Ethics of Intelligent Vehicles
First meeting

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Universität Bamberg

Today's agenda

1. getting to know each other ($\approx$ 20 minutes)
2. How is the course organized? ($\approx$ 20 minutes)
3. Q & A about the organization ($\approx$ 10 minutes)
4. What is this course about? ($\approx$ 40 minutes)
5. Q & A about the content ($\approx$ 10 minutes)


Let's get
to know
each other
Coca-Cola
Pepsi

How is the course organized?

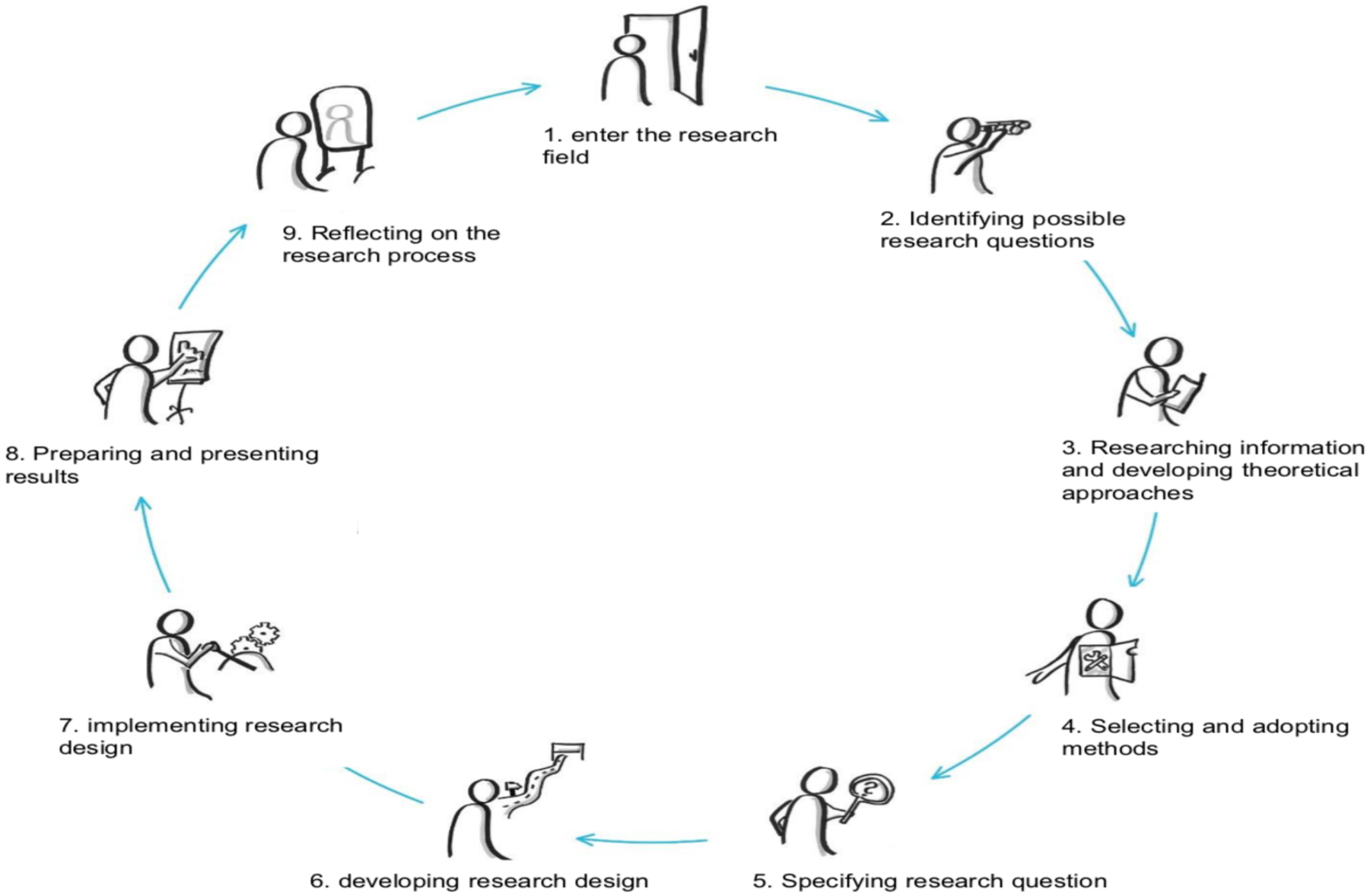
Basic information

- Type: research training with integrated seminar
- Credits: 6 ECTS
- Contacts: christoph.benzmueller@uni-bamberg.de and martin.aleksandrov@fu-berlin.de
- Routine: bi-weekly
- Time slot: Wednesday 12:00-14:00
- Location: room WE5/01.003 (https://www.uni-bamberg.de/its/dienstleistungen/pc-pools/we501003/)
- Registration: via the VC system

