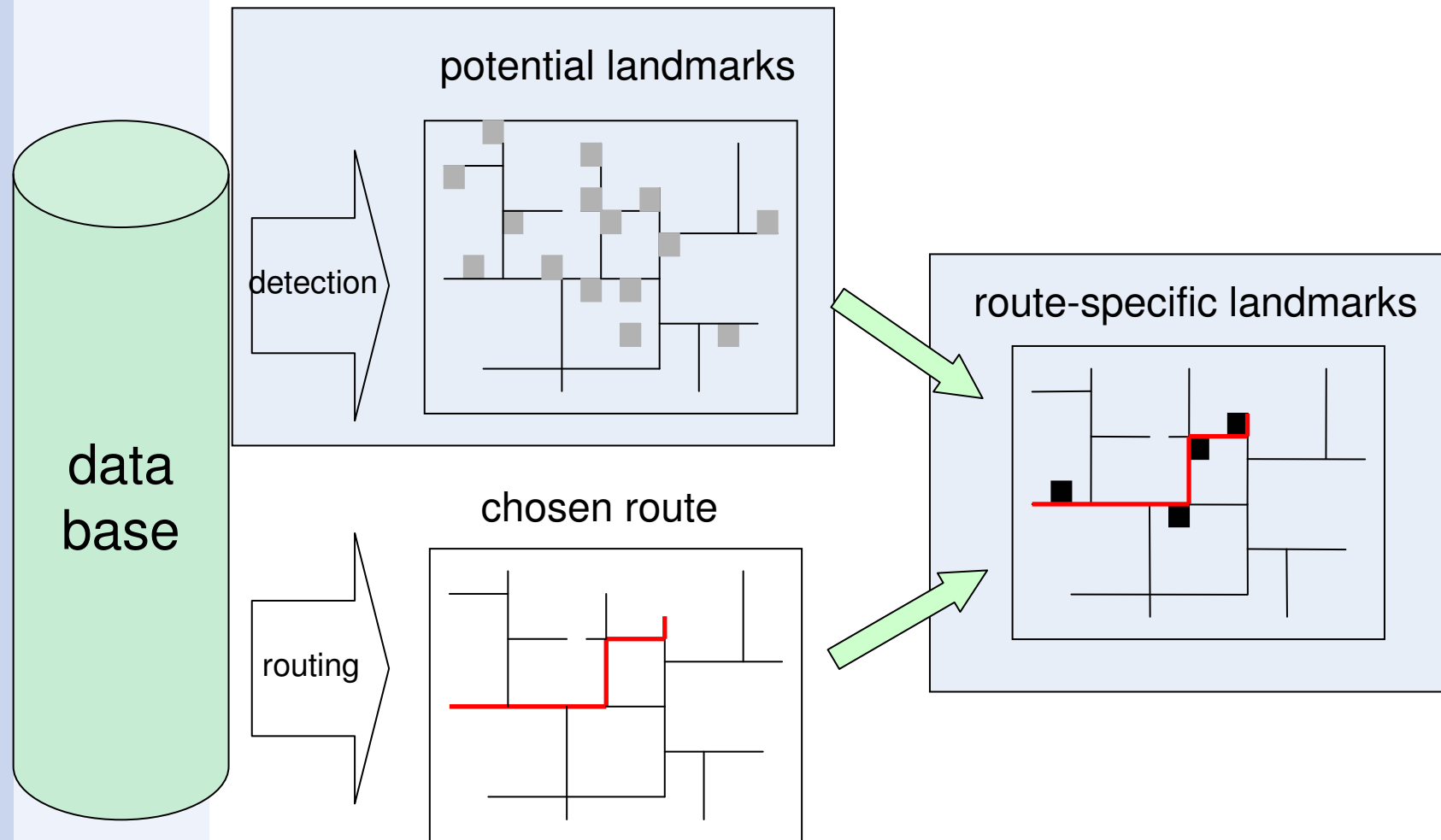


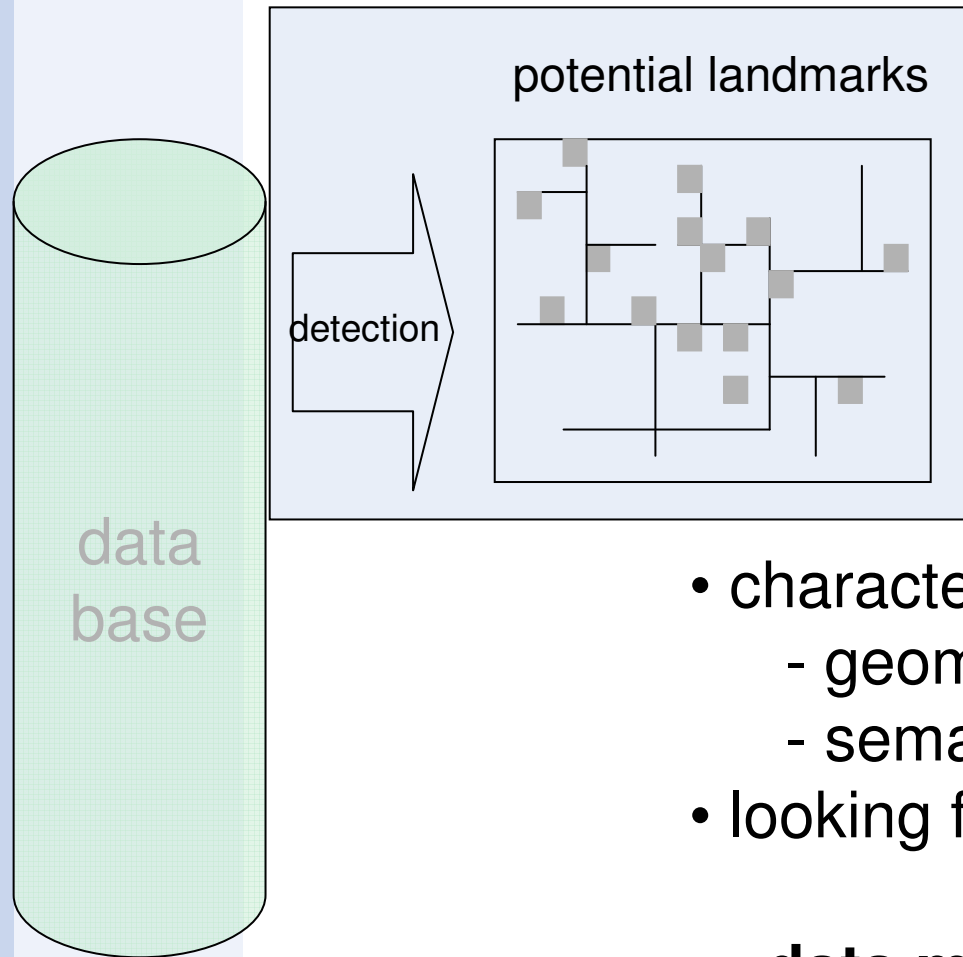
Landmarks – Determination and Reliability Criteria

