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2019

Unit 5

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Recommended Citation

Bowlick, Forrest J., "Unit 5" (2019). *Introduction to Geographic Information Science (GIS) course materials*. 5. https://scholarworks.umass.edu/intro_GIS/5

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GPS and Friends



Forrest J. Bowlick, Intro GIS UMASS – Amherst, Fall 2018

Overview

- Reviewing Projections and Datums
 - Frustrations within the ArcMap Universe
 - How to overcome
 - Some surveys
- Global Positioning Function and Theory
- GIS Potpourri

POTPOURRI

Projecting

- Tx.ag/GIS5
- Anonymous
- 5 questions concerning the lab activity and this week's content

Talking 'bout the Practical

• Practical is next week!

• Held during lab time.

 You will have three hours to complete the practical, which is mostly GIS problem solving.

Review



Breaking News: Kyrie Apologizes

Kyrie Irving Is Sorry For Ironically(?) Perpetuating The Flat Earth Theory



Samer Kalaf Monday 6:31pm + Filed to: HATE WHEN THAT HAPPENS ~



SBNATION

BLOGS VIDEO NFL - NBA - WNBA MLB - CFB - SOCCER - UFC - GOLF NHL - CBB - STORE STUBHUB MORE 💳

TODAY'S NBA NEWS NBA

Kyrie Irving apologizes to science teachers for spreading flat earth theories

Irving says he was in a conspiracy theory mindset and went down a rabbit hole. It happens.

By Kristian Winfield | @Krisplashed | Oct 1, 2018, 5:56pm EDT



Geoid



• Shape is called an oblate spheroid

• True shape of the Earth

http://en.esstatic.us/upl/2011/04/geoid_bumpy.jpg

The Ellipsoid



a - semi major axis (equatorial radius) b - semi minor axis (parallel to the rotation axis) f = (a-b)/a or flattening

Does it Make a Difference?



C:\aklein\Education\Cartography\Lectures\Lecture07\shif

The Map Projection Process



Properties of a Globe

The Globe Preserves:

Maps Can Be:

Area Shape Distance Direction Equal Area Conformal Equidistant Azimuthal https://play.kahoot.it/#/k/1f48b7e2-c152-4548-aeb4-76e1131700b8

Why are Projections so _ in ArcMap?

- There are over 6,000 projections loaded into ArcMap
 - Plus you can define your own!
- Each of them has their own uses.
- Navigate smart!

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What is Happening







Questions?

Location

- We can describe location in two ways: Relative and Absolute.
- Relative location requires some understanding of distance or relation.
- Absolute location requires precise understanding of some measurement technique.

Relative Location

- Relative location positions you in relation to another object.
- In this example, we can say that Hawaii is south of Alaska.



Absolute Location

Absolute locations references some standardized grid or location system, like latitude and longitude along with a datum, like the World Geodetic System.



GPS

The global positioning system allows us to know our absolute location, with reasonable accuracy, anywhere on the planet.





GPS II

- Consider imaginary spheres centered on each GPS satellite.
- GPS receiver uses time and speed (of light) to calculate distance to satellite.



GPS III



http://en.wikipedia.org/wiki/File:GPS_Satellite_NASA_art-iif.jpg

• All electromagnetic radiation (radio waves to xrays) travel at speed of light (300,000,000 meters/second).

• GPS systems use radio waves to transmit information.



NAVSTAR Satellite Transmitter







https://www.e-education.psu.edu/natureofgeoinfo/book/export/html/1796, gps_time_difference.gif

GPS radio signal can be affected by many factors, including:

- Clouds or other atmospheric conditions.
- Proximity to buildings and other structures, and even water.
- Terrain features like mountains.
- Earth's rotation.
- Current satellite configuration.



Multipath error

GPS Satellites

Mobile phone with GPS

AGPS information

Cell tower

GPS V

GPS Issues

Despite the general reliability of GPS, it is not a perfect system. Atmospheric and physical features distort and confuse the GPS signal, while the shape of the planet is also a difficulty.



From: <u>University of</u>

- On September 1, 1983, navigational errors cause KAL 007 to stray into prohibited Soviet airspace.
- Soviet MiG-23 interceptors shoot down KAL 007, killing all 269 people aboard.
- President Ronald Reagan orders U.S. military to make GPS system available for civilian use.





 May 2, 2000: President Clinton orders U.S. military to cease intentional scrambling of GPS satellite signals used by civilians.

• Effectively improved GPS receiver accuracy by 10x.

Questions?