Main research steps

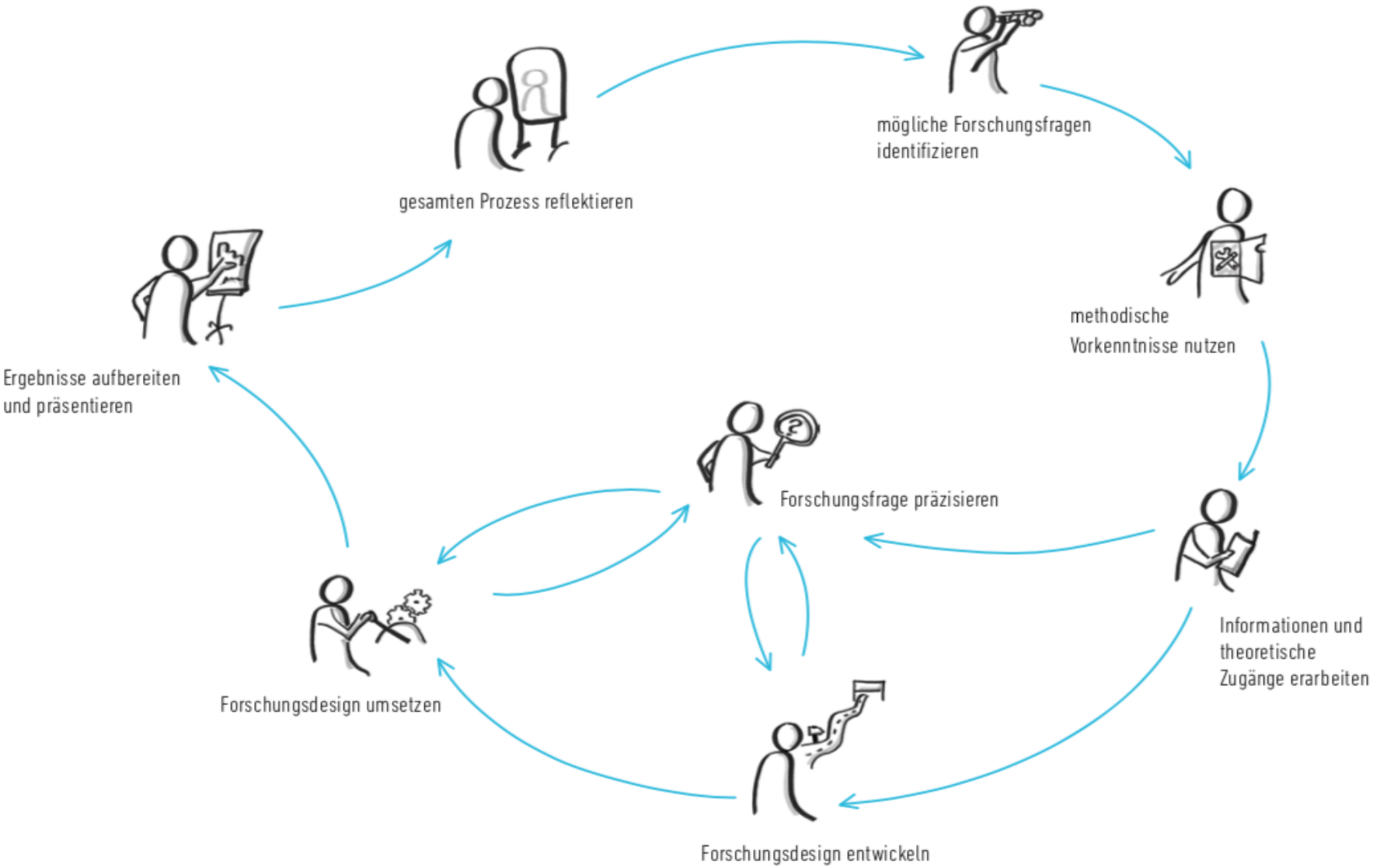
Fig 1: The "Zürcher Framework" of Tremp and Hildbrand (2012).

Example 1: ideal research process[1]



[1] Huber, L. (2009). Warum Forschendes Lernen notig und moglich ist.

Example 2: seminar research process[2]



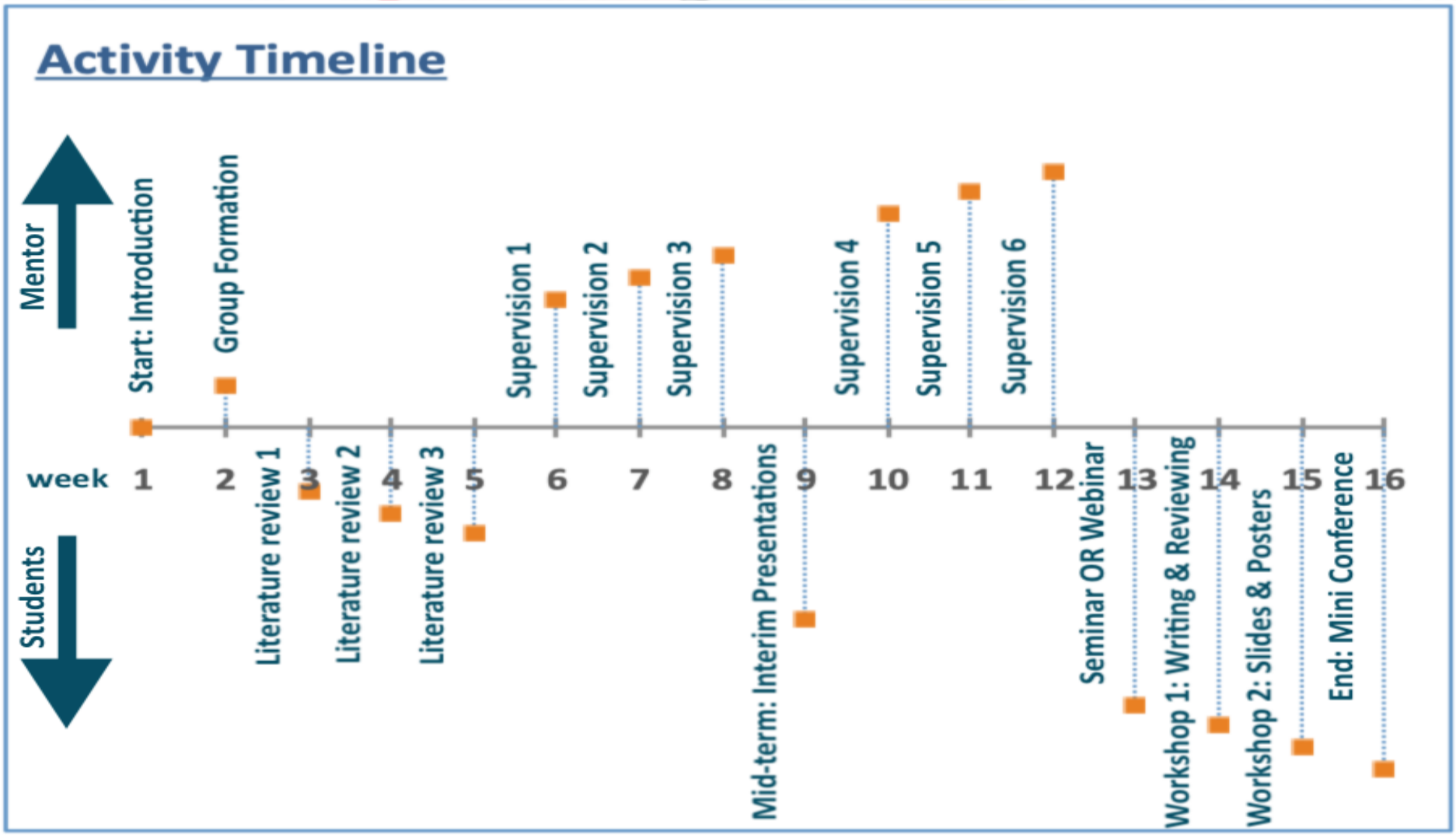
[2]Huber, L. (2009). Warum Forschendes Lernen notig und moglich ist.

