MassGIS’ Geocoding Resources

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Outline

- Brief overview of Geocoding
- Data products from MassGIS
- Address best practices
- Web services from MassGIS
Geocoding is the process of transforming a description of a location—such as a pair of coordinates, an address, or a name of a place—to a location on the earth's surface.
Address matching is a type of geocoding based on an input table of street addresses.
Geocoding requirements

- **Address table**
- **Reference data** – feature classes representing real-world objects (streets, buildings, etc., with address info)
- **Software** – ArcMap, ArcGIS Pro, etc.
- “**Address locator**” - the main tool for geocoding in ArcGIS
Linear geocoding – e.g. streets

Segment ranges:

12 Main Street placed here (but could be to the left or right of this in reality)

From/To Left: 10-18
From/To Right: 11-19
**Point geocoding** – e.g. buildings

Benefits: exact location, unit/floor
Types of reference data: Lines vs. points

Geocode to lines

Geocode to points
Types of reference data

- Polygon geocoding – e.g. ZIP Codes

Useful for counts, where exact location is not necessary or prohibited by privacy concerns
Types of reference data

Example of summarizing matches by ZIP Code to produce a choropleth map
Statewide Address Points for Geocoding data layer

- 3.6 million points
- **Free download**, updated weekly
- Located on building or at parcel centroid
- From parcels and 911 Emergency Service List (ESL), voter registration, MassDOT, DCR, Comcast, National Grid, and field data collection
What data MassGIS provides - Points

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>OBJECTID</td>
<td>1928612</td>
</tr>
<tr>
<td>REL_LOC</td>
<td>&lt;null&gt;</td>
</tr>
<tr>
<td>FLOOR</td>
<td>&lt;null&gt;</td>
</tr>
<tr>
<td>UNIT</td>
<td>&lt;null&gt;</td>
</tr>
<tr>
<td>STATE</td>
<td>MA</td>
</tr>
<tr>
<td>SHAPE</td>
<td>Point</td>
</tr>
<tr>
<td>CENTROID_ID</td>
<td>M_241853_881975</td>
</tr>
<tr>
<td>FULL_NUMBER_STANDARDIZED</td>
<td>49</td>
</tr>
<tr>
<td>ADDRESS_NUMBER_PREFIX</td>
<td>&lt;null&gt;</td>
</tr>
<tr>
<td>ADDRESS_NUMBER</td>
<td>49</td>
</tr>
<tr>
<td>ADDRESS_NUMBER_SUFFIX</td>
<td>&lt;null&gt;</td>
</tr>
<tr>
<td>ADDRESS_NUMBER_2</td>
<td>&lt;null&gt;</td>
</tr>
<tr>
<td>ADDRESS_NUMBER_2_SUFFIX</td>
<td>&lt;null&gt;</td>
</tr>
<tr>
<td>STREET_NAME</td>
<td>PROCTOR ROAD</td>
</tr>
<tr>
<td>MASTER_ADDRESS_ID</td>
<td>2393397</td>
</tr>
<tr>
<td>STREET_NAME_ID</td>
<td>114003</td>
</tr>
<tr>
<td>SITE_ID</td>
<td>&lt;null&gt;</td>
</tr>
<tr>
<td>BUILDING_NAME</td>
<td>LIBERTY SCHOOL</td>
</tr>
<tr>
<td>GEOGRAPHIC_TOWN_ID</td>
<td>40</td>
</tr>
<tr>
<td>COMMUNITY_ID</td>
<td>42</td>
</tr>
<tr>
<td>COMMUNITY_NAME</td>
<td>BRAINTREE</td>
</tr>
<tr>
<td>GEOGRAPHIC_TOWN</td>
<td>BRAINTREE</td>
</tr>
<tr>
<td>POSTCODE</td>
<td>02184</td>
</tr>
<tr>
<td>PC_NAME</td>
<td>BRAINTREE</td>
</tr>
<tr>
<td>COUNTY</td>
<td>NORFOLK</td>
</tr>
</tbody>
</table>
What data MassGIS provides - Points

- Download includes data and address locators

Statewide Address Points for Geocoding data package from MassGIS
- MassGIS_Statewide_Address_Points.gdb
- MAD_ADDRESS_POINTS_GC
- MAD_ADDRESS_POINTS_COMPOSITE
- MAD_ADDRESS_POINTS_GEOG TOWN
- MAD_ADDRESS_POINTS_MSAGCOMM
- MAD_ADDRESS_POINTS_POSTOWN

The locators work in ArcMap and ArcGIS Pro

Statewide address points file GDB feature class
- Composite address locator referencing the next three locators
- Address locator using geographic town as ‘City or Place’
- Address locator using MSAG community as ‘City or Place’
- Address locator using postal town as ‘City or Place’
“Base” streets
- Only for public agency staff (originally from Navteq, has proprietary ranges), by request
- We have a composite locator that looks at points first, then lines.

TIGER 2010 streets
What data MassGIS provides - Polygons

- ZIP Codes, municipalities, legislative districts, counties, etc.