Birgit Elias
University of Hannover

Determination of Landmarks



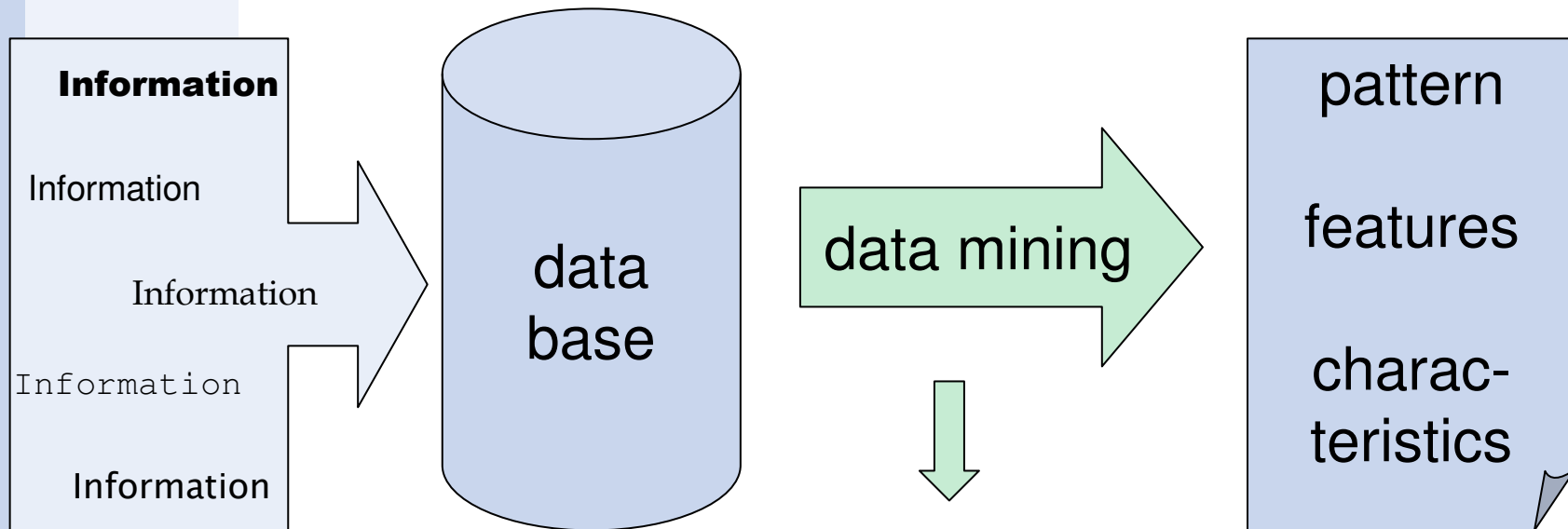
Potential Landmarks



- characteristics of objects
 - geometry
 - semantics
- looking for similarity and exception

-> data mining

Data Mining



machine learning

supervised

-> classification (ID3)

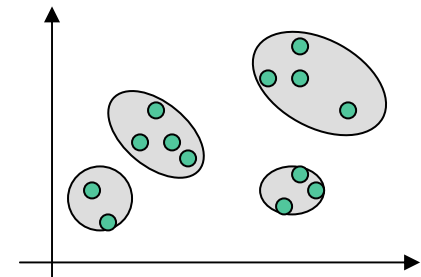
unsupervised

-> clustering (Cobweb)

Clustering with Cobweb

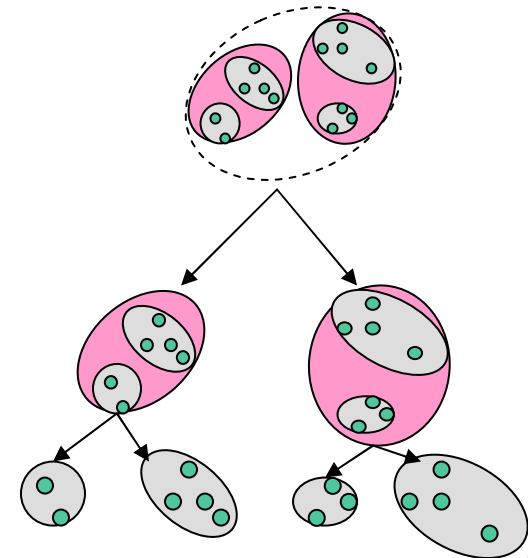
► Clustering

- structures a given set of unclassified instances in natural groups
- based on similarities found in the training data
- > **concept that covers all example**



► Cobweb

- incremental, hierarchical clustering algorithm
- attribute-value representation
- (only nominal attributes)
- uses category utility for quality measure