Programme

week	class sessions	student integration tasks	date
1	**First meeting** • introduction & case studies • goals & programme	**1]** stage of the study, the field of study, strong skills, weak skills **2]** expectations, roles, tasks, Q&A	Oct 19, 2022 (Wed, 2h)
2	**Introduction to theory & tools** • VRP & COMSOC • MiniZinc & Gurobi	**1]** literature search, knowledge synthesis, hypothesis formulation **2]** install, coding "Hello world!", Q&A	Oct 26, 2022 (Wed, 2h)
3	**Data sources & management** • NEO, CVRPLIB & PrefLib • ethics & statistics	**1]** data search, collection, cleaning, processing, formatting, privacy **2]** analysis: mean; deviations; Q&A	Nov 2, 2022 (Wed, 2h)
4-13	**Research** • joint work & supervision • discussion & practice	**1]** independent work, teamwork, presentation of results, practice talks **2]** problem solving, critical thinking	Nov 9, 16, 23, 30, Dec 7, 14, 2022, Jan 4, 11, 18, 25, 2023 (Weds, 10x2h=20h)
14	**Scientific formats & conferences** • scientific report vs. article • StuFo, IV, APORS	**1]** writing and reviewing practices, structures of report and article **2]** publishing formats, Q&A	Feb 1, 2023 (Wed, 2h)
15	**Presentation & poster preparation** • structure & content • LaTeX, Excel, PowerPoint	**1]** implementation of initial structures, common tips **2]** experiences, practices, Q&A	Feb 8, 2023 (Wed, 2h)
16	**Final meeting** • student talks & posters • evaluation & reflection	**1]** talks and posters, i.e. 10:00-15:00 **2]** student feedback and suggestions, Q&A, grading, i.e. 15:00-17:00	Feb 15, 2023 (Wed, 5h)

Workload: 180 h (35 h work in classes, 145 h work at home)
Consultation hours: via Zoom by an appointment

Implementation



Group formation

- select a project and, based on your selection, write a 300-word motivation statement
- describe your skills by using keywords, e.g. modelling, algorithms, data, evaluation, math, statistics, ethics, Python, C/C++, etc.
- include your student data: Last Name, First Name, University, Faculty, Study Program Name, Study Program Type (e.g. BA, MA), Semester Number, Student Number, Student Email
- email the statement until the end of Sunday, October 23

Roles and their tasks

- *Researchers*: modeling FMAs, modeling features, algorithm design, and algorithm analysis.
- *Programmers*: algorithm implementation, algorithm testing, algorithm evaluation, and algorithm comparison.
- *Data scientists*: data collection, data cleaning, data processing, data formatting, and data analysis.
- *Philosopher*: investigating ethical frameworks for FMAs, and formalizing such frameworks.

Seminars and webinars

Australian Society for Operations Research

The ASOR seminar provides an excellent opportunity for **students** to connect with international experts.

At the IEEE webinars, **students** can learn about publishing and outreach for their results.

Seminars offered by
(AI Systems Engineering)

The AISE group offers seminars where **students** can listen to invited talks given by national experts.

Project requirements

- A presentation (≈15 slides, ≈10-15 min per person)
  - present your findings
  - take part in events
  - deadline: end of teaching term
- A poster (size A1/A0)
  - present your findings
  - showcase at the seminar
  - deadline: end of teaching term
- A scientific report (≈15 pages, max. 20 pages)
  - introduction and related work
  - results and conclusion
  - deadline: end of semester term
- A scientific review (≈3 pages, min. 2 pages)
  - short summary of the article
  - feedback and evaluation
  - deadline: end of semester term

Conference participation

Science Communication

- **90%** of my past graduates have presented and published their results.
- **90%** of my past graduates have participated in national and international conferences.
- The **future** students will have similar publishing and outreach opportunities.

Student feedback

Giulia Grasso: "This course taught me how to develop an idea from the first step to the final result.

Starting from the literature review, through the modeling, to the coding. In the end, I presented my results at a conference.

