

Identifying movement patterns from large scale WiFi-based location data

A case study of the TU Delft Campus

Matthijs Bon, Xander den Duijn, Balázs Dukai, Simon Griffioen, Yuxuan Kang,
Martijn Vermeer

Supervisor: Edward Verbree

MSc Geomatics Synthesis Project

- Connects courses and graduation project
- Group project:
 - 5 students * 8 weeks (10EC)
- Agile Management
 - Iterative, Interactive, incremental

Topic: Wi-Fi 'user' data

- Eduroam connection data
 - Campus-wide
 - MAC-address (hashed)
 - Network-id (hashed)
 - Staff & Students
 - Connection-sessions (5 minutes interval)



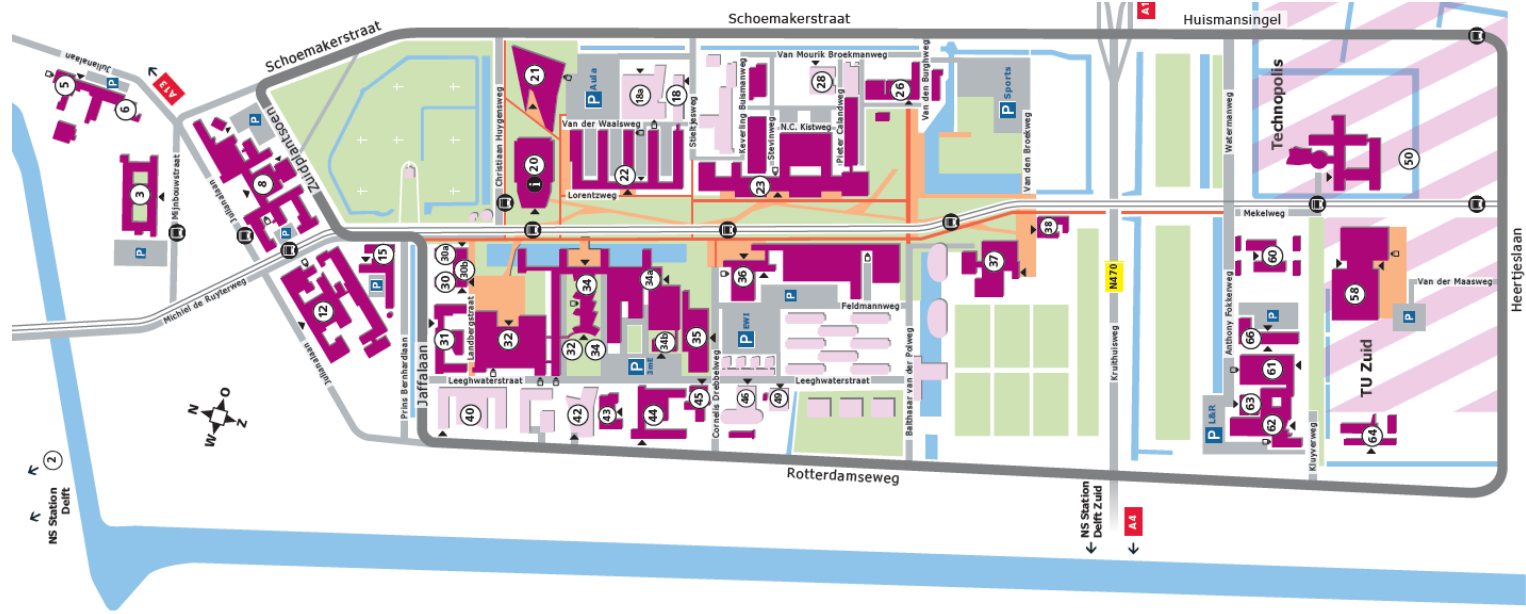
Three Parallel Project

1. *Extracting* **presence** of people at specific places
2. *Unravelling* **patterns** of movement between buildings and within buildings
3. *Identifying* **activities** and irregular use

Cross Cutting Topics

- Privacy
- Validity and Accuracy
- Representativeness
- Data Collection: system of Access Points

TU Delft Campus





“To understand human motion behaviour for better decision making”

Research Question

*To what extent can **movement patterns in and between buildings** be identified from large scale **WiFi-based location** data of the **eduroam** network?*

Wi-Fi log statistics



> 8.800.000 **sessions** over 2 months collected

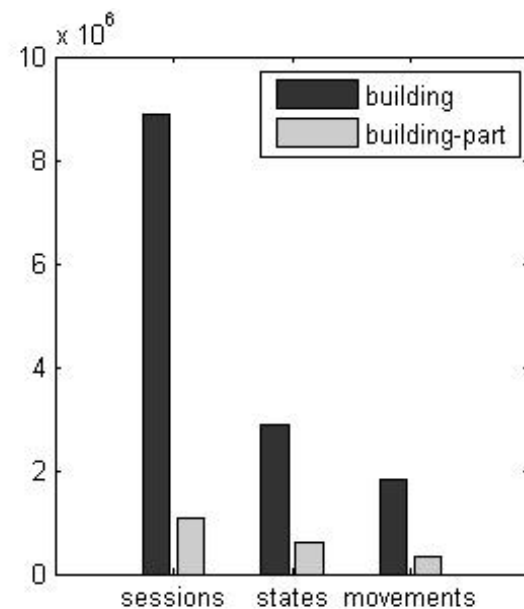
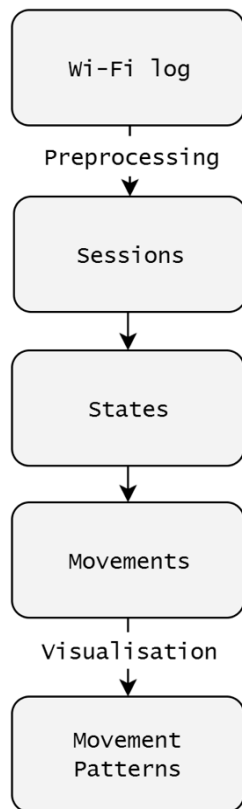


