Why Should I Teach Performance Evaluation to Students in Networking?

Michela Meo
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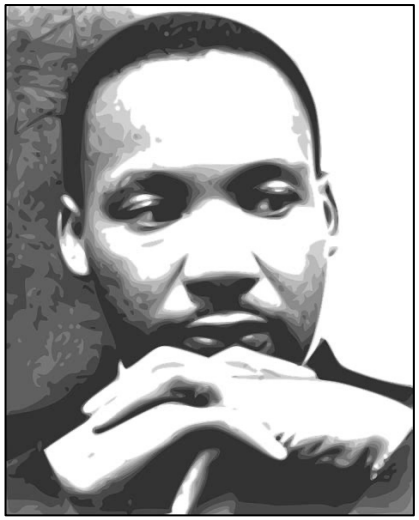
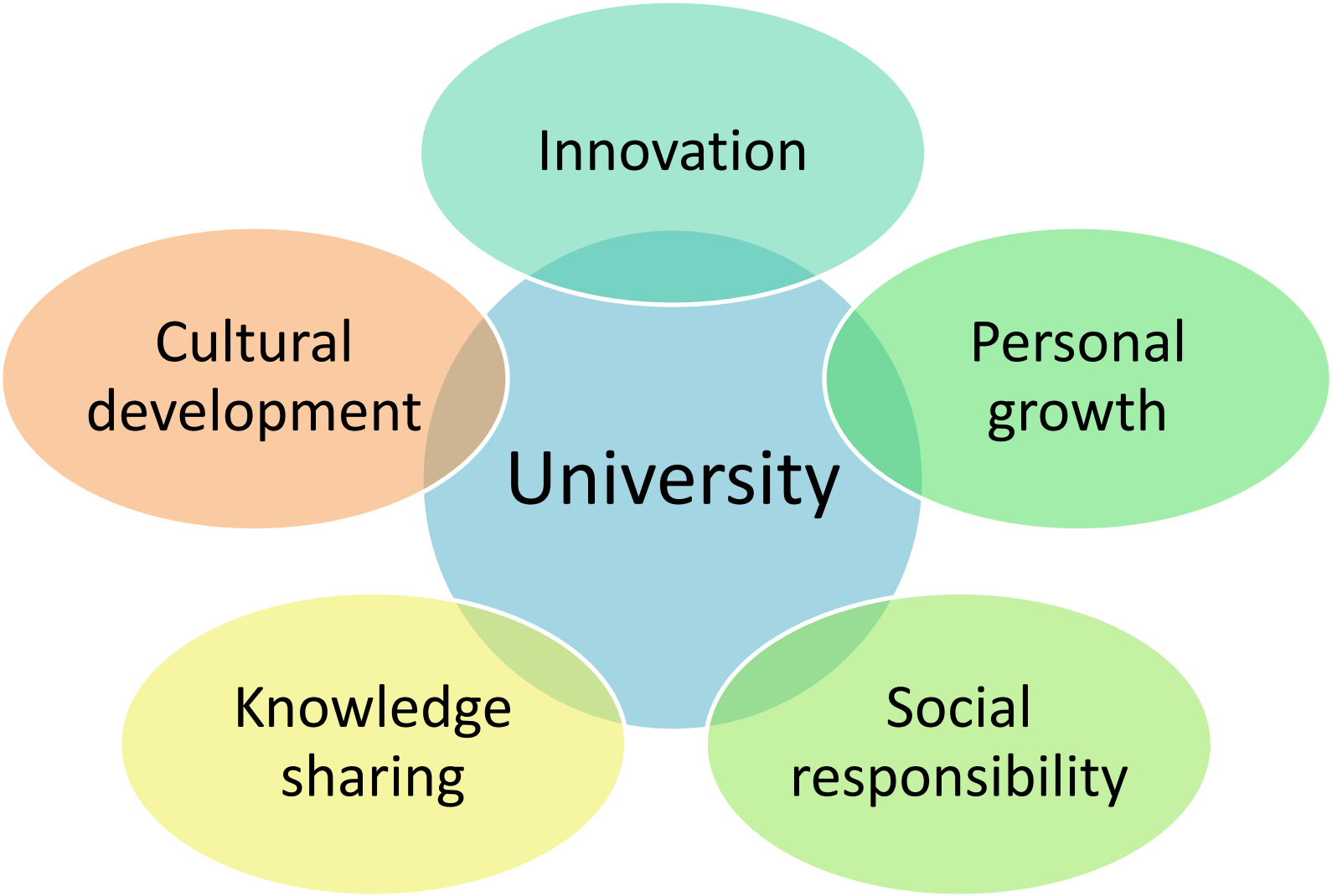
"The function of education is to teach one to think intensively and to think critically. "
Martin Luther King



Source: "The Purpose of Education”, https://kinginstitute.stanford.edu/king-papers/documents/purpose-education


Innovation
Cultural development
University
Personal growth
Knowledge sharing
Social responsibility


SUSTAINABLE DEVELOPMENT GOALS
1 NO POVERTY
2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
5 GENDER EQUALITY
6 CLEAN WATER AND SANITATION
7 AFFORDABLE AND CLEAN ENERGY
8 DECENT WORK AND ECONOMIC GROWTH
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE
10 REDUCED INEQUALITIES
11 SUSTAINABLE CITIES AND COMMUNITIES
12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
14 LIFE BELOW WATER
15 LIFE ON LAND
16 PEACE, JUSTICE AND STRONG INSTITUTIONS
17 PARTNERSHIPS FOR THE GOALS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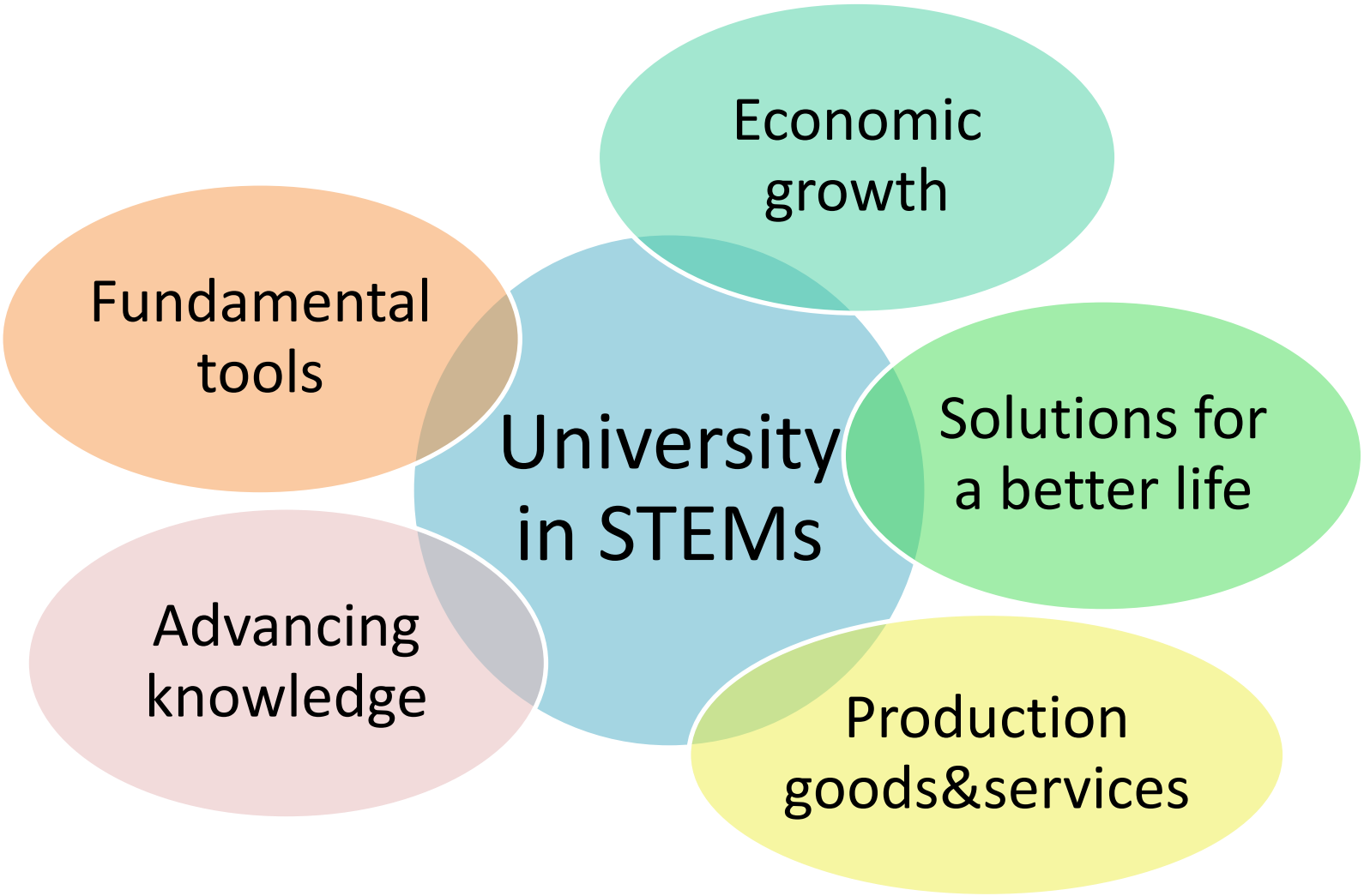
Economic growth
Fundamental tools
University in STEMs
Solutions for a better life
Advancing knowledge
Production goods&services


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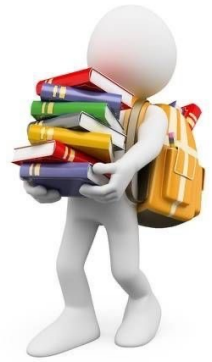
Objectives of education in STEM



Knowledge

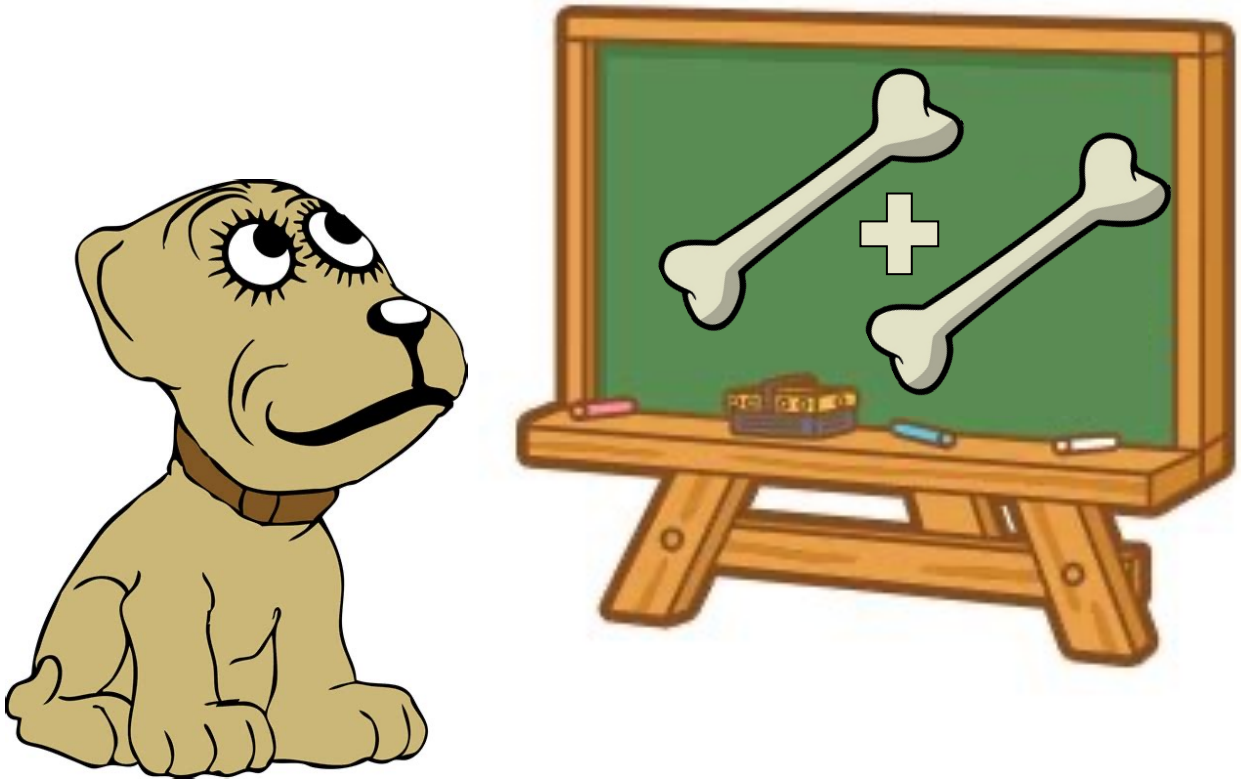
- Fundamental concepts in science
- Fundamental mathematical principles
- Grasping impact of technologies
- Holistic views

