Introduction to transportation planning

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Lecture 1
Introduction

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Introduction to transportartion planning

What to expect?

Introduction to complex system.

Case-studies from real problems.

Interdisciplinary approach.

Mathematical methods to handle complex systems.

Models descibing personal decisions of intelligent person.

Understanding of transport problems: congestion, pricing, parking, sustainablility, road design.

Algorithms on graphs.

Why transport?

Transportation is part of civil environment

Civil engineer shall understand how a civilians behave – commute.

What are their travel needs and patters.

What transportation system is needed to keep the civilians moving.

It’s part of civil engineering faculty at most of renowned Uni’s.

You can start your career from this course to wherever.

Side effects

We compute and simulate huge systems

- i.e. 100 iterations of 1000x1000 shortest path searches on graph with 100k edges simultaneously on 16 cores in few minutes

We understand the complexity of the systems

- from single mode-choice decision of a work-home commuter, to the traffic jam at Aleje.

We are interdisciplinary

- psychology, economy, math, architecture, urbanism, mechanical engineering, construction, physicis – we demonstrate the links

Interdisciplinary

- psychology
  - risk-averse behavior. You will not change your bus to another if you can loose, but you will if you can gain.
- physics
  - traffic flow is handled with hydrodynamic theory of fluid, or gas.
- IT
  - computation results are transmitted to traffic light controllers throughout the city in miliseconds.
- urbanism
  - our demand models tell urbanists if they can narrow the roads and if the city center can be banned for traffic.
- …

System of humans

Usually we model the deterministic.

In physics we model Newtonian particles.

In engineering we use Newtonian models (when the bridge will collaps).

In maths we get the exact solution.

…

but in transportation there are people

free, independent, making rational (subjectively) decisions.

how to model system of million people moving independently

Mr. Andrzej will use his car and drive via Nowohucka, but the next day he will take a tram because he wants to, and on Wednesday he is working from home… and you ask ***how to set the traffic lights.***

System of humans

why the traffic lights at Planty are turned off?