+/- 45.000 different **users** of eduroam network

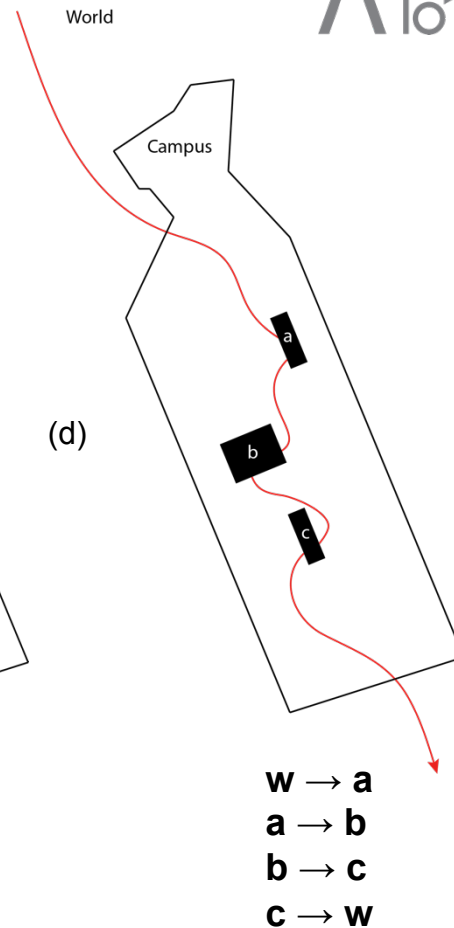
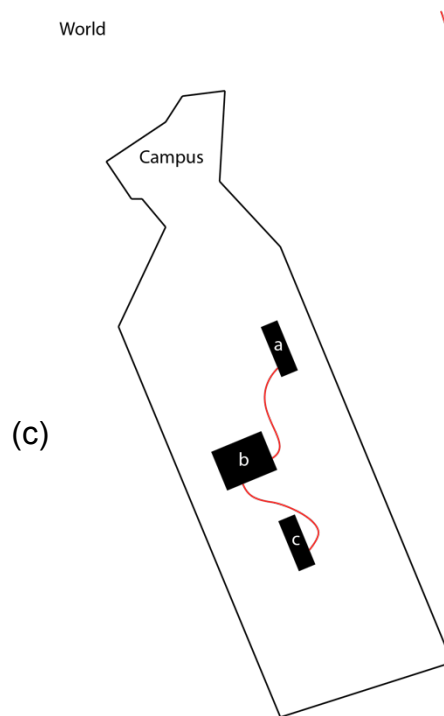
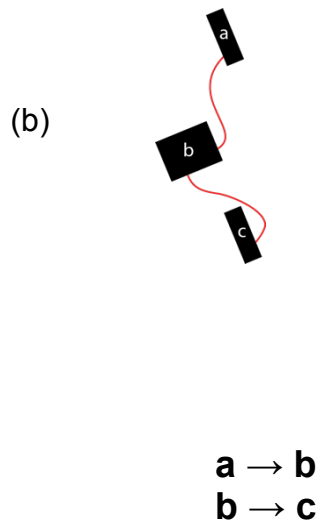
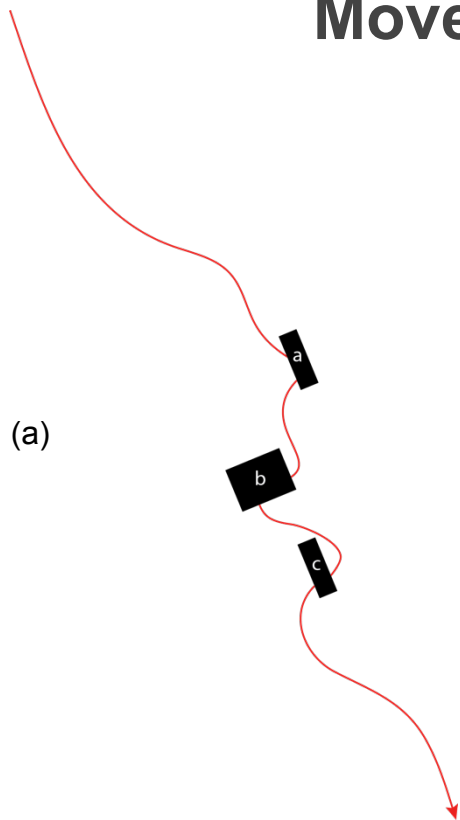


