Intermediate Geocoding Part 2

By Kate Norris & Erik Finlay

URP6275

Module 5 – Part 2-2

UF | GEOPLAN CENTER

Intermediate Geocoding Part 2

* Geocoding - What's the Point?
* What is Geocoding?
* Common U.S. Address Elements
* How Address Matching Works
* Geocoding Accuracy
* Common Address Locator Styles
* Geocoding Steps
* Basic ArcMap Geocoding Example
* Available Street Datasets or Geocoding Services
* Geocoding Toolbox
* Automation Using Python Scripting
* Geocoding Best Practices
* Geocoding Tips, Tricks & Pitfalls
* Business Analyst Geocoding Example
* Summary, Resources, & Questions

Available Street Datasets or Geocoding Services

Dataset/Service	Dataset	Service	Accuracy	Cost	Data Prep
ESRI StreetMap Premium	HERE©	No	Highest	Expensive	None
ESRI Business Analyst	HERE© (1-2 yr old data)	No	High	Free for UF	None
US CENSUS TIGER	TIGER	Yes	Med	Free	High
Local Agencies	Local/Varies	No	Varies	Varies	High
OpenStreetMap	OSM	Yes	Varies	Free	None
Google Maps	No	Yes	Highest	0-100k: $5 per 1000 100k-500k: $4 per 1000 >500k: Contact Sales	None
ArcGIS Online	No	ESRI only	Highest	Expensive	None

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0-100k: $5 per 1000
100k-500k: $4 per 1000
>500k: Contact Sales

What is Streetmap Premium (SMP)

* High-Quality Street Data for:
  * Display (ArcGIS Online "Like" Fancy Basemap)
  * Geocoding
  * Routing/Navigation (For Example, UPS trucks and deliveries)
* Available for different areas around the world.
* Data stored on-premise, behind your firewall.
  * Important when dealing with confidential information tied to address data
* For use in ArcGIS Desktop or ArcGIS Pro
  * Viewable only data (non-exportable)
* Statewide and Nationwide Street Data packages are available for purchase at different use and user levels.

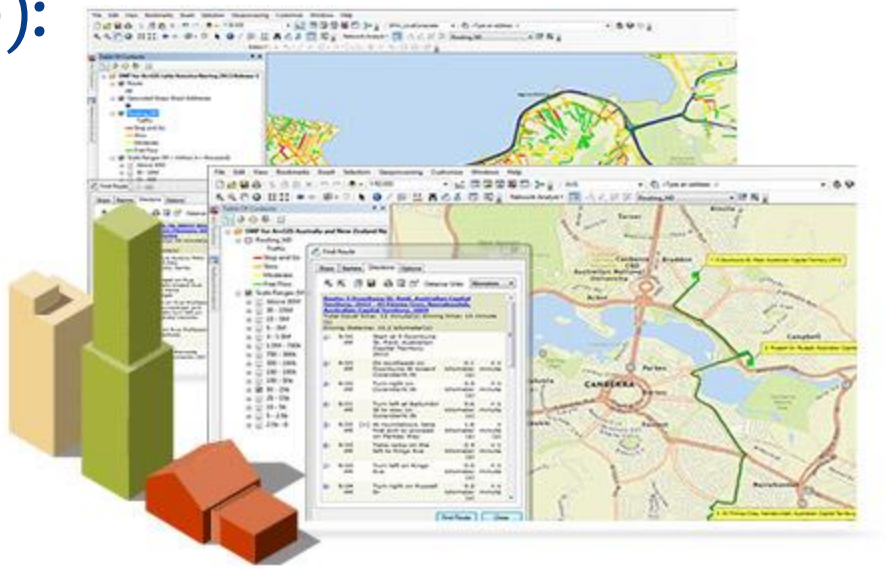
HERE: Image via HERE [https://commons.wikimedia.org/wiki/File:HERE_logo.svg] (Public Domain)
TomTom: http://searchengineland.com/figz/wp-content/seloads/2015/05/logo-1.png

Streetmap Premium Costs: Statewide

* Single Use (Single Person: John Doe):
  * $1000 per year display/geocode
  * $2000 per year display/geocode/route
* Concurrent Use (Any Person: # User at a time):
  * $2500 per year per seat display/geocode (# x)
  * $5000 per year per seat display/geocode/route
* Server (4 cores):
  * $12,500 per year display/geocode
  * $25,000 per year display/geocode/route

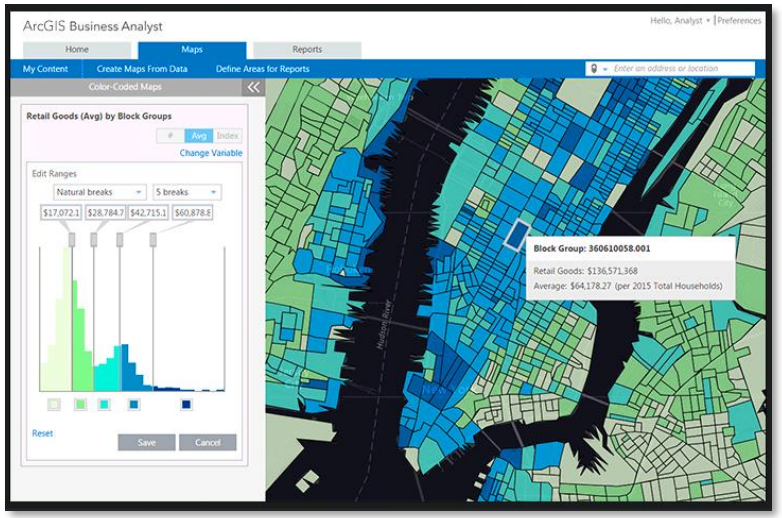
Streetmap Premium Costs: Nationwide

* Single Use (Single Person: John Doe):
  * $3000 per year display/geocode
  * $6000 per year display/geocode/route
* Concurrent Use (Any Person: # User at a time):
  * $7500 per year per seat display/geocode (# x)
  * $15000 per year per seat display/geocode/route
* Server (4 cores):
  * $37,500 per year display/geocode
  * $75,000 per year display/geocode/route



Esri Business Analyst for Desktop

* High-Quality Street Data for Display, Geocoding, and Routing.
* Uses HERE© Street Network (1.5-2yrs older than SMP)
* Free for Campus
  * Teaching
  * Research
* Data stored on-premise
* Viewable only data (non-exportable)
* Extensive download and complicated licensing, only available as entire Business Analysis package (~50GB)
* However, Business Analysis offers much more than just geocoding.