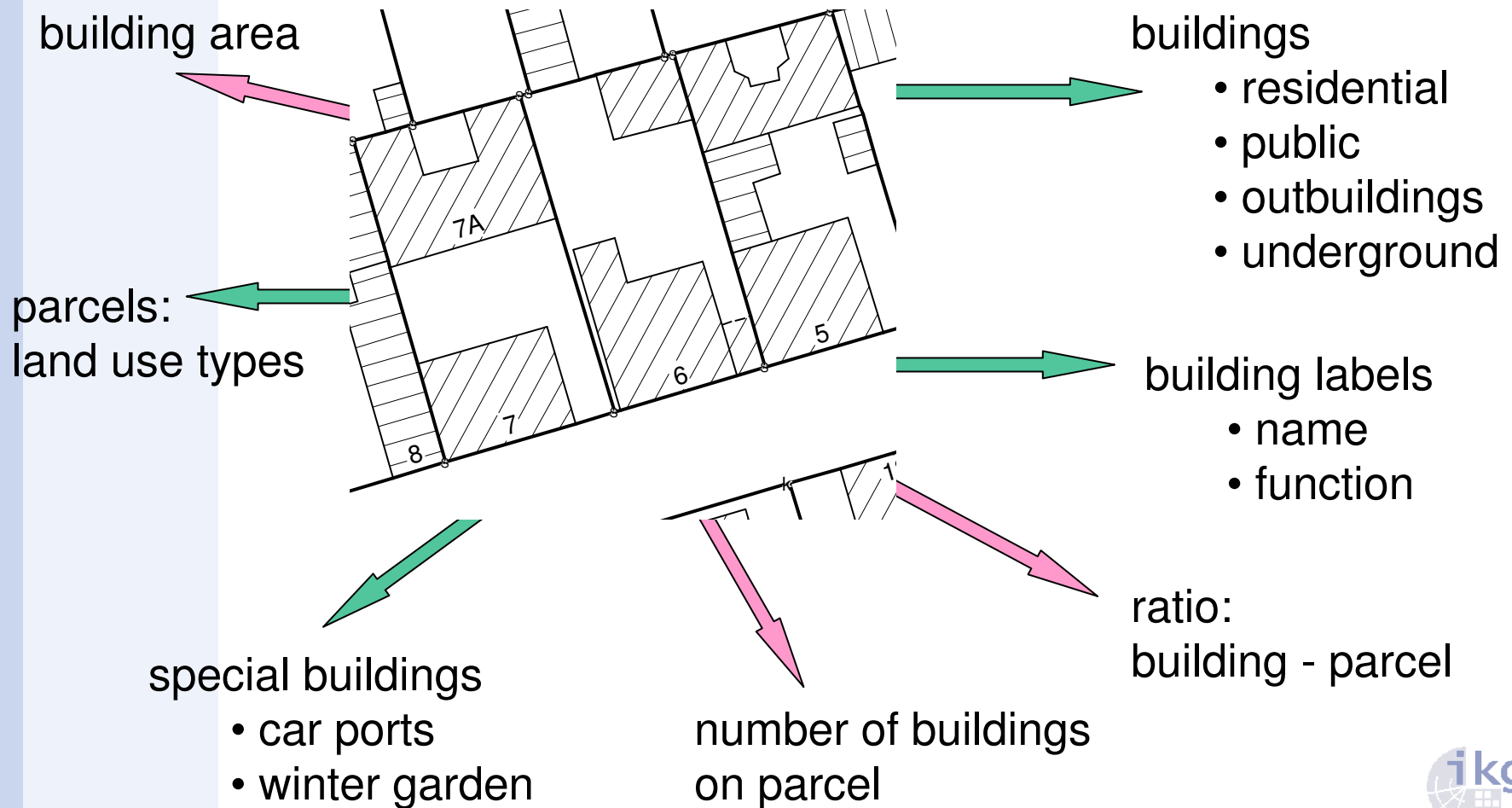
Approach of Identifying Landmarks

- ▶ Data base: instances with attributes
 - buildings
 - using Cadastral Map of Germany
- ▶ Identification of landmarks
 - objects, singular in its local environment
 - investigate “decision points”
- ▶ Extract singular objects with data mining techniques
 - objects differing from the mean (in its attribute values)





-> potential landmark

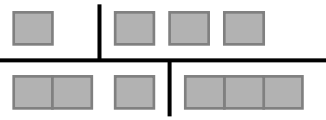
Composition of Data Base

Digital Cadastral Map - buildings

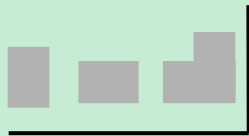



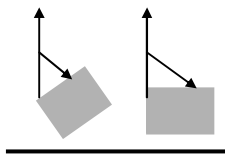
Attributes and Relations of Buildings

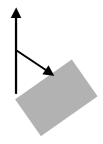
 building area
  building form
  number of corners
  perpendicular angles

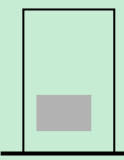
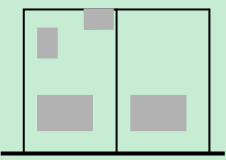
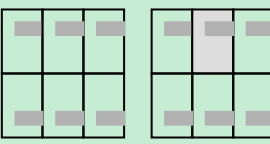
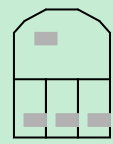


