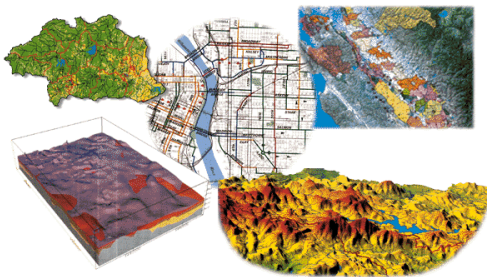


# APLIKOVANÁ GEOINFORMATIKA IV



## Prostorové operace v GIS



Aplikovaná geoinformatika

# Členění prostorových operací

*Podle Cornelius a Heywood (1994) in Tuček (1998):*

1. Jednoduché (single operations)
2. Složité (multiple operations)
3. Kartografické modelování
4. Prostorové interpolace
5. Digitální modely terénu
6. Síťové analýzy

# 1. Jednoduché

- Vykonávají se jen na jednotlivé informační vrstvě, rastrové nebo vektorové
  - výpočty vzdáleností, ploch a obvodů
  - dotazy na databázi – prostorové a atributové
  - sousedské funkce – buffering, reklasifikace rastrů

# Dotazy na databázi

- Dotazovací operace má obecně 3 hlavní komponenty (platí jak pro atributové, tak pro prostorové dotazy):
  - specifikace údajů, kterých se týká
  - formulace podmínek, kterým musí údaje vyhovovat
  - instrukce, co se má na vybraných údajích udělat
    - vytvořit selekci, odmazat ze stávající selekce, přidat ke stávající selekci, vybrat prvky pouze z již existující selekce

Create a new selection  
Add to current selection  
Remove from current selection  
Select from current selection

## 2. Složitě

- Operace, které vyžadují použití dat:
  - ze dvou nebo více informačních vrstev
  - ze dvou nebo více objektů
  - z informační vrstvy GIS a externího zdroje
- Těžiště prostorových operací
- Data musí splňovat určité požadavky
  - stejná kvalita, lokalizace ve stejném souřadnicovém systému, vhodná struktura
- **Overlay algebra**



# 3. Kartografické modelování

- Postupy na integraci (kombinování) informačních vrstev na matematickém principu podle určitého schématu
- **Mapová algebra**
- Posloupnost používání analytických nástrojů

# Další skupiny analytických funkcí (nespadají plně do výše uvedených kategorií)

- Geostatistické analýzy
- Analýzy obrazů (především DPZ)

