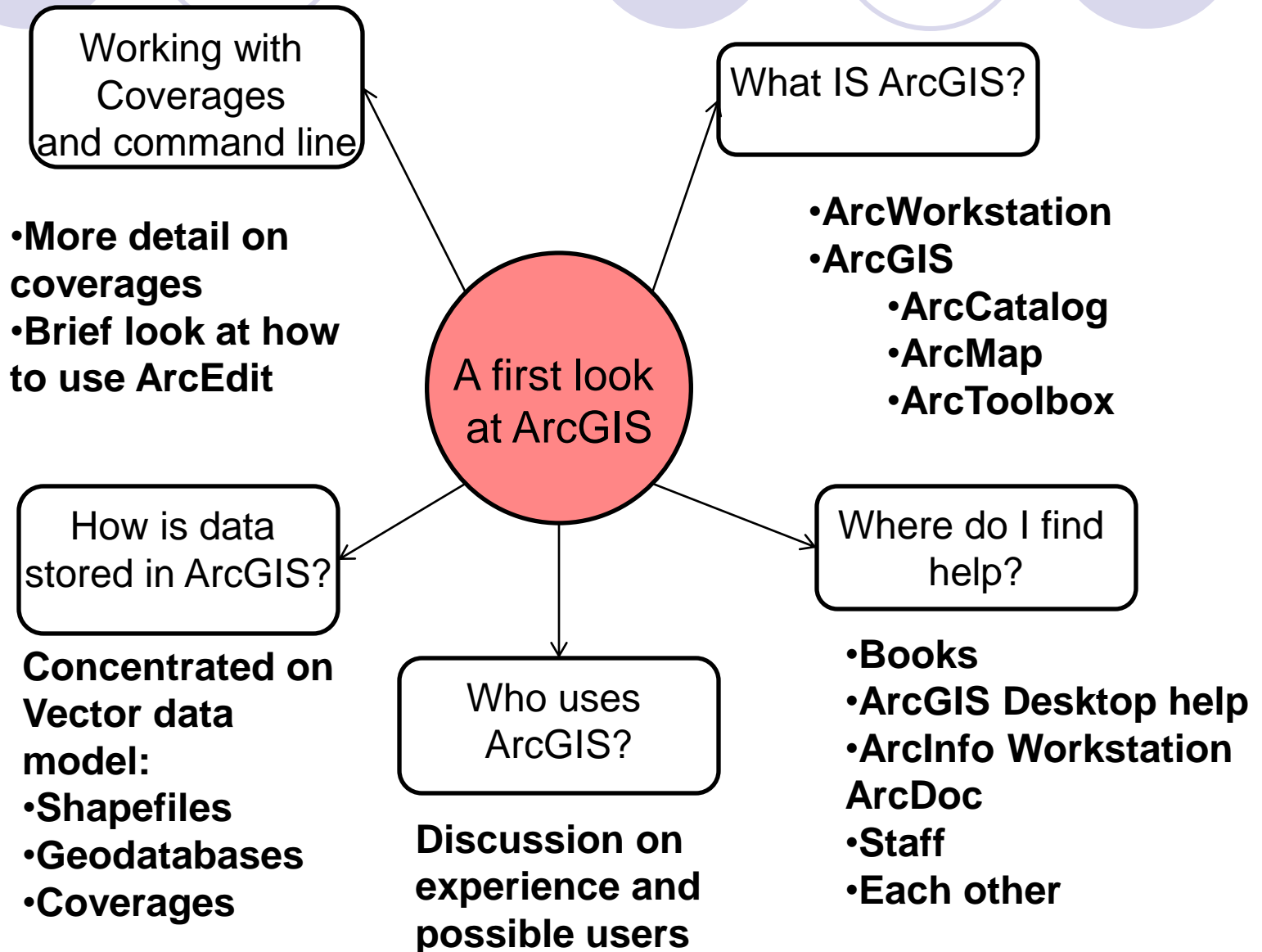


Geog5040: Using and adapting ArcGIS

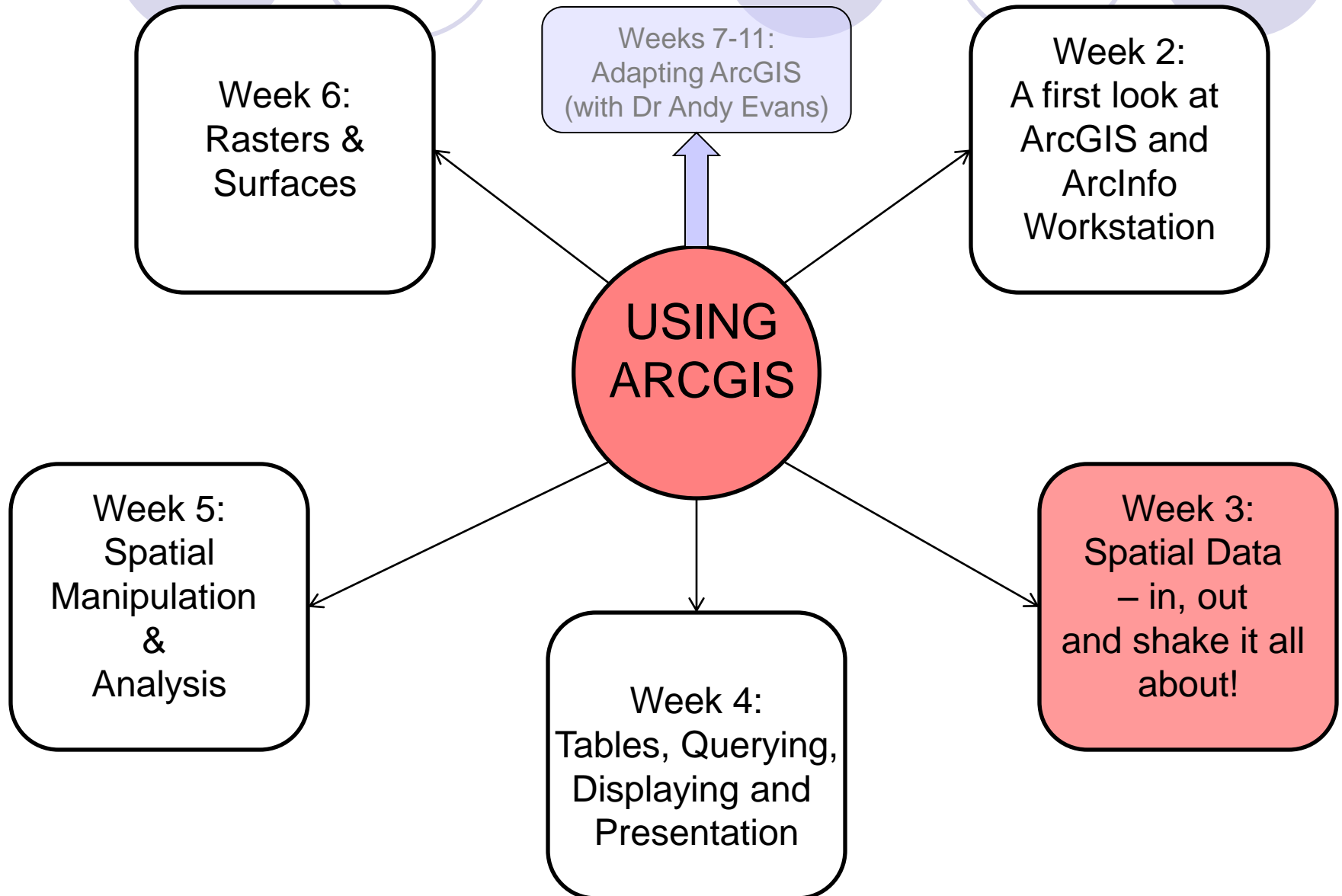
Lecture 3

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

Last week



Overview of Weeks 2-6 of GEOG5040





Aims and objectives of this lecture

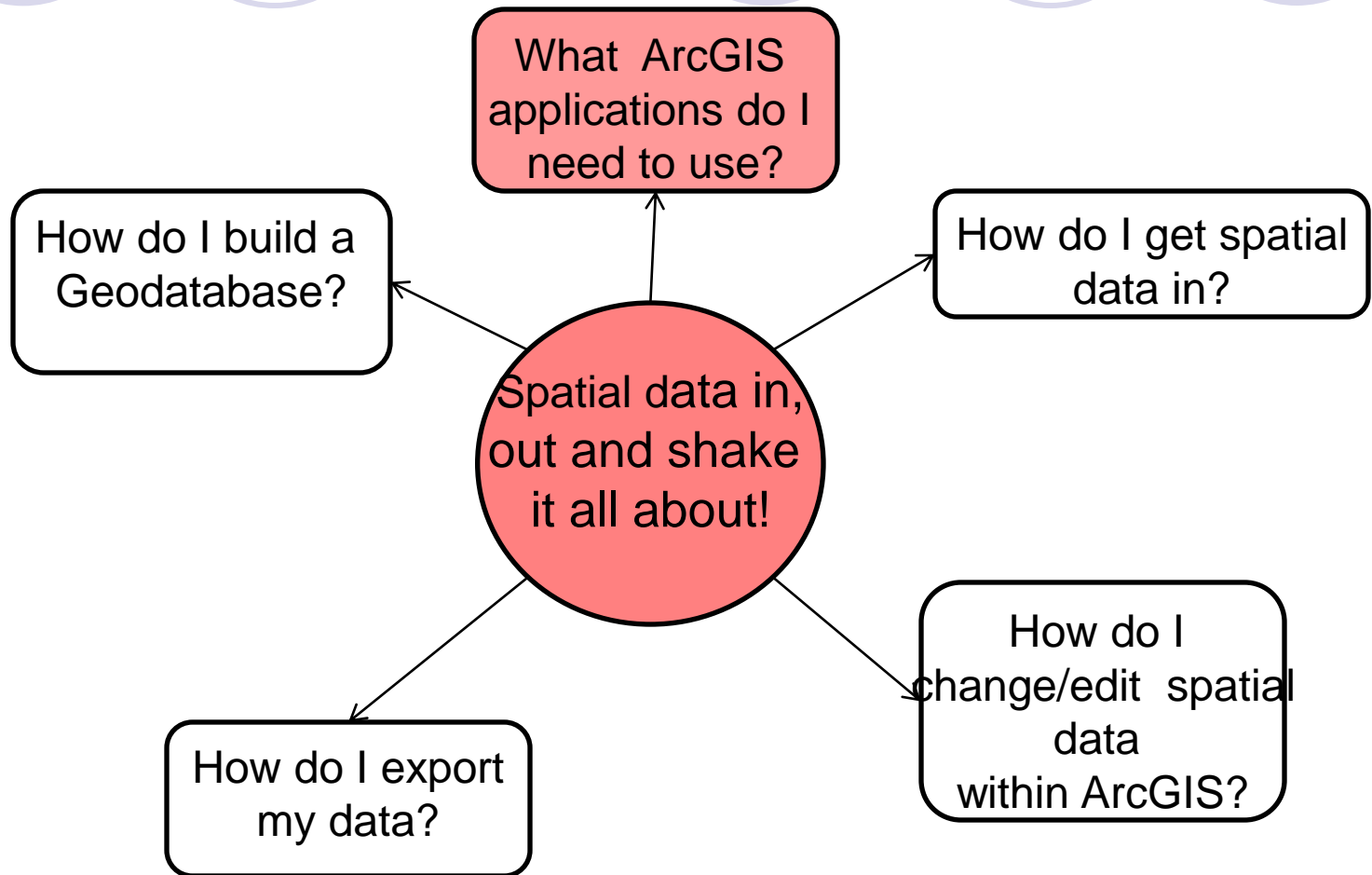
This lecture/workshop aims to :

- 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.

