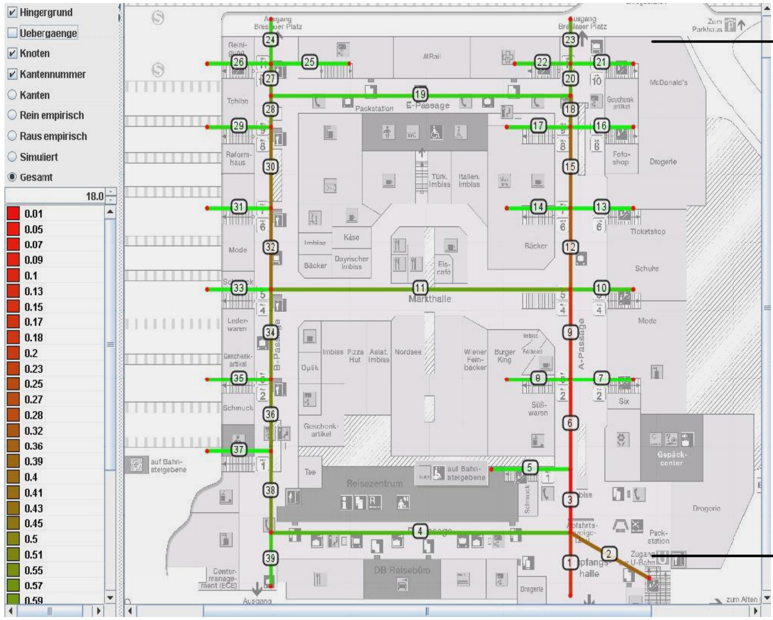
A Data Mining Approach on POI Based Traffic Flow Estimation - an Industrial Case Study



Thomas Liebig

Outline

- Motivation
- Related work
- Algorithm with measurements
- Algorithm with POI
- Results
- Conclusion