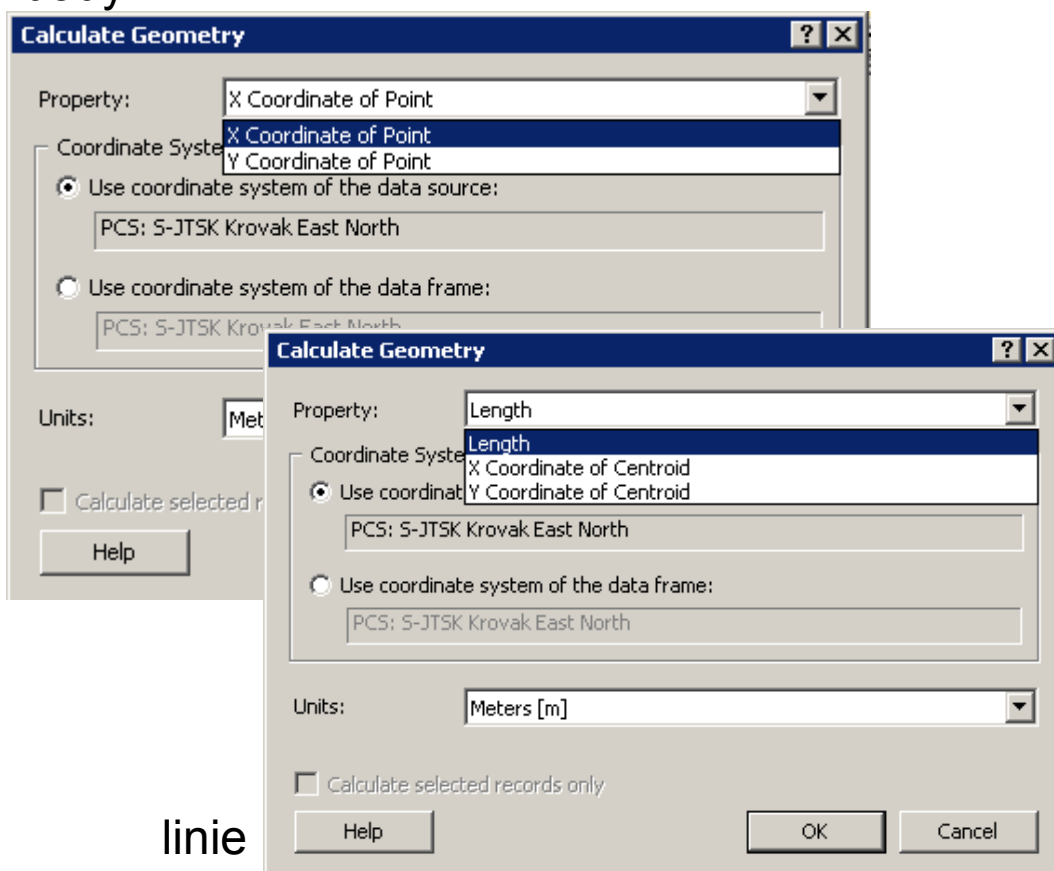
# Prostorové operace v ArcGIS



# Výpočty vzdáleností, ploch a obvodů

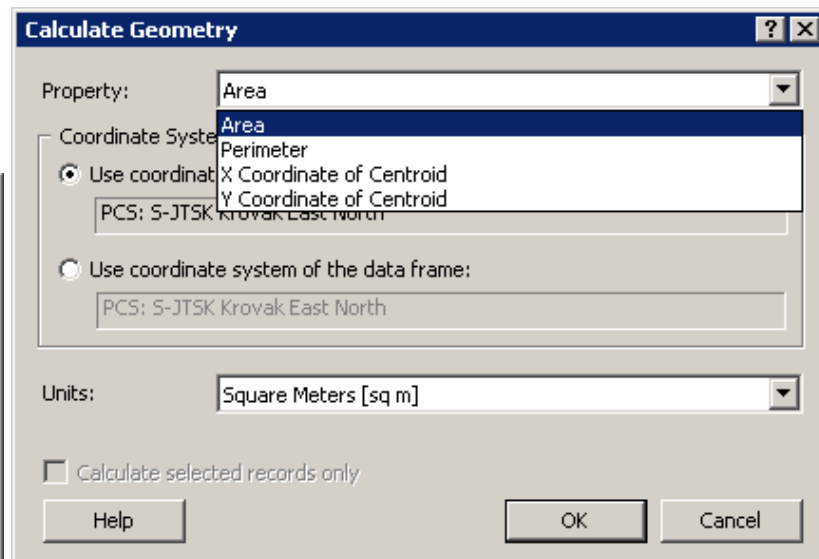
- Výpočty v prostředí atributové tabulky

body



linie

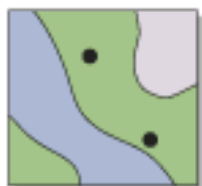
polygony



# Jiný způsob zápisu souřadnic do atributové tabulky

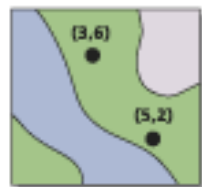
## Add XY Coordinates

Adds the fields POINT\_X and POINT\_Y to the point input features and calculates their values.



INPUT

OBJECTID
1
2



OUTPUT

OBJECTID	POINT_X	POINT_Y
1	3	6
2	5	2

- Data management Tools → Features → Add XY Coordinates
- Pouze bodové vrstvy
- Doplní souřadnice v jednotkách souřadnicového systému
  - metry
  - zeměpisná šířka a délka

# Prostorové dotazy na databázi

- **Select by Location**
- Prostorové operátory:
  - intersect
  - are within a distance of
  - completely contain
  - are completely within
  - have their centroid in
  - share a line segment with
  - touch the boundary of
  - are identical to
  - are crossed by the outline of
  - contain
  - are contained by

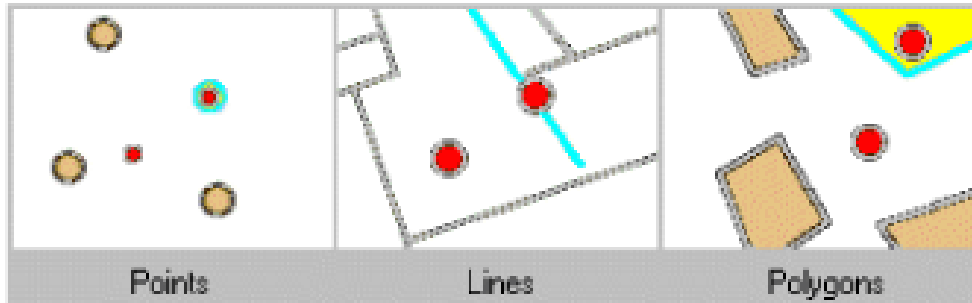
## intersect

are within a distance of  
completely contain  
are completely within  
have their centroid in  
share a line segment with  
touch the boundary of  
are identical to  
are crossed by the outline of  
contain  
are contained by

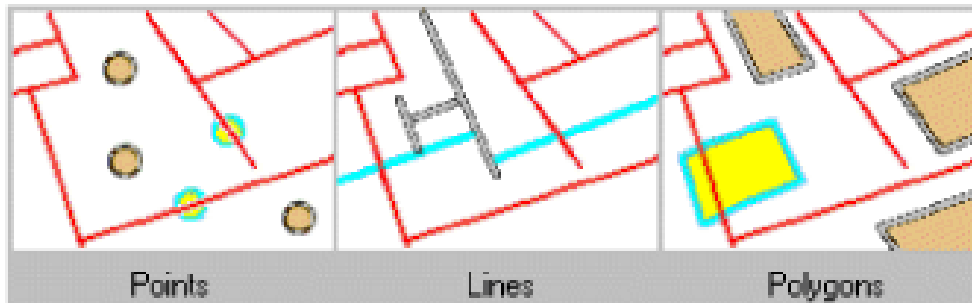
# Intersect

- Vrátí prvky (i z více vrstev), které geometricky sdílí jakoukoliv společnou část s prvky „hlavní“ vrstvy
- Stejný efekt mají i další operátory v konkrétních případech, např:
  - **are identical to** ... když se srovnávají pouze bodové vrstvy
  - **are within a distance of** ... když by se zadala nulová hodnota bufferu

