Maplex for ArcGIS

An ESRI White Paper

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ESRI® Maplex® for ArcGIS® is the advanced, high-quality cartographic text placement engine for ArcGIS. It extends the standard labeling capabilities of ArcGIS by introducing a wide range of placement properties, fitting strategies, and conflict resolution options. Maplex for ArcGIS provides fine control over the label placement process by allowing you to define an extensive set of label position and placement parameters through the use of a sophisticated, well-developed set of labeling algorithms. Text is placed quickly, without overlap or ambiguity, with the best aesthetic quality, reducing map production time and costs and making it possible for high-quality cartographic label placement when creating multiscale cached Web map services.

Who Uses Maplex for ArcGIS

Maplex for ArcGIS is designed for users who produce high-quality geographic information system (GIS)-based cartography. Examples include users who produce the following types of maps:

- Street and highway maps (U.S. and European styles)
- Road and town atlases
- Parcel and zoning maps
- Topographic maps
- Nautical and aeronautical charts
- Utility maps
- Oil and gas maps
- Geological maps
- Cached Web maps

The main prerequisite to use Maplex for ArcGIS is to have data in a vector format (supported by ArcGIS) that has text attribution.

Key Features of Maplex for ArcGIS

In addition to high-quality label placement and conflict detection, Maplex for ArcGIS provides many features that extend the standard labeling capability of ArcGIS such as

- Street placement techniques
- Contour line labeling
- River labeling
- Land parcel placement
- Offset label placement with leader lines
- Label stacking
- Automatic font size reduction
- Label abbreviation
- Label repetition along lines
- Word and character spreading
- Placement of formatted text
- Alignment to map projection
Benefits of Using Maplex for ArcGIS

Reduce Manual Editing Time

Text placement has traditionally been one of the most time-consuming tasks in high-quality map production. Maplex for ArcGIS can significantly reduce the amount of manual editing time by placing more labels right the first time according to your map labeling specifications. Maplex for ArcGIS label placement and conflict detection tools use a highly evolved and mature set of algorithms that work across all map layers and take into account multiple placement priorities and feature rankings. You can choose from a wide range of placement styles, fitting strategies, and conflict resolution options.

High-Quality Text Placement for Web Mapping

Maplex for ArcGIS provides high-quality text placement when editing isn't an option, for example, when creating cached map services for the Web. A cached map service is created from a set of regenerates map tiles that are stored as images and make it possible for maps to be drawn and refreshed very quickly. Maps are typically cached over large areas and at multiple scales, so that as you zoom in and out in a Web application, the map can move between scales and pan across the full extent of a study area. These areas are often too large to make it practical to edit all of the map text, and in these cases, Maplex for ArcGIS is the solution for high-quality label placement. Maplex for ArcGIS allows you to define the rules and parameters necessary for completely automated high-quality labeling. Placement rules can be defined independently for each cached scale, allowing you to customize the automated placement of text at every zoom level and provide high-quality text placement throughout the entire cached map service.

Ease of Use

Maplex for ArcGIS is easy to use. Simply selecting the Maplex Label Engine will provide enhanced labeling results. The experience of using Maplex for ArcGIS matches that of using the ESRI standard label engine. Maplex for ArcGIS label placement rules are grouped into label position, fitting strategy, and conflict resolution. Each of the label placement properties is presented with intuitive graphic examples. Labels draw quickly so that a property can be changed and the results evaluated and modified if required. Maplex for ArcGIS also provides placement rules for specific types of features including streets, street addresses, contours, rivers, and land parcels. Each of these has a unique set of placement parameters that make it easier for you to define the rules for improved label placement.

Labeling Toolbar

The Labeling toolbar is used to interactively work with the labeling engine. It provides tools such as Lock Labels, Pause Labeling, and View Unplaced Labels and provides access to the placement quality. You can select the option Fast to get draft placement, or Best to get higher cartographic quality.
Label Manager

Maplex for ArcGIS uses the Label Manager dialog box to set up the labeling properties. You can define a subset of features to be labeled using a SQL query, specify the feature attributes to use for labeling (including advanced expressions), set the text symbol (which may include a background symbol with callouts), and specify the placement properties. Each of these properties is set on a per label class basis.

