

# Smartness knocking at GIS' door

## Intelligent Editing of Spatial Data

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## The problem

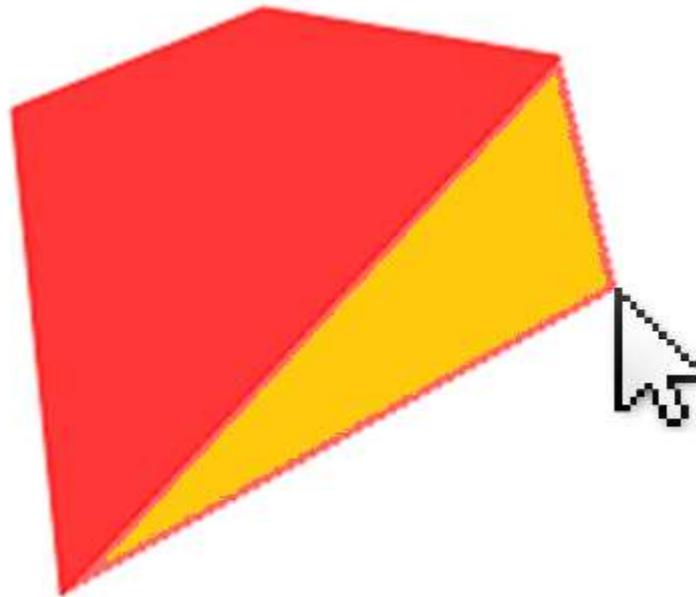
The editing and vector register procedure demands too many human interactions,  
See the next example:



1. We have to activate the layer in the TOC
2. Start editing with an icon
3. Add a feature with an icon, there are various icons for each geometries
4. Register feature on palette
5. Finish part / feature (other mouse button or keystroke)
6. Save edits (toggle editing)
7. Change layer to an other feature with an other type of geometry
8. ... Etc

## The spark

In QGIS we can finish a polygon with a right click  
(the last point is not included)



## The idea

Until now GIS lived in an inductive way,  
we created the features (objects)  
we declared the type of feature (geometry)

If the software could possibly find out things, like  
geometry in a deductive way?

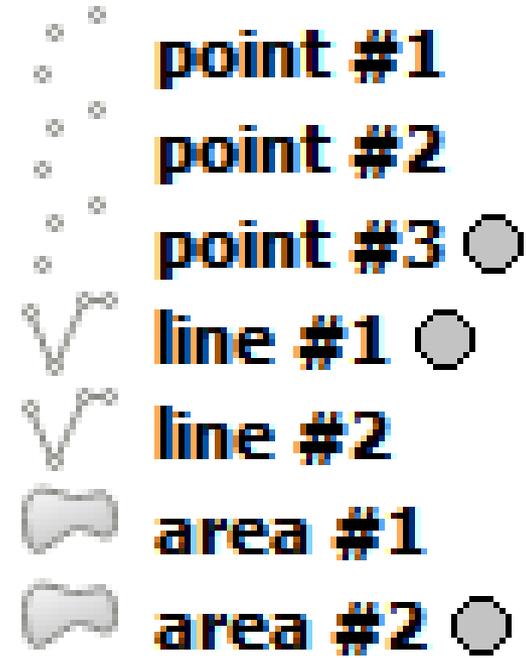
It would reduce the number of human  
interactions

# Theory I

So we made SmartLayers

Each type of geometry  
(point, line, area)  
inherit a Smartness circle

It becomes clear later

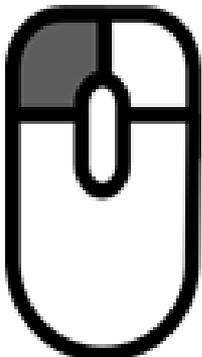
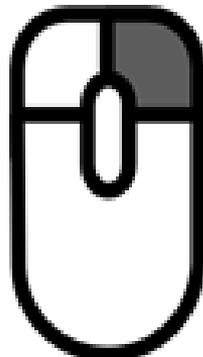


## Theory II

A novel application of the unbalanced usage of the mouse

Left click – Open Object

Right click – Save Object

		
<i>Click</i>	<i>Open Object</i>	<i>Save Object</i>
1.	line point	POINT
2.	line point	LINE (with 2 point)
3.	line point	LINE (with 3 point)
4.	line point	LINE (with 4 point) POLYGON (triangle)

## Theory II+I

Vivify the combination:

- The series of buttons with positions determines the type of object
- The set Smart layers are paired with the object

