Analysis Workspace Framework

Version: 1.5

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# System requirements

The software is build upon Smallworld 5.3 core. No TSBs are required.

# Installation

The Analysis Framework is delivered as a Smallworld product, consisting of 3 modules:

* analysis\_workspace: the core analysis collections.
* analysis\_workspace\_framework: the framework, plugins and dialogs to perform analysis.
* analysis\_workspace\_test: test module to run on munit in a Cambridge environment.

1. First load the analysis\_workspace\_framework module using either sw\_module\_dialog or the sw\_module\_manager.
2. Next add the snippet:

<plugin name="analysis\_plugin" class\_name="rwan:framework\_plugin"/>

To the config.xml of your application.

1. Next add the snippet:

<action name="analysis\_plugin.activate\_framework"/>

To the gui.xml of your application.

# Concept

The main concept in the AF is usage of analysis collections. You don’t work directly with the collections, geometries and trail in the application directly. You first add them in one way or another as an analysis collection to the AF. Then you create your analysis based on the analysis collections.

As a simple example: If you want to search for all hotels in some trail, you do the following:

1. Set a trail and add it to the AF with . Name it “Search area”
2. Add the Hotel collection to the AF with 
3. AF will look like this:

Afbeelding met tekst, schermopname, Lettertype, software

Door AI gegenereerde inhoud is mogelijk onjuist.

1. Select both collections and click on the filter 
2. A dialog opens and you can select the operation “Within”. Ok.
3. AF will look like this:

Afbeelding met tekst, Lettertype, software, Webpagina

Door AI gegenereerde inhoud is mogelijk onjuist.

1. The top collection represents the hotels in the trail.
2. Now you can use that collection to continue your analysis, for example search for hotels near a park etc. You can also export the result to Excel immediately.

There are 3 basic analysis collections: Record collections, Geometry collections and Area collections.

## Record collections

Record collections contain records. Before you do any analysis, you need to add the relevant smallworld collection from the application to the AF. The AF only works on the data that is available in AF.

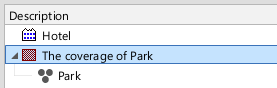
You can use  to select the available smallworld collections in the application to add to the AF. You can also select a few objects in the map and add their underlying smallworld collections to the application with . Also you can use the Explorer or Scrapbook to get your records.

## Geometry collections

Geometry collections contain geometries. For spatial analysis you need a geometry collection as the spatial component. For example, if you want to find hotels near a park coverage then you need to create a geometry collection for the park coverage.

You should do the following in that case:

1. Add Hotels and Parks to AF using 
2. Select Parks and use  to create a spatial collection for Coverage
3. AF will look like this:



1. Select Hotel and “The coverage of Park” both and use  to filter on distance. Enter 100 m as the distance.
2. AF will look like this:

Afbeelding met tekst, Lettertype, lijn, software

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1. You can no view the result by highlighting the hotels or exporting them to Excel

You can use  to convert the trail to a geometry collection, for example to find the pubs within the trail. You can use  to convert a record collection to a geometry collection by picking the geometry to use.

## Area collection

Area collections contain an area. The area can be complex and contain polygons and holes. You use area collections to manipulate areas using typical areal functions like Union, Xor, Intersection, Subtraction.

You can use  to convert a closed trail to an area collection or use the buffer operation  on a record collection.

Typically you will use the area collection to build up a specific area then look for records inside that area.

## Approach

Note that you must think in reverse to solve your problem. Say for example you want to know the Restaurants of French cuisine that are near a park.

You would go about it like this:

1. Add the park collection 
2. Use the Buffer  function to build an area collection on it with a certain distance (50m)
3. Add the restaurant collection 
4. Build a predicate  filter on it for cuisine = French
5. Spatially combine both based on the location of the restaurant to be in the buffer .

The result is one Restaurant, “Midsummer House”.

Afbeelding met tekst, schermopname, diagram, software

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# GUI

The main GUI of the AF is like this:

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**Workspace**

**Tools**

**Execution**

It consists of 3 areas:

1. The tools area contains toolbar buttons and menu buttons
2. The workspace area shows the analysis collections in the chosen workspace. You can add more workspaces and switch between them.
3. The execution has tools to show the results of the analysis collections. Either send to the explorer, goto the area in the map or highlight it in different colors.

