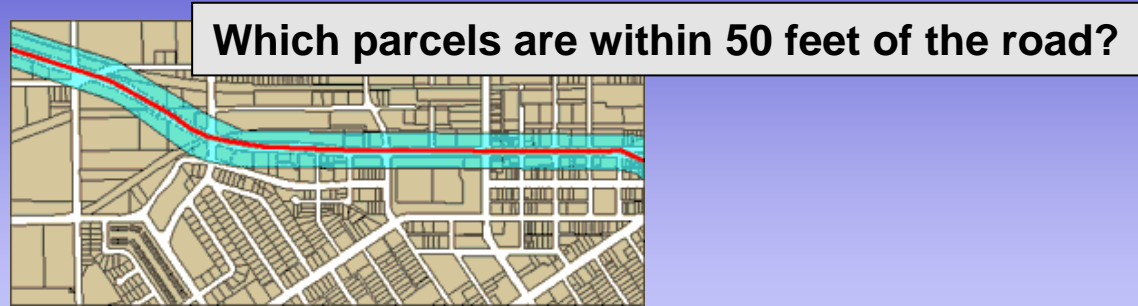
- Raster formats
 - Use square cells to model reality



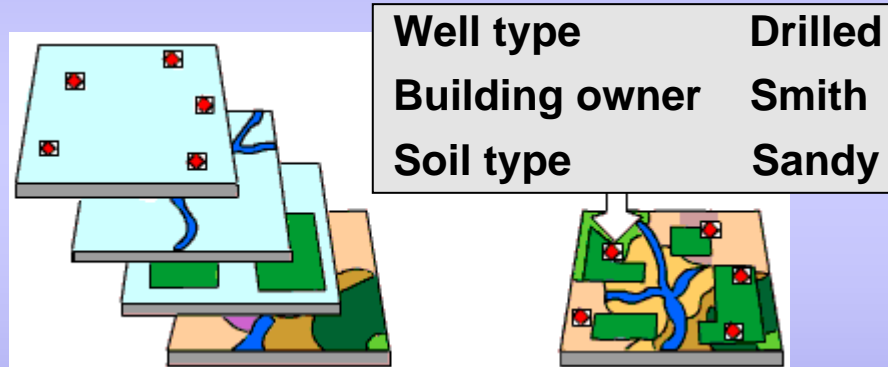
Reality
(A highway)