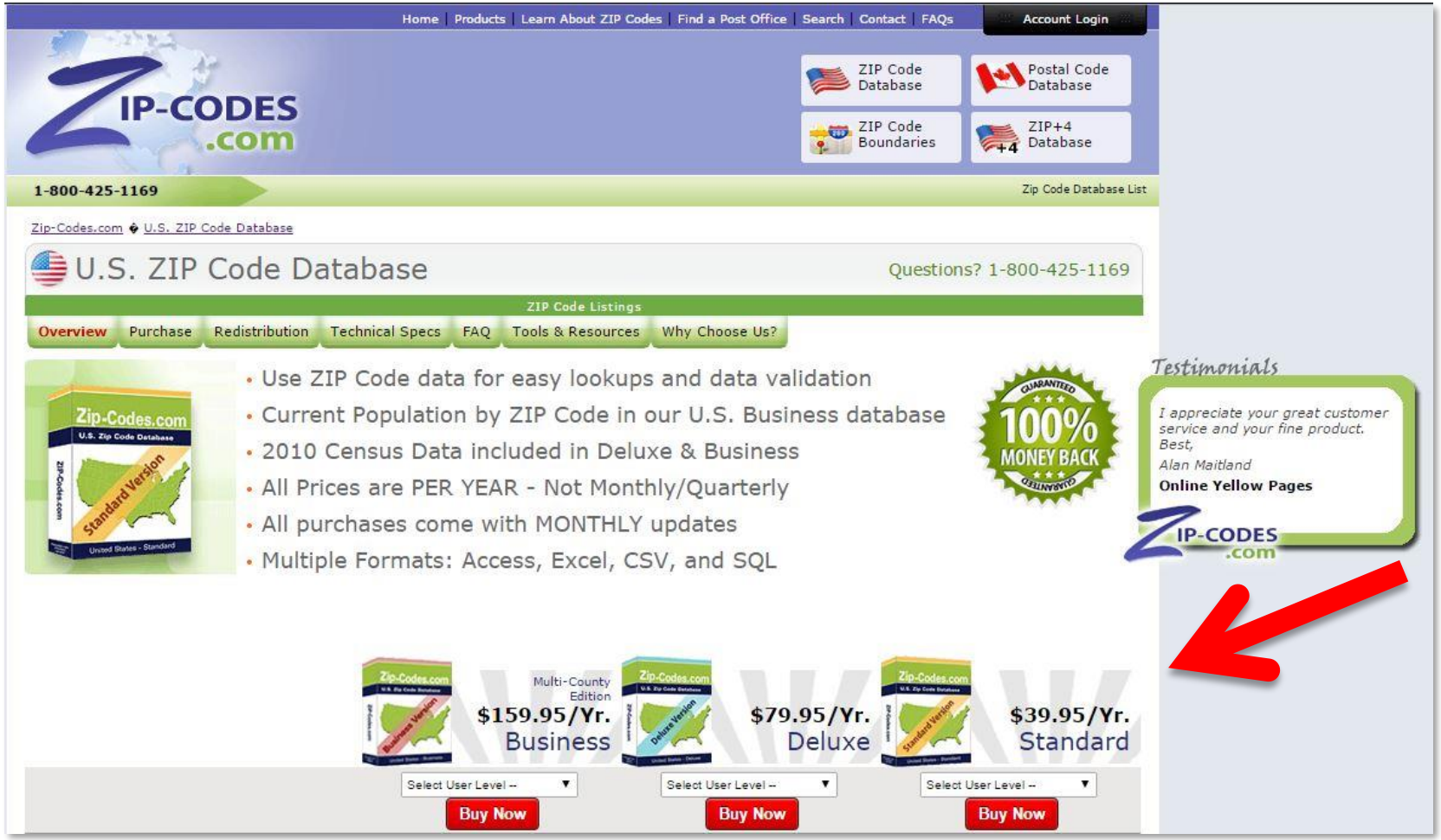
U.S. Census Bureau TIGER

(Topologically Integrated Geographic Encoding and Referencing)

* Free Downloadable Street Data
  * TIGER Roads database (Just Road Names)
  * Tiger Edge Files (Right From/To, Left From/to)
  * 5-digit ZIP Code Tabulation Area (ZCTA)
  * ftp://ftp2.census.gov/geo/tiger/TIGER2016/
* One time costs for initial data cleanup
  * Man hours / Computer processing time
    * For Example, 1 State = 1 Week, Country = 1 Month
      * Time estimates based on Field Calculator user level: Master Wizard
  * Must purchase a standardized Zip Code Table (~$40)
* Less accurate than commercially available data
* TIGER API Access Web Interface for Batch Geocoding

Tiger: Image via US Census Bureau [https://commons.wikimedia.org/wiki/File:US-Census-TIGERLogo.svg] (Public Domain)

Zip Code and Postal Code City Names Standards
https://www.zip-codes.com/



www.zip-codes.com/

20.) City Alias Code

This field is indicates what type the City Alias name is

Code	Description
{blank}	Any record that does not have any of the above codes in them is a regular non military, non business, non government, non university ZIP code.
A	Abbreviation - USPS designated abbreviation of a City Alias Name (ex. "Yorktown Heights"= "Yorktown HGTS" or "Yrktwn HTS", etc.)
B	Business - A specific business uses this zip code. This may be either exclusively or shared with a city. To determine if it is exclusive, look to the "Classification Code" column and if it has a "U" for Unique, it is exclusive to the particular business name in the "CityAliasName" field.
M1	Military Base - Actual U.S. military base non primary name as designated by the USPS.
M1P	Miltary Base Primary - Primary name of U.S. military base as designated by the USPS.
M2	Non Specific Military/Consulate - Military or Consulate ZIP code which is not specifically identified to any particular military base or consulate. These are used primarily for foreign military/consulate mail.
M2P	Non Specific Military/Consulate Primary - USPS designated primary ZIP code for foreign/consulate mail.
G	Government - A specific government entity uses this zip code. This may be either exclusively or shared with a city. To determine if the ZIP is exclusive, look to the "Classification Code" column and if it has a "U" for Unique, it is exclusive to the particular government entity name in the "CityAliasName" field.
U	University - USPS designated as a U.S. university. Not the primary record for this university.
UP	University Primary - Primary record for this U.S. university as designated by the USPS.

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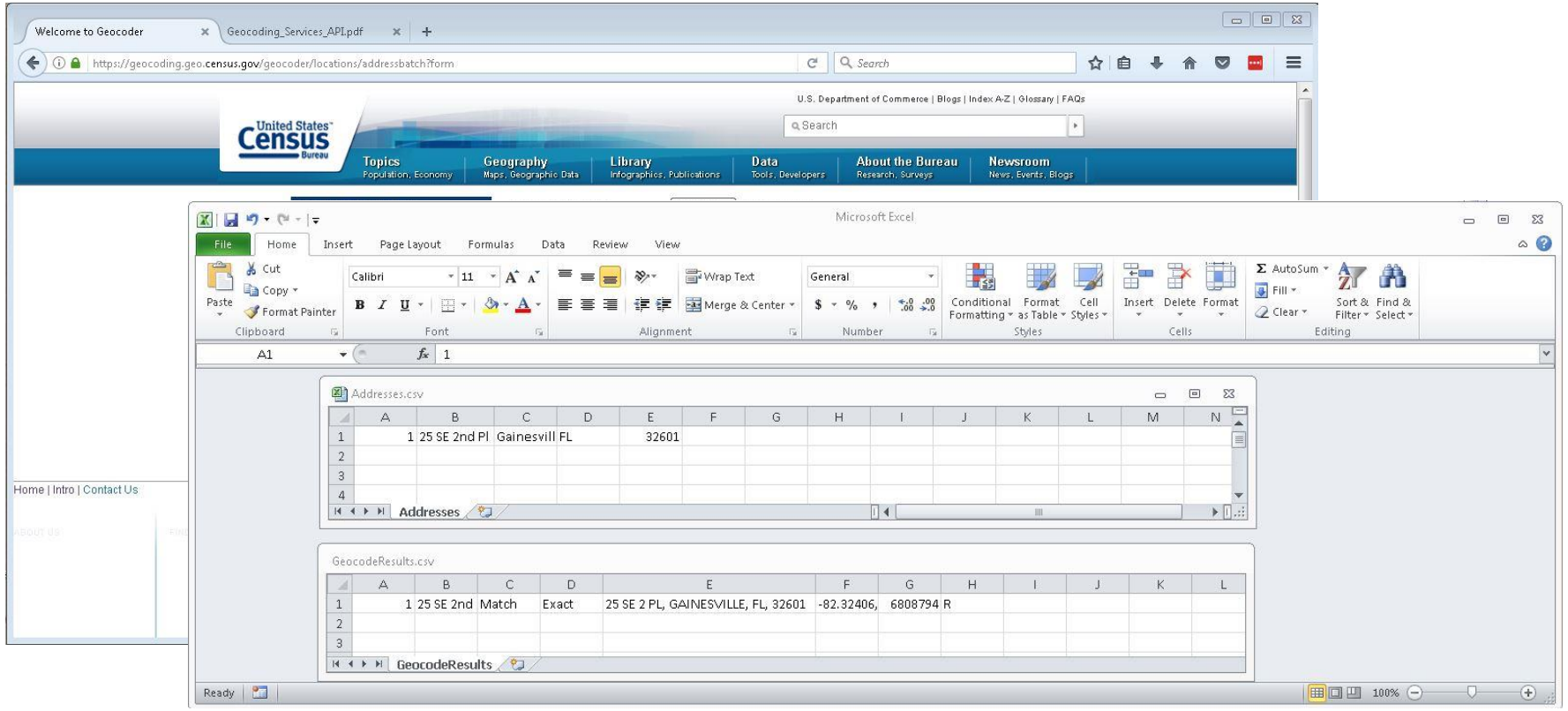
#	Field Name	Data Type	Description
01	ZipCode	Char(5)	00000-99999 Five digit numeric ZIP Code of the area.
02	City	VarChar(35)	Name of the city as designated by the USPS.
03	State	Char(2)	2 letter state name abbreviation.
04	County	VarChar(45)	Name of County or Parish this ZIP Code resides in.
05	AreaCode	VarChar(55)	The telephone area codes available in this ZIP Code.
06	CityType	Char(1)	Indicates the type of locale such as Post Office, Stations, or Branch.
07	CityAliasAbbreviation	VarChar(13)	13 Character abbreviation for the city alias name.
08	CityAliasName	VarChar(35)	Alias name of the city if it exists.
09	Latitude	Decimal(12, 6)	Geographic coordinate as a point measured in degrees north or south of the equator.
10	Longitude	Decimal(12, 6)	Geographic coordinate as a point measured in degrees east or west of the Greenwich Meridian.
11	TimeZone	Char(2)	Hours past Greenwich Time Zone this ZIP Code belongs to.
12	Elevation	Integer	The average elevation of the county.
13	CountyFIPS	Char(3)	FIPS code for the County/Parish this ZIP Code resides in.
14	DayLightSaving	Char(1)	Flag indicating whether this ZIP Code observes daylight savings.
15	PreferredLastLineKey	VarChar(10)	Links this record with other products ZIP-Codes.com offers.
16	ClassificationCode	Char(1)	The classification type of this ZIP Code.
17	MultiCounty	Char(1)	Flag indicating whether this ZIP Code crosses county lines.
18	StateFIPS	Char(2)	FIPS code for the State this ZIP Code resides in.
19	CityStateKey	Char(6)	Links this record with other products ZIP-Codes.com offers such as the ZIP+4.
20	CityAliasCode	VarChar(5)	Code indication the type of the city alias name for this record. Record can be Abbreviations, Universities, Government, and more.
21	PrimaryRecord	Char(1)	Character 'P' denoting if this row is a Primary Record or not. Absence of character denotes a non-primary record.
22	CityMixedCase	VarChar(35)	The city name in mixed case (i.e. Not in all uppercase letters).
23	CityAliasMixedCase	VarChar(35)	The city alias name in mixed case (i.e. Not in all uppercase letters).
24	StateANSI	VarChar(2)	ANSI code for the State this ZIP Code resides in.
25	CountyANSI	VarChar(3)	ANSI code for the County/Parish this ZIP Code resides in.
26	FacilityCode	VarChar(1)	The type of locale identified in the city/state name.
27	CityDeliveryIndicator	VarChar(1)	Specifies whether or not a post office has city-delivery carrier routes.
28	CarrierRouteRateSortation	VarChar(1)	Identifies where automation Carrier Route rates are available.
29	FinanceNumber	VarChar(6)	A code assigned to Postal Service facilities.
30	UniqueZIPName	VarChar(1)	Field that specifies whether the City State Record contains the organization name for a unique ZIP Code.

