

## Transformation and Analysis

### Introduction to GIS

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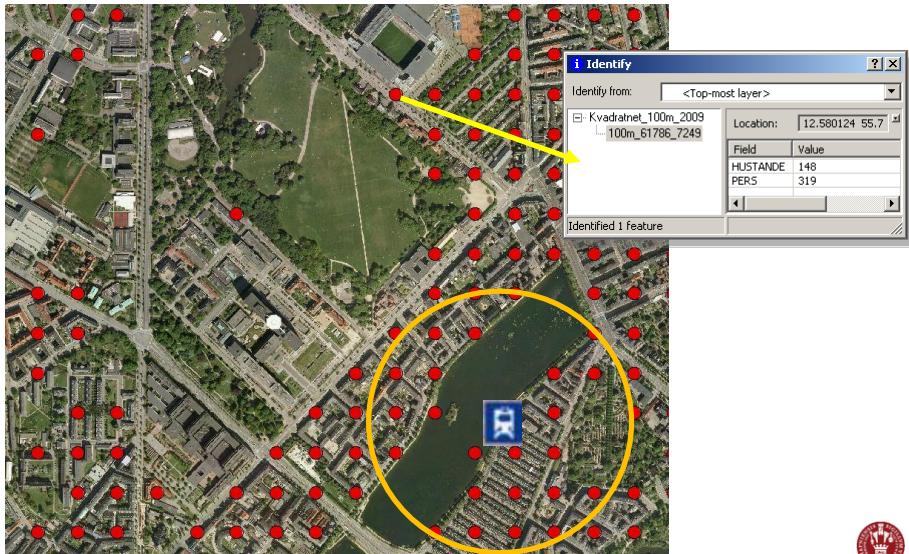


### Program of the day

- Selecting, measuring, and aggregating
- Distance
- Buffers
- Overlay
- Spatial join
- Flow charts and model building



## Buffering the 100x100 Square Net (Population)



## Assignment I: Space matters!!

### Problem statement:

Is it really so that everyone living within the buffer is evenly important and that nothing outside means anything?



### Assignment:

Consider, with your neighbor, ways to incorporate the effects of increasing distance on the potential utility of a given tube station.



# Selecting, measuring, aggregating etc...

## Non-transforming analysis

Identification

Measuring

Selection

- Interactively
- By attribute
- By location

Statistics

Summarize

Calculating values for attribute

- By value
- By geometry

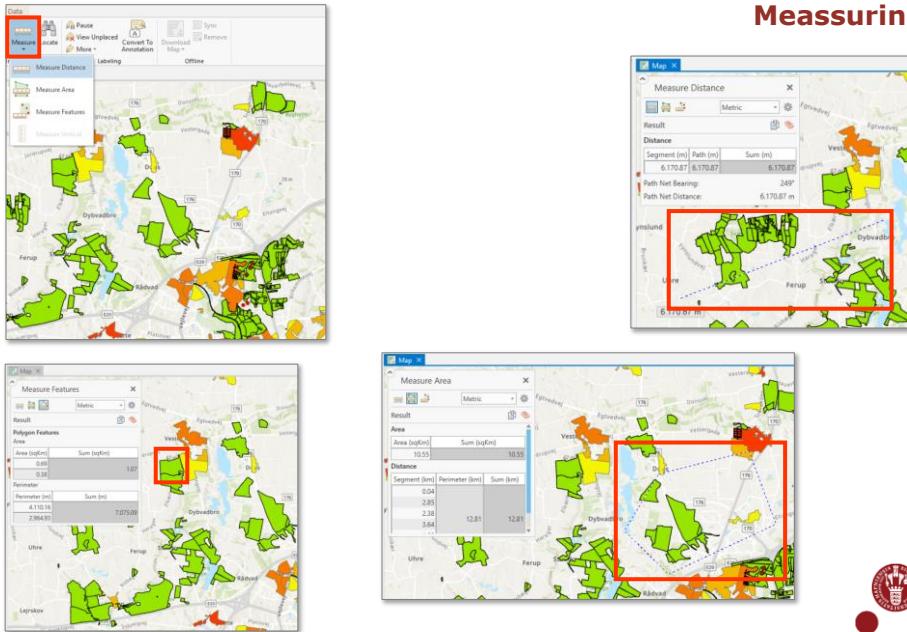


## Identification (ID)

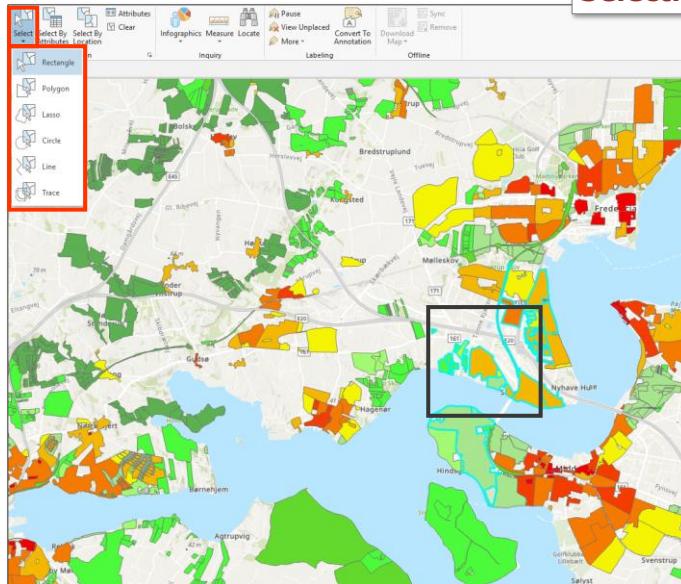
OBJECTID	1896
FOT_ID	1088734202
MOS_ID	341963
FEAT_CODE	999
FEAT_TYPE	Kommune/grænse
FEATURESTATUS	Tæpet i brug
GEOGSTATUS	Endelig
NAME_KR	Østjylland
TIME_CRT	09-12-2015
TIMEOF_PUB	09-12-2015
TIMEOF_REV	chub#
TIMEOF_EXP	09-12-2015
Shape.Share()	701587822.394643
Shape.STLength()	200670.112464