Analysis

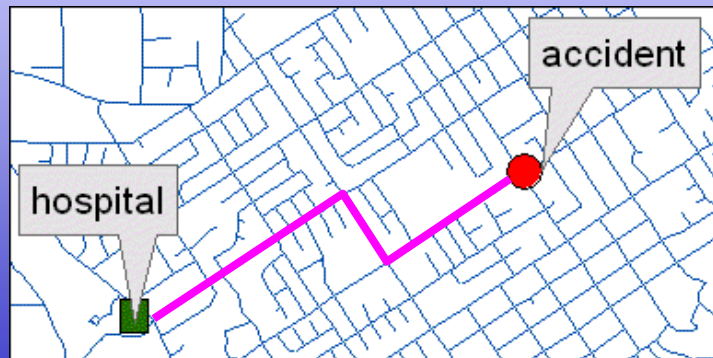
- Proximity



- Overlay

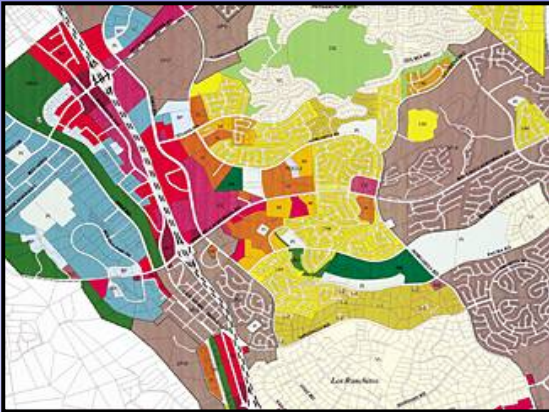


- Network

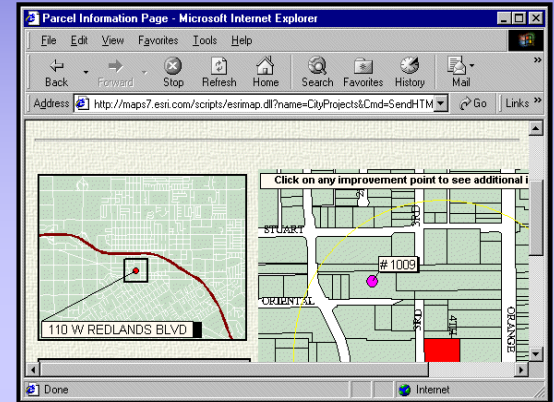


Output

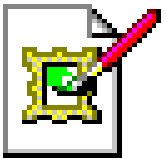
Paper map



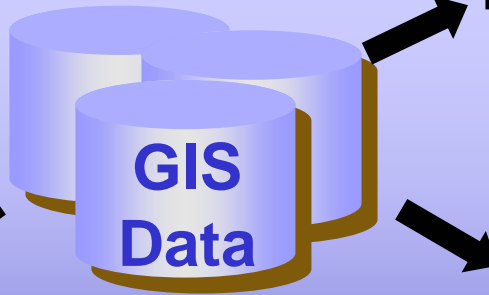
Internet



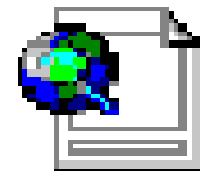
Image



florida.jpg

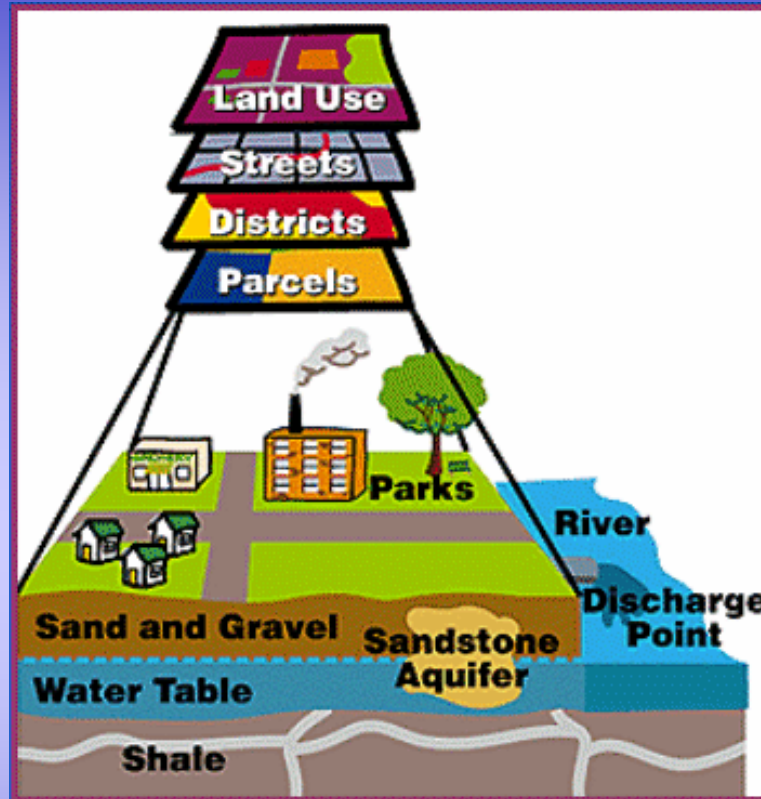


Document



Florida.mxd

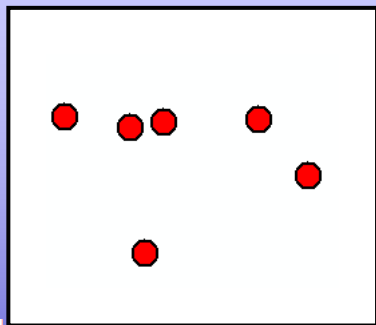
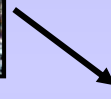
- A GIS works with thematic layers of spatial data



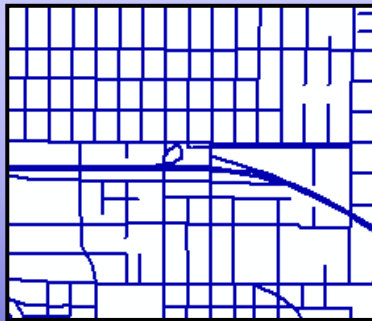
- Answer questions by comparing different layers of data

Representing features in vector data

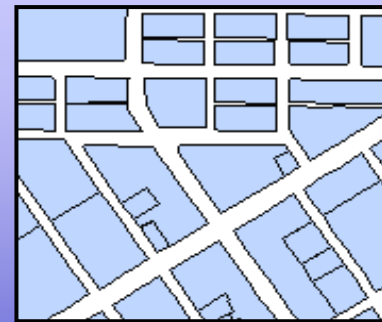
- Real-world entities are abstracted into three basic shapes



