Examples for using GISAlgebra

This document describes how to work with GISAlgebra in Secondo.

GISAlgebra is used for terrain analysis, like slope or contour calculation.

1 Operator reference

The GISAlgebra consists of five operators' aspect, contourlines, hillshade, ruggedness and slope. All operators are written for Raster2- and TileAlgebra data.

1.1 aspect

The aspect operator calculates the direction in which a hillside is shown. As parameter the z-factor (conversion factor between different scale units) must be assigned.

syntax:

```
_ aspect [_]
```

signatures:

```
sT x double -> sT for T in {int, real}
stream(tT) x double -> stream(tT) for T in {int, real}
```

examples:

```
query [const sint value ((1.0 1.0 1.0)(3 3)(0 0 (90 91 92 114 115
116 132 133 134)))] aspect[1.0]

query treal feed aspect[1.0] consume
```

1.2 contourlines

The contourlines operator calculates the contour for a given interval.

syntax:

```
_ contourlines [_]
```

signatures:

```
sT x integer -> stream(lines) for T in {int, real}
stream(tT) x integer -> stream(lines) for T in {int, real}
```

examples:

```
query [const sint value ((1.0 1.0 1.0)(3 3)(0 0 (90 91 92 114 115
116 132 133 134)))] contourlines[2] consume

query treal feed contourlines[2] consume
```

1.3 hillshade

The hillshade operator calculates a hypothetical illumination of a surface. As parameters the azimuth and the altitude of the illumination source and the z-factor (conversion factor between different scale units) must be assigned.

syntax:

```
_ hillshade [_,_,_]
```

signatures:

```
sT x double x double x double -> sT for T in {int, real}
stream(tT) x double x double x double -> stream(tT) for T in {int,
real}
```

examples:

```
query [const sint value ((1.0 1.0 1.0)(3 3)(0 0 (90 91 92 114 115
116 132 133 134)))] hillshade[1.0, 100.0, 20.0]

query treal feed hillshade[1.0, 100.0, 20.0] consume
```

1.4 ruggedness

The ruggedness operator calculates the amount of elevation difference between adjacent cells.

syntax:

```
_ ruggedness
```

signatures:

```
sT -> sT for T in {int, real}
stream(tT) -> stream(tT) for T in {int, real}
```

examples:

```
query [const sint value ((1.0 1.0 1.0)(3 3)(0 0 (90 91 92 114 115
116 132 133 134)))] ruggedness

query treal feed ruggedness consume
```

1.5 slope

The slope operator calculates the maximum rate of change from a cell to its neighbors. As parameter the z-factor (conversion factor between different scale units) must be assigned.

syntax:

```
_ slope [_]
```

signatures:

```
sT x double -> sT for T in {int, real}
stream(tT) x double -> stream(tT) for T in {int, real}
```

examples:

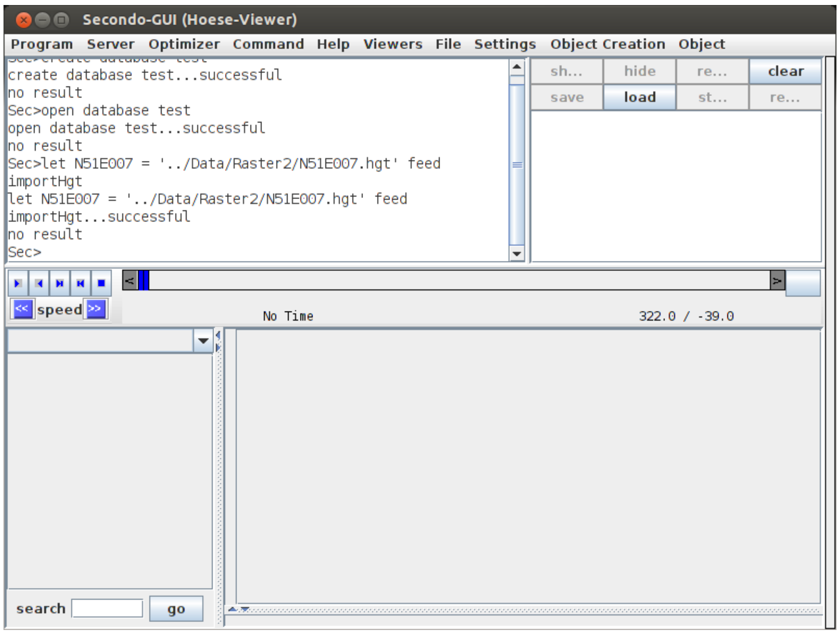
```
query [const sint value ((1.0 1.0 1.0)(3 3)(0 0 (90 91 92 114 115
116 132 133 134)))] slope[1.0]

query treal feed slope[1.0] consume
```

2 Example for slope usage

In this chapter the route for a bicycle trip will be planned.

