RBS Riga Business School
Riga Technical University

The mathematics and computer science in BITL

Why is mathematics important in IT? What technical skills will I learn in BITL?
January 16, 2023

- 2009 - 2014: University of Waterloo, Canada
- 2014 - 2019: University of Illinois at Chicago, USA
- 2019 - 2020: University of Aberdeen, UK
- 2020 - : RTU Riga Business School, Latvia

What is IT?

Information technology:
- How to work with information
- How large amounts of information are created, stored, processed, analyzed
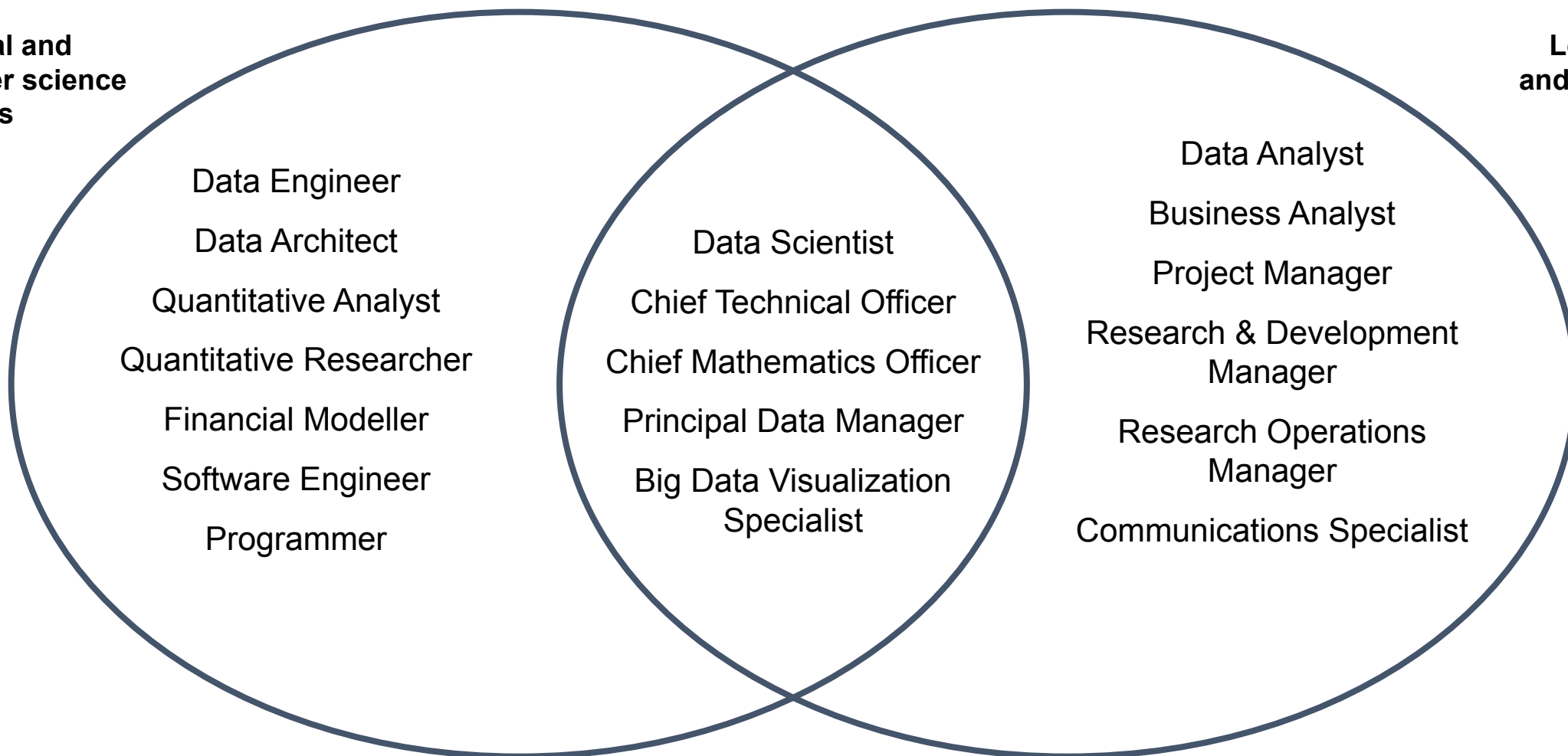
Operations management:
- Managing information
- Managing people