Points
(Retail stores)



Lines/Arcs/Routes
(Streets)



Areas/Polygons/Regions
(Land uses)



understand
our world

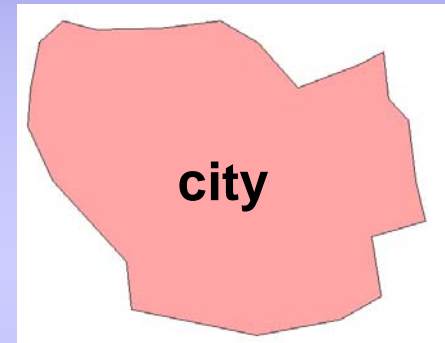
Map scale

- Map scale determines the size and shape of features

- Large scale

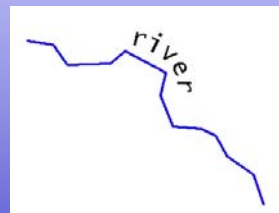


1:500



1:24000

- Small scale



1:24000



city

1:250000

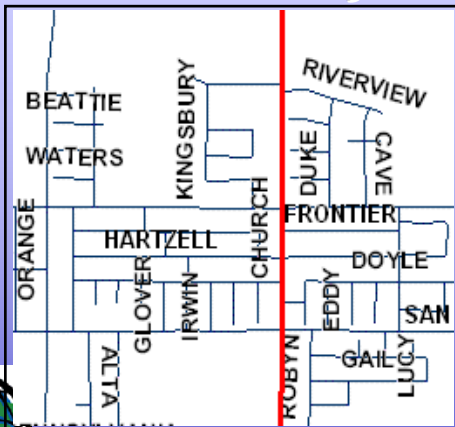


Components of geographic data

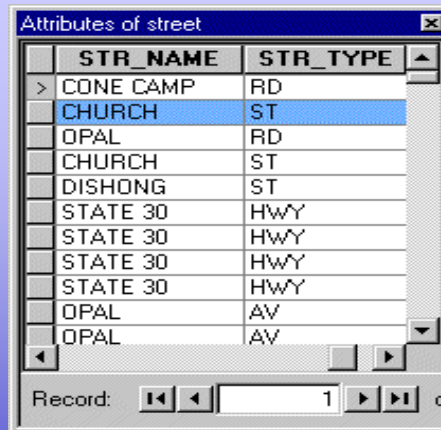
- Three general components to geographic information



Geometry



Attributes

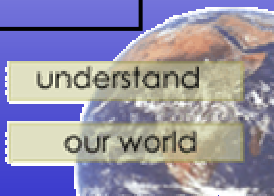


| STR_NAME | STR_TYPE |
|-------------|----------|
| > CONE CAMP | RD |
| CHURCH | ST |
| OPAL | RD |
| CHURCH | ST |
| DISHONG | ST |
| STATE 30 | HWY |
| STATE 30 | HWY |
| STATE 30 | HWY |
| STATE 30 | HWY |
| OPAL | AV |
| OPAL | AV |