The entire experience allowed me to grow and improve my personal skills and knowledge!"

Tobias Labarta: "Are you interested in starting your own research, but you don't know how to do it?

I was exactly at that point and this course was the perfect start for me. Throughout the whole research cycle, we were supported by Martin, but still free in the way we did our research. Additionally, my results were accepted at two conferences.

Overall, I had a great learning experience and would highly recommend the course!"

Shally Jain: "The course was great! It helped me develop my idea which then reached at the finals of the Research 2 Market start-up challenge.

Reviewing, *Presenting*, *Reflecting*! These keywords describe best the course learning cycle. Ooh, I almost forgot! *Conferencing* too."

Student Feedback

Publications and Outreach

1. Grasso, G. *Minimizing the response time of support units in earthquakes: prediction and assignment*. Abstract accepted at the 7th Conference for Student Research, StuFo 2022, October 4-5, 2022, Berlin, Germany, 2022.
2. Jain, S. *Multimodal Route Selection via Carbon Emission Measures*. Abstract accepted at the 7th Conference for Student Research, StuFo 2022, October 4-5, 2022, Berlin, Germany, 2022.
3. Labarta, T. *Sexual Harassment Prevention Mechanisms for Taxi Allocations under Gender Preferences*. Poster accepted at the 7th Conference for Student Research, StuFo 2022, October 4-5, 2022, Berlin, Germany, 2022.
4. Cong, Y., Díaz, M., Ehmendörfer, C., Le, P. A., Tang, C. K., Wang, M. *bARlin: Enhancing the Exploration of Touristic Attractions with Augmented Reality*. Abstract accepted at the 7th Conference for Student Research, StuFo 2022, October 4-5, 2022, Berlin, Germany, 2022.
5. Aleksandrov, M. and Labarta, T. *Sexual Harassment Prevention in Taxi Allocations under Gender Preferences*. In Proceedings of the 13th Triennial International Conference of the Association of Asia Pacific Operational Research Societies, APORS 2022, November 9 - 12, 2022, Quezon City, Philippines, 2022, World Scientific, APJOR.

A summary of student benefits

1. work on a research project
2. work in a research environment
3. improve technical writing skills
4. develop critical thinking
5. learn about decision making
6. network with other researchers
7. turn ideas into publications
8. turn ideas into theses
9. get credits for all these
10. often free food at conferences

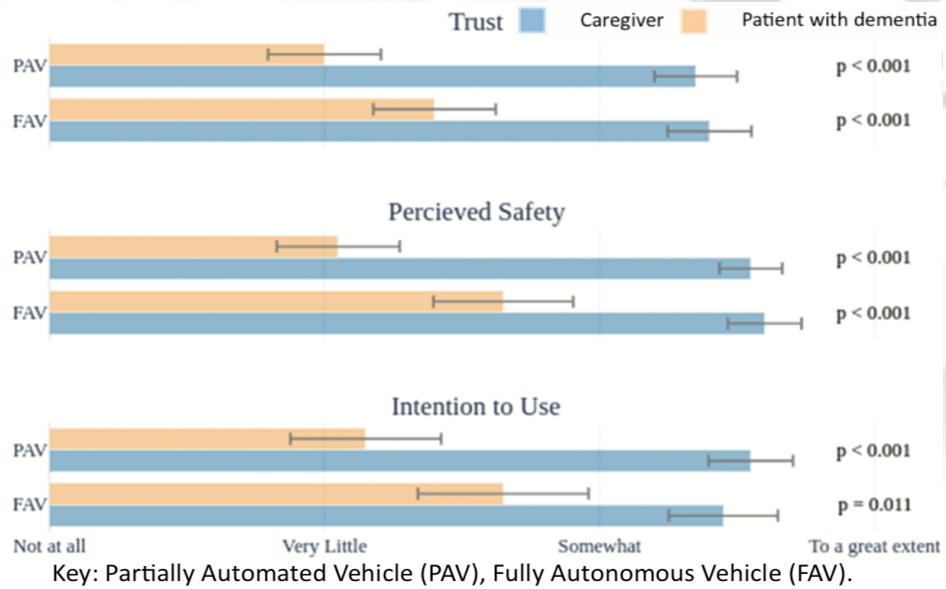

Q & A

What is this course about?

How can we model and solve (ethical) challenges for **future mobility applications (FMAs)**?

Part 1: Case studies of FMAs

Case study 1: assistive technology



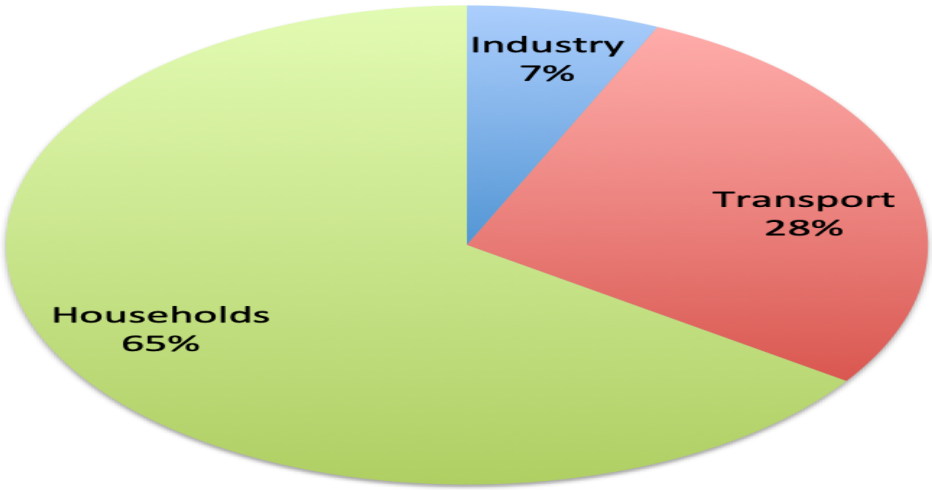
Key: Partially Automated Vehicle (PAV), Fully Autonomous Vehicle (FAV).