# Open, Close and Save

The AF uses a dataset to store the analysis collections. When the AF is started for the first time, there is no dataset yet. So you first must create a dataset by using File|New … The dataset can be created on a local drive or a network drive. The AF needs single user access to the dataset, the dataset can not be shared with other users.  
When the AF is started for the second time the last dataset is opened automatically.

The title of the main framework will show the filename and location of the dataset.

If any changes are made in the framework then title show asterisks to indicate change.



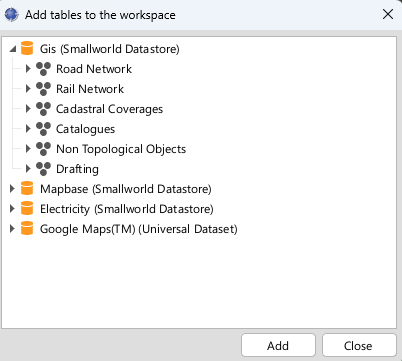
Save your work to avoid losing changes.

# Adding collections

Each analysis will start with some analysis collection at its core.

## Add Smallworld collection

This will open a dialog to select one or more Smallworld collections. Press Add to add them to workspace (or doubleclick).



## Add Shapefile

Read a shapefile and create a materialized collection in the Analysis dataset from it. Note: the coordinate system of the shapefile is ignored, the coordinates are imported in the coordinate system of the application.

Afbeelding met tekst, schermopname, software, nummer

Door AI gegenereerde inhoud is mogelijk onjuist.

Use the  button to open the shapefile. That will show the attributes in the shapefile. Next:

* Check the attributes that you want to copy.
* Enter a table name.
* Enter the scale to apply during import. Often Smallworld uses [mm] while the shapefile will use [m]. In that case use the scale of 1000 to convert.
* Press OK to import.
* Notepad will open with log information.

If you like to check the imported data, use Refresh Application 13.1.1 to update the Object Control.

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You can now use the Object Editor, the Browser and other Smallworld tools to analyze the imported data. The style of the geometries will be the default style, since the ACE is not configured obviously for this data.

*Quick note: if you are using the Cambridge training database for release 5.3, note that the default style for points is not configured correctly and it will look like shape points are not visible. Fix the styles and it will be ok.*

## Add trail

This will add the trail to the workspace. If the trail is closed then an area collection is added, otherwise a geometry collection. An area collection can typically answer questions about what is inside, a geometry collection is more likely used to answer what is near.

For a single point trail

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For a closed trail

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## Add selection

This will add the selection in the main map to the workspace. Each geometry type will be converted to a separate geometry collection, except for the areas who will be combined in one area collection.

This is the result of a large selection in the Cambridge environment:

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## Add selection collections

This will add the collections of the selection on the map. This way you don’t have to look up the collection in a large list but you can simply select the element from the collection in the map.

## Add from explorer

This will add all elements from the explorer window in the workspace. If you have a lot of records in the explore this will take a long time.

## Add from explorer selection

This will add the selected elements from the explorer in the workspace. If you have a large selection this will take a long time.

## Add from scrapbook

This will add elements from the scrapbook to the workspace.

# Filter collections

There are three basic operations to filter an analysis collection; either filter by geometry, by distance or by predicate.

## Filter by geometry

This will filter a collection by only allowing records that have a certain geometrical interaction with another collection. For this to work you will have to select a record collection (the one to be filtered) and an area or spatial collection.

The following dialog will open:

Afbeelding met tekst, schermopname, diagram, Perceel

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Select the geometry of the source collection that should be tested. Next select the operation that should limit the source. Note that the picture will change for each Operation as to clarify what is meant by it. Click Ok to acknowledge.

If you want to combine two record collections, then you have to convert one of them to a geometry collection using .

## Filter by distance

This will filter a collection by checking for the distance to another object. Only the records that are near the object will be yielded. Use this filter to find objects near another one. You have to select a record collection for this to work since they are the only ones having records.