Behavior

Rules

Streets and highways may not intersect



Using spatial relationships

**I-80 connects
San Francisco
and New York**

**New York is
adjacent to the
Atlantic Ocean**



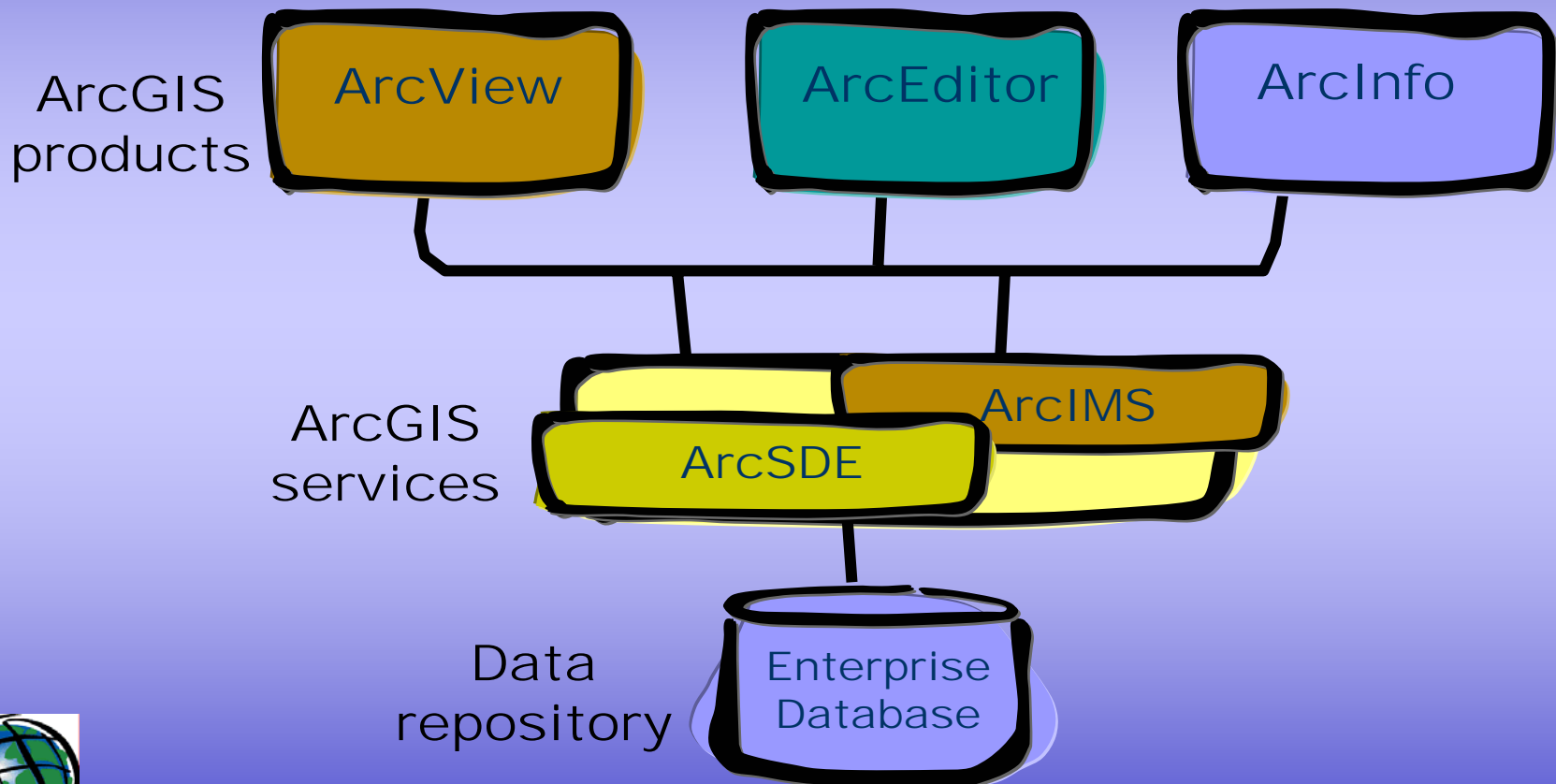
**San Francisco is
contained by California**