ZIP Codes

MSAG Communities
Geocoding in ArcGIS Desktop

- Basic process

Your Addresses
- 1200 W Lawrence
- 62704
- 830 S MacArthur
- Springfield, IL
- 1015 W Governor St
- Springfield, IL

Address Standardization
- 1200 W Lawrence Ave
- Springfield, IL 62704
- 830 S MacArthur Blvd
- Springfield, IL 62704
- 1015 W Governor St
- Springfield, IL 62704

Address Locator
- (39.793950°, 89.672800°)
- (39.78685°, -89.668357°)

Points on a Map
Right-click a table in a map
Geocoding in ArcGIS Desktop

1. **Step One: About your table**
   Look at your data to determine how many fields in your data you want to use for geocoding.

2. **Step Two: What locator are you using?**
   Decide whether to use World Geocoding Service, a custom service or a custom locator.

3. **Step Three: Mapping the fields in your table**
   Look at the fields in your data and the fields in your locator to see how they connect to each other to maximize efficiency.

4. **Step Four: Output**
   You can specify where you want your output feature class to be created based on the type of geocoding operation that will be performed.

![Geocode Table](image)

- **Input Table**: Addresses.csv
- **Input Locator**: \OrgsProgs\911\Geocoding\AddressLocators\MAD_A
- **Input Address Fields**: Multiple Field
- **Data Field**: ADDRESS
- **Street or Intersection**: GEOGRAPHIC_TOWN
- **City or Placename**: STATE
- **ZIP Code**: ZIPCODE
- **Output**: Addresses_Geocoded
- **Add output to map after completion**: 

![Run Button](image)
Rematch any unmatched addresses if necessary.
Geocoding in ArcGIS Desktop

Result is a feature class of points with all the attributes of the input table, plus a Score and other fields added by the GP tool.

<table>
<thead>
<tr>
<th>Status</th>
<th>Score</th>
<th>Match_type</th>
<th>Match_addr</th>
</tr>
</thead>
<tbody>
<tr>
<td>M</td>
<td>100</td>
<td>A</td>
<td>508 WESTFORD STREET, LOWELL, MA, 01851</td>
</tr>
<tr>
<td>M</td>
<td>97.06</td>
<td>A</td>
<td>2 LANTERN LANE, POCASSET, MA, 02559</td>
</tr>
<tr>
<td>M</td>
<td>100</td>
<td>A</td>
<td>12 MAIN STREET, KINGSTON, MA, 02364</td>
</tr>
</tbody>
</table>
Applications of geocoding

- Analysis
- Business and customer management
- Emergency response
- Spatial patterns and trends (crime, diseases…)
- So many!!
Applications of geocoding

Map by Dr. John Snow of Cholera cases in London, 1854 – an early example of geocoding!
Address best practices

- Prepare and clean your addresses
  - Check for misspellings and improper formatting
    - BAYLSTON ST or BOYLSTON ST
    - HORSENECK ROAD or HORSE NECK ROAD
    - SHEPARD STREET or SHEPHERD STREET
    - ELIOT STREET or ELLIOT STREET
    - 3 RIVER ROAD, not 3RIVER ROAD
    - GAR HWY vs GRAND ARMY OF THE REPUBLIC HIGHWAY
    - ORLEANS, not S ORLEANS or SOUTH ORLEANS
Address best practices

- Prepare and clean your addresses
- Do not use P.O. Boxes
- Put unit info in separate field
- Have town and/or ZIP Code, but you need at least one
- Beware of “vanity addresses”
- Optionally use alias table and/or place name table
- Standardize with custom code
### Address best practices

- Prepare and clean your addresses

<table>
<thead>
<tr>
<th>STREET_NAME</th>
<th>UNIT</th>
<th>GEOG_TOWN</th>
<th>COMMUNITY_NAME</th>
<th>POSTAL_NAME</th>
<th>ZIPCODE</th>
<th>STATE</th>
</tr>
</thead>
<tbody>
<tr>
<td>88 RIVER RIDGE DRIVE</td>
<td></td>
<td>BARNSTABLE</td>
<td>MARSTONS MILLS</td>
<td>MARSTONS MILLS</td>
<td>02648</td>
<td>MA</td>
</tr>
<tr>
<td>92 FALMOUTH ROAD</td>
<td>B</td>
<td>BARNSTABLE</td>
<td>CENTERVILLE</td>
<td>CENTERVILLE</td>
<td>02632</td>
<td>MA</td>
</tr>
<tr>
<td>12 GOODSON STREET</td>
<td>4</td>
<td>BOSTON</td>
<td>DORCHESTER</td>
<td>DORCHESTER CENTER</td>
<td>02122</td>
<td>MA</td>
</tr>
<tr>
<td>5 SAINT ROSE STREET</td>
<td>23</td>
<td>BOSTON</td>
<td>JAMAICA PLAIN</td>
<td>JAMAICA PLAIN</td>
<td>02130</td>
<td>MA</td>
</tr>
<tr>
<td>86 LEWIS STREET</td>
<td></td>
<td>QUINCY</td>
<td>QUINCY</td>
<td>QUINCY</td>
<td>02171</td>
<td>MA</td>
</tr>
<tr>
<td>78 DAVID AVENUE</td>
<td></td>
<td>BARNSTABLE</td>
<td>CENTERVILLE</td>
<td>WEST HYANNISPORT</td>
<td>02672</td>
<td>MA</td>
</tr>
</tbody>
</table>