Skills

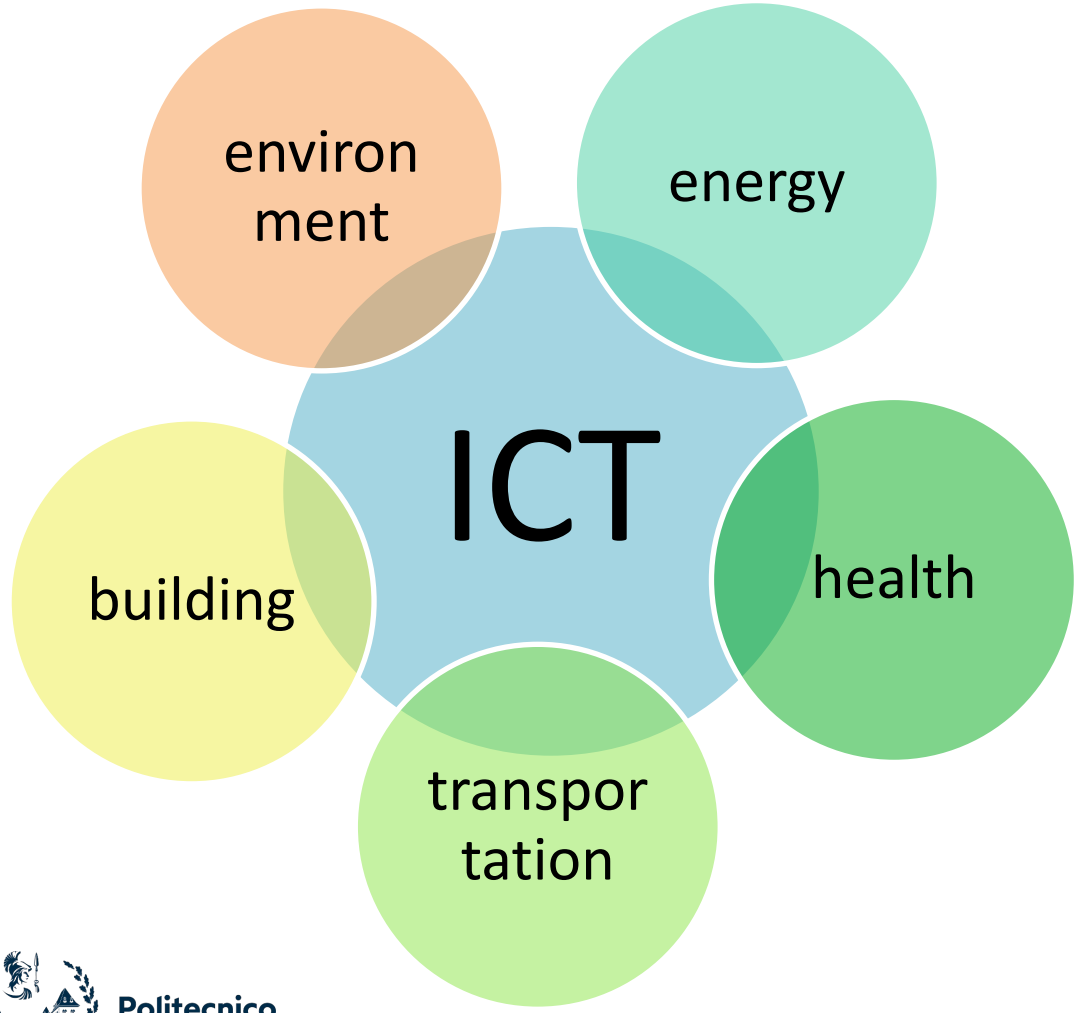
- Scientific method: hypothesis, experiments, data, …
- Critical thinking
- Creative thinking
- Using tools

What do students want?

About my experience



MSc: ICT for Smart Societies

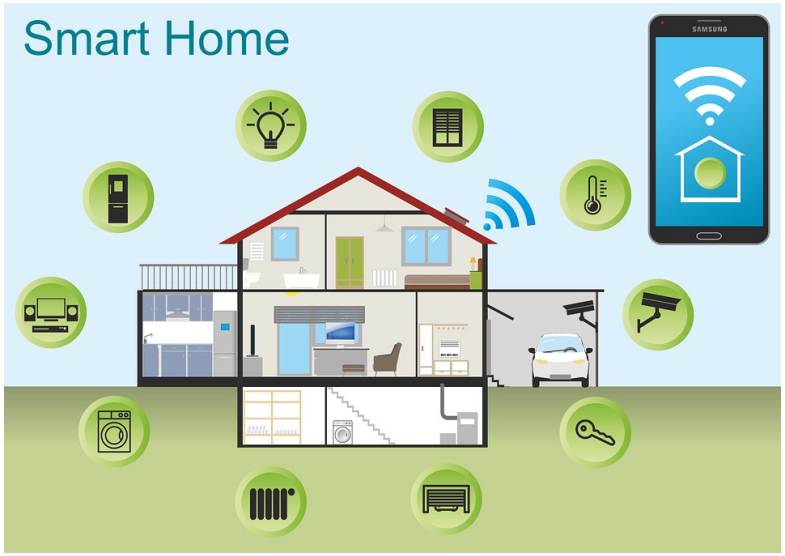


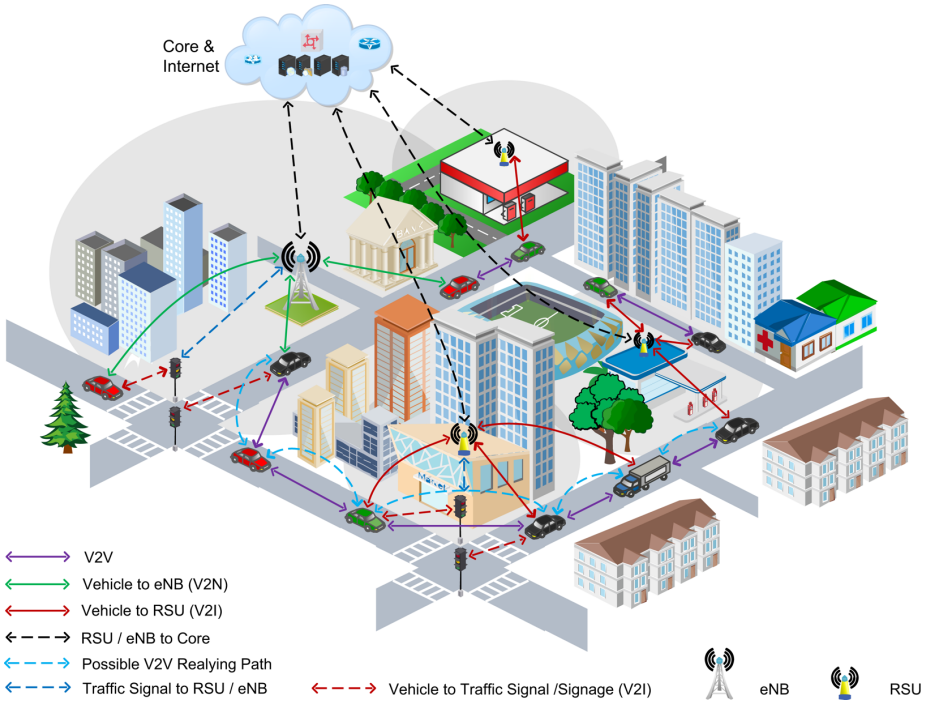
Interdisciplinary MSc

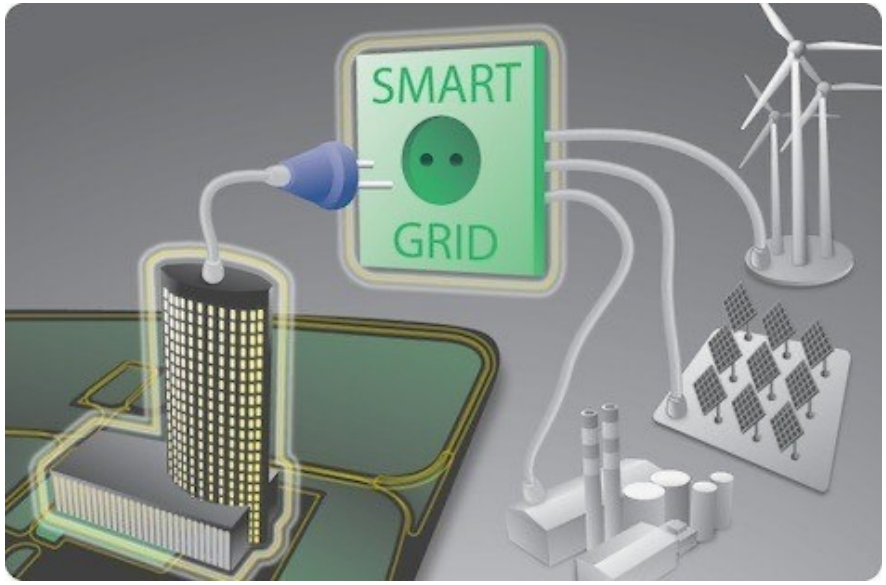
- ICT
  - ML & AI
  - Communications & networking
- Domain knowledge