Maplex for ArcGIS

Label Placement Rules

Labeling Position

Labeling Point Features

There is a wide range of options for placing labels against point features.
A common placement method for point features is to find a good position for the label around the feature, taking into account nearby features and other labels. Maplex for ArcGIS evaluates up to 96 candidate positions around every point feature before determining the best position.

When placing text around a point feature, you can indicate your preferences for zones by ranking each zone numerically. For example, you can indicate that the first attempt for placement should be in a northeast direction; second, a northwest direction; and so on. It is also possible to block certain zones from placement.
You can specify the offset of the label from the point symbol perimeter in either map units (meters, feet, decimal degrees, etc.) or page units (inches, millimeters, points) and indicate whether the label should be placed farther away from the point feature if necessary. In this situation, a maximum offset can be entered to limit the distance.

There are a number of fixed positioning methods available, such as an option to place the label centered directly on top of the feature. In these cases, it is also possible to allow a small amount of shift around the fixed position to obtain a better placement.

The angle of a label can be derived from an attribute of the associated feature, and an additional rotation angle can be added. This is particularly useful for geological maps. You can specify the coordinate system used by the angle; whether the label should be placed straight, horizontal, or perpendicular to the angle; and whether the label is allowed to flip and be placed upside down.

Labels can also be aligned to the map projection as typically seen on small-scale maps. The alignment can be tangential at the point of intersection with the line of latitude on the map or curved to follow it. Again, you can control whether the label is allowed to flip and be placed upside down.
Labeling Line Features

There are many placement methods that control whether the label should be placed on the feature itself or offset from the feature and whether the label should be horizontal, straight, perpendicular, or curved with the feature. Maplex for ArcGIS also has specific labeling options for the placement of contour lines, streets, street addresses, and rivers.

Labeling Contour Lines

Contour lines are often represented by many individual line features in a GIS, which can result in many more labels being placed than necessary. To avoid this problem, line features that represent contours can be treated as a special type. Maplex for ArcGIS groups segments of contour features if they are connected and the symbology and label properties match. In these cases, they are treated as single, long features. This allows labels to be placed for the contour as a whole rather than for each segment. Contour labels can be aligned in ladders where the label will appear to step up and step down the contours in a straight (or curved) path. These ladders can be created with labels from multiple label classes. The contour labels can be aligned to the page, ensuring that the...
label is never placed upside down or aligned to the contour elevations so that the top of the label is always facing uphill.

**Labeling Streets**

Street labeling requires a different, more complex set of rules than regular line placement, and Maplex for ArcGIS has a street placement style to take these requirements into account. The label engine is more aware of the line casing, junction connection is more sophisticated, and individual words can be moved for better placement.

The street placement methods support both a U.S. map style where street names are typically placed offset from the street and a European style where the placement is within a wide, double-cased street symbol. Properties provide control over the offset of the label
from the ends of the street and how labels are to be placed on either side of junctions. You can select word-spread placement where the words are spread along the street (and may span junctions) or character-spread placement where the label is spread along the length of the street. You can also control the distance of the label from the ends of the street.

Additional features allow the placement of labels horizontally across the street, the reduction of leading (the spacing between lines of type) of stacked labels at the end of the streets, and the placement of the primary name under the street type designation. Labels can also be placed offset from the street feature, with or without a leader line, to maximize the number of labels placed.

Labels are placed on either side of road junctions in such a way as to avoid any ambiguity as to which road is associated with which label, but without overlabeling the map. You can select whether the labels can span the road junctions, which will minimize the number of labels, or whether strictly unambiguous labeling of the junctions is required, which will result in a label being placed on either side of each road junction.
**Labeling Street Addresses**  
Maplex for ArcGIS allows street address range labels to be intelligently placed on either side of street features. The distance from the road end and the offset from the road can be easily controlled. The labels are placed in left/right pairs at the beginning and end of each street feature; if there is only one label on one side of the street, it is still placed in the correct position.

**Labeling Rivers**  
Rivers are special features that have many curves and tight bends that are not easily labeled without seeming cramped. River labeling will generalize the turns of a river and will place the label following that smoother line. River labeling will also allow the label to be placed following more than one bend. There are two placement positions for river features: centered curved and offset curved.

**Repeat Label**  
You can repeat a label along a linear feature by specifying a repetition interval. The interval represents the minimum distance that must elapse before another section of the line is labeled.
Spread Characters

The characters of a label can be stretched along the linear feature. One option is to stretch the label to the full length of the feature, or you can limit the amount of character spread (and word spacing) if required. This is useful for labeling large features on the map such as mountain ranges.