In the context of RBS:
- Synonymous with big data & data analysis
- BITL is not a program to create Sys Admins or Dev Ops (though you may work in such roles)

Technical and computer science strengths

Leadership and business strengths

Data Engineer

Data Architect

Quantitative Analyst

Quantitative Researcher

Financial Modeller

Software Engineer

Programmer

Data Scientist

Chief Technical Officer

Chief Mathematics Officer

Principal Data Manager

Big Data Visualization Specialist

Data Analyst

Business Analyst

Project Manager

Research & Development Manager

Research Operations Manager

Communications Specialist

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Math is important for everyone

- Many students have a bad experience with mathematics teachers in high school / elementary school

- There is no such thing as "natural-born" ability to be "good at math"

- Practicing math (not being good at math!) improves analytical skills

Information technology seems complicated

- Used as a tool by people in power to push their changes on unsuspecting people (e.g. Facebook)

- Misused by people why interpret it to mean what they want, not what it is (e.g. politicians)

- Reinforces the beliefs of those who created it, requires deep knowledge to change

Mathematics is the science of finding the essence in a confusing situation and creating order

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Practical applications*

- *The simplex method in optimization:* create a geometric figure from constraints, move along the boundary to find the best solutions to the constraints

- *Machine learning in medical imaging:* interpret visual patterns as mathematical definitions, train a computer to find them more reliably / accurately than a human

- *Creating financial forecasting models:* analyze huge amounts of data, compress to a single number that the customer can understand

- *Perfecting communications networks:* detect network strengths at a distance, modify the signals (without affecting the transmission) to adapt to dynamic changes

* These may seem simple, unrelated, contrived, not really math

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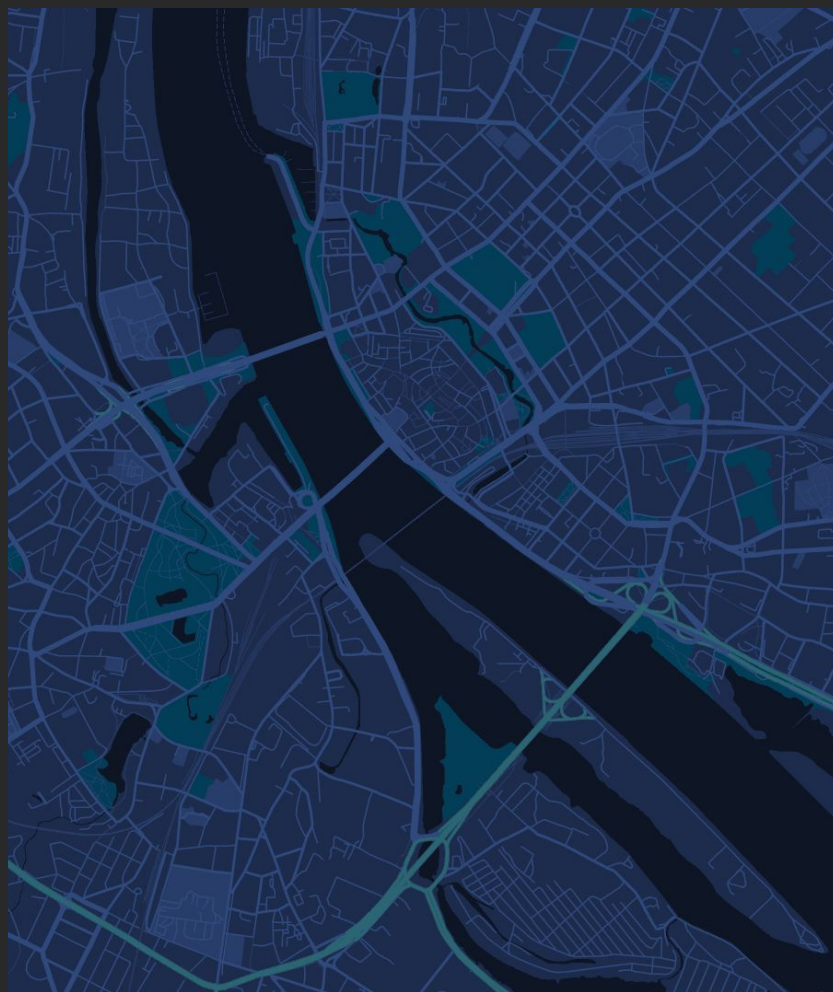
Traffic modifications