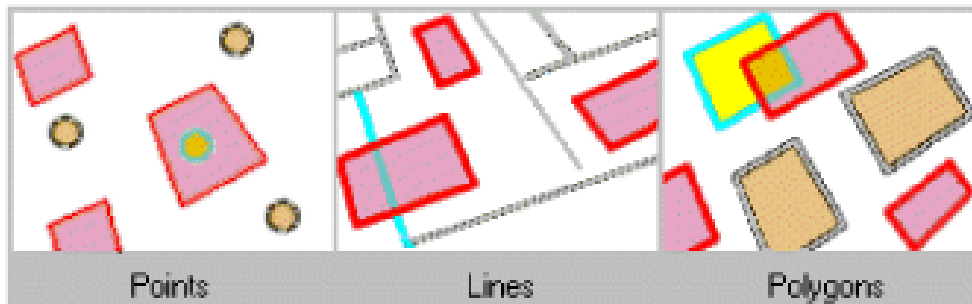
When finding features that intersect with point features



When finding features that intersect with line features



When finding features that intersect with polygon features



ArcGIS Help

The highlighted cyan features are selected because they intersect the red features.

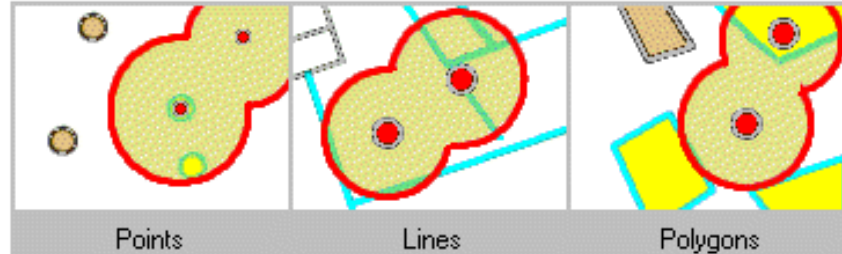


# Are within a distance of

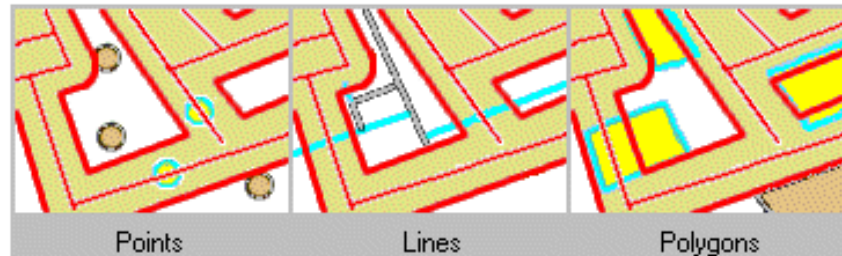
- Operátor vytváří buffer (nebo buffery) okolo hlavní vrstvy se zadanou vzdáleností a vrací prvky, které protnou (pravidlo intersect) daný buffer (nebo buffery)

ArcGIS Help

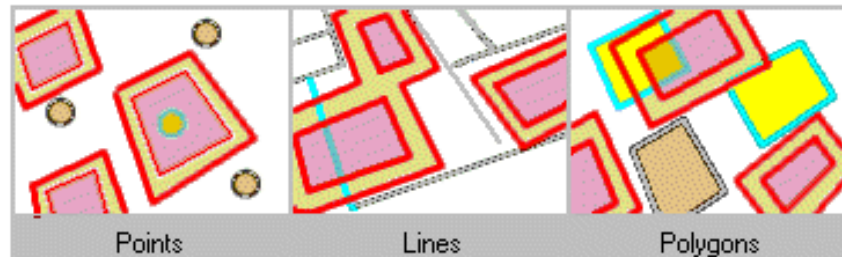
When finding features that are within a distance of point features



When finding features that are within a distance of line features



When finding features that are within a distance of polygon features



The highlighted cyan features are selected because they are within the selected distance of the red features.



# Completely contain

- Pro některé uživatele mírně zavádějící nástroj
- **Výběr polygonu**, v němž je plně obsažen nějaký další prvek
- Pro platnost operátoru musí každý bod geometrie ležet vevnitř polygonu, výsledkem výběru je vnější polygon
- „**Select from kraje that completely contain okresy**“ → vybere kraje, které mají takový okres, který leží celý uvnitř . Nevybere okresy, ale kraje.
- Na výběr okresů, které celé leží uvnitř kraje je jiný operátor → **viz. další slide**

When finding point, line and polygon features completely contained by polygon features