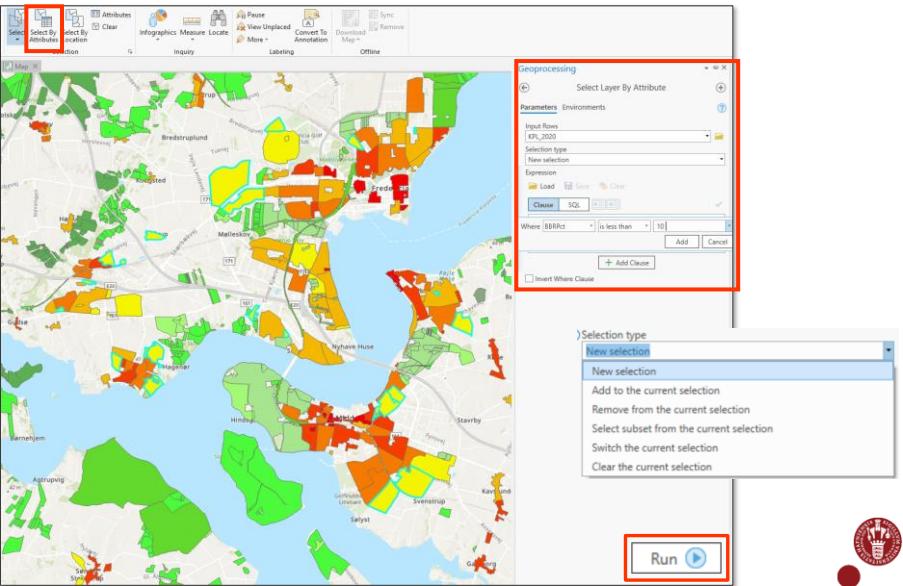
## Measuring



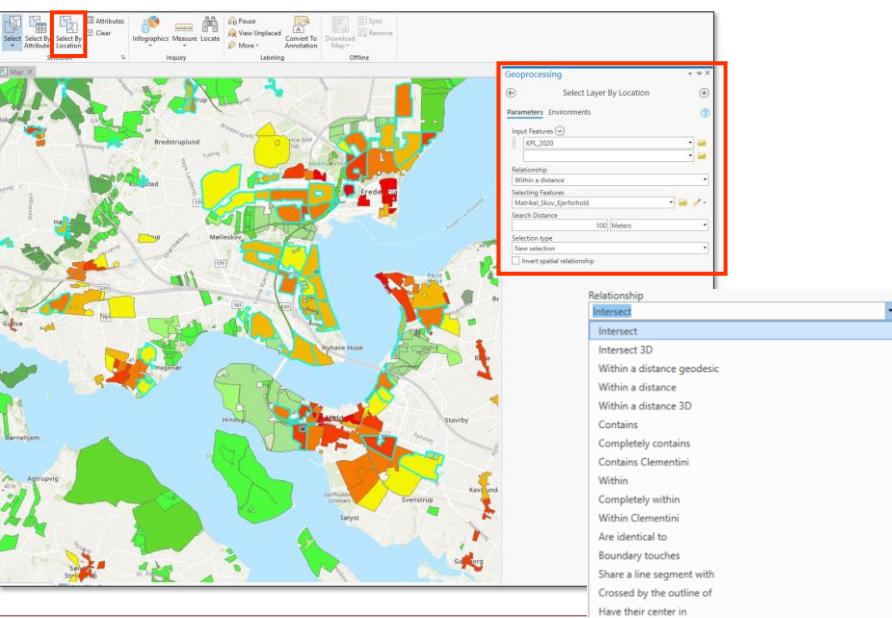
## Selection: Interactive

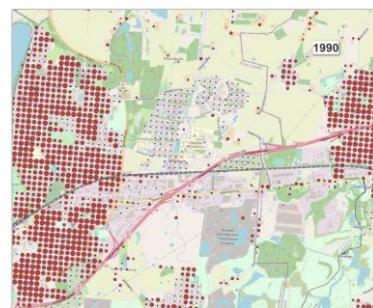
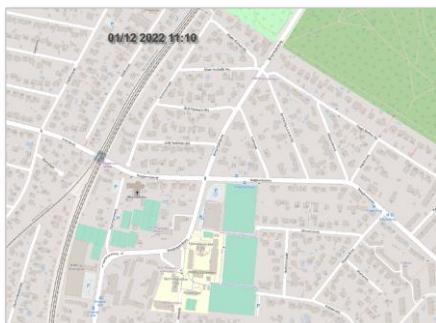


## Selection: By attribute

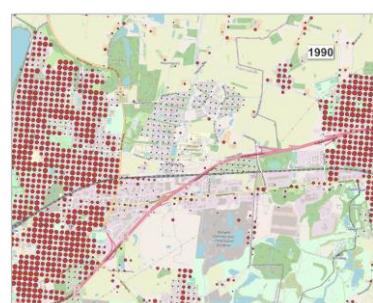


## Selection: By location

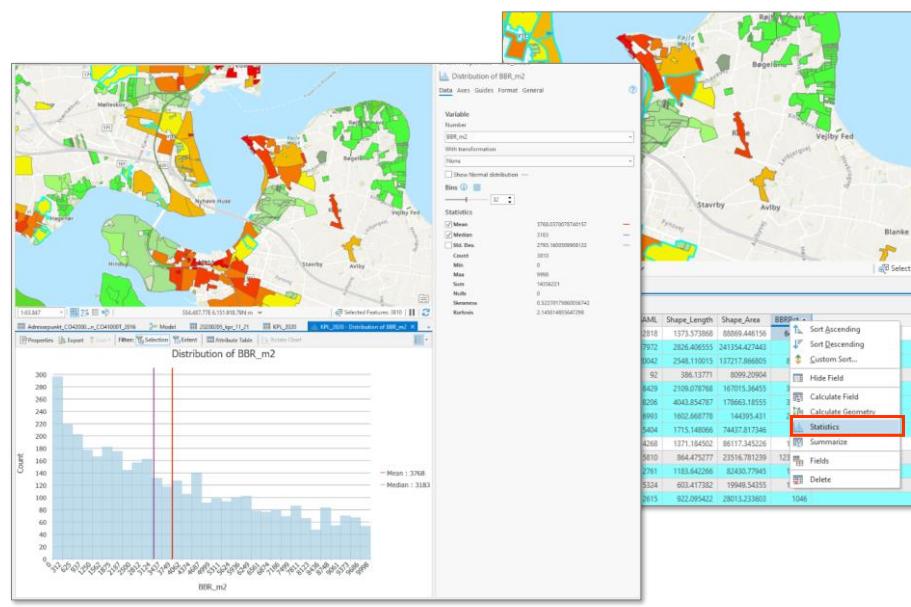


**Time?****Assignment II: Time?**

Consider, with your neighbor, a set of relevant temporal selection criteria



## Attribute statistics



## Adding new field to an attribute table

## Calculate: Attribute values

The screenshot shows the QGIS interface with the 'ForestTest' layer selected. The 'Fields' dialog is open, displaying the attribute table for the layer. A red box highlights the 'Add' button at the top left. Another red box highlights the 'AreaHa' field in the table below. A third red box highlights the 'Save' button at the bottom right.