The following dialog will open:

Afbeelding met tekst, schermopname, scherm, Lettertype

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Select the geometry field to apply to and enter the distance to use. If you want the objects outside the given distance then toggle Inverse?. By default the object within the given distance are returned.

Click Ok to acknowledge.

## Filter by predicate

This will filter a collection by applying a predicate to it. You have to select a record collection for this to work since they are the only one having records to test predicates.

The following dialog will open:

Afbeelding met tekst, schermopname, scherm, nummer

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Construct a predicate to limit the records that are found in the source collection. Note that there is list of indexes available to the collection. The list is only there for information, predicates based on indexes are much faster than others.

Click Ok to acknowledge.

# Follow collections

Follow collections travel from one table to another using different mechanisms. Either by following topology, tracing out, following a join, executing a method or by yield root records.

## Topology collection

This will yield the topological connected objects from a chosen table. You have to select a record collection for this to work.

The following dialog will open:

Afbeelding met tekst, schermopname, scherm, Lettertype

Door AI gegenereerde inhoud is mogelijk onjuist.

Select the geometry to test and the collection to yield.

Click Ok to acknowledge.

Note that the collection will not yield the same target object twice.

## Trace collection

This will yield the object that are found while doing traces starting at the records of the chosen table. You have to select a record collection for this to work.

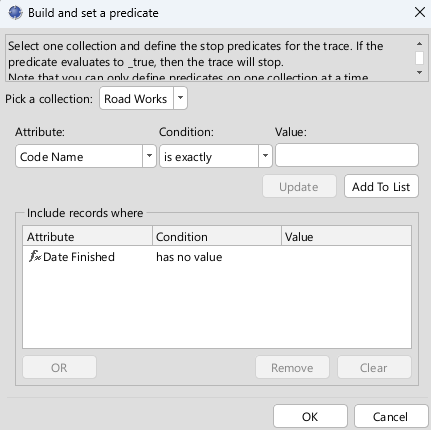
The following dialog will open:

Afbeelding met tekst, schermopname, software, scherm

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You can set a maximum distance for the trace. The input is in values of length, so you can enter “1m” or “1000 mm”.

You can also set stop predicates to guide the trace. If any of the predicates evaluate to true, then the trace will stop at that object.  
Use the buttons to either add, edit or delete a predicate.  Both Add and Edit will open e new dialog to construct a stop predicate. The following dialog will open:



This dialog works similar to the dialog for the predicate filter dialog. If there is no predicate formulated, the trace will stop at any instance of that collection. Press OK to apply the collection and the predicate (can be empty) to the Trace Dialog.

When you press OK in the Trace Dialog, the collection is added to the workspace.

## Join collection

This will yield the joined objects from the chosen table. You must select a record collection for this to work.

The following dialog will open:

Afbeelding met tekst, schermopname, Lettertype, nummer

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Select the join to follow into the target collection. Note that heterogeneous joins are not supported.

Click Ok to acknowledge.

Note that the collection will not yield the same target object twice.

## Method collection

This will create a collection that uses a customized method to yield records from another table. The developer should provide the software for this to work. Basically anything can be provided here what can be programmed. For example, on the collection of supply point could be a method that yields the feeding transformers.

The following dialog will open:

Afbeelding met tekst, schermopname, scherm, software

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Select the method to invoke and click OK to acknowledge.

Note that the collection will not yield the same target object twice.

If you like to define your own custom methods, please check **min\_road.rwan\_methods** as example.

## Root collection

This will yield the root records of one of the collections that make up the selected collection. An example can clarify this:

Suppose you have an analysis collection that follows the topology of roads to the hotels with a predicate on type. This will give you all the hotels you need, but suppose you now want the roads that led to the hotels in question. That is where the root comes in.

Suppose you have the following setup:

Afbeelding met tekst, schermopname, diagram, software

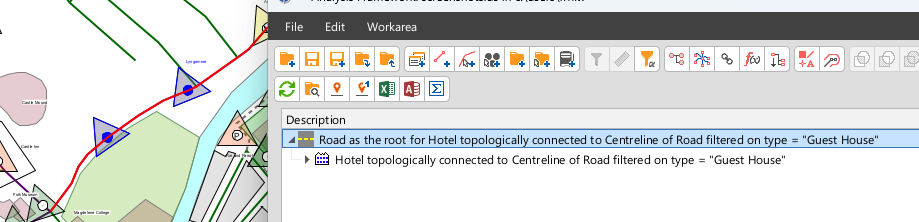
Door AI gegenereerde inhoud is mogelijk onjuist.