ArcGIS Help

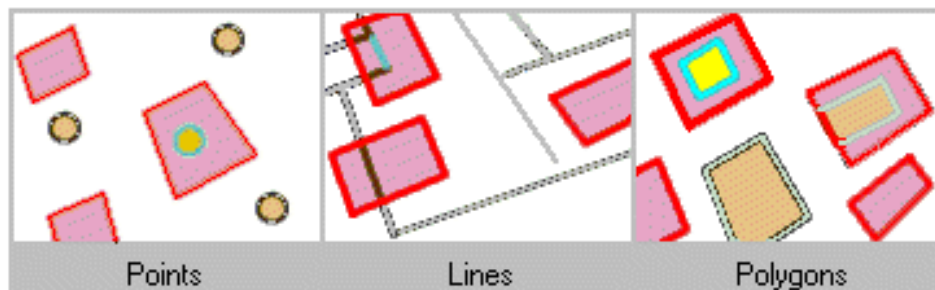
The highlighted cyan features are selected because they completely contain the red features.

# Are completely within

- Výběr prvku, který je plně uvnitř jiného prvku
- Každý bod geometrie musí ležet uvnitř, hranice se bere jako že je vně
- Reverzní operátor vůči Completely contain
- Hlavním prvkem musí být polygon nebo se musí nadefinovat buffer okolo bodů a linií

When finding features that are completely within polygon features

ArcGIS Help

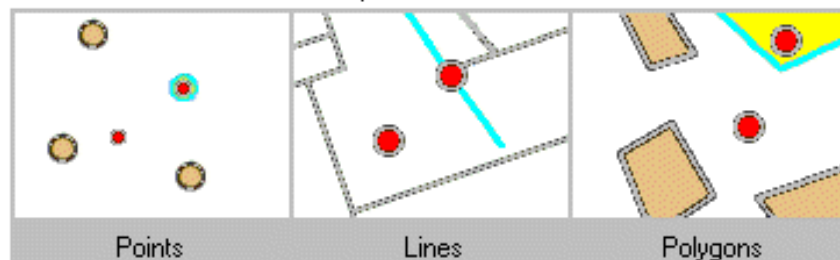


The highlighted cyan features are selected because they are completely within the red features.

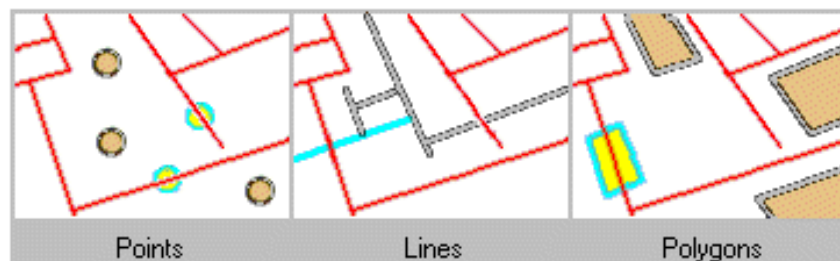
# Have their center in

- Prvek bude vybrán, pokud jeho centroid leží vevnitř nebo se dotýká geometrie prvku
- Lze opět definovat buffer – vzdálenost ve které musí centroid ležet

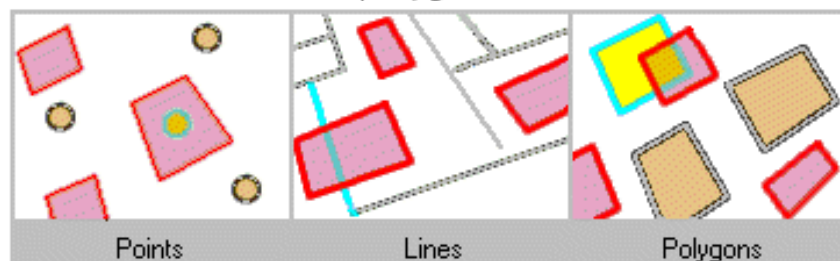
When finding features that have their centers within a distance of point features



When finding features that have their centers within a distance of line features



When finding features that have their centers within a distance of polygon features



ArcGIS Help

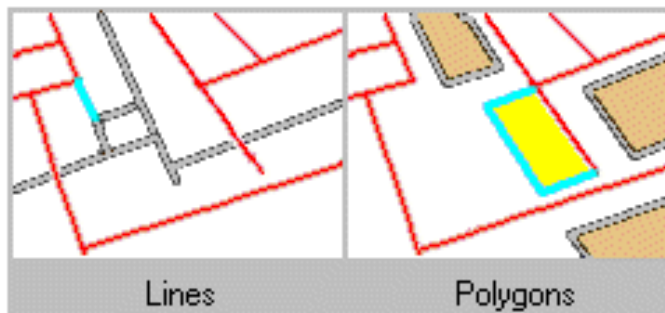
The highlighted cyan features are selected because they have their centers in the red features.