make *** smarter

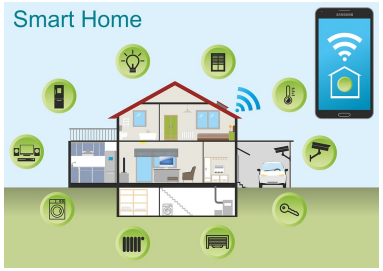
ICT for Smart Societies

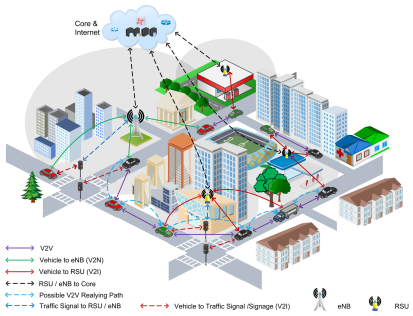


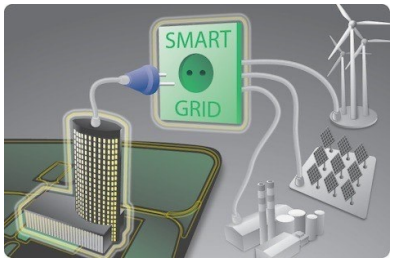




Smart environments → networking





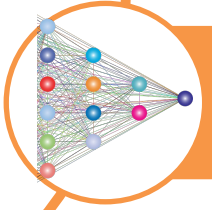


Collect & receive data

Transport

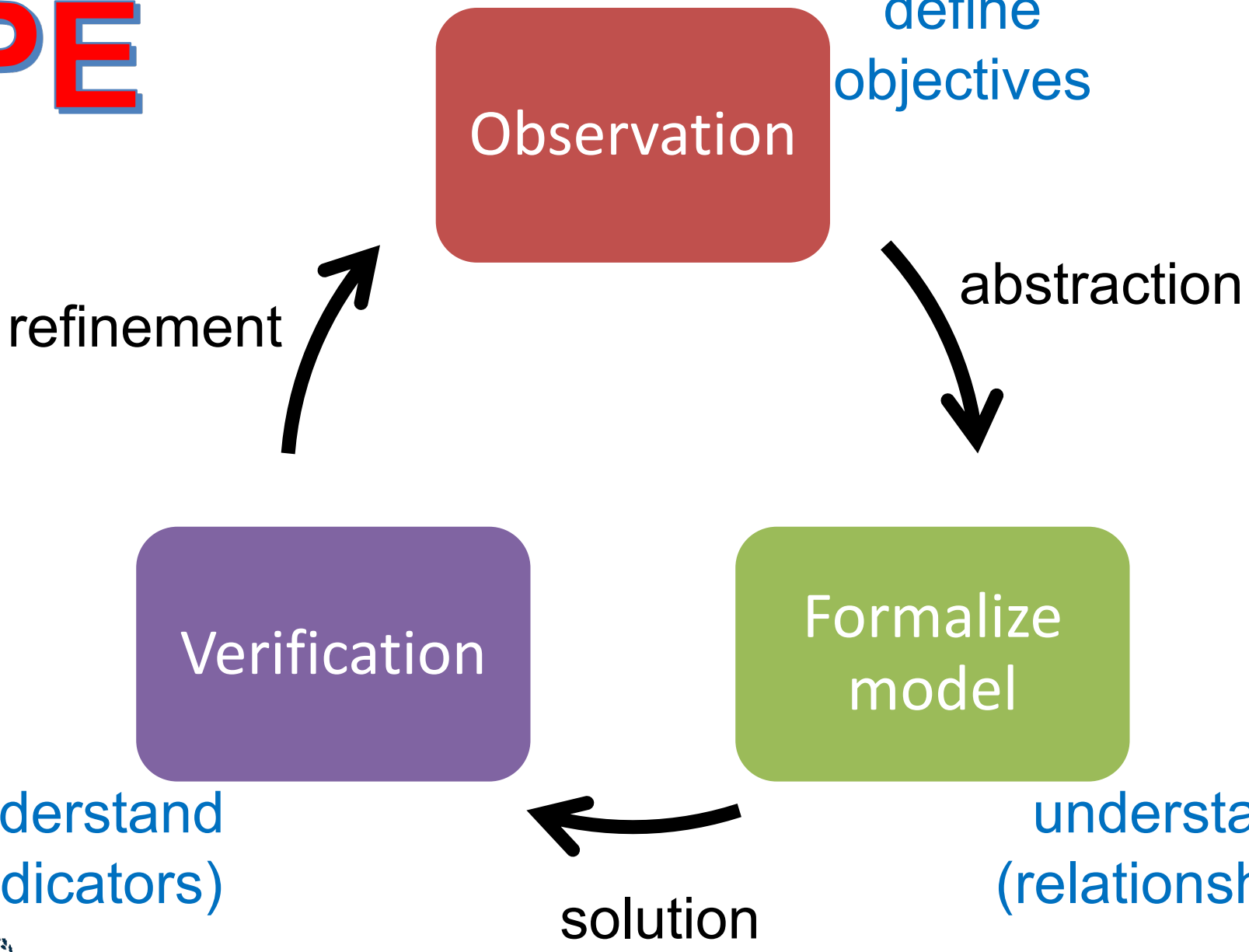
Store and elaborate

networking

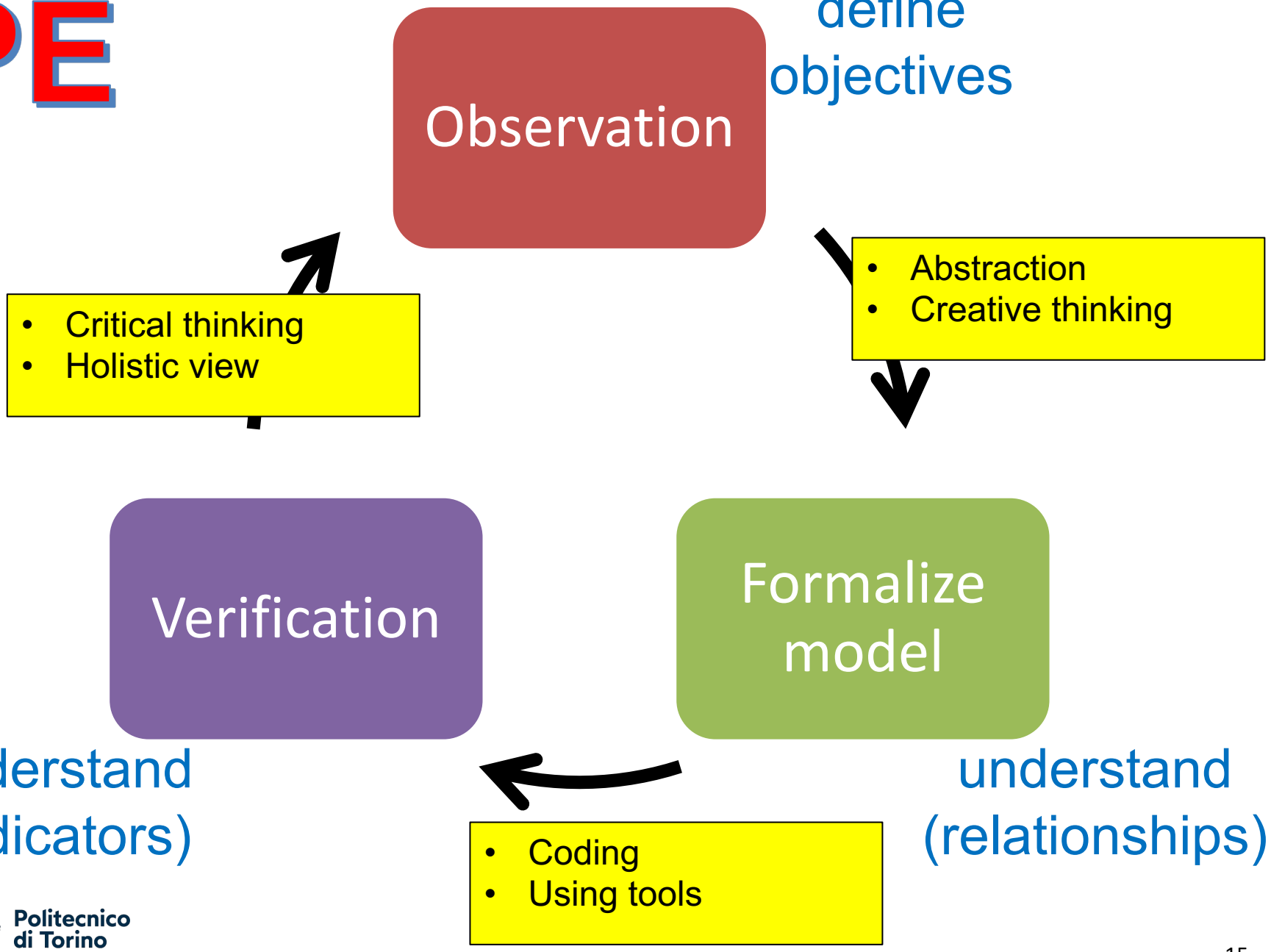


algorithms

PE


Observation
define objectives
abstraction
Formalize model
understand (relationships)
solution
Verification
understand (indicators)
refinement

PE



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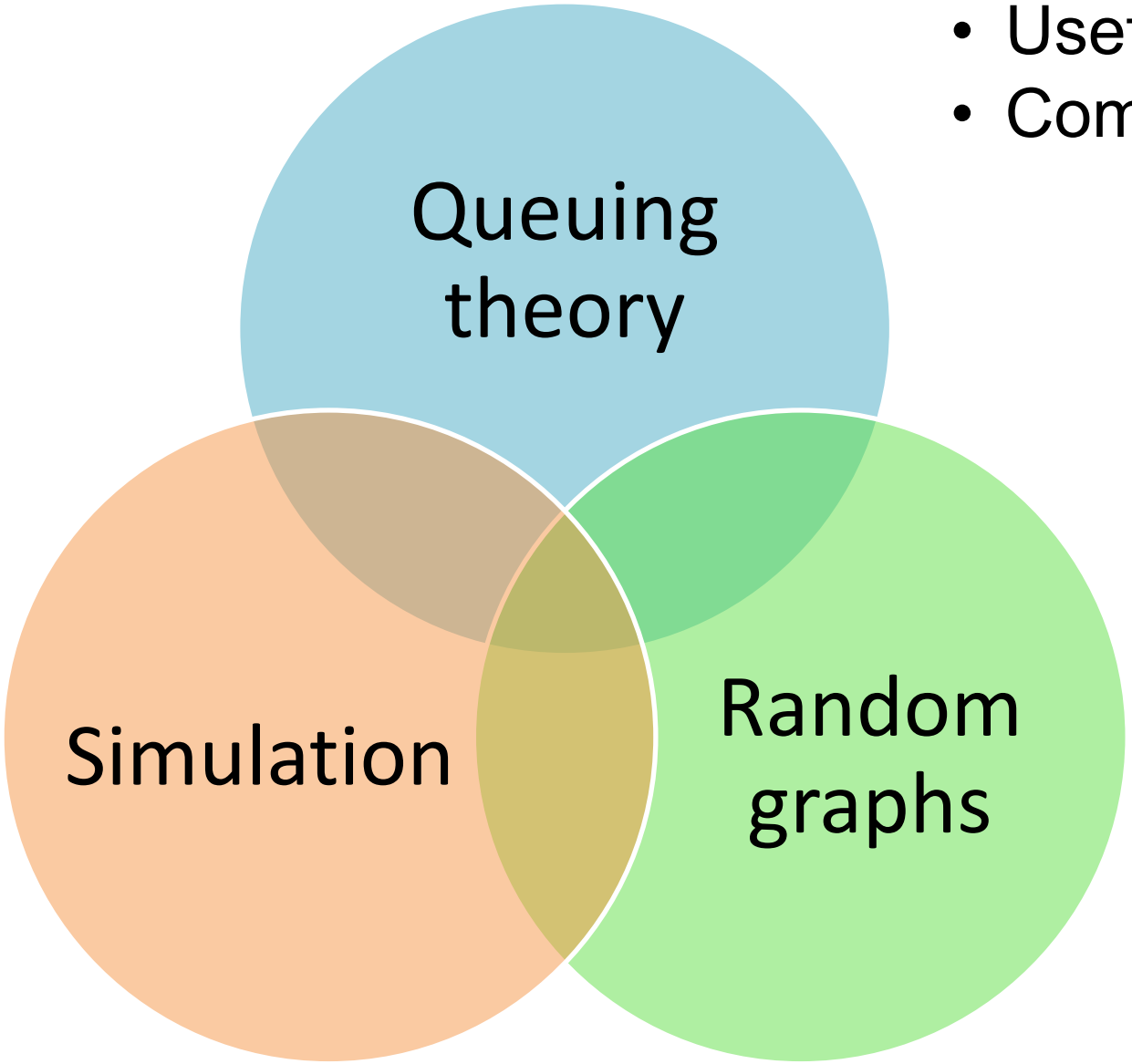
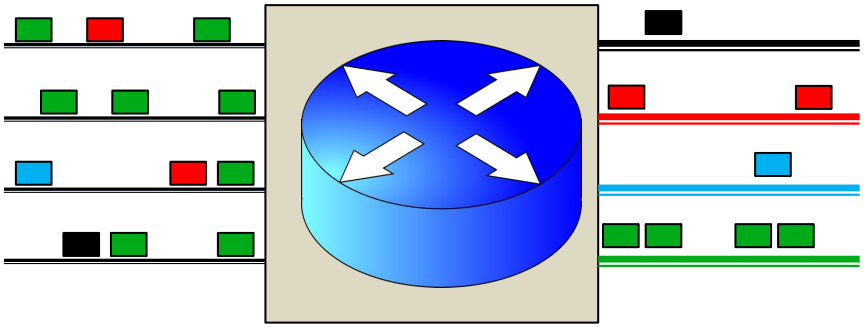
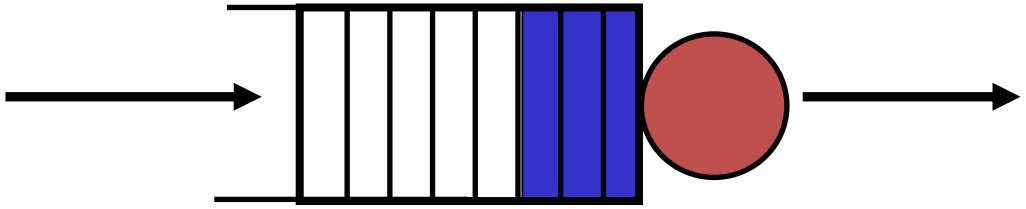
- Useful
- Complementary