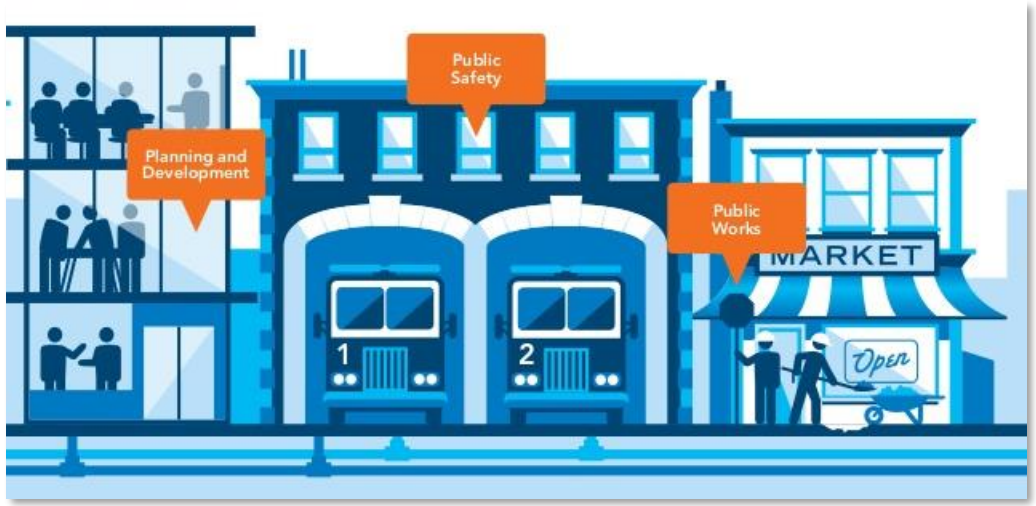
U.S. Census Bureau TIGER:
TIGER API Access Web Interface for Batch Geocoding



Census Geocoder: https://geocoding.geo.census.gov

Local Agencies/Government Data

* Free or Costly Downloadable Data
  * E911 Streets
  * Parcel Centroids with Physical Address Information
    * Data cleanup and prep similar to TIGER process
* Difficult to aggregate if using data from more than one source
  * Inconsistent table structures / Data schemas
  * Data updates / Currency issues
* Metadata is often lacking



OpenStreetMap

* Free Downloadable Street Data
* Crowdsourced
* Varying Levels of Accuracy
  * Urban vs Rural
  * Unknown level of quality assurance and quality control
    * Non-standardized
  * For Example, The Haiti Earthquake in 2010.
* Available as a service through QGIS Plugin (MMQGIS)

GIS Web Service Geocoding

- Available as a QGIS Plugin (MMQGIS)
- Requires install of QGIS Desktop (Open Source GIS software)
- Geocode with Google Maps API or OpenStreetMap API
  - Google Maps: Not Free (anymore), but highly accurate
  - OpenStreetMap: No limit, but accuracy varies depending on location.
- Requires .csv file as input table
- Output is a shapefile with two appended fields:
  - Address Type: examples include a street address or a political entity.
  - Location Type: stores additional data about the specified location.
    - Examples include “rooftop”, centroid, or approximate match.

ArcGIS Online Services

* Very Easy to use Geocoding Services
  * Integrated with ArcGIS Desktop, ArcGIS PRO, and ArcGIS Online
* Credits are Required
  * Credits used based on number of records
  * 40 credits per 1000 records geocoded
  * Access to UF's credits for geocoding determined on a case by case basis
  * UF has limited allotment of credits
    * Each student limited to 1000 credits

How much does ArcGIS Online cost?

Creator

FOUNDATIONAL

- Create maps and apps with your data
- Access authoritative data to accelerate your work and expand analysis
- Analyze data to understand trends
- Share maps with stakeholders in a variety of ready-to-use apps

Learn more

$500 / year

Quantity – 0 +

Viewer

POPULAR

- Securely view your team's maps and apps
- Monitor project performance through dashboards
- Use location information to make decisions

Learn more

$100 / year

Quantity – 0 +

Field Worker

POPULAR

- Use apps for data collection, surveys, and inspections
- Seamlessly integrate field-collected data
- Share updates with your team in real time

Learn more

$350 / year

Quantity – 0 +

Editor

- Add and modify data using apps
- Review and edit incoming data to improve accuracy
- Securely view your team's maps and apps

Learn more

$200 / year

Quantity – 0 +

GIS Professional

- Create and manage 2D and 3D location data
- Access authoritative data to accelerate your work and expand analysis
- Produce advanced maps with ease
- Use scientific analytical tools to deepen your understanding
- Share maps, apps, and insights with your team