Select the top analysis collection and invoke the root dialog. The following dialog will open:

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Click OK to acknowledge. When highlighting this leads to the following map:



This looks correct, the blue hotels are the hotels with correct type and the red lines are the road connected to it. Note, again, that the root collection will not yield the same target object twice.

# Geometry operators

There are two functions that create geometry collections, one simply selected one geometry from a collection and the other builds a buffer around a geometry.

## Geometry collection

Select a record collection and invoke the dialog. The following dialog will open:

Afbeelding met tekst, schermopname, Lettertype, nummer

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Select the geometry to require and click OK to acknowledge.

## Buffer collection

Select a collection and invoke the dialog to create a buffer around it. The following dialog will open:

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Select the geometry that you want to buffer. Next enter the distance the buffer should be from the geometry.

Optionally you can select the way the corner and the ends are modeled.

Click OK to acknowledge.

Note that the buffer function is rather time consuming so you want to thinks about materializing it for further analysis. Also note that if you only are using the buffer to find objects nearby you rather should use the distance filter because that is more efficient with memory and performance.

# Set operators

The AF provides basic set operators, namely intersection, subtraction, union, xor

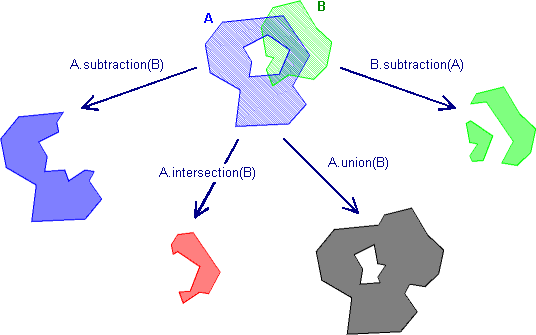
* Intersection: yield the elements or the part that is contained in both.
* Subtraction: yield the elements or the part that is in one, but not in the other. Obviously, the order of the collections of important here.
* Union: yield the elements or the part that is combination of both.
* Xor: yield the elements or the part that are unique to each element.

These operators can be applied to record collections, area collections and spatial collections.

## Area collections

All area collection can be combined with these operators.

For area operators:



For subtraction the order of the operation is important. So for that function a dialog is available:

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Accept the order of the operation or click Swap to swap the order. Click OK to acknowledge.

## Record collections

Set operators only make sense for records collections of the same base collection.

If the starting set of collections is like this:

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Then a set operator can detect which roads belong to both sets.

## Spatial collections

Set operators only make sense for spatial collections when they are dealing with the same type of geometries. There is no sense in subtracting point from lines, because they will never match.

# Views

A view is a collection that combines the attributes of two collection. The AF supports two types of views, views defined by a join and views defined by a common attribute.

## View on join

This creates a collection that is a combination of attributes from two collections that are joined by a join. This function only works on analysis collections that directly relate to a smallworld collection, it will not work on a filtered collection, set collection, etc.

The following dialog will open:

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In the left list you must select a join field and click the Link button. This will fill the middle list with attribute values. Note that heterogeneous joins are not allowed, neither are cross dataset joins.

* Next check the boxes of the fields you want to appear in the target collection. You can include geometry fields.  
  You should enter the name of the new collection at the label “Collection”. You can use spaces in the name, the AF will create a correct internal name for you.
* You can also rename the target fields by clicking in the column “New Name”.

Press ok to create a new collection in the source dataset. Note that the view is created in the source dataset not in the analysis dataset. In the example above the view collection will be added to the GIS dataset.

The resulting collection can be send to the explorer or highlight, but also become the base collection for further analysis, filtering, etc.

The resulting records can be send to the explorer and they will look like this:

Afbeelding met tekst, schermopname, Lettertype, nummer

Door AI gegenereerde inhoud is mogelijk onjuist.