+/- 86.000 different **devices** detected

Methodology / workflow



Movement



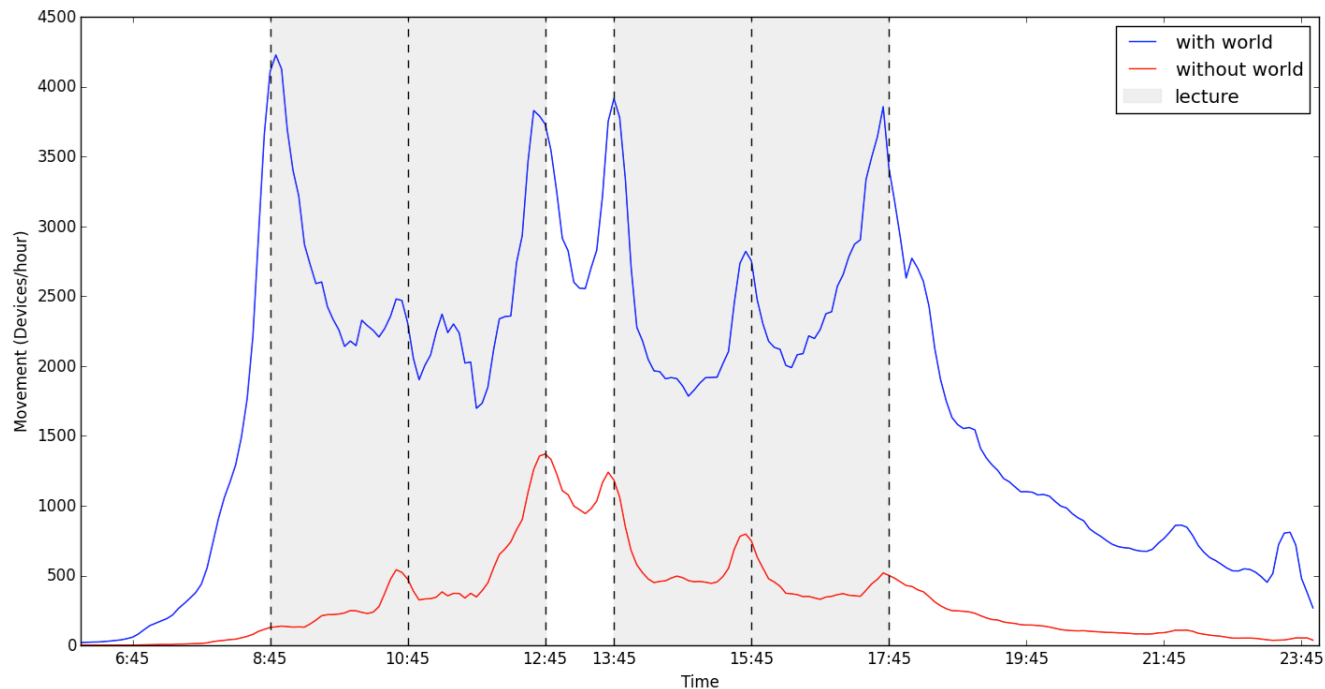


Building level

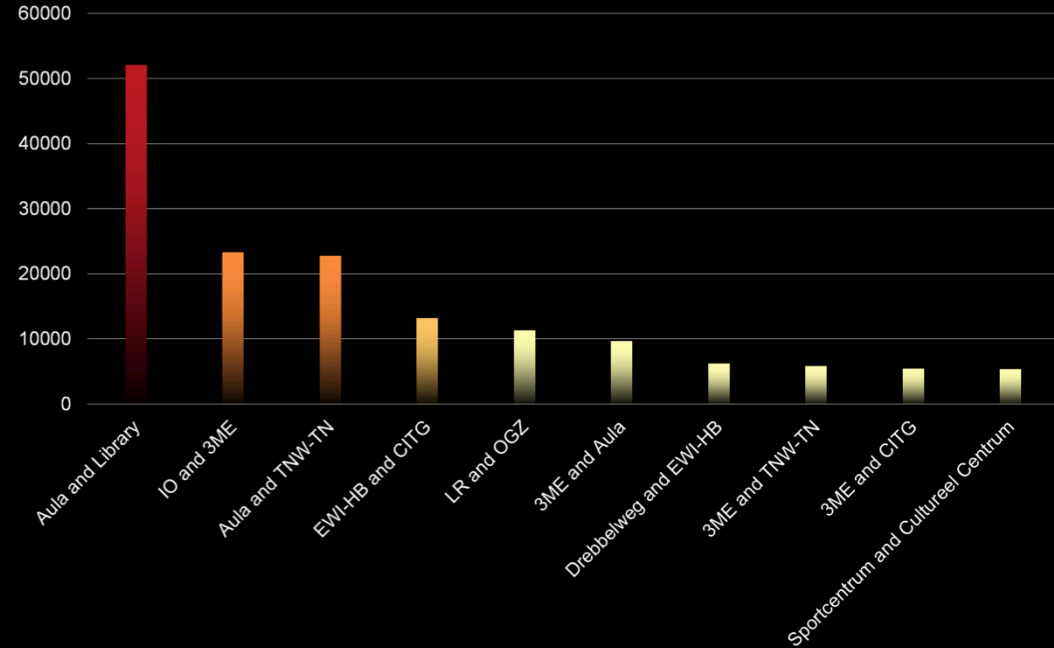
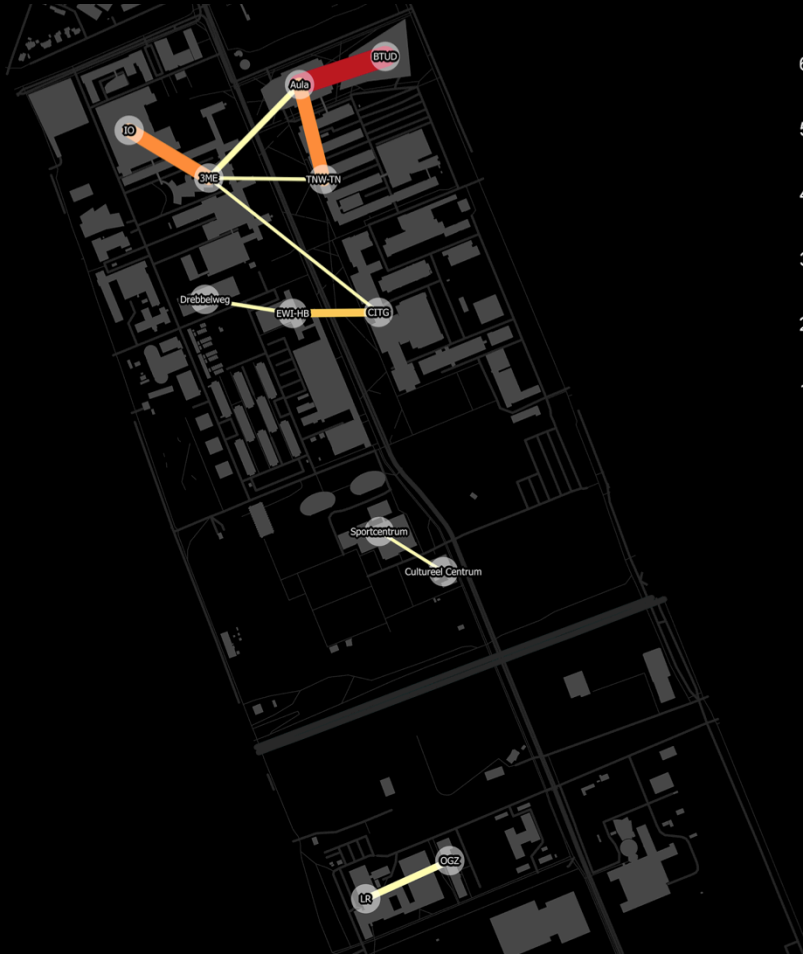
Movement from, to and between buildings