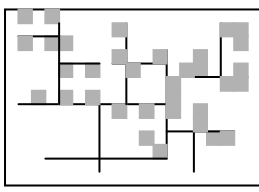
 adjoined or detached

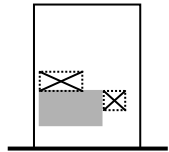


 orientation to road
  distance to road

 orientation to neighbor

 orientation to north

 ratio (building/parcel)
  number
  unequal land use
  parcel form

 density of buildings

 special buildings
  land use
  church

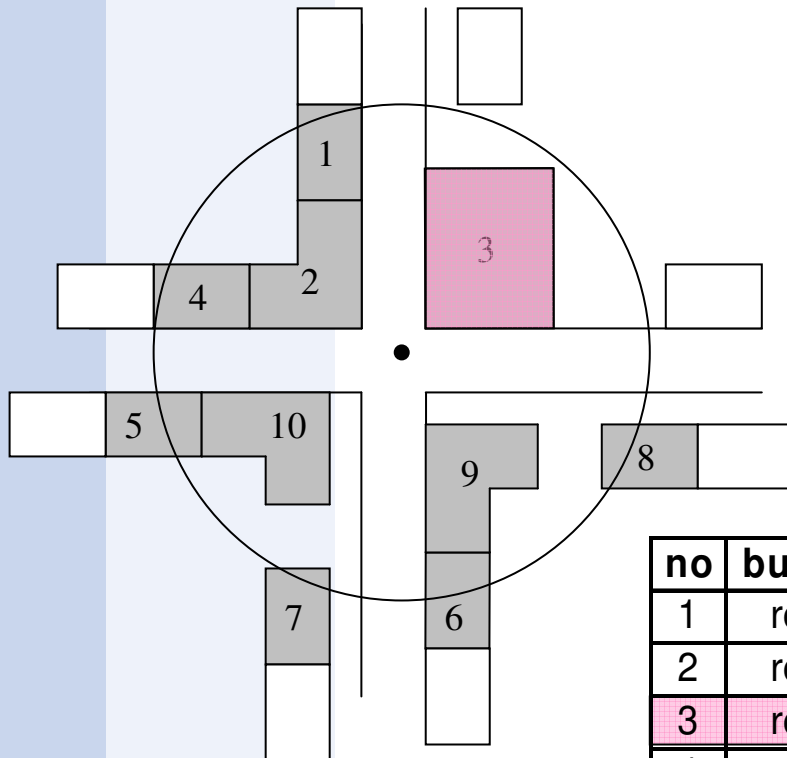
 name or function

Neighborhood



100 m

Chosen Area for Analysis



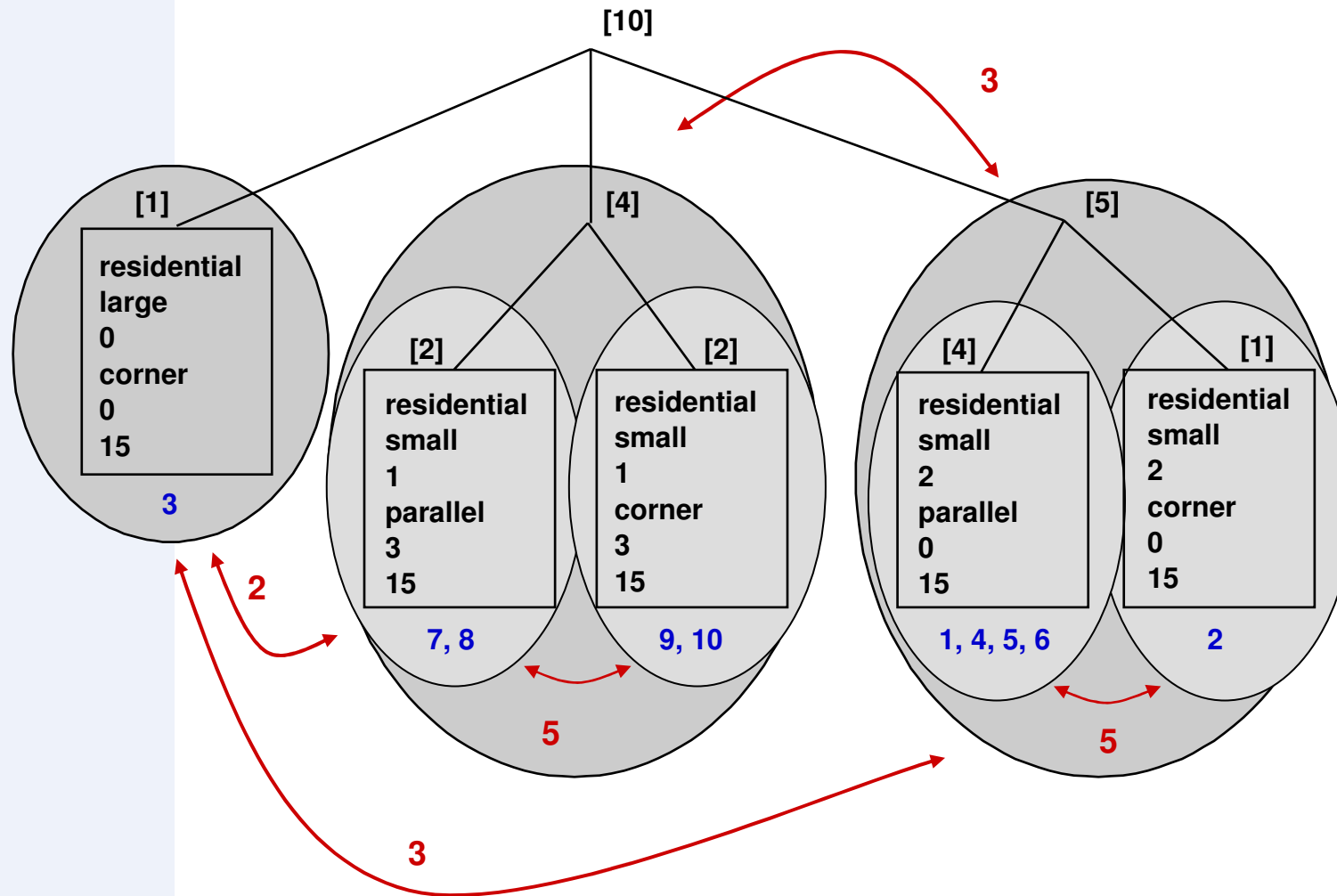
synthetic data set:

10 buildings
with 6 nominal attributes

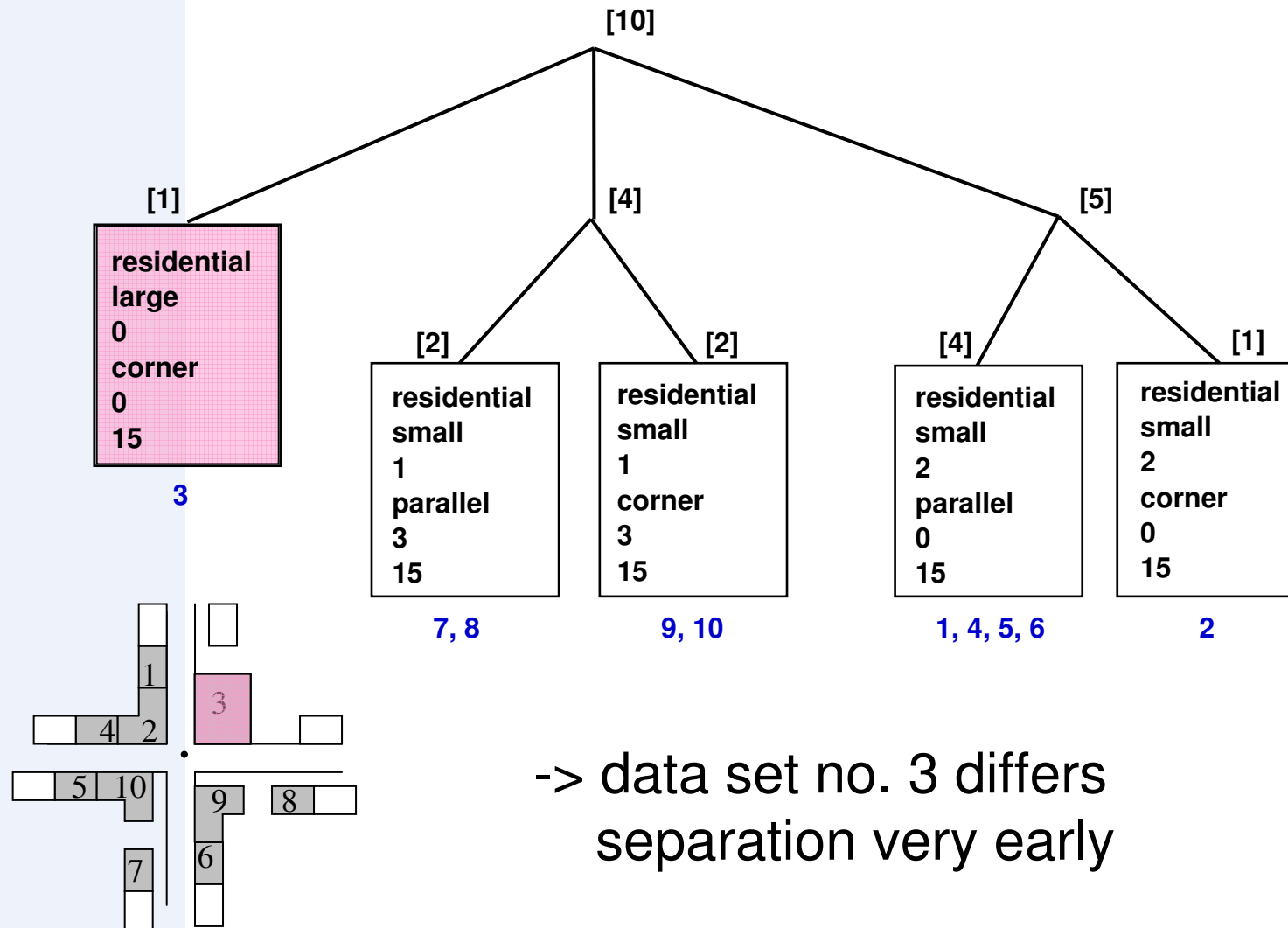
clustering with COBWEB

no	building use	size	neighbors	orientation	dist	height
1	residential	small	2	parallel	0	15
2	residential	small	2	corner	0	15
3	residential	large	0	corner	0	15
4	residential	small	2	parallel	0	15
5	residential	small	2	parallel	0	15
6	residential	small	2	parallel	0	15
7	residential	small	1	parallel	3	15
8	residential	small	1	parallel	3	15
9	residential	small	1	corner	3	15
10	residential	small	1	corner	3	15

