Distributed Analysis Service

iServer distributed analysis service is based on Spark computing platform, and provides GIS distributed analysis and processing capabilities. It can access to distributed storage of geographic data, such as the data stored in HDFS (Hadoop Distributed File System), the relational data stored in iServer DataStore and the point/line/region data stored in UDB. It provides powerful spatial analysis capabilities, such as map tiles outputting, analysis and management on big data. All features provide REST API for easy development and extension.

The configuration and usage of the distributed analysis service are as follows:

1. Prepare the distributed cluster environment
2. Start distributed analysis service
3. Prepare data
4. Use distributed analysis service

There are two output formats for the result of the distributed analysis service:

1. If the current iServer has an iServer DataStore registered, then the result datasource is preferentially stored in the relational database of the iServer Datastore; and the result datasets which named analystResult_* are also listed under the %bigdatacatalog_uri%/relationship/datasets resource; and the result workspace is stored in the folder which named by the ID of the task in the %iServer_Home%/webapps/iserver\processingResultData\Analyst directory under the iServer product home directory.

2. If the current iServer does not have an associated iServer DataStore, then the result datasource and workspace are stored in the folder named by the ID of the task in the %iServer_Home%/webapps/iserver\processingResultData\Analyst directory under the iServer product home directory.
Point aggregation analysis

It means a spatial processing to create the aggregation map based on the point data. Separate the points in the map with grids or regions, then calculate the number of the points in every region and take it as the statistics value of the region, where the weight information can be used, at last display the values with different color ribbons in the regions.

The types of point aggregation analysis supported by iServer include grid aggregation and polygon aggregation, in which the grid aggregation can be divided into quadrilateral and hexagonal grid.
It needs the following parameters for the point aggregation analysis task:

- Source dataset: required, only supporting point dataset. The aggregatepoints resource page in iServer will list the datasets which meet the analysis condition.
- Aggregation type: require, specifies whether it is grid type or polygon type.
- Range: optional, specifies which points to be processed, the default is the full map range.
- Weight field: optional. The field set for the weight value. Format as: col7,col8
  - You can specify multiple fields that represent weights, separated by commas, which is to perform multiple analysis operations and each time it corresponds to different weight value.
  - **If null, the weight is 1.**
  - Whether the parameter is set or not, the condition when the weight value is 1 will be analyzed, which is to take the number of the points as the statistics value of the region. The result will be saved in the attributes field in the result dataset.
o When this field is set, the Statistics mode should be set also, and the two should correspond to each other.
  • Statistics mode: Optional. Supported modes include: max, min, average, sum, variance, stdDeviation. The field should be have the same count with the count of the Weight fields.

If choosing grid aggregation map, it also needs to set the following parameters:
  • Grid type: required, including quadrilateral and hexagonal grid.
  • Grid size: required. For quadrilateral grid, it is the edge length; for hexagonal grid, it is the distance from the vertex to the center of the hexagon. The default value is 10.
  • Grid size unit: Optional: Meter, Kilometer, Yard, Foot, Mile (default is Meter)

If choosing region aggregation map, it also needs to set the following parameters:
  • Aggregation region dataset: required, its type should be region dataset. Specify the region objects the input data needs to be aggregated to, such as administrative division regions.

Density analysis

The density analysis in distributed analysis services includes both simple point density analysis and kernel density analysis.
  • Simple point density analysis: it is used to calculate the value per unit area within the specified neighborhood scope for each point. The calculation method is that the specified neighborhood area divided by the measured value of the points. When the neighborhood areas overlap, the density also increases. Each output grid is the sum of all the neighborhood density values imposed on the grid. The unit of the raster value is the reciprocal of the square of the
original dataset, that is, if the original dataset is in meters, the unit of the result raster value is in square meters.