OBJECTID	Shape	UUID	MATNR	KOMMUNE	KOMKODE	HOVEDNOT_KODE	SKOVNOT_KODE	EjerForHoldsCode	Shape_Length	Shape_Area
1	Polygon	dk.gist мат.pt.1237206	9c	Kolding Kommune	621 L	D		<Null>	5444.113441	53139.609565
2	Polygon	dk.gist мат.pt.1237716	3a	Kolding Kommune	621 L	D		<Null>	2274.347693	230614.907425
3	Polygon	dk.gist мат.pt.1237871	5a	Kolding Kommune	621 L	D		<Null>	4110.159918	690186.408689
4	Polygon	dk.gist мат.pt.1237813	2d	Kolding Kommune	621 L	D		<Null>	3397.86541	376788.858822
5	Polygon	dk.gist мат.pt.1237743	4d	Kolding Kommune	621 L	D		<Null>	2475.475808	327004.922815
6	Polygon	dk.gist мат.pt.1237747	12b	Kolding Kommune	621 L	D		<Null>	1242.78329	85350.68698
7	Polygon	dk.gist мат.pt.1237764	3b	Kolding Kommune	621 L	D		<Null>	1614.222266	91352.197162
8	Polygon	dk.gist мат.pt.1237764	3b	Kolding Kommune	621 L	D		<Null>	1003.110519	63561.196292
9	Polygon	dk.gist мат.pt.1237664	3r	Kolding Kommune	621 B	D		<Null>	814.898608	25339.545388
10	Polygon	dk.gist мат.pt.1238074	3c	Kolding Kommune	621 L	F		<Null>	1399.084598	21778.115855
11	Polygon	dk.gist мат.pt.1238074	3b	Kolding Kommune	621 L	F		<Null>	2887.790124	114746.0774
12	Polygon	dk.gist мат.pt.1238067	3b	Kolding Kommune	621 S	F		<Null>	562.804074	14426.587061
13	Polygon	dk.gist мат.pt.1238064	36	Kolding Kommune	621 S	F		<Null>	933.465341	24466.919478

## Calculate: Attribute values

The screenshot shows the QGIS interface with the 'ForestTest' layer selected. The 'Geoprocessing' dialog is open, showing the 'Calculate Field' tool. A red box highlights the expression 'AreaHa = Shape\_Area / 10000'. Another red box highlights the 'Run' button at the bottom left. A third red box highlights the 'Calculate Field' option in the context menu for the 'AreaHa' field.

KOMKODE	HOVEDNOT_KODE	SKOVNOT_KODE	EjerForHoldsCode	Shape_Length	Shape_Area	AreaHa
621 L	D	<Null>	5444.113441	53139.609565	5.313961	
621 L	D	<Null>	2274.347693	230614.907425	23.06149	
621 L	D	<Null>	4110.159918	690186.408689	69.01864	
621 L	D	<Null>	3397.86541	376788.858822	37.67889	
621 L	D	<Null>	2475.475808	327004.922815	32.70049	
621 L	D	<Null>	1242.78329	85350.68698	8.535069	
621 L	D	<Null>	1614.222266	91352.197162	9.13522	
621 L	D	<Null>	1003.110519	63561.196292	6.35612	
621 B	D	<Null>	814.898608	25339.545388	2.533955	
621 L	F	<Null>	1399.084598	21778.115855	2.177812	

## Calculate: Geometries as attribute values

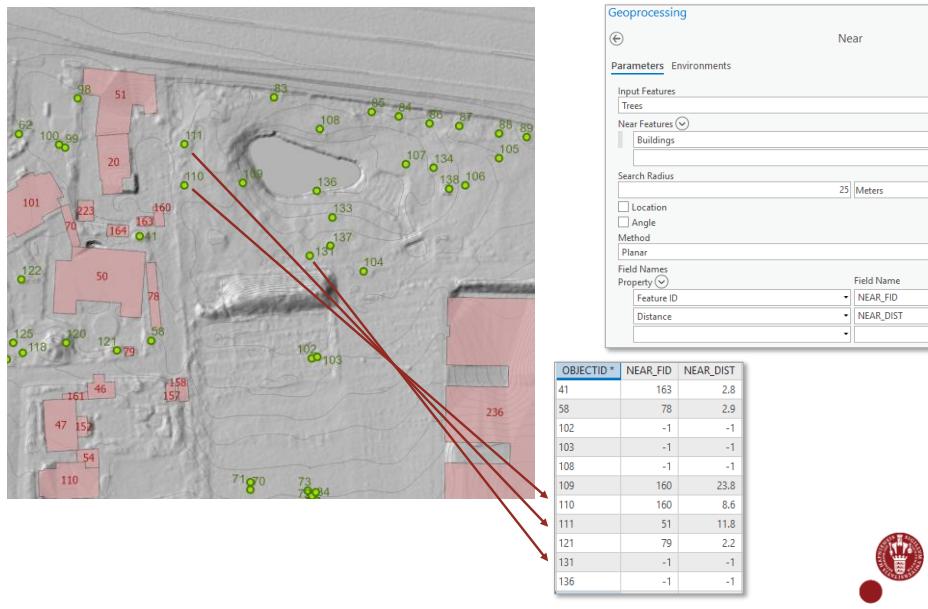
The screenshot shows the ArcGIS Pro interface with the 'Geoprocessing' window open. The 'Calculate Geometry Attributes' tool is selected. In the 'Parameters' tab, 'Input Features' is set to 'ForestTest'. Under 'Geometry Property', 'Target Field' is set to 'CentroidX'. A dropdown menu is open over this field, showing options like 'Centroid x-coordinate', 'Centroid y-coordinate', etc. The 'Run' button at the bottom of the dialog is highlighted with a red box.

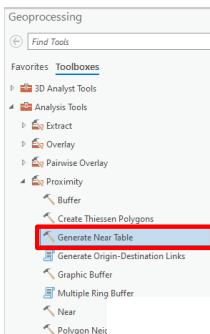
EjerForHoldsKode	Shape_Length	Shape_Area	AreaHa	CentroidX	CentroidY
<Null>	5444.113441	33139.609565	5.313961	530346.7	61538015
<Null>	2274.347693	230614.907425	23.06149	527602.6	6156065
<Null>	4110.159918	690186.408689	69.01864	528624.4	6155233
<Null>	3397.86541	376788.858822	37.67889	527326.6	6157530
<Null>	2475.475808	327004.92815	32.70049	527958.5	6154668
<Null>	1242.78329	85350.68688	8.535069	527351.4	6158177
<Null>	1614.222266	91352.197162	9.13522	527616.9	6154762
<Null>	1003.110519	63561.196292	6.35612	528241.9	6158303
<Null>	814.989609	25339.545588	2.533955	529089.6	6154894
<Null>	1399.084598	21778.115855	2.177812	532464.5	6154342
<Null>	3900.700314	11474.107734	1.147410		