- Roads and intersections provided by Rīgas Dome
- Observed and predicted traffic flow
- Solve:
  - *How does flow change, if roads closed?*
 - *Where should a new crosswalk be created to give the greatest benefit to pedestrian flow?*

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Emme 4
Transportation forecasting software

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Researching artificial networks

- 6 million nodes, 40 billion connections
- Replicates ~1mm^2 of a mammal's brain
- 10 seconds of "real time" takes ~24 hours of real time
- Simple basis: binary communication of neurons
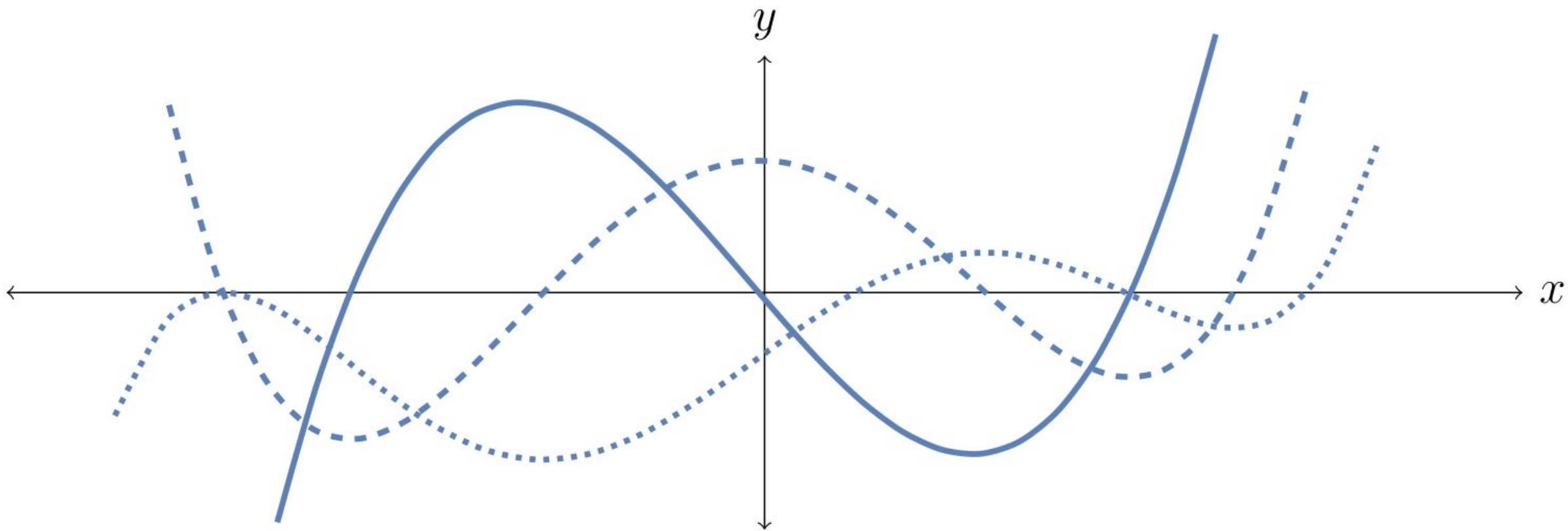- Knowing the effect, what was the cause?