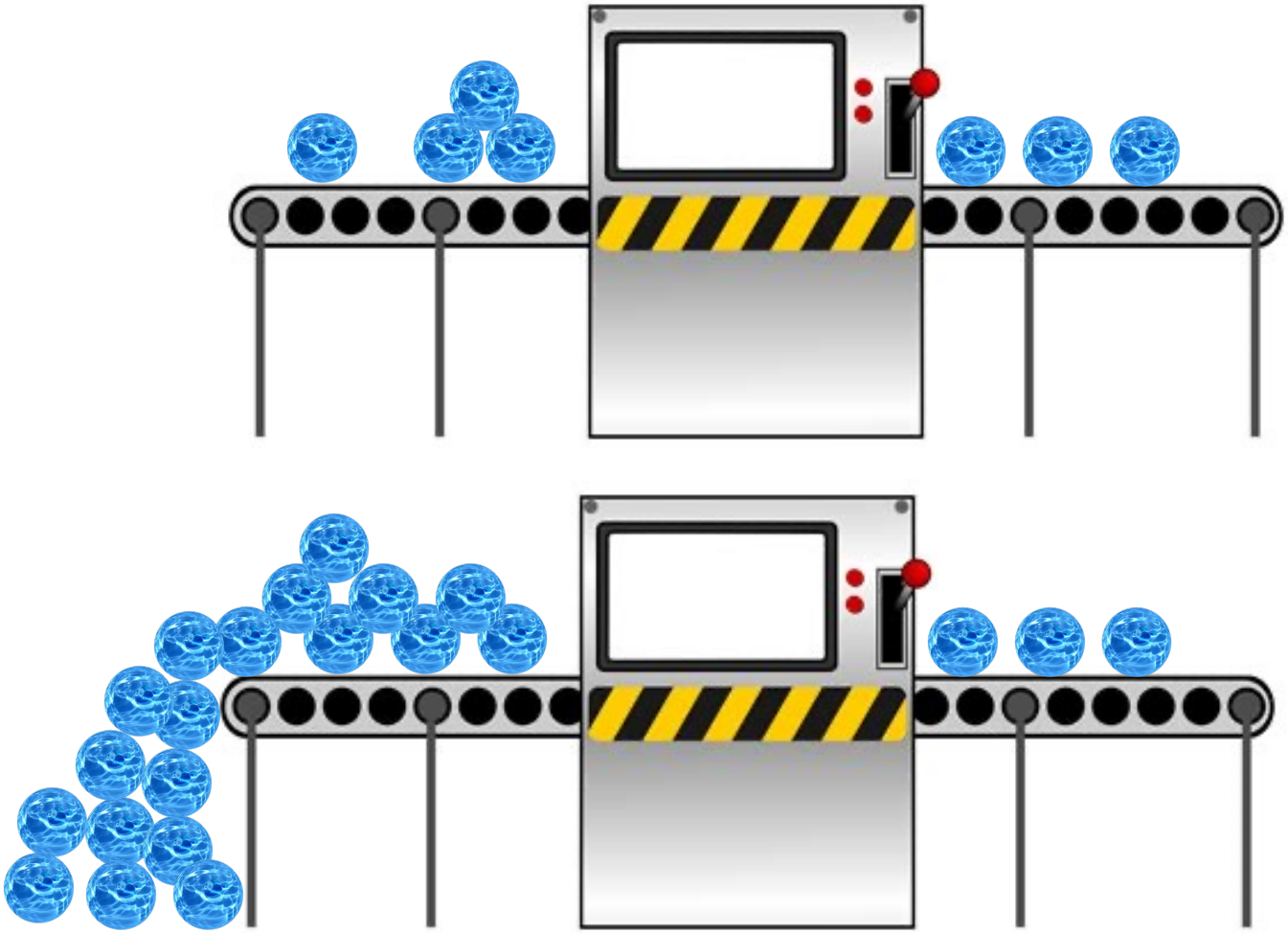


Queuing theory



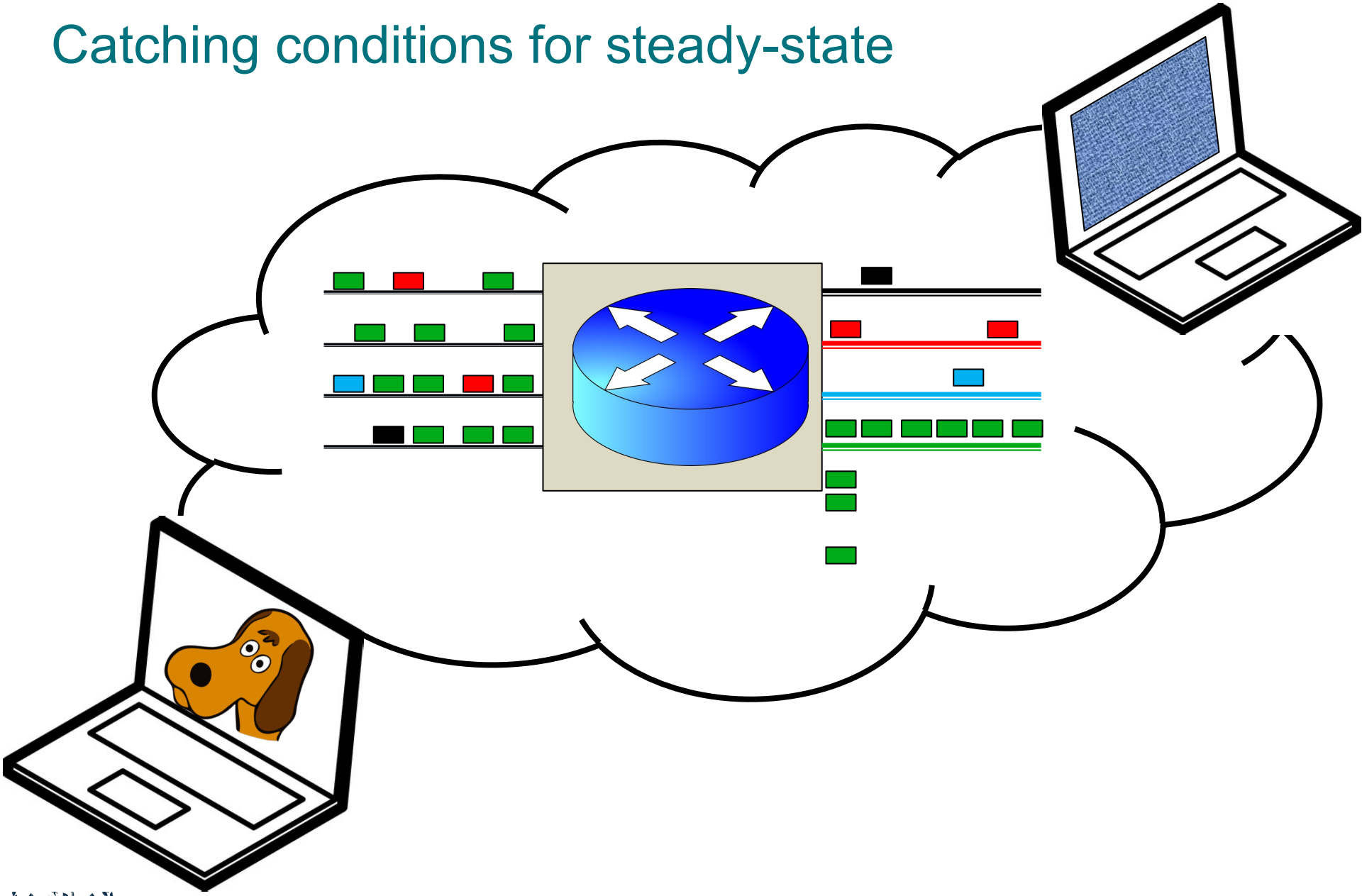


Catching conditions for steady-state

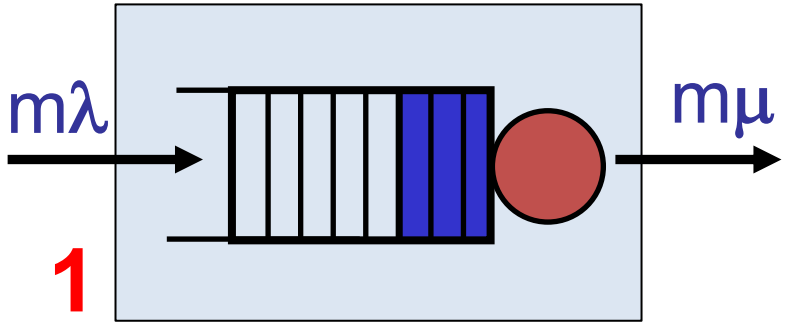


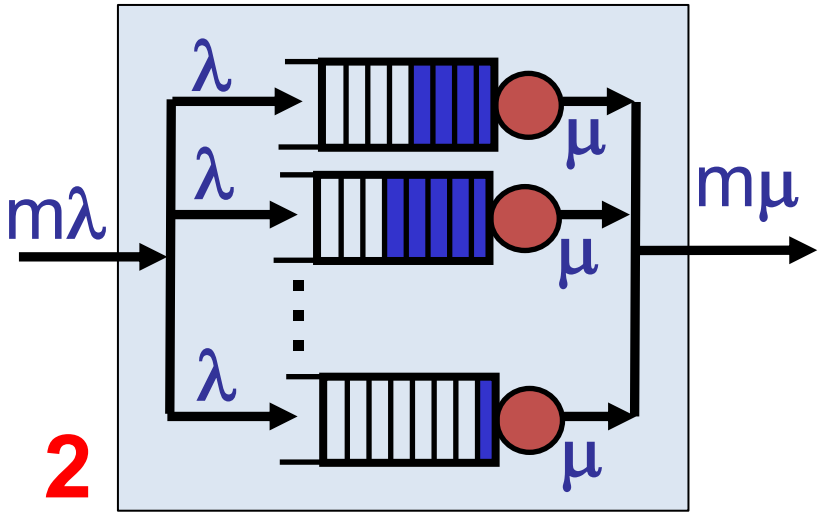
Catching conditions for steady-state

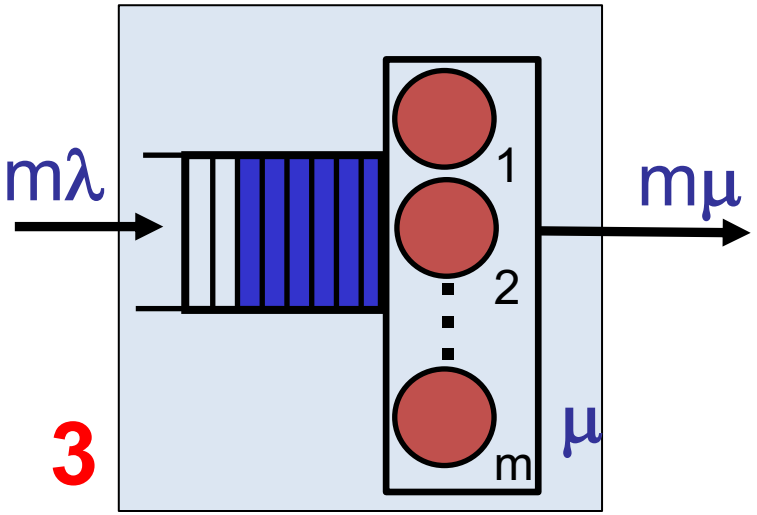
Catching conditions for steady-state



Some of the hints from queuing theory



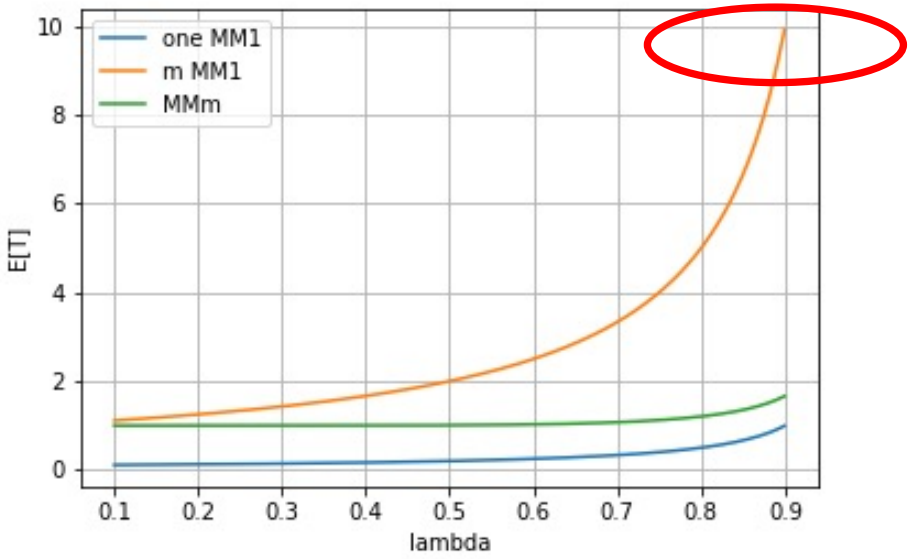




Comparison of the 3 systems

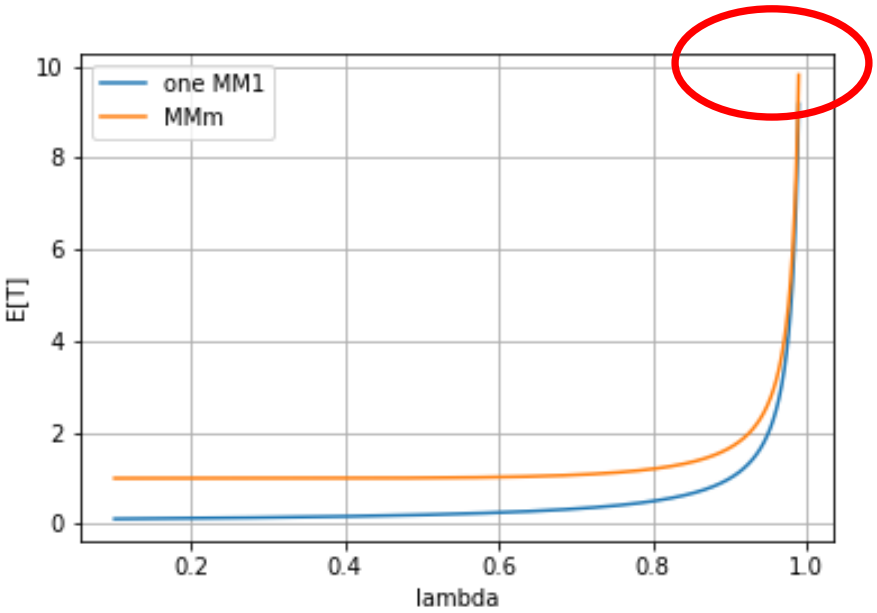
m=10, μ=1

system 2
is much worse



effect of service
time at low load

1 and 3 behave the
same at high load



Lessons learnt in networking

The M/G/1 queue

$$E[T] = E[S] + \rho E[S] \frac{(1 + C_S^2)}{2(1 - \rho)}$$

Pollaczek-Khintchin formula

- For the M/M/1 queue

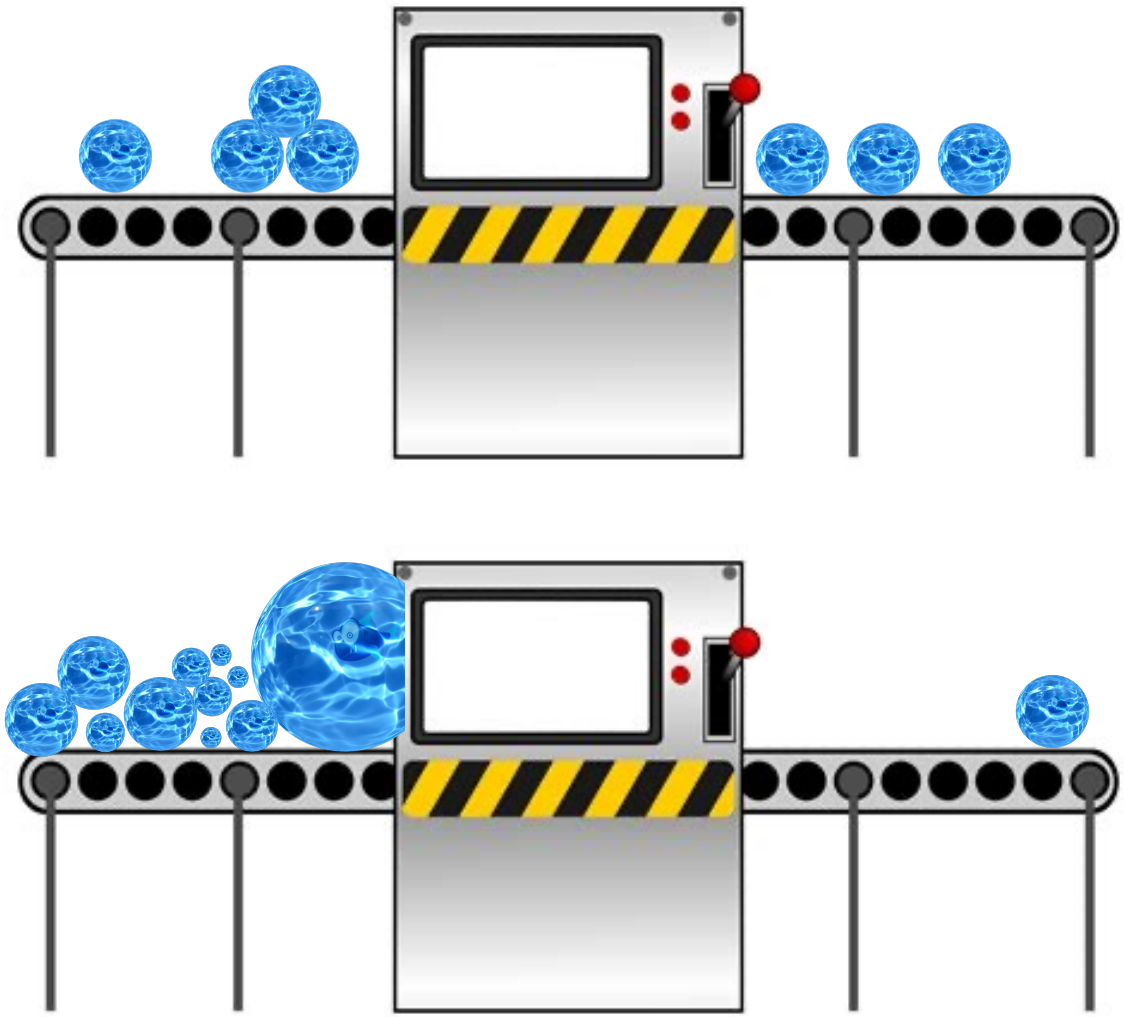
$$E[T^{(a)}] = \frac{1}{\mu} + \frac{\rho}{\mu} \frac{1}{1 - \rho}$$