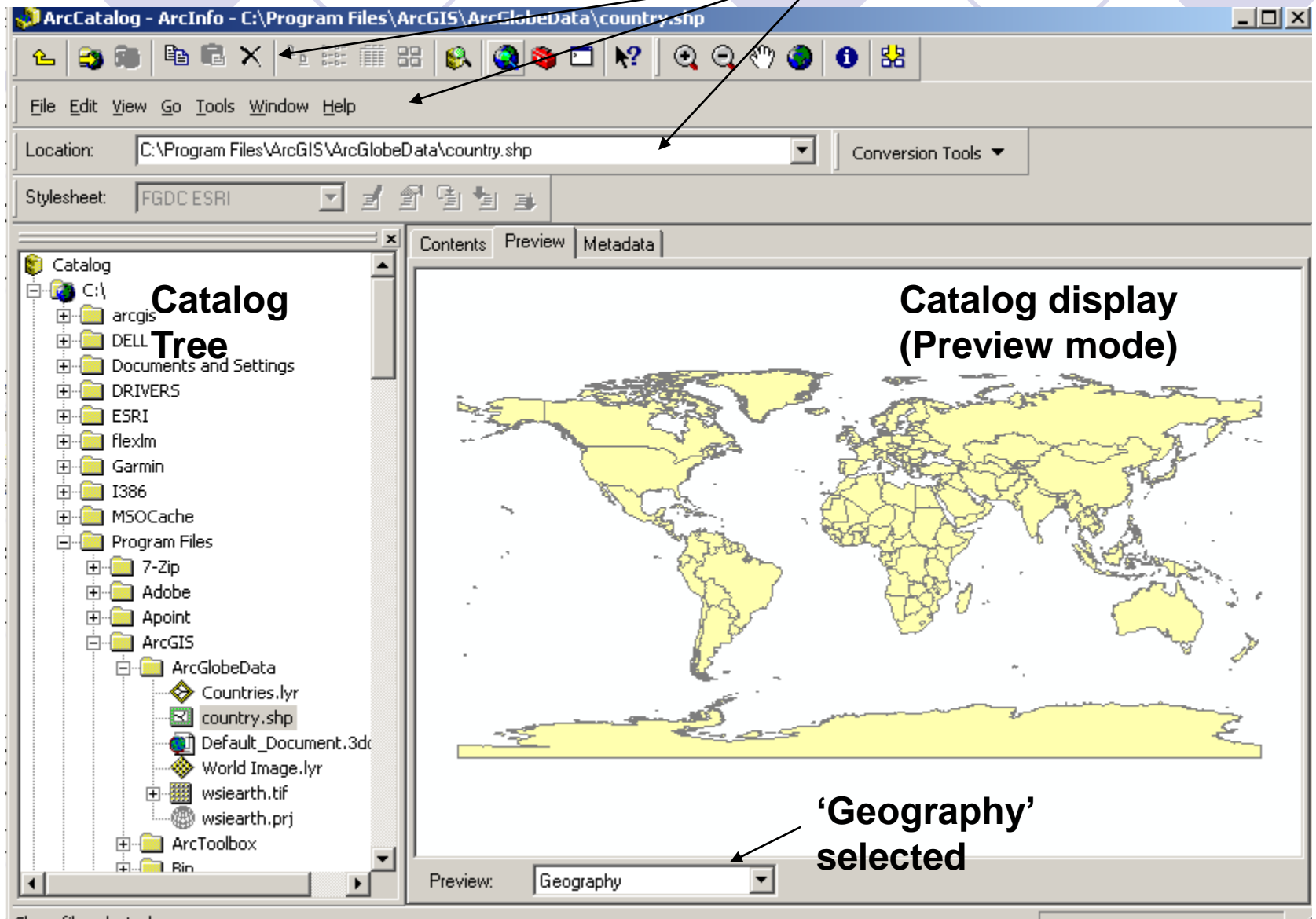


What do we do in ArcCatalog?

- 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

Toolbars



ArcCatalog interface

Catalog display
(Preview mode)

ArcCatalog - ArcInfo - C:\Program Files\ArcGIS\ArcGlobeData\country.shp

File Edit View Go Tools Window Help

Location: C:\Program Files\ArcGIS\ArcGlobeData\country.shp Conversion Tools

Stylesheet: FGDC ESRI

Contents Preview Metadata

Catalog

- C:\
- arcg
- DELI
- Doc
- DRI
- ESR
- flexl
- Garr
- I386
- MSC
- Proc

FID	Shape	FIPS_CNTRY	GMI_CNTRY	ISO_2DI	ISO_3DIG	CNTRY_NAME	LONG_NAME	SO
0	Polygon	AF	AFG	AF	AFG	Afghanistan	Afghanistan	Afghanistan
1	Polygon	AL	ALB	AL	ALB	Albania	Albania	Albania
2	Polygon	AG	DZA	DZ	DZA	Algeria	Algeria	Algeria
3	Polygon	AQ	ASM	AS	ASM	American Samoa	American Samoa	United States
4	Polygon	AN	AND	AD	AND	Andorra	Andorra	Andorra
5	Polygon	AO	AGO	AO	AGO	Angola	Angola	Angola
6	Polygon	AV	AIA	AI	AIA	Anguilla	Anguilla	United Kingdom
7	Polygon	AY	ATA	AQ	ATA	Antarctica	Antarctica	Antarctica
8	Polygon	AC	ATG	AG	ATG	Antigua & Barbuda	Antigua and Barbuda	Antigua & Barbuda
9	Polygon	AR	ARG	AR	ARG	Argentina	Argentina	Argentina
10	Polygon	AM	ARM	AM	ARM	Armenia	Armenia	Armenia
11	Polygon	AA	ABW	AW	ABW	Aruba	Aruba	Netherlands
12	Polygon	AS	AUS	AU	AUS	Australia	Australia	Australia
13	Polygon	AU	AUT	AT	AUT	Austria	Austria	Austria
14	Polygon	AJ	AZE	AZ	AZE	Azerbaijan	Azerbaijan	Azerbaijan
15	Polygon	BA	BHR	BH	BHR	Bahrain	Bahrain	Bahrain
16	Polygon	FQ	UMI	UM		Baker I.	Baker Island	United States
17	Polygon	BG	BGD	BD	BGD	Bangladesh	Bangladesh	Bangladesh