## Distance



## Distance: Nearest distances between features

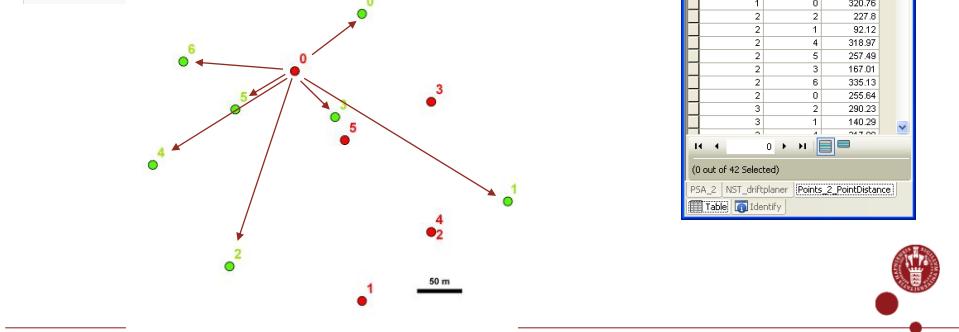




## Distances: between all combinations of features



INPUT_FID	NEAR_FID	DISTANCE
0	2	239.91
0	1	278.36
0	4	189.79
0	5	78.89
0	3	68.19
0	6	124.49
0	0	98.57
1	2	152.49
1	1	196.92
1	4	278.17
1	5	256.21
1	3	207.45
1	6	332.15
1	0	300.75
2	2	227.8
2	1	92.13
2	4	318.97
2	5	257.49
2	3	167.01
2	6	335.13
2	0	255.64
3	2	290.23
3	1	140.29



## Assignment II: Space matters, but how?

### Problem statement:

Is it really so that the distance per se is all that matters when moving around the world?

### Assignment:

Consider, with your neighbor, problems related to the 'buffer approach' to investigation of spatial impact.



- A close facility is of no use if the user is unaware of its existence or potential means of movement
- Distances vary according to mode of transport, activity at the destination, and personal preferences
- As the crows fly: Euclidian distance
- Constrained by a transport network
  - Length?
  - Time?
  - Perceived distance?
- Public transport
  - Based on schedules
  - Transport (typically walking) before/after the trip must be included
  - Time of departure must be included

## One more word on distance



## A word on distance



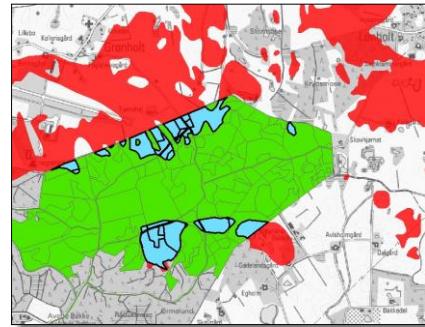
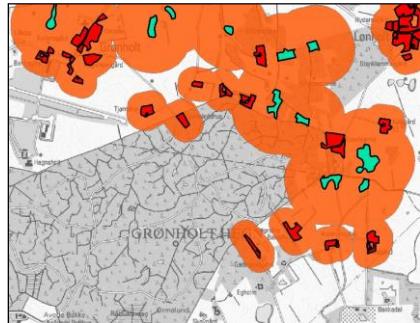
Distance vs.  
Impedance (Cost, time etc.)



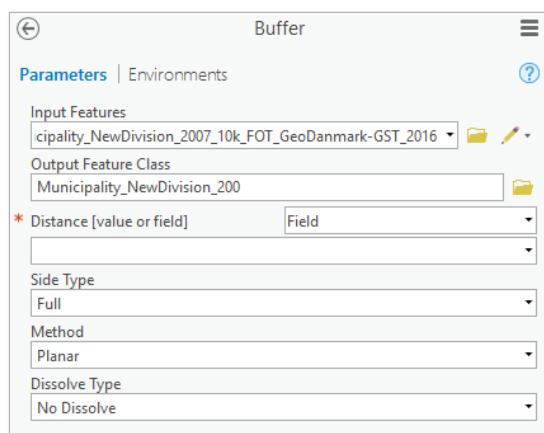
## Transforming analysis

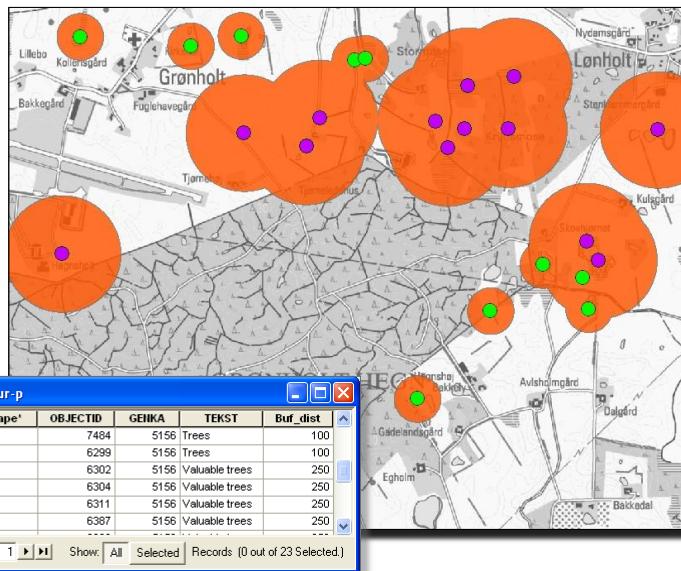
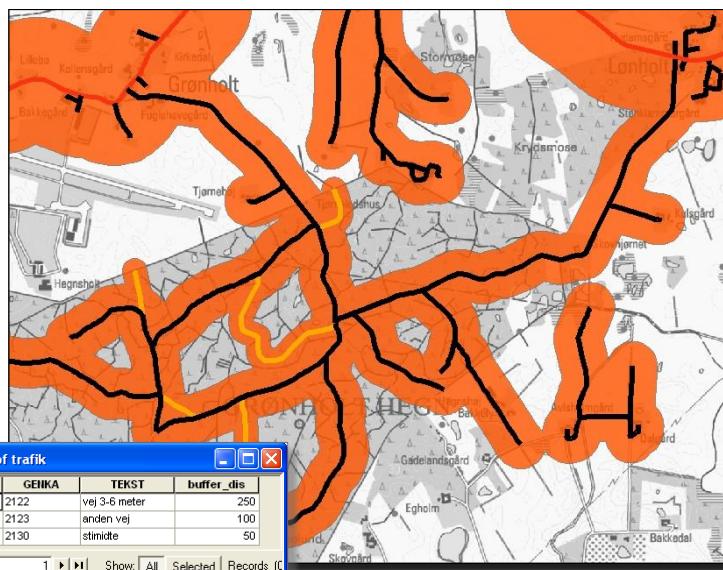
Transforming analysis include types of analysis that creates new features or make changes to existing ones

- Changes in primitive type (e.g. point -> polygon)
- Changes in shapes
- Changes in number of features