service time

waiting time

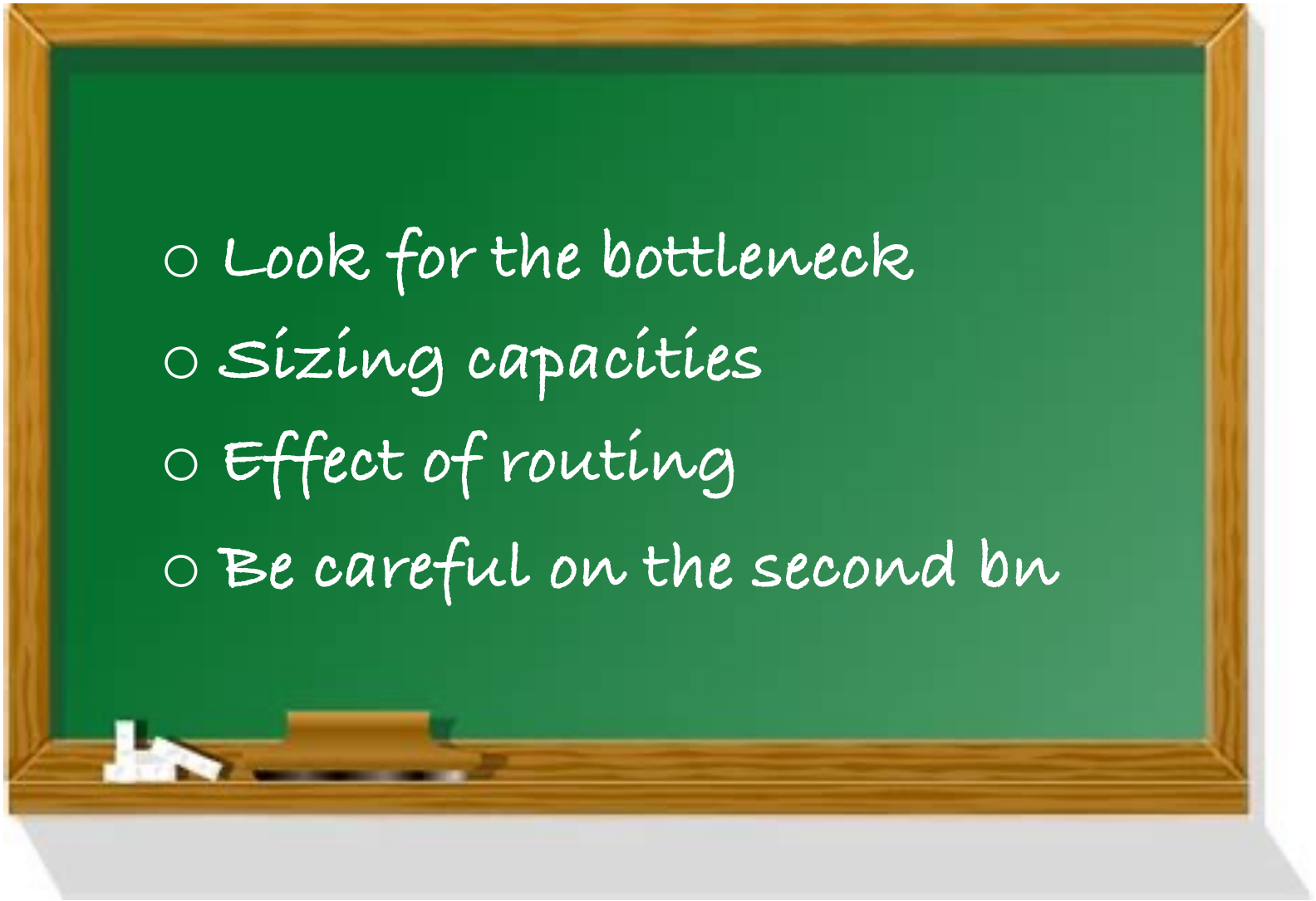
- For the M/D/1 queue

$$E[T^{(b)}] = \frac{1}{\mu} + \frac{\rho}{\mu} \frac{1}{2(1 - \rho)}$$



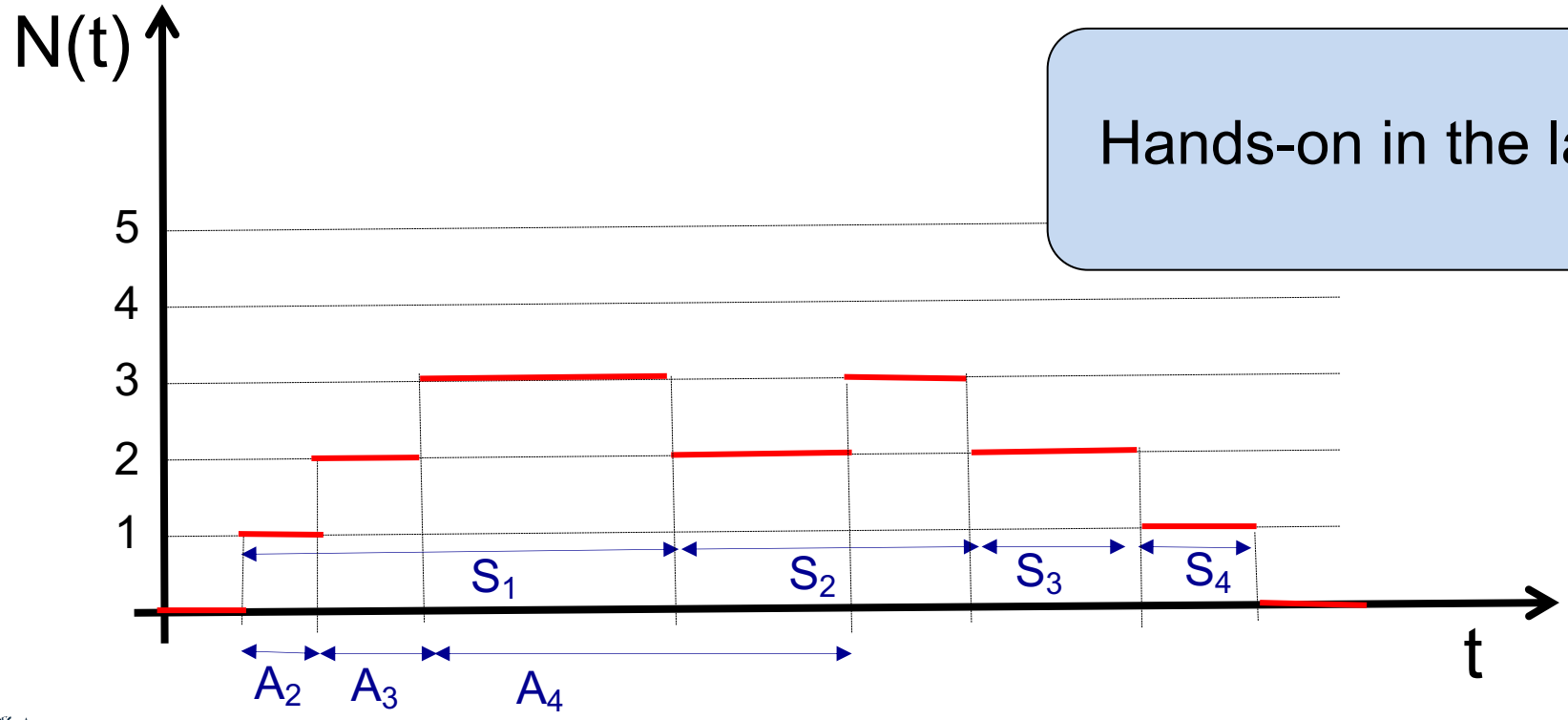
Lessons learnt in networking

Lessons learnt from queuing networks



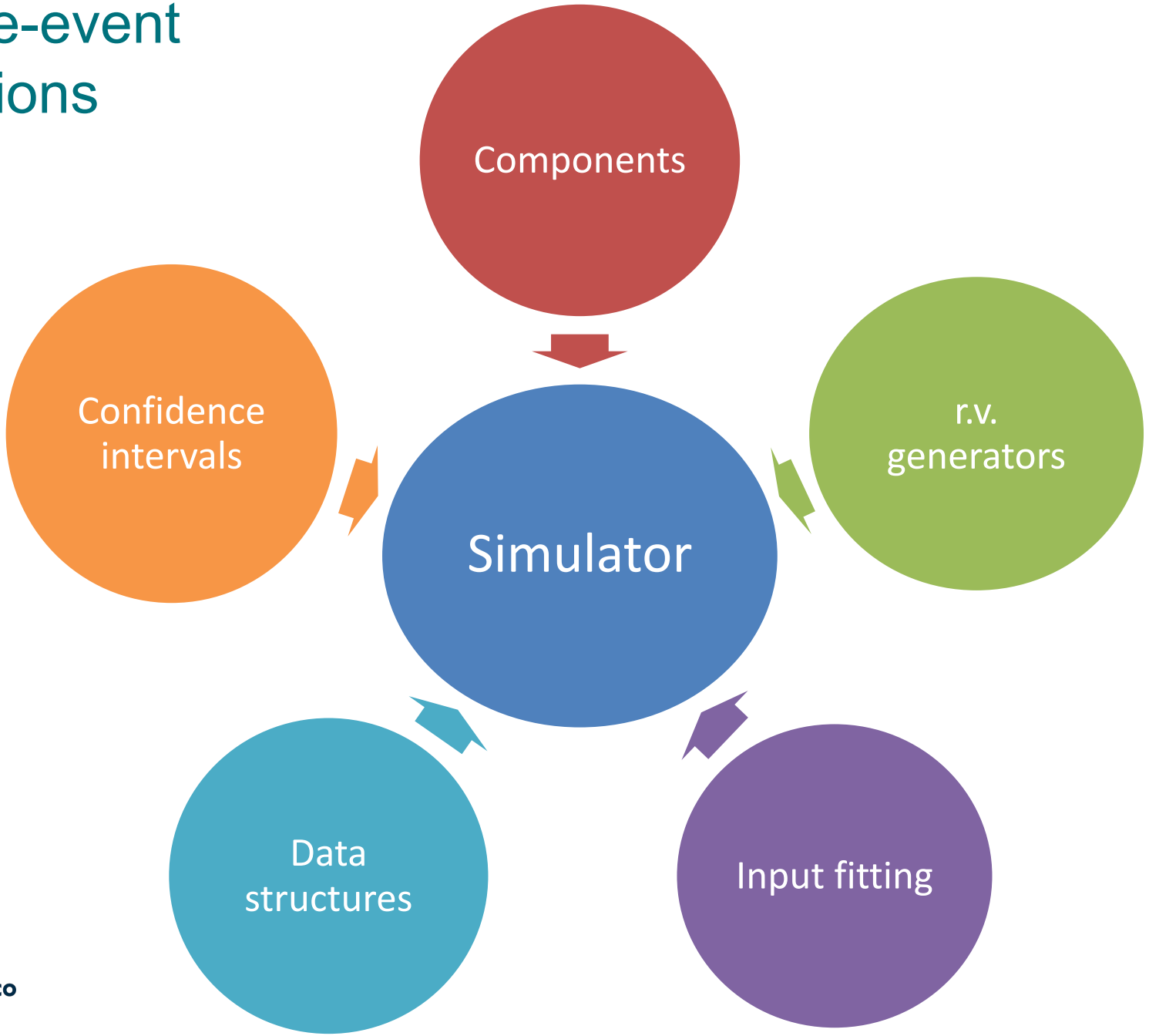
Discrete-event simulations