All movement on campus

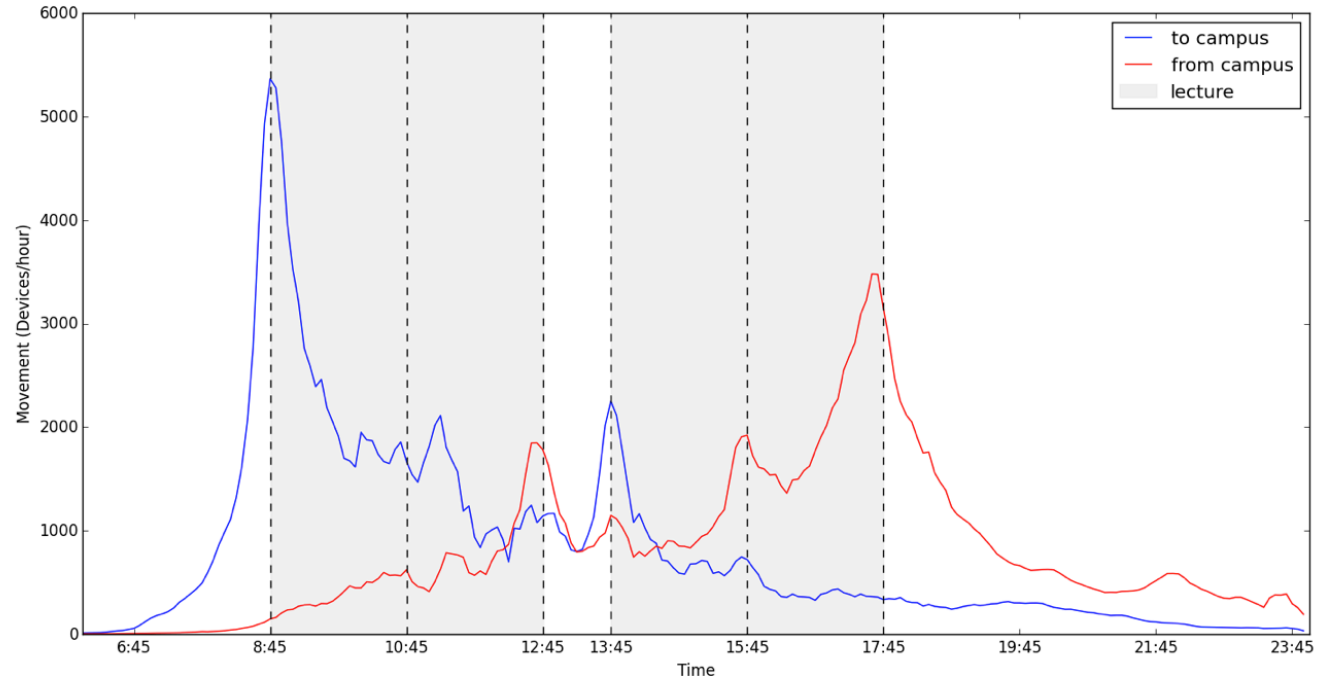
from, to and between buildings



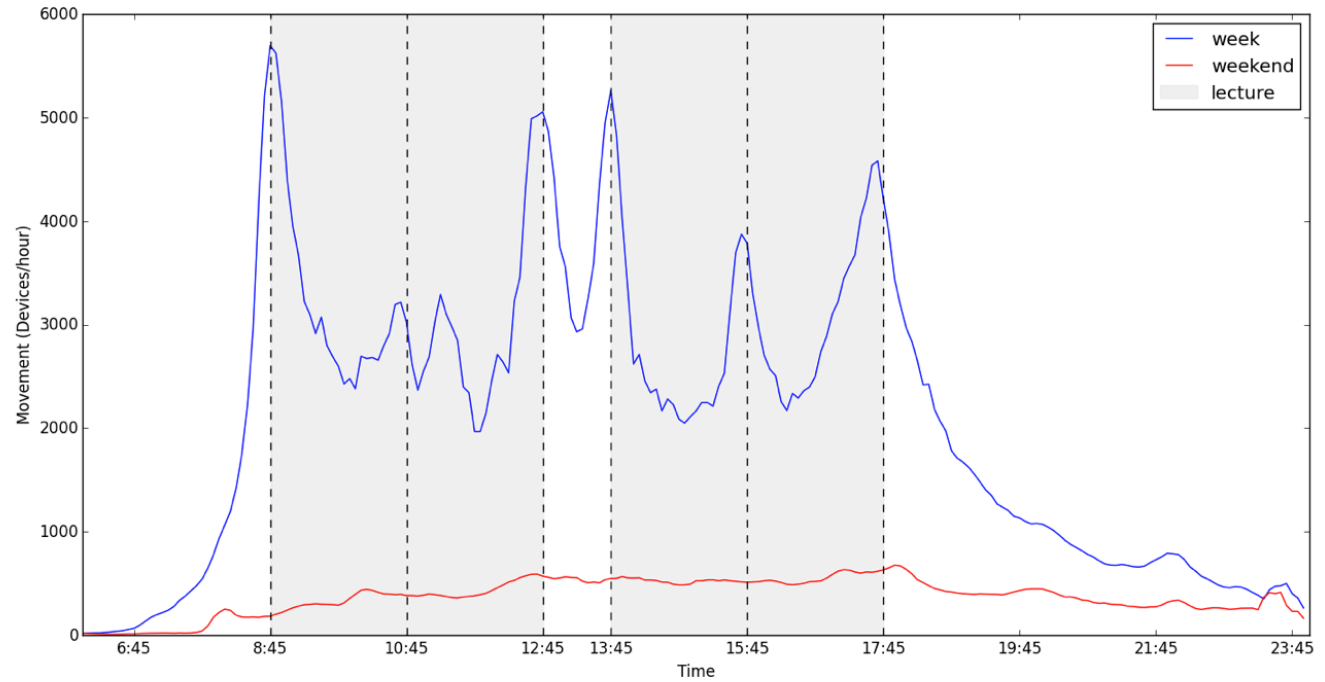
All movements between buildings



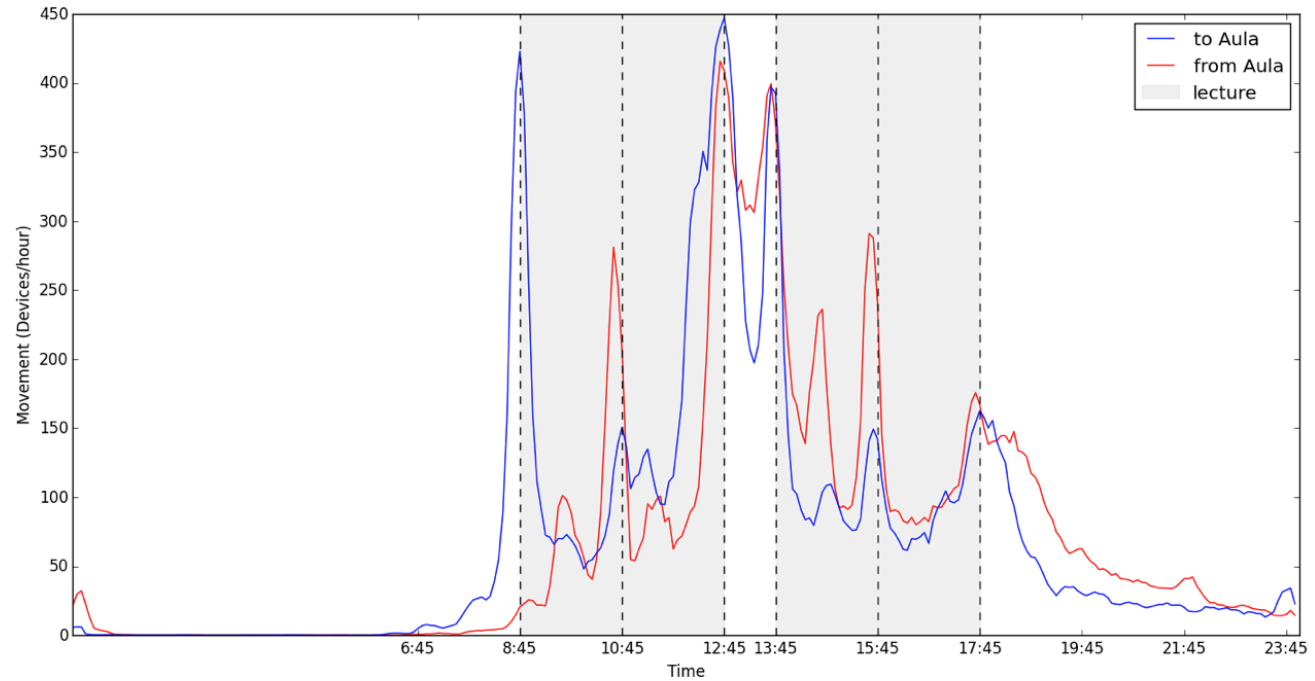
Movements from and to the campus



Week vs weekend