- **Goal**: Assist people with severe disabilities.
  - 9.5% of the Germans are disabled (7.9 million)
  - 21% of them live with dementia (1.6 million)

1. How to address autonomy in Intelligent Vehicles (IVs) for assistance?
2. Are there any possibilities for harm?
3. How to tackle fair use given the increasing number of patients with disabilities?
4. Is explainability important for assistive technologies? Why?

Case study 2: garbage collection

CO_2 emissions in Berlin in 2014



- **Goal**: Reduce the CO_2 emissions related to households.
  - 65% of all CO_2 emissions are related to households
  - 30t of CO_2 on average per household per year

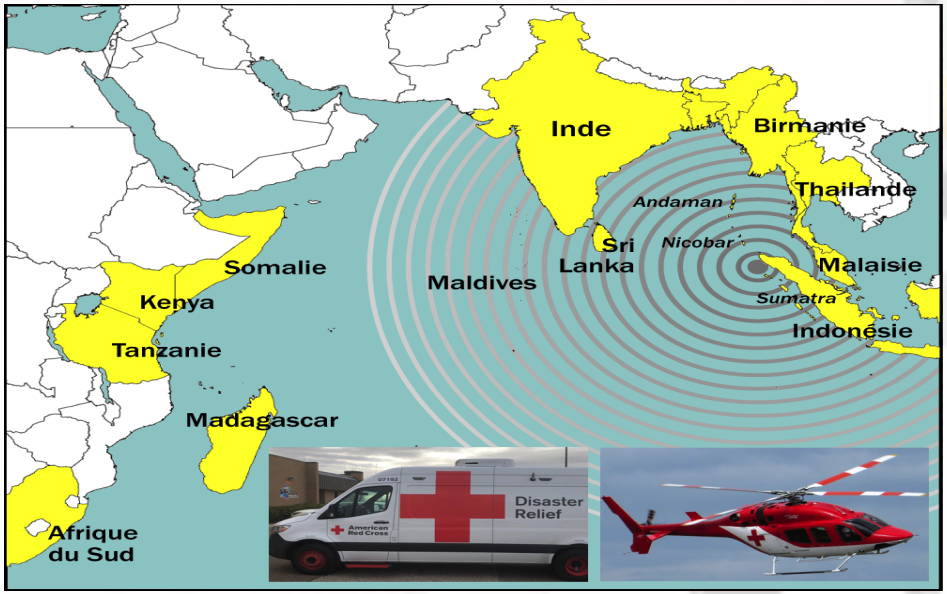
1. How to involve households in garbage collection?
2. Are there any technical and ethical challenges?
3. How to motivate households to generate less garbage?
4. Are there any associated privacy and bias challenges?

Case study 3: fighting fire

- **Goal**: Reduce the damage caused by fire.
  - ≈60-84 million acres and ≈3500 homes were lost
  - ≈480 humans and ≈3 billion animals were impacted

1. How to allocate observation drones to collect information to reduce uncertainty?
2. Are there any technical and privacy challenges?
3. How to allocate firefighting units to extinguish fire spots efficiently?
4. Are there any associated ethical consequences?

Case study 4: relief support



- **Goal**: Reduce the response time needed for help.
  - $\approx$ 230 000 people died in the 2004 earthquake and tsunami
  - $\approx$ 135 448 properties were seriously damaged

1. How to assign relief units to affected areas?
2. Are there any safety challenges?
3. How to minimize the response time?
4. Are there any associated constraints?

Case study 5: taxi allocation


The New York Times

$25,000 Fine Proposed in Taxi Driver's Snub of Black Family

Give this article

- **Goal**: Reduce any possible bias and discrimination.
  - drivers avoid customers based on race and location
  - NYC Office of Inclusion offers support to those in need

1. How to match taxis to passengers?
2. What preferences might drivers have?
3. What preferences might customers have?
4. How to match taxis to passengers under preferences?

DISCUSSION

What is this course about?

How can we **model** and **solve** (ethical) challenges for future mobility applications (FMAs)?

Part 2: Methodology for FMAs

Methodology: motivation

Crashes involving Tesla Autopilot and other driver-assistance systems get new scrutiny.

Federal safety regulators told automakers to provide more information about accidents involving cars and trucks with automation technology.

There has been growing concern about the safety of driver-assistance systems, in particular Tesla's Autopilot. KCBS-TV, via Associated Press

3

Claim: safety is **necessary**!

[3] https://www.nytimes.com/2021/06/29/business/tesla-autopilot-safety.html

Methodology: motivation

Problem: safety is **not sufficient**!

Table 2: Ethical Principles for a Trustworthy AI.

Code	Principles
EP1	Respect for human autonomy
EP2	Prevention of harm
EP3	Fairness
EP4	Explainability

Table 1: Key Requirements for a Trustworthy AI.

