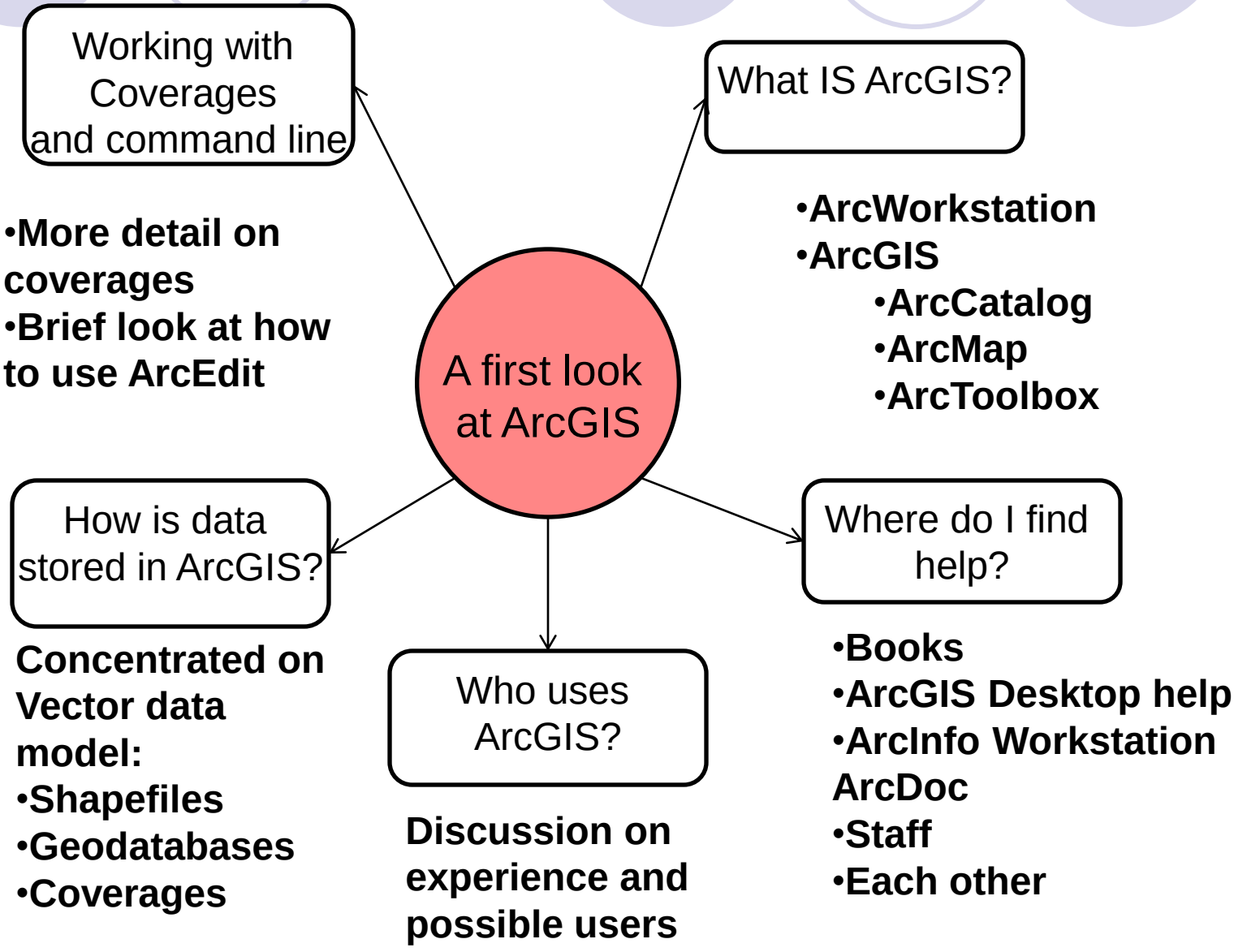
Geog5040: Using and adapting ArcGIS

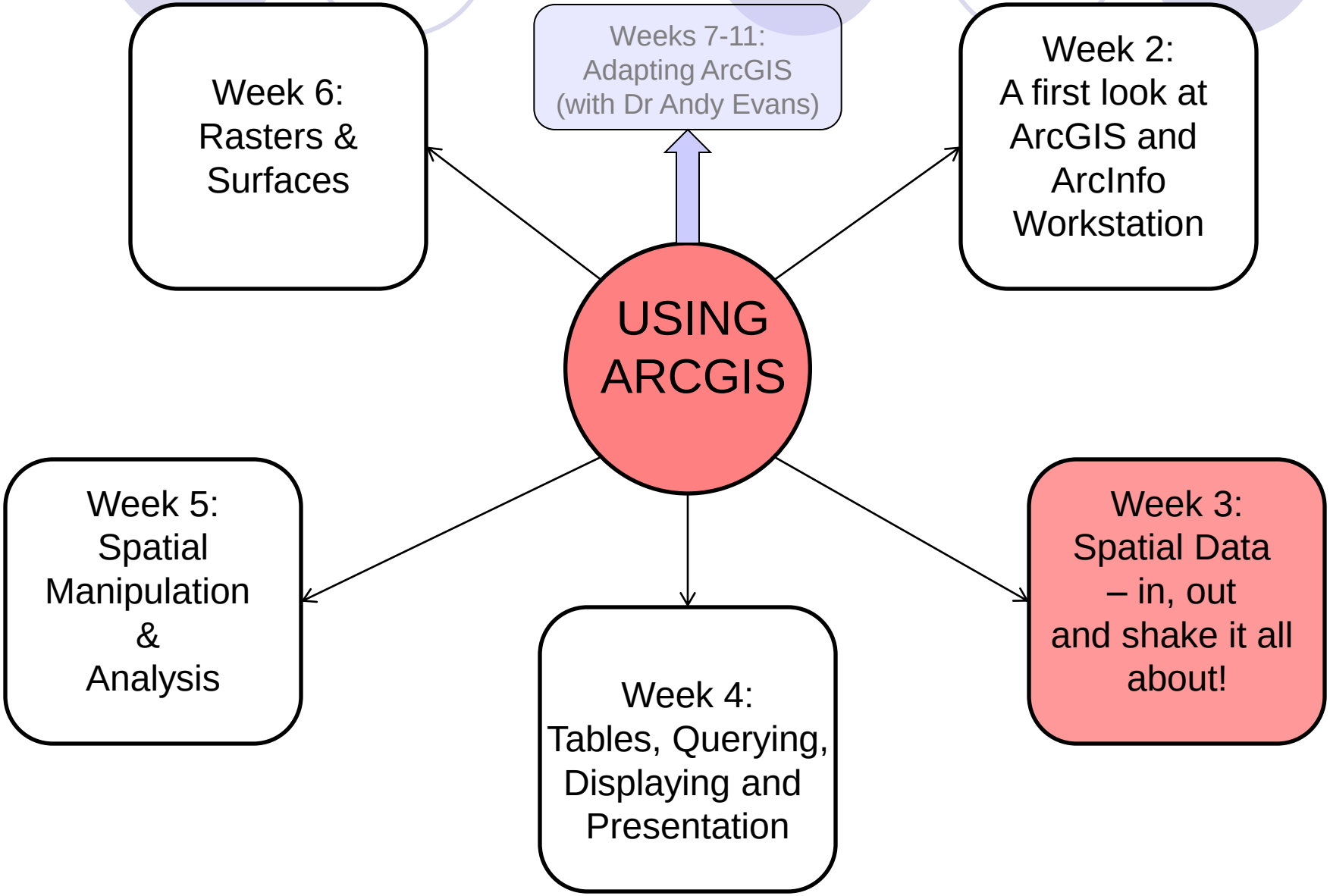
Lecture 3

ArcGIS Desktop - Spatial data - in, out and shake it all about!

Last week


A first look at ArcGIS
Working with Coverages and command line
•More detail on coverages
•Brief look at how to use ArcEdit
What IS ArcGIS?
•ArcWorkstation
•ArcGIS
•ArcCatalog
•ArcMap
•ArcToolbox
How is data stored in ArcGIS?
Concentrated on Vector data model:
•Shapefiles
•Geodatabases
•Coverages
Who uses ArcGIS?
Discussion on experience and possible users
Where do I find help?
•Books
•ArcGIS Desktop help
•ArcInfo Workstation ArcDoc
•Staff
•Each other

Overview of Weeks 2-6 of GEOG5040



Aims and objectives of this lecture

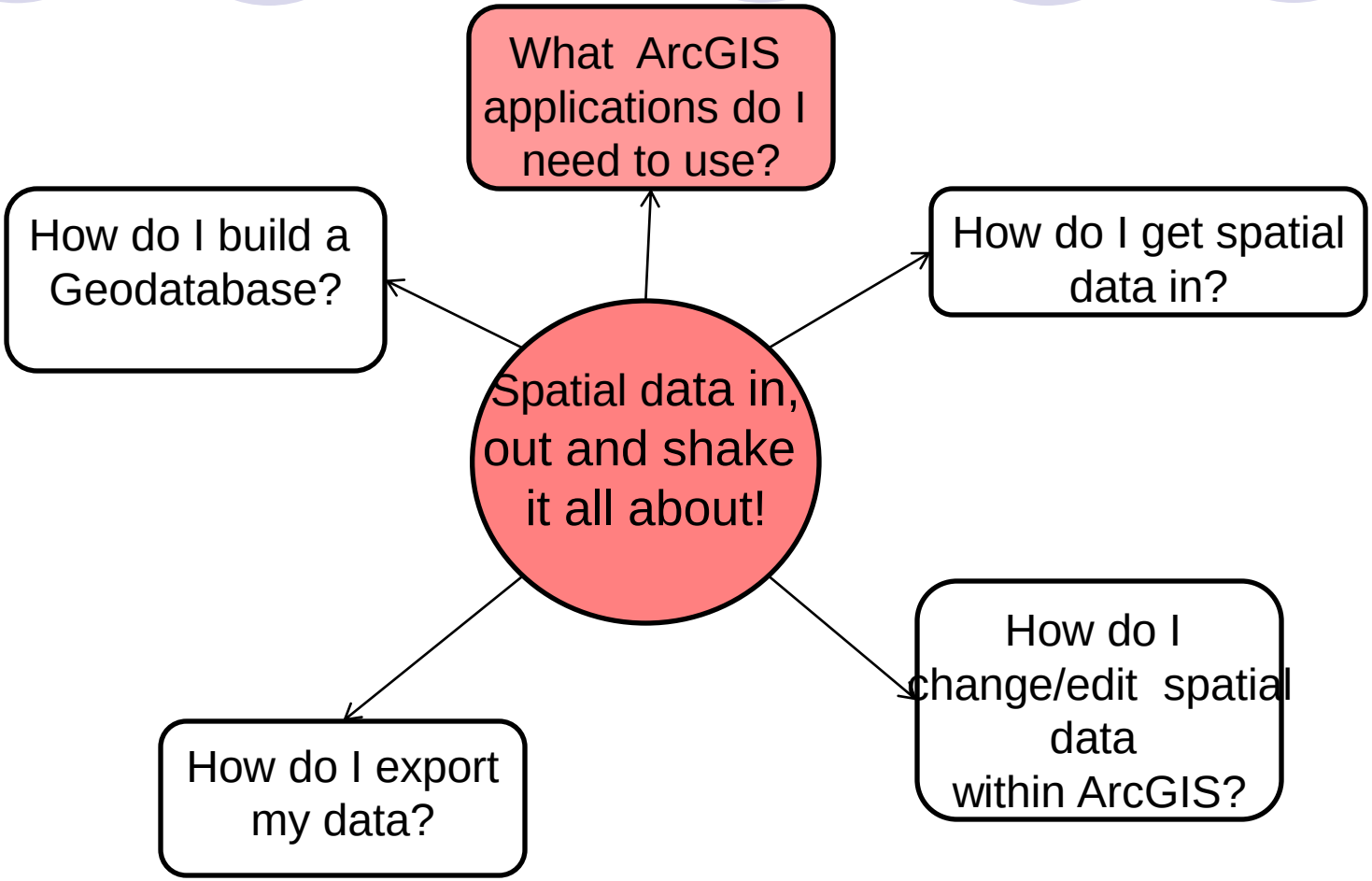
This lecture/workshop aims to :

- Introduce you to ArcGIS Desktop, in particular ArcCatalog, ArcMap and ArcToolbox
- Explore different methods of getting spatial data into ArcGIS
- Give you the opportunity to use the Editor Toolbar
- Guide you on exporting your data
- Provide support to start building a geodatabase

Upon completion of this lecture/workshop you should:

- Be familiar with ArcGIS Desktop basics
- Have an appreciation of the different means of inputting and exporting spatial data
- Have started to build a geodatabase

Week 3: Data – In, out and shake it all about!