EPFL   Blue Brain Project
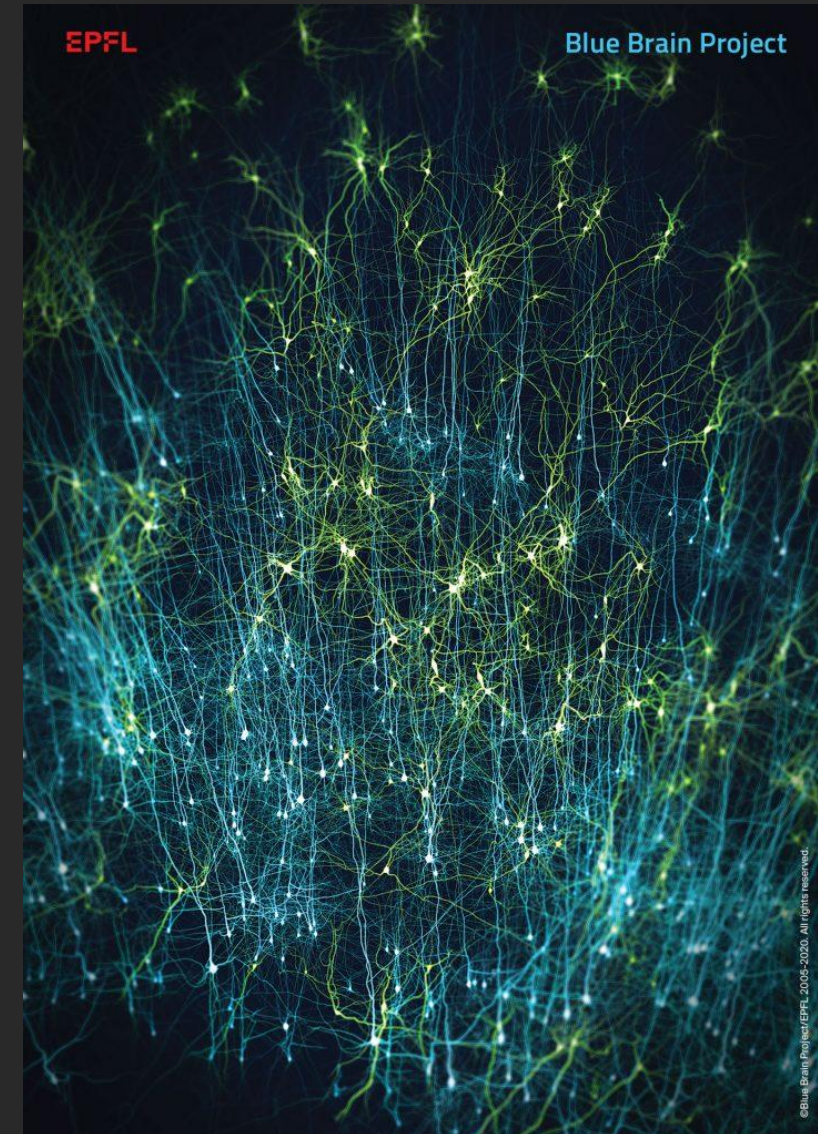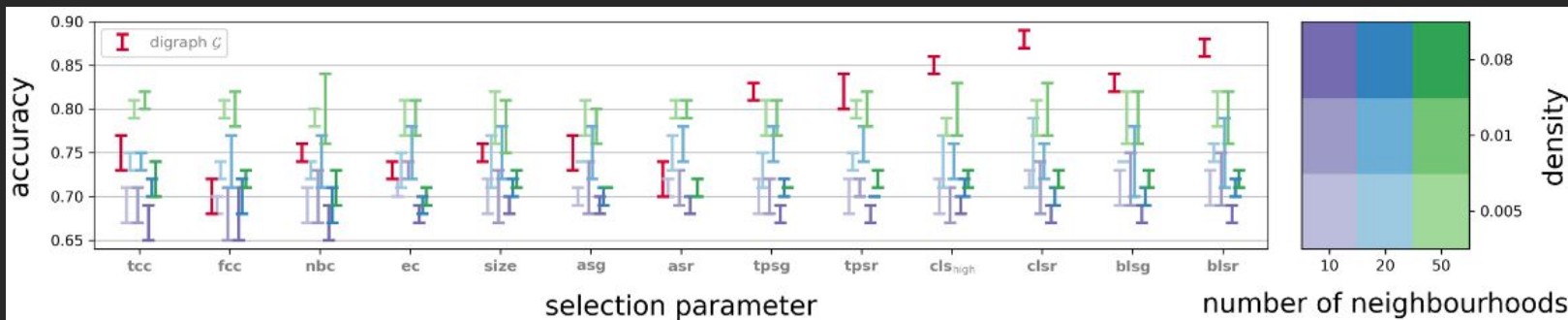
BITL courses