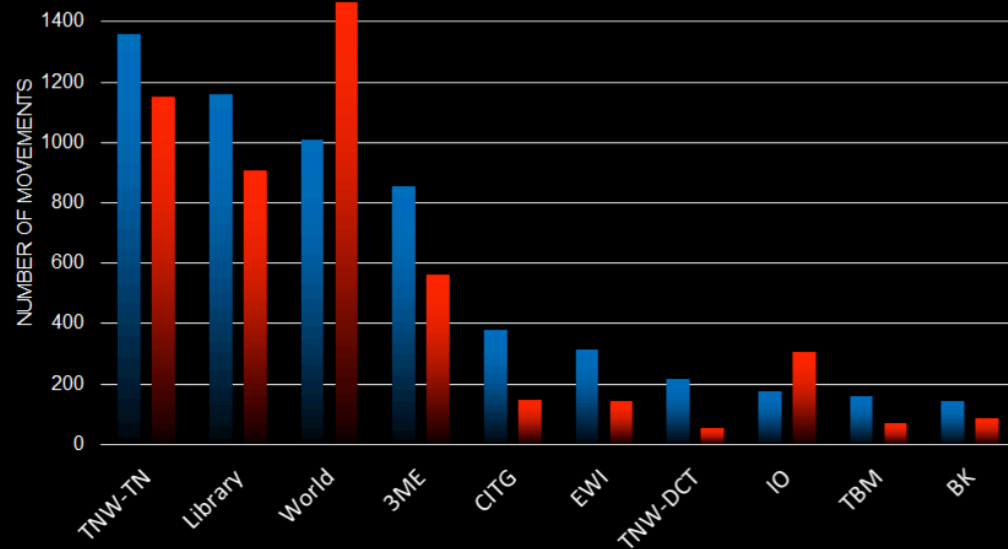


Movements from and to Aula



Movements to and from the Aula

between 12:15 and 13:00

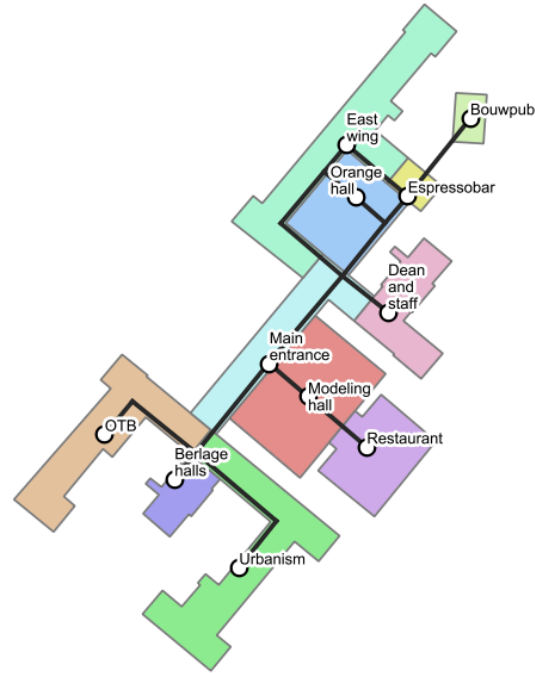




Building-part level

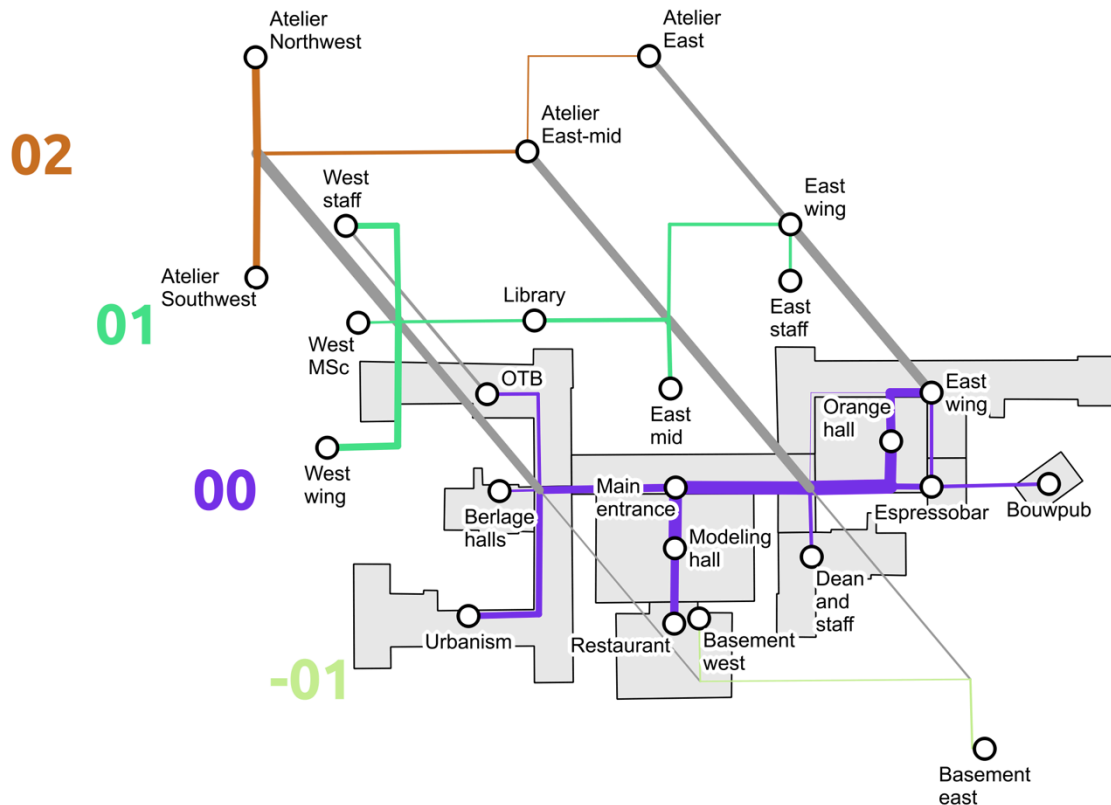
Movement from, to and between large indoor regions

