Physics of social systems

New USE learning line

Prof. dr. F. Toschi

A new USE learning line

- **Challenge Based Learning (CBL):** *from teaching to learning, matching TU/e 2030 vision for education*

- Intrinsically **multidisciplinary challenges:** *alpha, beta, gamma*

- **Education and research:** *hand in hand*
Sociophysics (examples)

“Social physics or sociophysics is a field of science which uses mathematical tools inspired by physics to understand the behavior of human crowds. In a modern commercial use, it can also refer to the analysis of social phenomena with big data.” Source: Wikipedia

- Spreading of diseases (Ebola, Coronavirus, …)
- Spreading of opinions (Facebook–Cambridge Analytica,…)
- Econophysics (stock exchange, cryptocurrencies,…)
- Crowd dynamics (urban infrastructures, …)
- …

2020/21
Key questions

• How to observe a social system?
  Sociophysics 1

• How to model a social system?
  Sociophysics 2

• How to nudge a social system?
  Sociophysics 3
A multidisciplinary science

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<th>Mathematics / physics</th>
<th>Machine learning</th>
<th>Psychology</th>
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A multidisciplinary team

Federico Toschi  
Physics

Antal Haans  
Psychology

Wybo Houkes  
Philosophy & Ethics

Alessandro Corbetta  
Physics

Yvonne de Kort  
Psychology

Gunter Bombaerts  
Ethics

Vlado Menkovski  
Machine learning

Frank vd Schadewijk  
Crowdmanagement specialist

+ TAs (PhD or MSc students)
The format

- **3 courses** (5 ECTS each): students must follow them one after the other, preferably **in year 2** (quarters 1, 2 and 3)

- Work on a **single project** that spans over the 3 courses

- In course 1 emphasis on “How to observe a social system?”

- In course 2 emphasis on “How to model a social system?”

- In course 3 emphasis on “How to influence a social system?”

- **Basic lectures** at beginning of course(s) (namely course 1).
The format

• **Students work in groups** of 4

• **Admission** to the USE learning line **requires an application**, with a motivation letter. Students will be selected.

• **Groups are heterogenous**, groups define their project(s) and ambition(s)

• In year 2020/21 we start with a **cap of 36 students** (9 groups), 3 TAs (supervising 3 groups each)

• Students will analyse **real-life data**, will **develop models** and will **perform experiments**

• **Eindhoven centraal station** and/or Strijp-S will be flagged as “experimental” to facilitate students experiments
The format

At the end of the course(s):

• Students **present a poster** (weight 15%)

• Students deliver **a group report** (weight 60%)

• Students **peer-grade** their work in groups (weight 10%)

• Students **give a presentation** to the Stakeholder(s) and lecturer(s) (weight 15%)
Education and research hand in hand

d\Pi[\gamma] = \rho[\gamma] D\gamma = \frac{1}{M} e^{-S[\gamma]} D\gamma

S[\gamma] = \frac{1}{\bar{\gamma}'} \int dt (\dot{\bar{\gamma}} + \bar{\gamma})
In the future

• Connection with multidisciplinary research

• Evaluation of the first year(s)...

• Involve more lecturers (open platform): cover different disciplines

• Introduce more topics (at least one academic leader and one stakeholder), e.g.:

  • *Spreading of diseases*
  
  • *Spreading of opinions*
  
  • *Econophysics*
  
  • …