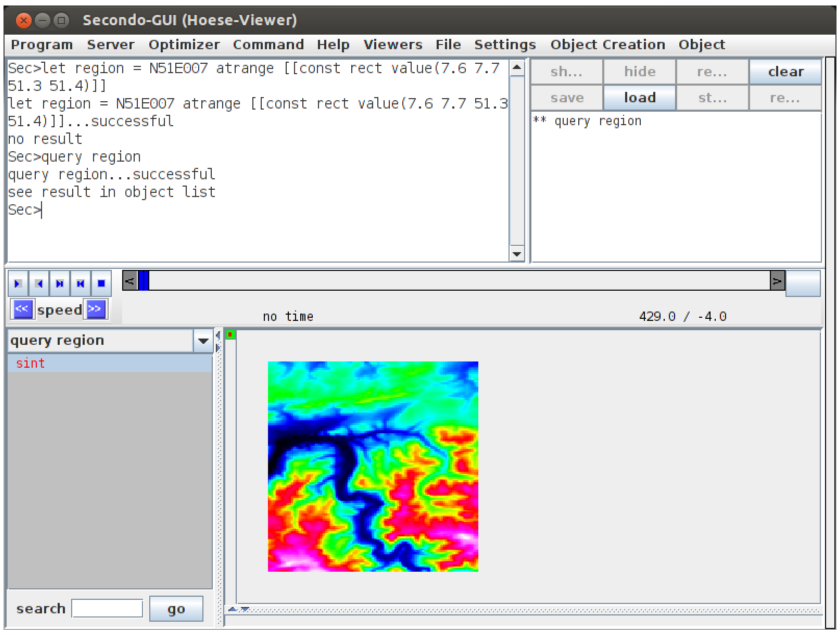
First Secondo must be started; a database must be created and opened
```
create database test
open database test
```

Next step is to import raster data in hgt-format. For example import file N51E007.hgt
```
let N51E007 = '../Data/Raster2/N51E007.hgt' feed importHgt
```


Secondo-GUI (Hoese-Viewer)
Program Server Optimizer Command Help Viewers File Settings Object Creation Object
sh... hide re... clear
save load st... re...
speed
No Time
322.0 / -39.0
search go

```
create database test...successful
no result
Sec>open database test
open database test...successful
no result
Sec>let N51E007 = '../Data/Raster2/N51E007.hgt' feed
importHgt
let N51E007 = '../Data/Raster2/N51E007.hgt' feed
importHgt...successful
no result
Sec>
```

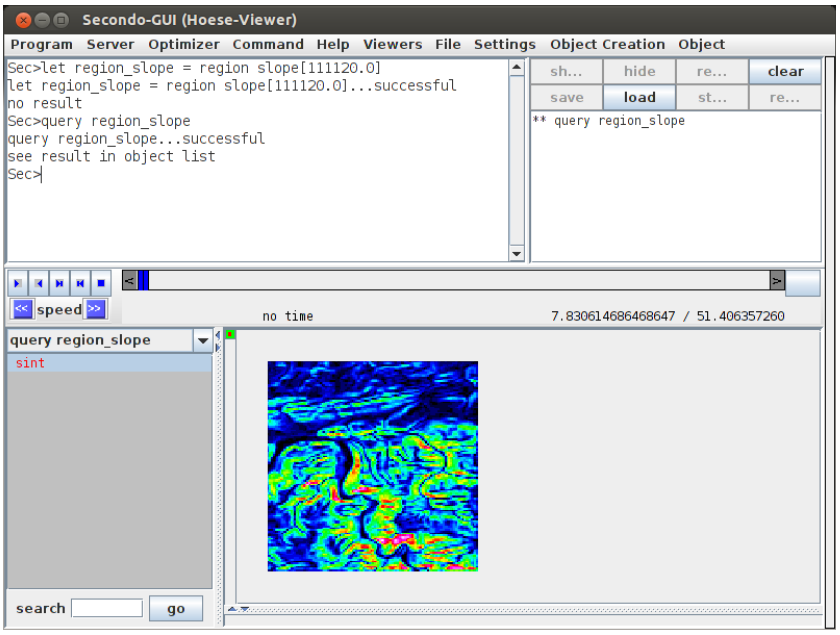
The loaded data must be cut to the area of interest
```
let region = N51E007 atrange [[const rect value(7.6 7.7 51.3
51.4)]]
```