**I-80 has length
and direction**



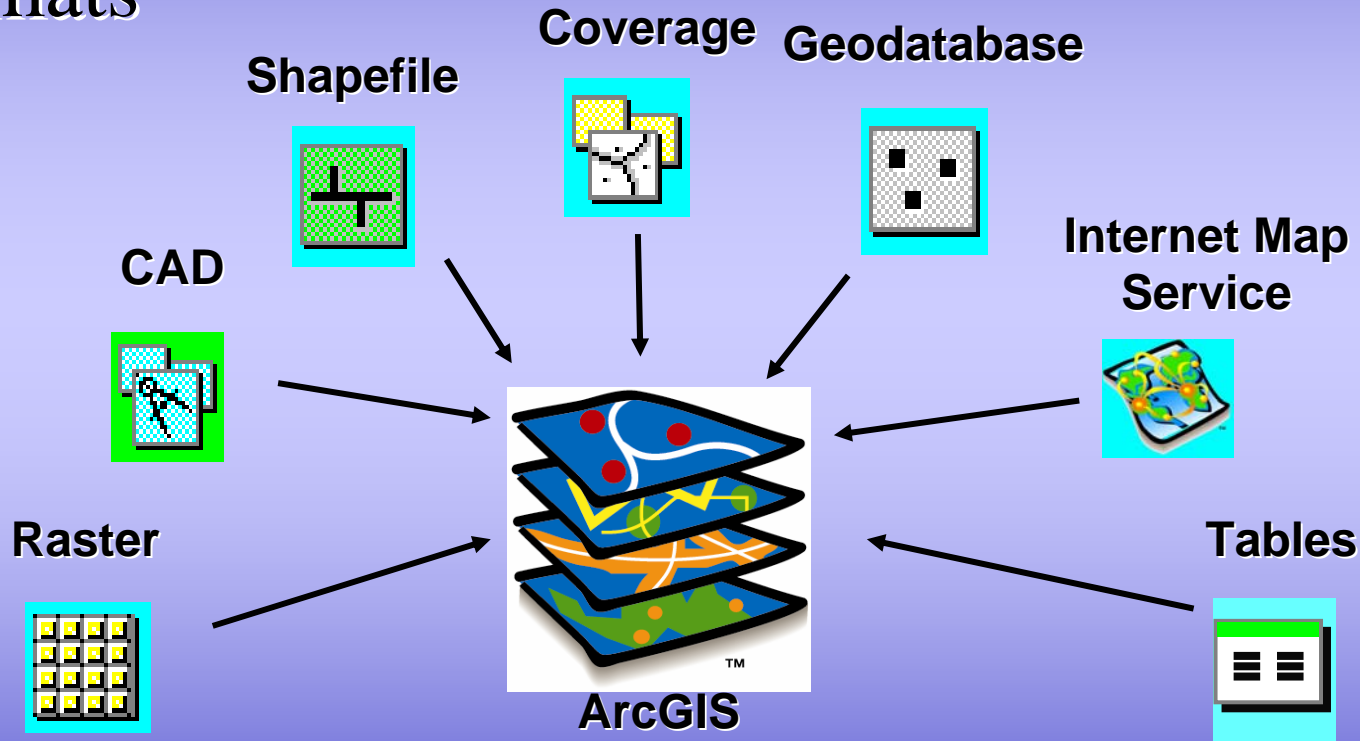
Overview of ArcGIS

- Increasing functionality from ArcView to ArcInfo



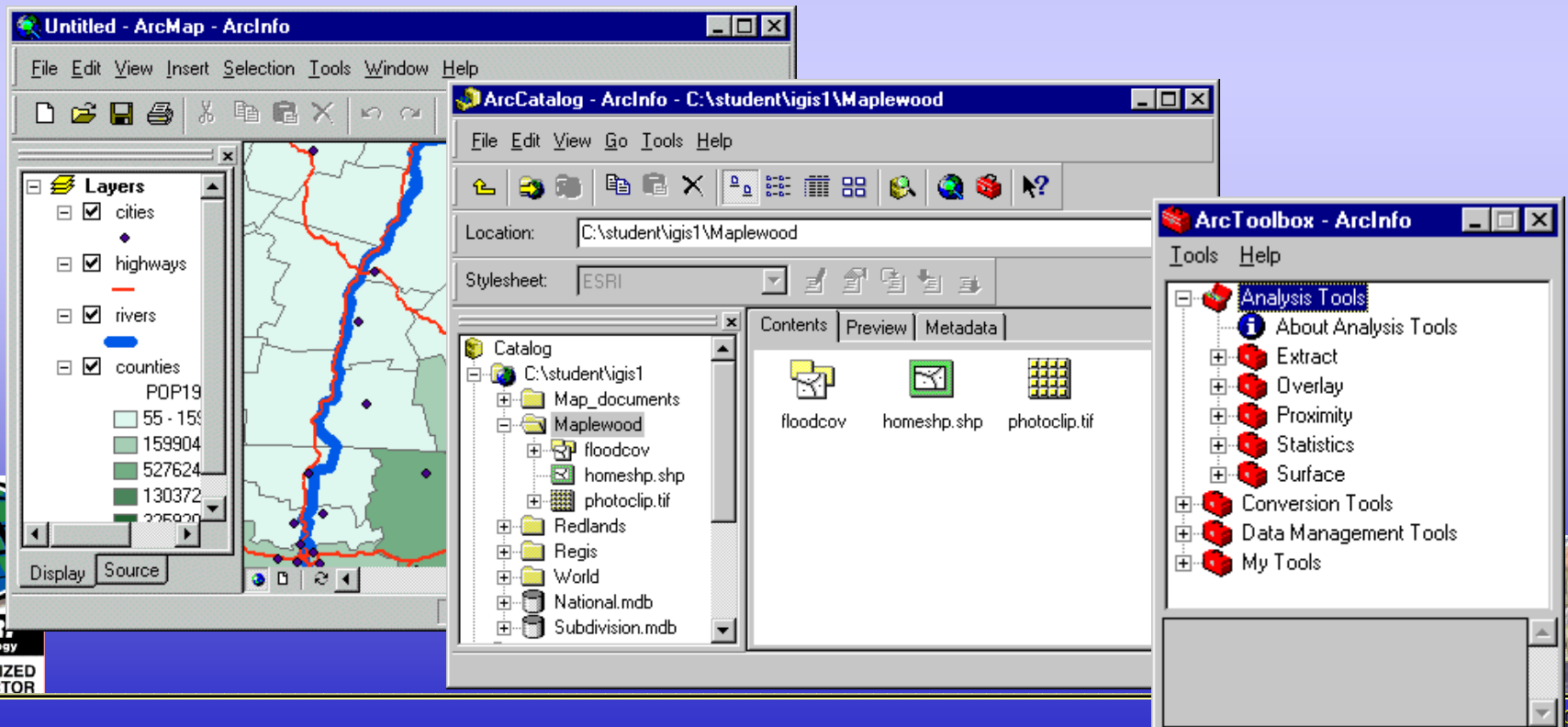