- Change perspective, **complementary approach**
- Stochastic processes → time evolution
- Stochastic characterization → observe statistics



Hands-on in the lab!

Discrete-event simulations



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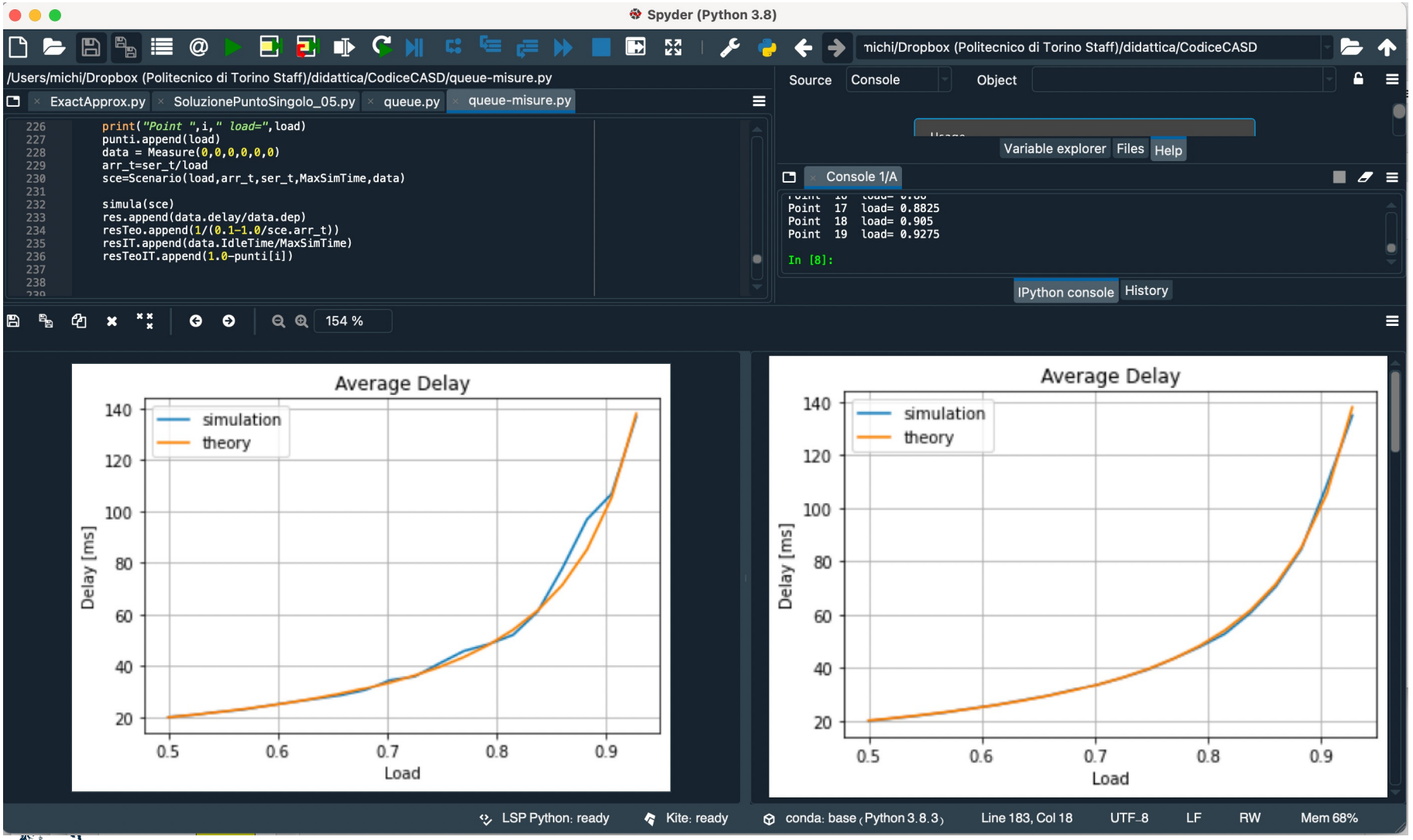
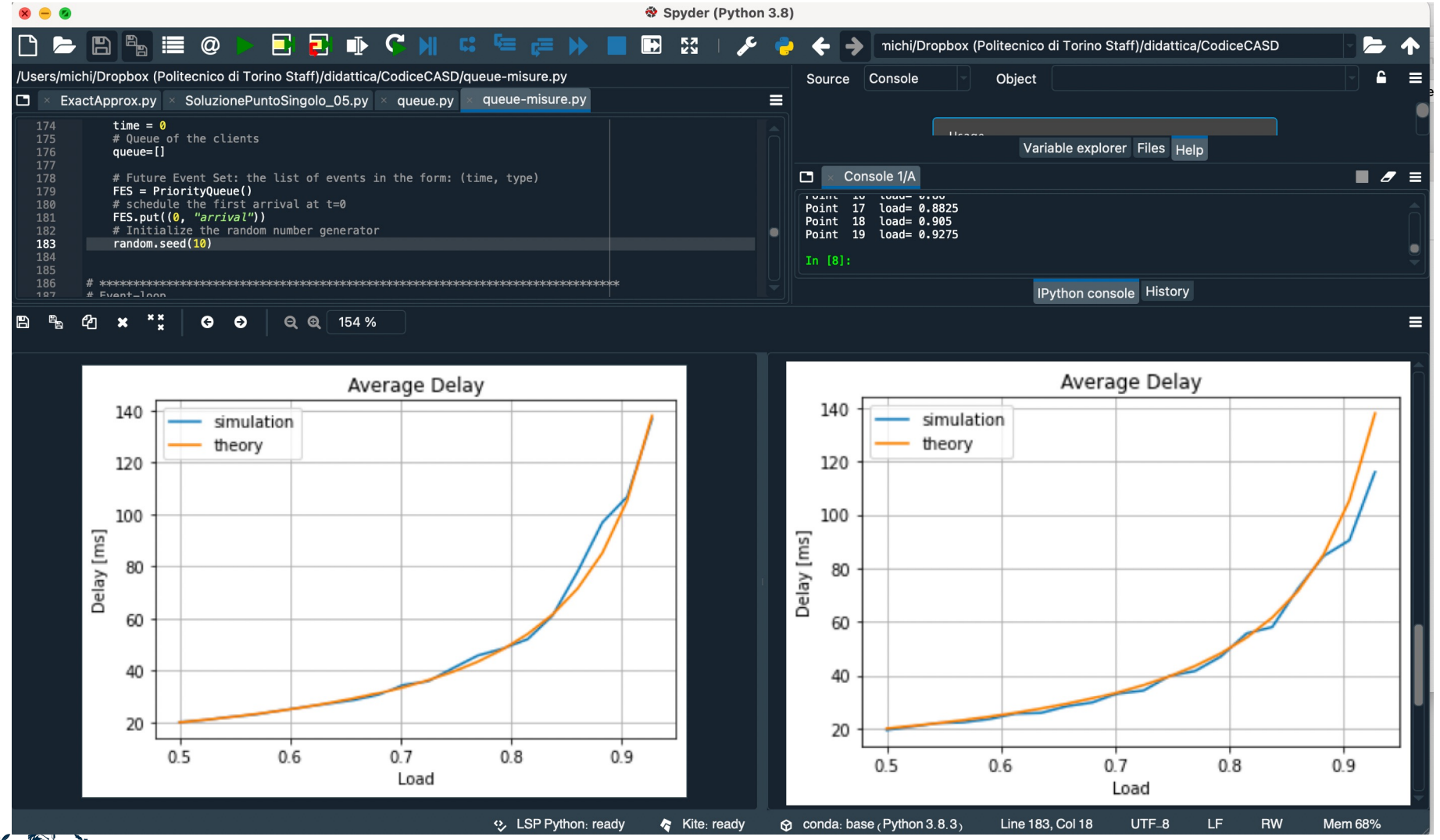
In the lab: Duration of simulation



