Pythoni abil GIS ülesannete lahendamine

Rein Kask - AlphaGIS

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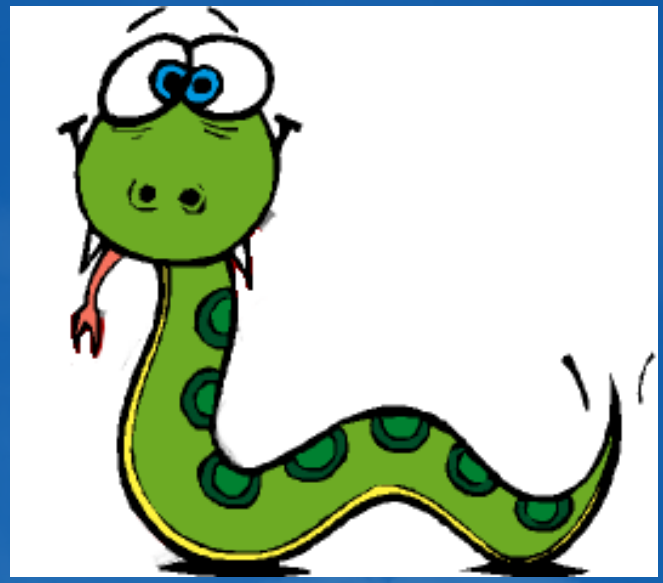
Sissejuhatus

Python



- Vaba
- Lihtne kasutada ja õppida

- Miks mitte kasutada C, mis on kiirem?
- Python viib kokku erinevad töövahendid
- Võimaldab kasutada mooduleid (os, arcpy, numpy, scipay, sympy jne jne)

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Sisukord

- Kursorid
- Iteratsioonid andmetel
- Teaduslikud paketid
- E-maili saatmine

Kursorid

Lubavad itereerida üle tabeli ridade või lisada ridu

arcpy.da.SearchCursor	**Ridade lugemiseks**
arcpy.da.UpdateCursor	**Ridade muutmiseks või kustutamiseks**
arcpy.da.InsertCursor	**Ridade lisamiseks**

Kursori objektid list'id ja tuple'd

Ridade väärtustele ligipääs indeksitega

```
with arcpy.da.SearchCursor('Tabel', ['vali1', 'vali2', 'vali3']) as minuKursor:
    for rida in minuKursor:
        print rida[1]
```

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Kursorid

Võimaldavad lisada tabelile ridu:

```
valjad = ['vali1', 'vali2', 'vali3']
kursor = arcpy.da.InsertCursor('Tabel', valjad)
rida[0] = 5
rida[1] = 15
rida[2] = rida[0] * rida[1]
kursor.insertRow(rida)
```

Saab lisada ka nähtuste klassidele geomeetriaga objekte:

```
kursor = arcpy.da.InsertCursor(fc, ["SHAPE@"])
array = arcpy.Array([arcpy.Point(530500, 6548500), arcpy.Point(530500, 6549500),
                     arcpy.Point(531500, 6549500), arcpy.Point(531500, 6548500)])
polygoon = arcpy.Polygon(array)

kursor.insertRow([polygoon])
del kursor
```

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Kursorid

Võimaldavad parandada olemasolevaid objekte:

```
with arcpy.da.UpdateCursor("Tabel1", valjad, "Vali3 is not null") as kursor:
    for rida in kursor:
        rida[0] = rida[2]
        kursor.updateRow(rida)
```

Kasutab ka olemasolevaid päringuid, selektsioone

Kasutada võimalusel with-lauset (Search, Update), vabastab ise tabeli luku

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Kursorid

Kasuta välju, mida vajad, järgnev lisab nt ka ‘ObjectID’, ‘Shape’

```
with arcpy.da.SearchCursor('Tabel1', '*') as kursor:
    for rida in kursor:
        print rida
```

Kasutada geomeetriat:

Täisgeomeetria (SHAPE@)

on mahukas

SHAPE@XY —A tuple of the feature's centroid x,y coordinates.

SHAPE@TRUECENTROID —A tuple of the feature's true centroid x,y coordinates.

SHAPE@X —A double of the feature's x-coordinate.

SHAPE@Y —A double of the feature's y-coordinate.

SHAPE@Z —A double of the feature's z-coordinate.

SHAPE@M —A double of the feature's m-value.

SHAPE@JSON — The esri JSON string representing the geometry.

SHAPE@WKB —The well-known binary (WKB) representation for OGC geometry. It provides a portable representation of a geometry value as a contiguous stream of bytes.

SHAPE@WKT —The well-known text (WKT) representation for OGC geometry. It provides a portable representation of a geometry value as a text string.