people are better optimizng themselves then the controllers

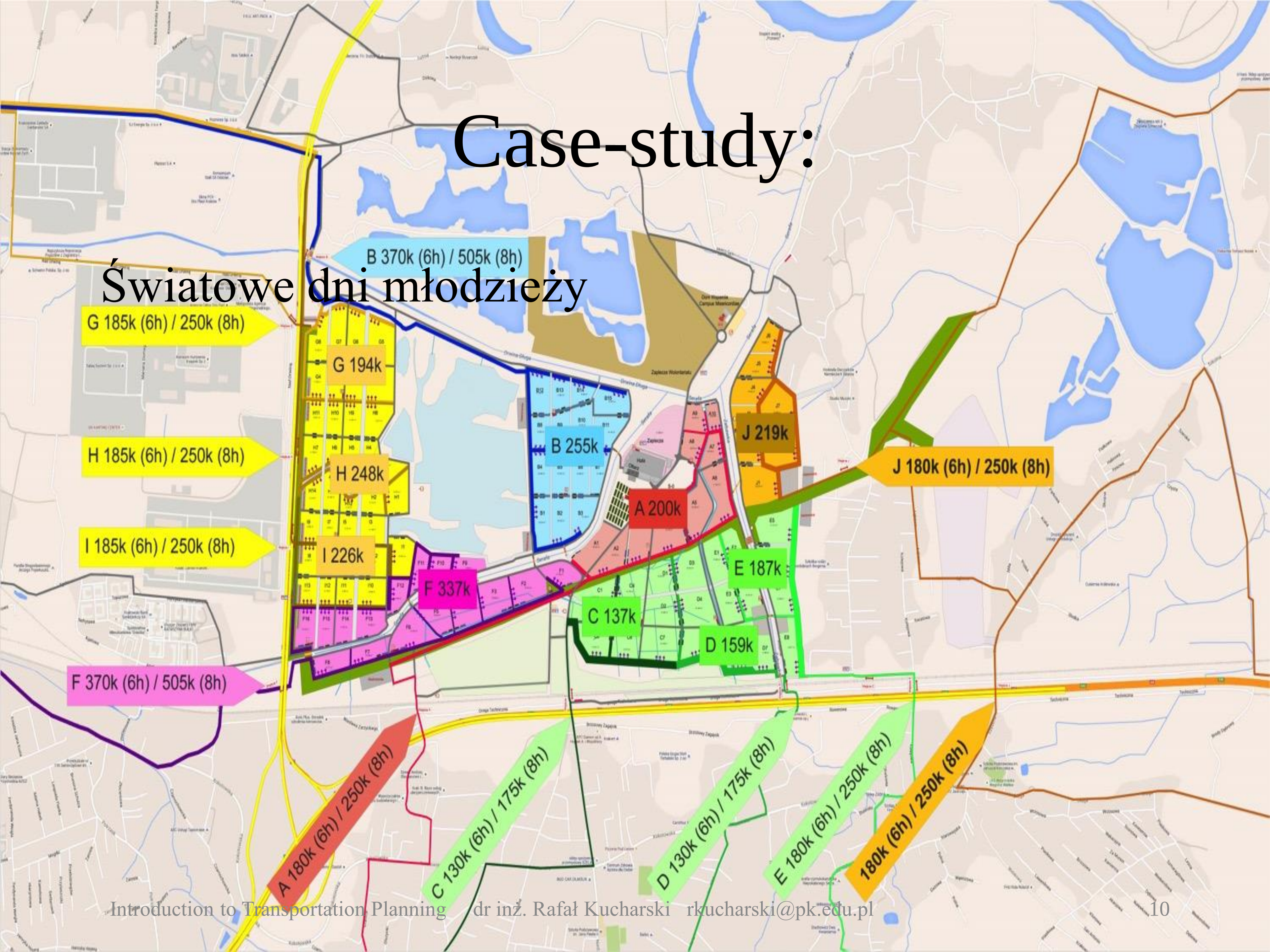
but we need to design the system properly (transport planning)

Case-studies

1. ŚDM – how to take 2mln pilgrims home? (ZSK, KNSK, ITP students)
2. Metro or tram in Kraków – let's rationalize the political decision. (ZSK, dr Marek Bauer)
3. Real-time bus congestion used in route planning. (mgr inz. Arkadiusz Drabicki)
4. What happens in the network if something happens, i.e. car accident (dr. Rafal Kucharski)
5. PhD opportunities

Case-study:

Światowe dni młodzieży

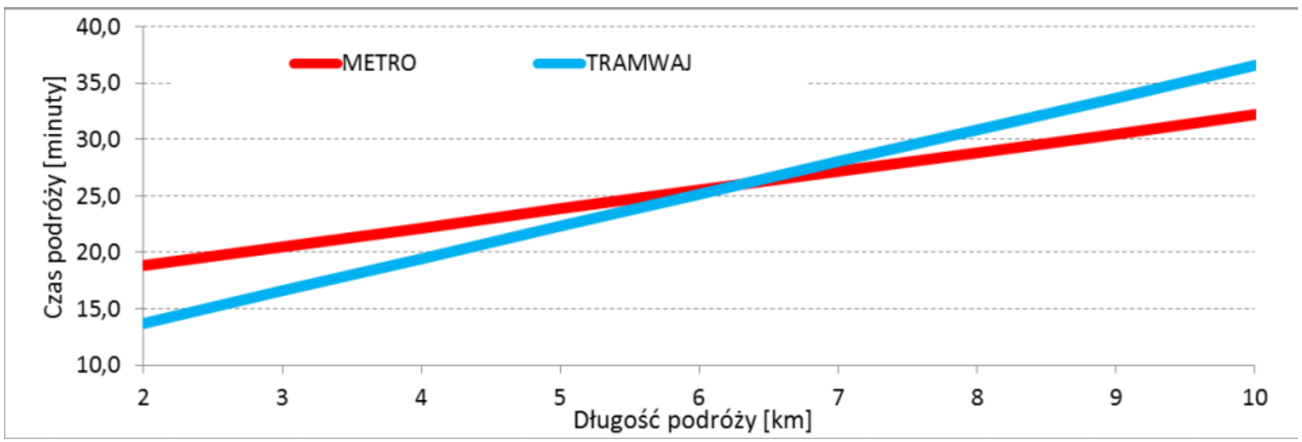


Case-study:

Krakow metro

CZAS PODRÓŻY – przypadek 3 (pośredni)

- Odległości dojścia/odejścia do/z przystanków:
  - **Metro – 350 [m] + konieczność pokonania różnicy poziomów**
  - **Tramwaj – 200 [m]**
- Założone prędkość przejazdu:
  - Metro – 36 [km/h]
  - Tramwaj naziemny – 21 [km/h]

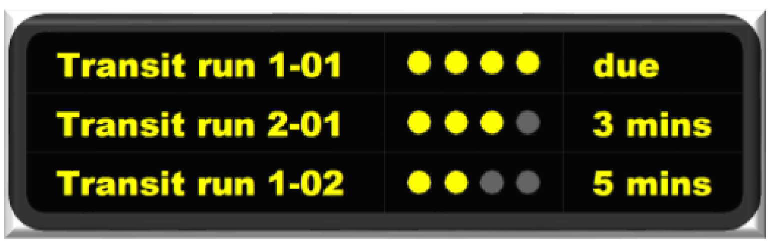


Case-study:

How to include the information in O-D path utility?

Backward (upstream) RTI-CL

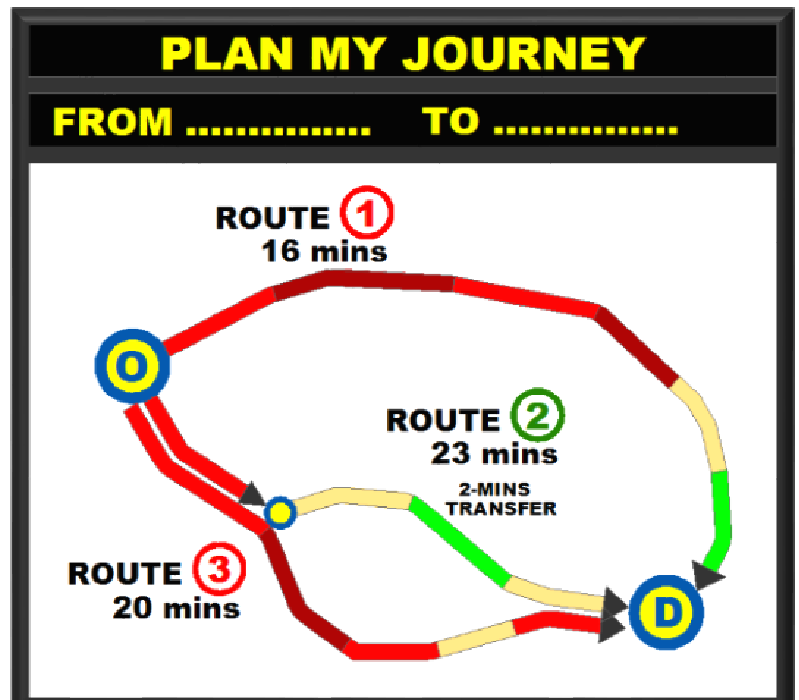
- crowding levels of vehicles that will yet arrive
- $\boldsymbol{\beta_s^{CL}(\tau)}$ - applies to total remaining path utility



➔ **both methods possible in BusMezzo**

Forward (downstream) RTI-CL

- crowding levels of vehicles that already departed
- $\boldsymbol{\beta_s^{CL}(\tau)}$ - applies individually to IVT segments