Learn more

Basic $700 / year

Quantity – 0 +

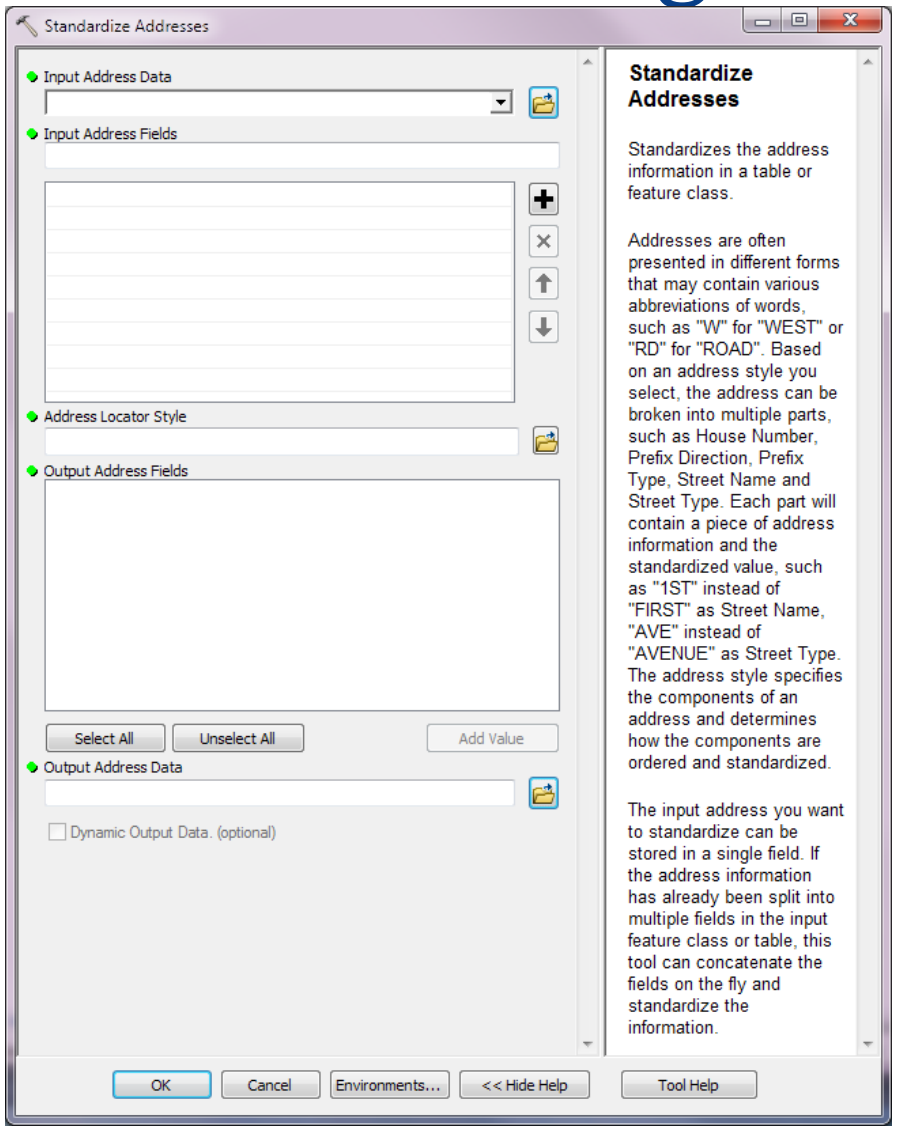
Standard $2,750 / year

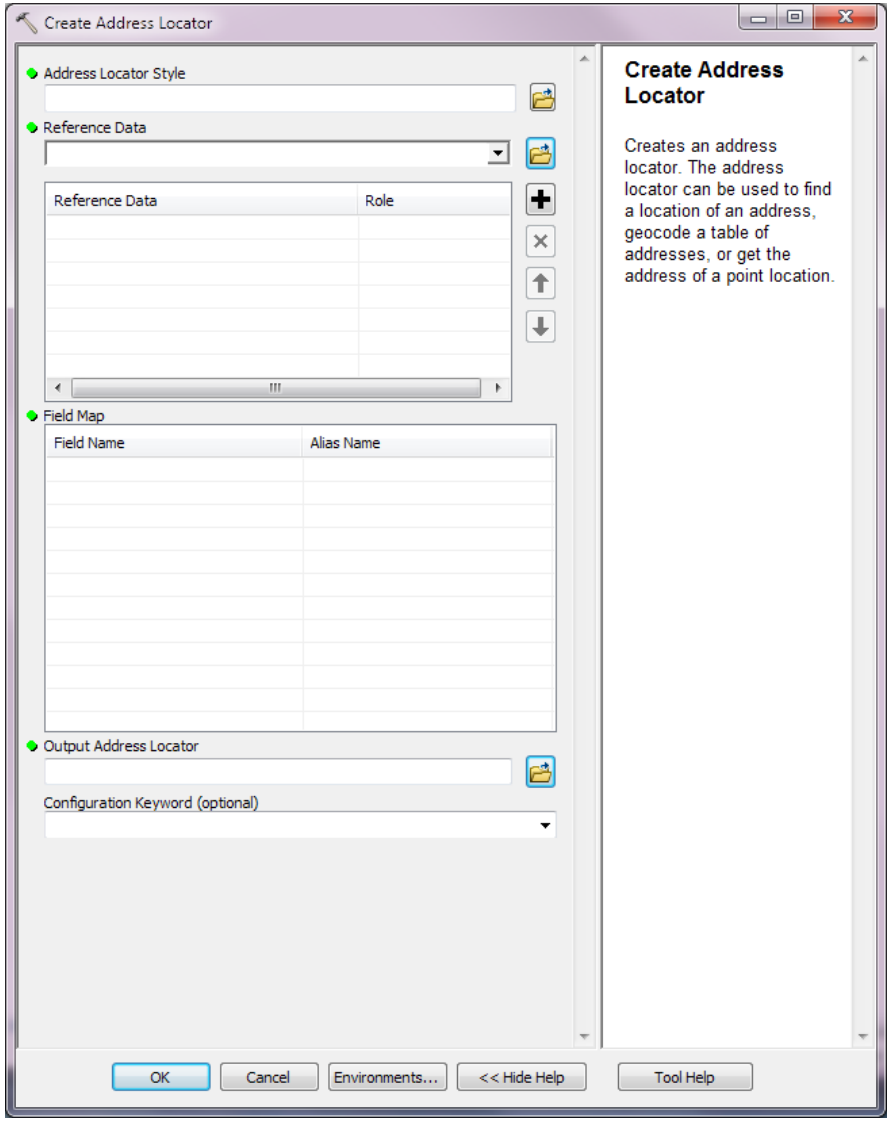
Quantity – 0 +

Advanced $3,800 / year

Quantity – 0 +

Geocoding Toolbox: Create Locators & Standardizing Addresses





Standardizing Addresses

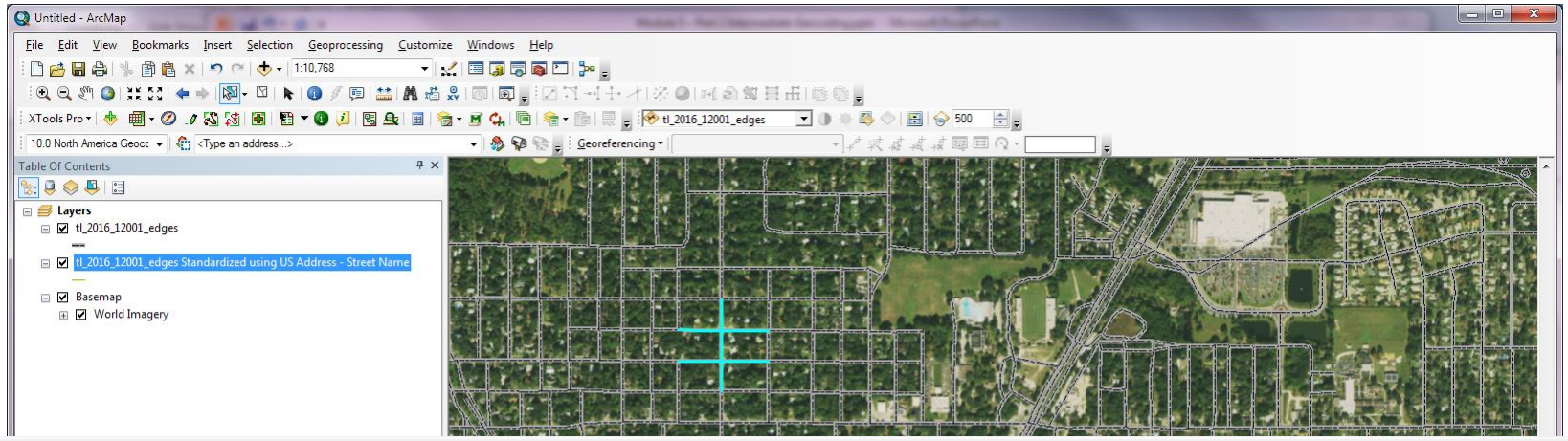


Table - tl_2016_12001_edges Standardized using US Address - Street Name

tl_2016_12001_edges

FID	Shape	STATEFP	COUNTYFP	TLID	TFIDL	TFIDR	MTFCC	FULLNAME	SMID	LFROMADD	LTOADD	RFROMADD	RTOADD	ZIPL	ZIPR	FEATCAT	HYDROFLG	RAILFLG	ROADFLG	OL
271	Polyline	12	001	6809040	208054385	208055314	S1400	NE 10th Ave	1267	800	898	801	899	32601	32601	S	N	N	Y	N
1250	Polyline	12	001	6809029	208055309	208055312	S1400	NE 10th Pl	1267	900	998	901	999	32601	32601	S	N	N	Y	N
1876	Polyline	12	001	6809026	208054385	208055312	S1400	NE 9 St	1267	1000	1022	1001	1019	32601	32601	S	N	N	Y	N
2481	Polyline	12	001	6809025	208055307	208054385	S1400	NE 10th Pl	1267	800	898	801	899	32601	32601	S	N	N	Y	N
2489	Polyline	12	001	6809024	208055307	208055309	S1400	NE 9 St	1267	1024	1098	1021	1099	32601	32601	S	N	N	Y	N
3708	Polyline	12	001	6809046	208055312	208055313	S1400	NE 10th Ave	1267	900	998	901	999	32601	32601	S	N	N	Y	N
3709	Polyline	12	001	6809041	208055314	208055313	S1400	NE 9 St	1267	900	998	901	999	32601	32601	S	N	N	Y	N