Record: 2 Show: All Selected Records (of 250) Options

Preview: Table

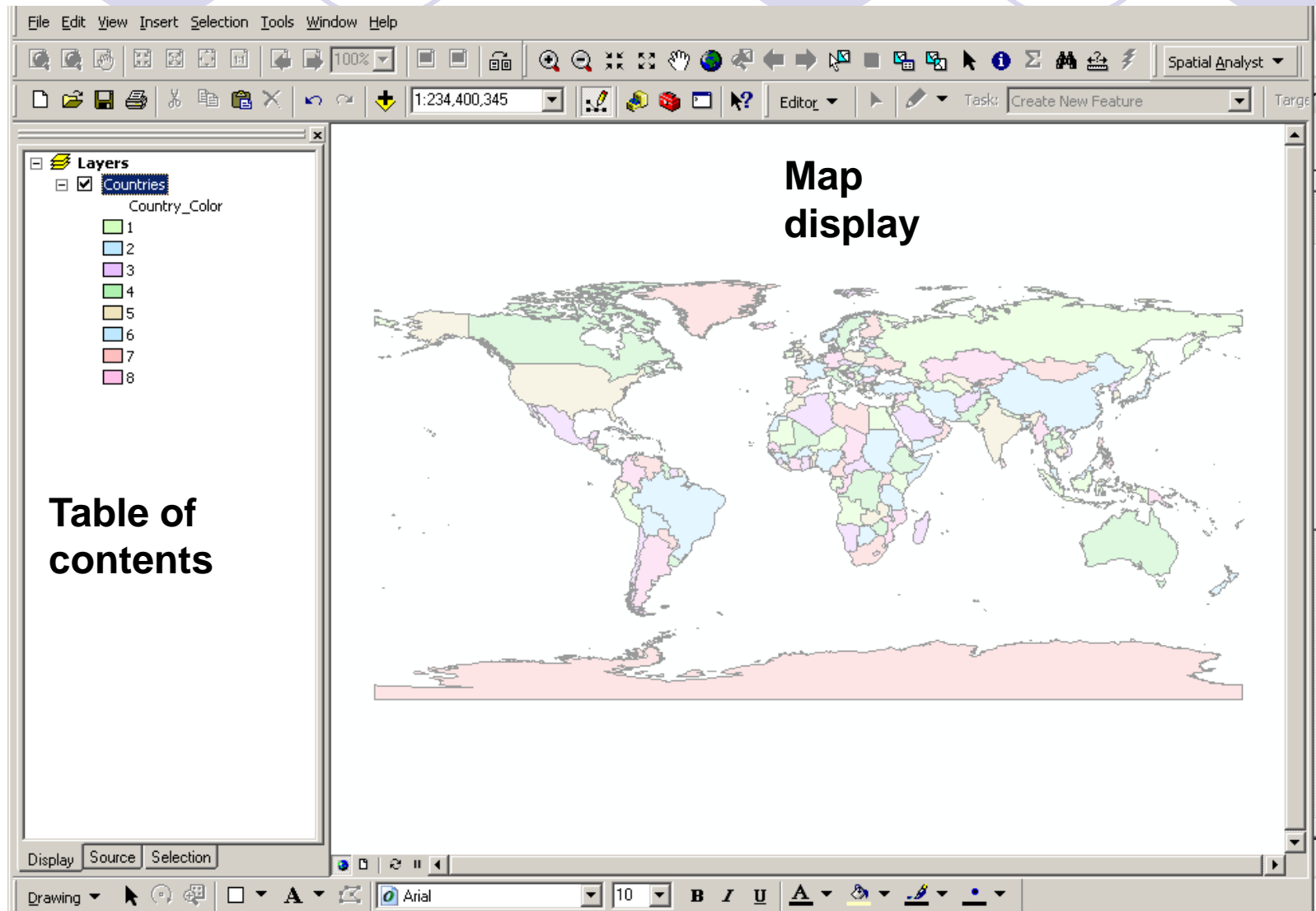
'Table' selected

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

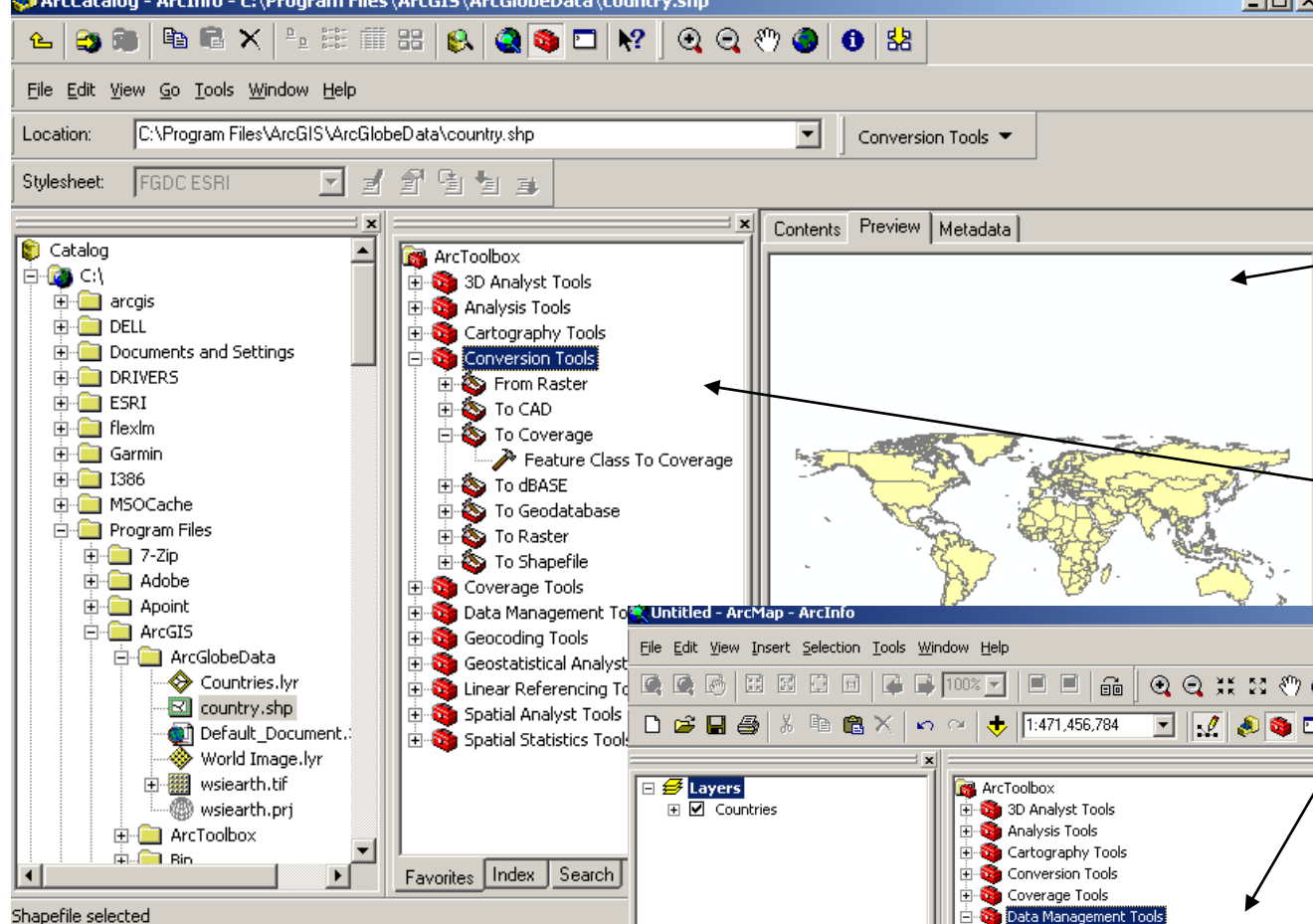
ArcMap interface





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

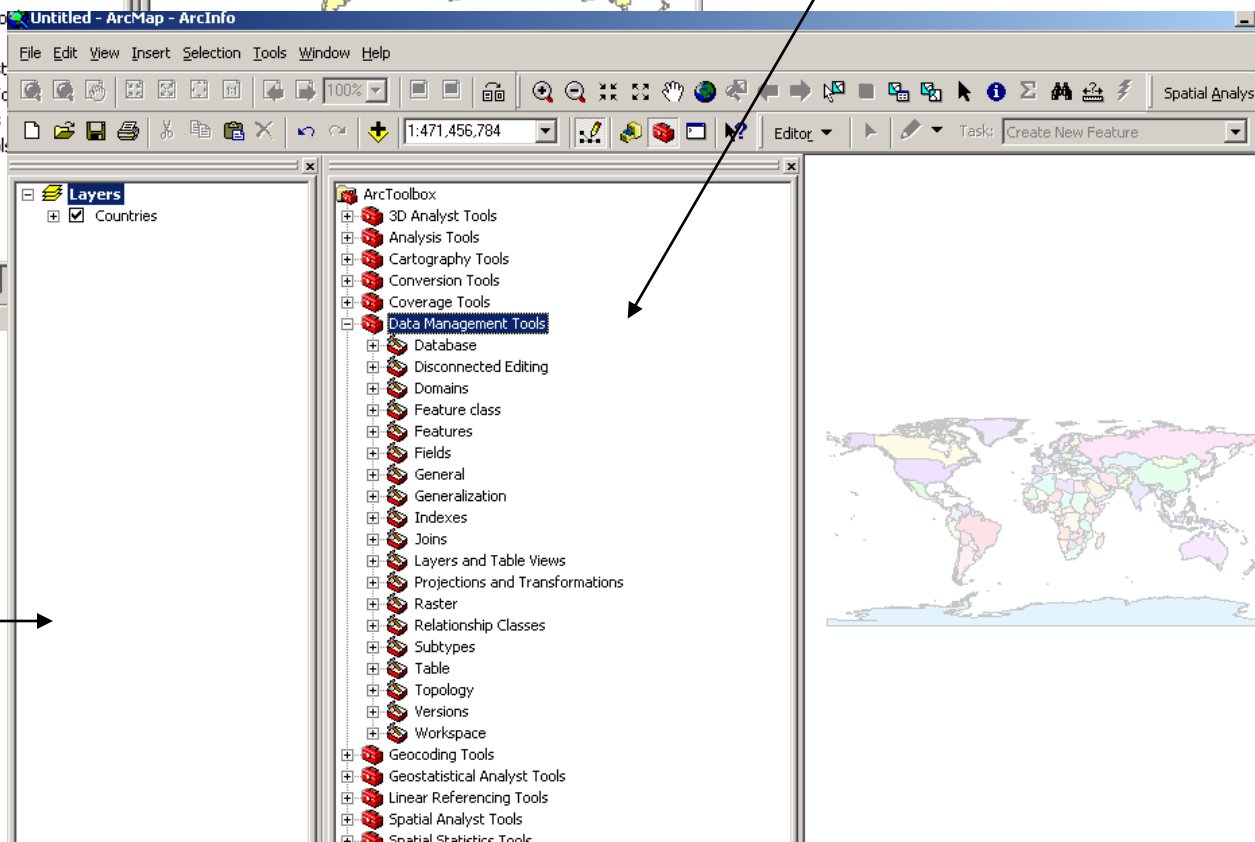


ArcCatalog

**ArcToolkit
window**

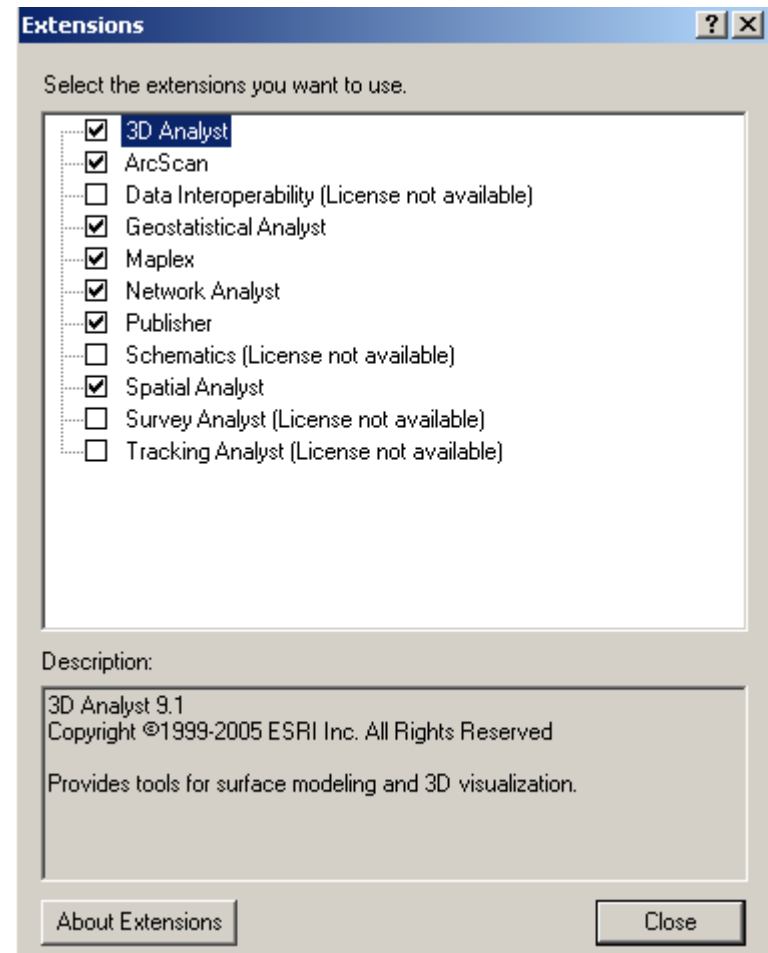
Shapefile selected

ArcMap



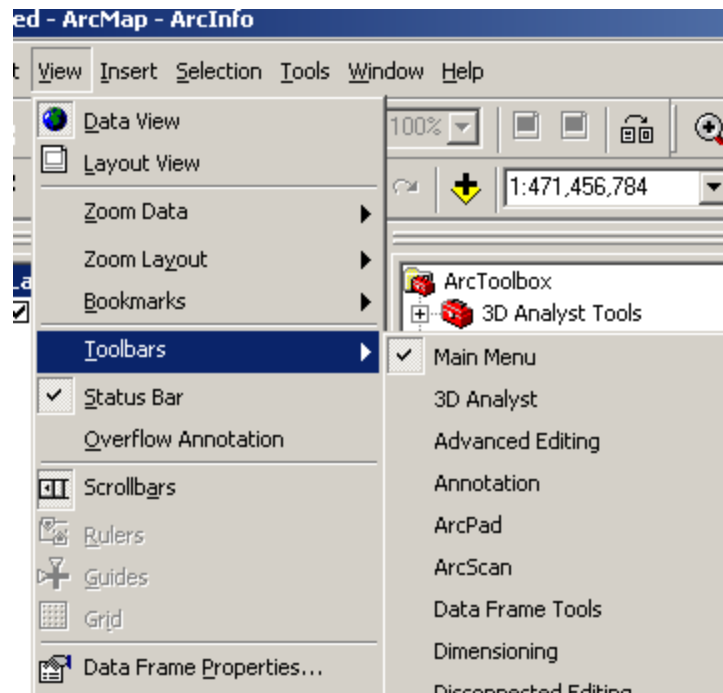
Extensions

- 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)