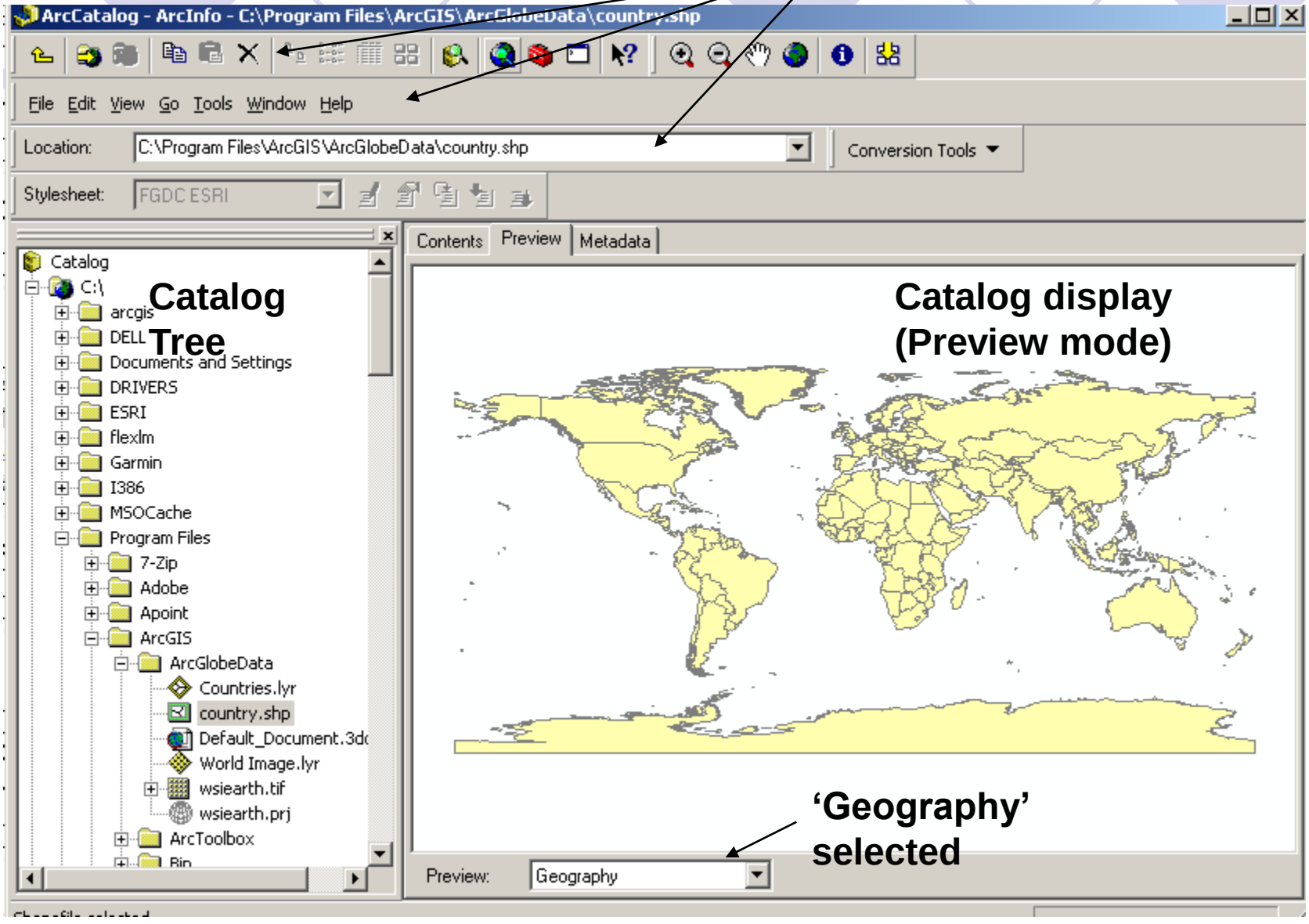
What ArcGIS applications do I need to use?

- In order to get data into ArcGIS, edit and export we need to be familiar with **ArcCatalog** and **ArcMap** and **ArcToolbox**
- First of all we will quickly take a look at the interfaces for these applications and discuss what each one does.

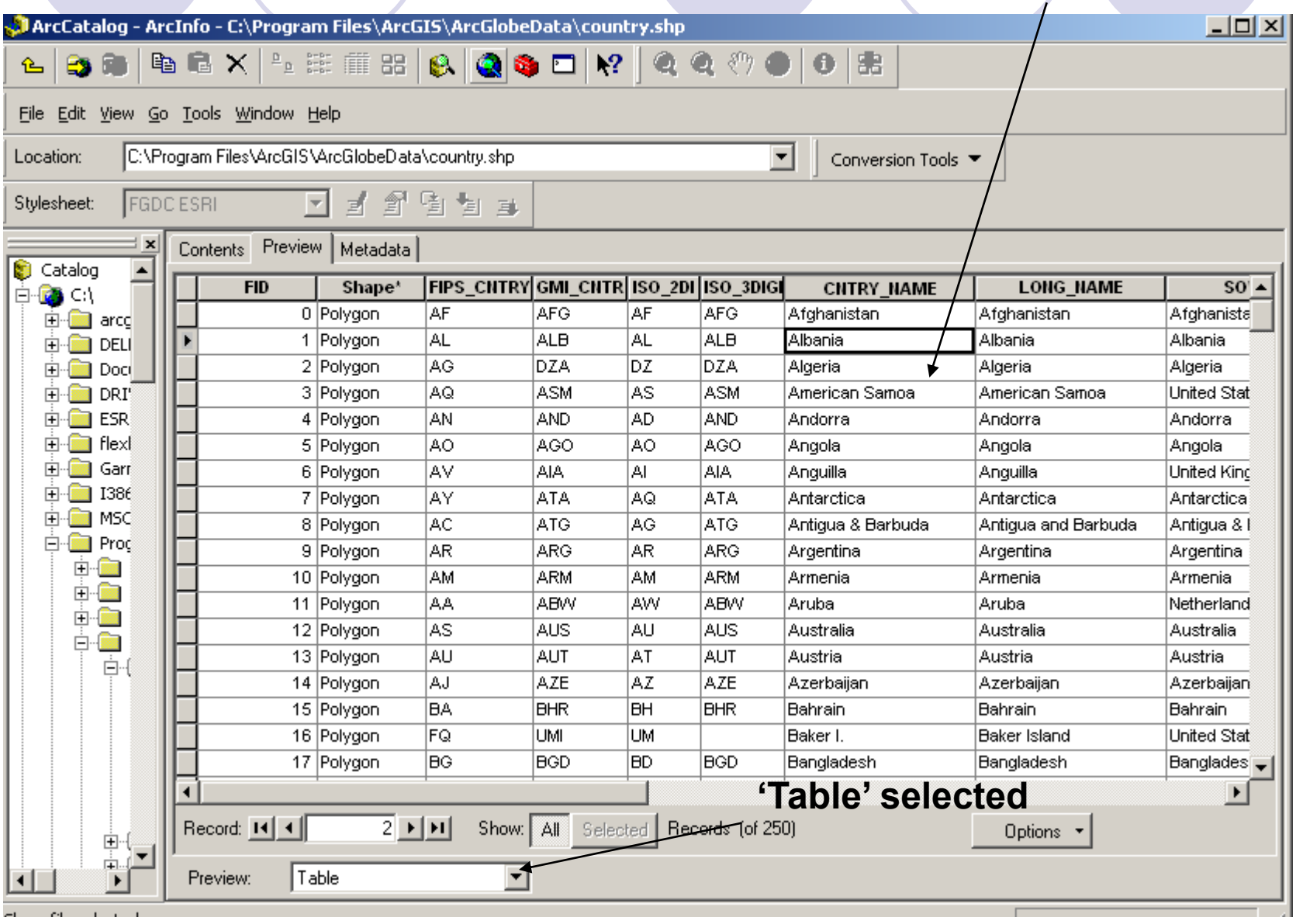
What do we do in ArcCatalog?

- Manage geographic data
- Copy, move, delete data
- Connect to drives on your computer
- Search for data on your drives or across a network
- View/add/edit metadata
- Drag data into ArcMap
- Export data

ArcCatalog interface



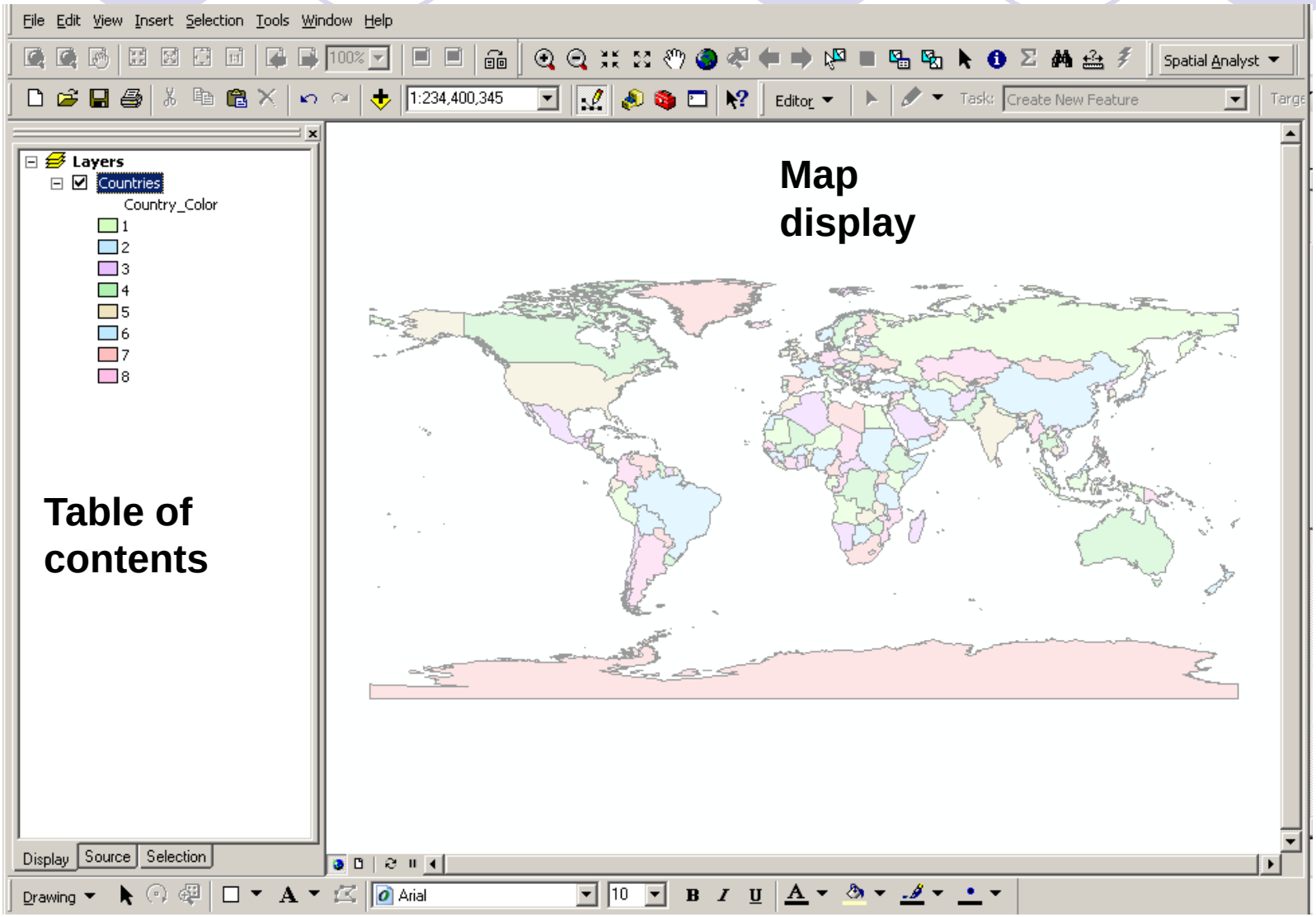
ArcCatalog interface



What do we do in ArcMap

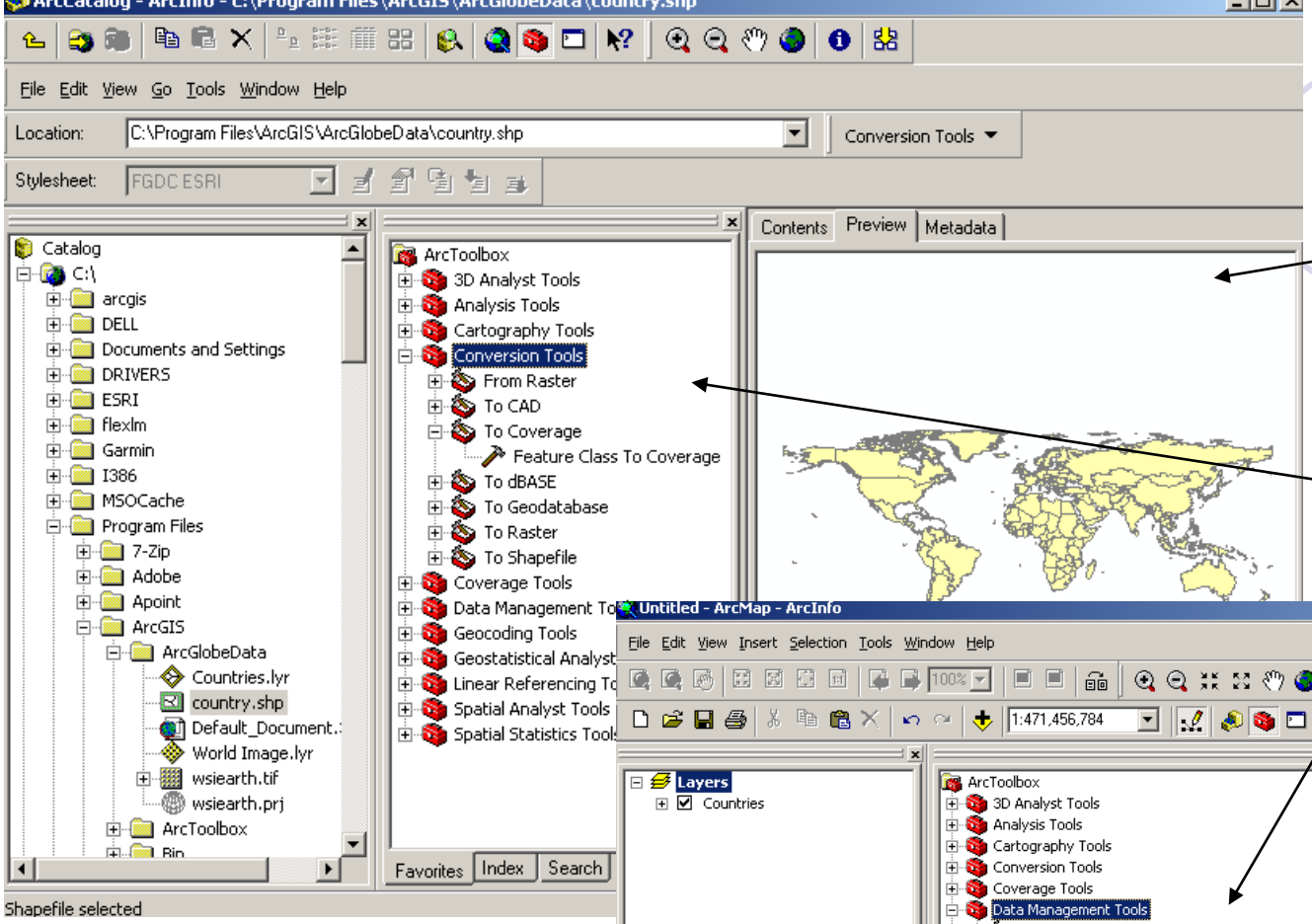
- Displaying map data
- Navigating/exploring a map
- Looking at feature attributes
- Editing features and attributes
- Query attributes
- Analyse spatial relationships
- Design map layouts