0 (7 out of 49337 Selected)

tl_2016_12001_edges

tl_2016_12001_edges Standardized using US Address - Street Name

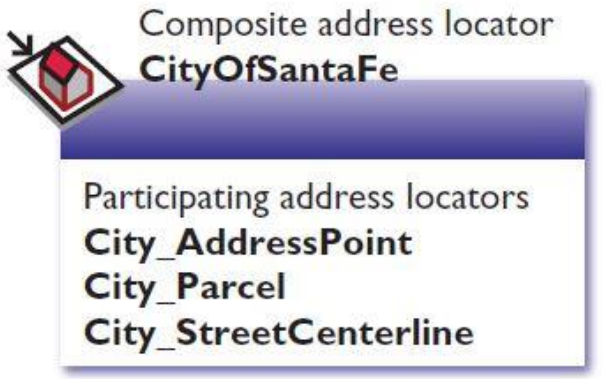
FID	Shape *	ADDR_PD	ADDR_PT	ADDR_SN	ADDR_ST	ADDR_SD	STATEFP	COUNTYFP	TLID	TFIDL	TFIDR	MTFCC	FULLNAME	SMID	LFROMADD	LTOADD	RFROMADD	RT
271	Polyline	Northeast		10th	Ave		12	001	6809040	208054385	208055314	S1400	NE 10th Ave	1267	800	898	801	89
1250	Polyline	Northeast		10th	Place		12	001	6809029	208055309	208055312	S1400	NE 10th Pl	1267	900	998	901	99
1876	Polyline	Northeast		9	St		12	001	6809026	208054385	208055312	S1400	NE 9 St	1267	1000	1022	1001	10
2481	Polyline	Northeast		10th	Place		12	001	6809025	208055307	208054385	S1400	NE 10th Pl	1267	800	898	801	89
2489	Polyline	Northeast		9	St		12	001	6809024	208055307	208055309	S1400	NE 9 St	1267	1024	1098	1021	10
3708	Polyline	Northeast		10th	Ave		12	001	6809046	208055312	208055313	S1400	NE 10th Ave	1267	900	998	901	99
3709	Polyline	Northeast		9	St		12	001	6809041	208055314	208055313	S1400	NE 9 St	1267	900	998	901	99

0 (7 out of 49337 Selected)

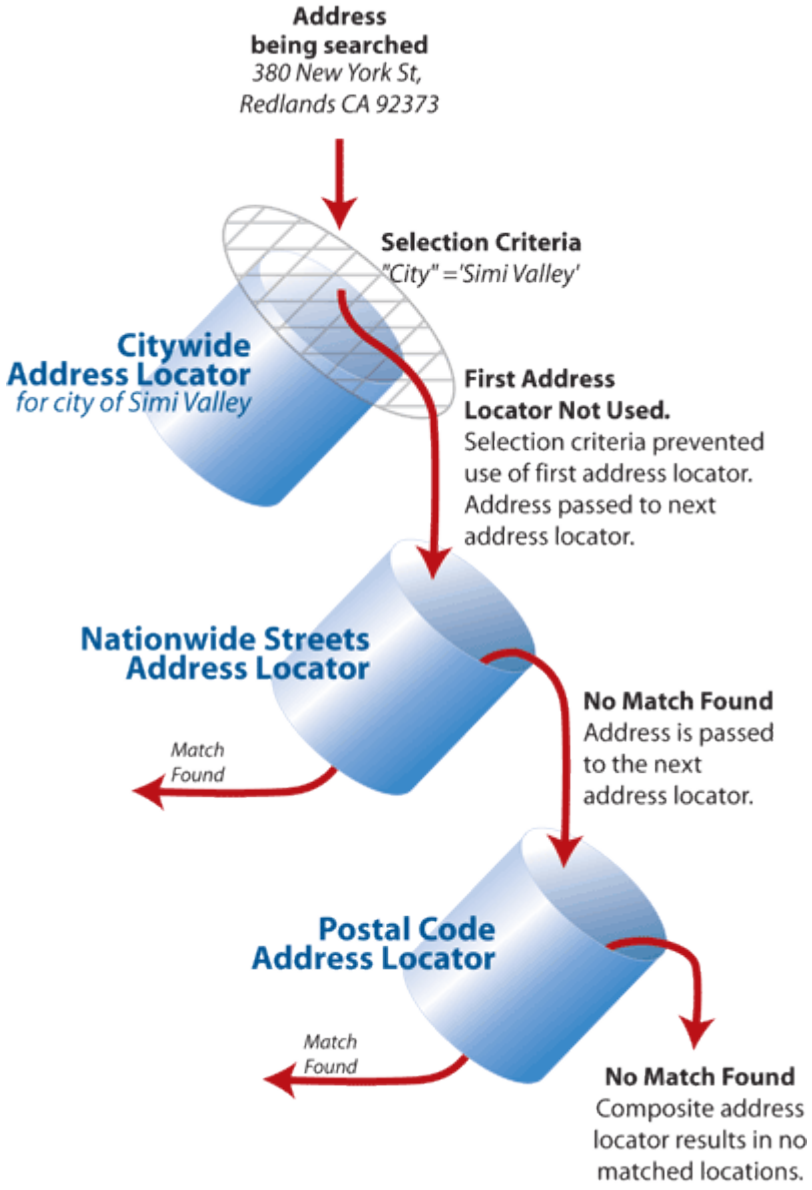
tl_2016_12001_edges Standardized using US Address - Street Name

Composite Locator Files

- Combination of multiple (previously constructed) address locators.
- Allows you to match input addresses with several variations in local address styles.

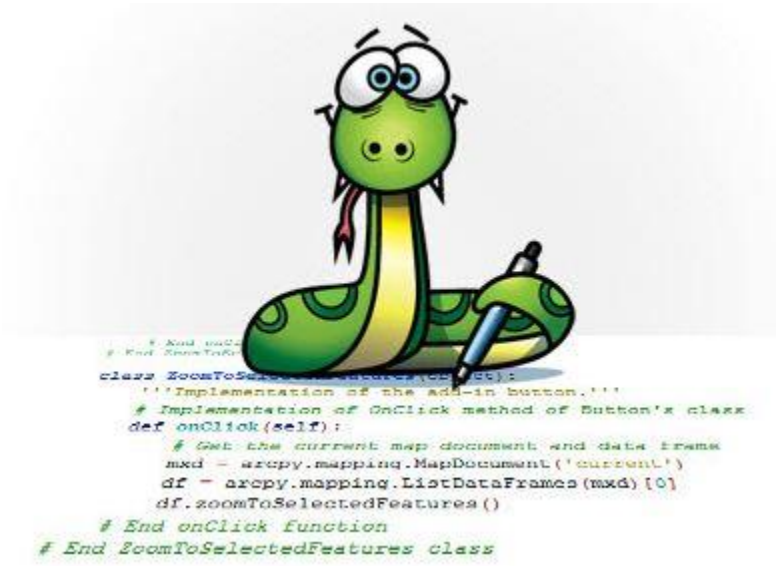


The city of Santa Fe uses a composite address locator with three participating address locators containing reference data built from three feature classes with progressive accuracy for address information.



Automation Using Python Scripting

* Automate the Standardization of your:
  * Streets Layers
  * Address Tables
    * For Example, Ordinal Numbers (NE 9 St to NE 9th St)
* Automate the Construction of your locators.
* Batch Process Geocoding Jobs:
  * With or without allowable record limits.