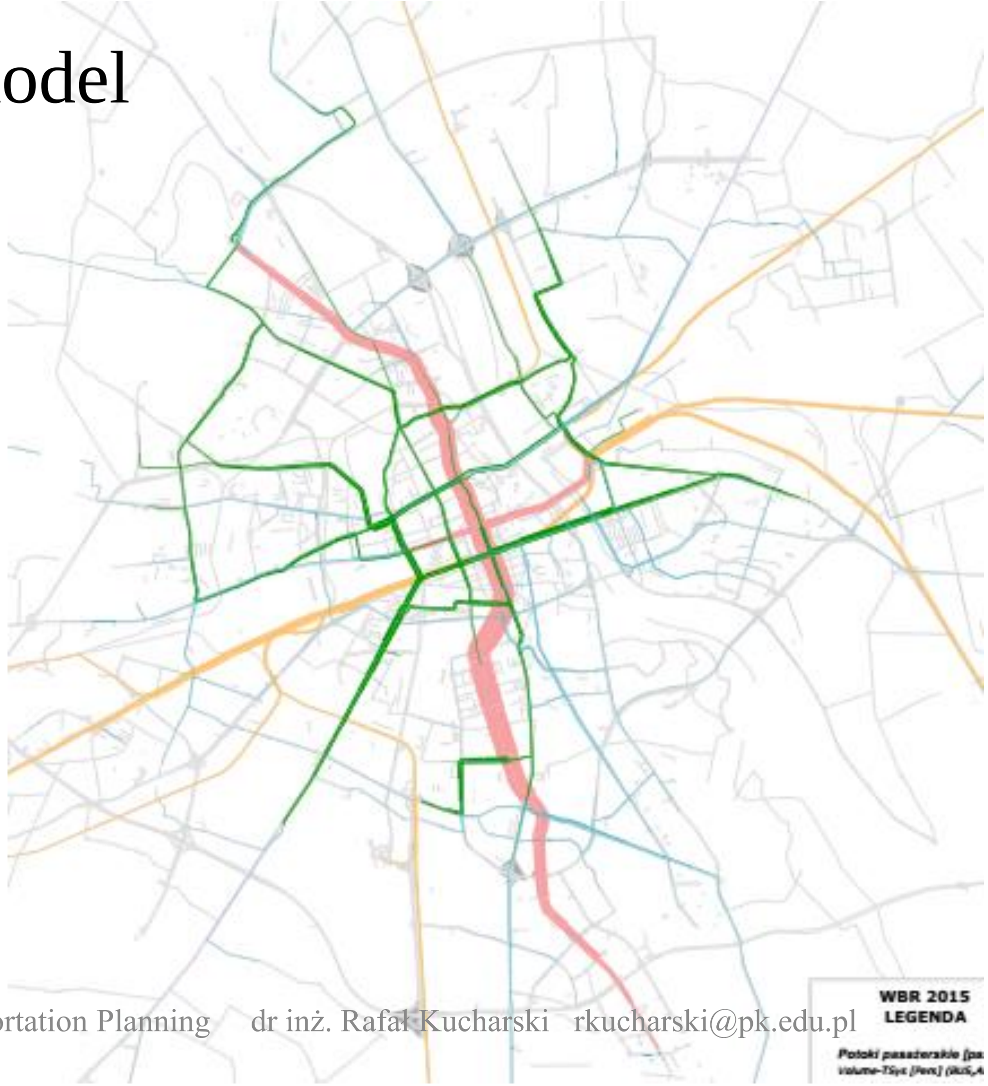
Case-study:

Case-study:

Pedestrian crossing by the Uni

Case-study:

Warsaw model



TED talks on transportation

one of most popular and viral

it forms crucial part of one of most trendy discipline in cont. science, so-called **urban studies**

i.e. how the city works, how it moves, grows, builds, maintains, attracts, supplies needs, …

https://www.ted.com/talks/jonas_eliasson_how_to_solve_traffic_jams

Is it your starting point?

1. Join us at www.KNSK.org and facebook/knsk.pk
2. Work with us at ZSK
3. Master studies
4. Numerous career opportunities
   (Kraków, Poland, EU)
5. PhD (?)
6. Start-up (?)

Next week

1. Introduce the transport network
2. Traffic flows
3. Travel times (costs)
4. Elasticity + evolution of the transport networks