Code	Requirements
KR1	Human agency and oversight
KR2	Technical robustness and safety
KR3	Privacy and data governance
KR4	Transparency
KR5	Diversity, non-discrimination and fairness
KR6	Societal and environmental well-being
KR7	Accountability

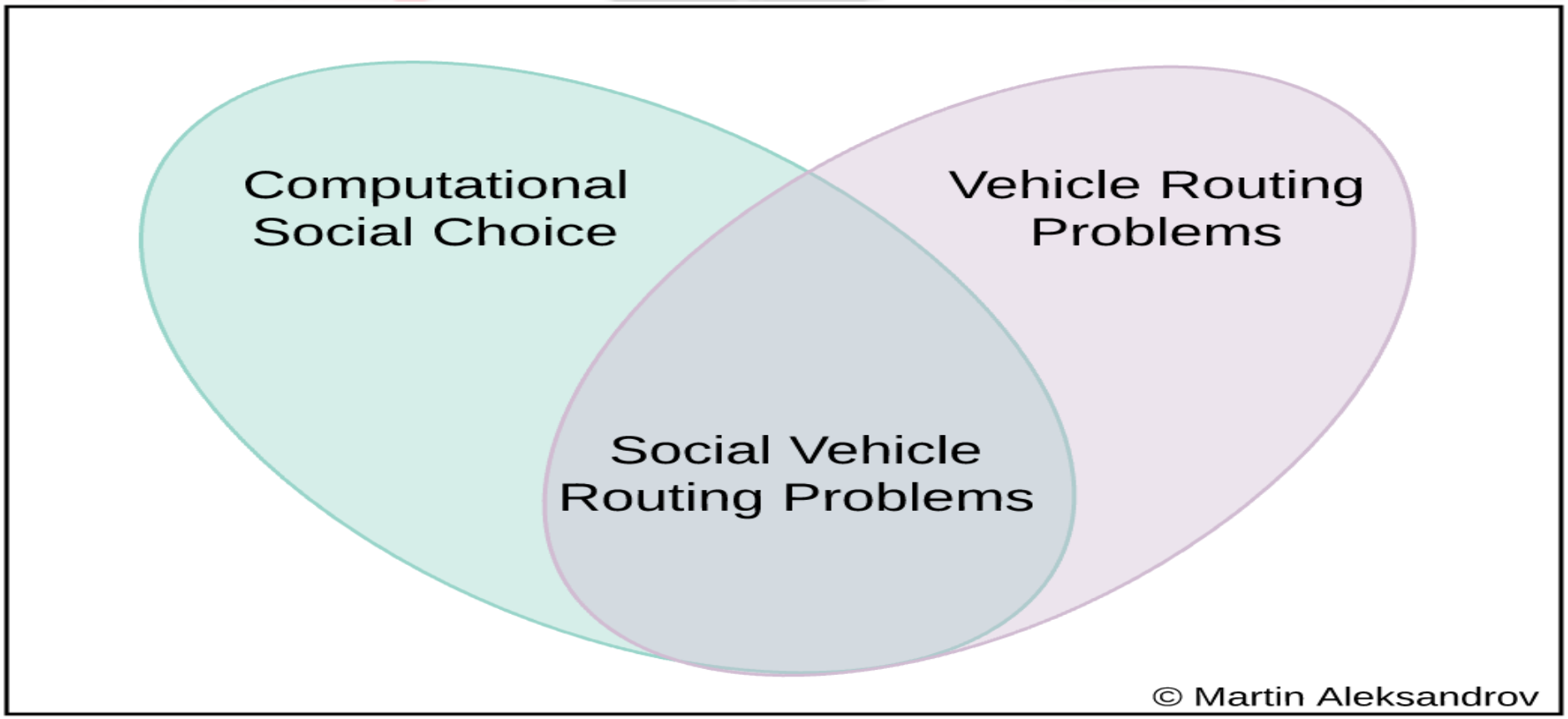
- Goal 1: promote *trust* (see Table 1)
- Goal 2: promote *ethics* (see Table 2)
- Goal 3: promote *fairness* (see Tables 1 and 2)

Methodology: motivation

- in 2020, European Institute of Technology grants 400 million
- **trust**, safety, transparency
- in 2020, EU Strategy for Sustainable and Smart Mobility
- the transition to future mobility requires using **preferences**
- a number of events, e.g. TRA 2022, ITF 2022
- *transport* and *preferences*

IDEA: VRP & COMSOC definition

Social VRP: driver and customer preferences play a crucial part in the management of the vehicles[4].



[4] DFG project "Fairness and Efficiency in Emerging Vehicle Routing Problems": http://www.mi.fu-berlin.de/inf/groups/ag-ki/Projects/Fairness-and-Efficiendy/index.html

