GEOG3140 GIS Database Design

ArcGIS Geodatabase

Three Methods to Create a Geodatabase



SchoolInCity Topology WaterSystem Admin Feature Dataset Feature Dataset City ۲ Flow ۲ Waterline ۲ Feature Class Range Domain School ۲ Feature Class Fields Feature Class 0 - 2000 Fields OBJECTID Fields OBJECTID SHAPE OBJECTID SHAPE SHAPE_Leng SHAPE Diameter SHAPE_Leng SHAPE_Area Name Coded Value Domain Linetype Name Type 1-inch (1) Diameter Indexes Indexes 3-inch (3) Capacity + FDO_OBJEC + FDO_OBJEC 6-inch (6) Indexes FD0_SHAPE + FDO_SHAPE 12-inch (12) + FDO_OBJEC + FDO_SHAPE SchoolInfo 🕱 Table Fields Water Main 🏠 Water Latera 🛠 Sewer Main 😭 OBJECTID Linetype Subtype Subtype 🔷 Туре Capacity Capacity Capacity Grade Diameter Diameter Diameter Indexes FD0_0BJEC SchoolInfoToSct

I. Create a geodatabase with ArcCatalog

- 1. Create an empty geodatabase in ArcCatalog
- \rightarrow Open ArcCatalog, find the folder you want to create the database.
- → Right click the folder to create a new empty geodatabase (use personal geodatabase. File geodatabase may cause issues with spatial indexing)

Relationship



- 2. Create feature dataset.
- → Right click the database and add a new dataset. You may want to select the right coordinate system.

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		Import		Feature Class	i
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→ Create two feature datasets: Admin and Water System

🔁 WaterSystem	Personal Geodatabase Feature Dat
🔁 Admin	Personal Geodatabase Feature Dat

Notes: datasets are similar to thematic layers which are used to group feature classes of the same theme together.

- 3. Create feature class.
- → Right click the dataset WaterSystem to create the feature class WaterLine

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→ Right click the Properties → Fields tab, add the following fields: Diameter (Long integer); Flow (Long integer), LineType (Short integer).

	Field Name	Data Type	-
	OBJECTID	Object ID	
	SHAPE	Geometry	
Ι	Linetype	Short Integer	
Ι	Diameter	Long Integer	
L	Capacity	Long Integer	
	SHAPE_Length	Double	
			-

→ Now add the following feature classes to Admin dataset: city and school

city (**polygon**): Name(string)

school (point): Name(string), Type(string)

→ Add a table to Admin dataset: schoolinfo

Field Name	Data Type	^
OBJECTID	Object ID	
Туре	Text	
Grade	Text	
		1
	Field Name OBJECTID Type Grade	Field Name Data Type OBJECTID Object ID Type Text Grade Text Image: Strategy of the strat

Note: You always need to check if you have include required attributes, set up fields correctly. You may revise the design of a feature class after you set up domains.

- 4. Configure a geodatabase in ArcCatalog
- → View database properties and select **Domains** Tab.
- → Type Diameter in the Domain Name, Pipe Diameters as Description. Select Coded Values as Domain Type. Short integer as the data type. You can use default merge policy and set up the split policy as Duplicate.
- → Add a code value and the corresponding description. Change its name to Diameter, Description to Pipe Diameters

atabase Properties		٢
General Domains		
Domain Namo	Description	
Diameter	Pipe Diameters	
-		
↓		
Domain Properties:		
Field Type	Short Integer	
Domain Type	Coded Values	
Split policy	Default Value	
Merge policy	Default Value	
Coded Velvery		
Code Values:		
Lode	Description	
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	*	
	OK Cancel Apply	
Code	Description	*
1	1-inch	
3	3-inch	
6	6-inch	
12	12-inch	
		Ŧ
•	4	

→ Add Flow as a range domain. Change the min value to 0 and the max value to 2000. Add description: Flow range in gpm.