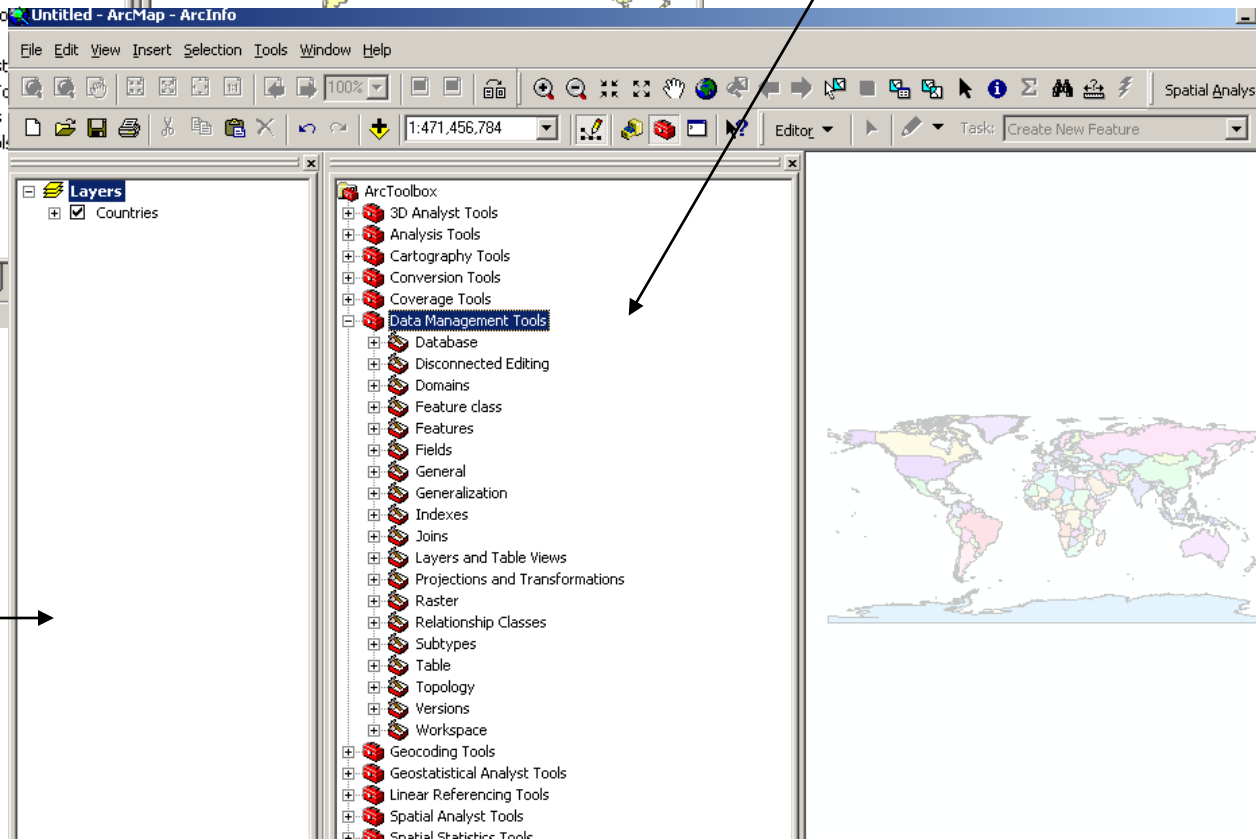
ArcMap interface



What do we do in ArcToolbox

- Tools to convert spatial data between formats
- Apply map projections
- Analysis tools
- Many tools have wizard interface
- Available from either ArcCatalog or ArcMap





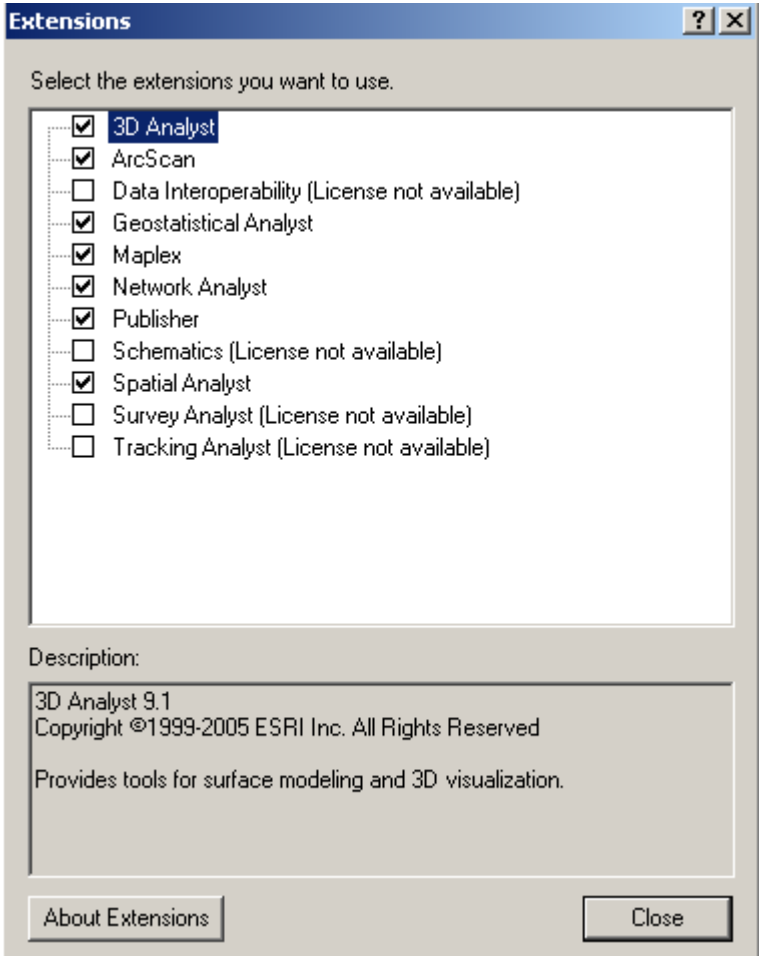
ArcCatalog

ArcToolkit window

ArcMap

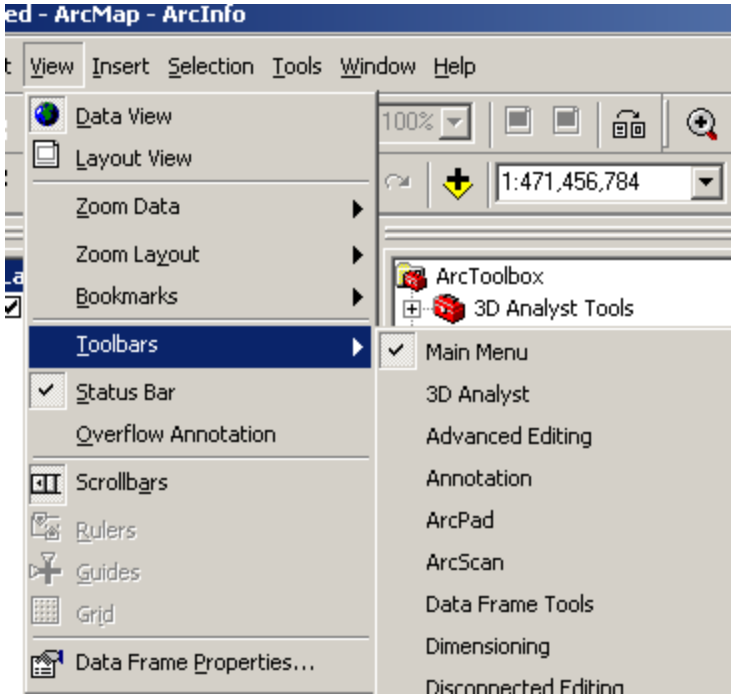
Extensions

- Extend the capabilities of ArcGIS with a number of products
- Add from the Tools menu in ArcCatalog or ArcMap
- Allows selection of products (subject to license)



Toolbars for extensions

- Toolbars for these extensions do not automatically open. Use `View > Toolbars` to open (in ArcMap)



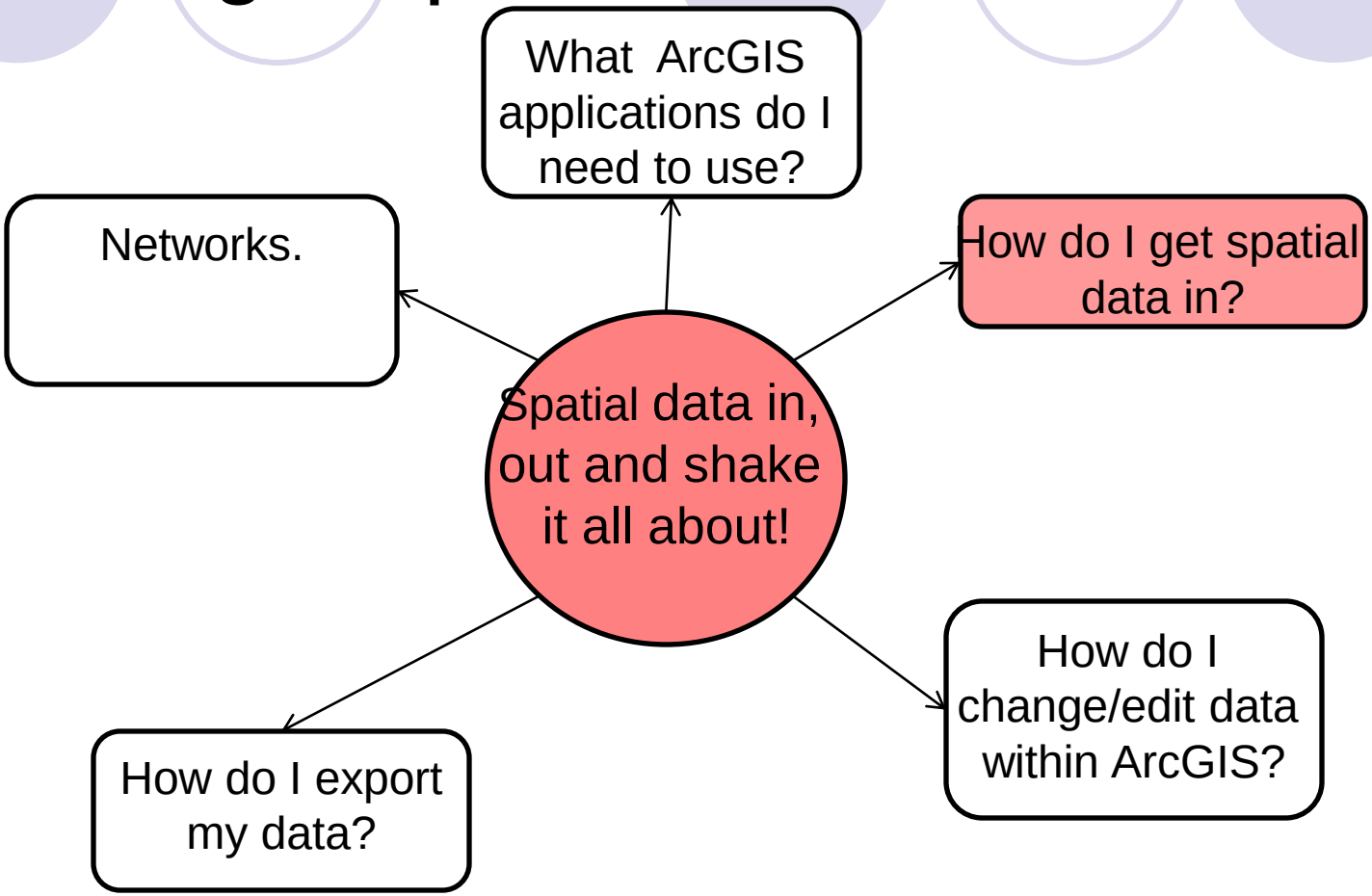
Summary: ArcGIS Desktop applications

- ArcCatalog : browse, search, preview, manage and add (to ArcMap) spatial data
- ArcMap: display data, query attributes, analyse data and design map layouts
- ArcToolbox: tools for converting, projecting and analysis of data

Activity 1 - Extensions

- Not all of ArcGIS's capabilities can automatically be seen. Some of the tools have to be enabled (as long as the University has the licence for it). For example, if you wish to use the Spatial Analyst tools from ArcToolbox (third tool from bottom when you look in ArcToolbox), none of the tools work unless Spatial Analyst has been enabled.
- Try this now....click on any of the tools within Spatial Analyst...do they open up a dialog box or does it come up with an error message saying the licence is not available? If the former then the tool has already been enabled but if the latter then you should enable this now.
- Add in any extensions that the University has a licence for that are not already enabled. When that is done, make the Network Analyst and Spatial Analyst toolbars visible. You do not need to leave these toolbars visible if you don't want to.

How do I get spatial data in?