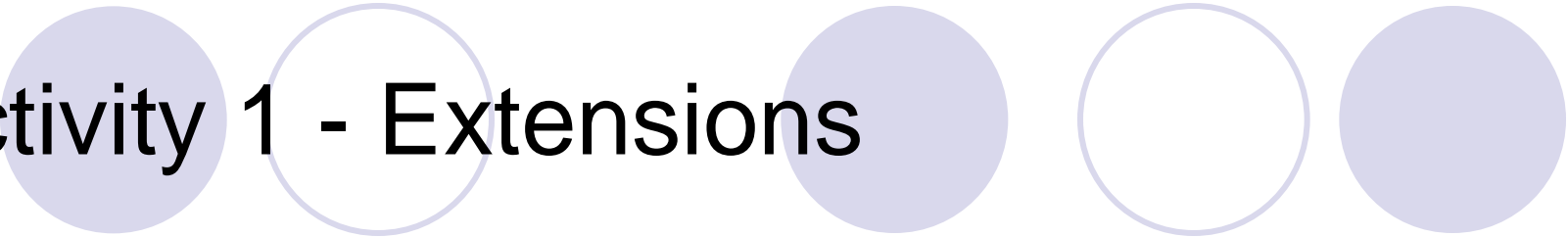




Summary: ArcGIS Desktop applications

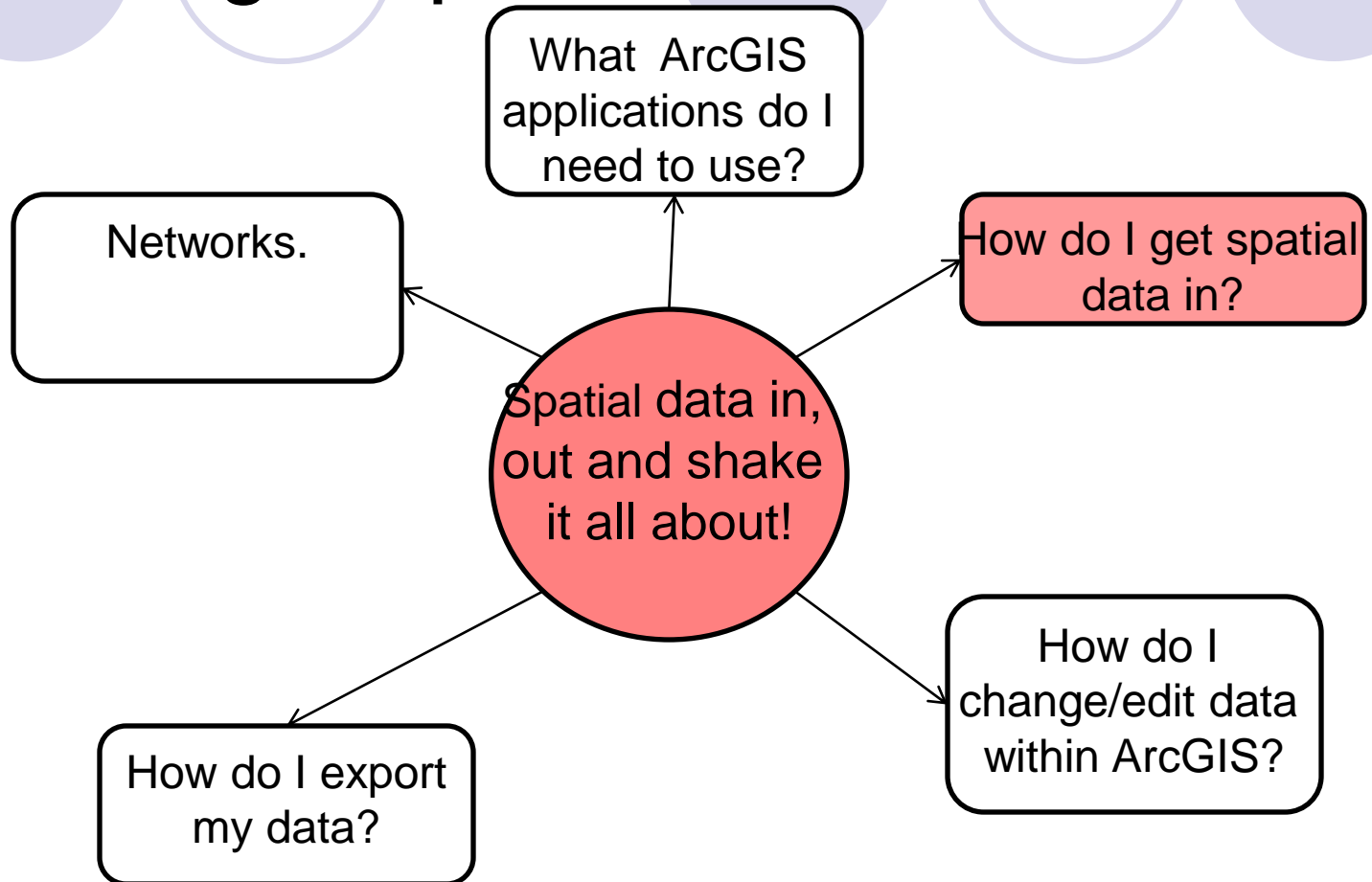
- ArcCatalog : browse, search, preview, manage and add (to ArcMap) spatial data
- ArcMap: display data, query attributes, analyse data and design map layouts
- ArcToolbox: tools for converting, projecting and analysis of data

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...

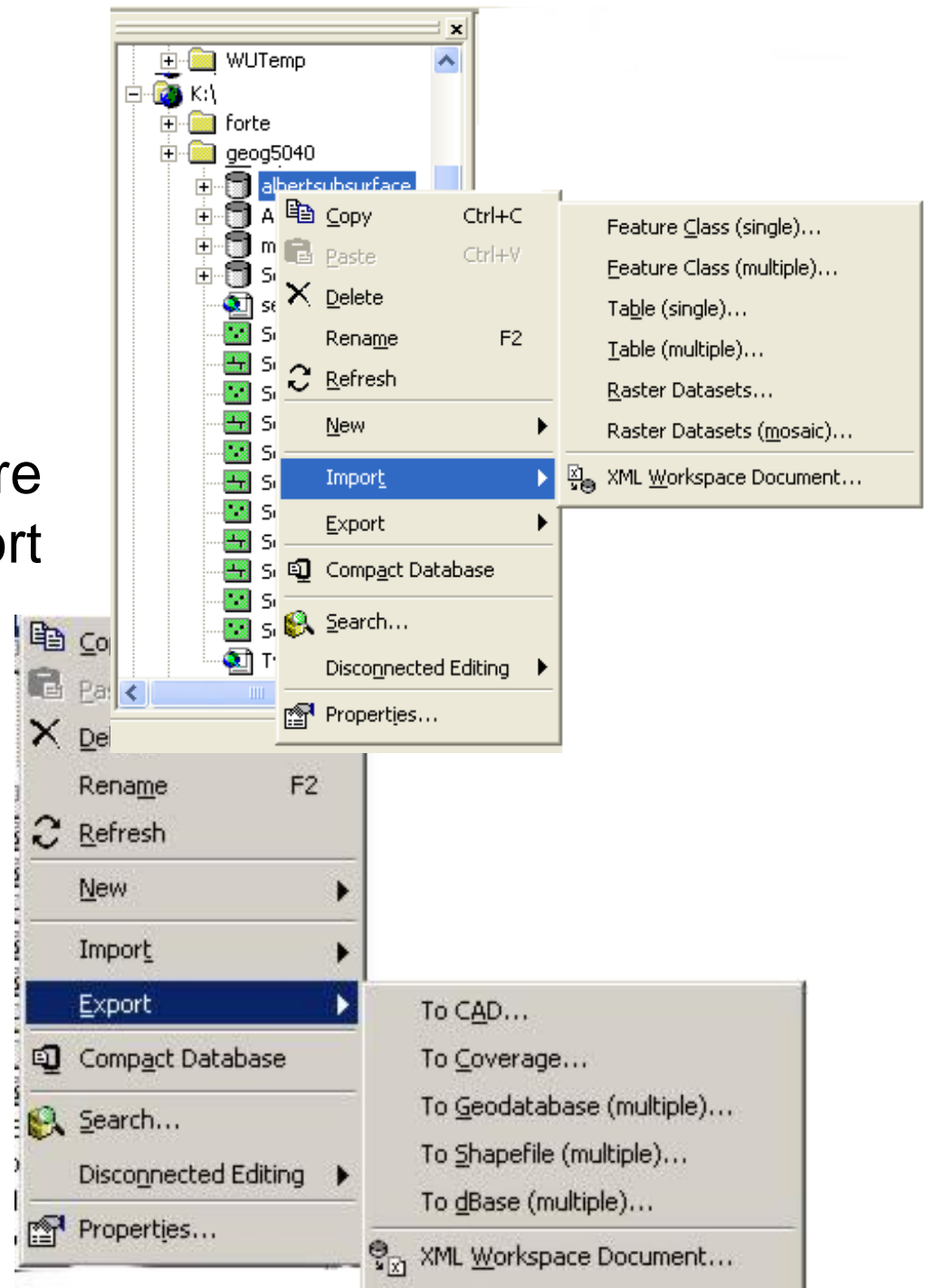
- Creating new data
- Importing shapefiles, coverages and geodatabases.
- Importing text files.
- Importing other formats.
- Importing from web services.

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

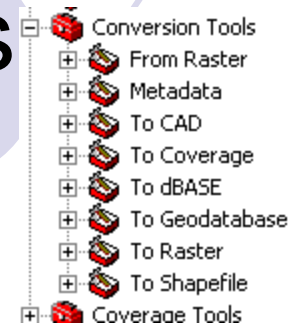
Importing

- 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.

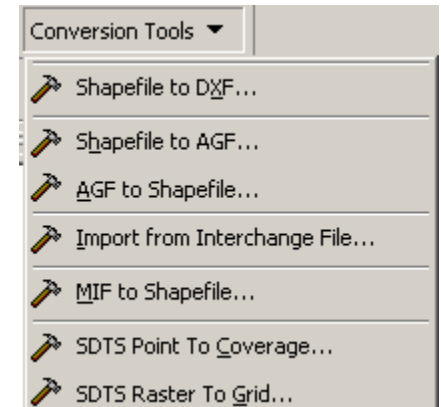


Importing other formats

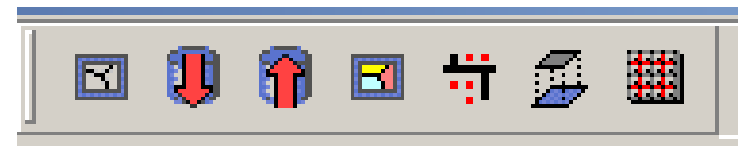
- ArcToolbox has a whole set of tools for conversion.



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



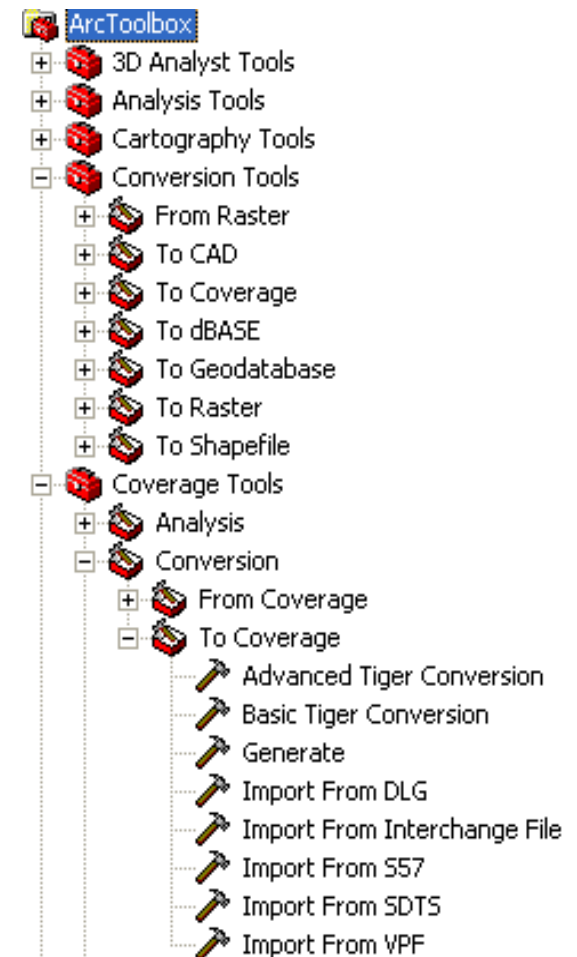
- MapManager (accessed via a toolbar in ArcCatalog or from the Start menu)



- 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

The screenshot displays the 'geography network explorer' website. The interface is divided into two main sections: 'FIND CONTENT' on the left and 'VIEW CONTENT' on the right. The 'FIND CONTENT' section has a 'Search' tab selected, showing a 'DEFINE SEARCH AREA' step with a search box containing 'Antarctica' and a 'GO!' button. Below this is a world map with a red box highlighting Antarctica. The 'VIEW CONTENT' section shows 'Search Results' with 'Records Found: 31'. It lists details for a specific record: Publisher: WorldSat, Content Title: Satellite Imagery (2km), Content Type: Image Service, Coverage Area: Full Earth, Resolution: 2km / pixel, and Latest Status: Service Running. There are buttons for 'View Details', 'View Map', and 'Add to ArcExplorer'. A 'back to top' link is at the bottom right.

geography network explorer

HOME SITE MAP HELP

FIND CONTENT

Search Browse

1 DEFINE SEARCH AREA

☐ Find Place for Search

Antarctica GO!