Spatial data formats

- ArcGIS can work with spatial data in multiple formats



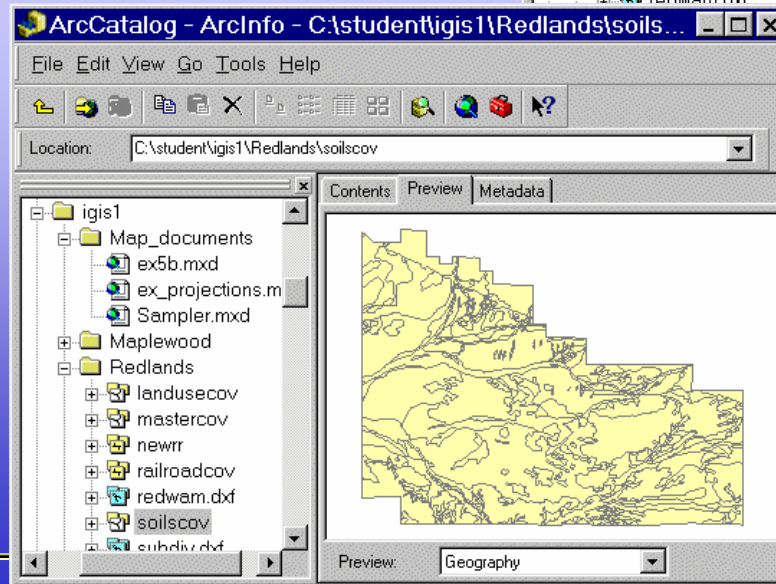
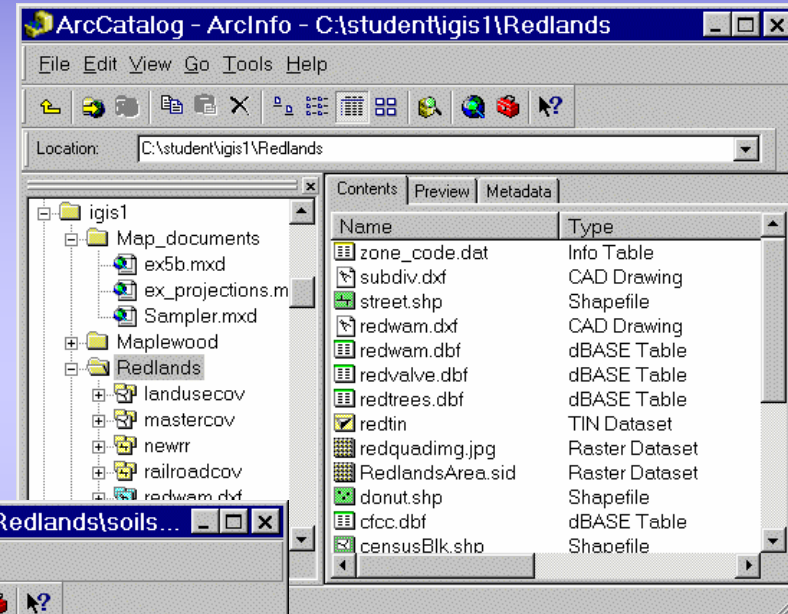
Overview of applications