Getting geographical data in…

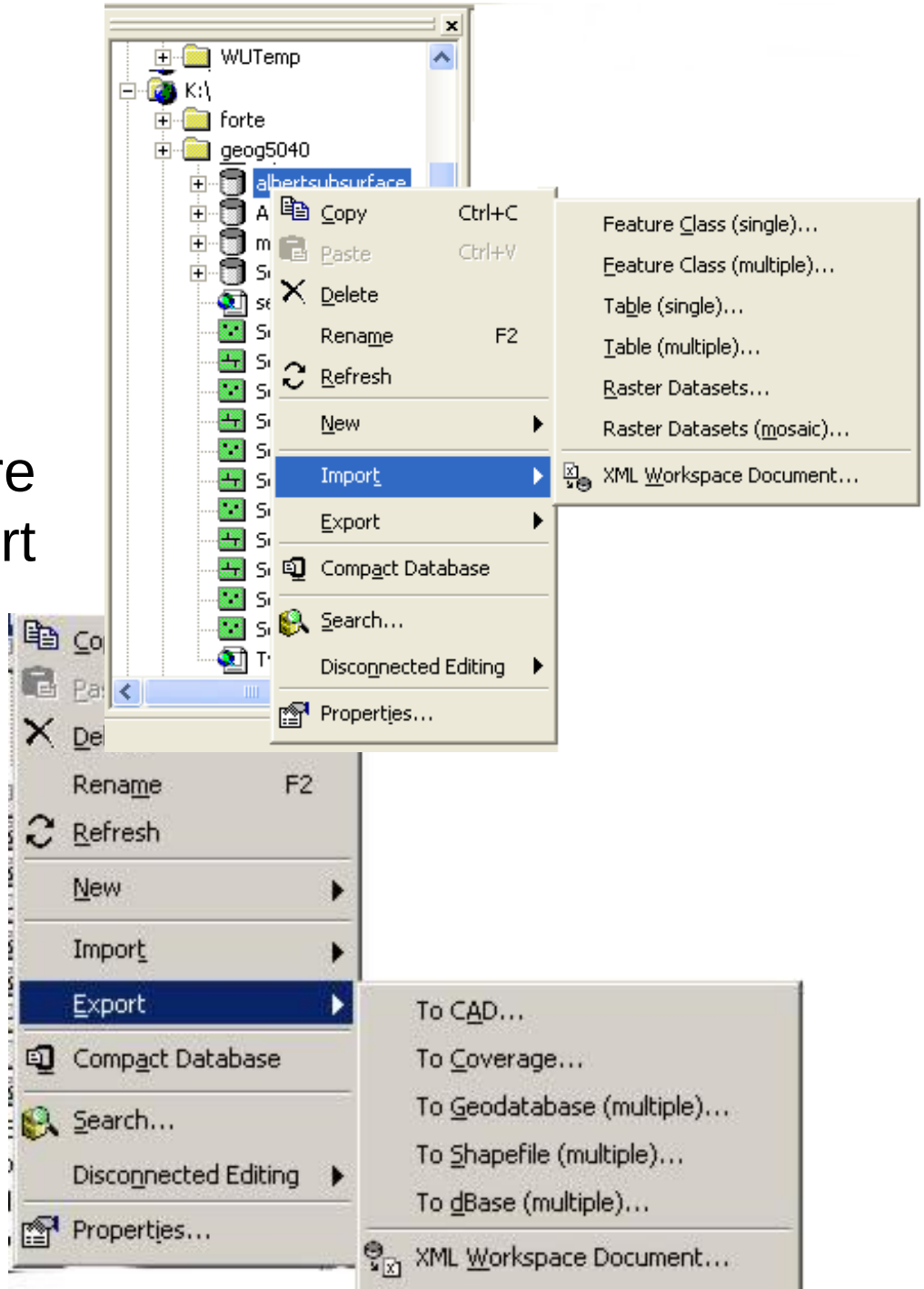
- Creating new data
- Importing shapefiles, coverages and geodatabases.
- Importing text files.
- Importing other formats.
- Importing from web services.

Creating new data

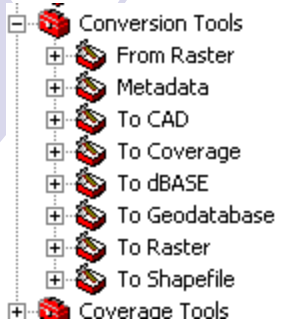
- Digitising
  - Produces vector data
  - Usually produced from paper maps, aerial photos or satellite images
- Heads-up digitising
  - Digitise image on computer screen
- Manual adding e.g. from raw coordinates. ArcGIS allows you to create shapes or specify angles and lengths of line segments and whether they are parallel or perpendicular to other segments

Importing

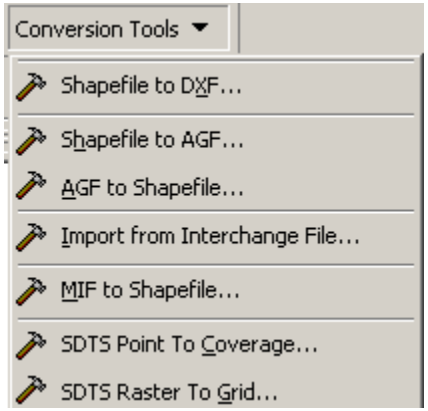
- Right-clicking on a Workspace, Geodatabase or Feature Dataset brings up import and export options, so you don't have to build Geodatabases from scratch.



Importing other formats

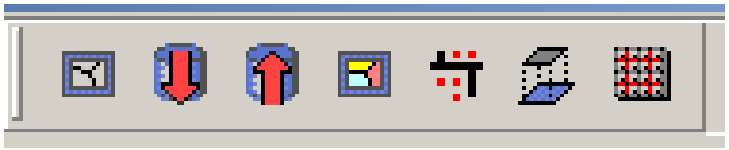


- ArcToolbox has a whole set of tools for conversion.



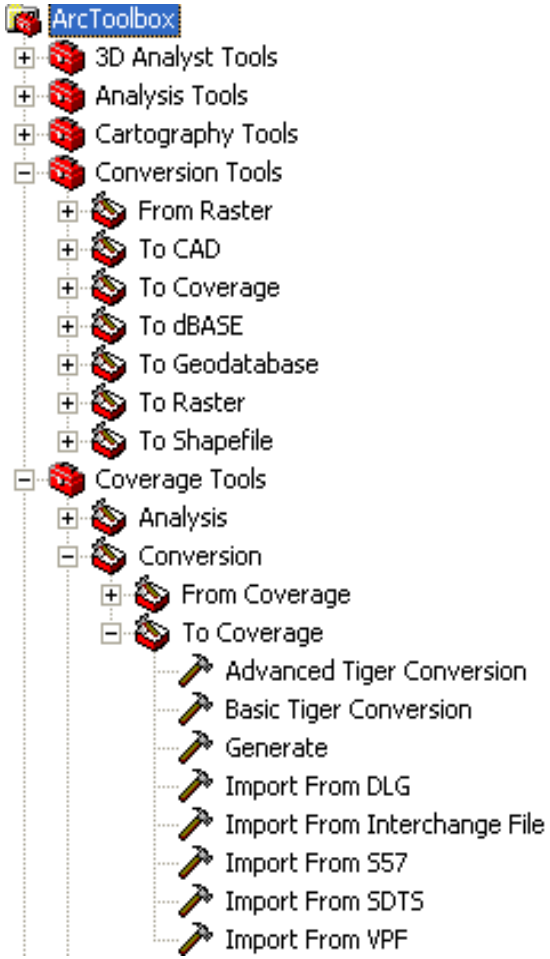
- In ArcCatalog there is an ArcView 8x Toolbar with Conversion Tools

- MapManager (accessed via a toolbar in ArcCatalog or from the Start menu)
  - NTF converter
  - OS MasterMap data converter



Importing text files (Coverages)

- ArcGIS can import ASCII text files (**A**merican **S**tandard **C**ode for **I**nformation **I**nterchange).
- ArcToolbox **`Generate to Coverage Wizard`**..

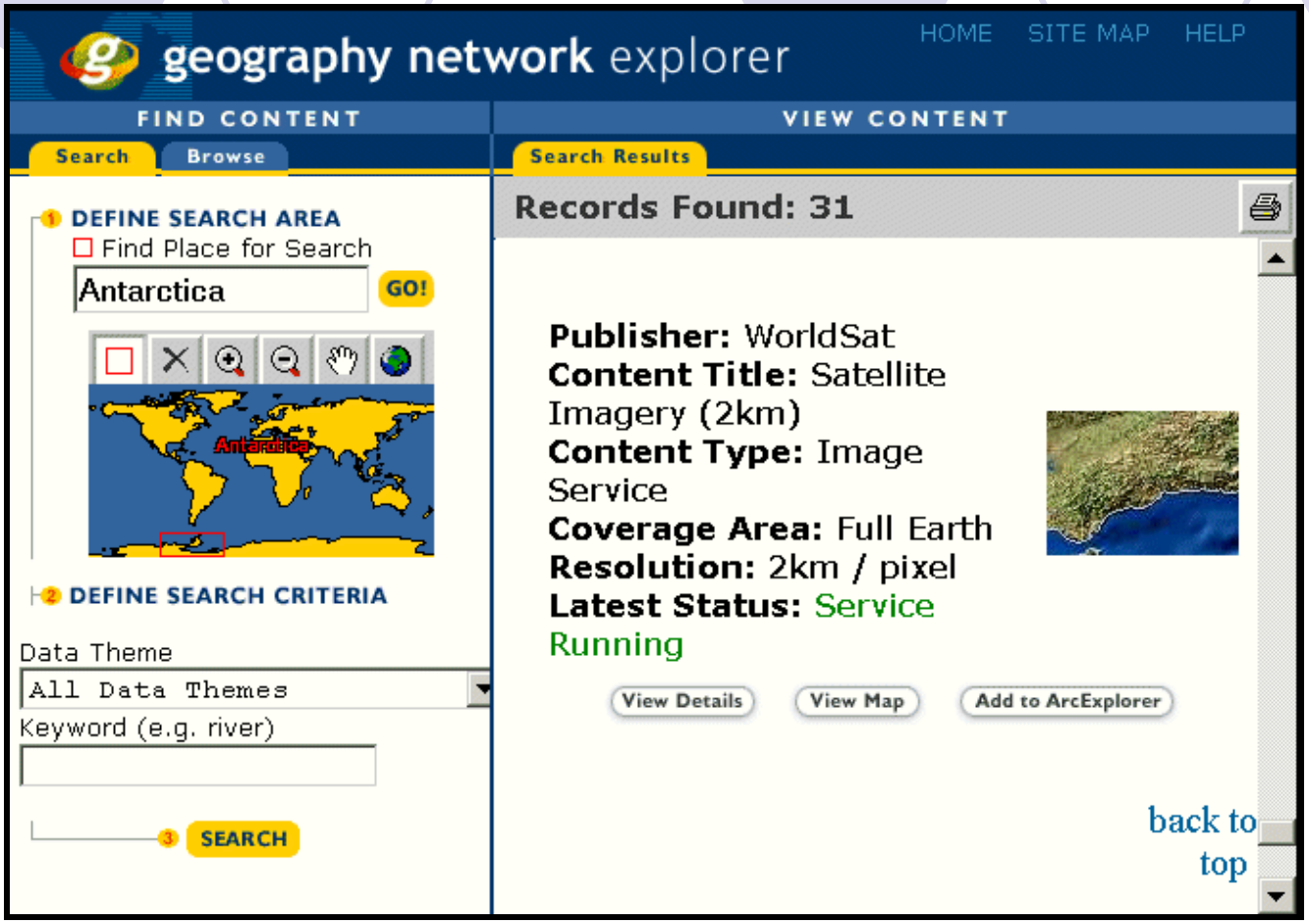


NB: Generate files only include geography, not attributes.

Importing from web services

- Web services: the Next Big Thing.
- Data storehouses – you connect via a menu on your GIS, they download the data to you. You don't save it locally.
  - For example, ESRI's online data warehouse, Geography Network (http://www.geographynetwork.com/)
- Ultimately online GIS will do the analysis – you just get the results.

Geography Network



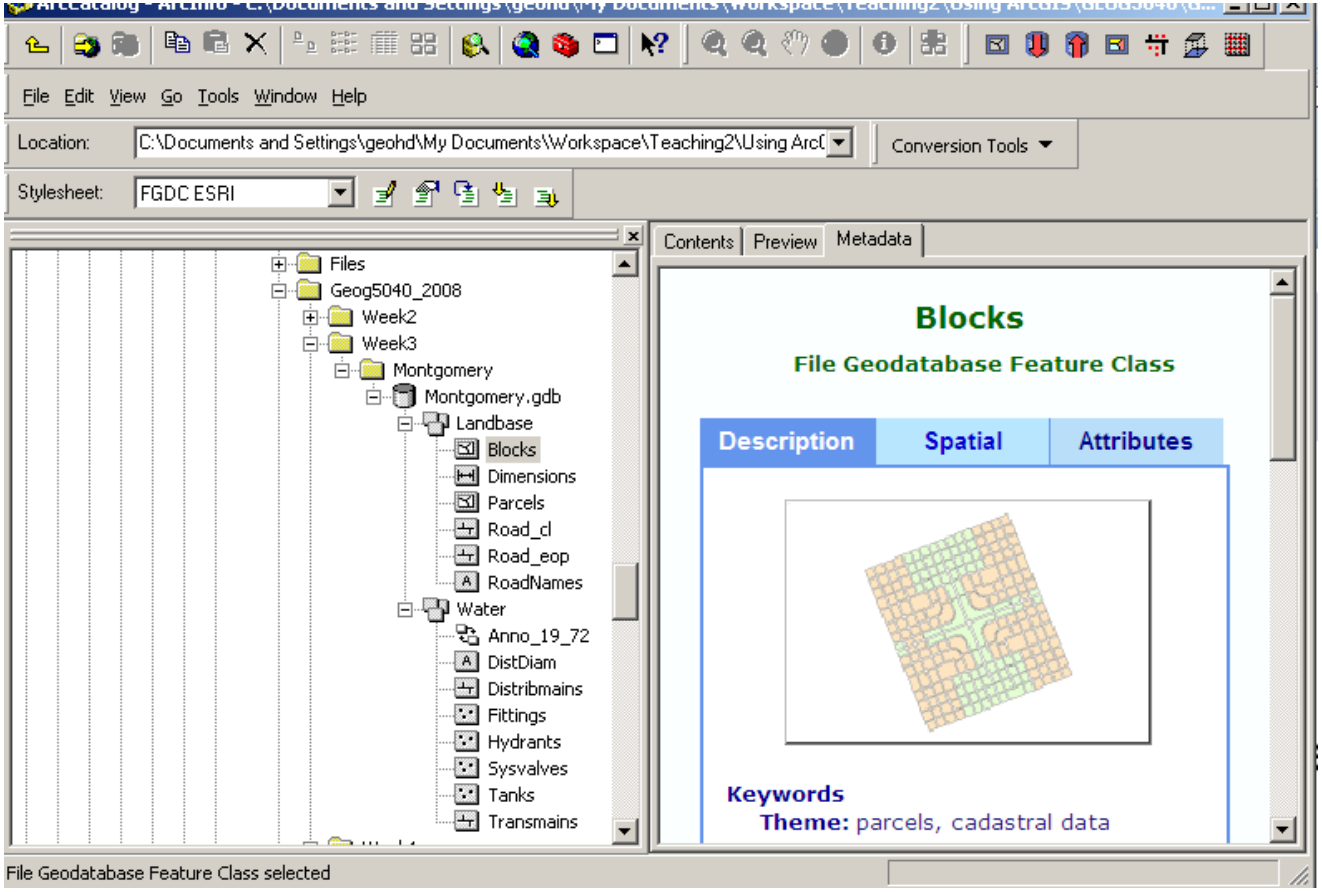
- Pick locality, dataset and it downloads the data from the website into your application.