Mathematics:

- Mathematics 1 & 2 (= College Calculus)
- Discrete Structures (= Combinatorics)
- Linear Algebra
- Statistics

Computer Science:

- Computer Science 1 & 2
- Programming Languages
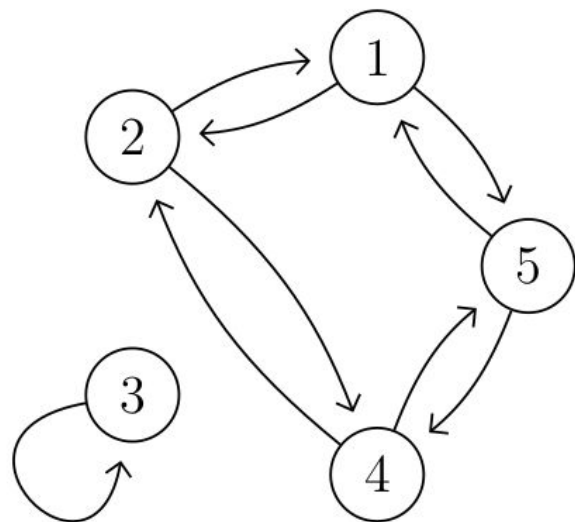- Computer Organization
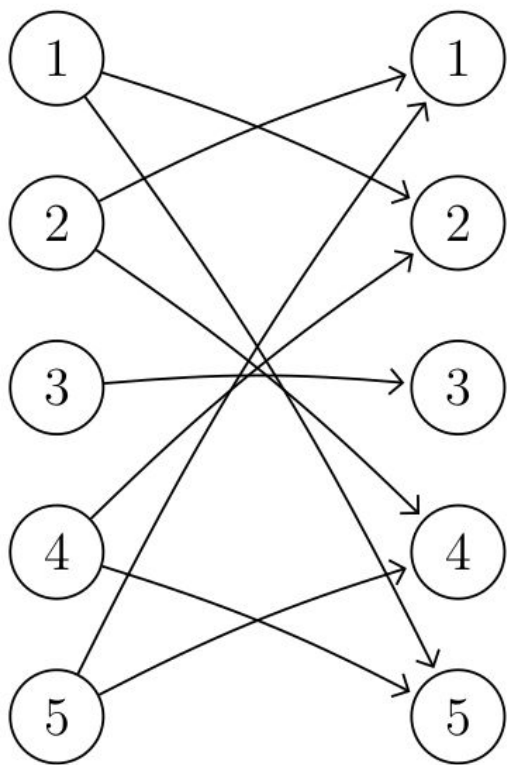- Algorithm Analysis & Design

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Mathematics 1 & 2: What is going on here? What is the relationship among the functions? Which function is "first"?

ⓘ Start presenting to display the poll results on this slide.