# Share a line segment with

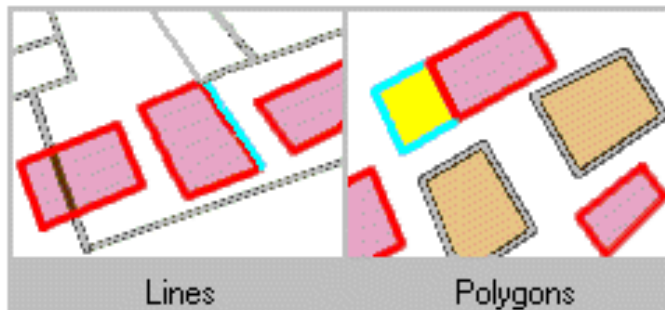
- Výběr prvků, které mají společné s hlavním prvkem minimálně 2 po sobě jdoucí vertexy
- Pouze pro linie a polygony

ArcGIS Help

When finding features that share a line segment with line features



When finding features that share a line segment with polygon features



Findin  
featur

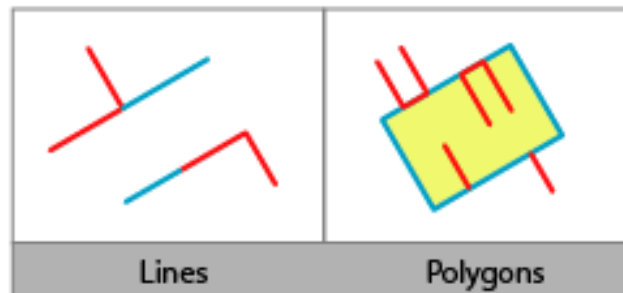
The highlighted cyan features are selected because they share a line segment with a red feature.



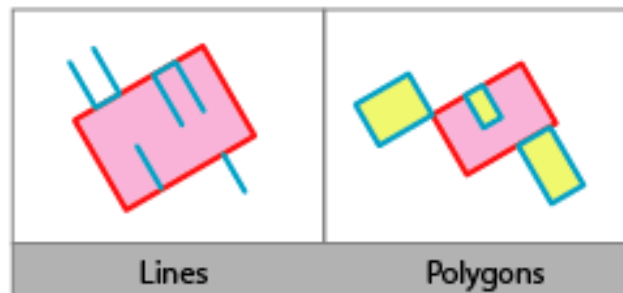
# Touch the boundary of

- Prvek bude vybrán tehdy, jestliže průnik jeho geometrie s geometrií hlavního prvku není prázdný. (tzv. Clementini touch operator)
- → průnikem se myslí stejné umístění vertexu !
- Dále ale bude vybrán i prvek, který leží celý uvnitř polygonu, jestliže sdílí část část linie, nebo vertex s hranicí polygonu
- Pro linie a polygony

When finding features that touch the boundary of line features



When finding features that touch the boundary of polygon features



Find

The highlighted cyan features are selected because they touch the boundary of a red feature.

ArcGIS Help

## povodí 4. řádu se nevyberou

**Layers**

- VYSKY
- vodni\_toky\_join\_hustota
- A03\_Vodni\_tok\_HU\_Clip
- kraje
- A08\_Povodi\_III\_Clip
- okresy
- A07\_Povodi\_IV\_Clip

**Select By Location**

Lets you select features from one or more layers based on where they are located in relation to the features in another layer.

I want to:

select features from

the following layer(s):

- VYSKY
- vodni\_toky\_join\_hustota
- A03\_Vodni\_tok\_HU\_Clip
- kraje
- A08\_Povodi\_III\_Clip
- okresy
- A07\_Povodi\_IV\_Clip

Only show selectable layers in this list

that:

touch the boundary of

the features in this layer:

okresy

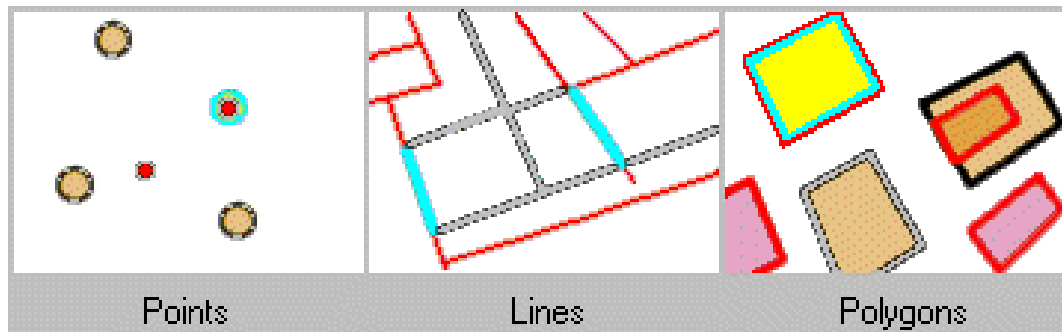
Use selected features (0 features selected)



# Are identical to

- Výběr prvků se striktně identickou geometrií
- Pouze pro stejné typy geometrie

When finding features that are identical to other features



The highlighted cyan features are selected because they are identical to a red feature.

ArcGIS Help

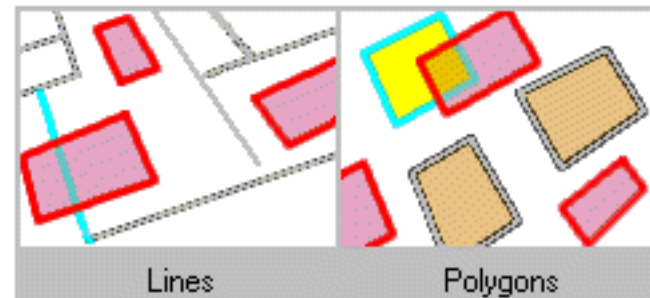
# Are crossed by the outline of

- Hranice prvků musí mít společnou alespoň jednu hranu, vertex či koncový bod, musí se protnout, nemusí sdílet část linie
- Pro linie a polygony

When finding features that are crossed by the outline of line features



When finding features that are crossed by the outline of polygon features



The highlighted cyan features are selected because they intersect the red features.