Line Label Offsets

There are many options for controlling the label's offset, both from the feature and along the length of the feature.

You can specify the distance of the label from the feature using either page units (millimeters, points, inches) or map units (meters, feet, decimal degrees, etc.), and you can constrain the offset above or below the feature (relative to the feature itself or to the map page). The offset can be measured from the perimeter of the feature's symbol or from the feature geometry (i.e., the center point of the feature).
The most common option is to allow the placement engine to find the best position for the label along the line, but you can also specify a fixed distance along the line if required. The label can be positioned along the length of the line, before the start of the line, or after the end of the line.

In each case, you can specify the anchor point on the label from where to measure, the distance (which may be a percentage of the line length), and a tolerance value to give the label some freedom of movement to either side of the fixed position.

A secondary offset range can be specified, allowing the label to be offset from the feature if it cannot be placed; a leader line can be automatically generated if required.

Labeling Polygon Features

There is a variety of placement methods for polygon features, including options to fix the position of the label in the polygon, curve the label in the polygon, place the label around the outside of the polygon, or label the boundary between adjacent polygons.
In addition to the regular polygon placement settings, there are two placement parameters for land parcel and polygon river placement.

River labeling for polygons works in the same way as river labeling for line features. Labels may be centered on or offset from the feature and can curve to follow the trend of the feature. Parcel labeling is a special option that assumes that the parcel polygon may contain an inner polygon, such as a building footprint, that can be taken into account to obtain a good position for the label.
Horizontal placement aligns the label to the horizontal axis of the page, and the curved and straight placement options align the label to the major axis of the polygon. You also have an option to try the horizontal position first. If the label does not fit inside the polygon, the label can be placed outside the polygon at a specified offset. As with point labeling, preferred zones outside the polygon can be specified. The character spacing for the label can be adjusted to stretch within the polygon to indicate the full extent of the feature.

The boundary placement option is for situations where polygons are adjacent to each other, such as a map containing state or provincial features. The label placement determines the boundaries between adjacent polygons and places a pair of labels on the boundary, creating a stacked effect.

Polygon placement takes into account all map layers in determining a good position for a label while avoiding features that fall within the boundary of the polygon. A strategy can be set up to control the placement of the label depending on the available space. For example, the label engine could be set to first attempt a curved position, then horizontal, then boundary overrun, and font height (or width) reduction before finally offsetting the label outside the polygon.
An additional parameter allows you to fix the position of a label within one of nine "zones" of a 3 x 3 grid within a polygon feature. An offset distance can be entered to move the label away from the polygon boundary and toward the center of the polygon by a specified amount.

Labels for a polygon feature (or point or line feature) can be defined as background labels. These labels are drawn first, and labels from other classes are allowed to overlap them.
**Leader Lines**

There is extensive support for text with leader lines. A threshold value can be entered so that the leader line is displayed if the label is placed (or moved) farther away from its feature, providing automatic leadering. This is especially useful for unplaced labels that are subsequently placed using the secondary offset function.

For polygon features, the position of the label anchor point can be specified. Available options include geometric center, closest point on outline, eroded center, and geometric center of the unclipped polygon (where the polygon is cut by the extent boundary). The geometric center may not always be within the polygon depending on its shape (e.g., Florida). If that is the case, the closest point on the outline is used.
Clockwise from top left are the geometric center, eroded center, unclipped geometric center, and closest point on outline label anchor point position options.

**Fitting Strategies**

A wide range of fitting strategies is used to adjust the placement of labels where there is insufficient space or there are too many labels to place in a dense area. In these cases, you have the option to stack labels, allow labels to overrun their features, automatically reduce the font size, and abbreviate specific words and text strings. You can set one or many of these placement strategies and override the default order in which these strategies are applied. For example, you may want to try abbreviation before stacking and stacking before reducing the font size.
Label Stacking

Labels can be automatically stacked onto multiple lines as Maplex for ArcGIS attempts to obtain a better label position. You can control the justification of the stack or allow the justification to be automatically determined. By default, Maplex for ArcGIS will use the generally accepted standard that labels placed to the right of a point feature are left justified, and labels placed to the left of a feature are right justified. Stacked labels placed above (or below) the feature are usually centered.