Metadata

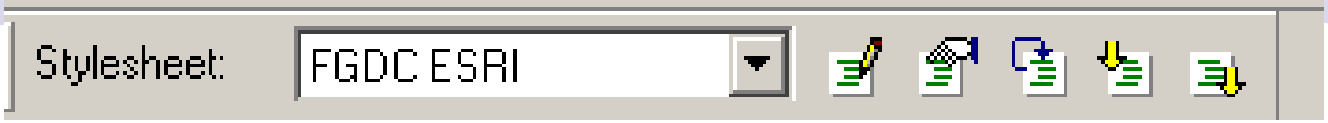
- What is metadata?
  - Data about data
  - Who created it
  - Where it came from
  - Coordinate system
  - What fields in attribute tables mean
- Why is it important?
  - Without metadata, data is useless
  - Dealing with undocumented data can be frustrating.

Viewing metadata

- Tabs and links in ArcCatalog

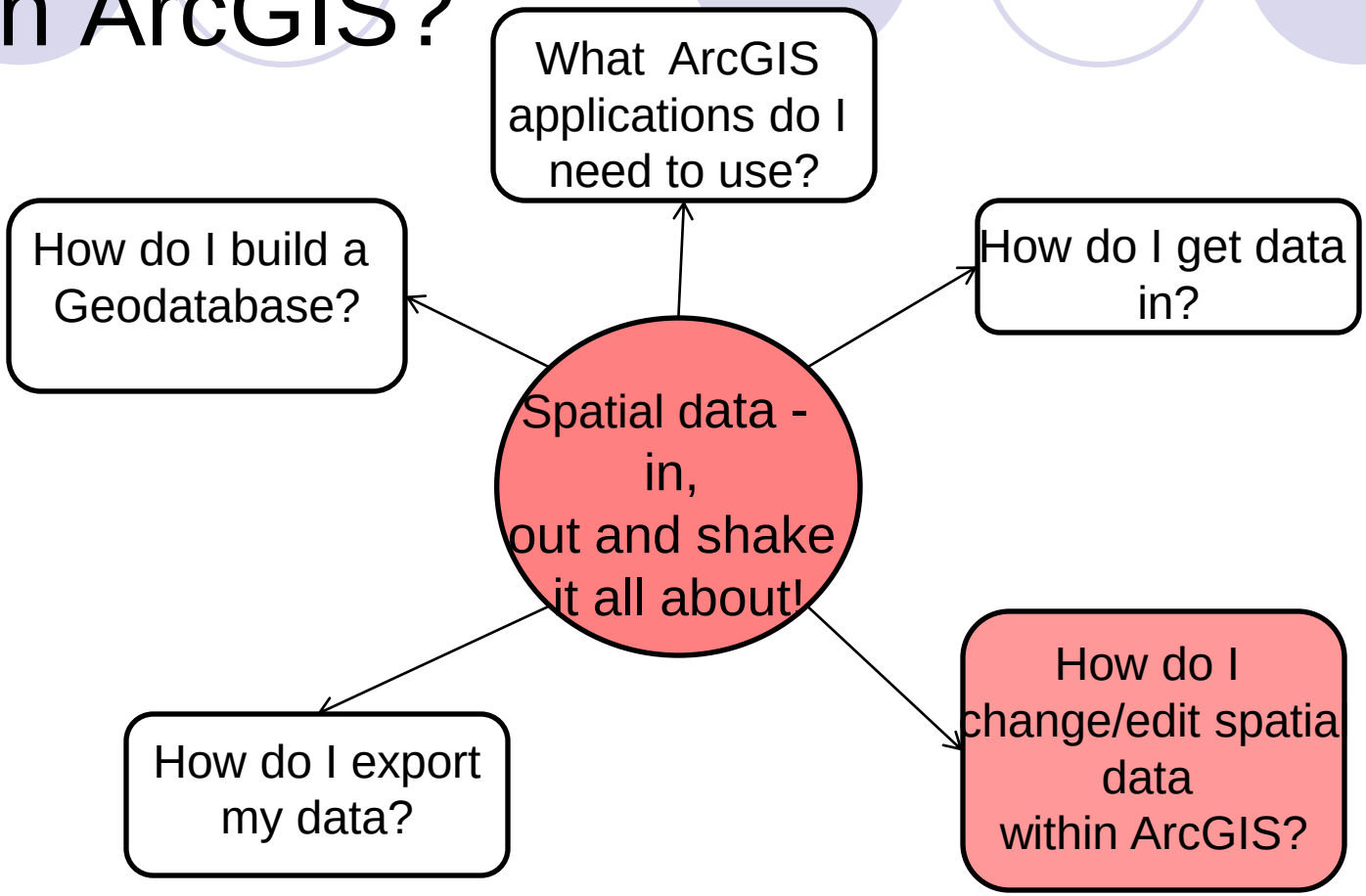


Editing metadata



- Editing metadata is done via the metadata toolbar
- Can select:
  - Stylesheet
  - Edit metadata
  - Metadata properties
  - Create/update metadata
  - Import metadata
  - Export metadata

How do I change/edit spatial data within ArcGIS?



Editing in ArcMap

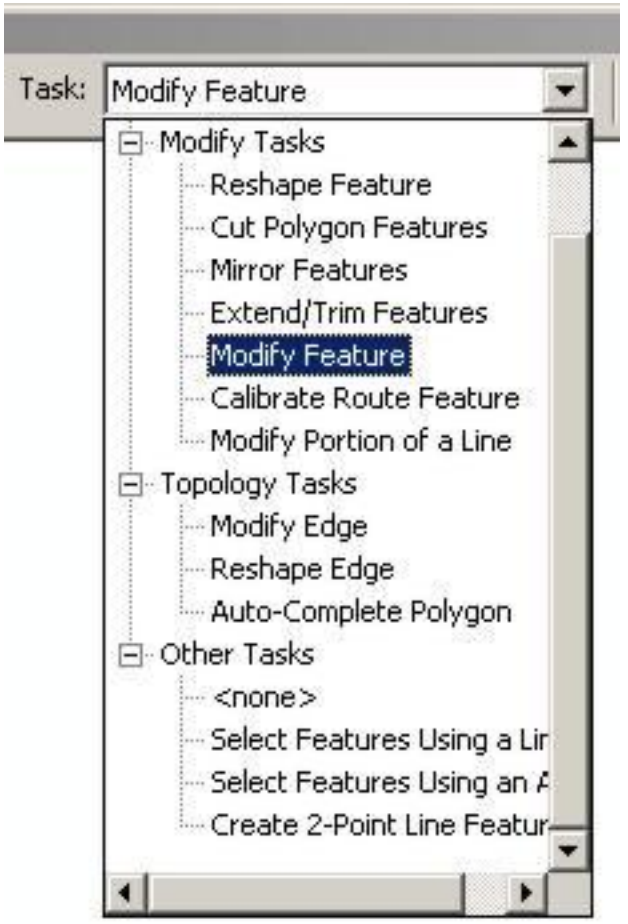
- Features can be deleted, moved, divided, merged, resized, reshaped or buffered
- When features edited, attributes ***may*** automatically update eg length, area.
- Some attribute data may need manual updating
- Can add new attributes to table

The Editor Toolbar

- All digitising (creating new features or modifying existing ones) is done in an ‘edit’ session
- Start Editing command - on Editor Toolbar
- Stop Editing command – also on Editor Toolbar
- When editing session started you specify:
  - The task – the operation, e.g. Create New Feature
  - The target – layer to which the data is going into
  - The tool – e.g Sketch Tool
- Errors made in editing can be undone on Standard Toolbar

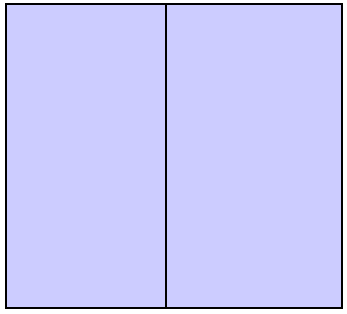
Tasks: Modify features etc

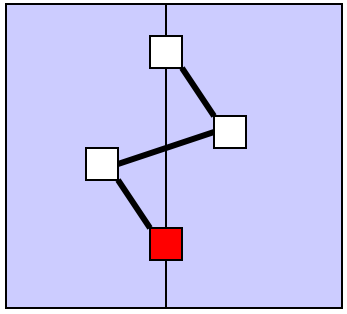
- There's a few additional menu items that might help you, if your topology doesn't clean or you need to edit your data.
- These are on the **`Task`** drop down list of the Editor Toolbar.

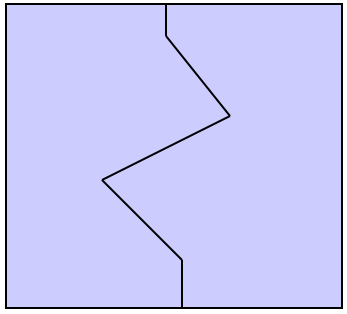


Editing Topological features

- Shared features have boundaries or nodes in common
- If you change a boundary between two polygons which share that boundary then you have to edit the first polygon and then the second, using snapping to align accurately.
- ArcGIS has a special tool for editing of shared features: Topology Edit tool (on the Topology toolbar)
- Then use the Topology tasks from the Task bar

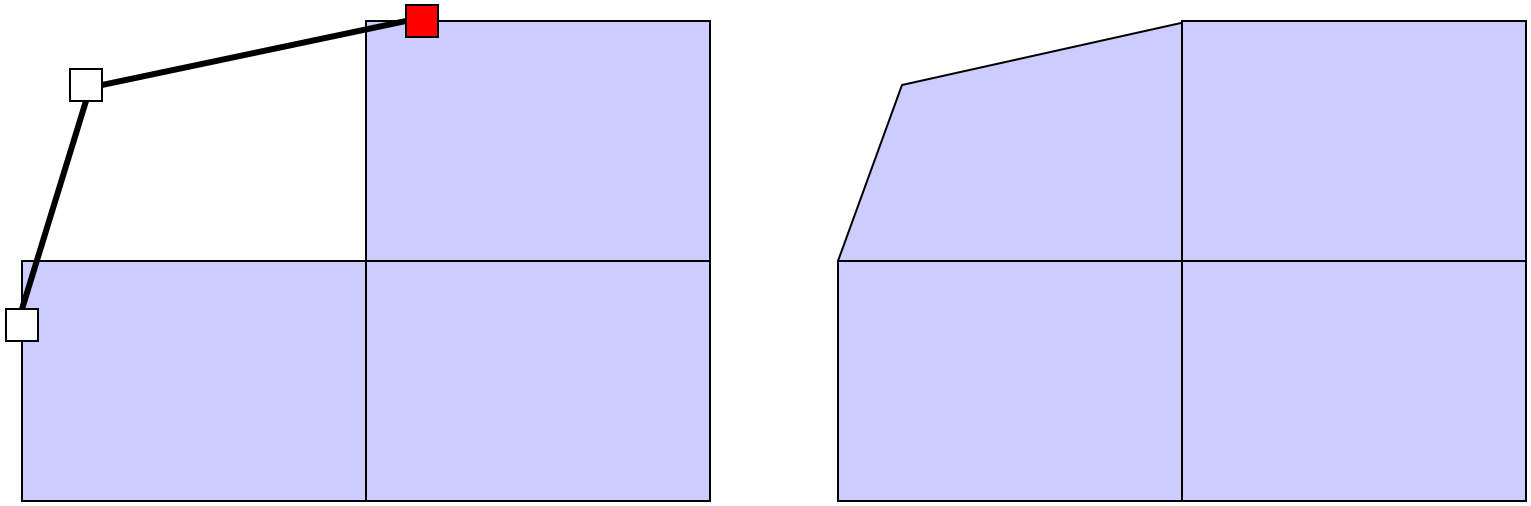




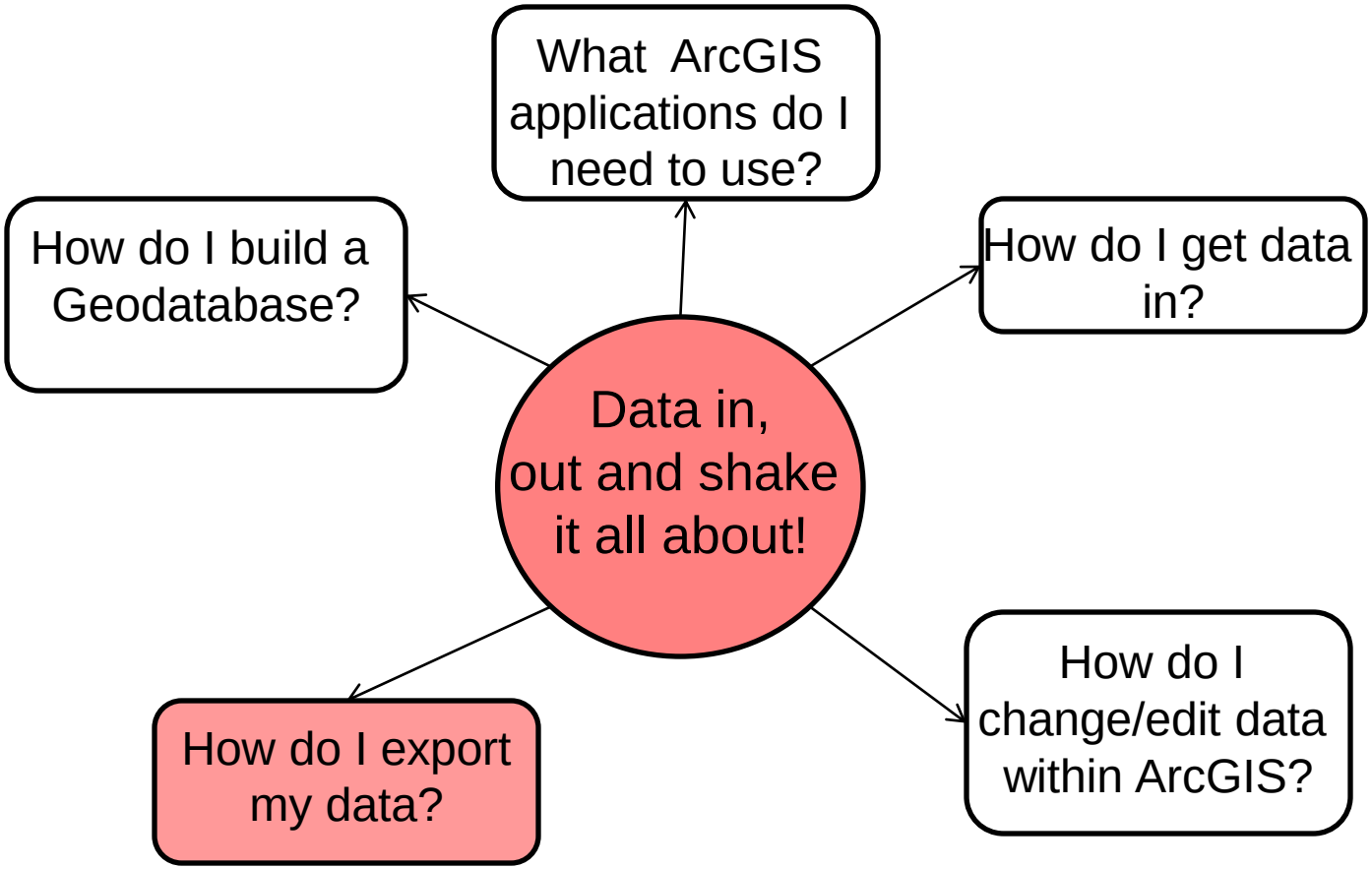


Autocomplete Polygon

- You can also use **`AutoComplete Polygon`** from the **`task`** list with the **`sketch tool`** to add Polygons with shared boundaries.