2 DEFINE SEARCH CRITERIA

Data Theme

All Data Themes

Keyword (e.g. river)

SEARCH

VIEW CONTENT

Search Results

Records Found: 31

Publisher: WorldSat

Content Title: Satellite Imagery (2km)

Content Type: Image Service

Coverage Area: Full Earth

Resolution: 2km / pixel

Latest Status: Service Running

View Details View Map Add to ArcExplorer

back to top

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

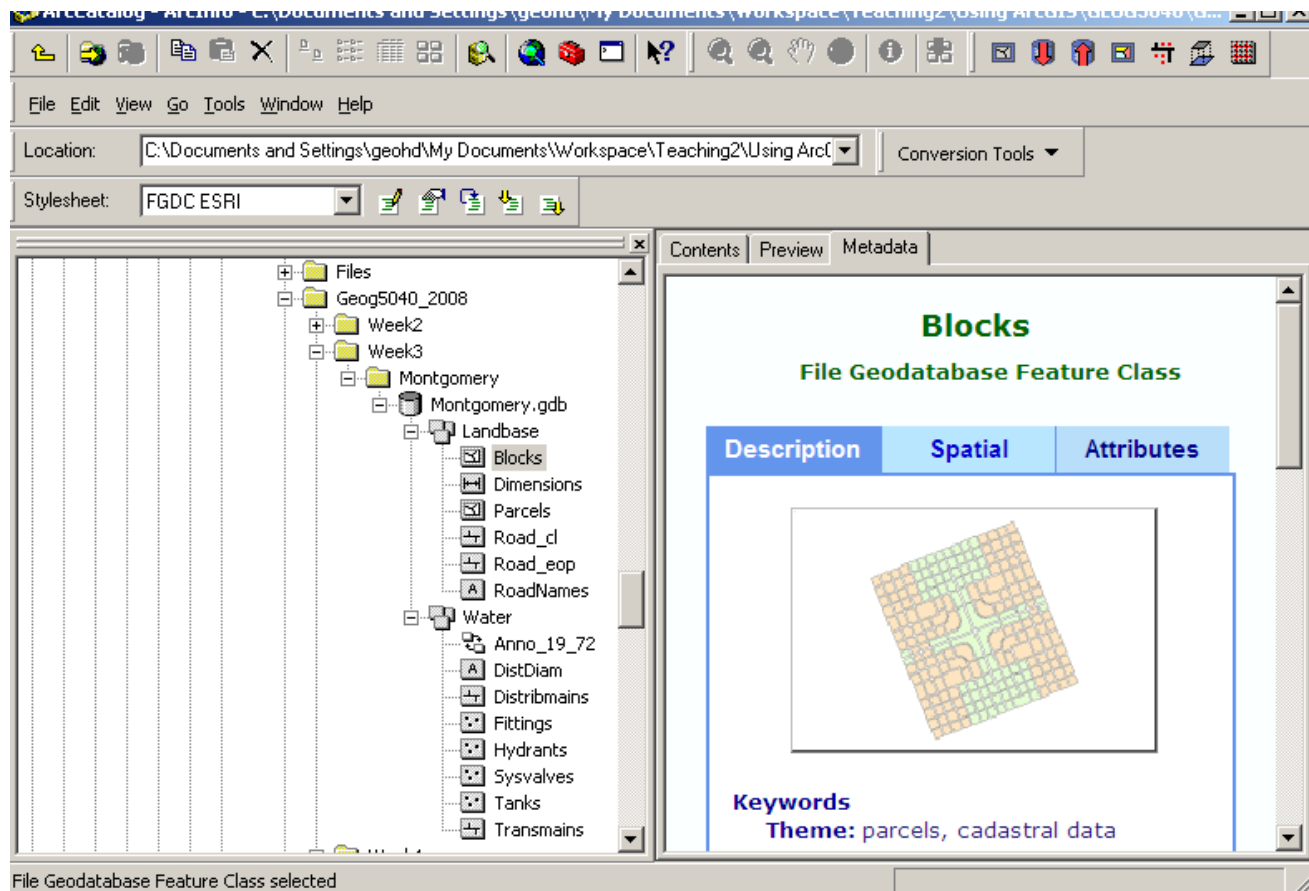
Metadata



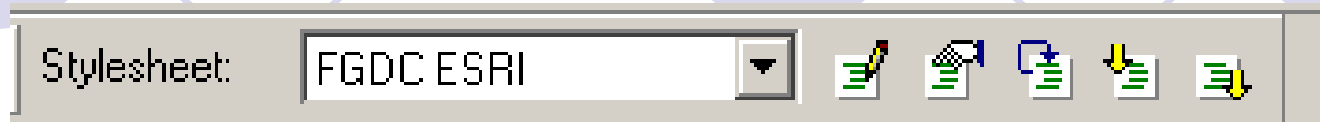
- What is metadata?
 - Data about data
 - Who created it
 - Where it came from
 - Coordinate system
 - What fields in attribute tables mean
- Why is it important?
 - Without metadata, data is useless
 - Dealing with undocumented data can be frustrating.

Viewing metadata

- Tabs and links in ArcCatalog

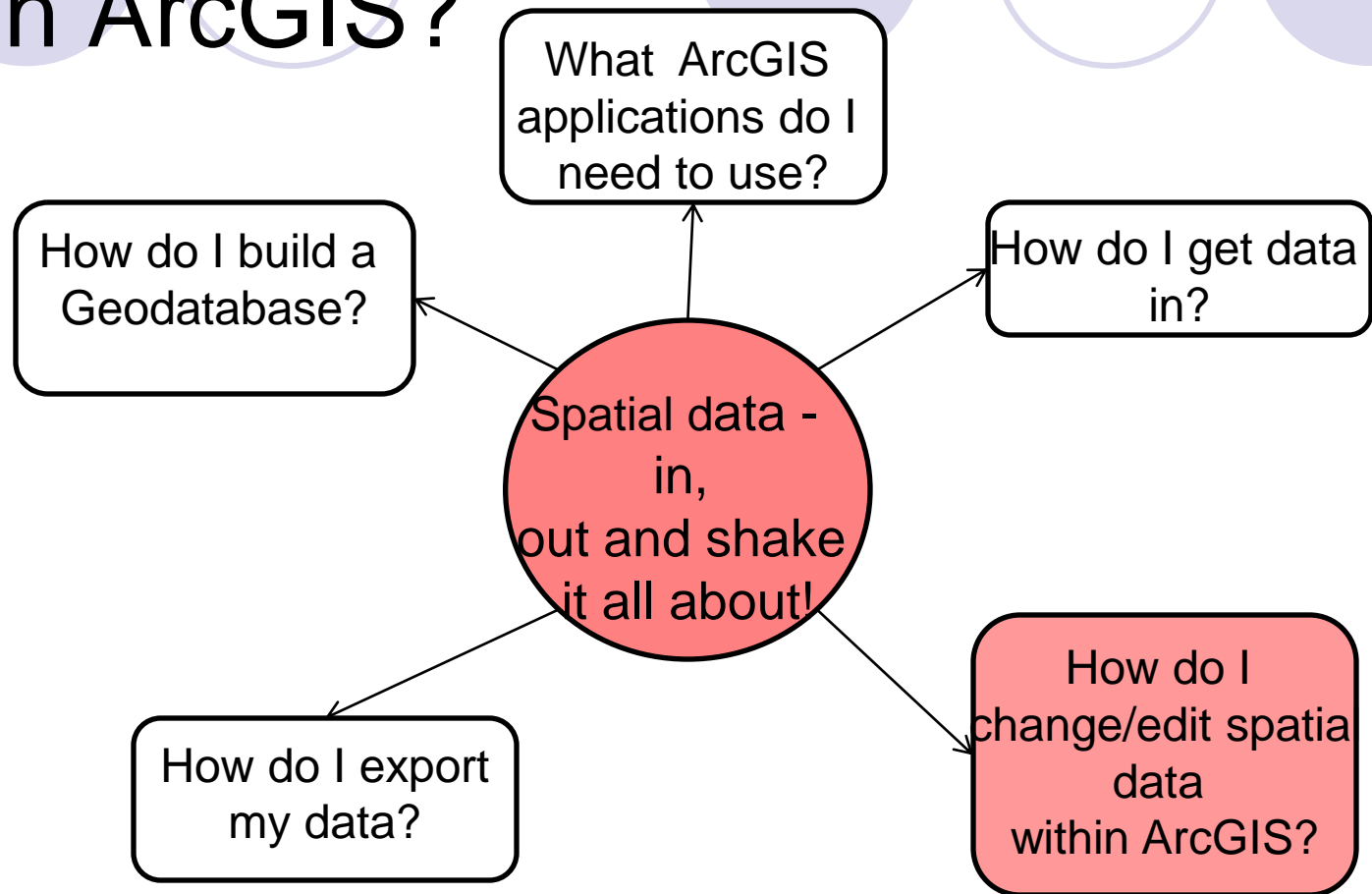


Editing metadata

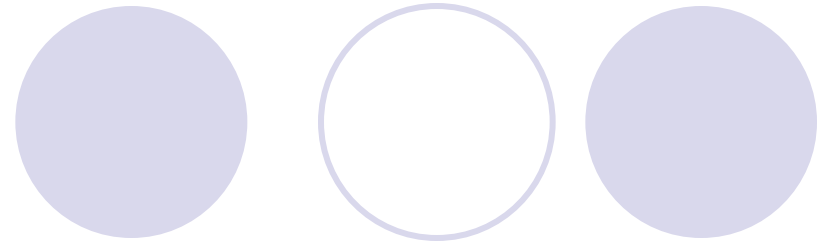


- Editing metadata is done via the metadata toolbar
- Can select:
 - Stylesheet
 - Edit metadata
 - Metadata properties
 - Create/update metadata
 - Import metadata
 - Export metadata