*Buttons [L/R, X,Y]*



*Theory II*

*Object [P,L,A]*



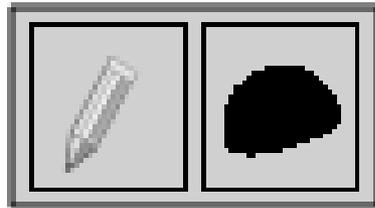
*Theory I*

*Layer [Smart]*

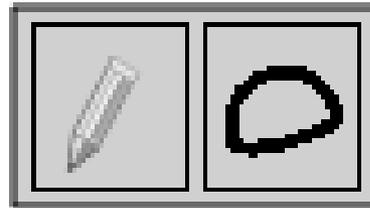
## One thing to clarify

Only two icons are responsible for Editing  
The right one has a toggle function:

- (a) area (polygon) mode
- (b) contour line (closed line) mode



*(a)*



*(b)*

# SmartEdit, on a sample map

The same quantity of each geometric feature

The most basic type of geometries

To avoid distortion



REAL LIFE



TEST CASE

RIGHT	RIGHT	LEFT, RIGHT	LEFT, RIGHT	LEFT, LEFT, LEFT, RIGHT	LEFT, LEFT, LEFT, RIGHT
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*house below*

*house above*

*left river*

*right river*

*forest above*

*forest below*

## Test, Conditions

	<i>Left</i>	<i>Right</i>	<i>All</i>	<i>Left/Right</i>
QGIS 2.0.1	26	4	30	6.50
GeoMedia Professional 6.1	22	4	26	5.50
ArcMap 10	26	2	28	13.00
AutoCAD Map 2013	28	4	32	7.00
MicroStation V8i	20	2	22	10.00
SmartEdit	8	6	14	1.33

- Change layer only, if every referring elements were digitized
- We defined forward the three layers (house, river, forest)
- Don't save attribute data
- Start the edit with selected layer
- Use keyboard only in necessary case
- Ease the edition if it's possible (suppress attributes pop-up windows)
- Deem the save of edits to the last phase
- We use the right mouse button if it doesn't take surplus clicks

## Test, Specifications

	<i>Left</i>	<i>Right</i>	<i>All</i>	<i>Left/Right</i>
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Software specifications under digitizing:

- QGIS: Settings/Options/Digitizing/Suppress attributes pop-up windows after each created feature
- GeoMedia: Tools/Options/Placement and Editing/Display properties dialog for new features
- AutoCAD Map 2013: Edit in Classic mode in three layer
- MicroStation V8i: Use Active point and SmartLine

## Convert to time

According to the KLM (Keystroke-Level Model) by David Kieras

$$T_{\text{EXECUTE}} = t_K + t_P + t_H + t_D + t_M + t_R$$

	<i>Operation</i>	<i>Execution time [s]</i>
K	pressing a key on the keyboard	0.28
H	home hands to keyboard or mouse	0.4
B	click mouse button	0.2
P	point with the mouse to target on the display	1.1
M	mental act of routine thinking or perception	1.2

<b>ArcMap 10</b>	
Editor (1)	M,P,B
Start Editing (2)	M,B
Create features, House (3)	M,P,B
Editing of houses (5)	M,P,B,M,P,B
Create features, Rivers (6)	M,P,B
Editing of left river (8)	M,P,B,M,P,B
Right click (9)	M,B
Finish sketch (10)	P,B
Editing of right river (12)	M,P,B,M,P,B
Right click (13)	M,B
Finish sketch (14)	P,B
Create features, Forest (15)	M,P,B
Editing of forest above (18)	M,P,B,M,P,B,M,P,B
Right click (19)	M,B
Finish sketch (20)	P,B
Editing if forest below (23)	M,P,B,M,P,B,M,P,B
Right click (24)	M,B
Finish sketch (25)	P,B
Editor (26)	M,P,B
Stop editing (27)	M,B
Yes (28)	M,P,B
<b>Operations:</b>	<b>24M,22P,28B</b>
<b>Sum of time [s] :</b>	<b>58.6</b>

<b>SmartEdit</b>	
Editing of houses (2)	M,P,B,M,P,B
Editing of left river (4)	M,P,B,M,P,B
Editing of right river (6)	M,P,B,M,P,B
Editing of forest above (10)	M,P,B,M,P,B,M,P,B,M,P,B
Editing of forest below (14)	M,P,B,M,P,B,M,P,B,M,P,B
<b>Operations:</b>	<b>14M,14P,14B</b>
<b>Sum of time [s] :</b>	<b>35.0</b>