- All ArcGIS products share common applications
- ArcMap, ArcCatalog, ArcToolbox



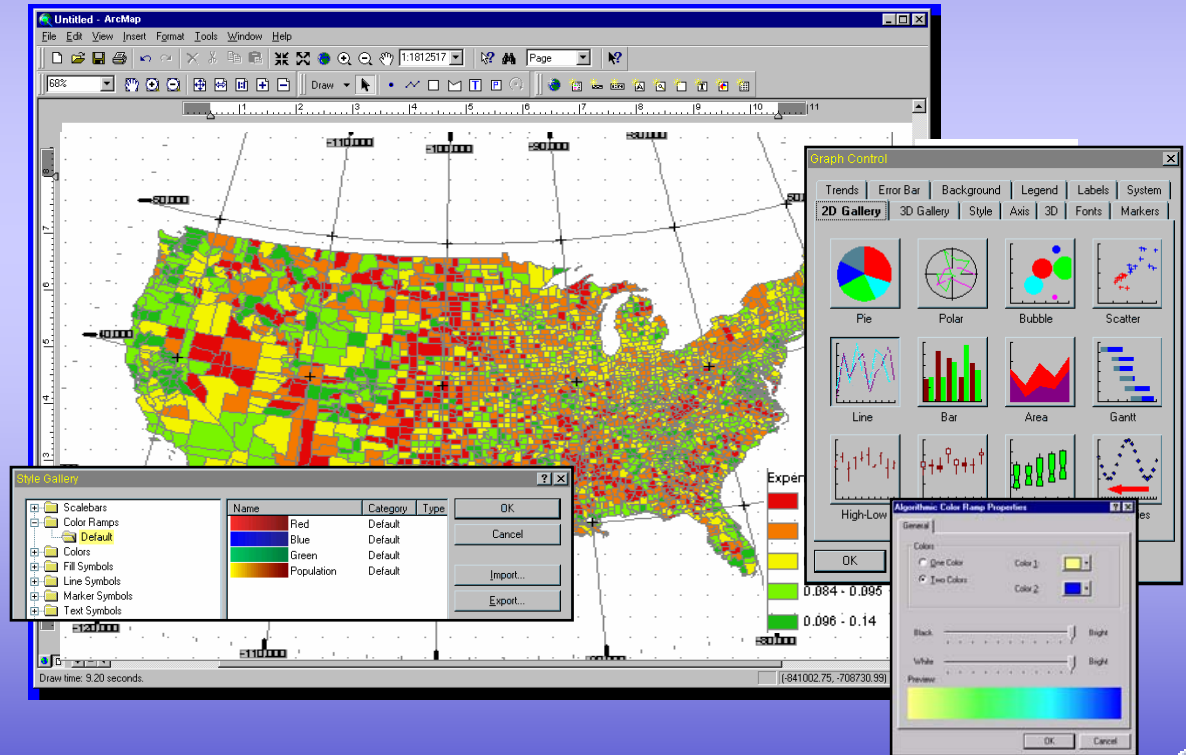
ArcCatalog

- A window into your database
- Browse your data
- Manage your data
- Create and view data documentation (metadata)



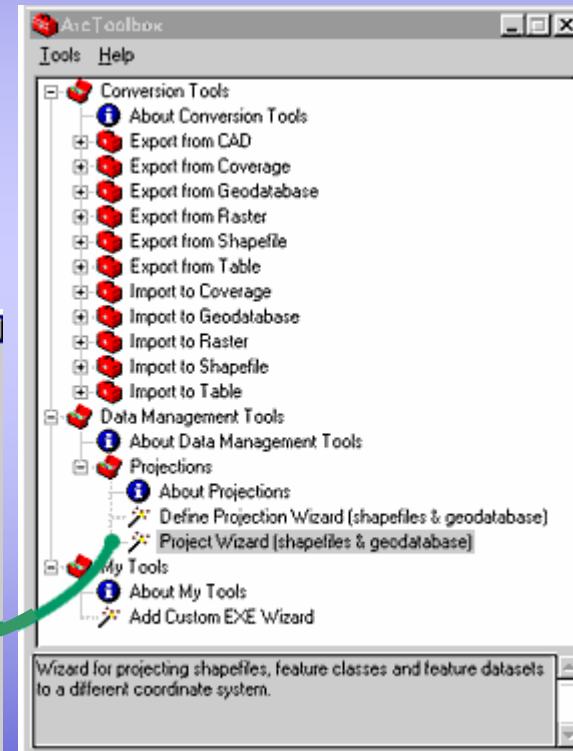
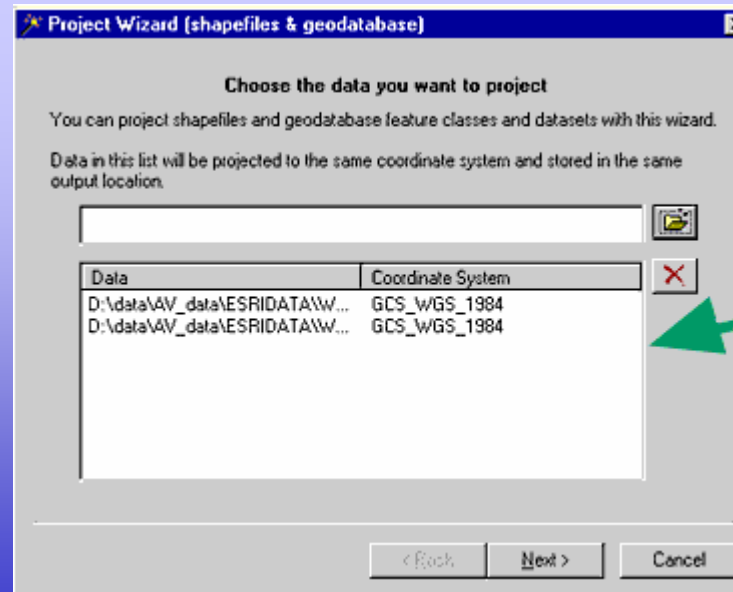
ArcMap