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

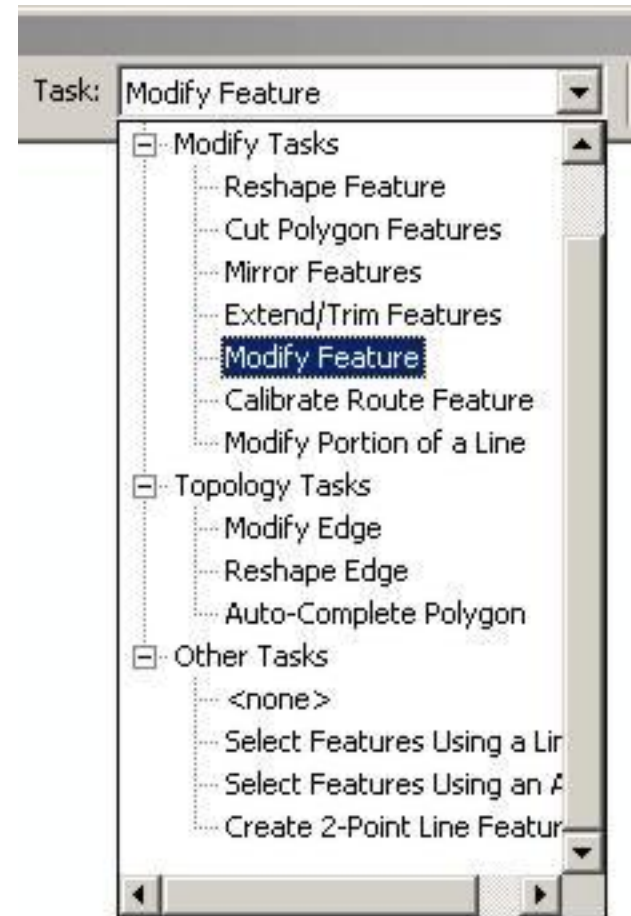
The Editor Toolbar



- 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

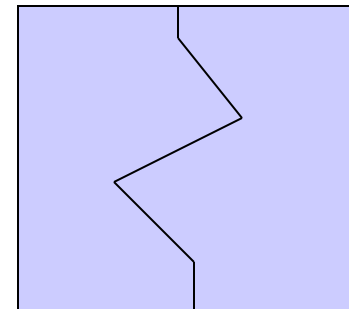
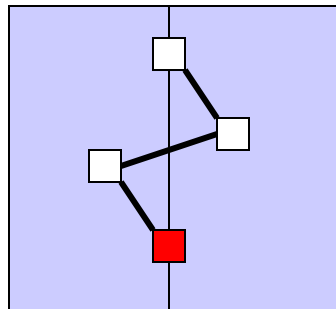
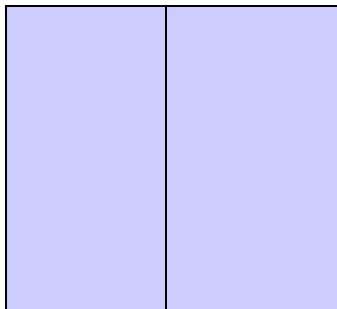
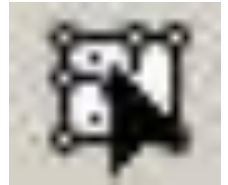
Tasks: Modify features etc

- 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.



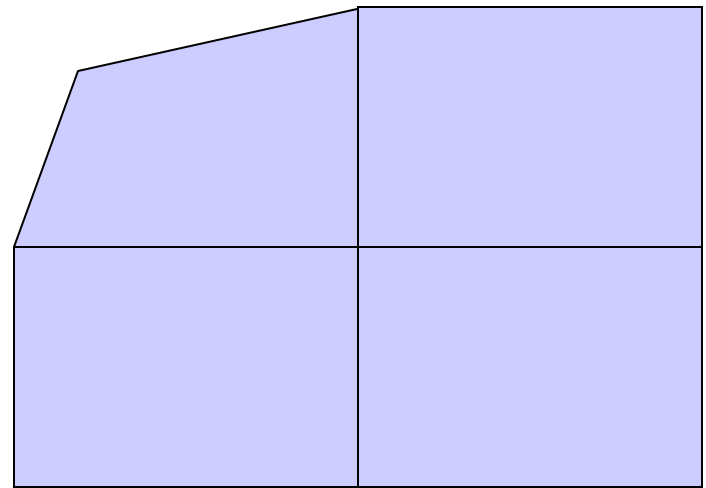
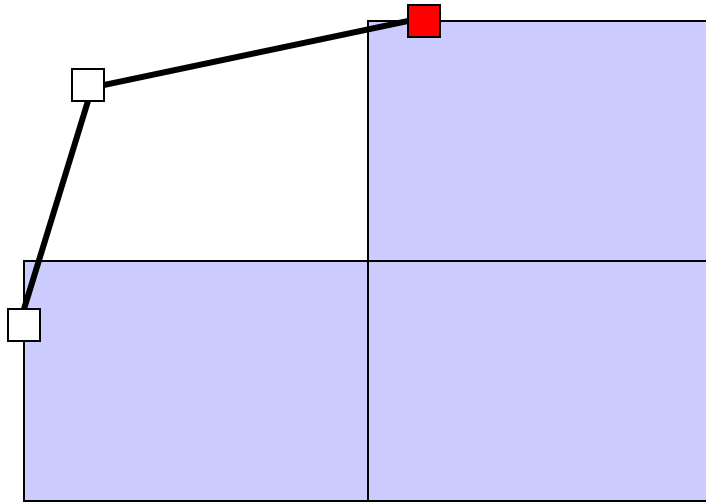
Editing Topological features

- 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

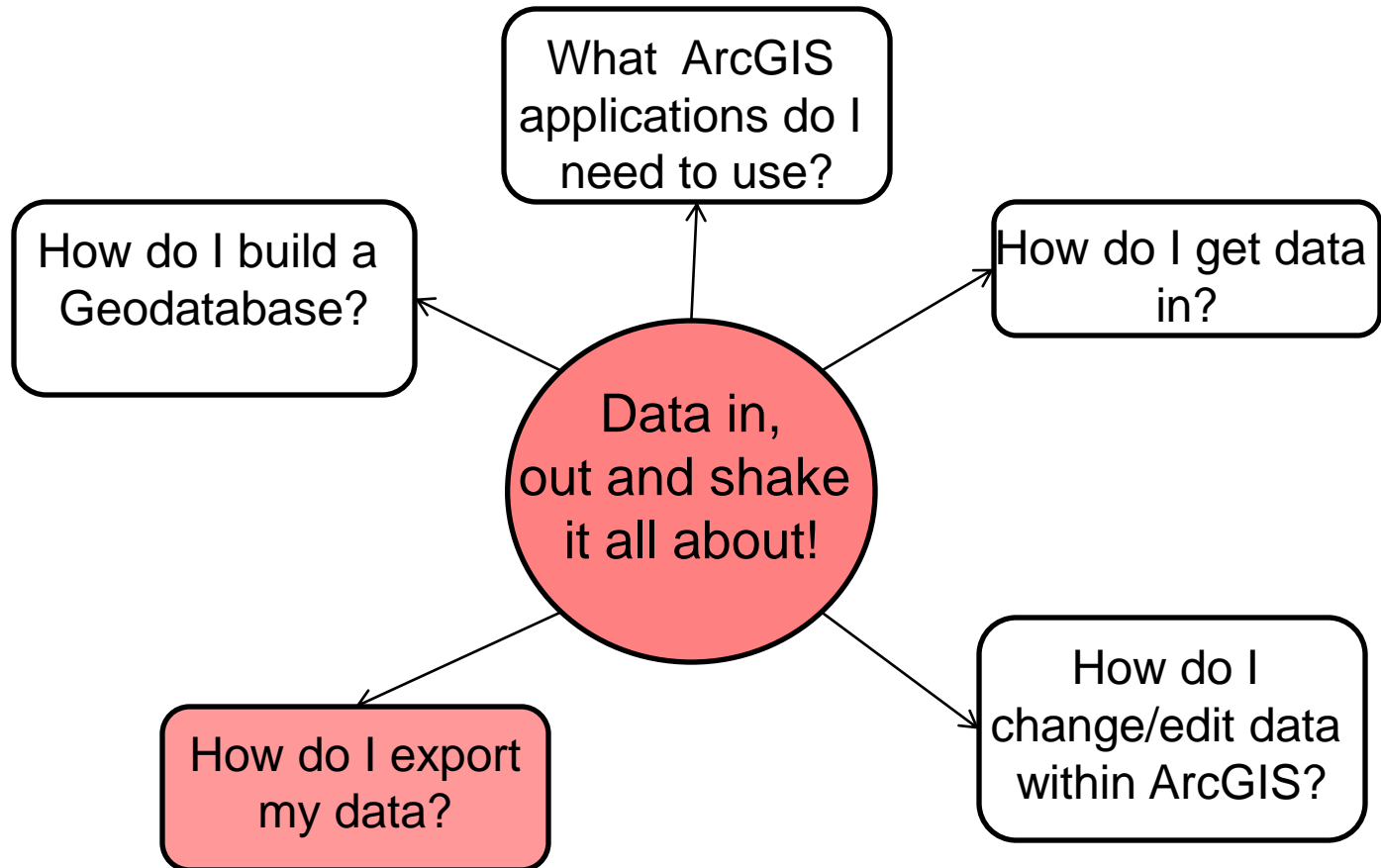


Autocomplete Polygon

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

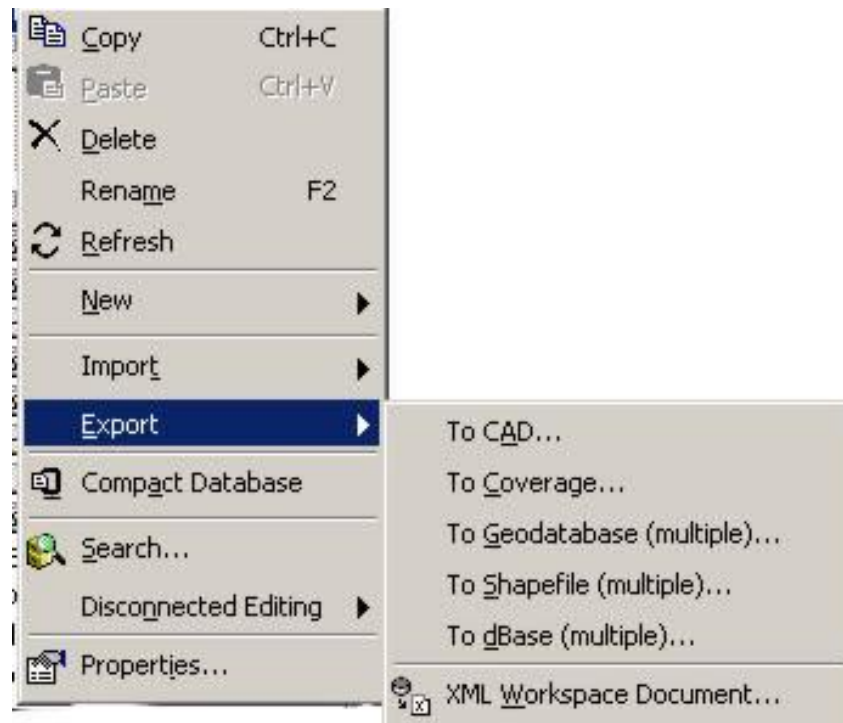


How do I export data from ArcGIS?