ArcGIS Help

- VYSKY
- vodni\_toky\_join\_hustota
- A03\_Vodni\_tok\_HU\_Clip
- kraje
- A08\_Povodi\_III\_Clip
- okresy
- A07\_Povodi\_IV\_Clip

**Select By Location** [?] [X]

Lets you select features from one or more layers based on where they are located in relation to the features in another layer.

I want to:

select features from

the following layer(s):

- VYSKY
- vodni\_toky\_join\_hustota
- A03\_Vodni\_tok\_HU\_Clip
- kraje
- A08\_Povodi\_III\_Clip
- okresy
- A07\_Povodi\_IV\_Clip

Only show selectable layers in this list

that:

are crossed by the outline of

the features in this layer:

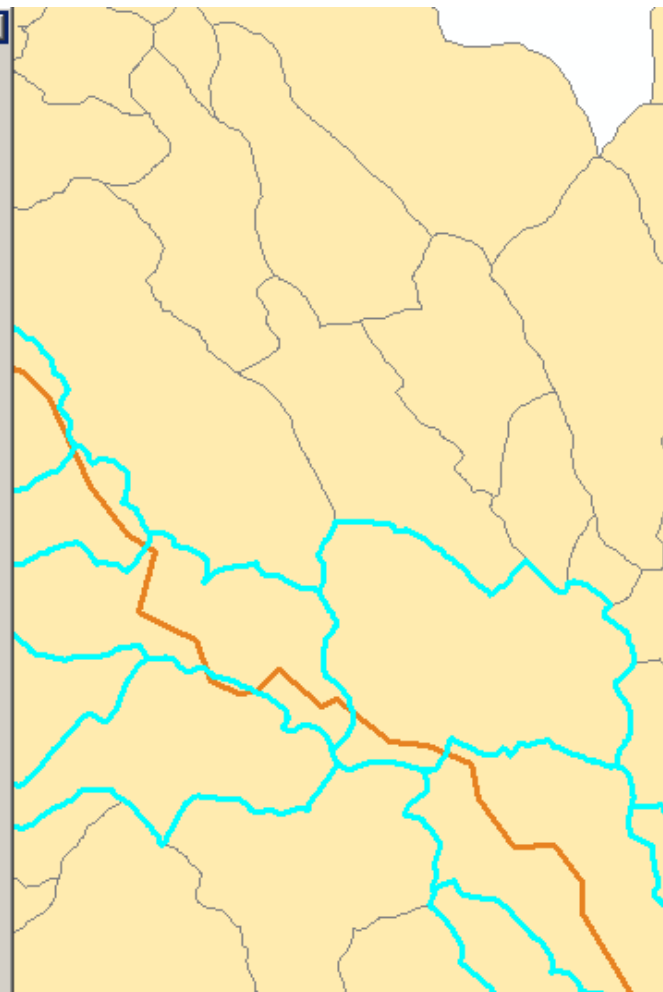
okresy

Use selected features (0 features selected)

Apply a buffer to the features in okresy

of: 0,000000 Meters

Help OK Apply Close

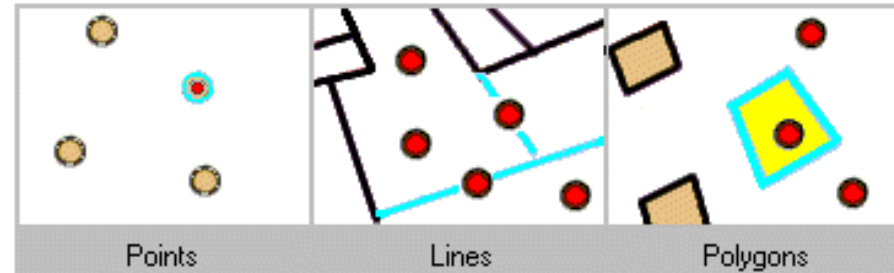


# Contain

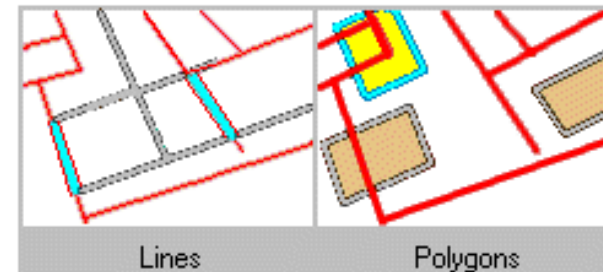
- Liší se od Completely contain tím, že se do výběru zahrnují i prvky, které mají společnou hranici
- Výsledkem výběr ale nejsou „prvky uvnitř“ ale takové, které ty prvky uvnitř obsahují

ArcGIS Help

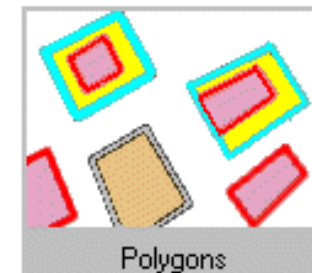
When finding features that contain point features



When finding features that contain line features



When finding features that contain polygon features



The highlighted cyan features are selected because they contain a red feature.