## View based on common attribute

This creates a collection that is a combination of attributes from two collections that are joined by a common attributes. This function only works on analysis collections that directly relate to a smallworld collection, it will not work on a filtered collection, set collection, etc.

You need to select two collections for this function.

The following dialog will open:

Afbeelding met tekst, schermopname, software, Computerpictogram

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In both the left and right list you should select the attribute that is used to match the collections. In this example the id from company is selected and the company\_id from office is selected. Next click the Link button to link the collection. The resulting equation is displayed at the “Relation” label.

* Next check the boxes of the fields you want to appear in the target collection. You can include geometry fields.  
  You should enter the name of the new collection at the label “Collection”. You can use spaces in the name, the AF will create a correct internal name for you.
* You can also rename the target fields by clicking in the column “New Name”.

Press ok to create a new collection in the source dataset. Note that the view is created in the source dataset not in the analysis dataset. In the example above the view collection will be added to the GIS dataset.

Click OK to acknowledge.

The resulting collection can be send to the explorer or highlight, but also become the base collection for further analysis, filtering, etc.

# Materialize

Most analysis collections are lazy evaluated. This means that you can create them quickly and the performance hit only comes when you use them in the explorer or when highlighting.

However some analysis will take a long time and you don’t want to repeat the analysis over and over to wait and wait for an answer. In that case you can materialize the analysis collection to the analysis dataset. This involves basically a copy of the collection.

You can materialize a record collection or an area/spatial collection.

## Materialize record collection

This will copy an analysis collection to the analysis dataset.

The following dialog will open:

Afbeelding met tekst, schermopname, scherm, software

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You can do the following:

* Check the fields you can in the new collection.
* Rename the fields by clicking in the Target Field column.
* Choose a different join aspect field for the 1:1 joins. In this example the join aspect is company\_name, but if you click in the join aspect column a combobox lets you chose a different value

Note that heterogeneous joins are not support. 1:n joins will automatically be converted to integers and the field will contain the number of matching elements.

Click OK to acknowledge. The label at the bottom will inform you of the progress of the operation as this may take a long time. You can abort the operation by clicking the abort button on the bottom right.

The resulting collection can be sent to the explorer or highlight in the map, but it can also become the base collection for further analysis, filtering, etc. Note that the highlight function will not draw the objects as you might expect them to do. Because the table is a copy of the original, the styling will not match the originals. This will typically be noticeable for the point objects. The highlight points are big red circles.

## Materialize geometry collection

This will copy a geometry or area collection to the analysis dataset. Select the appropriate collection and invoke the dialog.

The following dialog will open:

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Click OK to acknowledge. The geometry will be materialized and notepad will open to show the results of the process.

# Utilities

 Will open the dialog that created the analysis collection and you can change parameters.

 Will delete the current analysis collection. If the analysis collection is composed of other collections, then these collections will become available in AF again.  
Note that for large materialized collections this can take a while.

 Will copy the collection. Note that not really the content is copied but rather a new reference to the same content is made. This means that a copy of a large materialized collection is very fast.

Will open a dialog to pick a color to highlight the selected analysis collection.



 Will move the current selected analysis collection up in the list

 Will move the current selected analysis collection down in the list.

## rename

Each analysis collection can be renamed. Simple click on the name and enter another description.

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Door AI gegenereerde inhoud is mogelijk onjuist.

# Execution

There are 7 tools to evaluate your analysis results: explorer, goto, goto1, refresh, excel and access. These can all be time consuming so they are performed in a background thread. You can interrupt the execution with an abort button on the bottom right of the dialog.

## Explorer

This obviously only works for analysis collections that have records. It makes no sense for buffers or geometry collections. The explorer will use lazy evaluation when possible, this means that the first couple of records should appear pretty quick. When you scroll down the analysis collection is evaluated further to yield the follow results.

Note that the first time the explorer is used there is a significant delay to start the explorer. So be patient…

Also note that the explorer is \*not\* the explorer from the application but a local explorer in the workspace framework. The reason for that is a bit nasty, but in practice the application explorer is extended with customer and 3th party components that slow down large exports to the explorer or even crash the explorer. We have discovered this in several configurations so the analysis framework uses a clean local explorer to make sure the explorer will work as expected.