- Primary display application
- Perform map-based tasks
 - Displaying
 - Editing
 - Querying
 - Analyzing
 - Charting
 - Reporting



ArcToolbox

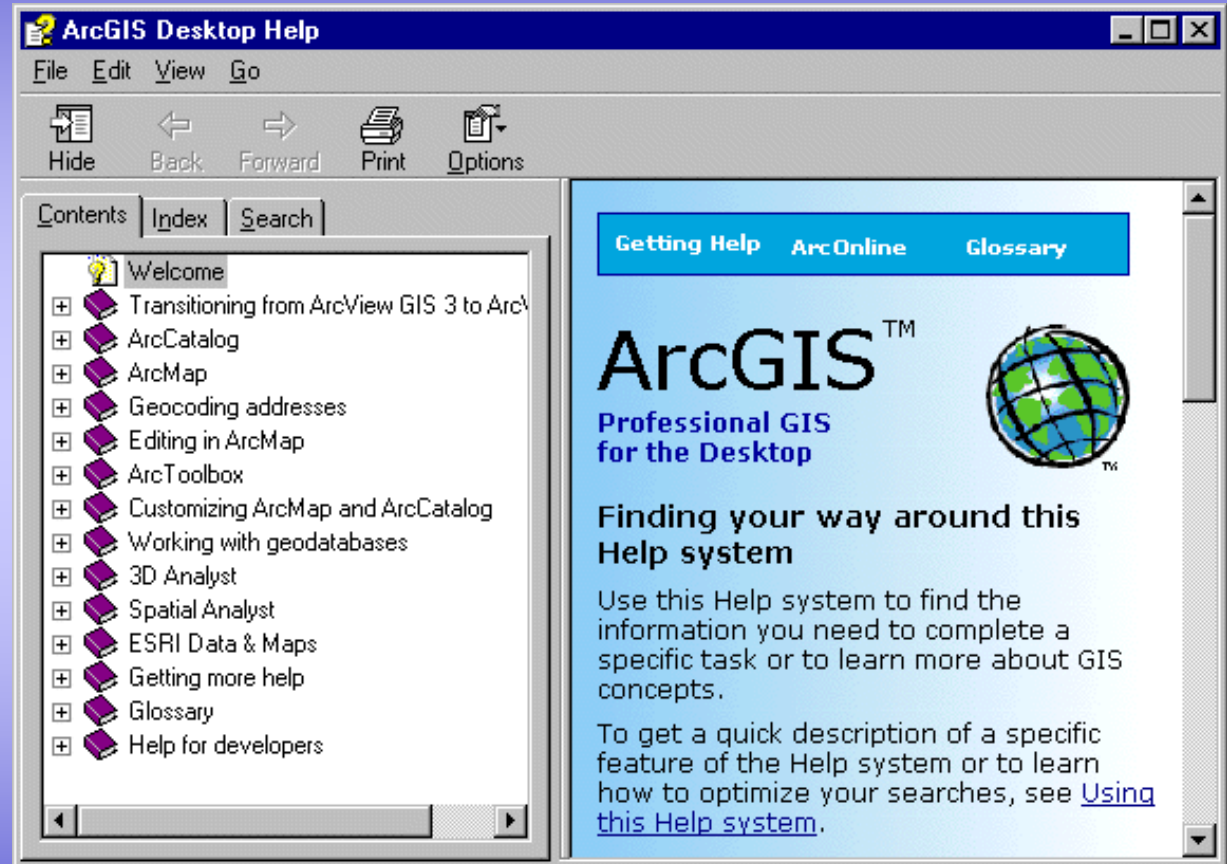
- Geographic processing functions
 - Data management, analysis, and conversion
 - Tools vary between ArcGIS products



understand
our world

Getting help

- Contents tab
- Index tab
- Search tab
- Other help
 - What's this?
 - Tool tips



understand

our world