Secondo-GUI (Hoese-Viewer)
Program Server Optimizer Command Help Viewers File Settings Object Creation Object
sh... hide re... clear
save load st... re...
** query region
speed
no time
429.0 / -4.0
query region
sint
search go

```
Sec>let region = N51E007 atrange [[const rect value(7.6 7.7
51.3 51.4)]]
let region = N51E007 atrange [[const rect value(7.6 7.7 51.3
51.4)]]...successful
no result
Sec>query region
query region...successful
see result in object list
Sec>
```

The slope must be calculated for the area of interest. Because x- and y-coordinates are given in degree and the height is given in meter the z-factor must be set to 111200.0.

```
let region_slope = region slope[111120.0]
```



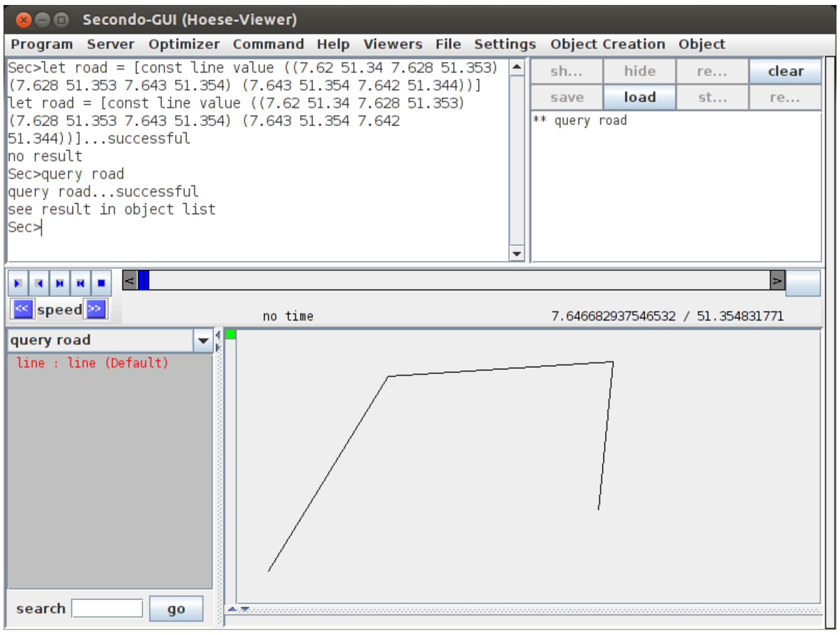
```
Sec>let region_slope = region slope[111120.0]
let region_slope = region slope[111120.0]...successful
no result
Sec>query region_slope
query region_slope...successful
see result in object list
Sec>
```

```
** query region_slope
```

All cells with yellow or red color have a high ascending slope, all cells with blue or green color are nearly flat.

To calculate the slope for a specific road a line must be created

```
let road = [const line value ((7.62 51.34 7.628 51.353) (7.628
51.353 7.643 51.354) (7.643 51.354 7.642 51.344))]
```