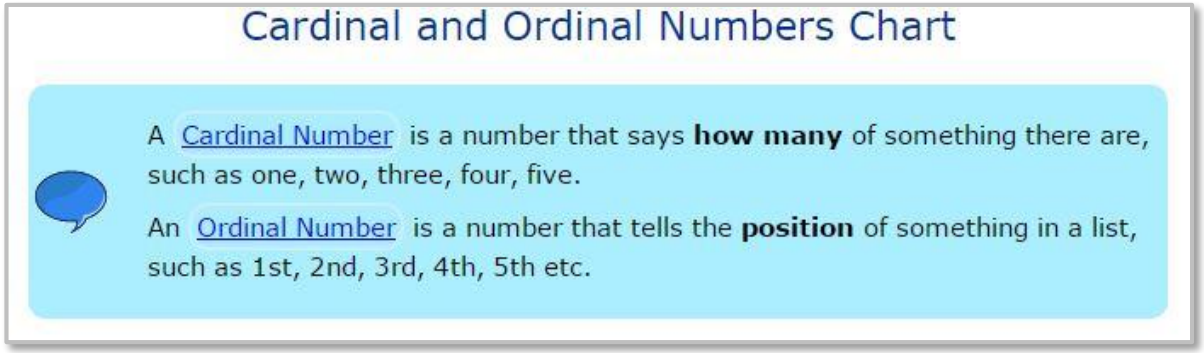
Geocoding Best Practices: Large Dataset Performance Enhancements

* Use 64-bit processing instead of 32-bit
  * Make sure background processing is enabled.
  * Make sure the 64-bit geoprocessing patch is installed.
* Optimizing Locator Files
  * Open locator file with text editor and change or add the following:
    * RuntimeMemoryLimit = 2048000000 *bytes (optimal performance ~ 2 GB of memory)
    * BatchPresortInputs = State
    * BatchPresortInputs = City
    * BatchPresortInputs = Zip
    * BatchPresortCacheSize = 100000 *records
* Use FGDB (SHP 2GB Limit).
* Use automation when you can.
* Try to use ArcGIS Pro (Buggy but has potential)

http://www.p2energysolutions.com/sites/default/files/styles/medium/public/field/image/Esri-Bound-Hear-P2-Share-Valuable-Tobin-Data-and-P2-GIS-Best-Practices.png?itok=fdtbmabF

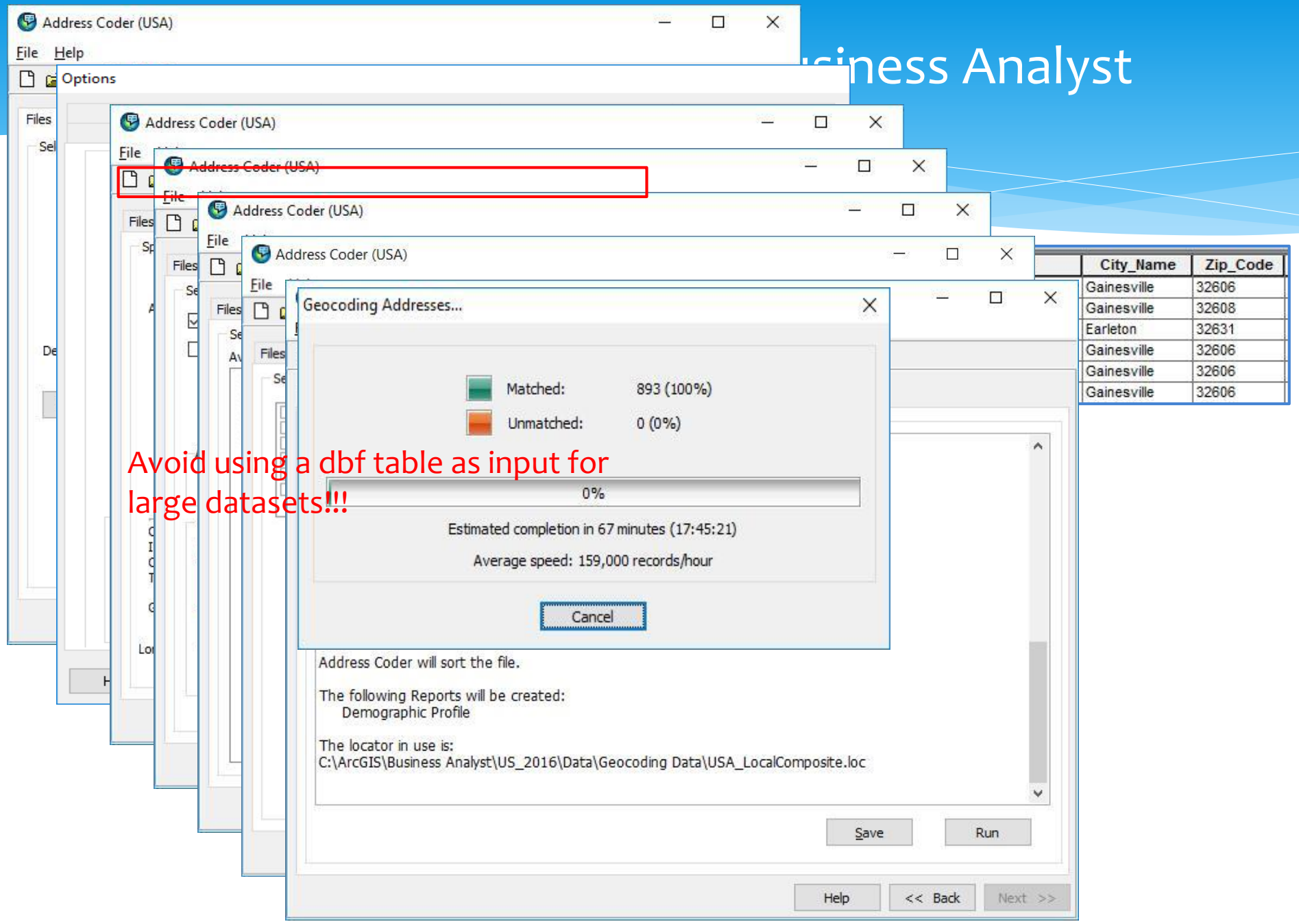
Geocoding Tips, Tricks & Pitfalls

* Cardinal Numbers vs Ordinal Numbers
* Street Name Abbreviations (MLK Blvd)
* Spelling Variations
  * For Example, Irlo Bronson Memorial Hwy
* Rematching
  * Errors at a glance, big picture
  * Quick checks for Zip code issues – Google
* End Use Goals: Parcel Centroid vs Street Centerline (in physical parcel vs Navigation, Routing, door to door access/canvasing).
* Standardize using Zip Code and Postal Code City Names Table.
* Alternate Name Table (Old County Rd renamed to Jefferson Rd).
* Use Online Services on off-times .



http://www.mathsisfun.com/numbers/cardinal-ordinal-chart.html

ness Analyst



Example: Geocoding with Business Analyst

Table

VotRegAlachua

Residence_Address	City_Name	Zip_Code	MATCH_CODE	LATITUDE	LONGITUDE
1505 Fort Clarke Blvd APT 5103	Gainesville	32606	MA100	29.667172	-82.434932
715 SW 10Th St	Gainesville	32601	MA100	29.645311	-82.33496
13001402 Jennings Hall	Gainesville	32612	MZ100	29.639951	-82.370103
1505 Fort Clarke Blvd APT 5103	Gainesville	32606	MA100	29.667172	-82.434932
1024 NW 13Th Ave	Gainesville	32601	MA100	29.663968	-82.335981
3620 NW 31St St	Gainesville	32605	MA100	29.686574	-82.367843
2515 NW 77Th Blvd APT T 212	Gainesville	32606	MA100	29.676554	-82.424291
8415 SW 78Th Ln	Gainesville	32608	MA100	29.582535	-82.431826
12040503 Beaty Towers E	Gainesville	32612	MZ100	29.639951	-82.370103
1213 NE 6th Ave	Gainesville	32601	MA100	29.657083	-82.309993
27 Office Pct	Gainesville	32601	MZ100	29.648864	-82.321551
2900 SW 23Rd Ter APT 225 D	Gainesville	32608	MA100	29.625118	-82.356282
4653 NW 24Th Blvd	Gainesville	32605	MA100	29.697116	-82.356601
4126 Alpine Dr	Gainesville	32605-5606	MA100	29.692532	-82.358544
823 SW 60Th Ter	Gainesville	32607	MA100	29.645288	-82.407967
19021201 Hume Hall E	Gainesville	32612	MZ100	29.639951	-82.370103
5083 NW 1St Pl	Gainesville	32607	MA100	29.653271	-82.397063
4509 NW 53Rd St	Gainesville	32606-4365	MA100	29.69616	-82.399619
4126 Alpine Dr	Gainesville	32605-5606	MA100	29.692532	-82.358544
4400 SW 20Th Ave APT 5101 C	Gainesville	32607	MA100	29.636854	-82.390107
13022701 Jennings Hall	Gainesville	32612	MZ100	29.639951	-82.370103
14408 NW 50Th Pl	Alachua	32615-3496	MA100	29.702853	-82.497404
4653 NW 24Th Blvd	Gainesville	32605	MA100	29.697116	-82.356601
11140101 Beaty Towers W	Gainesville	32612	MZ100	29.639951	-82.370103
1219 NW 35Th Ave	Gainesville	32609	MA100	29.684883	-82.337521
57041701 Cypress Hall	Gainesville	32612	MZ100	29.639951	-82.370103
16043301 Yulee Hall	Gainesville	32612	MZ100	29.639951	-82.370103
4215 SW 22Nd Ln UNIT 130	Gainesville	32607	MA100	29.631823	-82.387832
3221 NW 6Th St	Gainesville	32609	MA100	29.68268	-82.33074
6711 NW 30Th Ter	Gainesville	32653	MA100	29.716266	-82.367108
4361 NW 36Th Dr	Gainesville	32605	MA100	29.69448	-82.377781
4361 NW 36Th Dr	Gainesville	32605	MA100	29.69448	-82.377781
4361 NW 36Th Dr	Gainesville	32605	MA100	29.69448	-82.377781
18012 NW 32Nd Ave	Newberry	32669	MA100	29.683008	-82.534202
3900 SW 27Th St APT F 202	Gainesville	32608	MA100	29.613657	-82.362273
27 Office Pct	Gainesville	32601	MZ100	29.648864	-82.321551
2601 SW Archer RD APT F 223	Gainesville	32608	MS100	29.632185	-82.361635