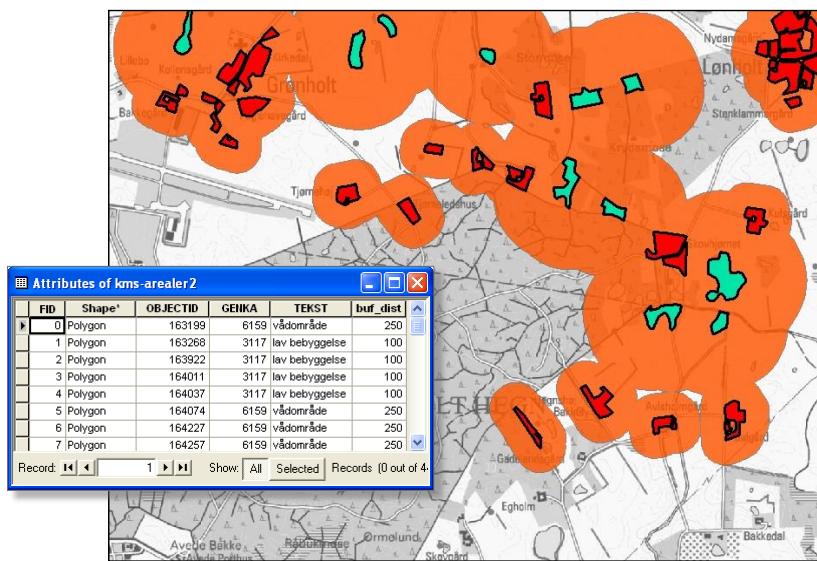


## Buffers

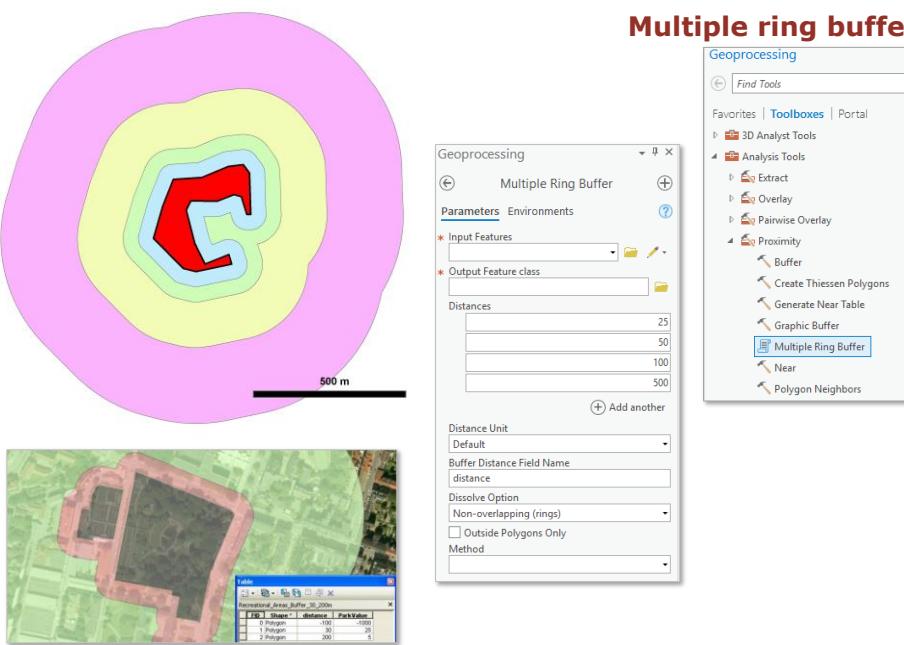


**Buffer zones (points)****Buffer zones (lines)**

## Buffer zones (polygon)



## Multiple ring buffer



## Spatial join

ID	ForestName
1	Ganløse
2	Ordrup
3	Rold
4	Råby Mølleskov
5	havdrup

ID	Soil
1	Sand
2	Clay

ID	Soil	ForestID	ForestName
1	Sand	2	Ordrup
1	Sand	3	Rold
1	Sand	4	Råby Mølleskov
2	Clay	NULL	NULL

**Spatial Join**

Parameters | Environments

- Target Features
- Join Features
- Output Feature Class

Join Operation

Join one to one

Keep All Target Features

Field Map of Join Features

Output Fields      Source      Properties

Match Option

Intersect

- Intersect
- Intersect 3D
- Within a distance geodesic
- Within a distance
- Within a distance 3D
- Contains
- Completely contains
- Contains Clementini
- Within
- Completely within
- Within Clementini
- Are identical to
- Boundary touches
- Share a line segment with
- Crossed by the outline of
- Have their center in
- Closest geodesic
- Closest

## Pause



## Overlay analysis



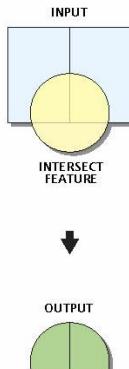
### Types of overlay analysis (I)



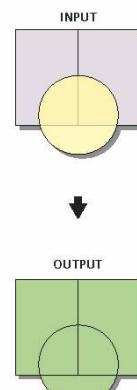
Obey rules of the 'set theory'

- **And:** Areas that is present in both datasets
- **Or:** Areas that is present in one, the other or both datasets
- **Xor either/or**