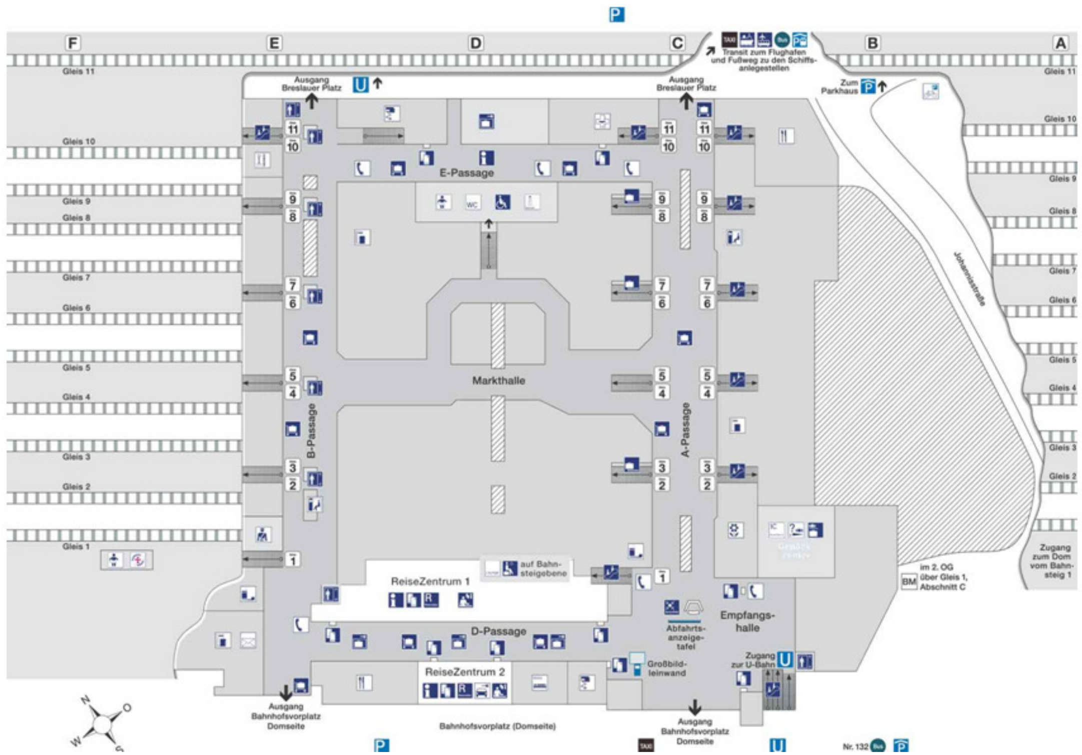
Frequency Map

Frequency Maps contain valuable information for

- Location planning
- Location evaluation
- Traffic monitoring
- Traffic prediction
- Emergency planning
- Environmental planning

Focus here on public buildings

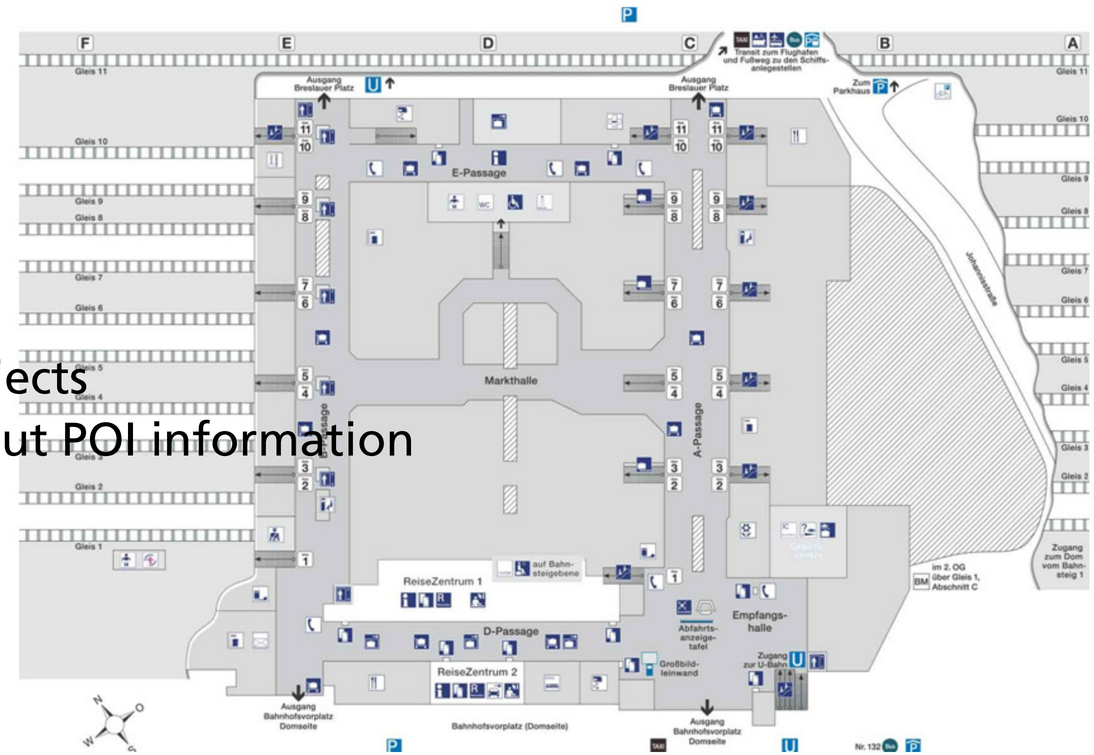
- airports
- train stations
- shopping malls



Frequency Map – related work

Methods for Traffic Flow Estimation

- Simulation
- s-kNN
- Markov Chain Model
- Regression



Challenge:

- Only measurements in few objects
- Generally, no measurements but POI information

→ Learn behaviour and transfer!