0 (0 out of 179009 Selected)

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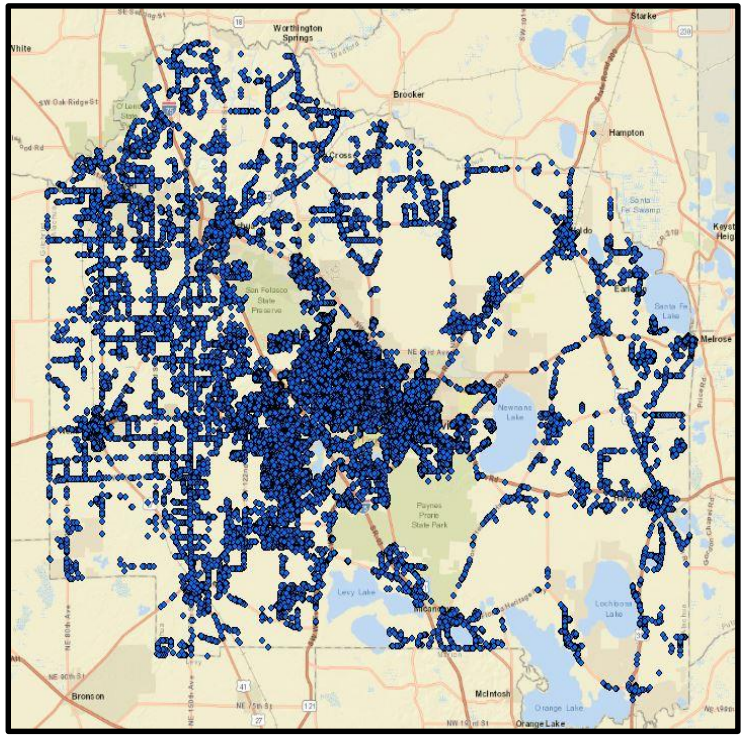
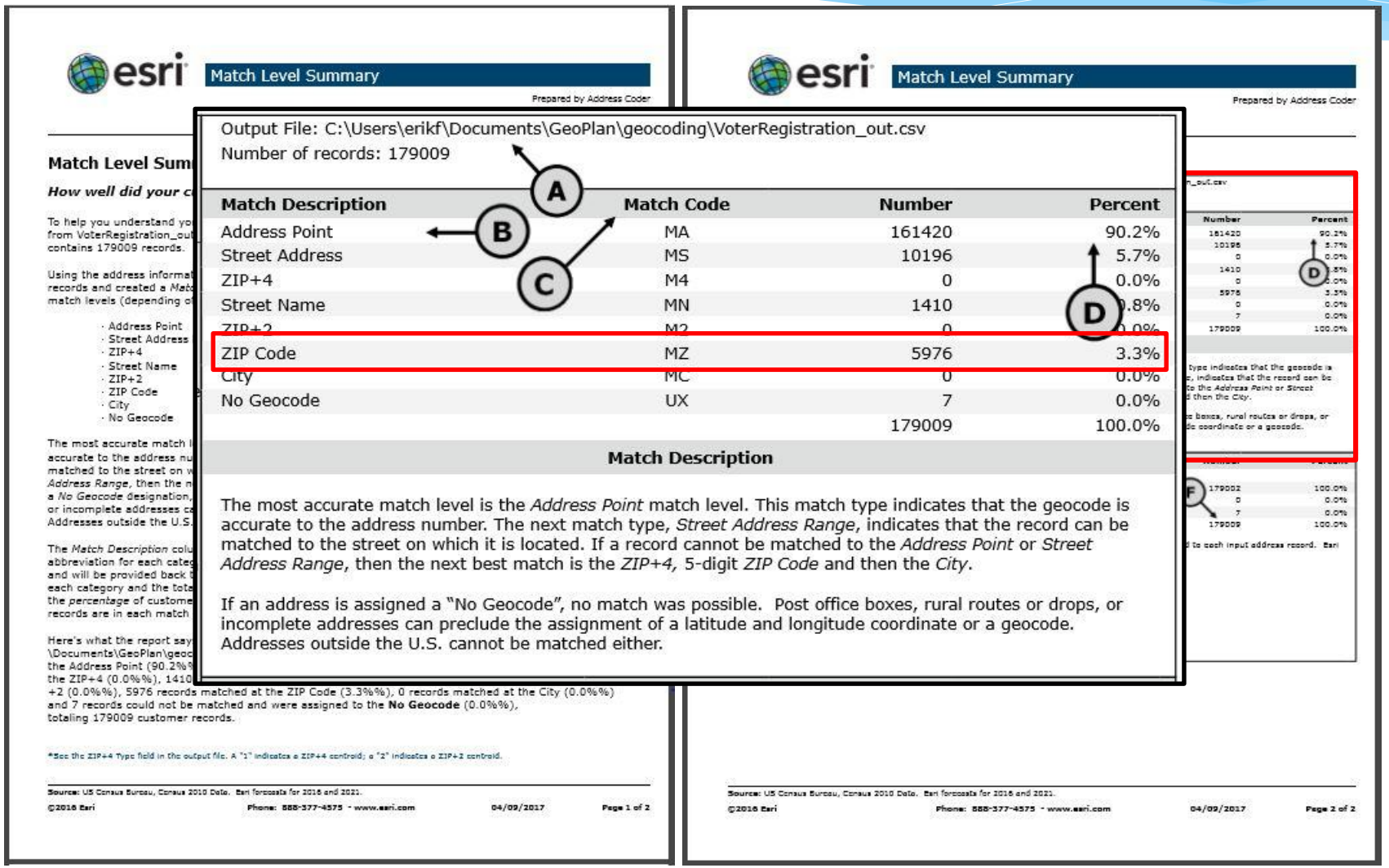


Example: Geocoding with Business Analyst



Strategies for Rematching Unmatched Addresses

Table

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Residence_Address	City_Name	Zip_Code	MATCH_CODE	LATITUDE	LONGITUDE
34023501 Buckman Hall	Gainesville	32612	MZ100	29.639951	-82.370103
14041001 Broward Hall	Gainesville	32612	MZ100	29.639951	-82.370103
26011103 Riker Hall	Gainesville	32612	MZ100	29.639951	-82.370103
27023603 Weaver Hall	Gainesville	32612	MZ100	29.639951	-82.370103
51020604 Lakeside Complex	Gainesville	32612	MZ100	29.639951	-82.370103
30053501 Murphree Hall	Gainesville	32612	MZ100	29.639951	-82.370103
28030601 East Hall	Gainesville	32612	MZ100	29.639951	-82.370103
4903 NW 209Th Ln					
4903 NW 209Th Ln					
4903 NW 209Th Ln					
16020201 Yulee Hall					
32011402 Sledd Hall					
26041301 Riker Hall					
58050104 Infinity Hall					
24010901 Tolbert Hall					
11110604 Beaty Towers W					
26011101 Riker Hall					
51020502 Lakeside Complex	Gainesville	32612	MZ100	29.639951	-82.370103
19123 NW 233Rd St	High Springs	32643	MZ100	29.831585	-82.594877
296 Diamond Vlg APT 13	Gainesville	32603	MZ100	29.657136	-82.347147
2040203 Beaty Towers E	Gainesville	32612	MZ100	29.639951	-82.370103
12050701 Beaty Towers E	Gainesville	32612	MZ100	29.639951	-82.370103
48020902 Springs Complex	Gainesville	32612	MZ100	29.639951	-82.370103
27 Office Pct	Gainesville	32601	MZ100	29.648864	-82.321551
27 Office Pct	Gainesville	32601	MZ100	29.648864	-82.321551
12050201 Beaty Towers E	Gainesville	32612	MZ100	29.639951	-82.370103
19034702 Hume Hall E	Gainesville	32612	MZ100	29.639951	-82.370103
15041901 Mallory Hall	Gainesville	32612	MZ100	29.639951	-82.370103
30014202 Murphree Hall	Gainesville	32612	MZ100	29.639951	-82.370103
11810 NE 203Rd Ter	Earleton	32631	MZ100	29.746208	-82.101859
11810 NE 203Rd Ter	Earleton	32631	MZ100	29.746208	-82.101859
14011702 Broward Hall	Gainesville	32612	MZ100	29.639951	-82.370103
12100701 Beaty Towers E APT 1007	Gainesville	32612	MZ100	29.639951	-82.370103
55040403 Lakeside Complex	Gainesville	32612	MZ100	29.639951	-82.370103
55040403 Lakeside Complex	Gainesville	32612	MZ100	29.639951	-82.370103
1101401 Beaty Towers W	Gainesville	32612	MZ100	29.639951	-82.370103
14021101 Broward Hall	Gainesville	32612	MZ100	29.639951	-82.370103