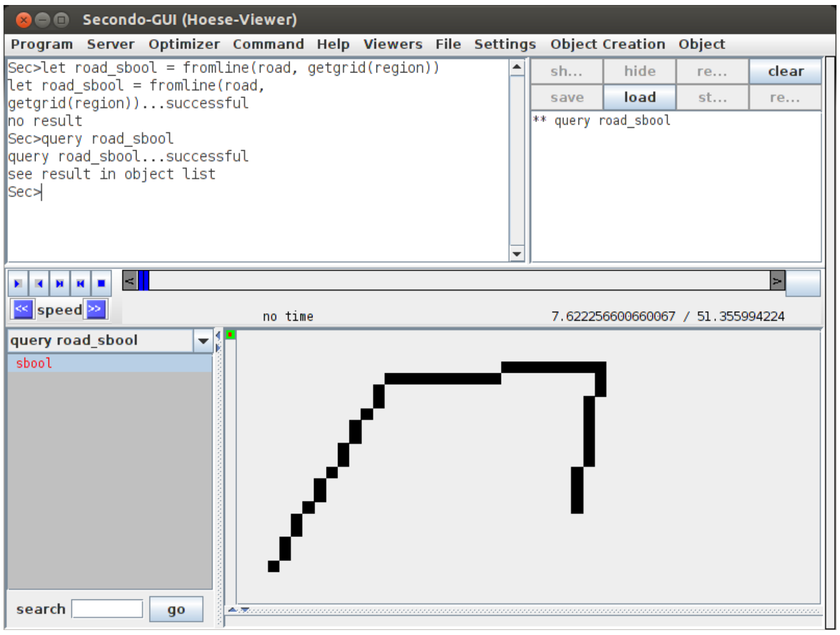


```
Sec>let road = [const line value ((7.62 51.34 7.628 51.353)
(7.628 51.353 7.643 51.354) (7.643 51.354 7.642 51.344))]
let road = [const line value ((7.62 51.34 7.628 51.353)
(7.628 51.353 7.643 51.354) (7.643 51.354 7.642
51.344))]...successful
no result
Sec>query road
query road...successful
see result in object list
Sec>
```

```
** query road
```

This line must be converted to a boolean Raster2-object with the same coordinates and cell size as the area of interest

```
let road_sbool = fromline(road, getgrid(zuschnitt))
```


Secondo-GUI (Hoese-Viewer)
Program Server Optimizer Command Help Viewers File Settings Object Creation Object
sh... hide re... clear
save load st... re...
speed
search go

```
Sec>let road_sbool = fromline(road, getgrid(region))
let road_sbool = fromline(road,
getgrid(region))...successful
no result
Sec>query road_sbool
query road_sbool...successful
see result in object list
Sec>
```

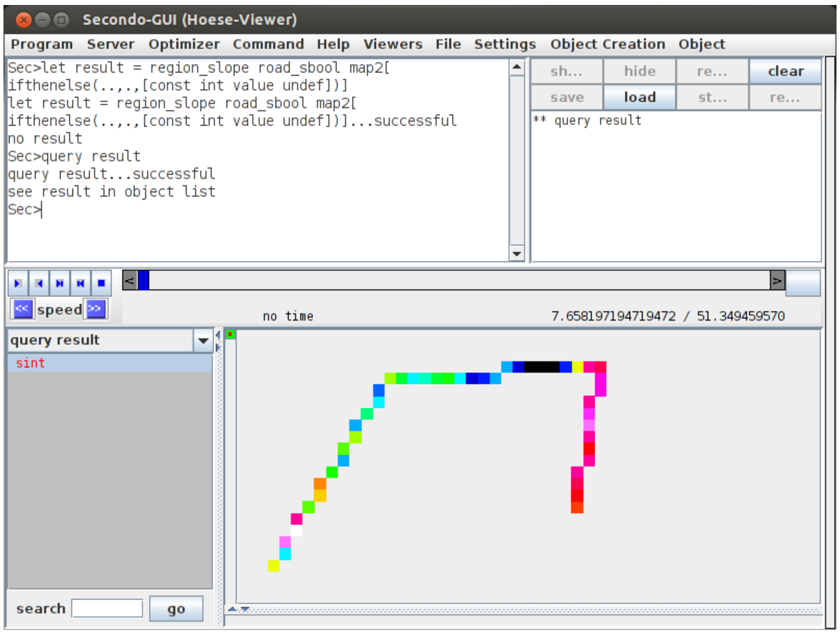
```
** query road_sbool
```

```
no time                7.622256600660067 / 51.355994224
```

```
query road_sbool
sbool
```

As final step the road and the calculated slope for the area of interest must be combined. The result is a line with colored cells.

```
let result = region_slope road_sbool map2[ ifthenelse(..,.,[const
int value undef])]
```