88 RIVERRIDGE DIRVE         BARNSTABLE  MARSTONS MILLS | MARSTONS MILLS | 02648   | MA    |
92B FALMOUTH ROAD           BARNSTABLE  CENTERVILLE | CENTERVILLE | 02632   | MA    |
12 GOODSON STREET UN#4      BOSTON       DORCHESTER | DORCHESTER CENTER | 02122 | MA    |
5 SAINT ROSE STREET APT 23  BOSTON       JAMAICA PLAIN | JAMAICA PLAIN | 02130   | MA    |
86 LEWIS STREET PO BOX 12   NORTH QUINCY | NORTH QUINCY | NORTH QUINCY | MA    |
78 DAVID AVENUE             CENTERVILLE  | MA    |
Address best practices

- Adjust geocoding options of the locator
If you are sure your addresses are correct, but they don’t match to our data? 

Let us know! Missing addresses that we can verify will be added to our database. 

Also see Esri’s Tips for improving geocoding quality
Basic definition: Same concept as in desktop but sending the request (address) to a web server to get the response (geographic location)

Our services use the same reference data already described
Web-based geocoding services

- **Out-of-the-Box Generic**: ESRI ArcGIS Server Geocode service with MassGIS point data (Where)

  Shape:
  - **Point**: X: 236052.86181816473, Y: 901068.6080946173
  - **Score**: 100.0
  - **Address**: 1 ASHBURTON PLACE, Boston, MA, 02108

  Can be used in a search widget in Web App Builder
**Custom:** MassGIS .NET Service Application (Where plus What – what is near me, closest X, distances to Y, etc., with extra analysis with all layers we have)

- **SOAP based request and response**

- **Extra processing behind the scenes**
- **Custom-made for client needs**
Web-based geocoding services

Example: Lead screening (user provides an address)

* \(<X>236052.86068687477</X>\)
* \(<Y>901068.60647998226</Y>\)
* \(<\text{MatchedAddress}>1\ ASHBURTON\ PLACE,\ BOSTON,\ MA,\ 02108</\text{MatchedAddress}>\)
  \(<\text{OwnerName}>COMMONWEALTH\ OF\ MASS</\text{OwnerName}>\)
  \(<\text{YearBuilt}>1960</\text{YearBuilt}>\)
  \(<\text{FiscalYear}>2016</\text{FiscalYear}>\)
  \(<\text{CensusID}>250250303003024</\text{CensusID}>\)
  \(<\text{VillageName}>BOSTON</\text{VillageName}>\)
* \(<\text{Score}>100</\text{Score}>\)
  \(<\text{Lat}>42.359284651514947</\text{Lat}>\)
  \(<\text{Long}>-71.062359621291677</\text{Long}>\)
  \(<\text{MassGISID}>35005052</\text{MassGISID}>\)

* Is returned by default
Web-based geocoding services

Example: Get closest RMV office and type of service center from a user’s input address

```xml
<XML>236052.86068687477</XML>
<Y>901068.60647998226</Y>
<MatchedAddress>1 ASHBURTON PLACE, Boston, MA, 02108</MatchedAddress>
<Score>100</Score>
<Lat>42.359284651514947</Lat>
<Long>-71.062359621291677</Long>
<AddressType>Exempt</AddressType>
<MasterAddressID>35005052</MasterAddressID>
</RMVLocationsWithDistance>
</RMVsArray>
</XML>
```
Example of Reverse geocoding: (Motor Vehicle Automated Citation and Crash System: MACCS - trooper’s handheld tablet generates lat/lon and we provide other info)

- Closest Exit #
- Closest Ramp
- Closest Intersection
- Closest Street
- Closest Mile Marker
Web based client application

Sex Offender Registry Board (SORB)

https://sorb.chs.state.ma.us/sorbpublic/standardSearchforSexOffenders.action?_p=PXgnGplB8GxzM9L4m0af-jvacSDuNagxnvdMMRYNNu4

Geographical/Neighborhood Search

This search relies on GIS map distance technology that is continually being updated. If you have concerns about a street name not matching a property address or have questions about the search results, please use the City/Town or name search options.

Street Number and Street Name (both are required for accurate results): 100 Cambridge St

City/Town: BOSTON

Address Radius: Within 3 Miles

Search
Web-based geocoding services

Results on a map

Results as a list
Some clients include:

- Dept. of Public Health
- Registry of Motor Vehicles
- Public Safety (SORB, Inspection, State Trooper)
- Dept. of Education
- Health & Human Services
We can expose two methods:
- Candidate List (e.g., unit, door) and
- Best Result (highest score)

We can use Point-based and Linear reference data

We can do Geocoding and Reverse Geocoding

One potential client can be ArcMap (a custom toolbar that accesses our custom .NET service application and presents results on a map)
Thank You

Questions?

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