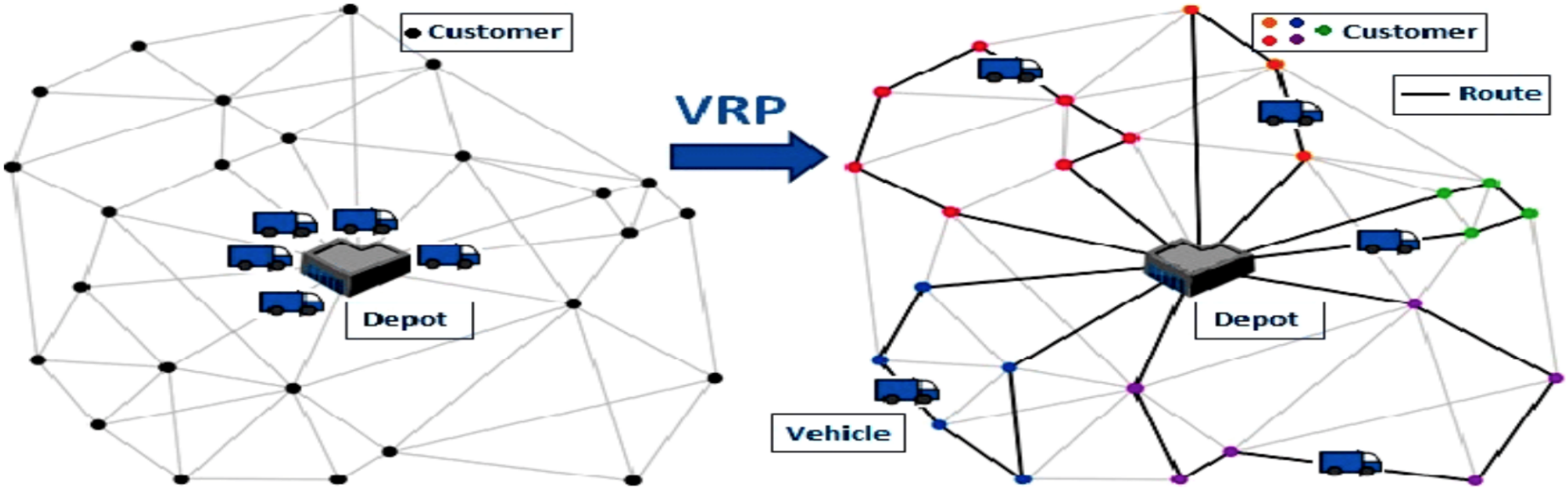
VRP definition

Vehicle Routing Problem:=Model+Objective

Model:

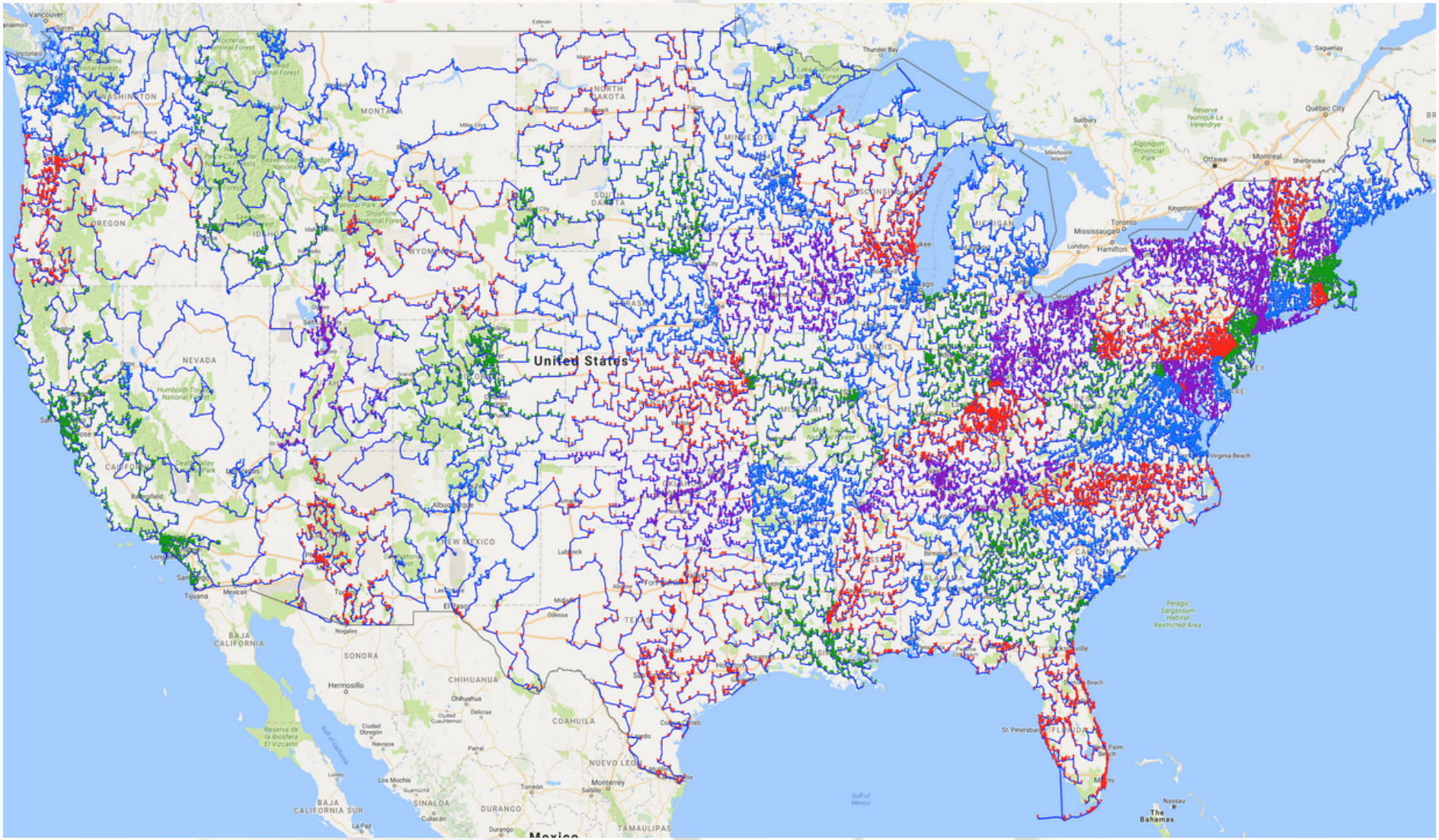
- $V = \{v_1, \ldots, v_n\}$: a finite set of *driver vehicles*
  - begin b_i, end e_i, cap q_i, time $t_i(l_1, l_2)$
- $R = \{r_1, \ldots, r_m\}$: a finite set of *customer requests*
  - pickup p_j, dropoff d_j, demand m_j

Objective: minimise the total time travelled by all vehicles[5].



[5] G. B. Dantzig and J. H. Ramser, "The truck dispatching problem," Management Science, vol. 6, pp. 8091, October 1959.