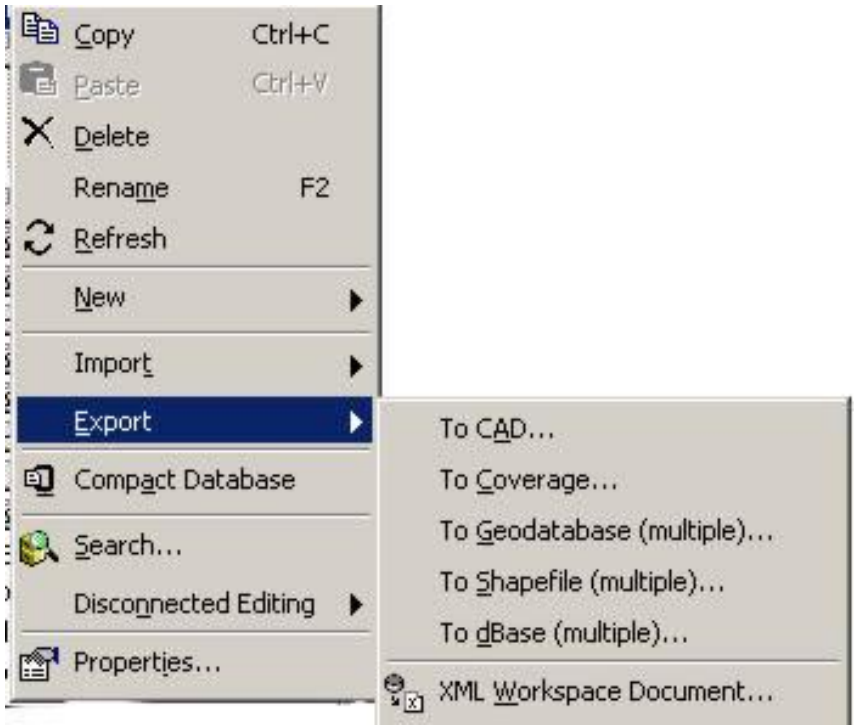


How do I export data from ArcGIS?



Exporting data

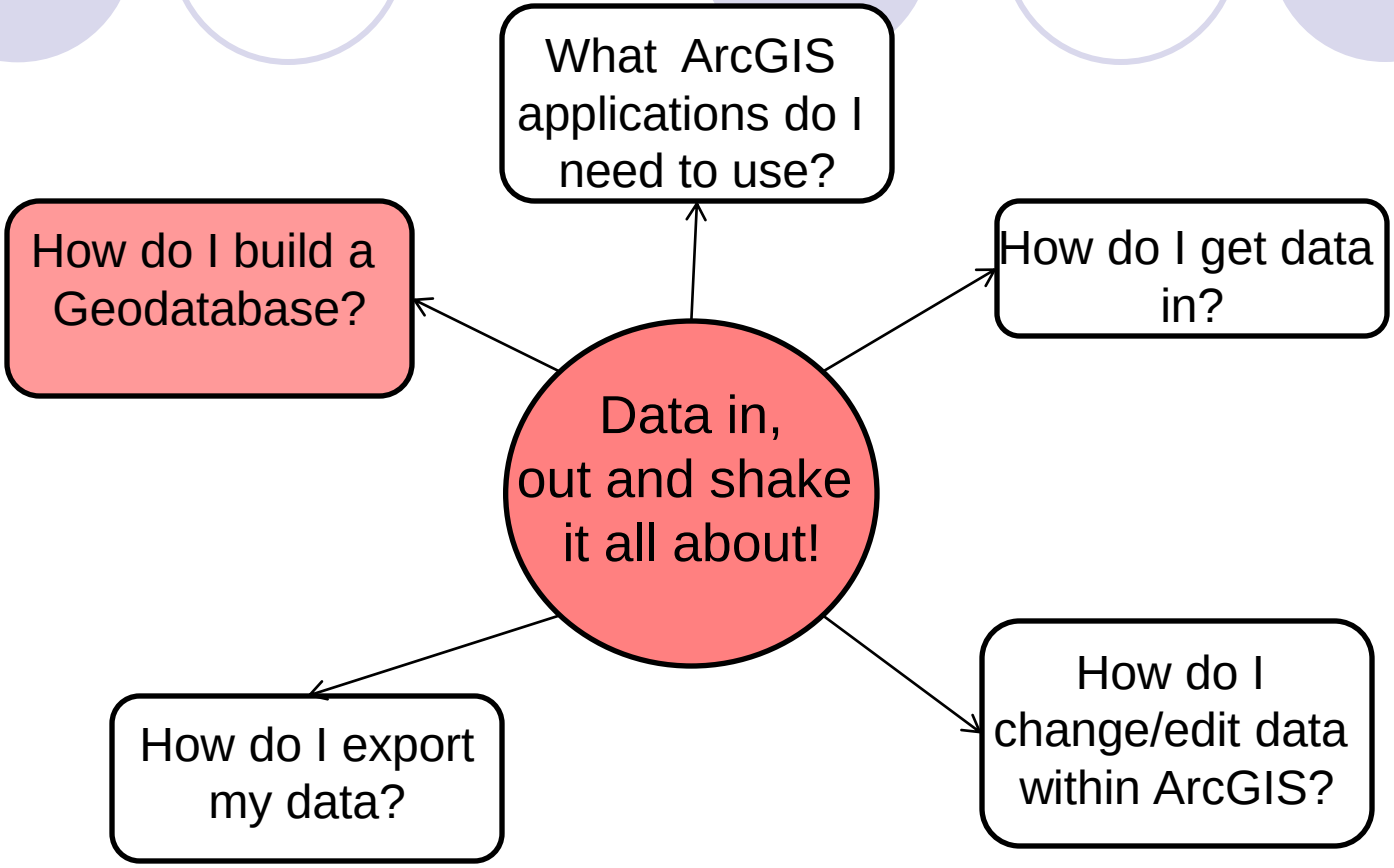
- Can use ArcCatalog to export to different formats by right-clicking on the data file….



Activity 2 – Editing a polygon shapefile

- Now you can have a play with editing a shapefile.
- Open the wyorks shapefile (showing the polygons of West Yorkshire) from Practical 1 in ArcMap. Make sure the Editor Toolbar is visible (use View > Toolbars..to add it if necessary). When you wish to start editing click on the little arrow next to 'Editor' on the toolbar and select 'Start Editing'. This makes the toolbar 'live' and areas which were previously greyed out or unselectable can now be selected. [Note: This shapefile may be read only (giving you an error message that you don't have permission to edit it) in which case you need to deselect the tick next to Read-only in the file's Properties.]
- Have a look at the tools on the editor toolbar and check out what they do. Have a look at the various tasks that are now available to you. Note that not all tasks may work, especially as you are working with a shapefile and you only have polygons to work with (so editing functions like extend and trim which are designed to work with lines/arcs won't work for polygons) but you can create new features, modify features, move them or split polygons.
- An example may be that you wish to modify a polygon. Select the task to be Modify features, click on the Edit tool (the arrow next to the Editor drop down menu, click on a polygon and you will see the vertices highlighted. You can then drag and move those vertices to create a new shape. When you have moved the vertices, right click in the map display area and select Finish Sketch. Your polygon should change.
- See what else you can do. When you have finished select 'Stop Editing' from the Editor drop down menu. Select 'No'when asked if you wish to save changes.

How do I build a Geodatabase?

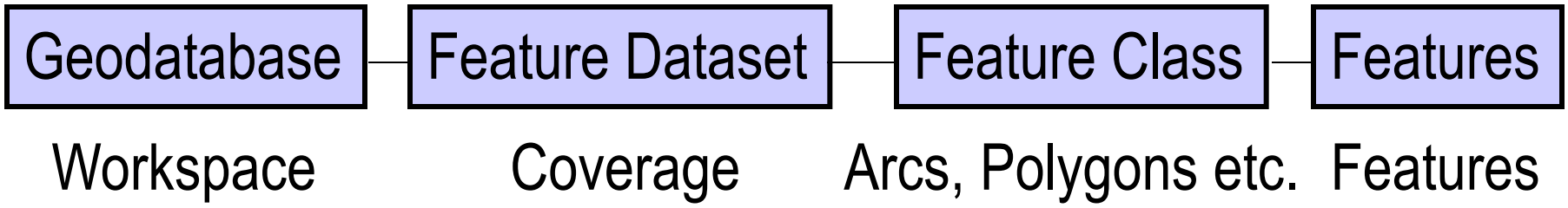


Geodatabases

- New ArcDesktop data format.
- The future for ArcGIS.
- Like a Coverage only stored in an Object Orientated Database.
- Local or Personal Geodatabases vs. SDE Geodatabases shared on a network.
- SDE databases can be on ArcSDE servers or most other databases. They have locking and versioning to resolve conflicts if more than one person edits a Feature.

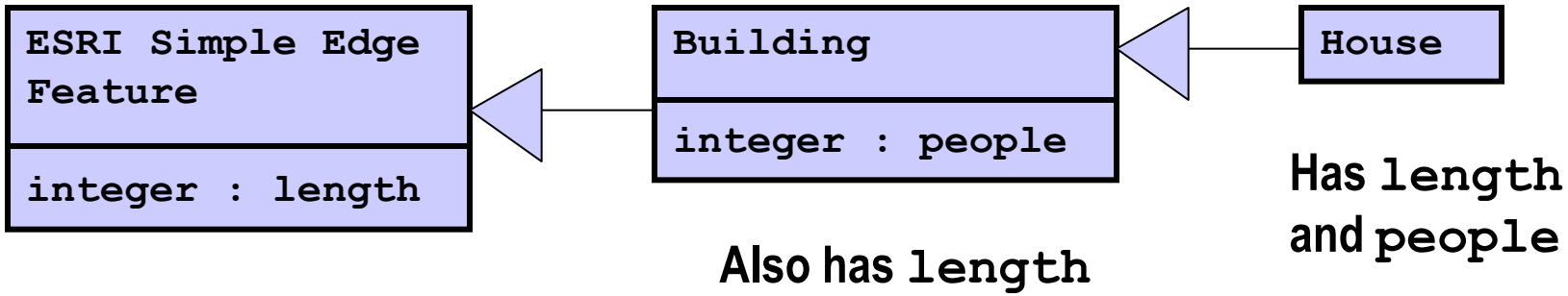
Geodatabases

- Can build them from scratch, import from other formats or build using drawings.
- Keep strict Topological and Data Item constraints on Features.
- Build Topology and confirm Features have appropriate data as they are edited.
- Because of this, are used as the basis of Network Analysis.



Object Orientated Databases

- Each feature is an Object stored in the Geodatabase.
- Each Feature is of a certain predefined type, or Class.
- You can define your own classes, and inherit properties from standard classes.
- When your classes inherit from another class, they pick up all the Classes Attributes.
- Classes inheriting from another are known as Subclasses of a Superclass.



Constraints

- Geographical.
- Class and data types.
- Variable ranges or categories.

Example

- Whereas previously you'd make an Arc for a road, you can now make a **`Road`** class from the **`Simple Edge Feature`** superclass.
- Constrain the Road so it must have a **`Surface type`** variable picked from a list.
- Subclass Road to make a **`Motorway`** class, with a **`Number`** variable which is constrained between 1 and 999.