In the lab: Sample paths (the seed)

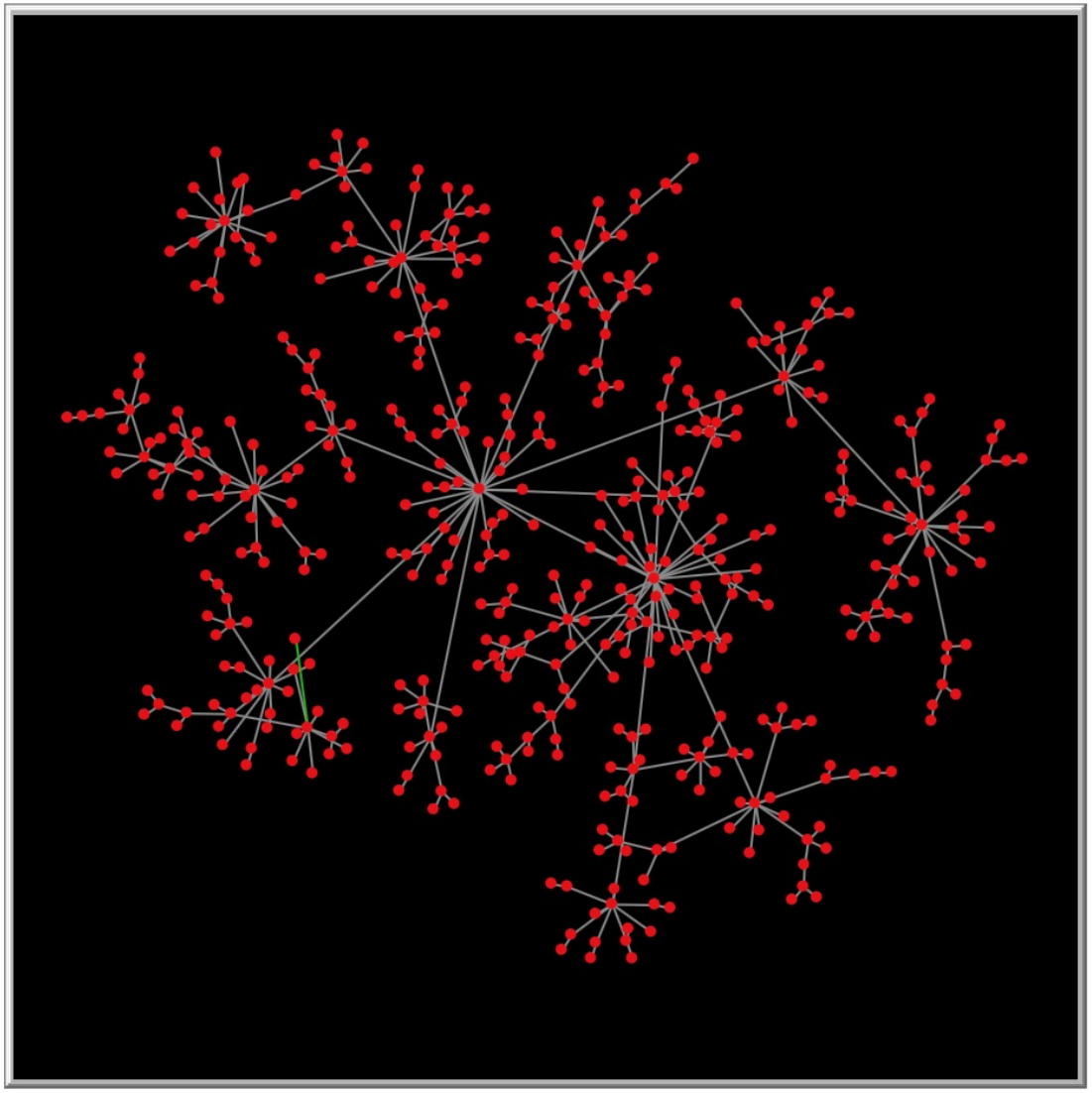


Lessons learnt on simulation vs analytical modeling

Random graph theory: complex systems

Change perspective

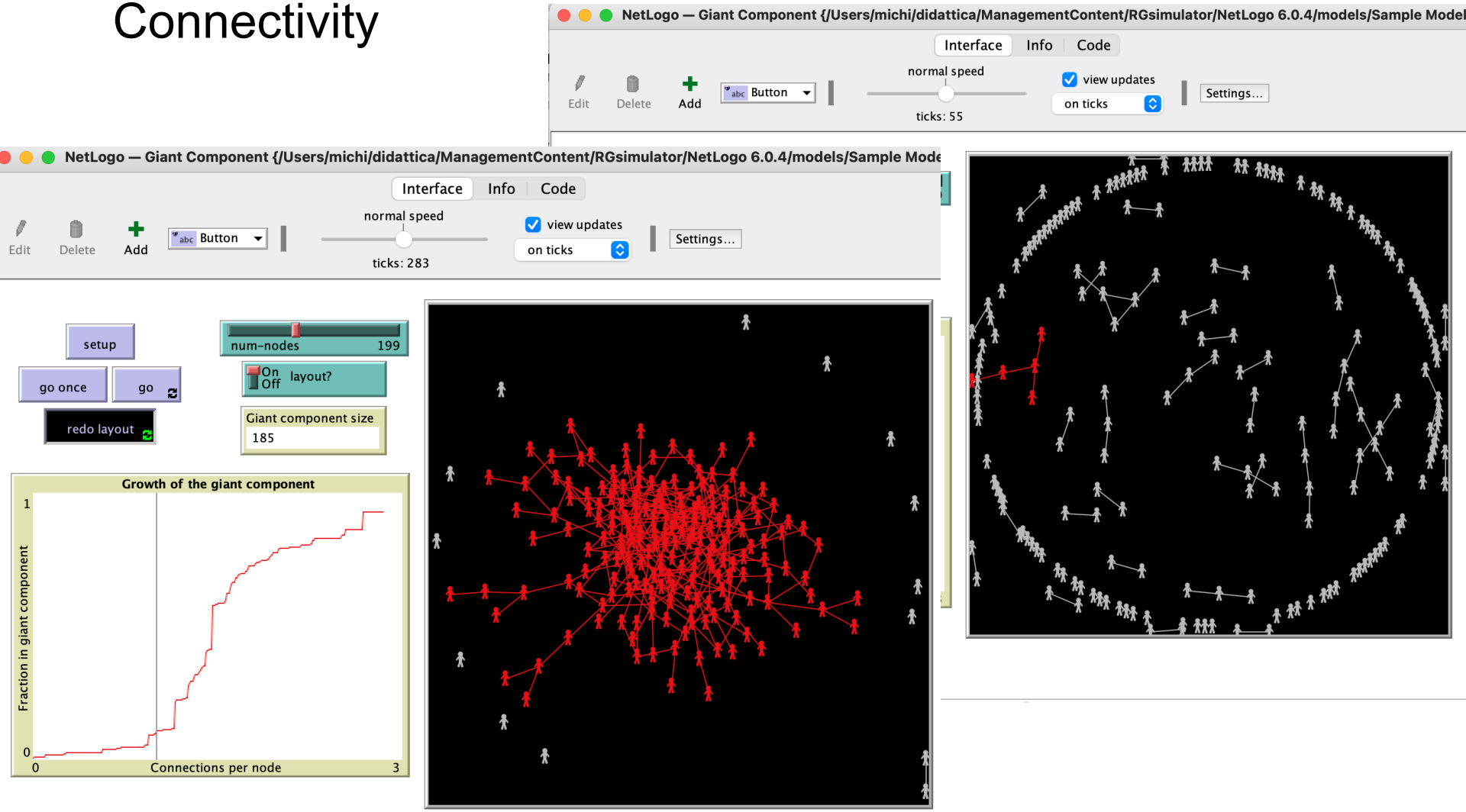
- Modeling
- Focus (interactions)
- Indicators