## Conclusion

The SmartEdit conception is 40 % faster than the traditional methods

Easy to use:

- Only two buttons are necessary

- Less button interaction needed

Easy to remember:

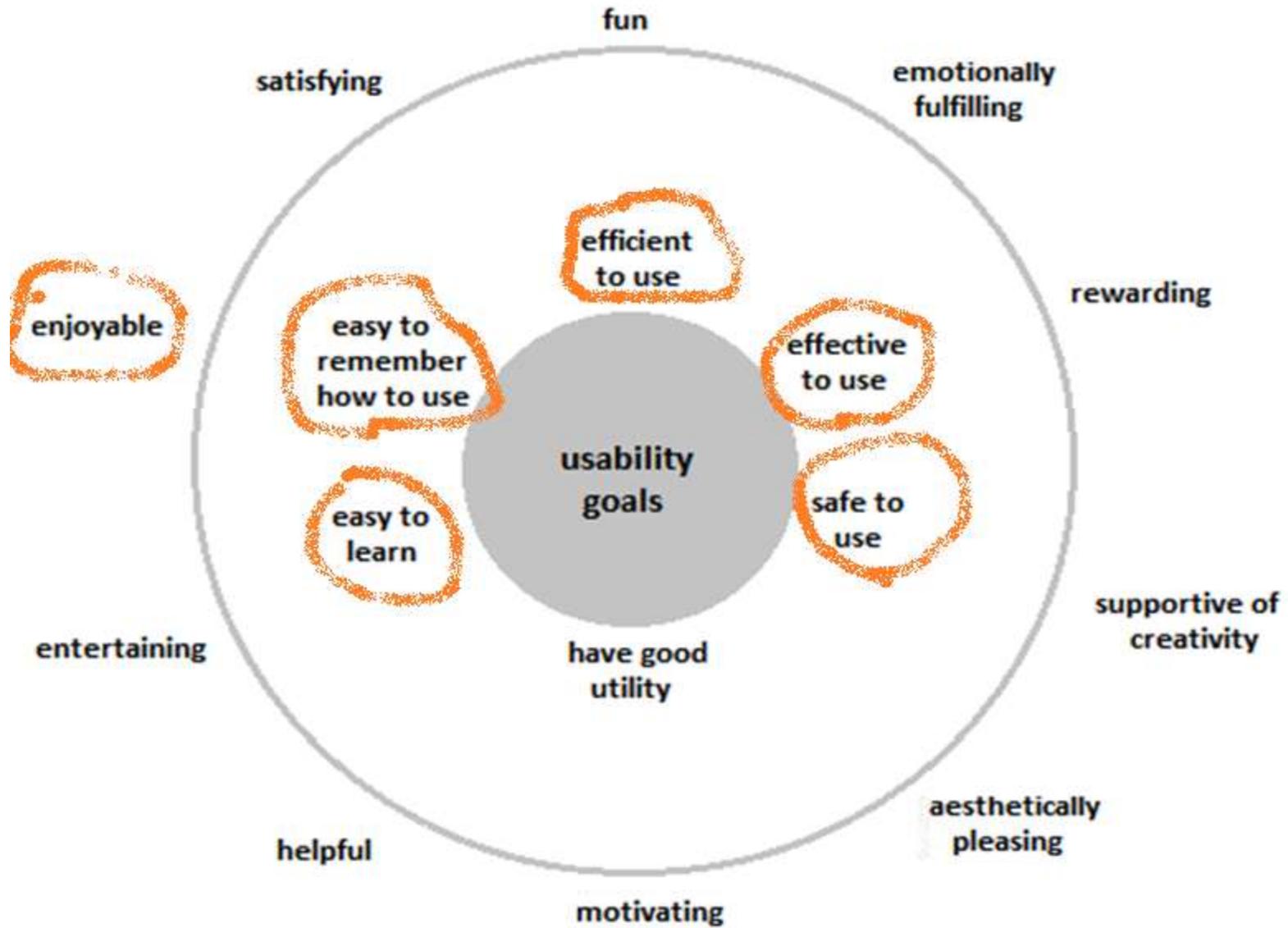
- Intuitive logic (left – open object; right – save object)

State of the art:

- We extended the usage to touchpad (lift and tap) as well

Enjoyable:

- It makes the editing an enjoyable, creation-like act



Thank you for your attention