SHAPE@ —A geometry object for the feature.

SHAPE@AREA —A double of the feature's area.

SHAPE@LENGTH —A double of the feature's length.

OID@ —The value of the ObjectID field.

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Iteratsioonid andmetel

Kokku üle 30 funktsiooni

ListFields(dataset, wild_card, field_type)
ListIndexes(dataset, wild_card)
ListDatasets(wild_card, feature_type)
ListFeatureClasses(wild_card, feature_type, feature_dataset)
ListFiles(wild_card)
ListRasters(wild_card, raster_type)
ListTables(wild_card, table_type)
ListWorkspaces(wild_card, workspace_type)
ListVersions(sde_workspace)

da-moodulis:

ListDomains
ListFieldConflictFilters
ListReplicas
ListSubtypes
ListVersions

Näiteks ListFields tekitab Field-objekti, millel on omadused (nimi, pikkus, …):

```
for vali in arcpy.ListFields("Tabel1"):
    print vali.name, vali.aliasName, vali.type
```

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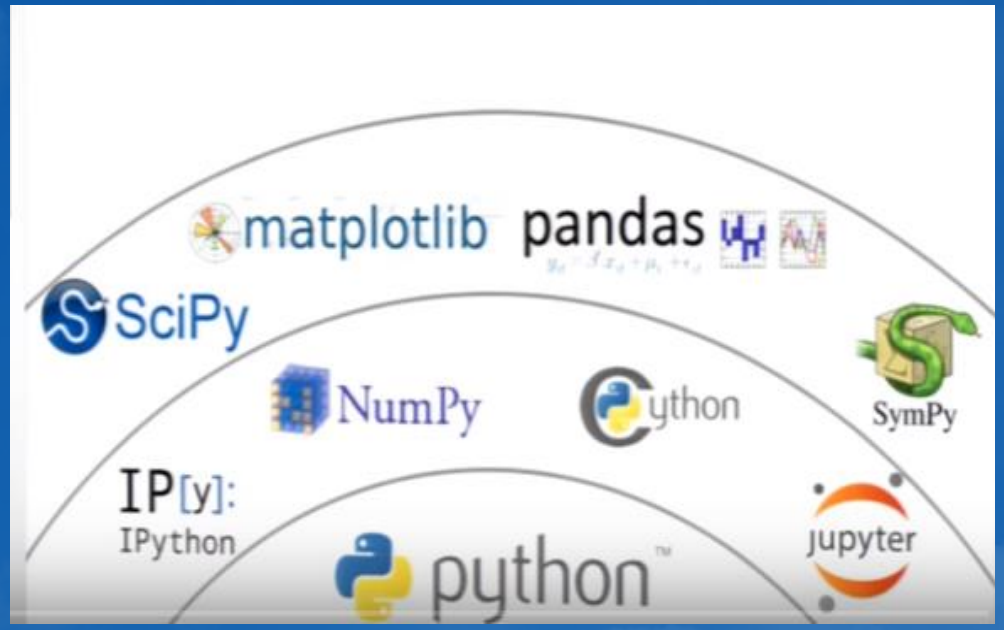
Teaduslikud paketid

Python seob kokku erinevad teaduslikud töövahendid



Osad olid juba olemas ArcGIS Desktop varasemates versioonides (NumPy), osad ArcGIS Pro-s, nüüd lisandusid ArcGIS Desktop 10.4-ga SciPy, SymPy, Pandas jne.

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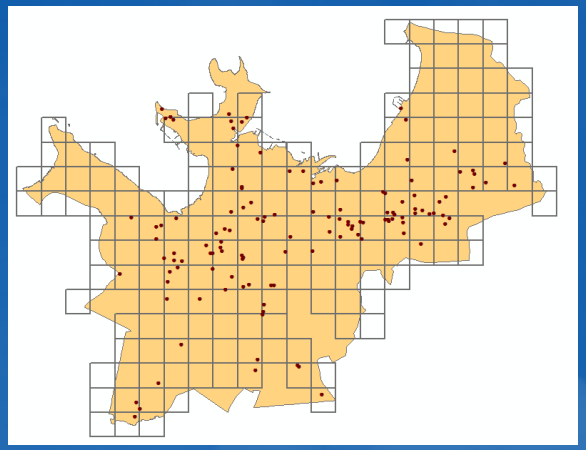
NumPy (Numerical Python)