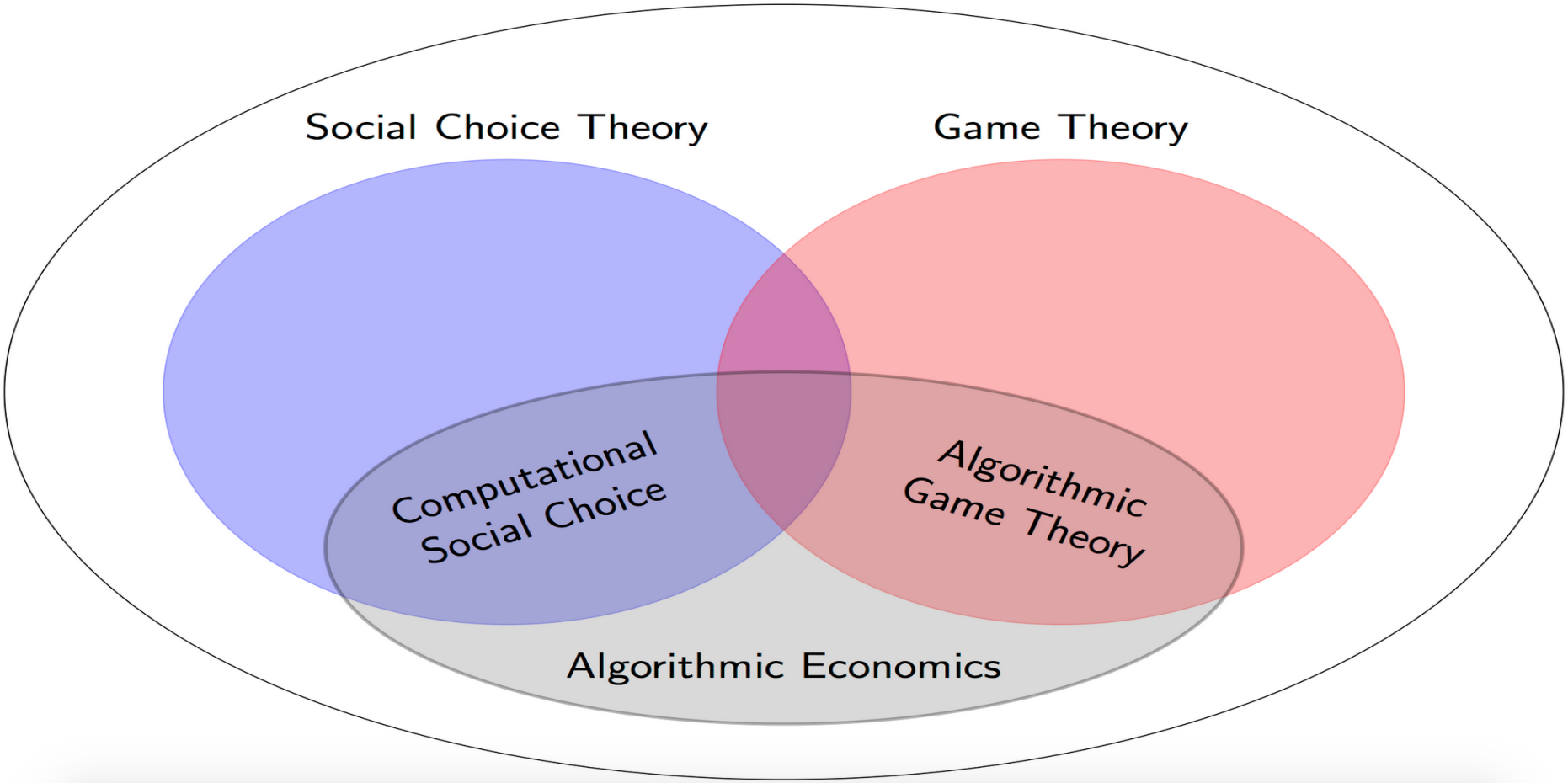
VRP example 1: optimal routes



VRP example 2: optimal plans

COMSOC definition

Computational Social Choice: computational analysis of problems arising from the aggregation of preferences of a group of agents.



COMSOC example 1: fair allocation[6]

Preferences

Valuations

			
	2	1.5	1
	1	2	1.5
	1.5	1	2

Disvaluations

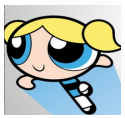
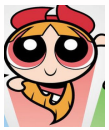
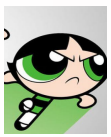
			
	−2	−1.5	−1
	−1	−2	−1.5
	−1.5	−1	−2

How should we allocate the cars to the people?

[6] H. Steinhaus. The Problem of Fair Division. Econometrica, 16:101–104, 1948.

COMSOC example 2: fair allocation

Valuations

						
	0.0426	0.0004	0.1019	0.1503	0.0541	0.1780
	0.0365	0.0004	0.2311	0.1479	0.0649	0.1115
	0.1124	0.0972	0.0574	0.0956	0.1441	0.1461
	0.0368	0.0582	0.0242	0.0784	0.1844	0.1260
	0.1212	0.0259	0.1574	0.1681	0.1501	0.1894
	0.0285	0.0362	0.0674	0.1272	0.0254	0.1273

How should we allocate the cars to the people?


Q & A

An upcoming call for student assistants

I hire students who are interested to do research on "Fairness and Efficiency in Emerging Vehicle Routing Problems".

- **Call 1**: send your application documents to information-ki@fu-berlin.de and martin.aleksandrov@fu-berlin.de
  - to be announced: March 2023
  - tentative deadline: March 31, 2023
  - employment type: 10h per week, but 41h per month
  - employment period: May 1, 2023 - April 30, 2024