Building graph model



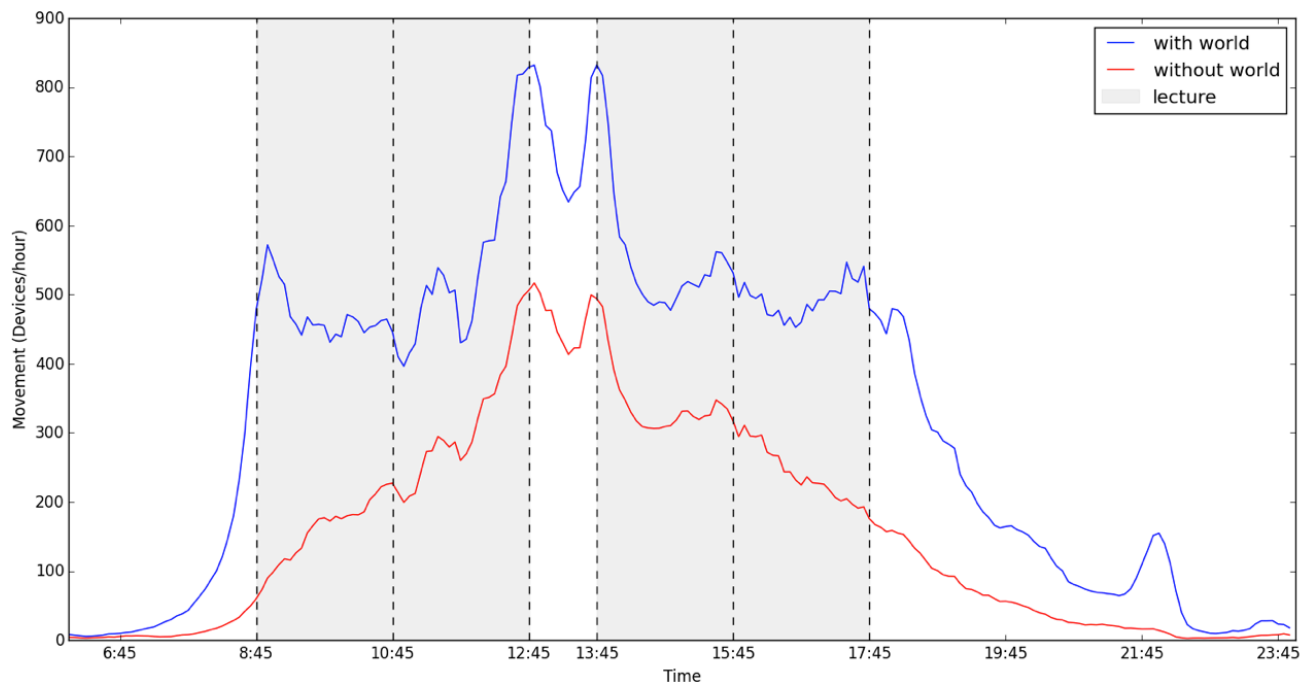
All movement

At the Faculty of Architecture and the Built Environment

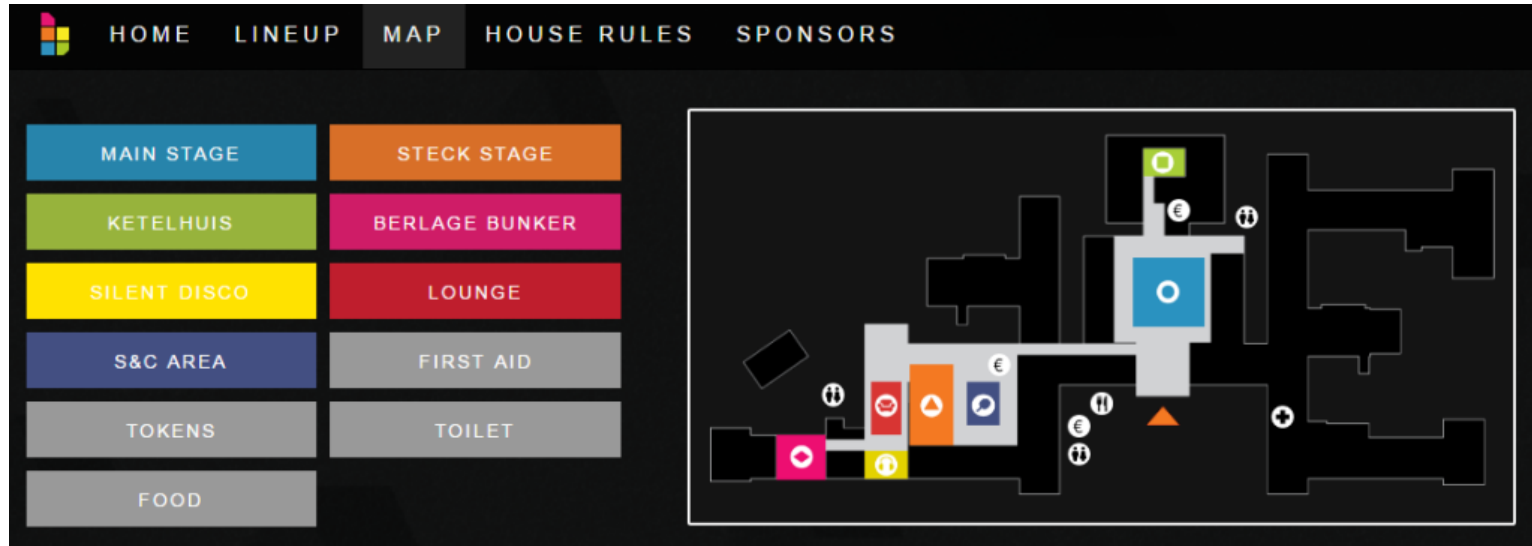


All movement

At the Faculty of Architecture and the Built Environment

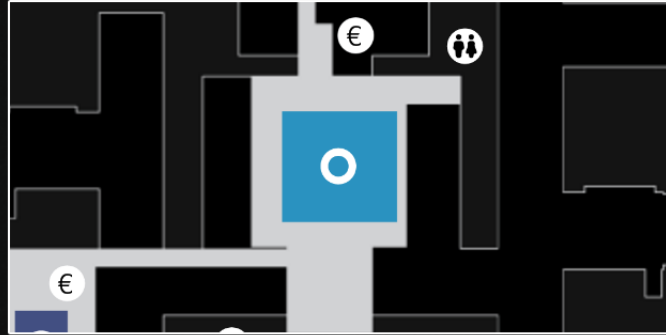


BK Beats



BK Beats

| | |
|--------------|----------------|
| MAIN STAGE | STECK STAGE |