	Description	
Diameter	Pipe Diameters	
Flow	Flow range in gpm	
omain Properties:		
Field Type	Long Integer	
Domain Type	Range	
Minimum value	0	
Maximum value	2000	
Split policy	Default Value	
Merge policy	Default Value	
Coded Values:	I	
Coded Values:	Description	
Coded Values:	Description	
Coded Values: Code	Description	
Coded Values:	Description	
Coded Values:	Description	

- → You can delete and add domains.
- → Open the properties of the feature class WaterLine. For each field, assign the correct domain to the field.

Alias	Diameter	
Allow NULL values	Yes	
Default Value		
Domain	Diameter	

Note: The field type of a domain should be the same as the field type of the attribute that the domain is applied to. Two types of domains are available: coded and range. After creating a domain, you should associate the domain with appropriate attribute.

- \rightarrow Create a domain for a field of your selection.
- → Create subtypes. Right click the waterline and click on Subtypes tab. Choose LineType as the subtype field. Define subtypes starting from Code =1
- → Set up the default values for the subtype to define that particular type. Do not forget to set up Domain.

Subtype Field:	- [Linetype		•
Default Subtype	:	Water Main		•
Subtypes:				
Code		Descript	ion	*
1	Water Ma	in		
2	Water Lat	teral		
3	Sewer Ma	ain		
-				
-				-
< □	1		4	
Default Values a	nd Domain:	s:		
Field Na	ime	Default Value	Domain	*
Diameter	ime (Default Value 6	Domain Diameter	•
Diameter Capacity	ime (Detault Value 6 700	Domain Diameter Flow	
Diameter Capacity SHAPE_Leng	ame (Default Value 6 700	Domain Diameter Flow	
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Diameter Capacity SHAPE_Leng	ame (Detault Value 6 700	Domain Diameter Flow	•
Field Na Diameter Capacity SHAPE_Leng	ime (Detault Value 6 700	Domain Diameter Flow •	•

The default subtype is Water Main. This makes Water Main as the only subtype for the waterline feature class. Only one default subtype is created.

Subtype	Diameter	Capacity	Code
Water Main	6	700	1
Water Lateral	3	125	2
Sewer Main	12	1500	3
Sewer Lateral	6	230	4

→ You can assign different domains to the fields of a subtype. Under Properties of the geodatabase, create a coded domain main diameter with 6-inch and 12-inch as codes.

	Code	Description	4
	6	6-inch	
	12	12-inch	1
-			

→ Under the properties of the feature class, click **Subtypes** field, assign the coded domain as the domain for **Diameter** for **Water Main**

Subtype Field:		Linetype		
Default Subty	pe:	Water Main		
Subtypes:				
Code		Descrip	otion	
0	Water	Main		
2	Water	Lateral		
3	Sewe	r Main		
Default Value	s and Dom	ains:		
Field	Name	Default Value	Domain	
Diameter		6	MainD	-
Capacity				
SHAPE_Le	ength	•		

5. Create relationship clas	s.
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•

Use Defaults

→ Create a one to many relationship class for School (point) and SchoolInfo(table). School includes the following attributes: school Name, Type; SchollInfo includes the following attributes: Type, Grade.

Domains...

→ Right click the **database** to create a new **relationship class**



→ Specify the relationship class name and choose the table and the feature class for the relationship class

New Relationship Class	
Name of the relationship class:	
SchoolInfo	
Select the table/feature classes that will be associat Origin table/feature class:	ted by this relationship class.
Admin WaterSystem SchoolInfo	A relationship class is a collection of relationships between objects in two tables/feature classes.
Destination table/feature class:	
WaterSystem SchoolInfo	Parcels are owned by owners. Owners own parcels.
	< Back Next > Cancel

- → Specify the relationship type as **composite**. Think about the benefit of using composite relationship.
- \rightarrow Specify the cardinality of the relationship class as 1 (schoolinfo)-M (school)



- → Specify keys for joining tables. The foreign key should be an attribute from the destination feature class/table (Type field in School) that corresponds to the primary key in the origin featureclass/table (Type field in SchoolInfo).
 - Origin Primary Key is the primary key (**Type**) of the **Origin Class** (SchoolInfo) and Origin Foreign Key is the name of the PK (**Type**) of Origin in the Destination Class (School).
 - If you are specifying a many-to-many relationship, you need to specify the Destination PK and Destination FK. But foreign keys are not physically present in the both sides. ArcCatalog will automatically create FKs.