Benefits of Geodatabase data model

- All data stored centrally in Access database
- Data entry and editing is more accurate – input validated
- Data objects more intuitive – roads, lakes rather than lines and polygons
- Features have richer context – define a features quality as well as its context with other features
- Better maps
- Many users can edit geographical data simultaneously – conflicts can be reconciled

Building a Geodatabase from scratch

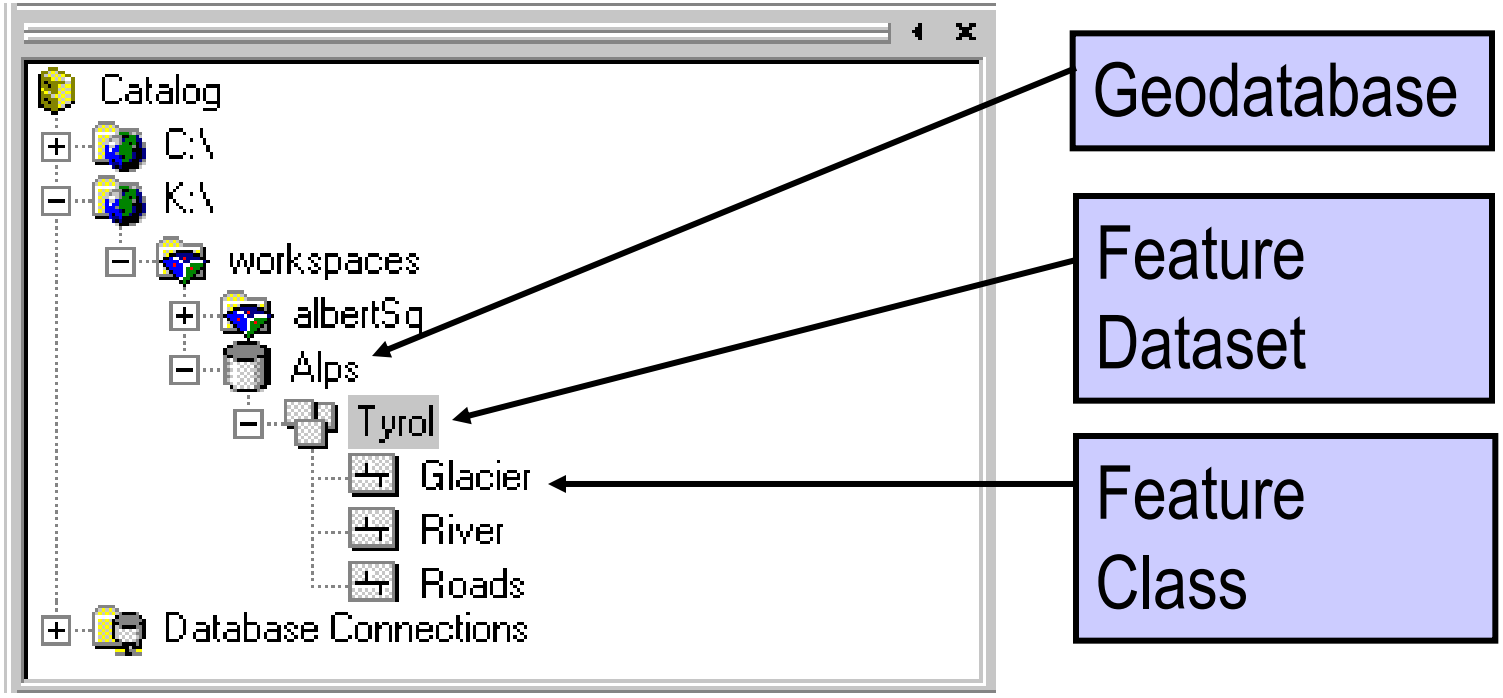
- First decide your requirements. Many parts of the creation process cannot be undone later, so get it right first time.

- What types of data do you want and what constraints?
- What geographical area do you need?
- Are you going to do analysis on the data?

- Build the Geodatabase in ArcCatalog.

Table of Contents

- You should end up with something like the following.



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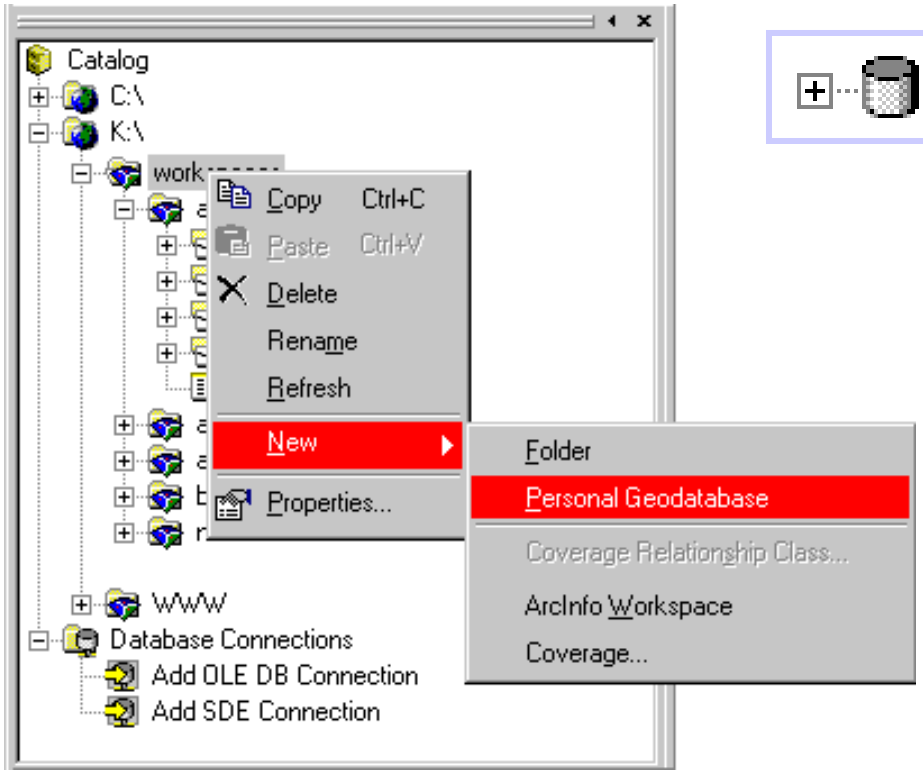
Building the Geodatabase

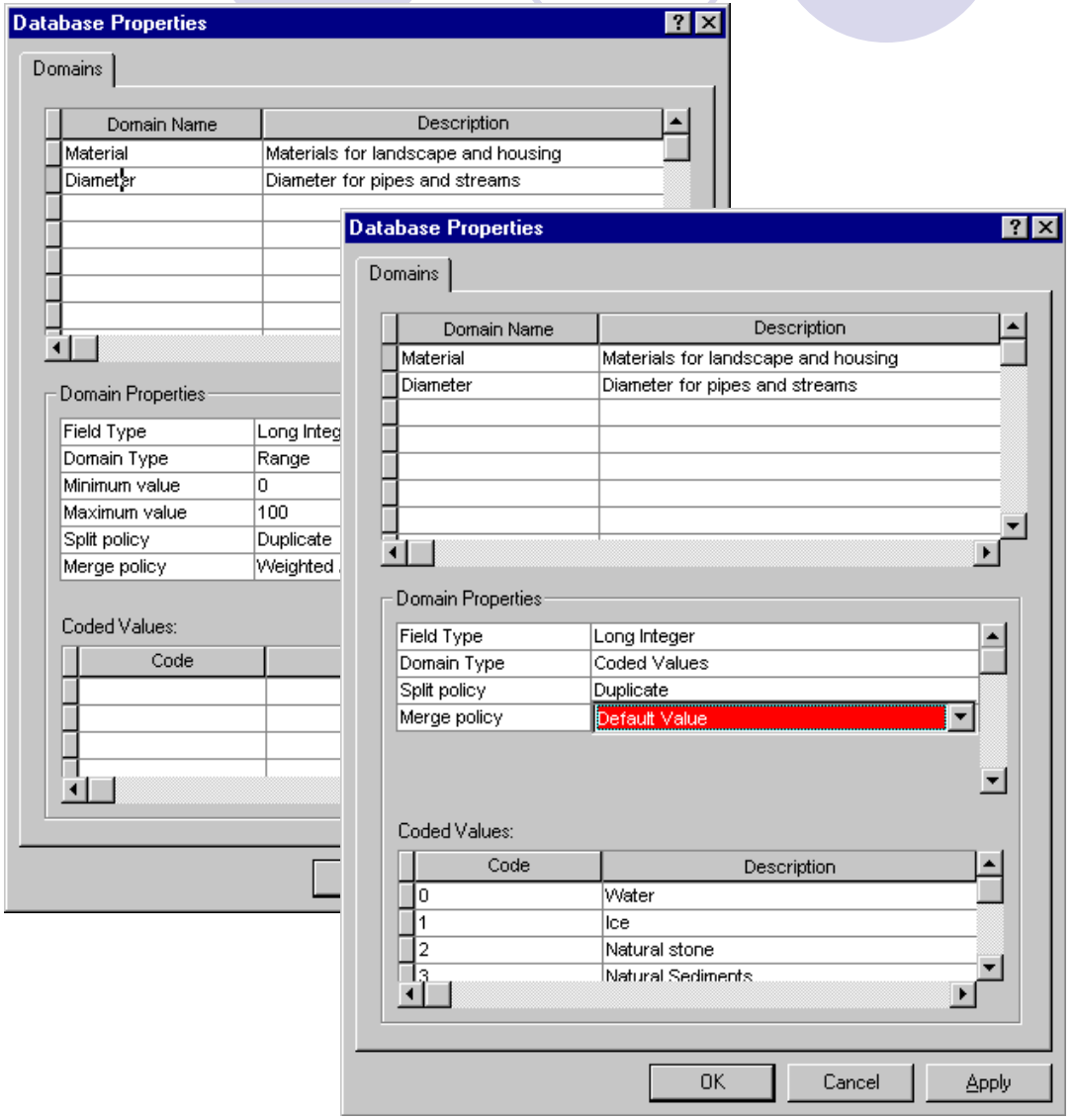
- Right-click on the Workspace and pick **`New`**…
- Unless a server is running ArcSDE, you'll only get the chance to create a **`Personal Geodatabase`**.



To connect to an existing SDE database, use **`Database Connections`**.

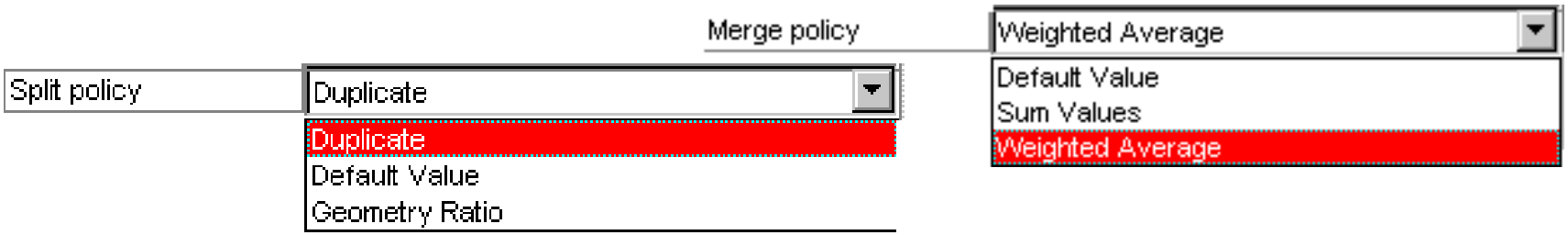
Building the Geodatabase

- You set constraints by creating Attribute Domains at the Geodatabase level in its **`Properties`**.
- These can be ranges or coded values (categories) data must fall in.
- These are then applied to specific Feature classes.



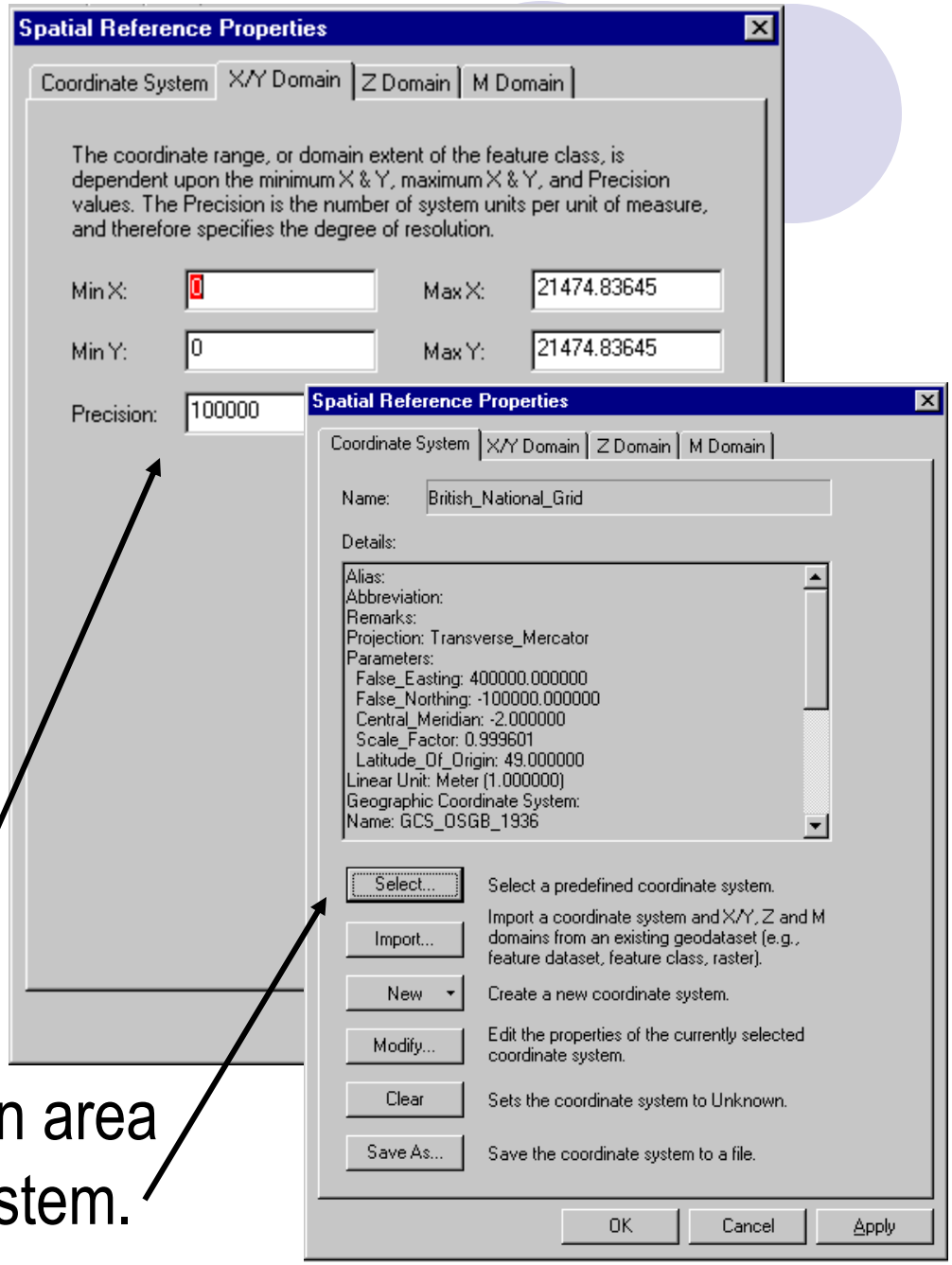
Attribute Domains

- Maximum and Minimum range, or build codes for categories with associated text descriptions.
- A Default Value for new Features.
- Split policy: if a Feature is split, how should the Attribute data be handled in each new Feature?
  - Each gets the default, duplicates the original, or is the original value split on the basis of the divided length/area.
- Merge policy: if two Features joined, how should the Attribute data be kept?
  - Feature gets the sum of the original, the default, or a length/area weighted average.