POTPOURRI

Dissolve



Dissolve II

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Dissolve III

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The show. All selected Records (0 out of 10075 Selected)		Rec		1	M Ch		alacted	Records (C	out of 16	075 Selecto	d)	Ontic	
		Rec			>II	. All 3	electeu	Records (C	out of 10	ord belette	u) _	optic	



Dissolve IV

			Mar War
Attributes of faults_buffer_dissolve	10 15		
FID Shape * Id			
		2-	
			$\left(\alpha \right) \left(1 - \frac{1}{2} \right) \left(\frac{1}{2} - \frac{1}{2} \right) \left(\frac{1}{2} \right)$
		NT	
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			110 112
		N	UNU IN
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			$ \rangle = 0\rangle - 2$
			\bigcirc
Record: II I I I Show	All Selected Records (0 out of 1 Selected) Options -	

Reminder – Clip & Erase

Clip keeps the info inside the shape

Erase keeps the info outside the shape



http://us.cdn4.123rf.com/168nwm/stylephotographs/stylephotographs1105/stylephotographs110500087/9622106-star-shaped-red-cookie-cutter-on-a-cookie-cookie-cutter-on-a-cookie-cutter-on-

Intersect

Intersect is like a clip (you end up with the inside), --except you retain the attributes from <u>BOTH</u> shapefiles



Intersect II

What is the total length of major roads in Amherst?



Intersect III

What is the total length of major roads in all MA towns?



Intersect IV

What is the total length of major roads in all MA towns?

Tal	Table											
0												
EC	EOTMAJROADS_ARC											
	CLASS	ADMIN_TYPE	STREET_NAME	RT_NUMBER	ALTRTNUM1	ALTRTNUM2	ALTRTNUM3	ALTRTNUM4				
	3	2	COLLEGE HIGHWAY	202	10	57	<null></null>	<null></null>				
	2	2	MEMORIAL DRIVE	3	2	3A	<null></null>	<null></null>				
	2	2	MYSTIC STREET	3	2A	3A	<null></null>	<null></null>				
	2	2	MYSTIC STREET	3	2A	3A	60	<null></null>				
	2	2	ALEWIFE BROOK PARKWAY	3	2	3A	16	<null></null>				
	2	2	ALEWIFE BROOK PARKWAY	3	2	3A	16	<null></null>				
	2	2	CONCORD AVENUE	3	2	3A	16	<null></null>				
	2	2	CONCORD AVENUE	3	2	3A	16	<null></null>				
	2	2	FRESH POND PARKWAY	3	2	3A	<null></null>	<null></null>				
	2	2	FRESH POND PARKWAY	3	2	3A	16	<null></null>				
	3	2	ALEWIFE BROOK- CONCORD AVE ROTARY	3	2	3A	16	<null></null>				
	3	2	ALEWIFE BROOK PARKWAY	3	2	3A	16	<null></null>				
	3	2	FRESH POND PARKWAY	3	2	3A	<null></null>	<null></null>				
	3	2	FRESH POND PARKWAY	3	2	3A	16	<null></null>				
	3	2	SOZIO ROTARY	3	2	3A	16	<null></null>				
	3	2	SOZIO ROTARY	3	2	3A	16	<null></null>				
E		î			~ ·							
1	• •	0 + +1	(0 out of 15819 Selected)									
E	OTMAJRO	ADS_ARC										

Roads attribute table **BEFORE**

Intersect V

What is the total length of major roads in all MA towns?

Т	able												
٦	TOWNS_POLY												
Г	Т	FID	Shape *	OBJECTID	TOWNS_ID	TOWN_ID	TOWN	FIPS_STCO	CCD_MCD	FIPS_PLACE	POP1980	POP1990	POP2000
	•	0	Polygon	1	1	259	SALISBURY	25009	145	59245	6745	6882	7827
		1	Polygon	2	2	7	AMESBURY	25009	005	01185	14563	14997	16450
IE		2	Polygon	3	3	180	MERRIMAC	25009	090	40430	4733	5166	6138
IE		3	Polygon	4	4	206	NEWBURYPORT	25009	790	45245	16545	16317	17189
IE		4	Polygon	5	5	128	HAVERHILL	25009	710	29405	47715	51418	58969
II.		5	Polygon	6	6	324	WEST NEWBURY	25009	170	77150	3084	3421	4149
II.		6	Polygon	7	7	206	NEWBURYPORT	25009	790	45245	16545	16317	17189
II.		7	Polygon	8	8	206	NEWBURYPORT	25009	790	45245	16545	16317	17189
II.		8	Polygon	9	9	205	NEWBURY	25009	110	45175	5150	5623	6717
II.		9	Polygon	10	10	206	NEWBURYPORT	25009	790	45245	16545	16317	17189
II.		10	Polygon	11	11	206	NEWBURYPORT	25009	790	45245	16545	16317	17189
II.		11	Polygon	12	12	205	NEWBURY	25009	110	45175	5150	5623	6717
II.		12	Polygon	13	13	205	NEWBURY	25009	110	45175	5150	5623	6717
		13	Polygon	14	14	181	METHUEN	25009	095	40675	38447	39990	43789
		14	Polygon	15	15	116	GROVELAND	25009	045	27620	5031	5214	6038
		15	Polygon	16	16	205	NEWBURY	25009	110	45175	5150	5623	6717
	1	10					NEW DOUBLE	05000		10.30		5000	
ľ	. (2												
	H	•	1		(0 out of	631 Selecte	ed)						
ĺ	TO	WNS_	POLY										

Towns attribute table **BEFORE**

Intersect VI

What is the total length of major roads in all MA towns?