Teaduslike arvutuste tegemiseks

N-mõõtmelised massiivid, kiired matemaatilised arvutused nendel

ArcGIS ja NumPy tegutsevad koos nähtuste klassidel, tabelitel ja rastritel



```
>>> array_ra = array1[valjad[0]]
>>> array_ev = array1[valjad[1]]
>>> numpy.mean(array_ra)
2328.1666666666665
>>> numpy.median(array_ra)
922.5
>>> numpy.mean(array_ev)
0.7126436781609195
>>> numpy.median(array_ev)
0.0
```

```
>>> imp
>>> val
>>> arr
>>> pri
[[ 1.
 [ 0.20
```

```
ted"]
yArray("Rahvaloendus", valjad)
]], array1[valjad[1]])
```

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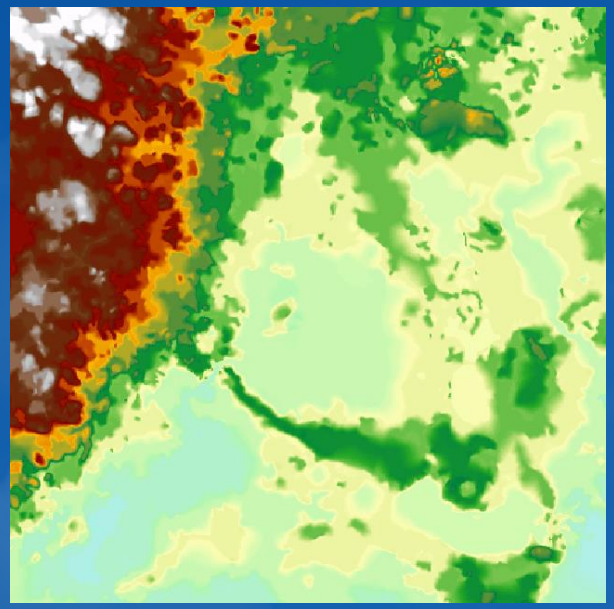
SciPy (Scientific Python)



$$\left(\prod_{i=1}^{n} a_i\right)^{1/n} = \sqrt[n]{a_1 \cdot a_2 \cdots a_n}$$

```
>>> rast = "dem4444.tif"
>>> rast_array = arcpy.RasterToNumPyArray(rast)
>>> rast_geom_keskm = scipy.stats.stats.gmean(rast_array, axis = None)
>>> rast_mediaan = scipy.stats.stats.nanmedian(rast_array, axis = None)
>>> print rast_geom_keskm, rast_mediaan
193.31 186.36
```

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SymPy

Kompuuteralgebra pakett

Võrrandite lahendamine:

$$x^2 - 4x + 4 = 0$$

```
>>> import sympy
>>> from sympy import *
>>> x = symbols('x')
>>> vorrand = Eq(x**2 - 4*x + 4, 0)
>>> vastus = solve(vorrand, x)
>>> vastus
[2]
```

$$x^3 + 2x^2 + 4x + 8 = 0$$

```
>>> vorrand = Eq(x**3 + 2*x**2 + 4*x + 8, 0)
>>> tulemus = solve(vorrand, x)
>>> tulemus
[-2, -2*I, 2*I]
```

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SymPy

Differentsiaalvõrrandite lahendamine:

$$y'' - y = e^t$$

$$y(t) = C_2 e^{-t} + \left(C_1 + t/2\right) e^t$$

```
>>> y, t = symbols('y t')
>>> vorrand_d = Eq(y(t).diff(t,t) - y(t), exp(t))
>>> tulem_d = dsolve(vorrand_d)
>>> tulem_d
y(t) == C2*exp(-t) + (C1 + t/2)*exp(t)
```

```
>>> vorr = diff(sin(x), x)
>>> vorr
cos(x)
```

```
>>> vorr = sin(x).diff(x)
>>> vorr
cos(x)
```

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SymPy

Matemaatilised probleemid:

$$\lim x- > 0, sin(x)/x$$

```
>>> limit(sin(x)/x, x, 0)
1
```

```
>>> integrate(2*x)
x**2
```

```
>>> x = symbols('x')
>>> y = symbols('y')
>>> Mat = Matrix([[1,x],[y,1]])
>>> Mat
Matrix([
[1, x],
[y, 1]])
>>> Mat**2
Matrix([
[x*y + 1,     2*x],
[    2*y, x*y + 1]])
```

Nii ei saa teha NumPy-s

```
>>> x = symbols('x')
>>> y = symbols('y')
>>> expand((x + y)**2)
x**2 + 2*x*y + y**2
```

```
>>> solve([x + 5*y - 2, -3*x + 6*y - 15], [x, y])
{x: -3, y: 1}
```

```
>>> simplify((x + x*y)/x)
y + 1
```

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E-maili demo

Tänan!

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