Street features are placed using predetermined stacking rules, but for other types of features, you have full control over the characters that are used to split the label text. You can specify the list of splitting characters, and for each character, you can indicate whether the character should appear on the map, whether you should stack after (or before) the character, and whether the character should force a split whenever it is encountered. Various limits, such as the maximum number of lines allowed in a stacked label, can also be specified (although curved labels are limited to a maximum of two rows).

Label Overrun

There are two types of label overrun: for a linear feature, the label may overrun the end of its line, and for a polygon feature, the label may overrun the boundary of the polygon. In both cases, you can specify a limit for the amount of overrun that is allowed.
Font Reduction

You can enable font reduction to automatically reduce the size of the label as part of your label fitting strategy. There are two forms of reduction: font size reduction, where the font height of the label is reduced and the aspect ratio is maintained, and font width reduction, where the width of the font is reduced to compress the label while maintaining the font height. You can also control the step interval and lower limit of the label reduction.
Label Abbreviation

Label abbreviation is a commonly used fitting strategy, especially on street maps. A typical requirement is to abbreviate words such as Street to St, or Road to Rd, when there is not enough space available on the map.

You can create one or more abbreviation dictionaries to specify the keywords and abbreviations to be applied. These dictionaries can be shared as text files or geodatabase tables. Each entry in the abbreviation dictionary consists of a keyword (or phrase) and its abbreviated form. There are different types of abbreviations depending on whether you want the abbreviation to apply to the last word in the label, any other word in the label, or every occurrence of the word, regardless of whether abbreviation is necessary. You can enter multiple abbreviations for a single word, and you can substitute a word with another word or even to an empty string if required.

The abbreviation mechanism recognizes Germanic languages in which the generic name is appended to the proper name, for example, Friedrichstrasse can become Friedrichstr. You can also separate the street ending with a hyphen Friedrich-str., and the label could be stacked.

In addition to user-specified dictionaries, labels can also be truncated; starting at the end of the word, first vowels are removed, then consonants. A period is added to the end of each word to indicate that it has been truncated.

In the example above, Street has been abbreviated to St in both cases. The labels are still too long to fit, so Crestfield has been truncated to Crstfl. (removing e, i, e, and d), and Belgrove has been truncated to Blgrv. (removing e, o, and e).
**Conflict Resolution**

**Label Priority Ranking**

Label priority ranking allows you to indicate the relative importance of the labeling classifications by arranging them in a list, with the most important at the top. The most important labels are placed first on the map and tend to occupy better positions.

![Label Priority Ranking](image1)

Label priority ranking is also a deletion ranking. When two conflicting labels are candidates to be removed from the map, the one with the lower ranking is removed and added to the unplaced label list.

**Feature Weight Ranking**

Feature weight ranking is used to indicate the relative importance of features on the map for determining overlap. The placement of a label will always be attempted in an area of free space first, but if an open area cannot be found, then the feature weight ranking is used to control which features will be allowed to overlap. Labels with the highest weighting are less likely to be overlapped than the features with the lowest weighting. A value from 0 to 1000 is used to indicate the ranking, where 0 allows full overlap, and 1000 designates that the feature should never be overlapped by a label from a different feature class. Note that for polygons, the interior and the boundary can be weighted separately.
In this example, a weight is applied to the river feature class, and the Little Atherfield town label is placed below the town point. When the river feature has no weight, the town label is placed on top and allowed to overlap the river.

Duplicate Labels

Duplicate labels can be removed from the map. A limit can be set to remove labels that lie within a certain distance of each other, thus reducing the amount of overlabeling, and multipart polygon features can be labeled once by taking the label attribute from the largest part only.
Formatted Text  Formatted text refers to text that contains embedded tags that change the appearance and placement of the label. Consider the example below that shows a label with its formatted text attribute.

"<LIN leading='-1.5'><CLR green='255'><FNT size='5'>" 
& [FCC] & 
"</FNT></CLR>" & vbcrlf & "</LIN> 

<BSE>" & "<CLR red='255'>" 
& [NEWFIELD] & 
"</CLR></BSE>" & vbcrlf & 

"<FNT size='4.5'>" & [LABEL] & "</FNT>"

Maplex for ArcGIS translates the tags and accurately places formatted text. In the example above, the tag BSE is used to designate the line of text that is aligned to the base line of the feature.