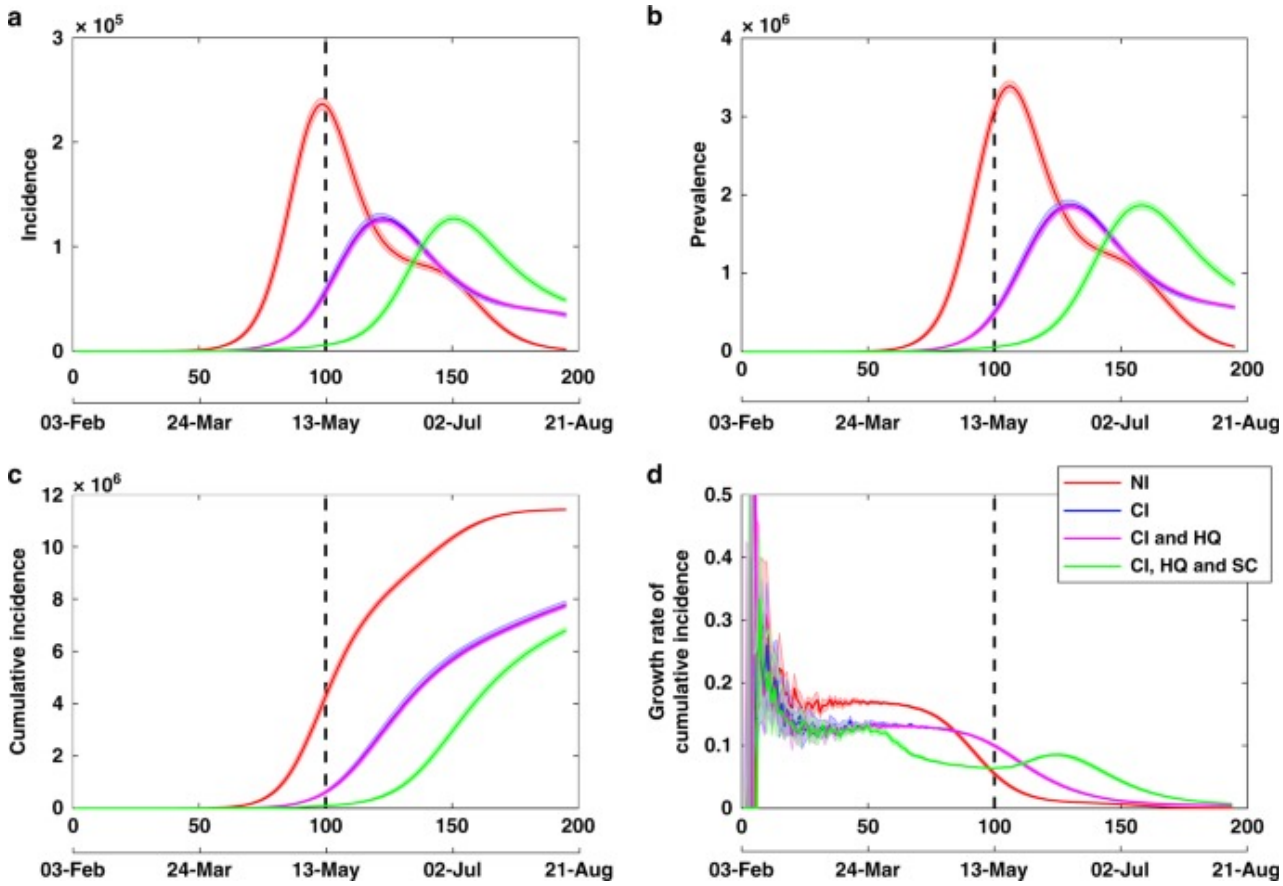
Random graph theory

Obtained with
netlogo simulator
https://ccl.northwestern.edu/netlogo/

Connectivity



Epidemic models

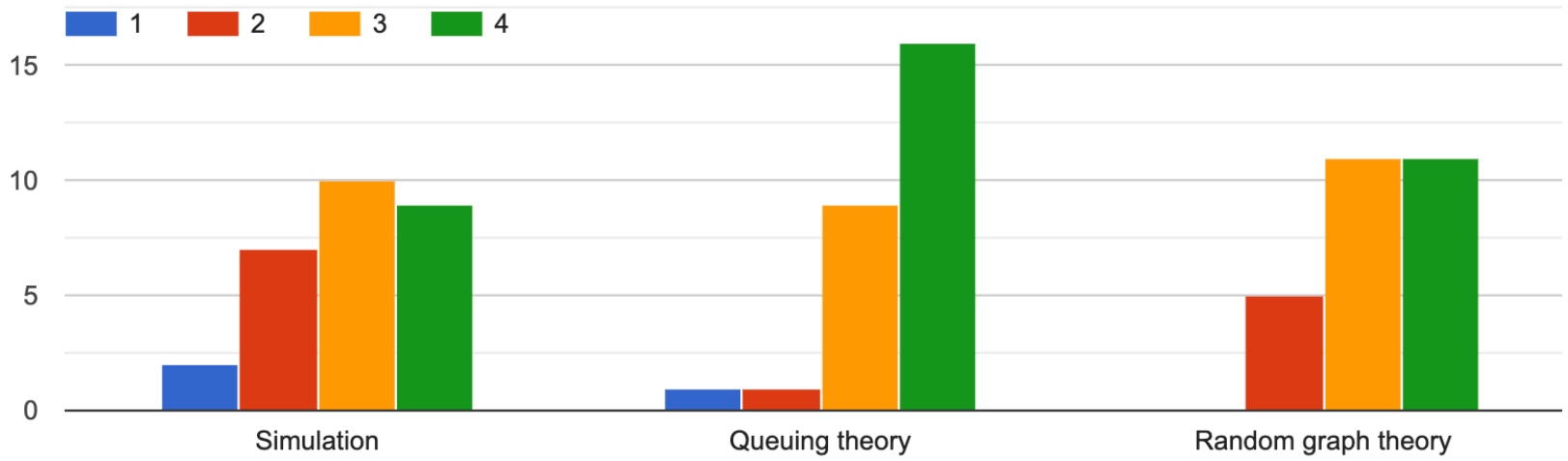


Source: S. Chang et al., "Modelling transmission and control of the COVID-19 pandemic in Australia", Nature Communications, Nov 2020

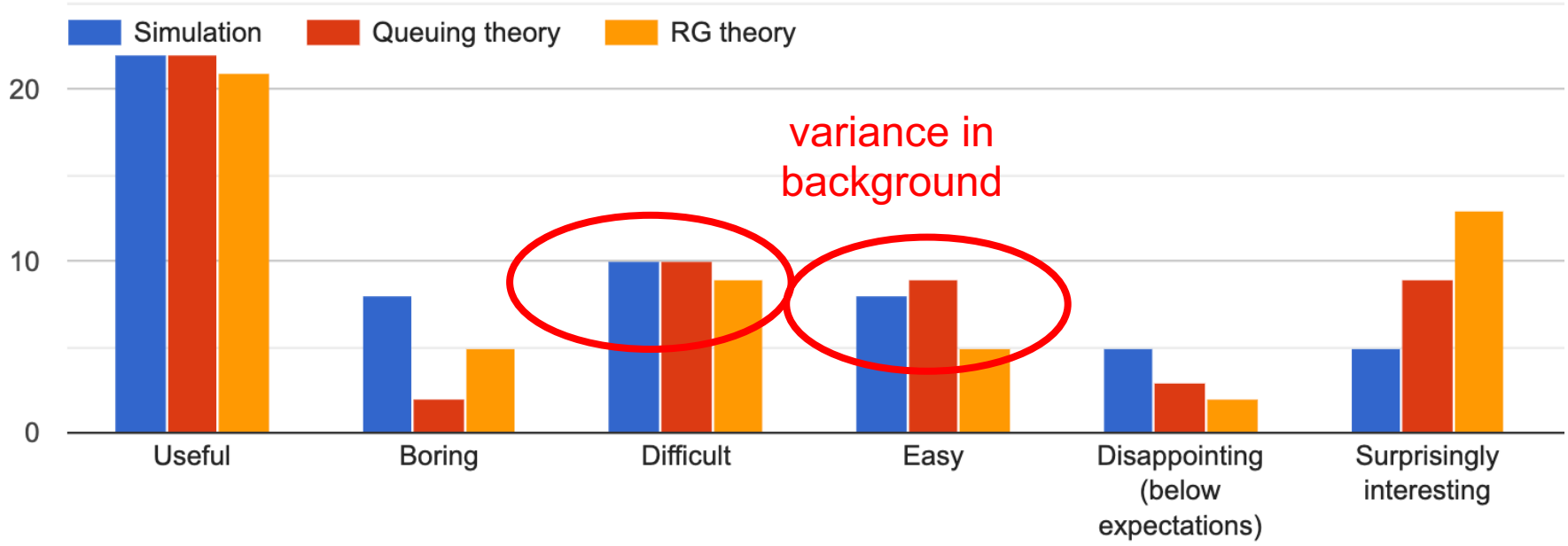
Asking to students

Asking to students

1. How much did you enjoy learning the following:
(1: not at all; 4: I enjoyed much)

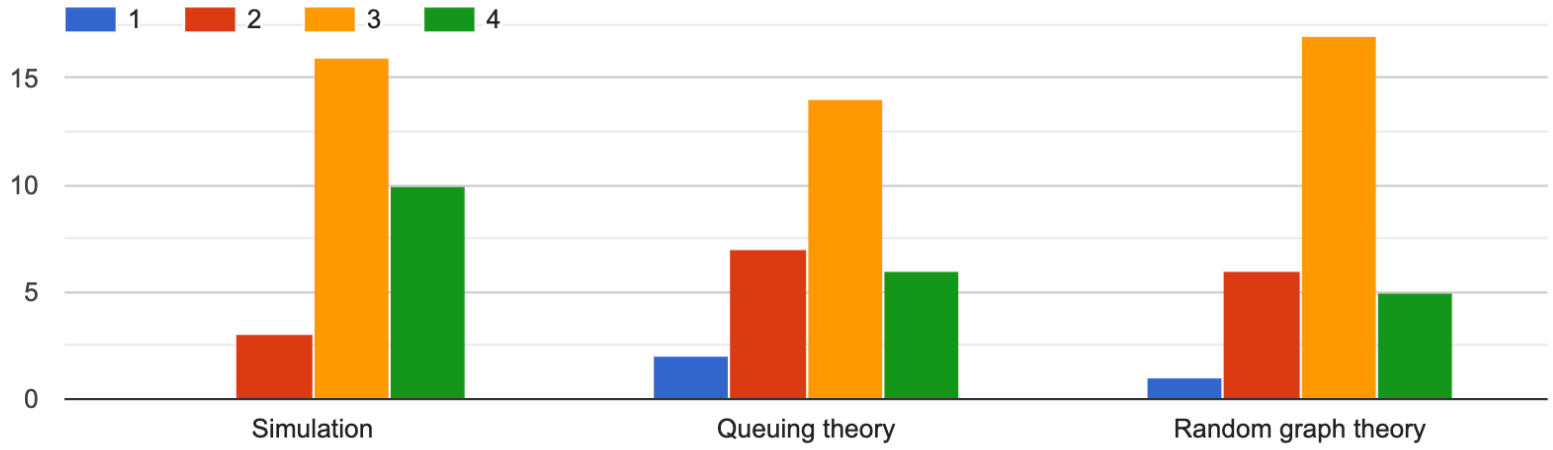


Asking to students



Asking to students

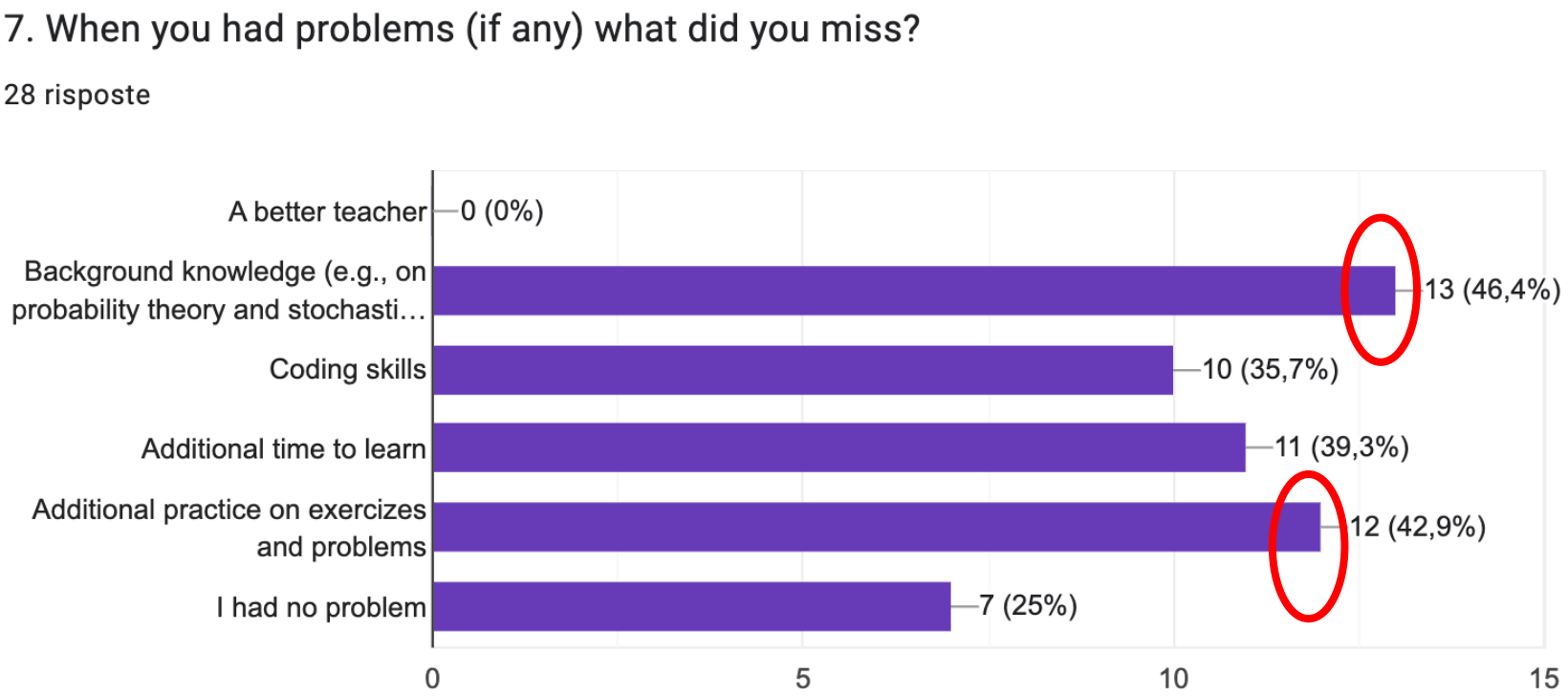
2. In your opinion, will these topics be useful in your future working life?
(1: useless; 4: very useful)



Students

- Appreciated also theoretical stuff
- Found it useful

Asking to students



- Learning needs time
- Background a potential issue

Wrap-up

- I enjoy teaching (performance evaluation)!

- Students are interested if it is
  - useful
  - creative
- Students like to practice
  - Problem solving
  - Hands on asap
- Warning about
  - Background knowledge (theory, math, probability)
  - Give them time to learn

Thanks!

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