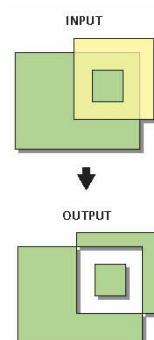
#### Intersect



#### Union



#### Symmetrical difference

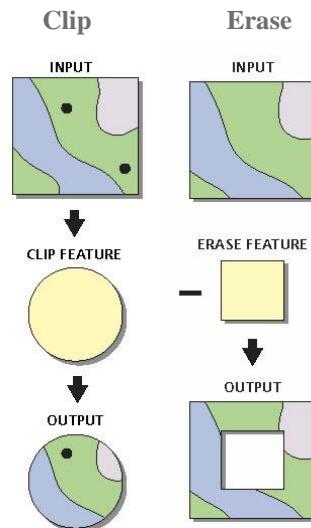


## Types of overlay analysis (II)

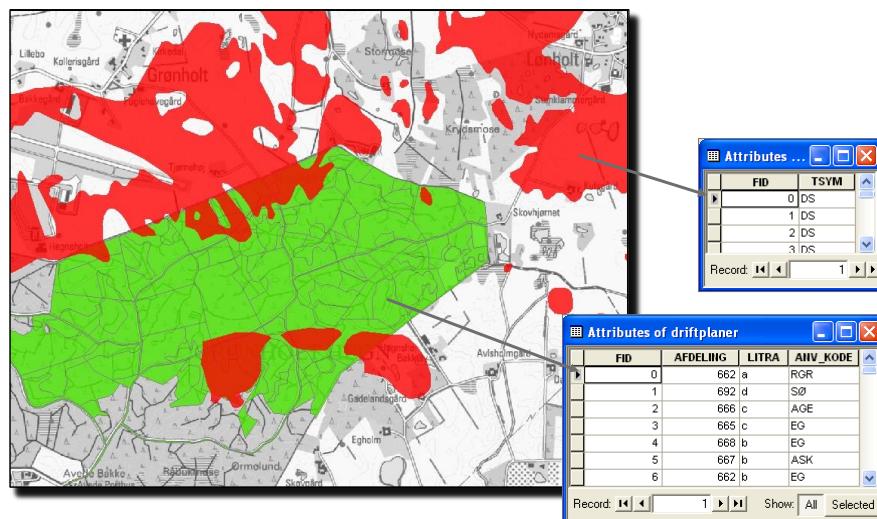


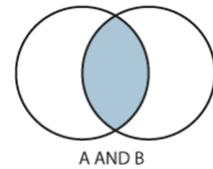
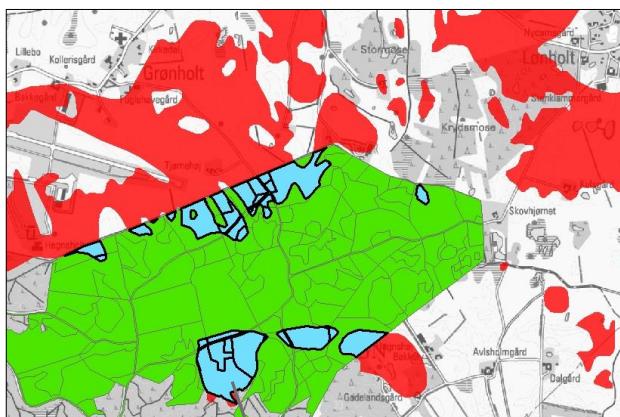
### Other possibilities

- **Clip:** Cuts out a portion
- **Erase:** Deletes a portion of the input layer



## Attributes in overlay analysis

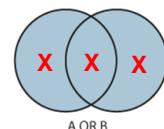
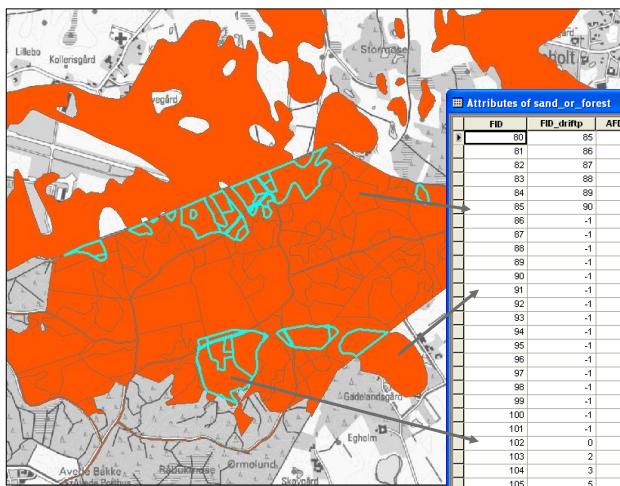


**Attributes in Intersects (= AND)**

Attributes of sand\_and\_forest

FID	FID_sand	TSYM	OBJECTID_1	AFDELING	LITRA	AHV_KODE
0	9 DS		396	662	a	RGR
1	9 DS		2407	666	c	AGE
2	9 DS		3067	665	c	EG
3	9 DS		3953	667	b	ASK

Record: 1 | Show: All | Selected | Records: 0 out of 34 Selected.

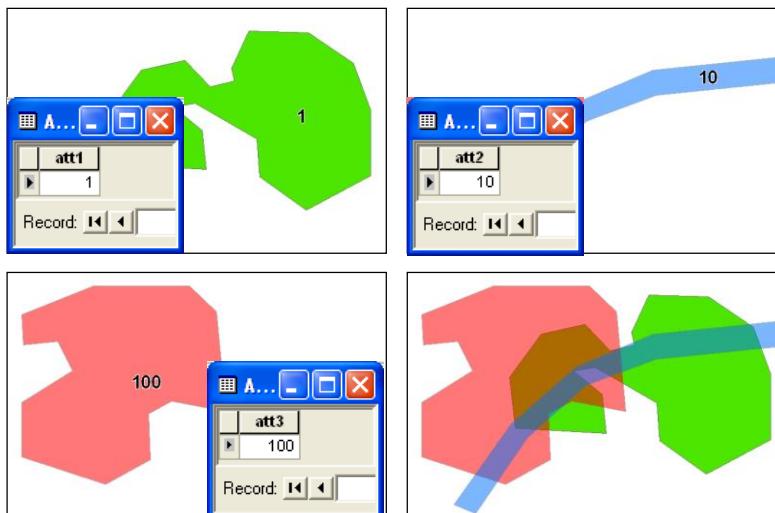
**Attributes in Unions (= OR)**

Attributes of sand\_or\_forest

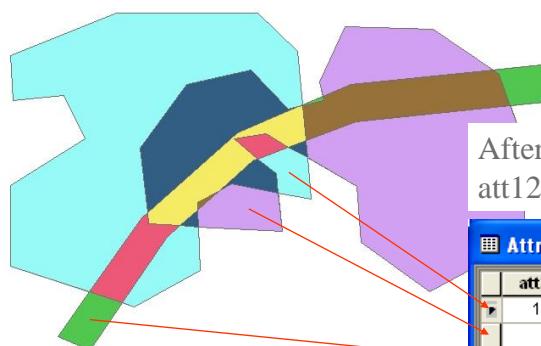
FID	FID_drift	AFDELING	LITRA	AHV_KODE	FID_sand	TSYM
80	65	667	d	ASK		-1
81	86	657	c	BIR		-1
82	87	652	c	ENG		-1
83	88	654	b	ASK		-1
84	89	653	b	ASK		-1
85	90	657	a	RGR		-1
86	-1	0				0 DS
87	-1	0				1 DS
88	-1	0				2 DS
89	-1	0				3 DS
90	-1	0				4 DS
91	-1	0				5 DS
92	-1	0				6 DS
93	-1	0				7 DS
94	-1	0				8 DS
95	-1	0				9 DS
96	-1	0				10 DS
97	-1	0				11 DS
98	-1	0				12 DS
99	-1	0				13 DS
100	-1	0				16 DS
101	-1	0				17 DS
102	0	662	a	RGR		9 DS
103	2	666	c	AGE		9 DS
104	3	665	c	EG		9 DS
105	5	667	b	ASK		9 DS
106	6	662	b	EG		9 DS

Record: 1 | Show: All | Selected | Records: 0 out of 136 Selected.