Feature Dataset

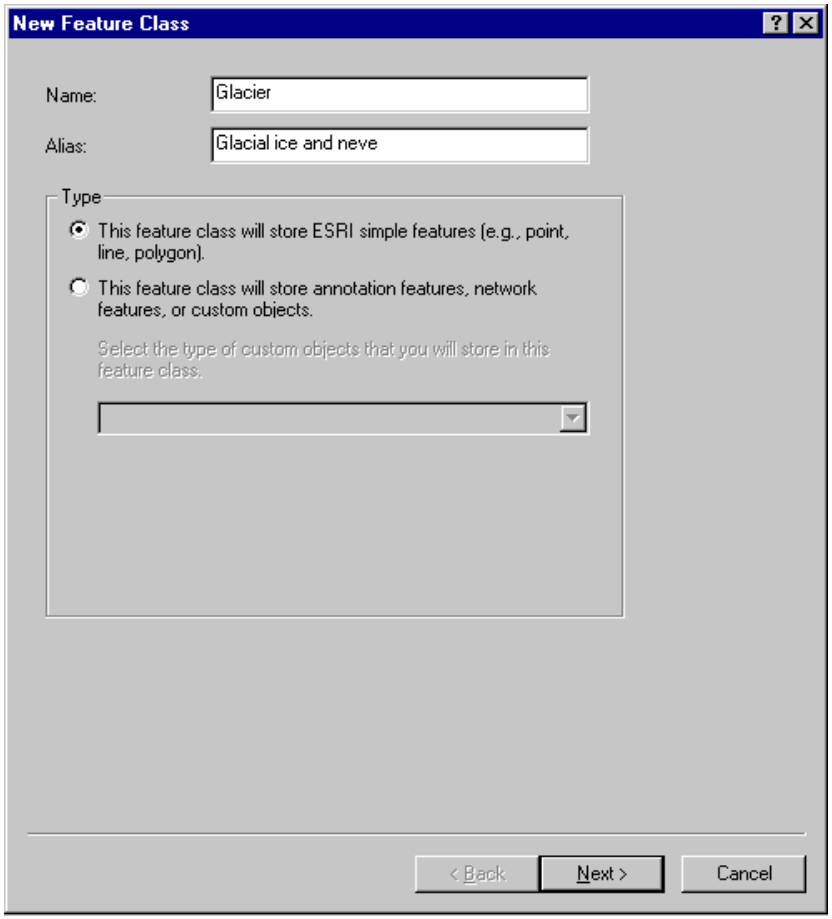
- **`Right-click Geodatabase > New > Feature Dataset.`**
- A collection of Features that share a Spatial Reference, i.e. area and coordinate system. Set this with the **`Edit`** button.

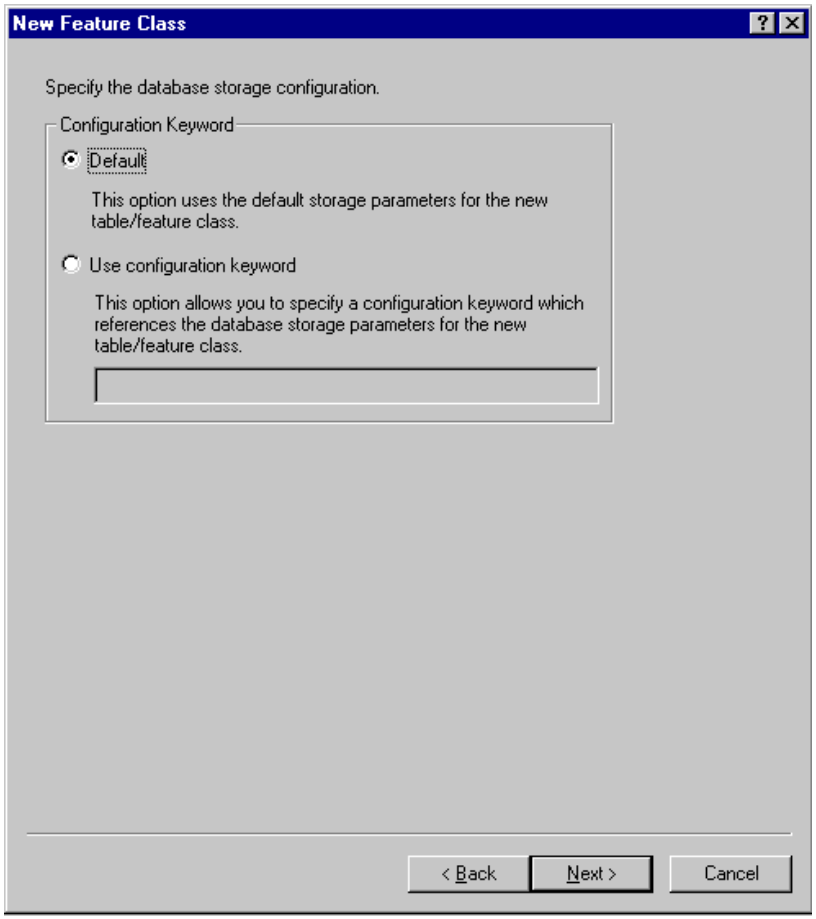


Give the Dataset a max/min area and Select a Projection System.

Feature Classes

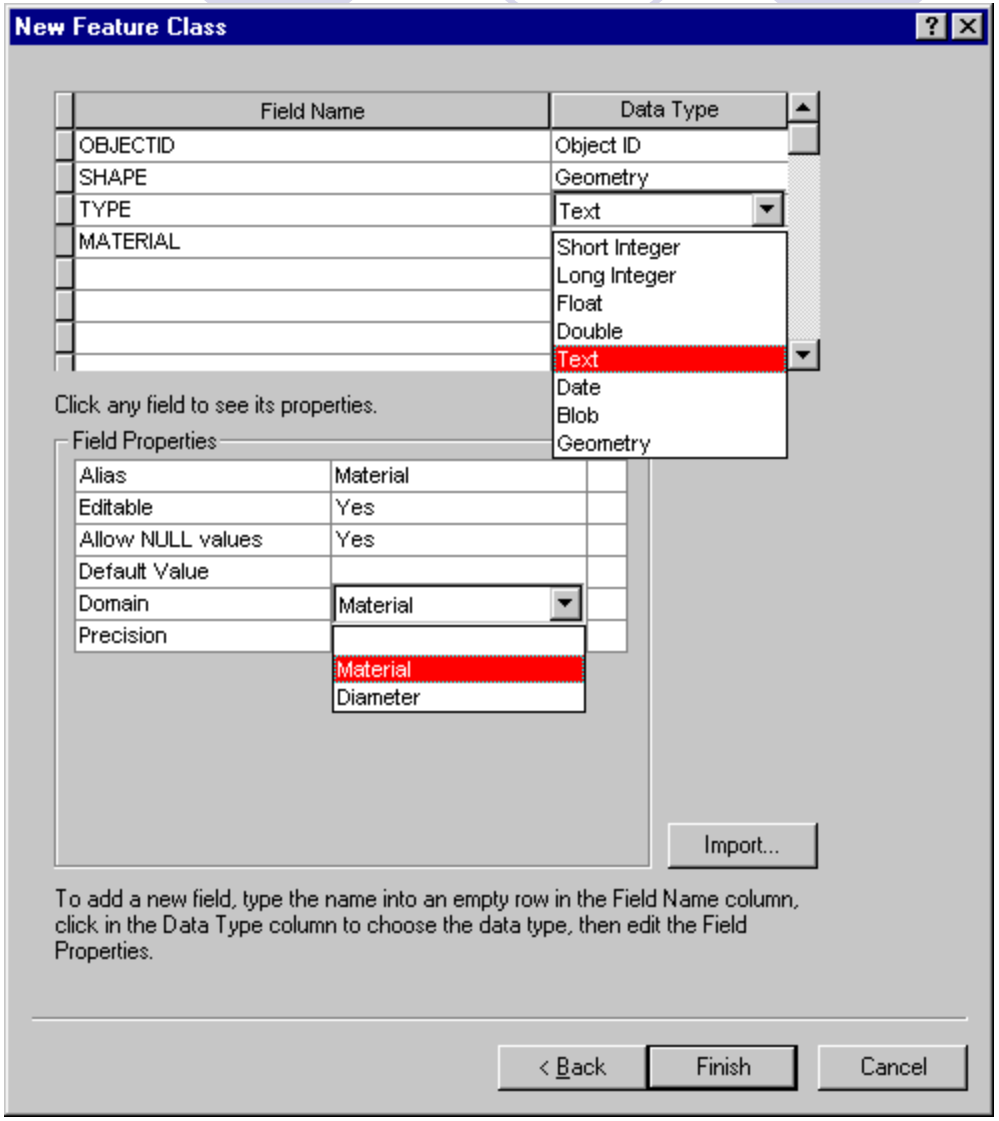
- **`Right-click Feature Dataset > New > Feature Class`**
- Choose a name and set the field.





Feature Classes: Constraints

- Add new Field.
- For each pick an Alias (alternative name - can include spaces), a Default Value, and an Attribute Domain if you want constraint.
- Field Properties change when you click on a Field Name.



Summary

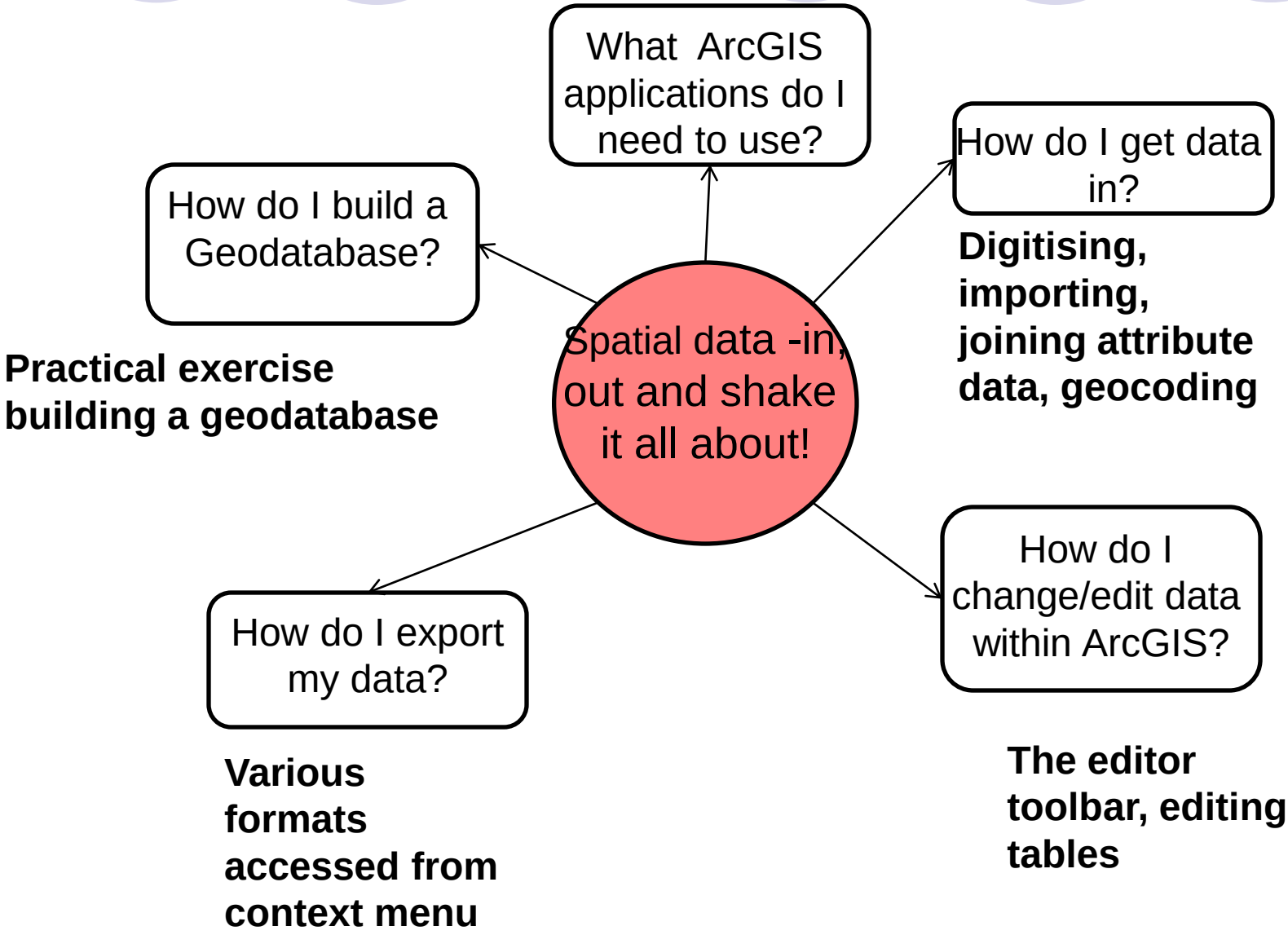
- Geodatabases are a new, highly controlled data storage technique.
- When you build one, you can set Attribute Domains which are constraints that can be applied to Features.
- You build a Feature Dataset for a particular area / spatial reference.
- You design Feature Classes e.g. “Roads” and set their constraints.

Activity 3 – Build a personal geodatabase

- Using the instructions given at http://www.geog.leeds.ac.uk/courses/postgrad/geog5040/lecture3/Pract3_08/index.html, start to build a geodatabase.
- Refer also, to the next 10 slides for further information.

Week 3: Spatial data – In, out and shake it all about!

ArcCatalog, ArcMap, ArcToolbox



Extra help

- ESRI have a number of tutorials (either in PDF or as videos) – these can be accessed from the ArcGIS online help system but I have put a couple of links (related to this week's lecture) in Week 3 on the VLE

Practical

- Build further the personal geodatabase started in the lecture
- Using ArcMap and the Editor Toolbar, create data in your geodatabase
- We will revisit this geodatabase in Week 5 and explore network analysis

Practical and Assignment

- This practical will give you experience in:
  - Building geodatabases
  - Using the Editor Toolbar to add new data and manipulate data
- Assignment (in brief – see VLE for full details)
  - Build the geodatabase and add some features to it.
  - Create some metadata for your Sewer Feature Dataset
  - Send me your geodatabase for assessment.

Next week

- Tables
- Querying
- Displaying data
- Presenting data