# Are contained by

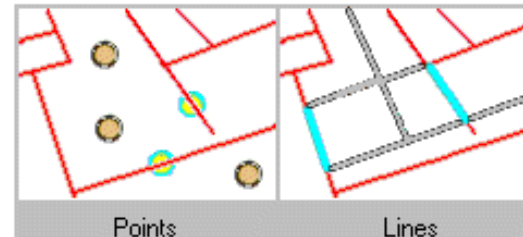
- Opět analogie k Area completely within
- I prvky se společnou hranicí
- Reverzní operátor ke Contain

ArcGIS Help

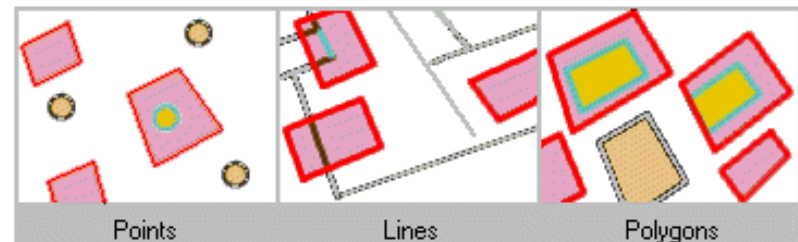
When finding features that are contained by point features



When finding features that are contained by line features



When finding features that are contained by polygon features



The highlighted cyan features are selected because they are contained by a red feature.



# Atributové dotazy na databázi

- Select by attributes
- SQL dotaz
- Select from \_\_\_\_ where:
- Logické operátory
- Kombinace podmínek v jednom dotazu
- Viz. kontextový help aplikace



# Atributové dotazy na databázi

The image shows two overlapping windows from an ArcGIS application. The primary window is titled "Select By Attributes" and is used for creating queries based on layer attributes. It features a dropdown menu for the layer (set to "VYSKY"), a checkbox for "Only show selectable layers in this list", and a dropdown for the selection method (set to "Create a new selection"). A list of attributes is shown, with "VYSKA" selected. Below this is a grid of logical operators (like, and, or, not) and comparison operators (equal, less than, greater than, etc.). A "Get Unique Values" button and a "Go To:" field are also present. The SQL query editor at the bottom shows the query: `SELECT * FROM VYSKY WHERE: "VYSKA"`. Buttons for "Clear", "Verify", "Help", "Load...", "Save...", "OK", "Apply", and "Close" are at the bottom.

The secondary window is titled "ArcGIS Dialog Help" and contains text explaining how to use the NULL keyword in queries. It states: "geodatabases and for date fields in shapefiles/dBASE tables and coverages/INFO tables. If you select a field of a type that supports null values, and if that field contains any null values in the records displayed by the Unique Values list, you'll see a NULL keyword at the top of the Unique Values list. You can double-click the NULL keyword to add it into your expression, where you can use the IS operator to query the field to select all its null values:"

Examples provided are:

- `"POPULATION96" IS NULL`
- or `IS NOT` to select all its values that aren't null:
- `"POPULATION96" IS NOT NULL`

The text further explains: "The NULL keyword is always preceded by IS or IS NOT."

**Querying numbers**

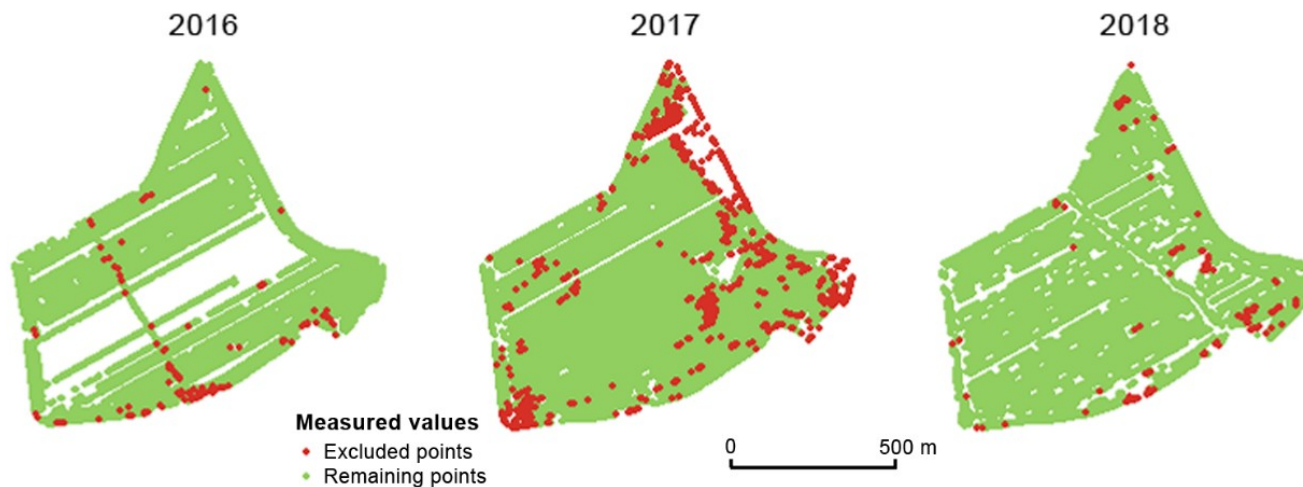
You can query numbers using the equal (=), not equal (<>), greater than (>), less than (<), greater than or equal (>=), and less than or equal (<=) operators.