Secondo-GUI (Hoese-Viewer)
Program Server Optimizer Command Help Viewers File Settings Object Creation Object
sh... hide re... clear
save load st... re...
speed
search go

```
Sec>let result = region_slope road_sbool map2[
ifthenelse(..,.,[const int value undef])]
let result = region_slope road_sbool map2[
ifthenelse(..,.,[const int value undef])]...successful
no result
Sec>query result
query result...successful
see result in object list
Sec>
```

```
** query result
```

```
no time                7.658197194719472 / 51.349459570
```

```
query result
sint
```

The example is also possible for TileAlgebra data. In that case the commands look slightly different and the raster data must first be converted to tile data.

```
let N51E007Tiles = tiles(N51E007) namedtransformstream[No] consume
let region_slope = region feed slope[111120.0] consume
```

3 Example for contourlines usage

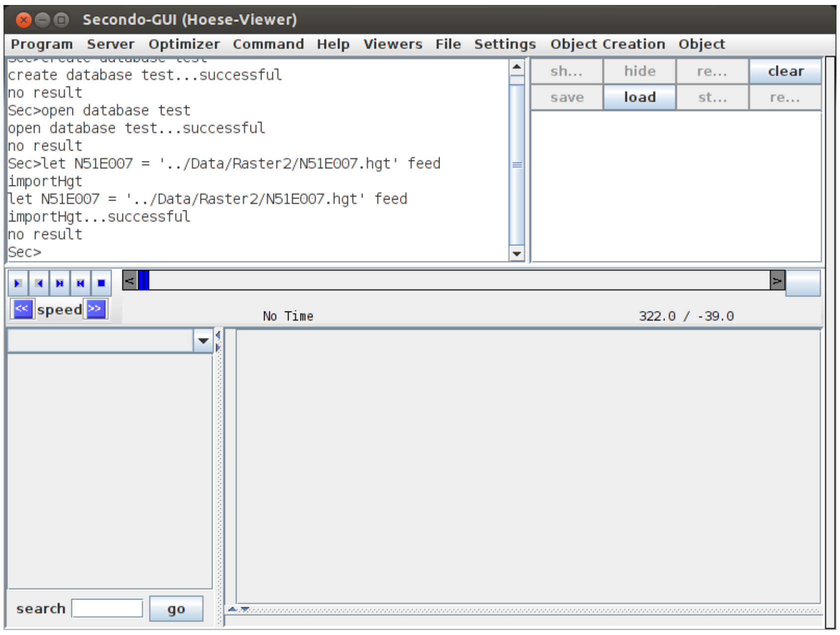
In this chapter it is shown how a topographical map can be created.

First Secondo must be started; a database must be created and opened

```
create database test
open database test
```

Next step is to import raster data in hgt-format. For example import file N51E007.hgt

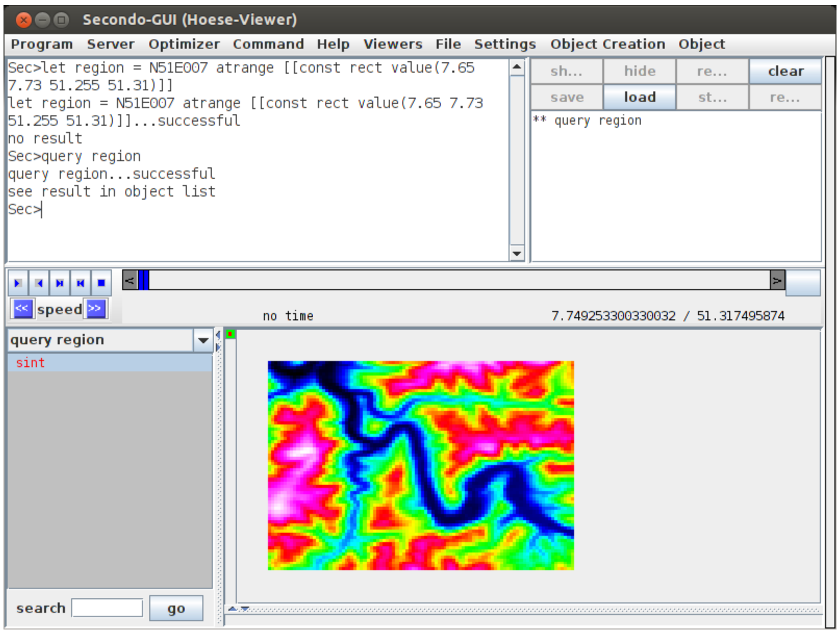
```
let N51E007 = '../Data/Raster2/N51E007.hgt' feed importHgt
```