COBWEB

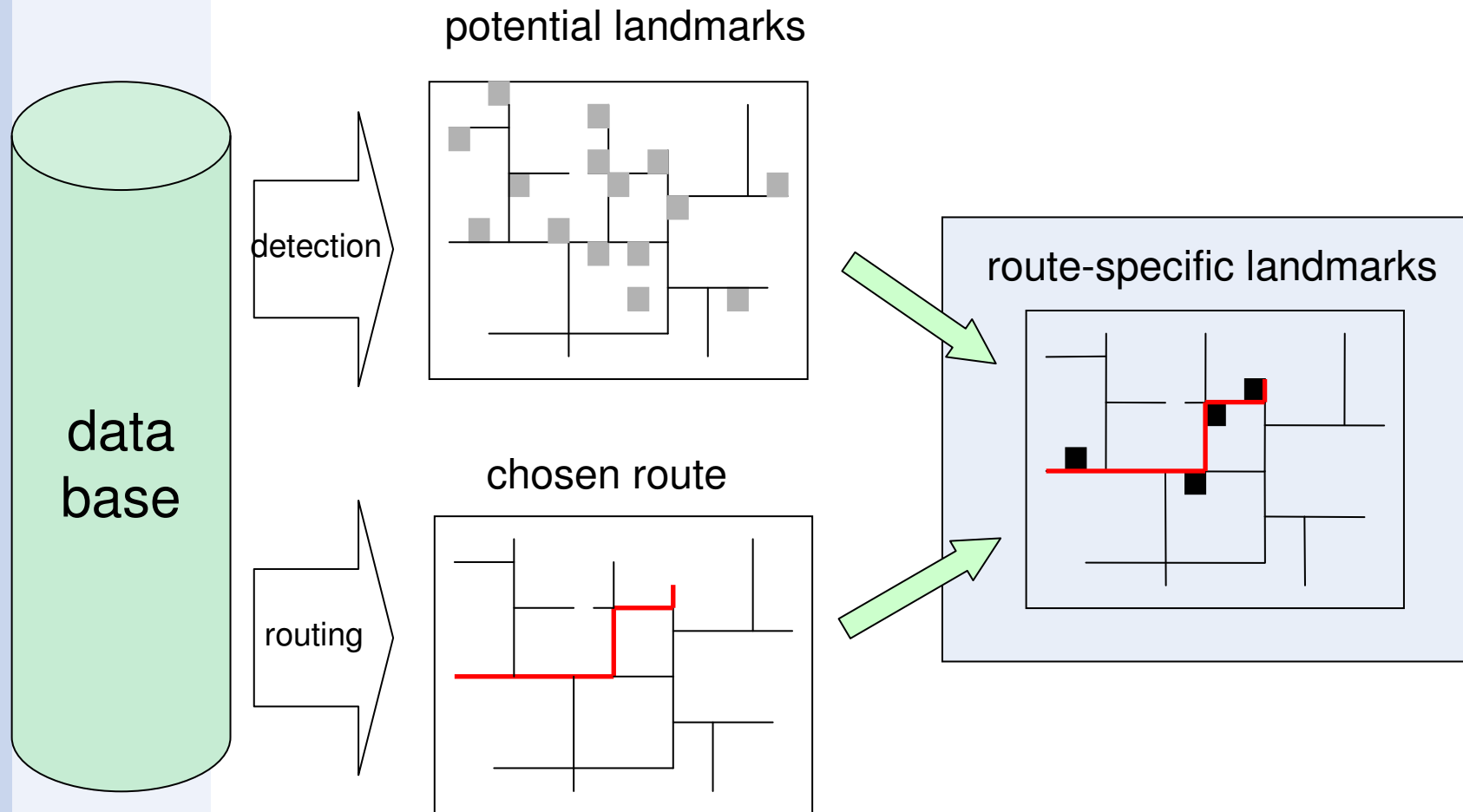


COBWEB – result dendrogram



-> data set no. 3 differs separation very early

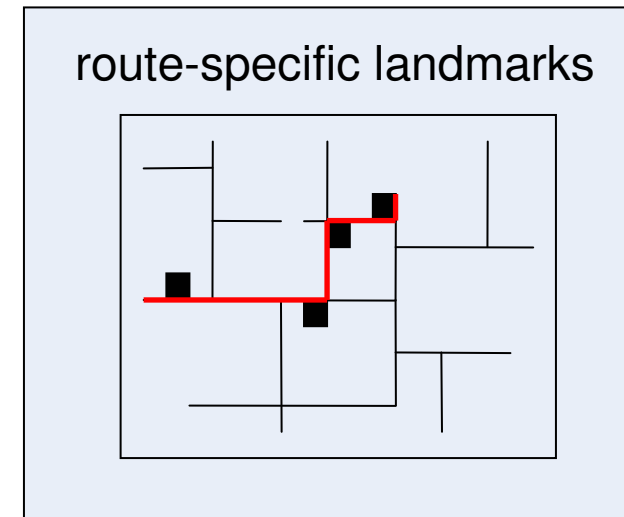
Determination of Landmarks



Route-specific Landmarks

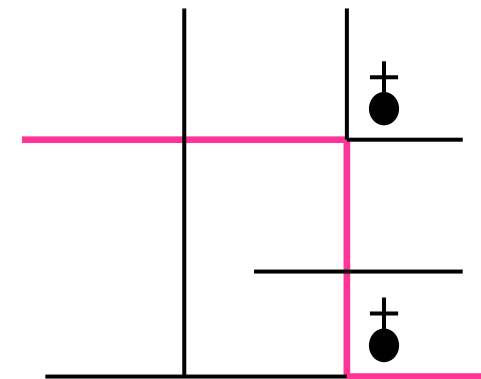
- extracting landmarks relevant for specific route
- depends on particular route chosen
- route-specific criteria
 - visibility
 - distance to route
 - orientation to route
 - quality / uniqueness