Example: `"POPULATION96" >= 5000`

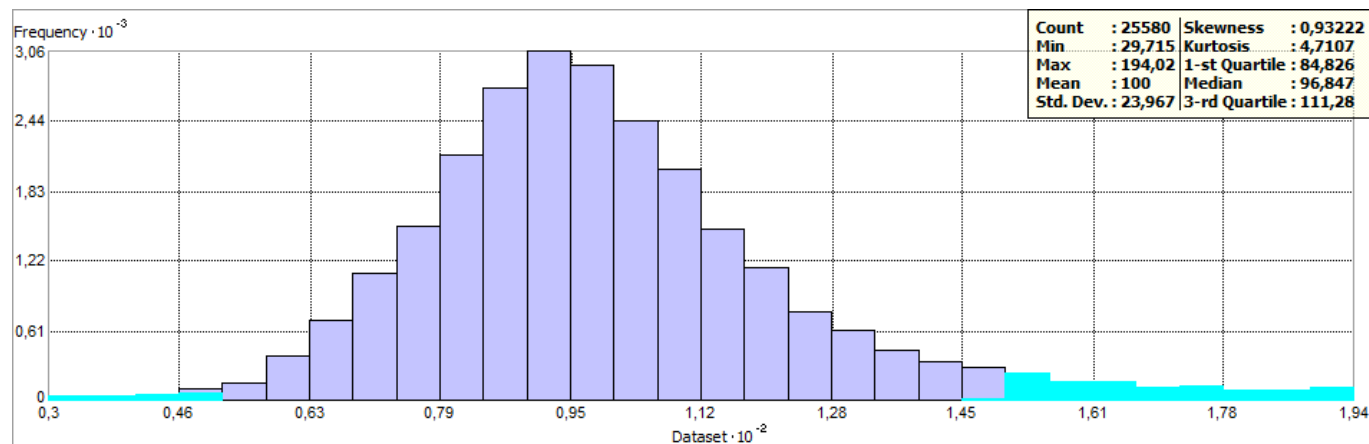
The text concludes: "The point is always used as the decimal delimiter regardless of your regional settings. The comma cannot be used as a decimal or thousands delimiter in a query."

**Calculations**

# Atributové dotazy na databázi



```
SELECT * FROM „measured values“ WHERE „yield_value“ > 50% AND „yield_value“ < 150%
```



# Proximity funkce (sousedské)

- Rozdílné nástroje pro vektory a rastry
- Vzdálenost 2 prvků
- Vzdálenost mezi jednotlivými prvky stejné vrstvy
- Buffery
- Nejbližší, nejvzdálenější bod
- Nejkratší cesta
- ...

## Proximity tools

### Vector distance tools

Tool	Location	What it does
<a href="#">Buffer</a>	<a href="#">Proximity toolset</a>	Creates new feature data with feature boundaries at a specified distance from input features.
<a href="#">Near</a>	<a href="#">Proximity toolset</a>	Adds attribute fields to a point feature class containing distance, feature identifier, angle and coordinates of the nearest point or line feature.
<a href="#">Point Distance</a>	<a href="#">Proximity toolset</a>	Creates a new table with distance and feature identifier attributes showing the distance from each point in the input feature class to all points in the Near feature class, within a given search radius.
<a href="#">Select by Location</a>	<a href="#">Layers and Table Views toolset</a>	Selects features from a target feature class within a given distance of (or using other spatial relationships) the input features.
<a href="#">Create Thiessen Polygons</a>	<a href="#">Proximity toolset</a>	Creates polygons of the areas closest to each feature, for a set of input features.
<a href="#">Make Closest Facility Layer</a>	<a href="#">Network Analyst/Analysis toolset</a>	Sets analysis parameters to find the closest location or set of locations on a network to another location or set of locations.
<a href="#">Make Service Area Layer</a>	<a href="#">Network Analyst/Analysis toolset</a>	Sets analysis parameters to find polygons that define the area within a given distance along a network in all directions from one or more locations.
<a href="#">Make Route Layer</a>	<a href="#">Network Analyst/Analysis toolset</a>	Sets analysis parameters to find the shortest path among a set of points.
<a href="#">Make OD Cost Matrix Layer</a>	<a href="#">Network Analyst/Analysis toolset</a>	Sets analysis parameters to create a matrix of network distances among two sets of points.

# Další typy prostorových operací – - viz. další přednášky

- Overlay algebra
- Digitální model terénu
- Prostorové interpolace
- Mapová algebra
- Síťové analýzy