Secondo-GUI (Hoese-Viewer)
Program Server Optimizer Command Help Viewers File Settings Object Creation Object
sh... hide re... clear
save load st... re...
speed
No Time
322.0 / -39.0
search go

```
create database test...successful
no result
Sec>open database test
open database test...successful
no result
Sec>let N51E007 = '../Data/Raster2/N51E007.hgt' feed
importHgt
let N51E007 = '../Data/Raster2/N51E007.hgt' feed
importHgt...successful
no result
Sec>
```

The loaded data must be cut to the area of interest

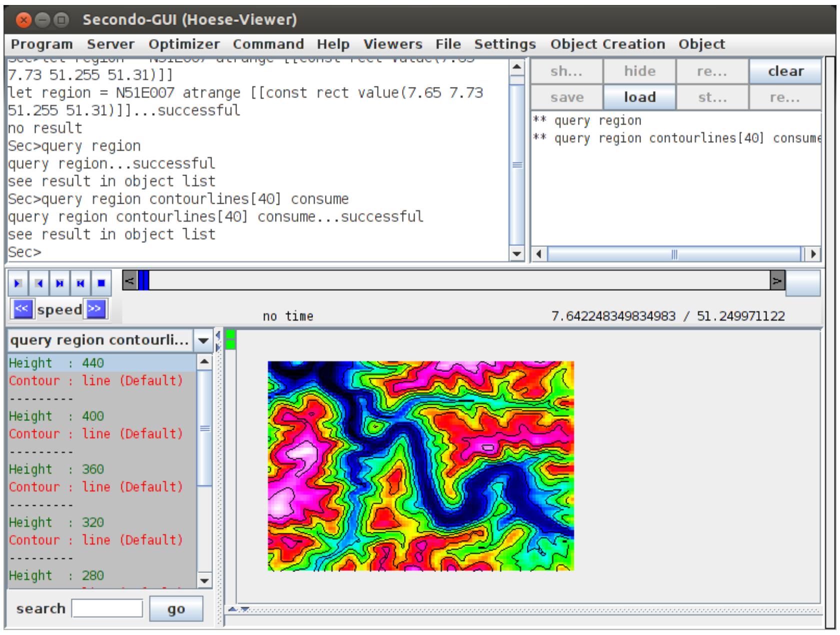
```
let region = N51E007 atrange [[const rect value(7.65 7.73 51.255
51.31)]]
```



```
Sec>let region = N51E007 atrange [[const rect value(7.65
7.73 51.255 51.31)]]
let region = N51E007 atrange [[const rect value(7.65 7.73
51.255 51.31)]]...successful
no result
Sec>query region
query region...successful
see result in object list
Sec>
```

The contour lines should be displayed every 40 meter

```
query region contourlines[40] consume
```



Secondo-GUI (Hoese-Viewer)
Program Server Optimizer Command Help Viewers File Settings Object Creation Object
sh... hide re... clear
save load st... re...
speed
search go

```
7.73 51.255 51.31)]]
let region = N51E007 atrange [[const rect value(7.65 7.73
51.255 51.31)]]...successful
no result
Sec>query region
query region...successful
see result in object list
Sec>query region contourlines[40] consume
query region contourlines[40] consume...successful
see result in object list
Sec>
```

```
** query region
** query region contourlines[40] consume
```

```
no time          7.642248349834983 / 51.249971122
```

```
query region contourli...
Height  : 440
Contour : line (Default)
---------
Height  : 400
Contour : line (Default)
---------
Height  : 360
Contour : line (Default)
---------
Height  : 320
Contour : line (Default)
---------
Height  : 280
```

This example is also possible for TileAlgebra data. In that case the commands look slightly different and the raster data must first be converted to tile data.

```
let N51E007Tiles = tiles(N51E007) namedtransformstream[No] consume
query region feed contourlines[40] consume
```