-> **reliability criteria**

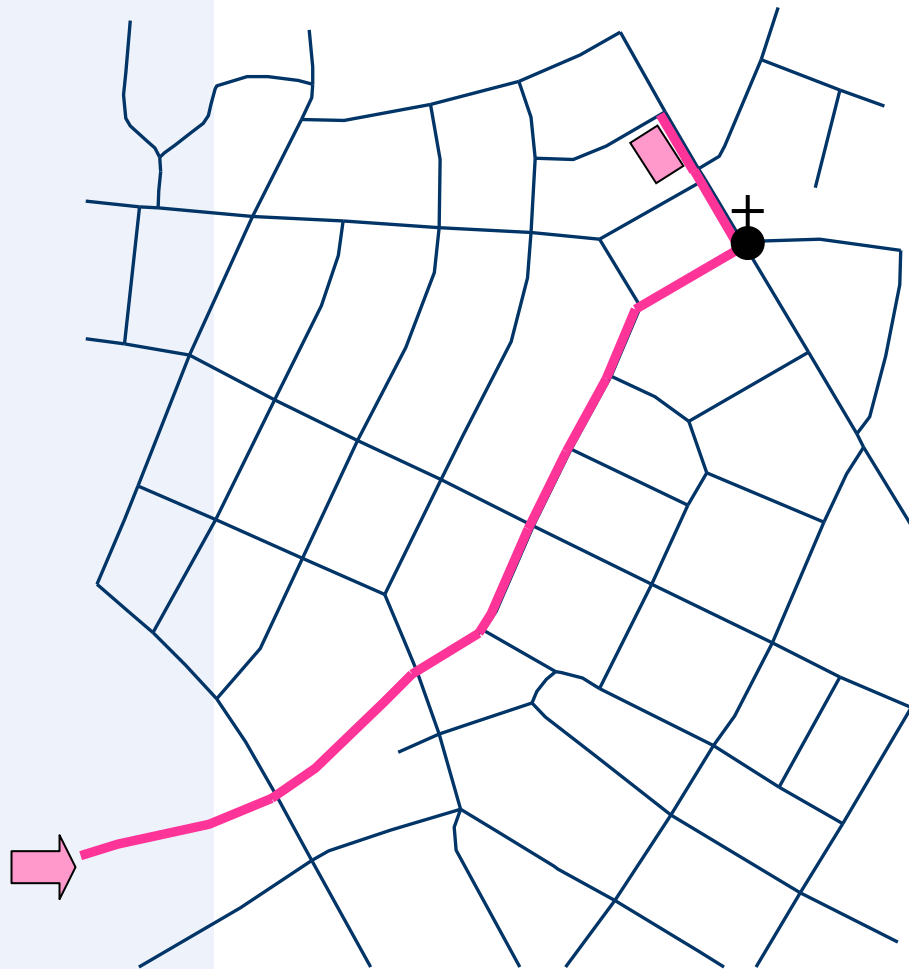


Assumption for Reliability Criteria

- ▶ How reliable is chosen landmark in context?
 - uniqueness
 - error probability
 - determine influence of same looking objects on / near the route
- ▶ Directions:
 - starting point
 - { move straight forward until landmark
 - arrive at landmark
 - make turn
 - end point



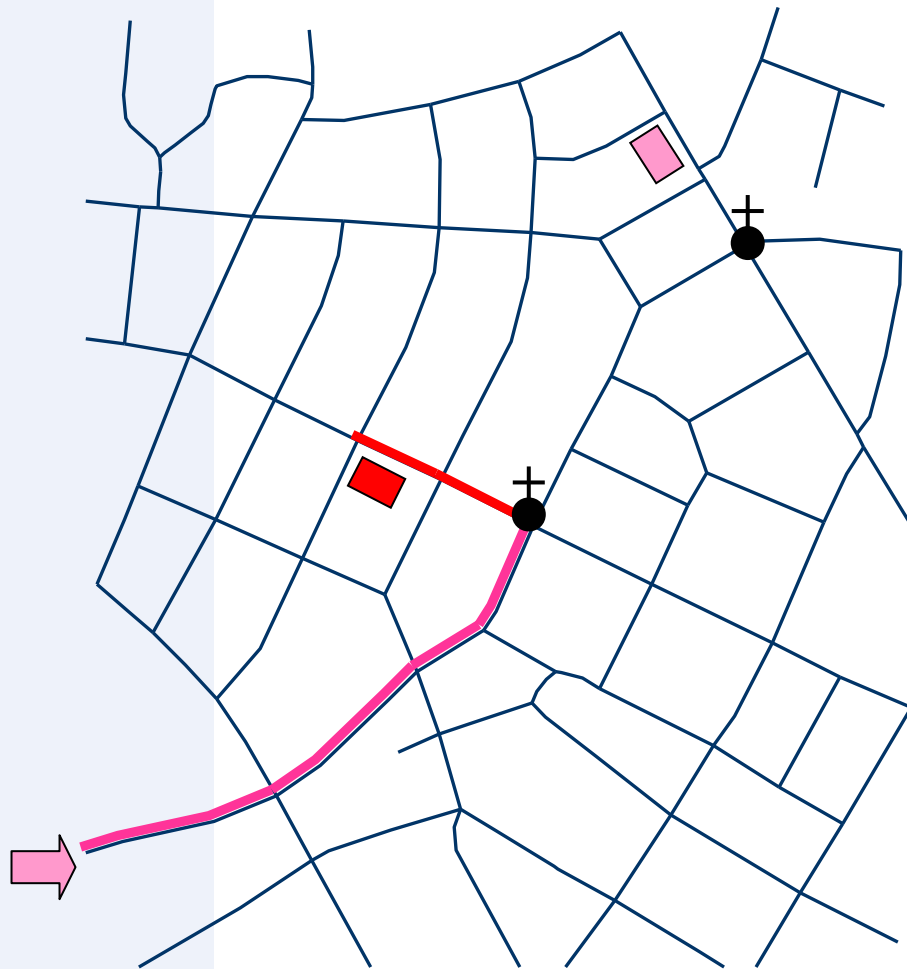
Routing with Landmarks



Instructions:

- follow the road
- turn left at the church
- cross the next road
- building on the left side