- Kernel density analysis: used to calculate density per unit of the point, line feature measurement value in the specified neighborhood. In simple terms, it can visually reflect the distribution of discrete measurements over successive regions. The result is a smooth surface with big values in the center and small values around. The grid value is the density and is reduced to 0 at the boundary of the neighborhood. Kernel density analysis can be used to calculate population density, building density, access to crime reports, population monitoring of tourist areas, chain stores operating analysis and so on.
When you create a density analysis task, you need to set the following parameters:

- **Source dataset**: Required parameter. The point dataset supported only. iServer's density resource page automatically lists the datasets that meet the analysis criteria.

- **Analysis method**: required parameter. Specify whether the analytical method is simple point density analysis or kernel density analysis.

- **Grid mesh type**: required parameter. Specify whether the grid mesh is a quadrilateral mesh or a hexagonal mesh.

- **Weight value field**: optional parameter. Specify the set of field names where the weight values of the points to be analyzed are located. Format: col7,col8
  
  - You can pass multiple field indexes that represent weights, separated by commas. It is equivalent to make multiple times of analysis for the points to be analyzed. For each time you correspond to different weight values.
  
  - If the parameter is empty, the weight of the point is 1.
  
  - Regardless of whether the value is set or not, the case where the weight value is 1 is automatically analyzed. The results are in the attribute table field of the result dataset.

- **Analysis range**: Points outside the analysis region will not be participated in the calculation. By default, the range is the full range of the input data.

- **Mesh size**: for the quadrilateral mesh, the size is the mesh edge; for the hexagonal mesh, the size is the distance from the hexagonal vertex to the center point. The default value is 10.

- **Mesh Size Unit**: Optional: Meter, Kilometer, Yard, Foot, Mile (default is Meter)

- **Search Radius**: The default value is 100

- **Search Radius Length Unit**: Optional: Meter, Kilometer, Yard, Foot, Mile (default is Meter)
Area Unit: the denominator unit of the density. Optional: SquareMeter, SquareKiloMeter, Hectare, Acre, SquareFoot, SquareYard, SquareMile (default is SquareMile)

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**Single object spatial query analysis**

Spatial query is a query method that selects map features based on their spatial relationships to other feature. For example, if you want to know the number of five-star hotels within 5km of Olympic venues in Beijing, you can first make a 5 km buffer of the Olympic venues; search the hotels within these buffers using the Containing query method; then, from the result hotels, find the hotels whose star level is 5 using attribute query and the final result can be obtained.

The single object spatial query in a distributed analysis service means that only one object in the query dataset is used for the spatial query. If there are multiple objects in the query dataset, the object with the smallest SmID defaults to the used object.
You need to set the following parameters:

- Source dataset: Required parameter, specify the dataset to be queried. The query resource page in iServer will list the datasets which meet the analysis condition.

- Query dataset: Required parameter, which refers to the dataset where the query object is located. Only the single object query is supported. If there are multiple objects in the query dataset, the object with the smallest SmID defaults to the used object.

- Spatial Query Mode: Different spatial query modes have different requirements for the type of source and query datasets.
  
  - Coincidence, separation, contain, intersection, adjacency, contained: The source dataset and the query dataset types are point, line, or region.
  
  - Crossover: Requires the source dataset type to be a line; the query dataset type must be a line or a region.
  
  - Overlay: The source dataset type and query dataset type must be line / line or region/ region.

Summary region analysis

It means a spatial processing to create the aggregation map based on the line/region data. Use the grid or polygon to separate the line/region features on the map, and then make statistics with standard attribute field or weight field for each grid
The concept of summary region analysis is similar to the concept of point aggregation analysis. The difference is that the point aggregation analysis is the statistical calculation of the point dataset, and the summary region analysis is the statistical calculation of the line dataset and the region dataset.

In the concept of summary region analysis, there are two statistical methods for the grid cell statistics value, by standard attribute field and weighted field. It will be explained with picture 1. Figure 1 is the summary region analysis based on quadrilateral grid, the figure shows the grid unit has two line objects, line object A and line object B. Where the total length of line object A is from A1 to A4, but only the part from A2 to A3 is in the grid; the total length of line object B is B1 to B3, but only the part from B1 to B2 is in the grid. Here it takes the "length" field in the line dataset to "sum" statistics.