0 (5976 out of 179009 Selected)

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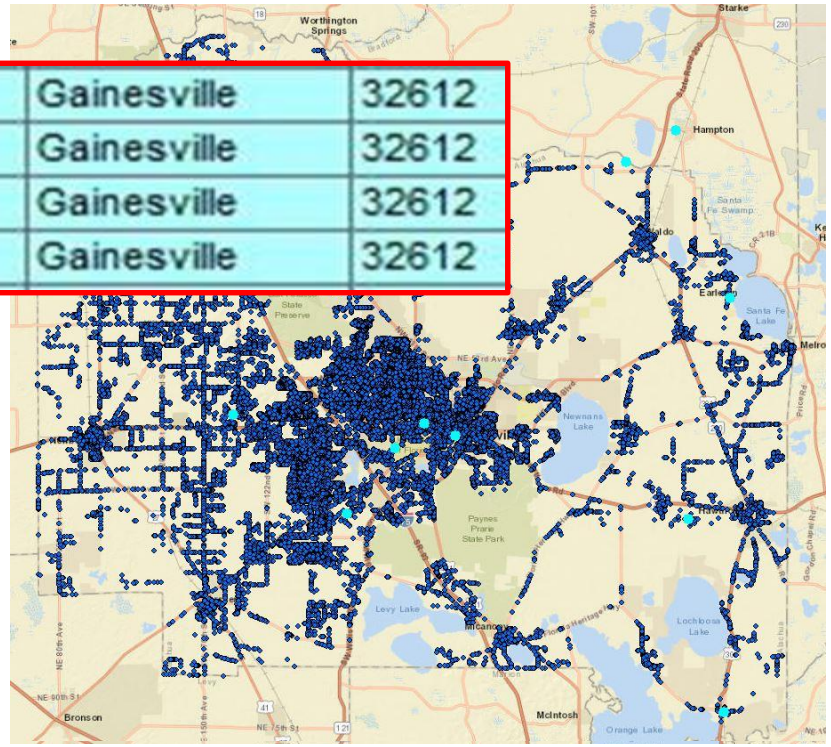
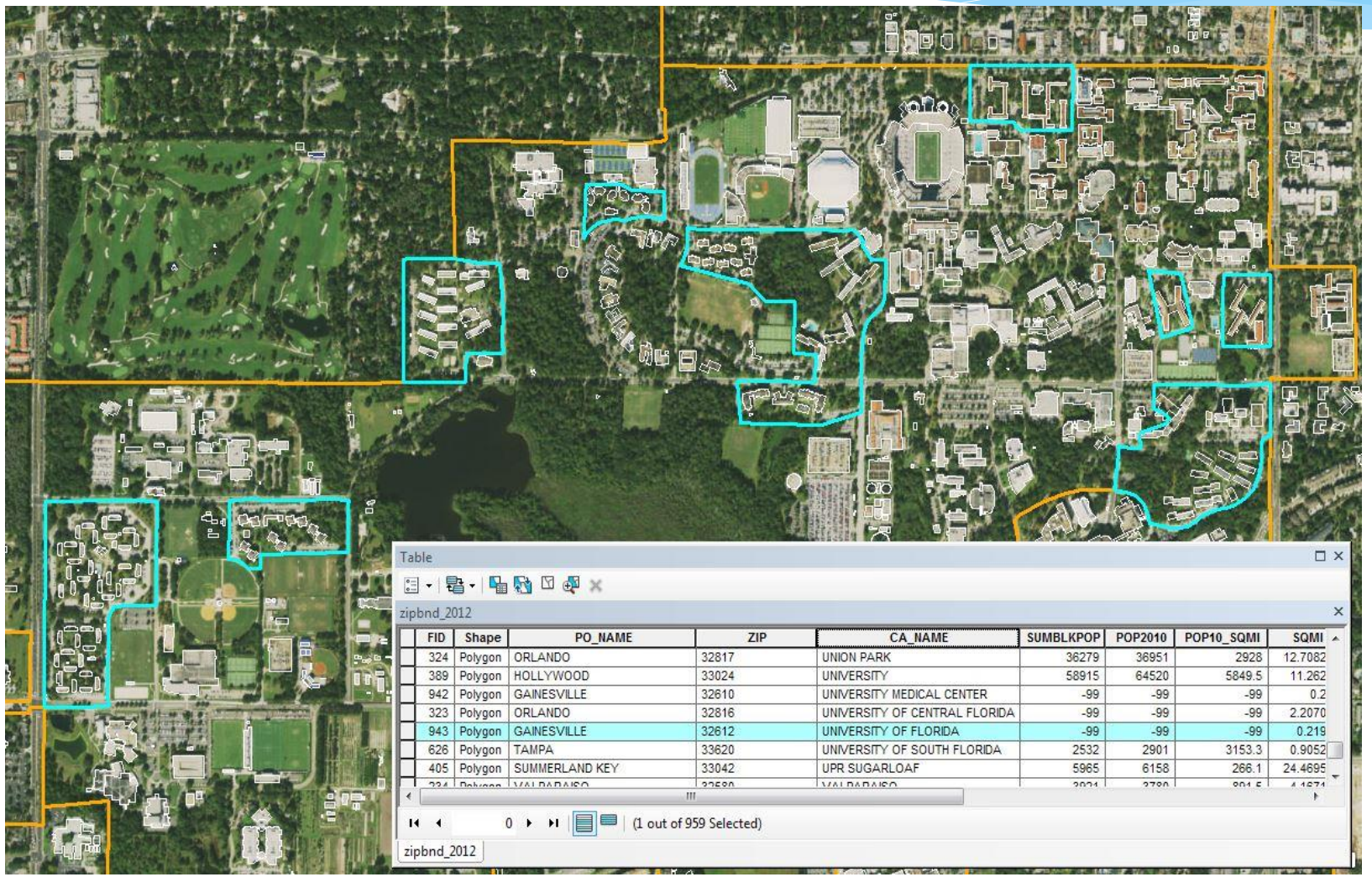
12050201 Beaty Towers E	Gainesville	32612
19034702 Hume Hall E	Gainesville	32612
15041901 Mallory Hall	Gainesville	32612
30014202 Murphree Hall	Gainesville	32612



Example: Geocoding with Business Analyst



Summary

* Steps of Geocoding
* Available Data and Services
* Your Time or Your Money
* Geocoding Toolbox
* Automation
* Best Practices
* Tips, Tricks & Pitfalls
* Garbage In Garbage Out (GIGO)

Resources & Sources

* TIGER API Access, batch geocode (web interface):
  * https://geocoding.geo.census.gov/geocoder/locations/addressbatch?form
* Texas A&M Geocoding Services
  * http://geoservices.tamu.edu/Services/Geocode/
* ArcGIS Python API: batch_geocode() method
  * https://developers.arcgis.com/python/guide/Batch-Geocoding/
* Improving batch geocoding performance
  * https://blogs.esri.com/esri/arcgis/2011/02/09/tuning-a-locator-for-improved-performance/
* Zeiler, M., & Murphy, J. (2010). Modeling Our World, 2nd Edition: The ESRI Guide to Geodatabase Concepts (pp. 164-181). Redlands, CA: ESRI Press.
* Cardinal and Ordinal Numbers Chart
  * http://www.mathsisfun.com/numbers/cardinal-ordinal-chart.html

Questions?

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