Teaching performance analysis:

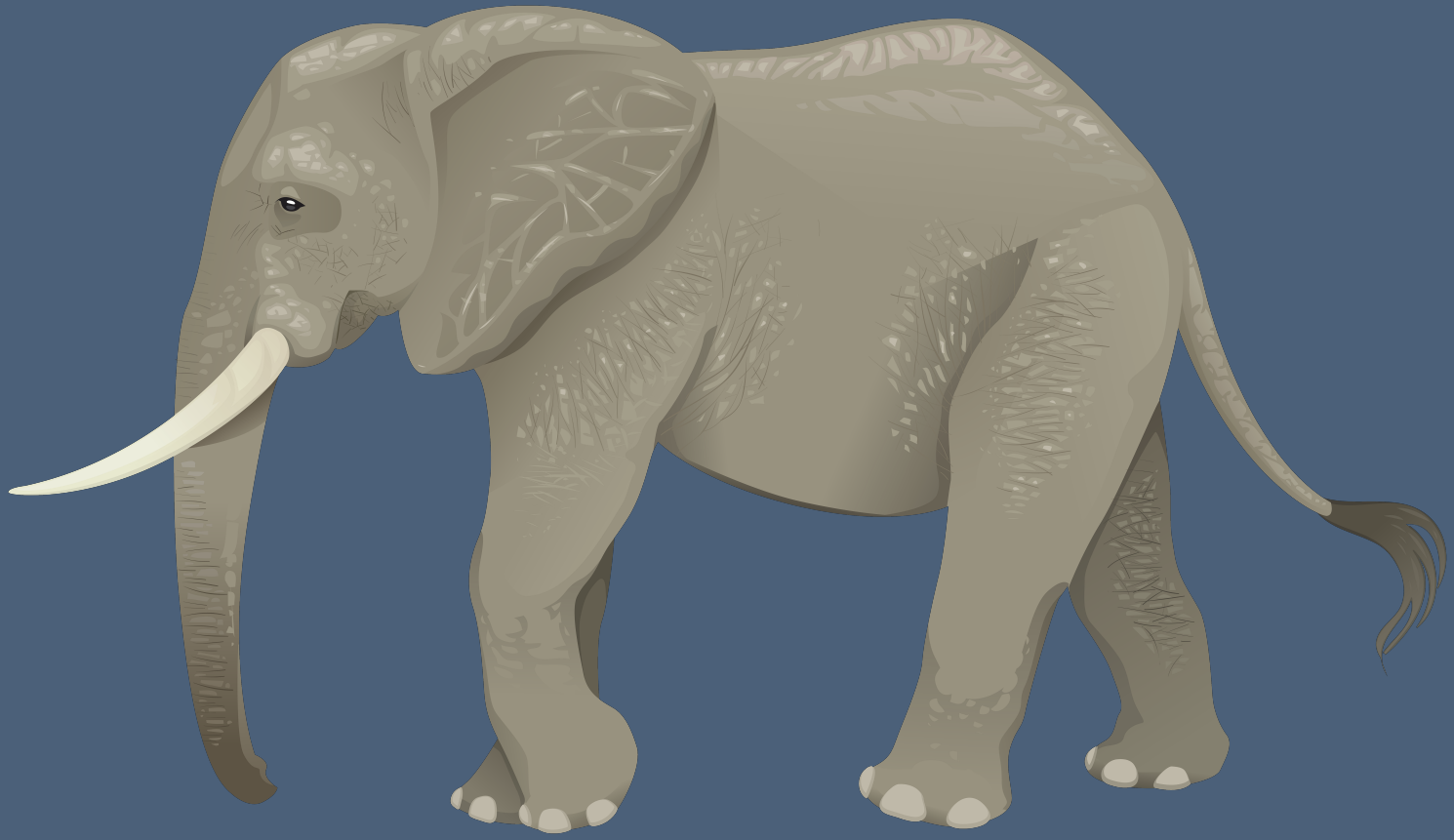
essential skills and learning outcomes

Dieter Fiems, 14 June 2024

Context

- History of performance evaluation courses
- Connections with research and personal preferences
- Programme committee politics
- Student interest
- Student preparation

The proverbial elephant



PE courses at UGent

1999

- Queueing theory A (3)
  - BD queues
  - Method of stages
  - Jackson/Newell networks
  - Little's result
- Queueing theory B (3)
  - discrete-time queues
  - Mostly papers
  - Transform approach
- Simulation (3)
  - Random variates
  - Monte Carlo
  - Variance reduction
  - Markov chains
  - DES

Additional theory courses: estimation and decision, stochastic processes

PE courses at UGent

2010

- Performance analysis (6)
  - BD queues
  - Method of stages
  - Jackson/Newell networks
  - Little's result
  - discrete-time queues
  - Mostly papers
  - Transform approach
- Queueing theory and simulation (6)
  - BD queues
  - QBDs
  - M/G/1
  - Jackson/Newell networks
  - Random variates
  - Monte Carlo
  - Variance reduction
  - Markov chain simulation/DES
- Simulation (6)
  - Random variates
  - Monte Carlo
  - Variance reduction
  - Markov chains
  - DES
  - Flexsim

PE courses at UGent

Now

- Simulation course: more theory, less focus on “Flexsim”
- Partial merger of PE and QaS
  - Joint part on classic QT
  - Separate parts: QT B and simulation
- Additional game theory course
- Additional traffic flow modelling course

PE Course design

What do we want to achieve

- System dynamics depend on the statistical properties of arrivals, services, etc
- Characterise performance in terms of these properties
- Critically assess performance studies

- Minimalist approach

Constraints

- Prior probabilistic background
- Prior knowledge of the application domain
- Time
- Interest

Observation

Probability is hard, solving systems of equation is easy

Observation

Interesting problems are hard to solve

Observation

Analysis and simulation do not mix well

Observation

Performance evaluation encompasses a passive look at systems

Observation

"Performance of Fun System" course
cannot compete with "Fun System" Course

Wish list

- BD queues
- Little
- Transforms
- M/G/1
- Priority/PS/GPS
- Queueing Networks
- QBD
- Fluid limits
- Diffusion limits
- Heavy/light traffic
- Mean field limits
- Markov decision processes
- Queueing games
- Random variates
- Monte Carlo
- Variance reduction
- Confidence intervals
- Markov chains
- DES

Wish list

- **BD queues**
- **Little**
- **Transforms**
- ~~M/G/1~~
- Priority/PS/DPS/GPS
- **Queueing Networks**
- **QBD**

- **Fluid limits**
- Diffusion limits
- **Heavy/light traffic**
- Mean field limits
- Markov decision processes
- ~~Queueing games~~

- Random variates
- Monte Carlo
- Variance reduction
- Confidence intervals
- Markov chains
- DES

Simplifications

- Focus on continuous time Markov chains only
- QBDs offer the versatility to investigate distributional effects
- Transforms simplify calculation and enable limit results
- Rigour is dropped in favour of more limit results
- Simulation is clearly separated from queueing, but a “black box” simulator can be used

“Il semble que la perfection soit atteinte non quand il n’y a plus rien à ajouter, mais quand il n’y a plus rien à retrancher.”

Antoine de Saint-Exupéry (Terre des hommes)

Beyond Computer Science

Thank you

Contact: dieter.Fiems@UGent.be