- **Statistics with the standard attribute field**: that is, the original attribute field information of the line or region objects in the grid unit is calculated.
  - The length value of the line object A (that is, the total length of the part from A1 to A4) is 364.11
  - The length value of the line object B (that is, the total length of the part from B1 to B3) is 165.01
  - With the "sum" statistical model, the statistical result is 364.11 + 165.01 = 529.12

- **Statistics with the weighted attribute field**: that is, the value is calculated from the attribute information of the intersecting part. The attribute information of the intersecting part is calculated from the weighted value of the standard attribute field.
  - The analysis algorithm intercepts the line object A at the A2 and A3 points, calculates the proportion of the A2A3 part in the entire line object A, through the length value of the line object A (ie, the total length of A1 to A4) 364.11, to calculate the attribute value of A2A3 is 79.70;
  - The analysis algorithm breaks the line object B at B2 and calculates the proportion of the B1B2 part in the entire line object B. through the length value of the line object B (ie, the total length of B1 to B3) 165.01, to calculate the attribute value of B1B2 is 31.72
  - With the "sum" statistical model, the statistical result is 79.70 + 31.72 = 111.42
It needs the following parameters for the summary region analysis task:

- Source dataset: required, only supporting line/region dataset. The summary region resource page in iServer will list the datasets which meet the analysis condition.
- Summary type: required, specifies whether it is grid type or polygon type.
- Range: optional, specifies which features to be processed, the default is the full map range.
- Statistics with the standard attribute field: that is, the original attribute field information of the line or region objects in the grid unit is calculated.
Users need to choose this type or "Statistics with the weighted attribute field", that is, one of both.

- Field name: Sets the field name for the standard attribute field statistics.
- Statistical mode: Sets the statistical mode used for standard attribute field statistics.
  - Statistics with the weighted attribute field: that is, the value is calculated from the attribute information of the intersecting part. The attribute information of the intersecting part is calculated from the weighted value of the standard attribute field. Users need to choose this type or "Statistics with the standard attribute field", that is, one of both.
  - Field name: Sets the name of the field for the weight field.
  - Statistical Mode: Sets the statistical mode for weighted attribute field statistics.
  - Whether the length or area is for statistics: If the source dataset is a line dataset, the length of the line is counted as part of the statistical result; if the source dataset is a region dataset, the area of the statistical surface is taken as part of the statistical result.

**If choosing grid summary region analysis, it also needs to set the following parameters:**

- Grid type: required, including quadrilateral and hexagonal grid.
- Grid size: required. For quadrilateral grid, it is the edge length; for hexagonal grid, it is the distance from the vertex to the center of the hexagon. The default value is 10.
- Grid unit: required. Optional: Meter, Kilometer, Yard, Foot, Mile (default is Meter)

**If choosing region summary region analysis, it also needs to set the following parameters:**

- Summary region dataset: required, its type should be region dataset. Specify the region objects which need to be collected, such as administrative division regions.
Vector clip analysis

Clip vector data. Vector clip includes inside clip and outside clip. For inside clipping, the portion of the clipped vector dataset within the clipping region is retained in the result dataset; for outside clipping, the portion of the data that is not within the clipping region is preserved the result dataset.

For vector clip in distributed analysis services, it is only supported to clip the source dataset with one object from the clip dataset. If there are multiple objects in the clip dataset, by default, the object with the smallest SmID value will be used to clip the source dataset.
Figure 1: Source Dataset (region dataset in blue) and Object in Clip Dataset (Orange Circle) Figure 2: The Result of Outside Clip
When creating an analysis task of vector clip, you need to set the following parameters:

- Source dataset: Required parameter. Specify the dataset to be clipped. The iServer vectorclip resource page automatically lists the Datasets That Meet the Analysis Conditions.
- Clip dataset: Required parameters. The dataset that contains the object to clip the source dataset.
- Clip Mode: Required parameters, including inside clip and outside clip.