## Goto

This will zoom the current map to the extent of the results of the analysis collection.  
Note that for this function the entire analysis collection has to be scanned to construct the bounds. So this function will take as long as a full export of the collection…

## Goto 1

This will zoom to the first element in the collection. Use this to investigate how an element looks that satisfies your collection definition.

## Refresh map

This will bring the map to the foreground and highlight all the checked items in the workspace with the indicated color in the main map. Use the  button to select the highlight color of the selected analysis collection.  
If you want to clear the highlight in the map, un-check the analysis collections and click refresh the map again.

The highlight will be optimized for performance (if possible) to only evaluate the elements that are visible in the map.

## Excel/ Access

This will export the collections to Excel or Access. The function is similar to exporting to the Explorer and then export it to Excel or Access.

# Example

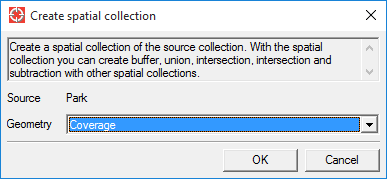
How to find the tenniscourts that are inside a park?

1. Open Analysis Workspace in the Cambridge application
2. Open a document (\*.ds) if you have not already.
3. Click  to select collections to add to the workspace
4. Select Park and Places of Interest
5. Click Add.
6. Select Places of Interest and click 
7. Select attribute “Type of Place”, condition “is exactly” and value is “Tennis Court”
8. Click Add To List

Afbeelding met tekst, schermopname, scherm, software

Door AI gegenereerde inhoud is mogelijk onjuist.

1. Click Ok. The workspace will look like this:  
   Afbeelding met tekst, schermopname, Lettertype, lijn

   Door AI gegenereerde inhoud is mogelijk onjuist.
2. Click in the blue area to change the name of the collection to “Tennis Courts”
3. To do a spatial analysis, one of the collections must be a geometry collection or an areal collection. At the moment both are now record collections. Because we are looking in the area of the park, we have to convert the Park to a geometry collection.
4. Click on Park and click on   
   
5. Click Coverage and click Ok. The workspace will look like this:  
   Afbeelding met tekst, schermopname, Lettertype, lijn

   Door AI gegenereerde inhoud is mogelijk onjuist.
6. Now select both collections and click 
7. Select Coverage and the function Within:  
   Afbeelding met tekst, schermopname, diagram, software

   Door AI gegenereerde inhoud is mogelijk onjuist.
8. Click Ok. The workspace will look like this:  
   Afbeelding met tekst, Lettertype, lijn, nummer

   Door AI gegenereerde inhoud is mogelijk onjuist.
9. Now you can select the collection and press  to go to the tennis courts bounding box.
10. If you check the box at “Hlt?” and refresh the map, then the courts will be shown in red.  
    Afbeelding met tekst, schermopname, kaart, diagram

    Door AI gegenereerde inhoud is mogelijk onjuist.
11. You can display the data in the Explorer or send it directly to Excel or Access.

## Export to Shapefile

Any collection can be exported to a shapefile: record collections, geometry collections and area collections. Select the collection and click .

Afbeelding met tekst, software, nummer, schermopname

Door AI gegenereerde inhoud is mogelijk onjuist.

That will show the attributes of the collection. Next:

* Select the geometry to export. Note that only one geometry can be included.
* Check the attributes that you want to copy.
* Enter the filename using the  button.
* Enter the scale to apply during import. Often Smallworld uses [mm] while the shapefile will use [m]. In that case use the scale of 0.001 to convert.
* Press OK to export.
* Notepad will open with log information.

# Unit Test

The delivery comes with several unit tests that run in the Cambridge environment. To run the unit tests do the following:

* Add the munit product. The product is not included in this delivery, it should be available at your company if you are serious about development.
* Load the module analysis\_workspace\_test
* Load the script drafting\_creation.magik in a writable GIS alternative. This will create areas and text labels that are used by the unit tests. Commit the dataset.
* On the prompt type: simple\_munit\_gui.open()
* Select analysis\_workspace and click on the green run button.

Afbeelding met tekst, schermopname, software, Computerpictogram

Door AI gegenereerde inhoud is mogelijk onjuist.