Exporting data

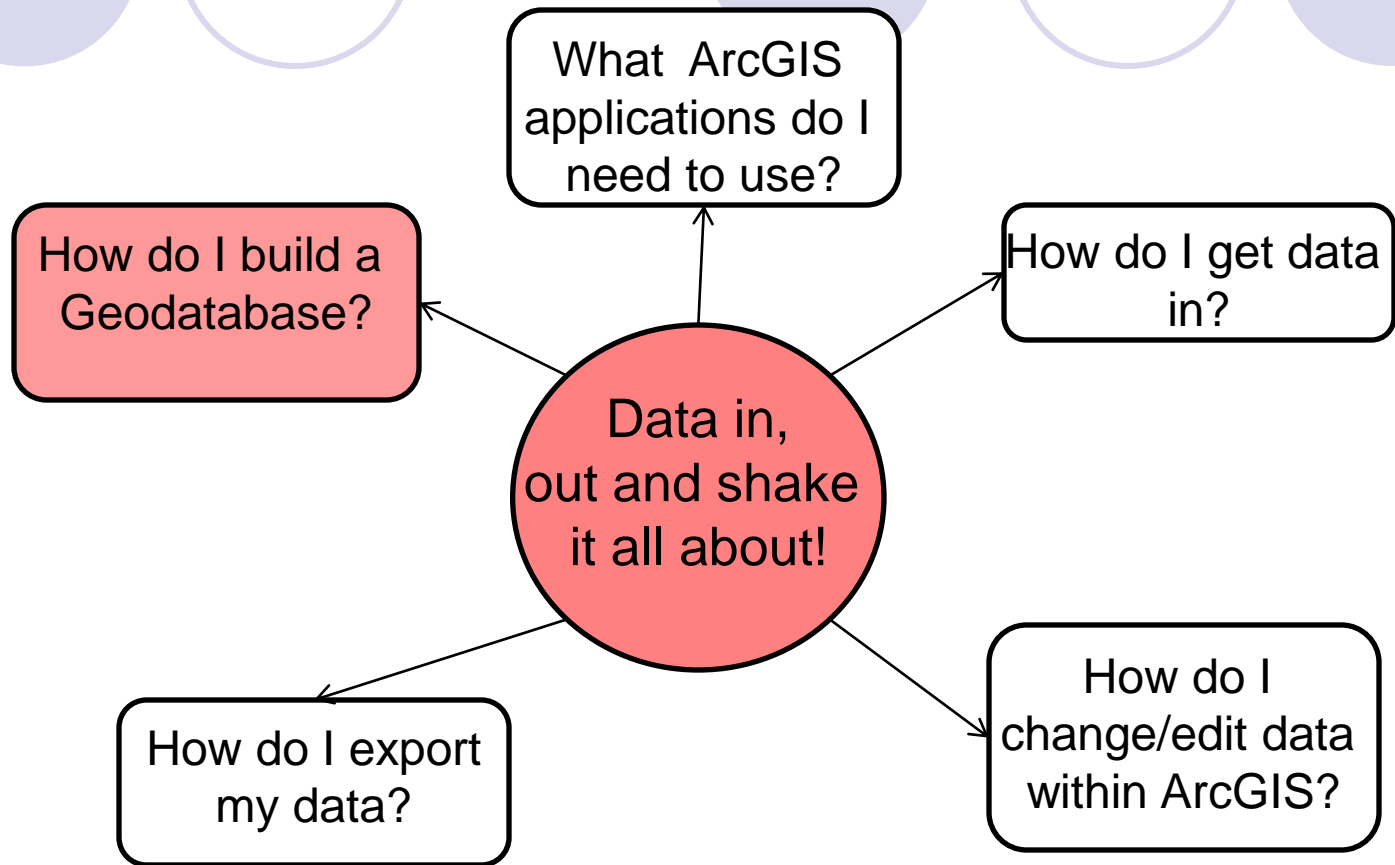
- Can use ArcCatalog to export to different formats by right-clicking on the data file....



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?



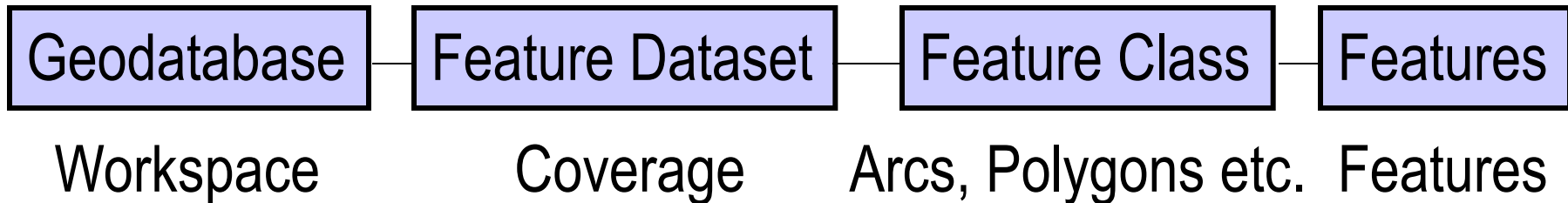
Geodatabases



- 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.

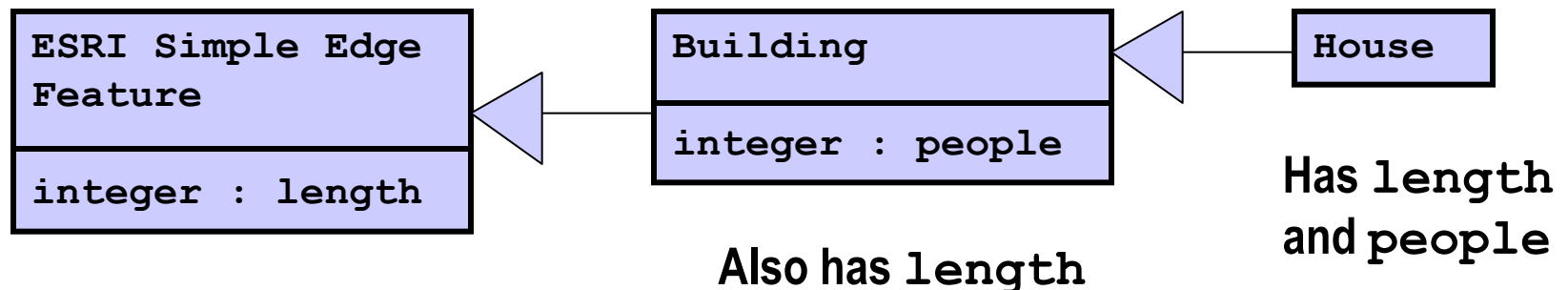
Geodatabases

- 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

The slide features decorative circles at the top. On the left, a solid light purple circle is partially behind the word 'Example', and an empty light purple circle is next to it. On the right, there are three circles: a solid light purple circle, an empty light purple circle, and another solid light purple circle.

- 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

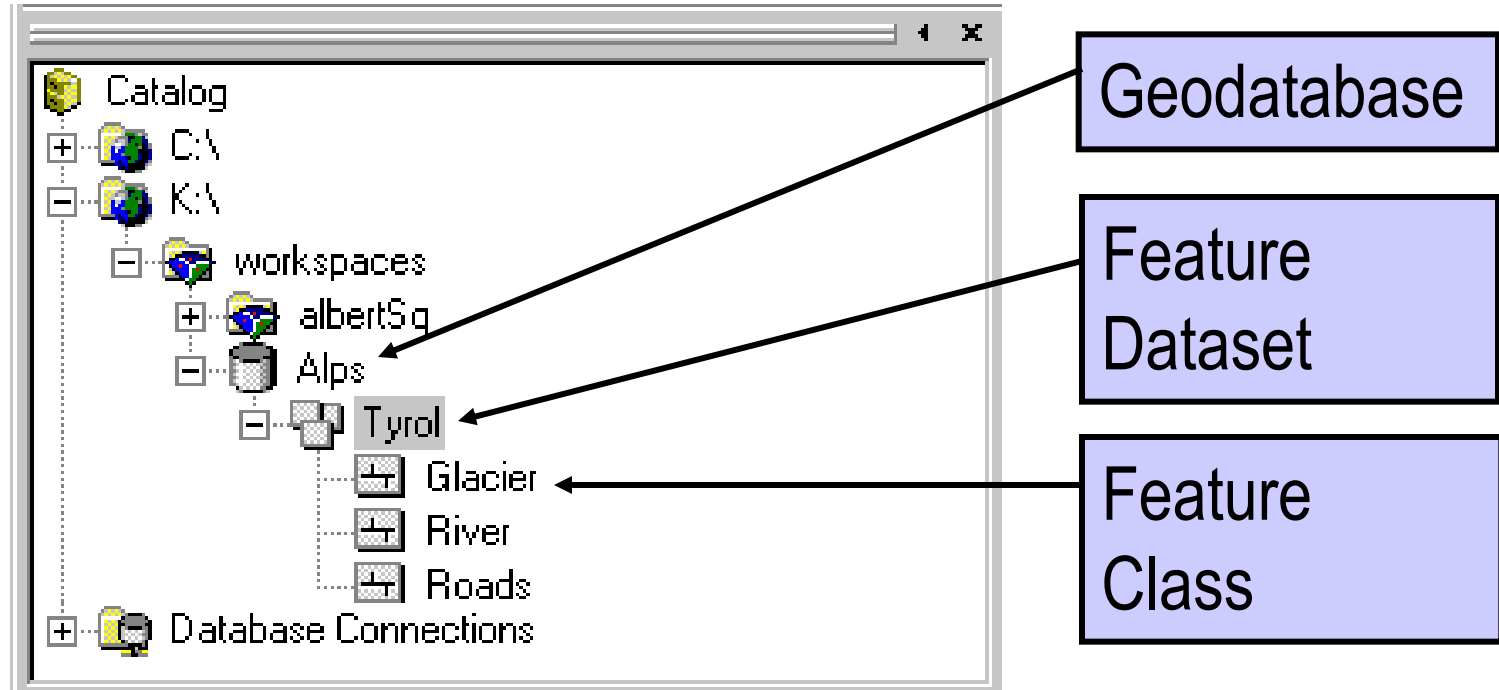
Building a Geodatabase from scratch



- 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.

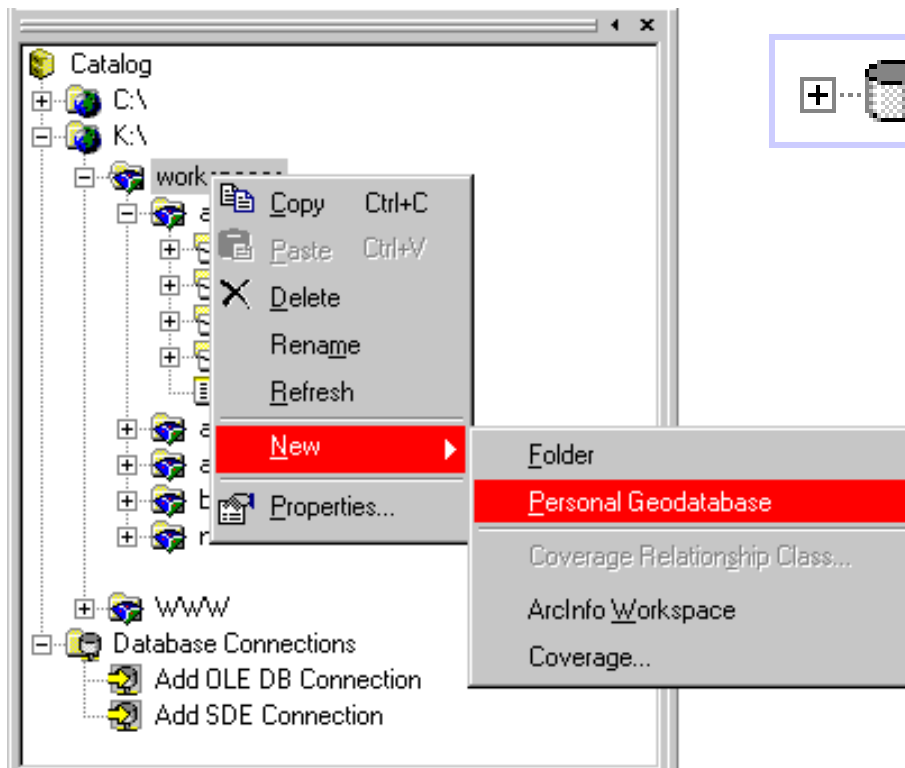


Benefits of Geodatabase data model

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- 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 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.

Database Properties

Domains

Domain Name	Description
Material	Materials for landscape and housing
Diameter	Diameter for pipes and streams

Domain Properties

Field Type	Long Integer
Domain Type	Range
Minimum value	0
Maximum value	100
Split policy	Duplicate
Merge policy	Weighted

Coded Values:

Code	Description

Database Properties

Domains

Domain Name	Description
Material	Materials for landscape and housing
Diameter	Diameter for pipes and streams

Domain Properties

Field Type	Long Integer
Domain Type	Coded Values
Split policy	Duplicate
Merge policy	Default Value

Coded Values:

Code	Description
0	Water
1	Ice
2	Natural stone
3	Natural Sediments

OK Cancel Apply

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.