New Relationship Class	x
Select the primary key in the origin table/feature class (generally, this will be the object identifier field). Select the foreign key in the destination table/feature class.	
Select the primary key field in the origin table/feature class:	
Select the foreign key field in the destination table/feature class that refers to the primary key field in the origin table/feature class: Type	
< Back Next > Cancel	

- 6. Create topological rules
- → Choose Admin Dataset. Topological rules should be created within a dataset.



→ Specify the name of the topological rule.

New Topology	x
Enter a name for your topology:	
SchoolInCity	
Enter a duster tolerance:	
0.000000089831528411952199 Decimal Degrees	
The cluster tolerance is a distance range in which all vertices and boundaries are considered identical, or coincident. Vertices and endpoints falling within the cluster tolerance are snapped together.	
The default value is based on the XY tolerance of the feature dataset. You cannot set the cluster tolerance smaller than the XY tolerance.	
< Back Next > Can	cel

→ Specify School and City as feature classes for participating the topological rule.

New Topology	×
Select the feature classes that will participate in the topology:	
✓ : School ✓ ⊠ City	
	Select All
<back next=""></back>	Cancel

→ You may want to change the rank too.

New Topology	X				
Each feature class in a topology must have a rank assigned to it to control how much the features will move when the topology is validated. The higher the rank, the less the features will move. The highest rank is 1.					
Enter the number of ranks (1-50): Specify the rank for a feature class by	Z Properties				
Feature Class ∵ School ⊠ City	Rank 1 1				
	< Back Next > Cancel				

 \rightarrow Specify the topological relationship that should be met.

Add Rule		X
Features of feature class: School Rule: Must Be Properly Inside Feature class: City V	Rule Description	Point features from one layer must be properly inside area features from another layer. Any point that is not inside an area feature is an error.
		OK Cancel

 \rightarrow Once you create a topological rule, you are asked to validate the data.



General Feature Classes Rules Errors		
Generate Summary	Expo	ort To File
Rule	Errors	Exceptions
Must Be Larger Than Cluster Tolerance Must Be Properly Inside	0	0
School, City	13	0
Total	13	0

→ Topology can be only added to a dataset which include feature classes participating in the topology. Multiple topological rules can be added to the same topology. However, you can not add another topology element to the dataset if all feature classes already participate in one topology.

N	ew Topology		-	×
	Specify the rules fo	r the topology:		
	Feature Class	Rule	Feature Class	Add Rule
	School	Must Be Covered	City	
				Remove
				Remove All
				Load Rules
				Save Rules
			< Back Next	:> Cancel

- → When only one feature class (e.g., waterline) participates in the topology, you can not set up rules such as "…with" because the *second* layer is not available.
- → Add a topology for the waterline feature class. You should add a rule for the subtypes (e.g., water main and sewer main can not intersect) and a rule for the waterline (e.g., not self-intersect)

II. Manipulate the geodatabase

 \rightarrow In geodatabase, verify alias has been correctly set up for each of the feature classes.



→ You can load data to every feature class by right click the layer and select Load.



 \rightarrow When you load the data, you can specify the attributes can be loaded.

Note: Fields in the source may not match the target fields. You should manually select the field that matches your target field.

Target Field	Matching Source Field	
Name [string]	NAME [string]	
Type [string]	<none></none>	
Target Field	Matching Source Field	
Target Field Name [string]	Matching Source Field	

→ Subtype. If you load data including subtype information, you may choose a) want to load one subtype → to show only subtype only or b) do not load all → all subtypes can show up.