**Multiple overlay****If you got three data sets...****Multiple overlay****Att123**

- 1
- 10
- 11
- 100
- 101
- 110
- 111



After UNION  
att123 = att1 + att2 + att3

	att3	att1	att2	att123
1	100	0	0	100
10	0	1	0	1
11	0	0	10	10
100	100	1	0	101
101	100	0	10	110
110	0	1	10	11
111	100	1	10	111

Record: [◀] [◀] [▶] [▶]



**ChatGPT**

HS

In arcgis pro how would you calculate the area of sandy soil types 200 m from a river



To calculate the area of sandy soil types within 200 meters of a river in ArcGIS Pro, you can follow these steps:

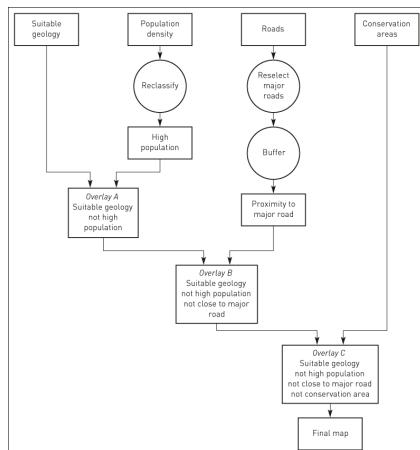
1. Open a new or existing project in ArcGIS Pro.
2. Add the river layer and soil type layer to your project.
3. Use the [Select By Location tool](#) to select soil type features that intersect with the river within 200 meters. To do this, go to the Selection menu and click Select By Location. In the Select By Location dialog box, choose the soil type layer as the target layer and the river layer as the source layer. Then choose the "intersect the source layer feature" option and set the distance to 200 meters.
4. [Create a new field](#) in the soil type layer attribute table to calculate the area of each selected soil type feature. To do this, right-click on the soil type layer in the Contents pane and select "Attribute Table". Then click on the "Add Field" button, choose a name for the field, and set the field type to "Double".
5. [Calculate the area of each](#) selected soil type feature using the Calculate Geometry Attributes tool. To do this, go to the Attribute Table, right-click on the new field and choose "Calculate Geometry Attributes". In the Calculate Geometry Attributes dialog box, choose the "Area" option and set the units to square meters.
6. Use the [Select by Attributes tool to select the sandy soil types](#). To do this, right-click on the soil type layer in the Contents pane and select "Selection" > "Select by Attributes". In the Select by Attributes dialog box, choose the field that contains the soil type information and set the query to select only the sandy soil types.
7. [Summarize the area of sandy soil types using the Summary Statistics tool](#). To do this, go to the Analysis tab, click on the Tools dropdown and choose "Summary Statistics". In the Summary Statistics dialog box, set the soil type layer as the input table, choose the new field as the statistics field, and choose the soil type field as the case field.
8. The resulting table will show the total area of sandy soil types within 200 meters of the river.



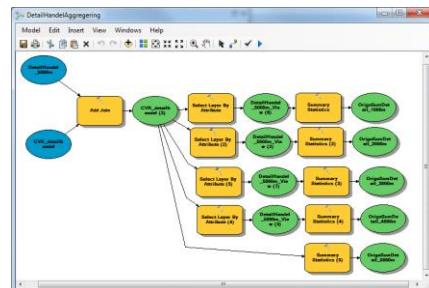
## Flow charts and model building



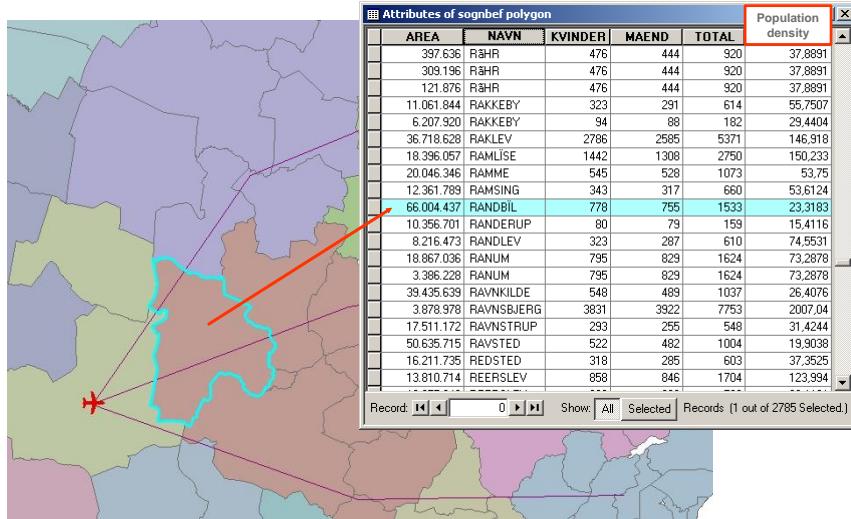
## Flow charts A way to organising your thoughts



ArcGIS' modelbuilder



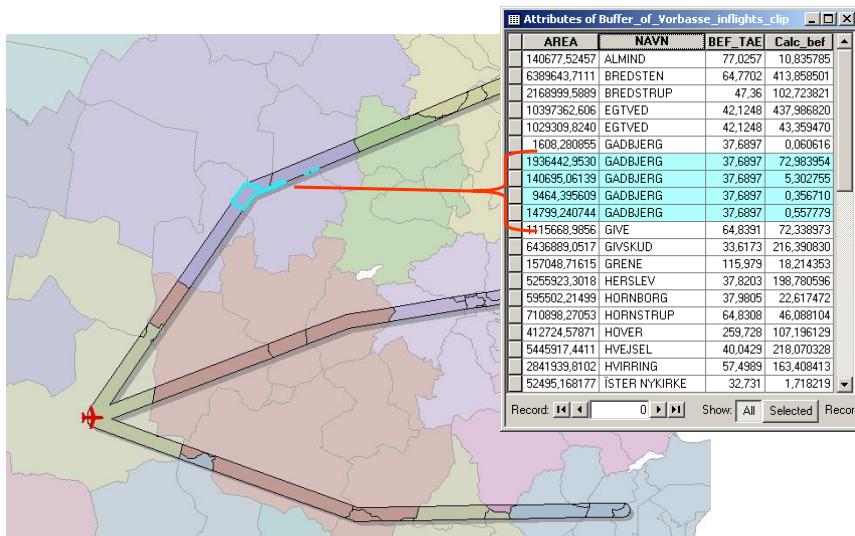
## Data aggregation – area dependent variables (I)



Case: New International airport in Vorbasse



## Data aggregation – area dependent variables (II)



Result: 12.150 people are affected



## Assignment III: Flow charts?

### Use:

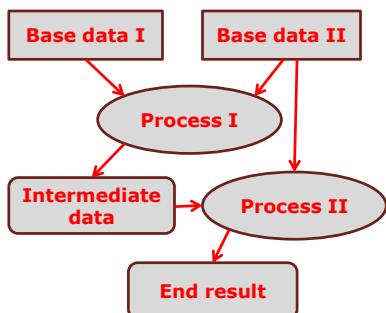
- Hard rectangles for base data
- Rectangles with soft corners for intermediate data and results
- Circles or spheres for processes

### Problem statement:

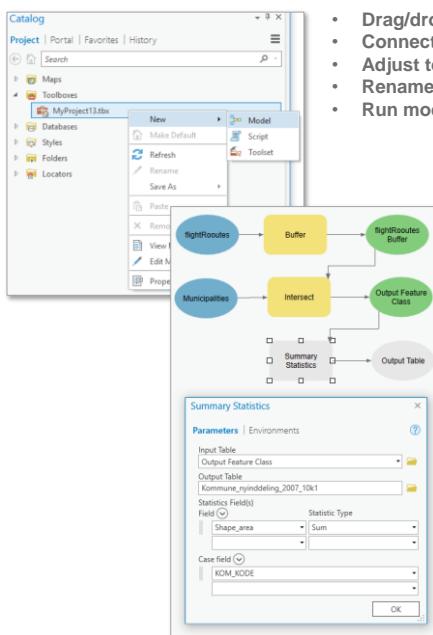
Can the previous analysis be stated as data/Intermediate data, and processes of a flow chart?