Table											
roads_in_MA_towns											
STREET_NAM	RT_NUMBER	TOWNS_ID	TOWN_ID	TOWN	FIPS_STCO	CCD_MCD	FIPS_PLACE	POP1980			
RAMP-RT 140 NB TO RT 195 EB		566	201	NEW BEDFORD	25005	770	45000	97738			
RAMP-RT 140 NB TO RT 195 WB		566	201	NEW BEDFORD	25005	770	45000	97738			
RAMP-RT 140 NB TO RT 95 NB		388	99	FOXBOROUGH	25021	045	24820	14388			
RAMP-RT 140 SB TO RT 195 EB		566	201	NEW BEDFORD	25005	770	45000	97738			
RAMP-RT 140 SB TO RT 195 EB		566	201	NEW BEDFORD	25005	770	45000	97738			
RAMP-RT 140 SB TO RT 195 EB		566	201	NEW BEDFORD	25005	770	45000	97738			
RAMP-RT 140 SB TO RT 195 WB		566	201	NEW BEDFORD	25005	770	45000	97738			
RAMP-RT 140 SB TO RT 495 NB		413	167	MANSFIELD	25005	050	38225	14089			
RAMP-RT 140 SB TO RT 95 NB		388	99	FOXBOROUGH	25021	045	24820	14388			
RAMP-RT 140 TO RT 2 WB		111	332	WESTMINSTER	25027	290	77010	5353			
RAMP-RT 140 TO RT 2 WB		111	332	WESTMINSTER	25027	290	77010	5353			
RAMP-RT 140 TO RT 2 WB		111	332	WESTMINSTER	25027	290	77010	5353			
RAMP-RT 140 TO RT 24 NB		428	293	TAUNTON	25005	220	69170	45411			
RAMP-RT 140 TO RT 24 NB		428	293	TAUNTON	25005	220	69170	45411			
RAMP-RT 140 TO RT 24 NB		428	293	TAUNTON	25005	220	69170	45411			
RAMP-RT 16 EB TO RT 1 NB		200	248	REVERE	25025	510	56585	43141			
				00000000	05005	700	10005	00050			
$I = \{ 0, b, b\}$ $[I = [0] out of 18081 Selected)$											
roads_in_MA_towns											

Intersected attribute table AFTER

Intersect VII

What is the total length of major roads in all MA towns?



Intersect VIII

What is the total length of major roads in all MA towns?

Ta	Table											
ro	roads_in_MA_towns											
	STREET_NAM	RT_NUMBER	TOWNS_ID	TOWN_ID	TOWN	FIPS_STCO	CCD_MCD	FIPS_PLACE	POP1980			
	MASSACHUSETTS TURNPIKE	90	284	328	WESTBOROUGH	25027	275	75400	13261			
	MASSACHUSETTS TURNPIKE	90	342	329	WESTFIELD	25013	690	77850	36924			
	MASSACHUSETTS TURNPIKE	90	342	329	WESTFIELD	25013	690	77850	36924			
	MASSACHUSETTS TURNPIKE	90	266	198	NATICK	25017	160	43895	30198			
	MASSACHUSETTS TURNPIKE	90	229	333	WESTON	25017	255	77255	10908			
	MASSACHUSETTS TURNPIKE	90	266	198	NATICK	25017	160	43895	30198			
	MASSACHUSETTS TURNPIKE	90	229	333	WESTON	25017	255	77255	10908			
	MASSACHUSETTS TURNPIKE	90	325	227	PALMER	25013	075	52105	11756			
	MASSACHUSETTS TURNPIKE	90	352	339	WILBRAHAM	25013	115	79740	12166			
	MASSACHUSETTS TURNPIKE	90	325	227	PALMER	25013	075	52105	11756			
	MASSACHUSETTS TURNPIKE	90	333	161	LUDLOW	25013	060	37175	18348			
	MASSACHUSETTS TURNPIKE	90	352	339	WILBRAHAM	25013	115	79740	12166			
	MASSACHUSETTS TURNPIKE	90	234	35	BOSTON	25025	440	07000	570719			
	MASSACHUSETTS TURNPIKE	90	234	35	BOSTON	25025	440	07000	570719			
	MASSACHUSETTS TURNPIKE	90	234	35	BOSTON	25025	440	07000	570719			
	MASSACHUSETTS TURNPIKE	90	231	35	BOSTON	25025	440	07000	570719			
				05	POOTON	05005		07000	C70740			
	$ \langle \rangle = $											
l î,	oads in MA towns	1										

You will end up with more features than you started with

Final Projects

 The list for signing up for projects is almost* live.

 Some are 'ideas' and 'explorations', while others have more concrete production goals and expectations.