- → After importing datasets to the geodatabase, open ArcMap and add all datasets from the geodatabase.
- → When you load data to schoolinfo, you will receive an error message below because "The Simple Data Loader can't be used with some types of nonsimple feature classes such as Origin feature classes in composite relationships." You should delete the relationship class first, load data into schoolinfo and add the relationship class.
- → Relationship class. Read the webpage to get the information of using relationship class in ArcGIS (http://desktop.arcgis.com/en/arcmap/10.3/manage-data/relationships/benefits-ofrelationship-classes.htm).
- → Verify relationship class with **Identify** tool to view the information linked through relationship class.

Identify		□ ×
Identify fro	m: <top-most layer=""></top-most>	•
⊡ · School ⊡ · Cor ⊡ · Sou ⊡ · Sou	ral Drive SchoolInfo elem thwest Middle SchoolInfo	
Location:	-103.278506 44.039014 Decimal Degrees	3
Field	Value	
OBJECTID	36	
SHAPE	Point	
Name	Corral Drive	
i jpe		
dentified 2	features	

- → Start Editor. Open the table of SchoolInfo, delete one record. Check the attribute table of School to see if the related records are deleted.
- → Stop editing. Do not save edits.
- → Verify domain constraints. View the attribute table of WaterLine. Check the properties of the Diameter field. While the data type shows Short, the content shows the

description of the code. When you perform queries on LineType (Select by Attributes), you should use short integer values (e.g., 6 not 6-inch).

Table								
🗄 • 🖶 • 🖳	🗄 + 🖶 + 🖳 🎇 🖄 🖄							
WaterLine								
OBJECTID *	SHAPE *	LineType	Diameter					
1	Polyline	WaterMain	12-inch					
2	Polyline	WaterLateral	6-inch					
3	Polyline	WaterLateral	6-inch					
4	Polyline	WaterLateral	6-inch					
5	Polyline	WaterLateral	6-inch					
6	Polyline	WaterLateral	6-inch					
7	Polyline	WaterLateral	6-inch					

→ Add a new feature to the WaterLine or select an existing feature through Editor. Modify the Diameter attribute. Note: ArcGIS may not be able to recognize the domains created through ArcGIS Diagrammer. Then you should recreate the domains within ArcCatalog.

Attributes	4 X				
🔶 🤹 🔤 🕇					
🛛 🗢 WaterMain	*				
	~				
	× I				
OBJECTID	1				
LineType	WaterMain				
Diameter	12-inch 💌				
Capacity	<null></null>				
SHAPE_Length	1-inch				
	3-inch				
	=6-inch				
Diameter	12-inch				
Short Integer					
Coded value domain: Diameter					

 \rightarrow Change the Capacity to 20000 which is beyond the range of Flow.

Attributes	Ψ×						
🔲 🔍 WaterMain	*						
	*						
	<u> </u>						
OBJECTID	1						
LineType	WaterMain						
Diameter	12-inch						
Capacity	20000						
SHAPE_Length	2490.19101						
OBJECTID							
Object ID							
Null values not allowed							
Create Fea	tributes 🔼 Edit Sketc						

→ Validate features. Select the feature. Editor-->Validate Features. Then you should receive a message saying the *field value* is not valid. This tool validates *attribute values*.



→ Create a new feature of water line with a subtype. When you specify the line type, the values of the other two fields are updated at the same time.

Create Features	ųΧ	Attributes	ų ×
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Waterline		🖃 🛷 Waterline	
		💷 🙂 Water Latera	I
		OBJECTID	542
		Linetype	Water Lateral
		Diameter	3
		Capacity	125
		SHAPE_Length	0.014590
	¥1		
Construction Tools			
Rectangle			
O Circle			
Ellipse			
2 Freehand			
0		Linetype	
		Short Integer	*
		Subtype	*
Attributes 📝 Create Fea 🔥 Ec	dit Sketc	Attributes 📝 Crea	te Fea 🔼 Edit Sketc

→ Split features. Choose a water line and select Split from the Editor toolbar.