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Frequency Map – Algorithm with measurements

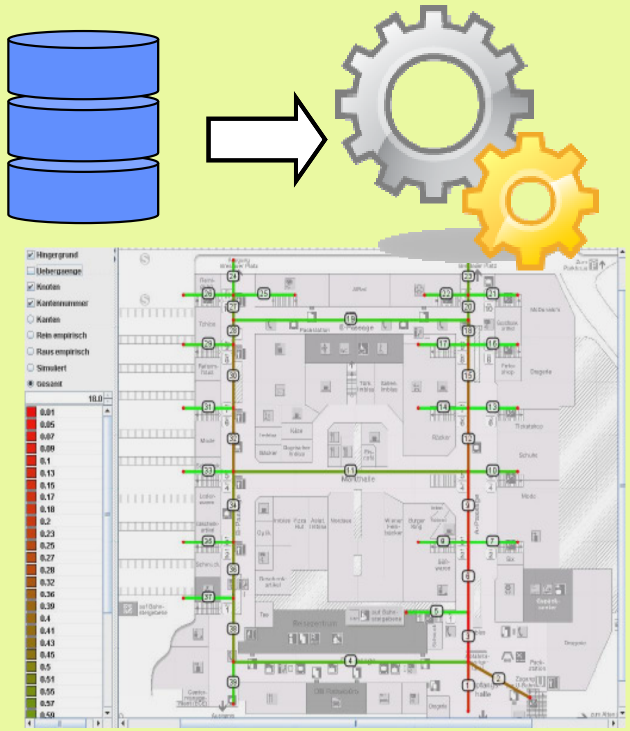
Case with measurement: (Tanyimboh ‘93)

1. Build traffic network (graph representing floors and junctions)
2. Enumerate possible paths through the object (path-set)
   requires: assumptions on the relevant pedestrian movement
3. Regression at the measurement places (flow estimation)

→ Frequency at all (unmeasured) edges: ‚**Frequency Map**‘
→ Probability distribution for path-set denotes dependencies of locations

Data flow

170 object plans
with
Traffic networks



Measured Frequency Map

for 15 public buildings (equal class)

Frequency Map

for 170 public buildings

Algorithm with POI

Given:

- overall frequency within a certain time-period
- Map depicting POI + additional POI sources (train schedules)

Can also create similar

- Traffic network and
- Path-set (by enumeration)

Problem description 1:

→ Predict edge frequency using POI data

Difficult! Can‘t distinguish people going there

- because of the POI or just
- because of its situation

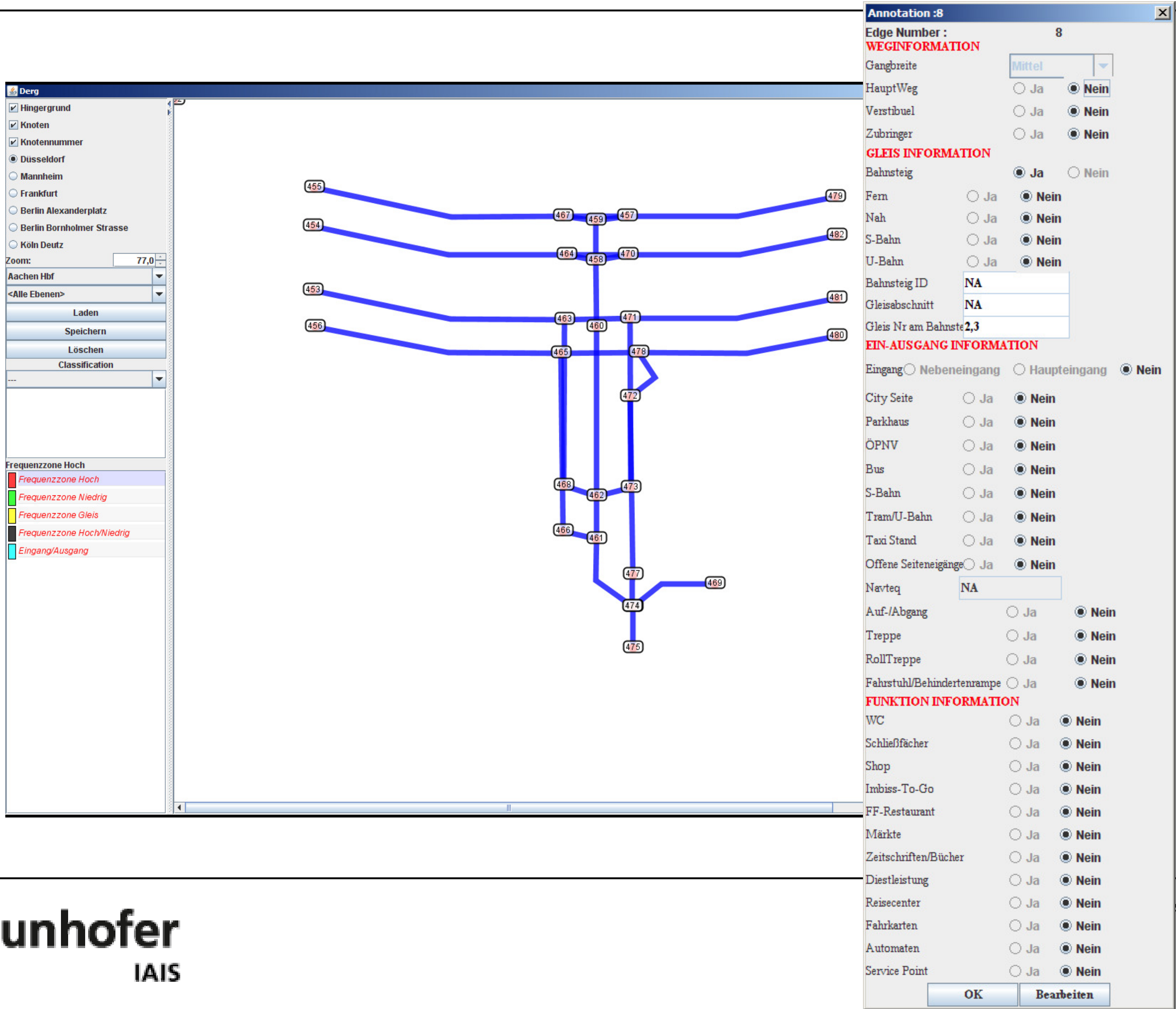
Algorithm with POI

Problem description 2:
→ Predict probability distribution among path-set using POI data

Attributvector creation:

1. Label all edges of traffic network with POI attributes
2. Label edges with additional attributes from the map (path-width, stairway, ..)
3. Aggregate attributes along pathes to attributvector
4. Add additional attributes to attributvector (detour factor)

Manual Annotation



Algorithm with POI

But: one path contains no information about its speciality:

→Can not use attributvector to predict ratio in probability distribution for a single path ☹

Solution:

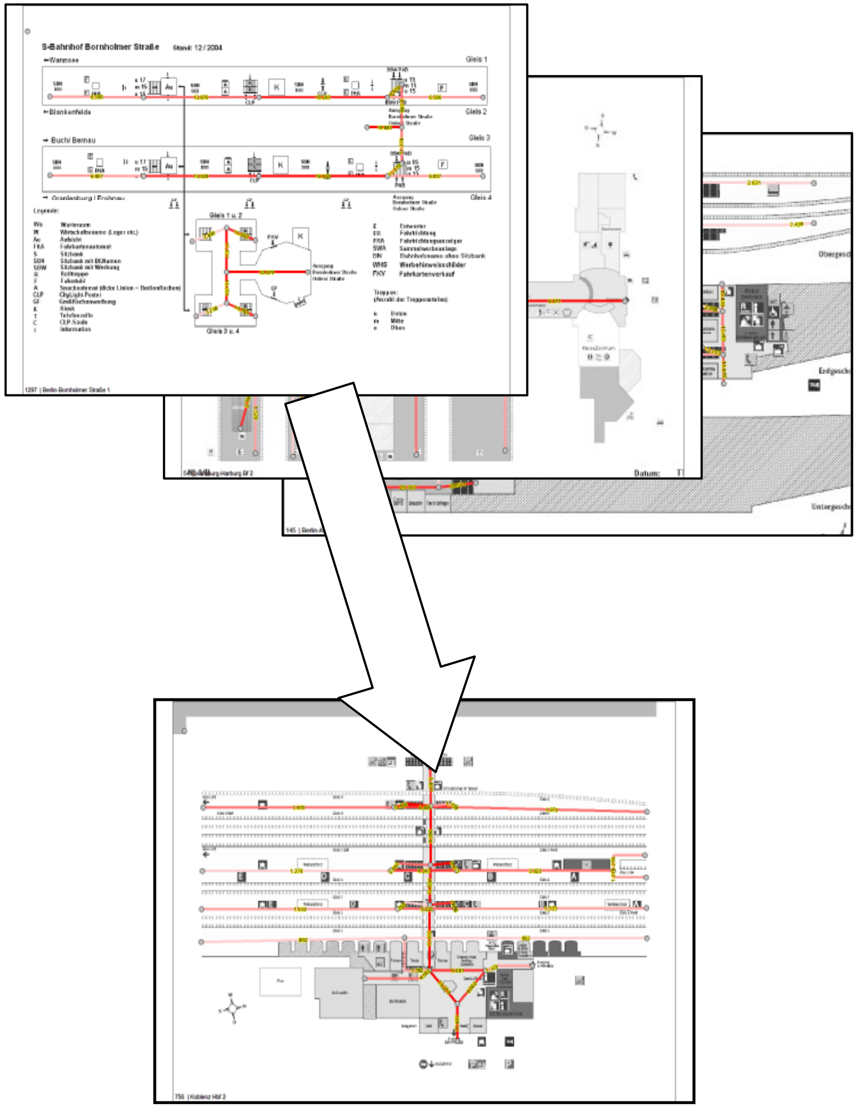
Z-transformation of aggregated attributes (per building)
(Mean and standard deviation get fixed)

Algorithm with POI - result

Prediction model:

Decision tree

- can validate decisions
- Can comunicate model to project partner



Result

cross-fold validation

correlation 83%

rank prediction accuracy 99%

170 Frequency Maps

Algorithm with POI - result

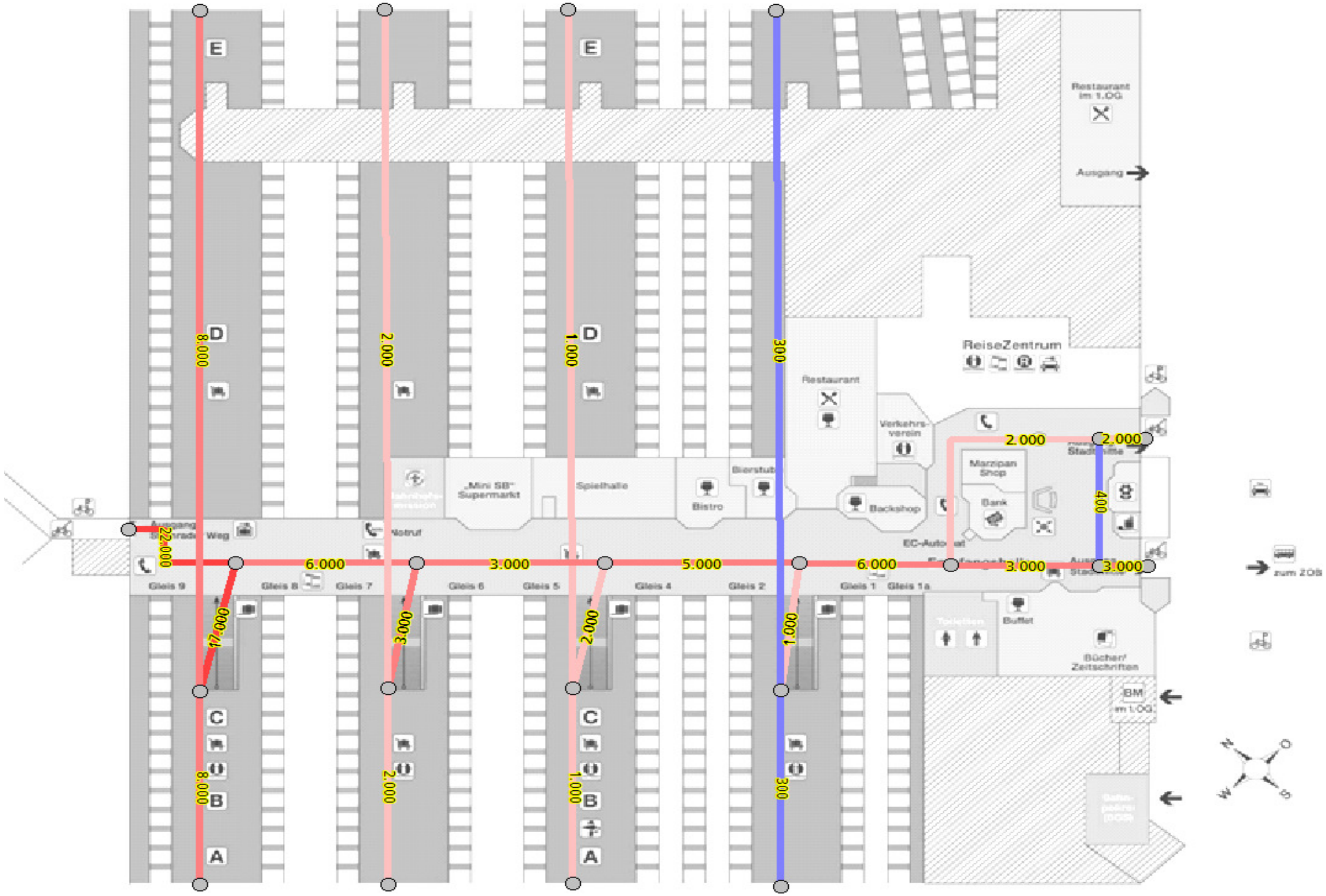
```
ANZAHL <= -0.64 :
|   MITTELWEG <= -1.399 :
|   |   Anteil3 <= 1.996 :
|   |   |   ANZAHL <= -2.054 :
|   |   |   |   TREPPE <= -0.098 :
|   |   |   |   |   VESTIBUEL <= -0.721 :
|   |   |   |   |   |   SHOPPING <= -1.828 :
|   |   |   |   |   |   |   Z_ZUG_1 <= -0.257 :
|   |   |   |   |   |   |   |   BREITWEG <= -0.38 :
|   |   |   |   |   |   |   |   |   Anteil3 <= -0.268 : LM1 (3/51.291%)
|   |   |   |   |   |   |   |   |   Anteil3 >  -0.268 : LM2 (10/25.325%)
|   |   |   |   |   |   |   |   BREITWEG >  -0.38 : LM3 (8/0%)
|   |   |   |   |   |   |   Z_ZUG_1 >  -0.257 :
|   |   |   |   |   |   |   |   NEBENEINGANG <= -0.025 :
|   |   |   |   |   |   |   |   |   SBAHN <= 0.437 :
|   |   |   |   |   |   |   |   |   |   Z_ZUG_1 <= -0.013 : LM4 (9/36.041%)
|   |   |   |   |   |   |   |   |   |   Z_ZUG_1 >  -0.013 : LM5 (13/34.662%)
|   |   |   |   |   |   |   |   |   SBAHN >  0.437 : LM6 (8/0%)
```