### Assignment:

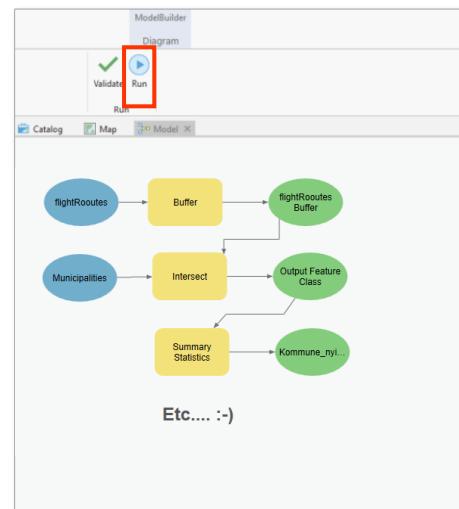
Consider, with your neighbor, how the New-International-AirPort- problem can be described by a flow chart.



## The 'Model builder'



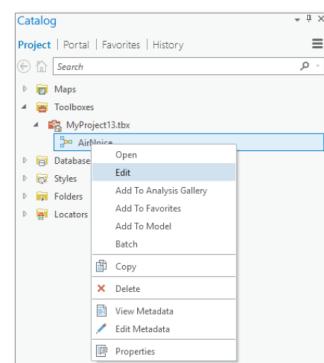
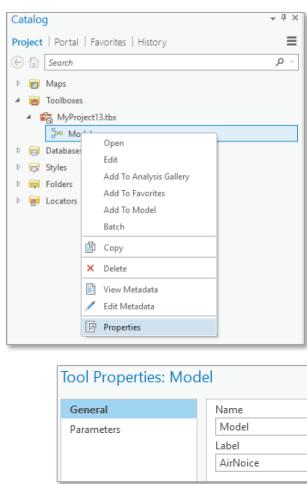
- Drag/drop data and tools
- Connect tools and data
- Adjust tool settings
- Rename if feasible
- Run model



Etc.... :-)

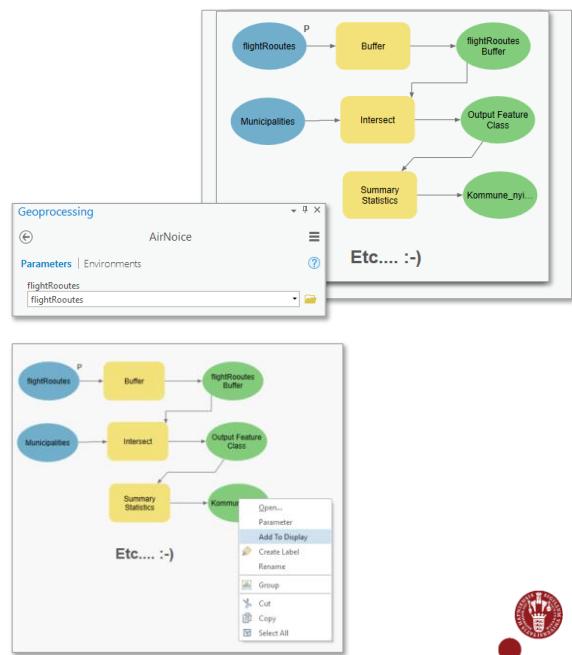
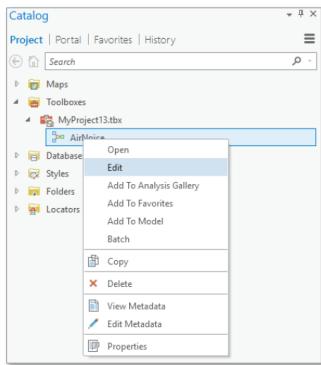
### Handling models in Catalog

- Renaming models (properties)
- Running models (open)
- Editing a model (edit)



## Handling models in Catalog

- Editing a model
- Set parameters
- Add results to display



## Low- or No-code tools CASE (Computer-Aided Software Engineering)

**You**  
what is the general term used for 'coding' facilities where the user instead of explicit coding is allowed to drag/drop data and function onto a canvas rather than via application of explicit coding languages (Python, c# etc)

**ChatGPT**  
The general term for the approach where users can create programs or workflows without explicitly writing code, by instead dragging and dropping elements onto a canvas or using a visual interface, is often referred to as "Low-Code" or "No-Code" development.

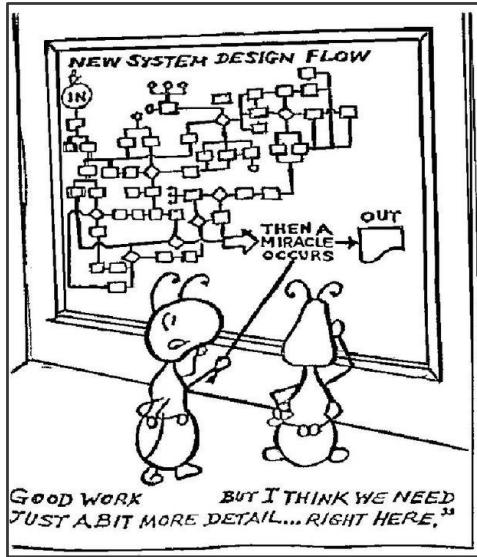
**You**  
I vaguely recall that the term CASE was used 10-20 years ago. Does that still apply and, in that case, what does the abbreviation stand for?

**ChatGPT**  
Yes, the term CASE, which stands for Computer-Aided Software Engineering, was indeed more commonly used in the past, particularly during the 1980s and 1990s. It referred to a set of tools and methodologies designed to assist in various phases of the software development life cycle. However, while the specific term "CASE" may not be as prevalent today, the concepts and tools associated with computer-aided software engineering are still very much alive and have evolved into broader categories like Integrated Development Environments, modeling systems, and modern software development tools.

**HS** You  
Thanks. It sucks getting old :)

**ChatGPT**  
Aging is a natural part of life, and while it may come with some challenges, it also brings wisdom, experience, and a unique perspective. Embracing the changes that come with getting older and finding ways to adapt to new technologies and trends can help maintain a positive outlook. Remember that each stage of life has its own joys and opportunities. If you ever feel overwhelmed or nostalgic, it might be helpful to reflect on the positive aspects of the journey and the knowledge you've gained along the way. Life is a continuous learning process, and every stage offers its own set of adventures and growth.

**Thank you for your  
attention...**



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