11	Start Ed	liting							
1	Stop Editing								
1	Save Edits								
	Move								
	Split								
	Constr Split			plit		— ×			
4	Copy P	• Split a selected I	Line Length: 0.006						
	Merge.	specified distant percentage of to measure value f start or end poir		Split Options					
I	Buffer.			Distance					
	Union			🔘 Into Equa	l Parts				
	Clip		L	Percentag	je	40			
₽,	Validate	e Features		🔘 By Measu	re	0			
	Snapping 🕨		Orientation						
	More Editing Tools 🔹 🕨		From End Point of Line						
	Editing Windows								
	Option	s	L			OK Cancel			

→ Check the attributes of the split features. Depending on the policies you set up earlier, the attributes of the split features may vary.

Before:

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]	OBJECTID *	SHAPE *	Linetype	Diameter	Capacity	SHAPE_Length
	511	Polyline	Water Main	12-inch	200	0.005671

After:

OBJECTID *	SHAPE *	Linetype	Diameter	Capacity	SHAPE_Length
545	Polyline	Water Main	12-inch	80	0.002269
511	Polyline	Water Main	12-inch	120	0.003403

- \rightarrow Open a new empty map. Add the topology rule from the database.
- → Enable Editor. Move or delete points of schools with Editor tool and validate topology again. You need to turn on the **Topology** toolbar.





- \rightarrow The error tolerance may change the results of validation.
- → You can validate topology in ArcCatalogy by right clicking the topology → Validate. Check the properties → Errors to get a report of the validation.

➔ If the topology does not work properly, you may want to rebuild the spatial index (if available) for feature classes or reload data records. When you create an empty feature class with the New Feature Class wizard, a spatial index is created for file, workgroup, desktop, and all enterprise geodatabases except those in DB2 databases.

General	Editor Tracking	XY Coordinate System	Domain, Resolu	tion and Tolerance
Fields	Indexes Subty	ypes Feature Extent	Relationships	Representations
Attribut FDO_C Unique: Ascendi Fields: OBJEC	e Indexes IBJECTID Yes ng: Yes TID		Add Delete	
Spatial I This Fea FDO_SH	index ature Class has a spa IAPE.	atial index named	Create	

III. Using existing ArcGIS data model designs

 Download the appropriate data model from the ESRI Support Center at <u>http://support.esri.com/datamodels</u> (suggested workable models: Census, Forestry, Biodiversity, Geology, Water Utilities)

- a. Select one application. You may want to choose the one with a sample geodatabase provided.
- b. Download the database model and the sample database (.gdb or .mdb). Some models are provided as UML diagrams and others are provided as ArcGIS UML diagrams. If you are not able to open the UML diagrams in .vsd format, try to view the images of the model.
- 2. View the data model, answer the following questions. If the UML diagram includes multiple data models (organized into several packages), view the simplest one.
 - a. What is the model about?
 - b. What are the feature types? Are there any raster datasets? For each of the feature class, view the attributes and subtypes or domains if available.
 - c. Does the model provide descriptions for non-spatial relationships? How? Does the model describe topological relationships? How?

Now, you can create a geodatabase with the models. But most models may not work without any modifications due to comparability issues.

- 3. Create an empty test geodatabase as a personal geodatabase.
 - a. Open ArcCatalog.
 - b. Right click the blank space to create a new geodatabase.



c. Right click the geodatabase and import the schema (the XML file). Import schema only.



d. If the XML does not work properly, you may want to export the sample geodatabase to create a schema first.

🗊 Transportati	on ac	lh	File Geodata	hase	2		
Readme.txt	Ē1	Сору	Ctrl+C	2			
🗴 Transportati	Ē	Paste	Ctrl+\	/			Ŀ.
x TRANSPOR	×	Delete					
		Rename	F2	2			
	З	Refresh	F5	5			E.
		Administration		•			
		Distributed Geo	database	•			
		New		•			alue
		Import		•			
		Export		►		To CAD	
	Q	Share as Geodat	a Service			To Coverage	
	P	Properties				To Geodatabase (multiple)	
l	_					To Shapefile (multiple)	
						To dBASE (multiple)	
					ų,	XML Workspace Document	

- 4. View the schema in the test database and compare the schema to the data model (the UML diagram)
- 5. Submit the XML schema