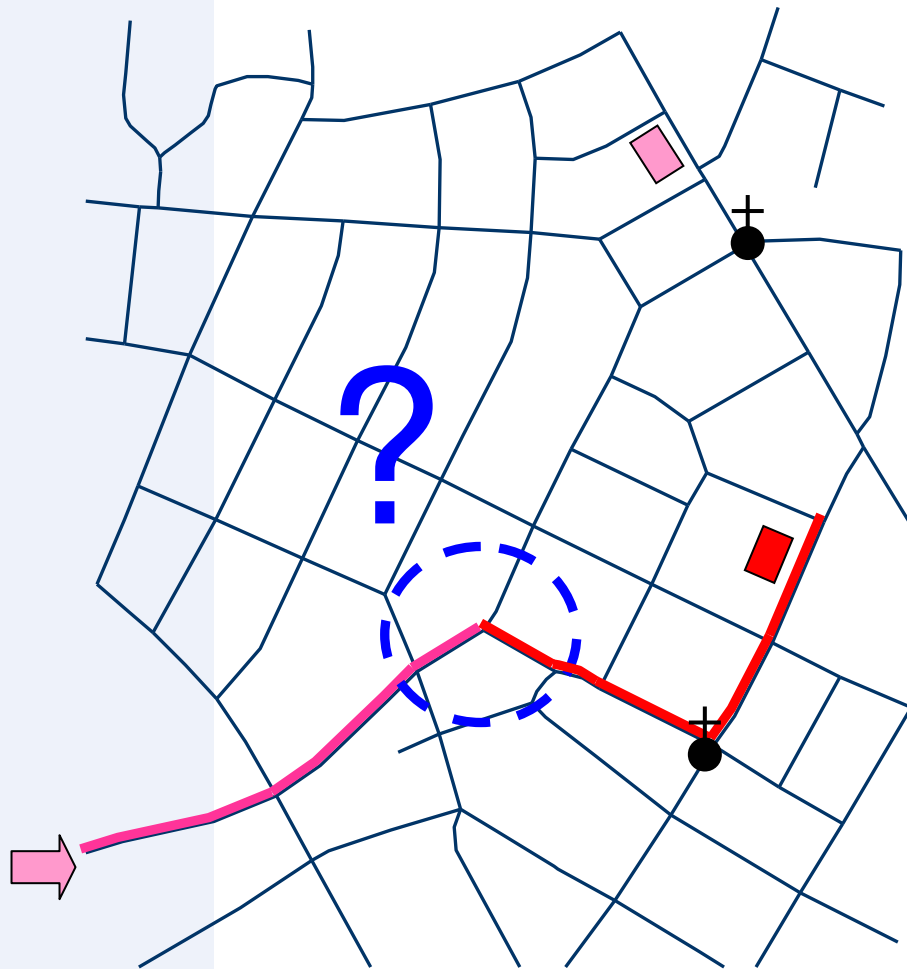
Routing with Landmarks – 1. Case



same looking object
on the route

-> “false” landmarks
on route

Routing with Landmarks – 2. Case

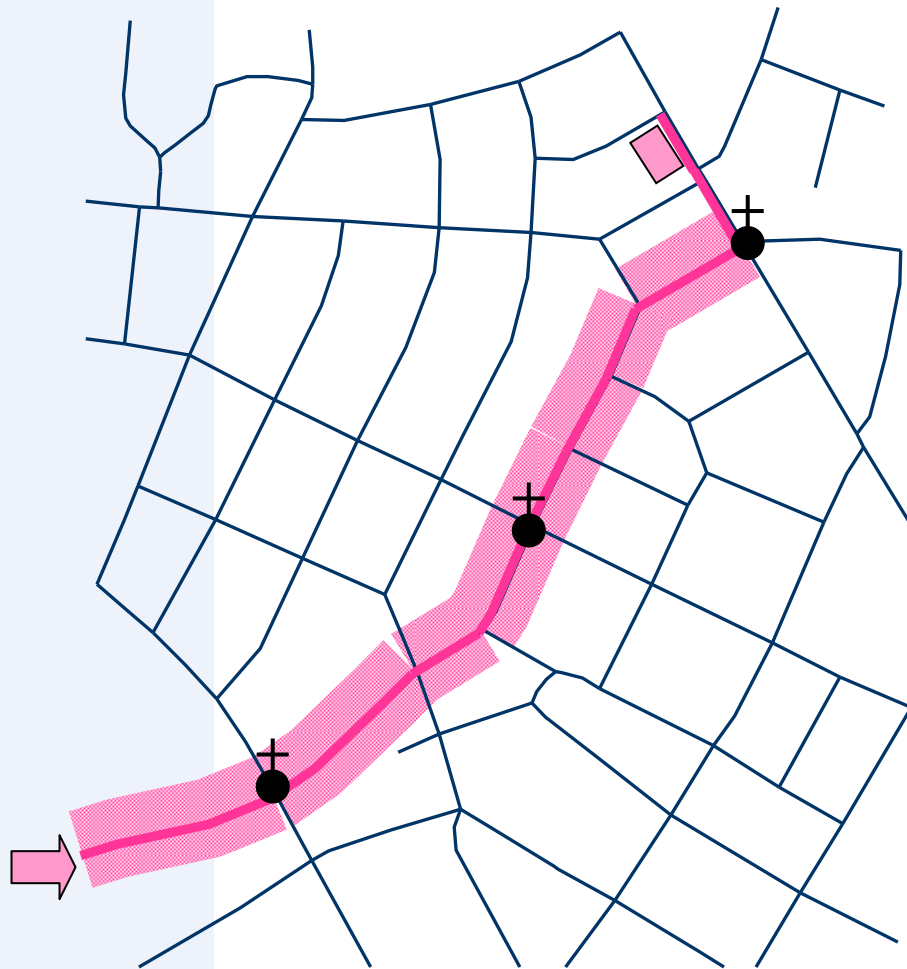


one navigation error

same looking object
confirms to be
on “right track”