| KETELHUIS | BERLAGE BUNKER |
| SILENT DISCO | LOUNGE |
| S&C AREA | FIRST AID |
| TOKENS | TOILET |
| FOOD | |



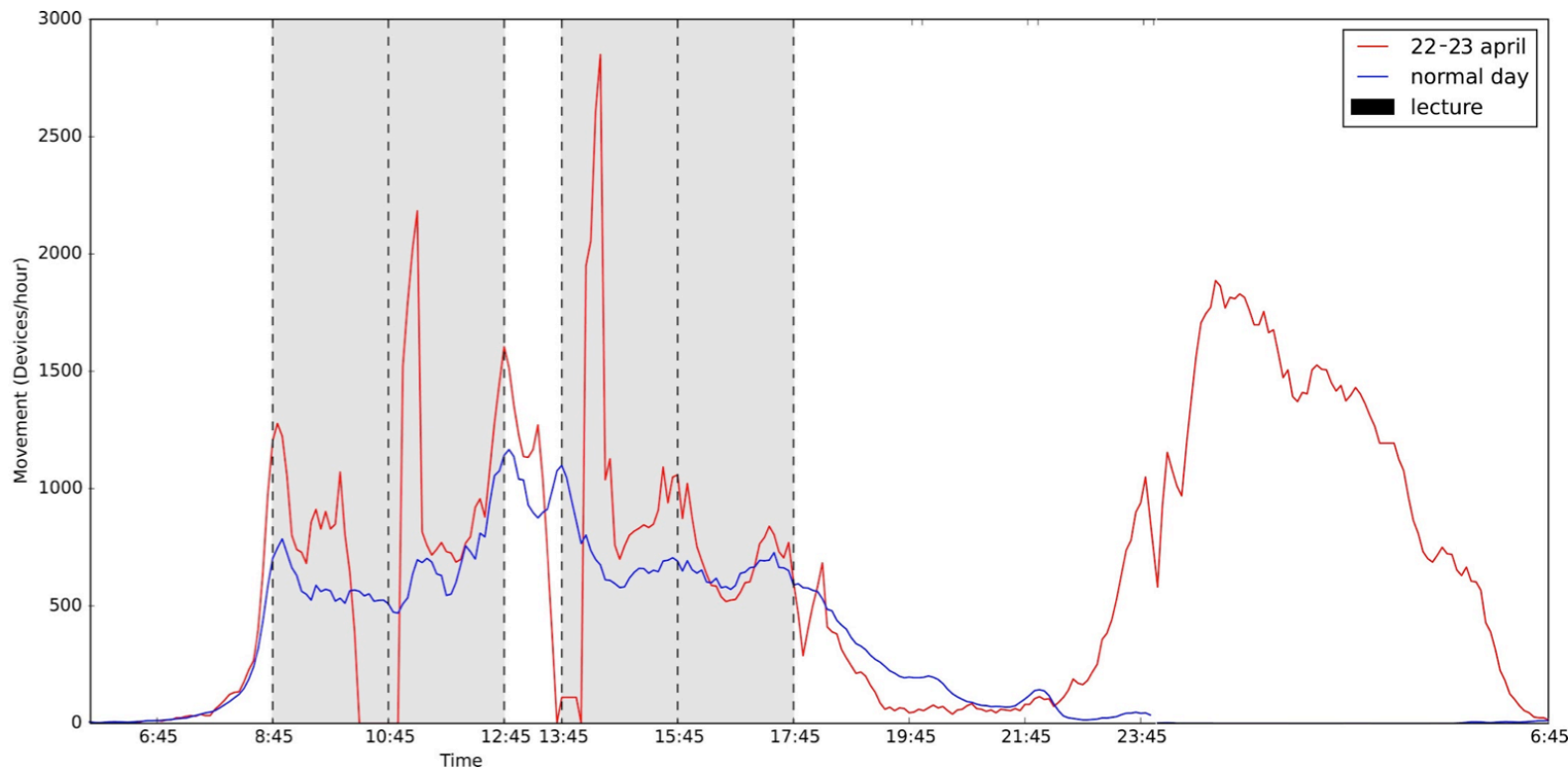
Main Stage

If you want to see the big guys playing their records. You should certainly go and see the main stage. The Him and Mr. Belt & Wezol are becoming big names in the music world.
Genres: Future house, French house