Algorithm with POI - result

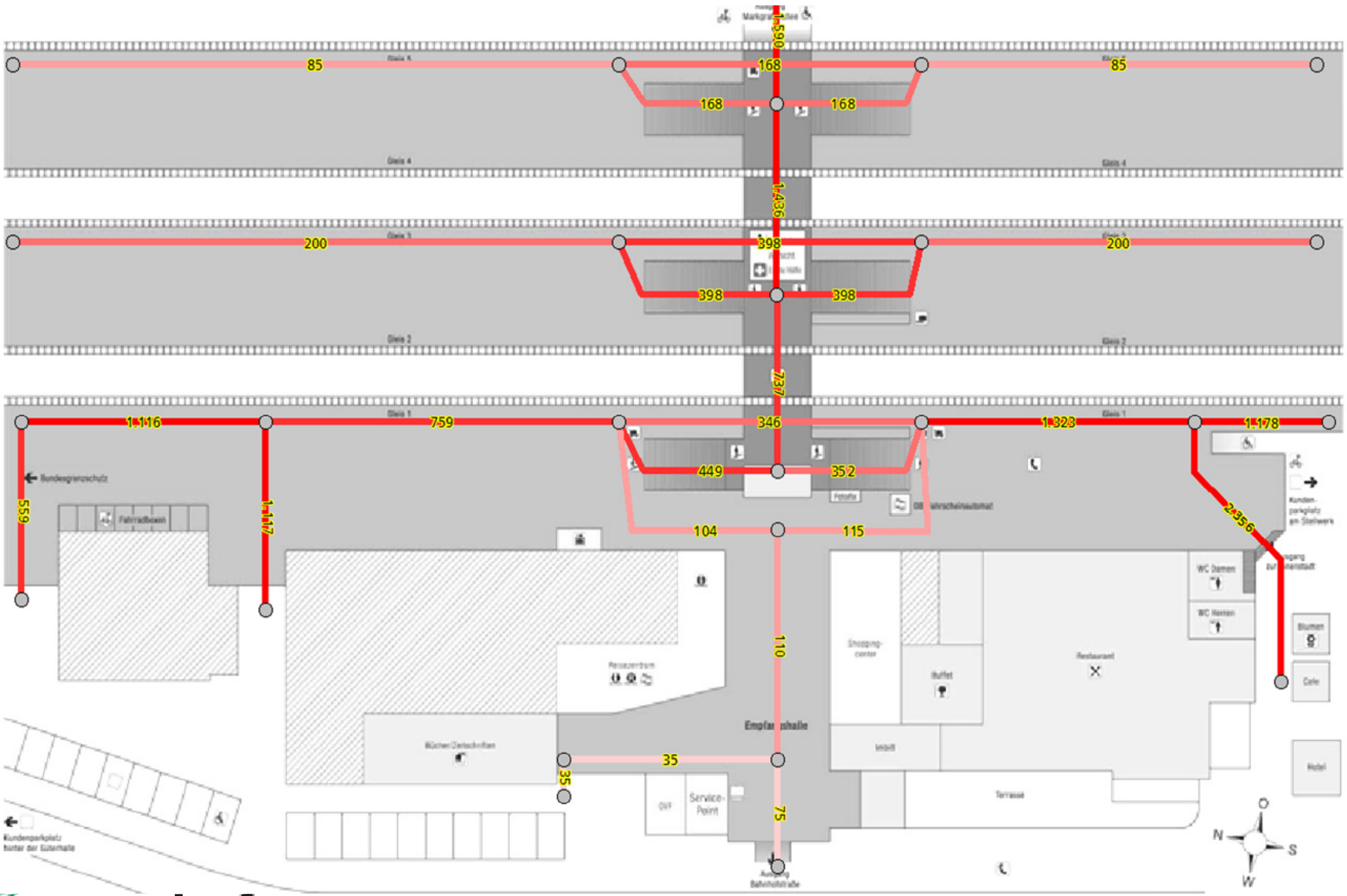
Most important attributes according to information gain

- path length
- path width
- detour factor
- stairs
- vestibül
- shops

Algorithm with POI - result



Algorithm with POI - result



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Algo

Conclusion and Further Steps

Created meaningful frequency map based on emergency maps

- Empirical measurements in similar buildings
- Attribute annotation of network segments
- Model pedestrian behaviour within an object type depending on attributes
- Transfer to unknown building

Further steps:

- Correction Model for inclusion of expert knowledge
- Time dependent frequency maps
- Online traffic flow estimation and prediction