-> “false” landmarks
near the route

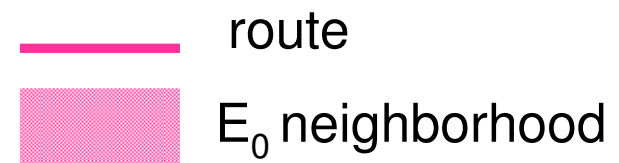
Assessment of 1. Case



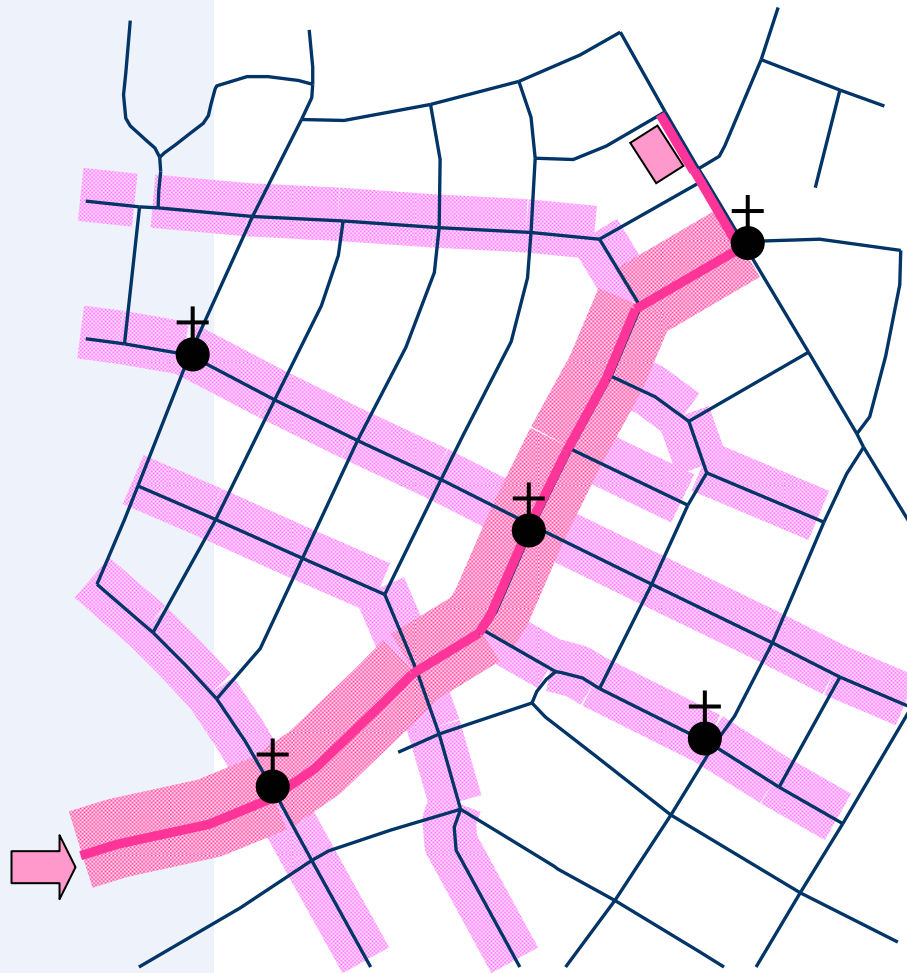
no wrong decision

“false” landmarks
on route

-> high impact on quality



Assessment of 2. Case



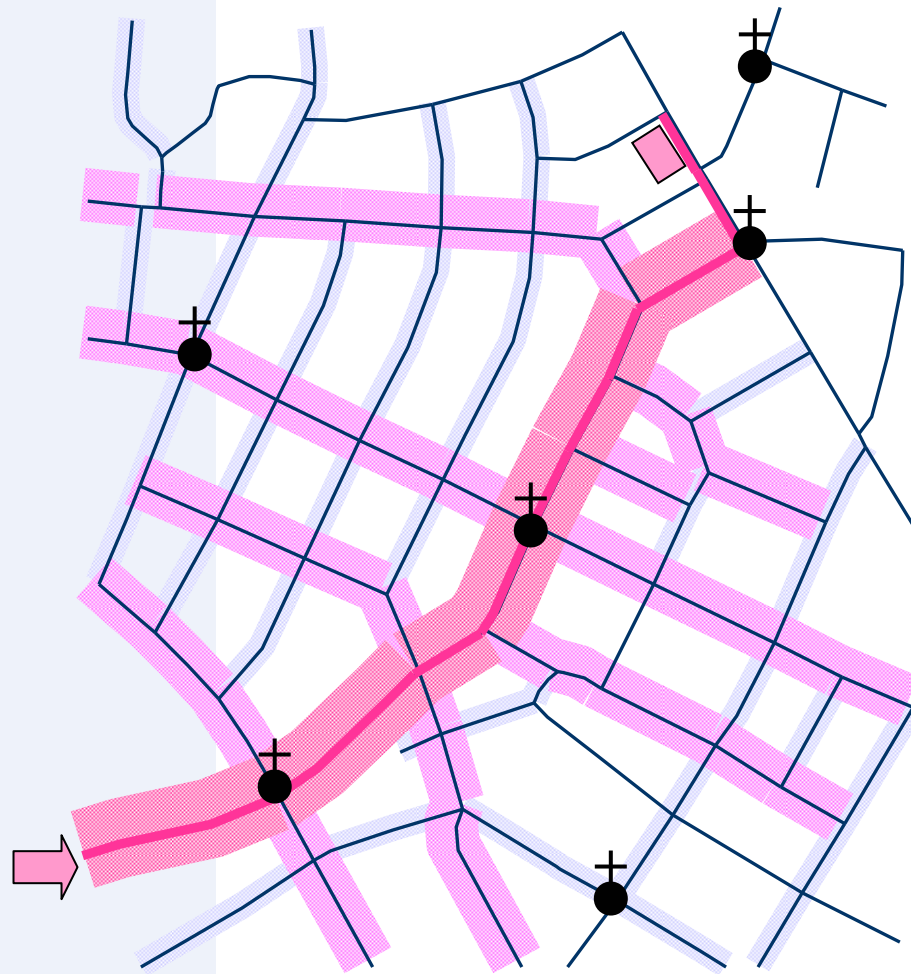
one wrong driving decision

more possibilities
to make a mistake

-> decreasing likelihood,
less impact on quality

- route
- █ E_0 neighborhood
- █ E_1 neighborhood

Assessment of Further “Navigation Errors”

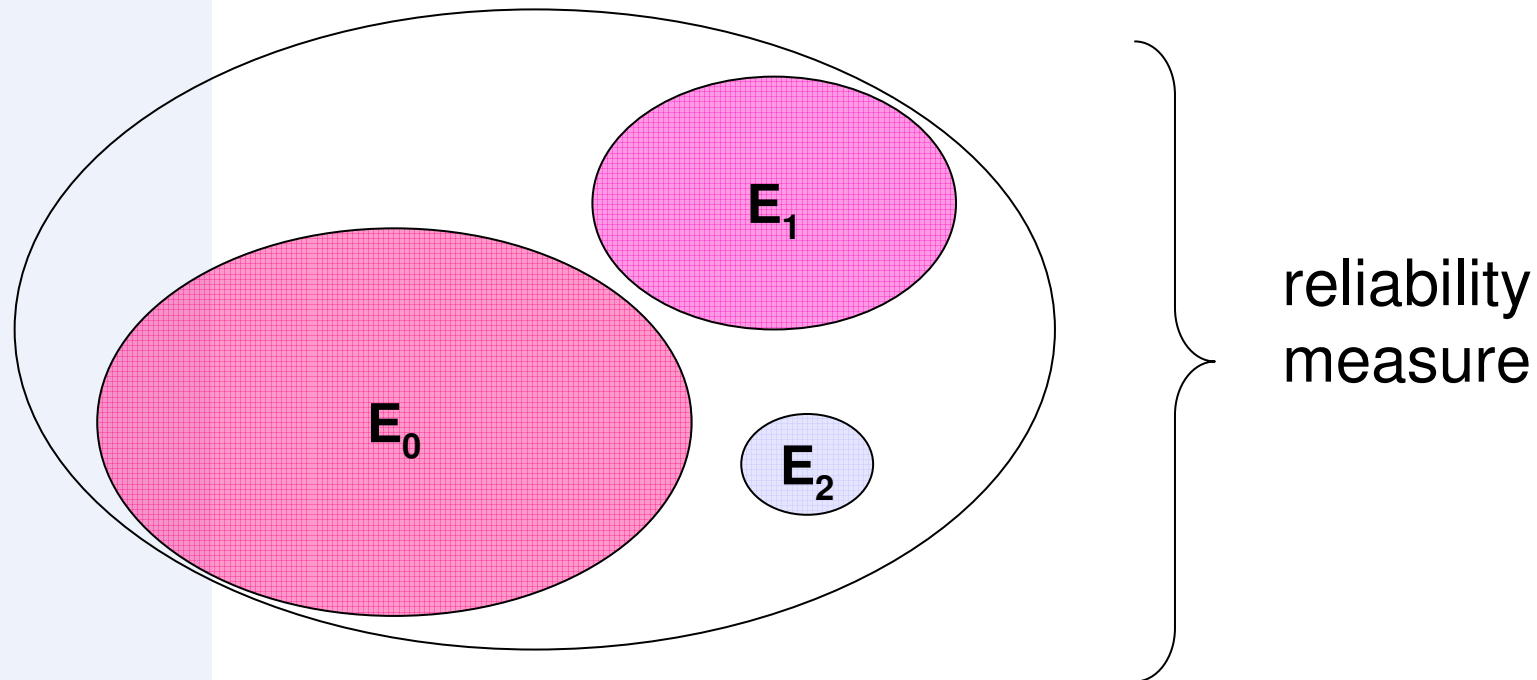


- different weighting for each “false” landmark
- only objects that are likely to cross the route



Measure for Reliability

- using “likely”-neighborhood not distance
- weighting of impact on reliability



Conclusions

- ▶ Potential landmarks:
 - extraction with data mining methods is promising
 - tests with “real data” (attribute-value table of cadastral data)
 - comparison of potential landmarks with real world
- ▶ Route-specific landmarks:
 - derive a quality measure for landmarks (“reliability”)
 - further route-depending aspect:
visibility -> in combination with laser scanning data

-> framework to derive landmarks