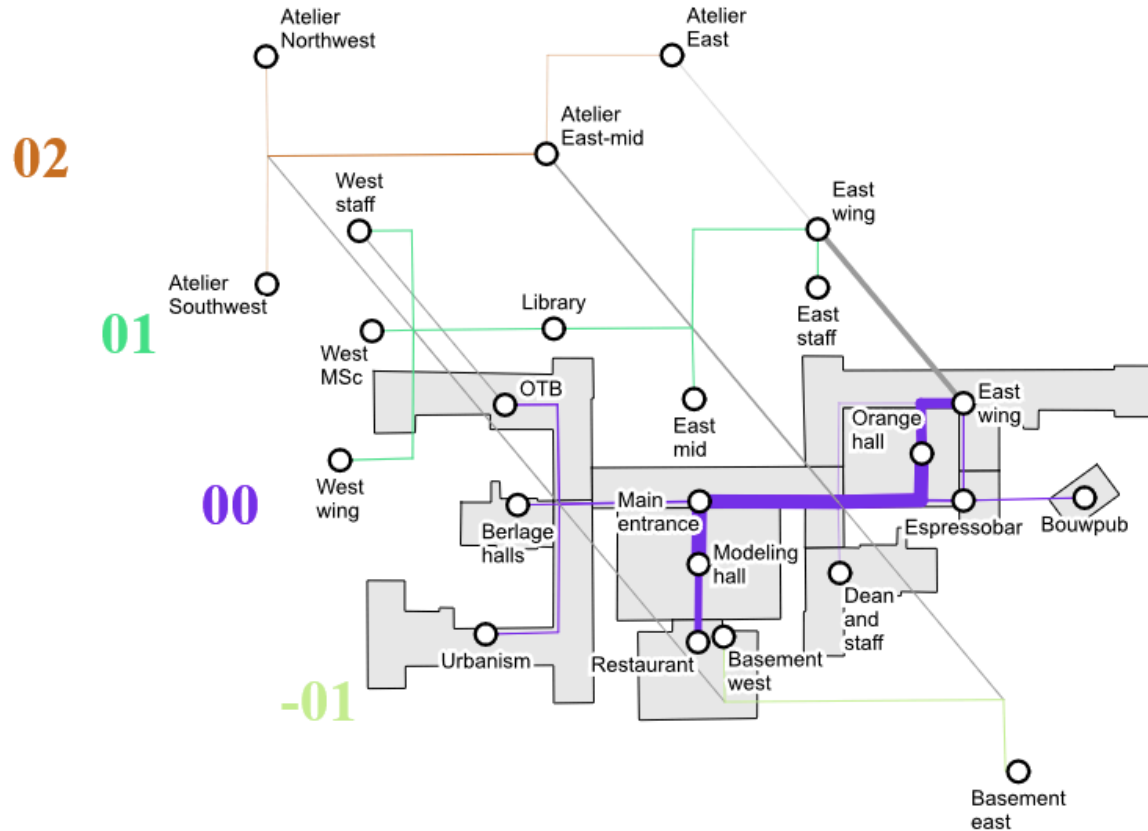
NOW PLAYING



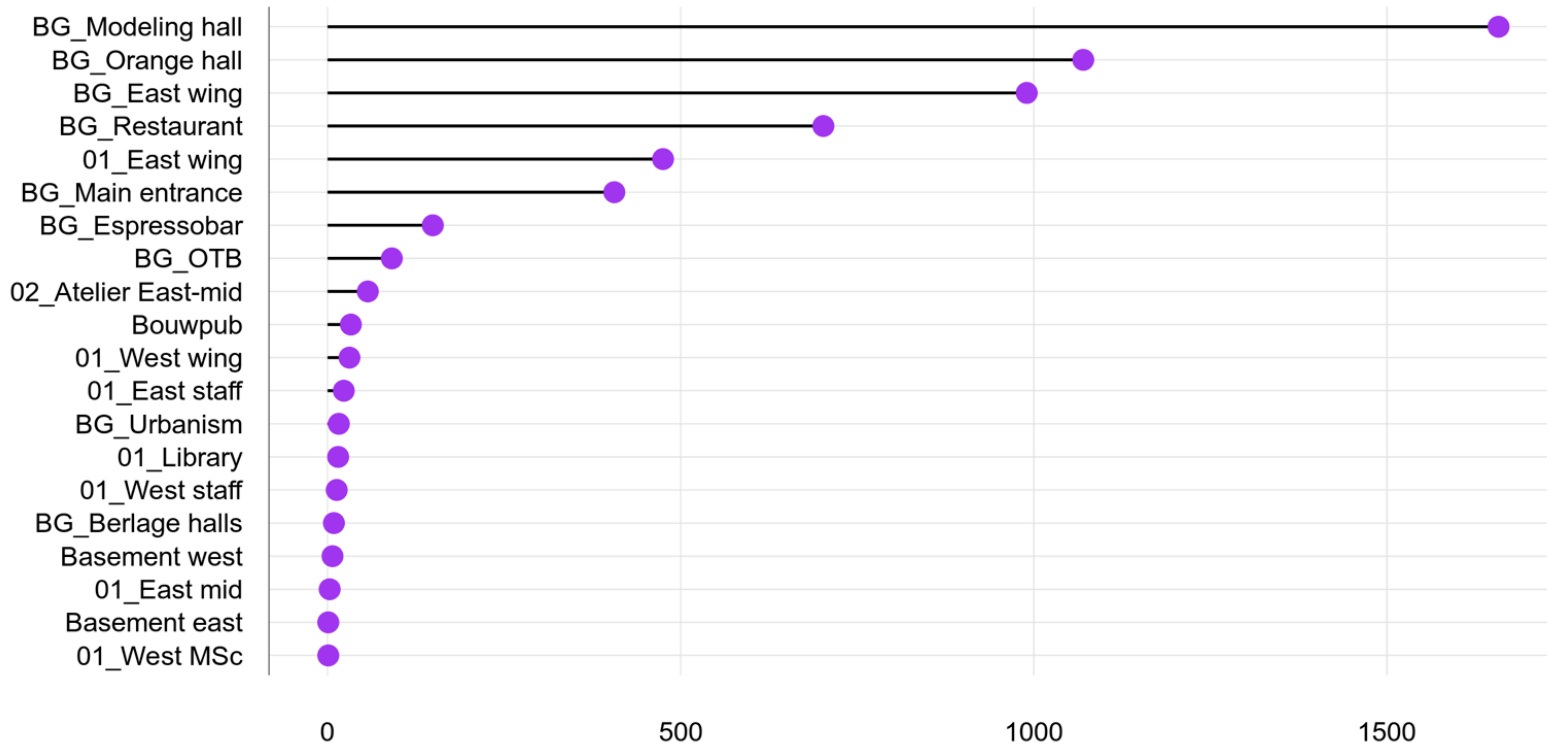
Movement during BK Beats



Movement during BK Beats



Movement during BK Beats



Is our privacy guaranteed?

- Movement patterns (trajectories) are rather unique
- **Additional (private) data needed**
- Access point map of the campus



Conclusions

Successfully identified movement patterns at two spatial levels

- Building level movement
 - Time profiles show the rhythm of the campus
 - Movement related to lecture hours
 - Most frequent movement between buildings: Aula & Library
- Building-part level movement
 - Similar movement patterns can be identified
 - Architecture people are less restricted to lecture hours
 - Network graph illustrates usage of corridors for movement
 - Range AP extends beyond floor level

Thank you for your attention!