Configuring the distributed analysis service

iServer supports configuring distributed analysis service in a visual way. To start the distributed analysis service it needs to start Spark cluster and the distributed analysis service. You can use the built-in Spark in iServer to create cluster. Before creating cluster, you need to make necessary settings, please see Prepare the environment to use the built-in Spark in iServer. You also can create Spark cluster service in other computer. After specifying the Spark cluster, access iServer web manager>Cluster to set. After creating Spark cluster, open the distributed analysis service tab to start the distributed analysis service.

After starting the distributed analysis service, you can add rich visual rendering effects to your published services by setting up thematic templates.

> Setting thematic map template
Setting thematic map template

- How to set thematic map template
- Make a template file
  - The thematic map template for density analysis, densityrange.xml
  - Template for the point aggregation analysis template, the scope set template file summarymeshrange.xml
  - Template for the point aggregation analysis template, the label set template file summarymeshrange.xml

How to set thematic map template

To enrich the visual effects of distributed analysis results, iServer supports setting up theme templates for the results of distributed analysis. You can customize the thematic map template, or you can export the template file from the iDesktop. To set up a thematic map template for distributed analysis results, follow these steps:

1. Create a folder named processingjobthemetemplates under % SuperMap iServer_HOME% / webapps / iserver and place the appropriate template files under the folder, with the following naming convention:
   - The thematic map template for density analysis is named densityrange.xml
   - Template for point aggregation analysis:
     - The range setting template file name is summarymeshrange.xml
     - The label setting template file name is summarymeshlabel.xml

2. Add content to each template file. If you are exporting a template file from iDesktop, refer to step 1 and rename it.

3. Restart iServer, create a distributed analysis task, after the analysis is complete, browse the automatically published map service through the client to see the visual effects.

Make a template file
Copy the following example and paste it into the template file you created to create the thematic map template. The value can be modified according to your needs.

The thematic map template for density analysis, densityrange.xml

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  <sml:ThemRepreFieldName/>
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22/47

Add: 6/F, Building 107, No. A10, Jiuxianqiao North Road, Chaoyang District, Beijing, 100015, CHINA, 100015
E-mail: request@supermap.com Website: www.supermap.com
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Template for the point aggregation analysis template, the scope set template file summarymeshrange.xml
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Template for the point aggregation analysis template, the label set template file summarymeshrange.xml

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  <sml:Caption>analystResult@UntitledDatasource</sml:Caption>
  <sml:Visible>TRUE</sml:Visible>
  <sml:MinVisibleScale>0.00000000000000000000e+000</sml:MinVisibleScale>
  <sml:MaxVisibleScale>0.00000000000000000000e+000</sml:MaxVisibleScale>
  <sml:ExtendExpressions/>
  <sml:IsUseRepresentation>FALSE</sml:IsUseRepresentation>
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  <sml:FieldExpression>RecordCount</sml:FieldExpression>
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  <sml:FontColorExpression/>
  <sml:FontSizeExpression/>
  <sml:FontAngleExpression/>
  <sml:LabelOverLengthMode>None</sml:LabelOverLengthMode>
  <sml:SplitSeparator/>
</sml:Theme>
```
Add: 6/F, Building 107, No. A10, Jiuxianqiao North Road, Chaoyang District, Beijing, 100015, CHINA, 100015
E-mail: request@supermap.com
Website: www.supermap.com
Preparing data

The input data sources supported by the iServer distributed analysis service include the following. After the data is ready, iServer will filter out all the datasets which meet the analysis condition when creating the distributed analysis service.

- The relational dataset stored in iServer DataStore
- The dataset in the big data sharing file
  - Shared directory
  - The distributed file storage HDFS directory
- The dataset stored in the spatial database

iServer DataStore

iServer DataStore is an application that allows you to quickly create data storage and associate the data storage with iServer. For how to build the DataStore distributed environment, please refer to build DataStore distributed environment.

The relational datasets in iServer DataStore are from the two sources:
- Create dataset: in the %bigdatacatalog_uri%/relationship/datasets page, you can create a dataset without any feature. You can connect to DataStore with iDesktop then add features.

- Import dataset: in the %bigdatacatalog_uri%/relationship/dataimport page, you can import a dataset. Supported formats are: CSV, UDB, workspace, and Excel. After imported successfully, the imported datasets will list on the %bigdatacatalog_uri%/relationship/datasets resource.

### Big data file sharing

The iServer administrator can register the CSV file, the UDB file, and the HDFS directory as iServer's large data file sharing. For the registration method, see Register the large data file sharing. The datasets in a large data file sharing that is registered successfully will appear in the datasets resource of the data category service and will also be used as input data for the distributed analysis service.

**The csv data files registered to iServer need to be validated for distributed analysis services.** The validation method is:

1. Access the data register page: http://localhost:8090/iserver/manager/datastores, if it registered a file directory, continue to click Storage ID, to open the dataset list
2. In the dataset list, the "Status" column with a question mark indicates that the file is not validated
3. Click the csv dataset name, specify X/Y index in the popped up dialog.
4. Click OK. When its status is changed to , it means it is validated successfully.

If you use distributed analysis services for csv data that is not registered in iServer, you also need to ensure that there is a .meta file in the csv storage path that contains meta information for the csv data file. Take the demo data newyork_taxi_2013-01_14k.csv as an example, the content of the .meta file is:

```
"FieldInfos": [  
    {  
      "name": "col0",  
      "type": "WTEXT"  
    },  
    {  
      "name": "col1",  
      "type": "WTEXT"  
    },  
    {  
      "name": "col2",  
      "type": "WTEXT"  
    },  
  
```

"name": "col2",
"type": "WTEXT"
},
{
"name": "col3",
"type": "INT32"
},
{
"name": "col4",
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{
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"type": "DOUBLE"
},
{
"name": "col12",
"type": "DOUBLE"
},
Spatial database

The iServer administrator can register the Oracle and PostgreSQL databases as the spatial database of iServer through the "Register data storage" function on the "Cluster" "Data registration" page. For the registration method, please refer to the Register spatial database. The datasets in the spatial database that is registered successfully will appear in the datasets resource of the data category service and will also be used as input data for the distributed analysis service.

Using distributed analysis service by iServer REST API

iServer distributed analysis services currently support outputting images and spatial analysis. All features have their REST API, which can be used to create processing tasks by executing POST requests.

The system administrator can also create a GIS service by accessing the processingJobs resource page in iServer to create a spatial analysis task. Here's how to create a spatial processing task from the REST API resource page.

Note: Only the user who belongs to the PUBLISH or ADMIN role can create the task.

Here are the steps to create an analysis task:

1. After the distributed analysis service is enabled, enter the iServer service resource page, such as http://supermapiserver:8090/iserver/services.
2. Go to the "distributedanalyst/rest" service resource and click to go to the "jobs", "spatialanalyst" resource page. The current spatial analysis operations support density analysis, point aggregation analysis, single object overlay analysis and other functions. According to your needs, click to enter the space analysis resource page that needs to be executed.

3. Click Create Task in the upper right corner.

4. Fill in the spatial analysis task configuration, with "*" is required information.

5. When you finish, click Create Analysis Task. The page will automatically jump to the task being executed, and display the configuration information, until the task is completed, it will automatically publish the service address.

For an introduction of the relevant REST API, see processingJobs.

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**Using distributed analysis services by iDesktop Cross**

SuperMap iDesktop Cross 9D supports the use of iServer's distributed analytics service by creating visual modeling.

1. Click the "Toolbox" button on the iDesktop Cross 9D menu bar and select "Online Analysis" to see the various analysis tasks supported by the iServer Distributed Analytics service.

2. Select the analysis task you are interested in, here we select Kernel Density Analysis, for example, in the pop-up dialog box, fill in the iServer service address, administrator user name and password, and set the analysis parameters, as shown below:
3. Click the Run icon in the lower-right corner of the Create Analysis Task dialog box to perform a distributed analysis task.

4. After the task is finished, the map window automatically displays the result dataset; you can also view the result datasource and result dataset in the Workspace Manager.