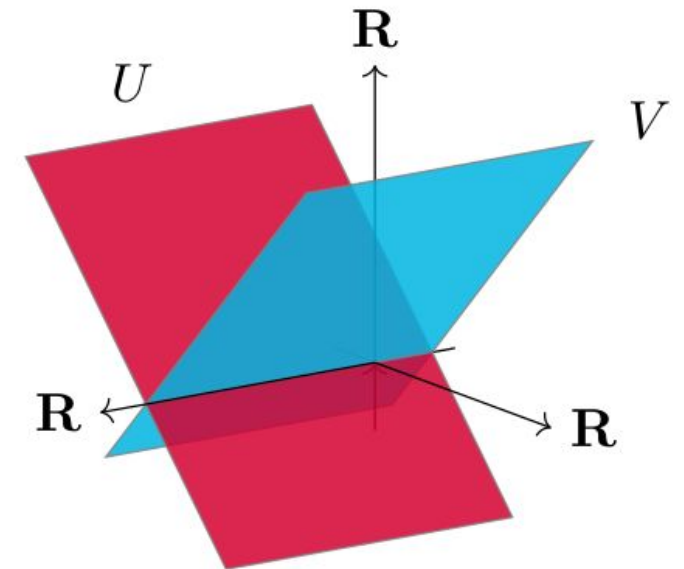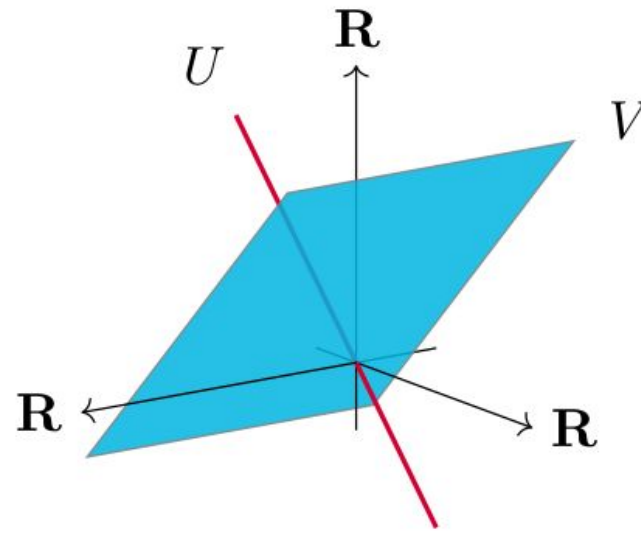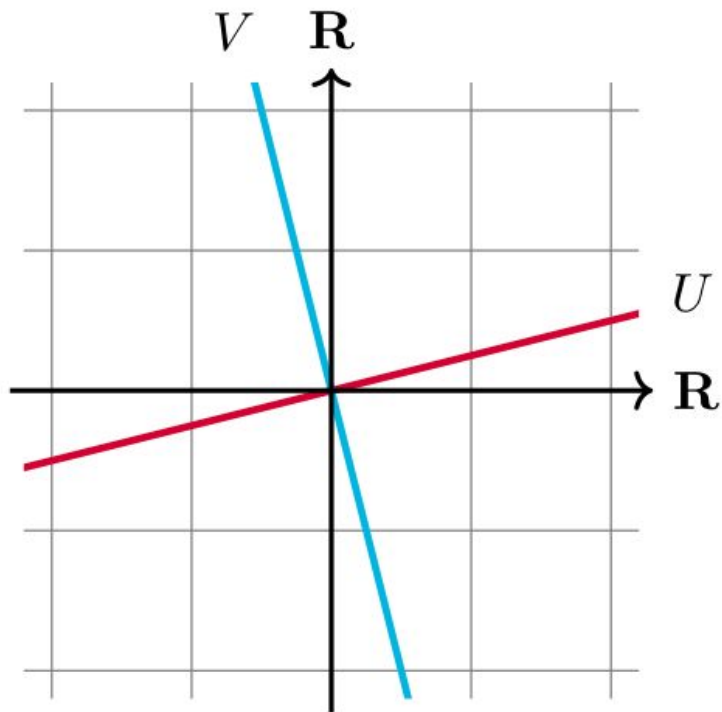|	1	2	3	4	5
1	F	T	F	F	T
2	T	F	F	T	F
3	F	F	T	F	F
4	F	T	F	F	T
5	T	F	F	T	F

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Discrete Structures: What is going on here? What is the relationship among the three visuals? What could it represent?

Linear Algebra: What is going on here? Which pictures are similar? How are they similar, how are they different?

Math & IT

A relationship forged at the foundations

- *A good base gives good results*
- *The result may not be obvious, but the process needs to be clear*

Delivered professionally

- *Modern, forward-thinking, relevant*
- *Adaptive, progressive*

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Relevant links:

- *The myth of "I'm bad at math"*, The Atlantic (link)

- *Understanding Facebook's EdgeRank,* Buffer blog (link)

- *Racial discrimination in face-detecting technology,* Harvard University (link)

- Financial mathematics: Jim Simons

- Medical mathematics: Gunnar Carlsson

- *BlueBrain Project,* Ecole Polytechnique Federale de Lausanne (link)

- *RBS Introduction to Linear Algebra*, JL (link)