Merge policy	
Split policy	<div>Weighted Average</div> <div>Default Value</div> <div>Sum Values</div> <div>Weighted Average</div>
	<div>Duplicate</div> <div>Duplicate</div> <div>Default Value</div> <div>Geometry Ratio</div>

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.

Spatial Reference Properties

Coordinate System | **X/Y Domain** | Z Domain | M Domain

The coordinate range, or domain extent of the feature class, is dependent upon the minimum X & Y, maximum X & Y, and Precision values. The Precision is the number of system units per unit of measure, and therefore specifies the degree of resolution.

Min X: Max X:

Min Y: Max Y:

Precision:

Spatial Reference Properties

Coordinate System | X/Y Domain | Z Domain | M Domain

Name:

Details:

Alias:
Abbreviation:
Remarks:
Projection: Transverse_Mercator
Parameters:
False_Easting: 400000.000000
False_Northing: -100000.000000
Central_Meridian: -2.000000
Scale_Factor: 0.999601
Latitude_Of_Origin: 49.000000
Linear Unit: Meter (1.000000)
Geographic Coordinate System:
Name: GCS_OSGB_1936

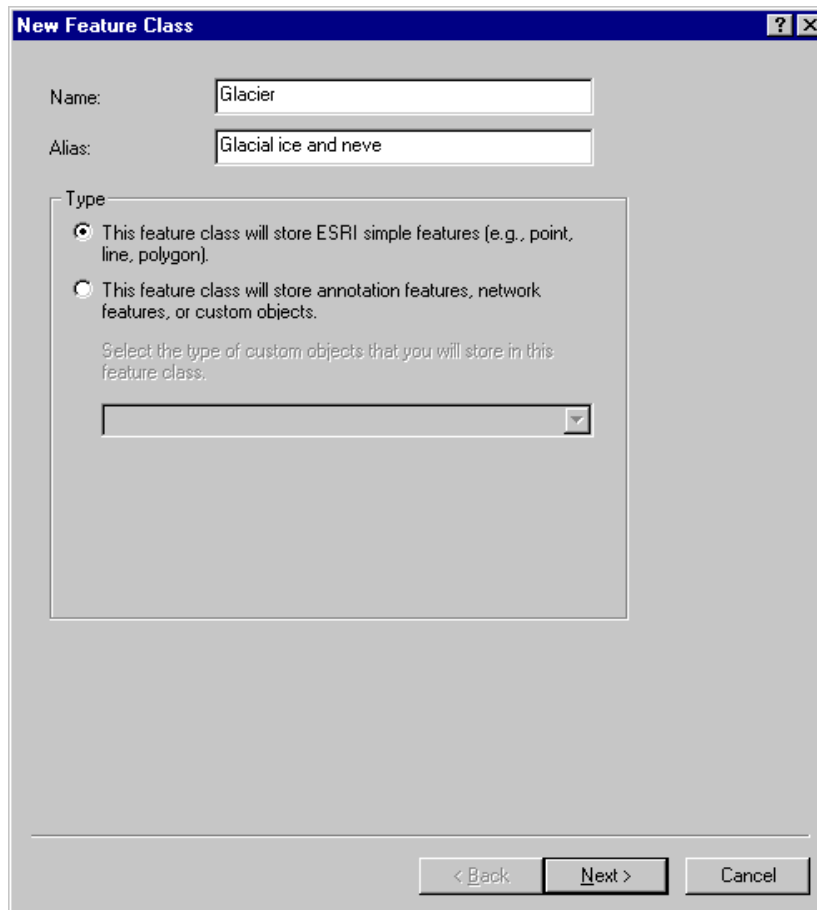
Select... Import... New... Modify... Clear... Save As...

Select a predefined coordinate system.
Import a coordinate system and X/Y, Z and M domains from an existing geodataset (e.g., feature dataset, feature class, raster).
Create a new coordinate system.
Edit the properties of the currently selected coordinate system.
Sets the coordinate system to Unknown.
Save the coordinate system to a file.

OK Cancel Apply

Feature Classes

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



New Feature Class

Name:

Alias:

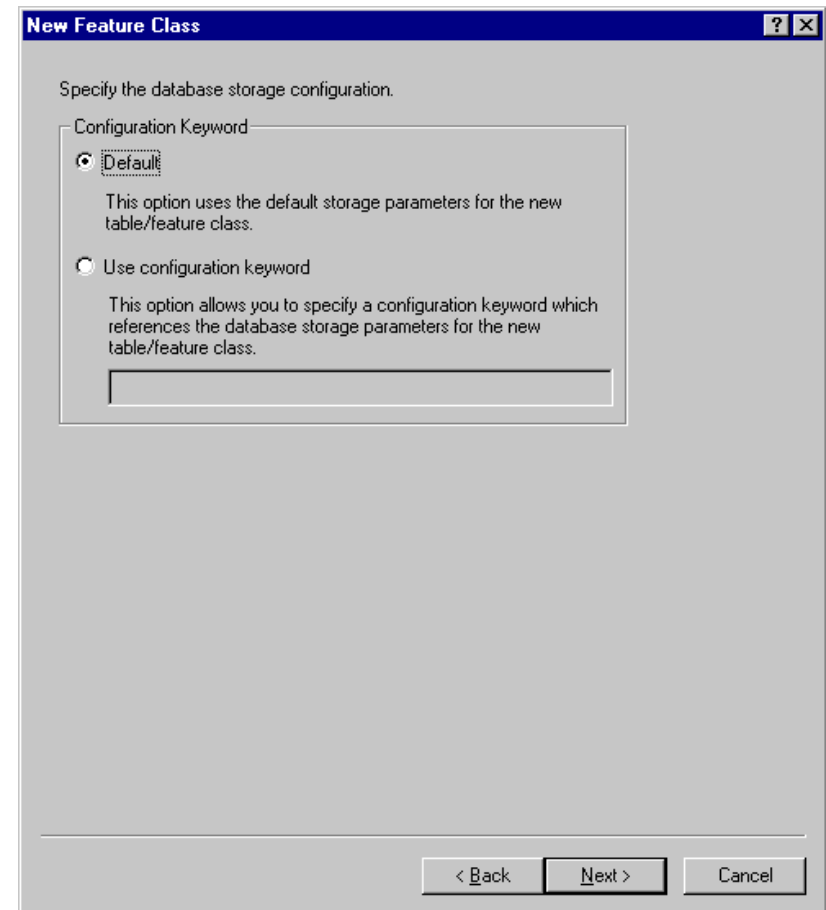
Type

☒ This feature class will store ESRI simple features (e.g., point, line, polygon).

☐ This feature class will store annotation features, network features, or custom objects.

Select the type of custom objects that you will store in this feature class.

< Back Next > Cancel



New Feature Class

Specify the database storage configuration.

Configuration Keyword

☒ Default

This option uses the default storage parameters for the new table/feature class.

☐ Use configuration keyword

This option allows you to specify a configuration keyword which references the database storage parameters for the new table/feature class.

< Back Next > Cancel

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.

New Feature Class

Field Name	Data Type
OBJECTID	Object ID
SHAPE	Geometry
TYPE	Text
MATERIAL	Short Integer
	Long Integer
	Float
	Double
	Text
	Date
	Blob
	Geometry

Click any field to see its properties.

Field Properties

Alias	Material
Editable	Yes
Allow NULL values	Yes
Default Value	
Domain	Material
Precision	

Domain

- Material
- Diameter

Import...

To add a new field, type the name into an empty row in the Field Name column, click in the Data Type column to choose the data type, then edit the Field Properties.

< Back Finish Cancel

Summary



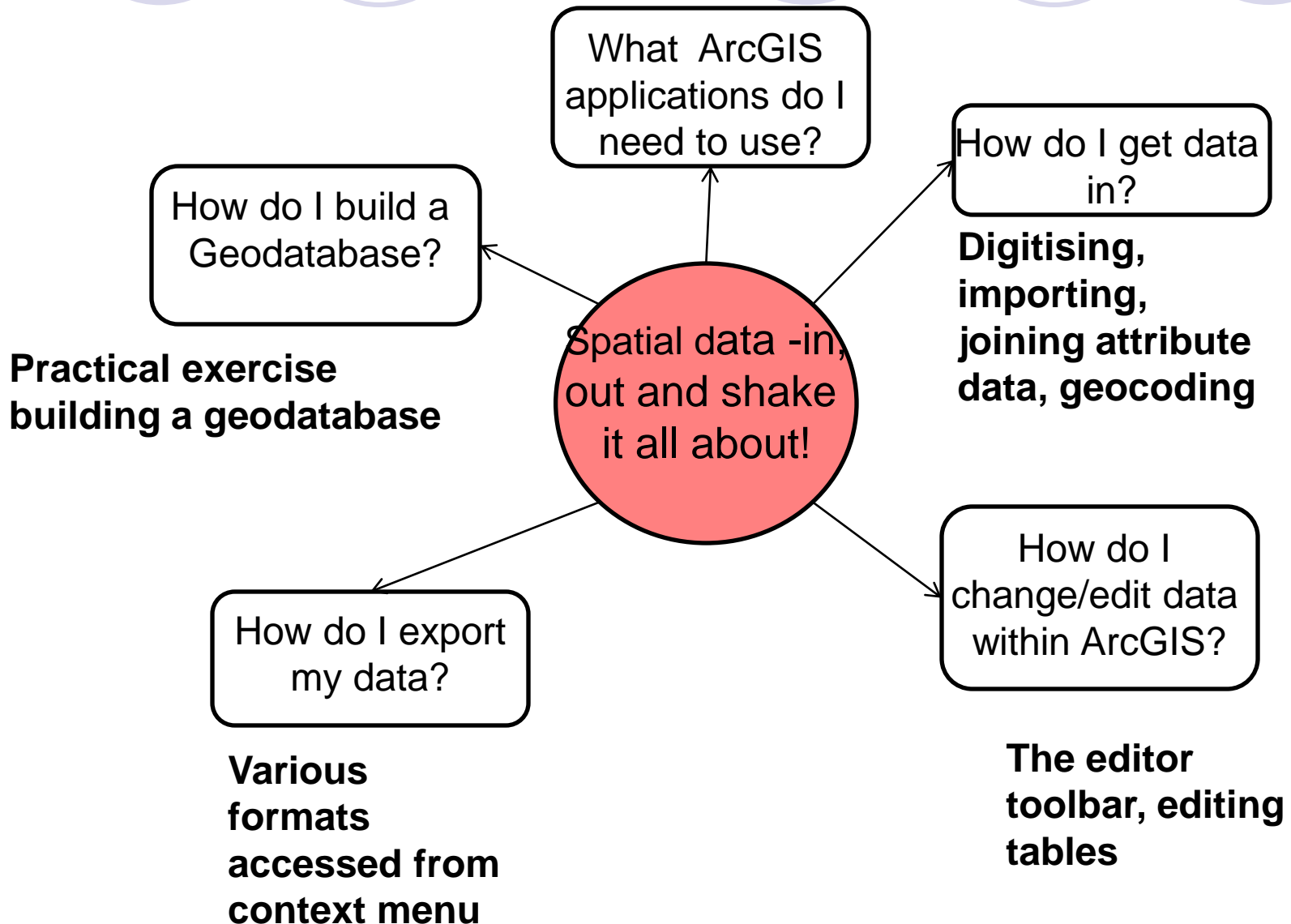
- Geodatabases are a new, highly controlled data storage technique.
- When you build one, you can set Attribute Domains which are constraints that can be applied to Features.
- You build a Feature Dataset for a particular area / spatial reference.
- You design Feature Classes e.g. “Roads” and set their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