The tags available for text formatting in ArcGIS include
Maplex for ArcGIS

**Developer Support**

Maplex for ArcGIS is available as a set of components for developer use. You can drive the placement process directly and access the property objects that specify the labeling rules through ArcObjects™.

<table>
<thead>
<tr>
<th>Formatting Element Description</th>
<th>Tag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Font name and/or font size</td>
<td>&lt;FNT&gt;</td>
</tr>
<tr>
<td>Color (RGB)</td>
<td>&lt;CLR&gt;</td>
</tr>
<tr>
<td>Color (CMYK)</td>
<td>&lt;CLR&gt;</td>
</tr>
<tr>
<td>Bold</td>
<td>&lt;BOL&gt;</td>
</tr>
<tr>
<td>Italic</td>
<td>&lt;ITA&gt;</td>
</tr>
<tr>
<td>Underline</td>
<td>&lt;UND&gt;</td>
</tr>
<tr>
<td>All capitals</td>
<td>&lt;ACP&gt;</td>
</tr>
<tr>
<td>Small capitals</td>
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</tr>
<tr>
<td>Superscript</td>
<td>&lt;SUP&gt;</td>
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<tr>
<td>Subscript</td>
<td>&lt;SUB&gt;</td>
</tr>
<tr>
<td>Character spacing</td>
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<tr>
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<tr>
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</tr>
<tr>
<td>Line Leading</td>
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<td>&lt;BOL&gt;</td>
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<tr>
<td>Un-Italic</td>
<td>&lt;ITA&gt;</td>
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<td>Un-Underline</td>
<td>&lt;UND&gt;</td>
</tr>
<tr>
<td>Un-Superscript</td>
<td>&lt;SUP&gt;</td>
</tr>
<tr>
<td>Un-Subscript</td>
<td>&lt;SUB&gt;</td>
</tr>
<tr>
<td>Baseline (Maplex only)</td>
<td>&lt;BSE&gt;</td>
</tr>
</tbody>
</table>

**Right-to-Left Language Support**

Maplex for ArcGIS provides full support for languages that read in a right-to-left direction, and there is also support for character combining (where multiple characters in the text are combined into a single glyph for display). The automatic stacking of labels and automatic justification of the stack are appropriate for a right-to-left language and also for bidirectional labels, where the label includes words from right-to-left and left-to-right languages in the same text string.
**East Asian Text Support**

Maplex for ArcGIS provides support for proper display of vertical Asian text. For fonts with vertical text metrics, you can specify to always use vertical or horizontal characters or to flip between the two when a threshold angle is passed.

**Conclusion**

Maplex for ArcGIS provides you with a high-quality text placement capability that creates maps with clear, well-placed labels. It provides a comprehensive set of placement options, label fitting strategies, and conflict resolution methods that can easily be defined to closely match a map specification or labeling requirement.

Labeling parameters are available for many common map labeling problems including streets, contours, rivers, and parcels. The Maplex for ArcGIS automated label engine greatly improves initial text placement and minimizes the amount of manual editing required to create a high-quality cartographic product, thus greatly reducing map production time and cost. Maplex for ArcGIS also provides high-quality text placement when creating cached Web map services or for situations where text editing is not an option.

Maplex for ArcGIS is ESRI's advanced labeling solution. It is the high-end label engine for the ArcGIS Desktop\(^1\) products (ArcInfo\(^{®}\), ArcEditor\(^{™}\), and ArcView\(^{®}\)) as well as for ArcGIS Engine and ArcGIS Server.

\(^{1}\) Maplex for ArcGIS is included with ArcInfo 9.1 and higher.
About ESRI

For four decades, ESRI has been helping people make better decisions through management and analysis of geographic information. Our culturally diverse staff work with our business partners and hundreds of thousands of people who use GIS to make a difference in our world.

A full-service GIS company, ESRI offers support for implementing GIS technology from the desktop to enterprise-wide servers, online services, and mobile devices. GIS solutions are flexible and customizable to meet the needs of all our users.

Our Focus

At ESRI, we focus on promoting the value of GIS and its applications throughout the world and pay close attention to our users’ needs. Our software development and services respond to our customers with products that are easy to use, flexible, and integrated. Our technology is multidisciplinary, productive, and valuable to our users.

We have a strong commitment to educating our customers through ESRI’s various training programs. ESRI is a socially conscious business and invests heavily in issues regarding education, conservation, sustainable development, and humanitarian affairs.

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