EMPOWERED BY PYTHON
A SUCCESS STORY

Jens Nie, Peer Wagner · PyCon.DE 2017 · Karlsruhe · 26. Oct 2017

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WELCOME

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OUR BUSINESS
INTRODUCING THE ROSEN GROUP

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ROSEN develops and manufactures equipment, software, and methods for the inspection, diagnosis, and protection of industrial structures in a wide range of industries.

NUMBERS AND FIGURES
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Company

- Founded in 1981 by Hermann Rosen
- Locations world-wide: over 25
- Employees world-wide: over 3,000

Market Position

- Market leader since 2008
- Technology leader since 2005
- Revenue: over 430 Mio. Dollar (2016)
- We work in over 120 countries

Business Portfolio

- Asset Care – Diagnostic and Integrity Solutions
- Enhanced Materials – Intelligent Plastic Solutions
- New Business – Flow Metering Solutions

OUR MARKET – SAFETY
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This damage can cause serious impacts:






TOOLS USED FOR PIPELINE INSPECTION
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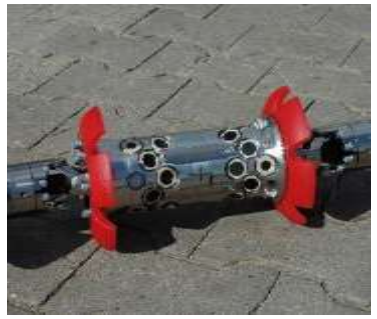
A selection of our tools.

3” – 56” ∅







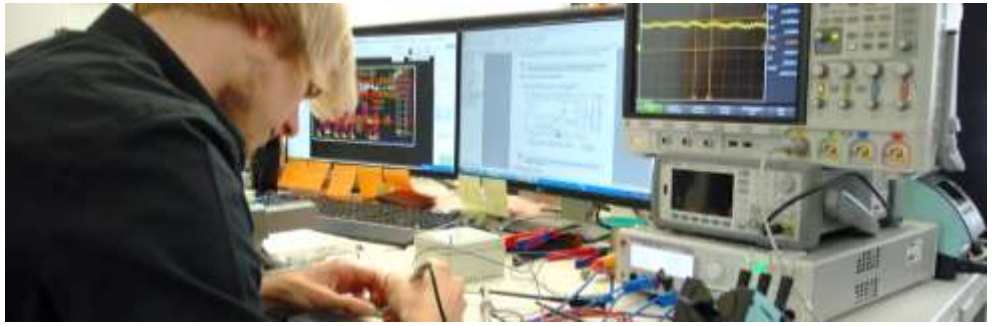








RESEARCH & DEVELOPMENT
INTRODUCING THE ROSEN GROUP



Innovating

- A team of experienced and highly skilled people from all over the world with a passion for technology and innovation.
- 15% of all ROSEN employees worldwide work in R&D.
- We are motivated by the challenges of our customers working in demanding operating and business environments.
- Cooperation with Universities, Industry Associations and Pipeline Operators
- We are constantly moving ahead, looking for the next challenge,
  striving to raise standard.

MAIN COMPETENCIES IN R&D
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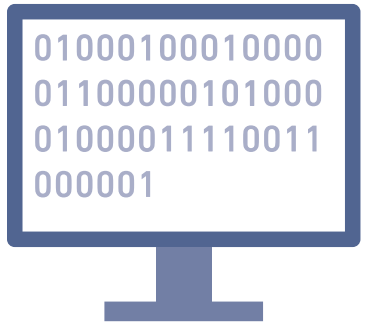
KNOW-HOW
IN VARIOUS DISCIPLINES:

Mathematics

Physics

Electronics

Mechanics &
Materials



Computer Science
& Software

Robotics

Chemistry

ROSEN & PYTHON
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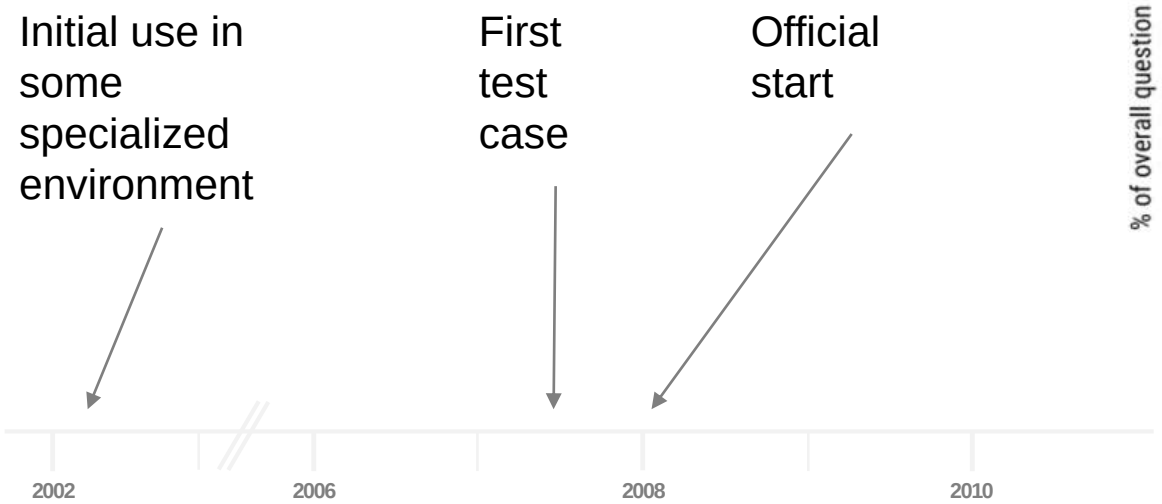
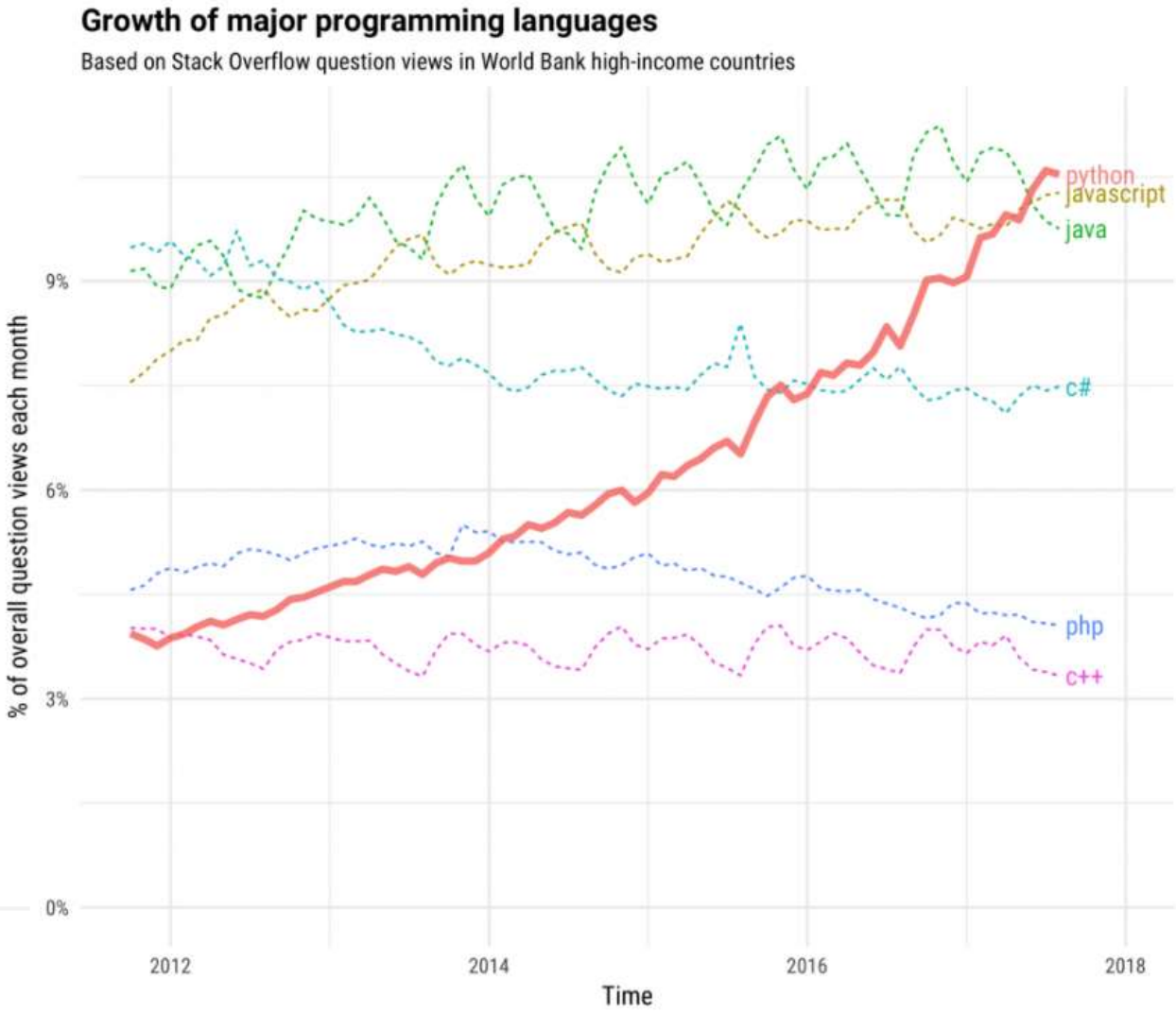
So when did it all begin?





BIG DATA IN A NUTSHELL
EMPOWERED BY TECHNOLOGY

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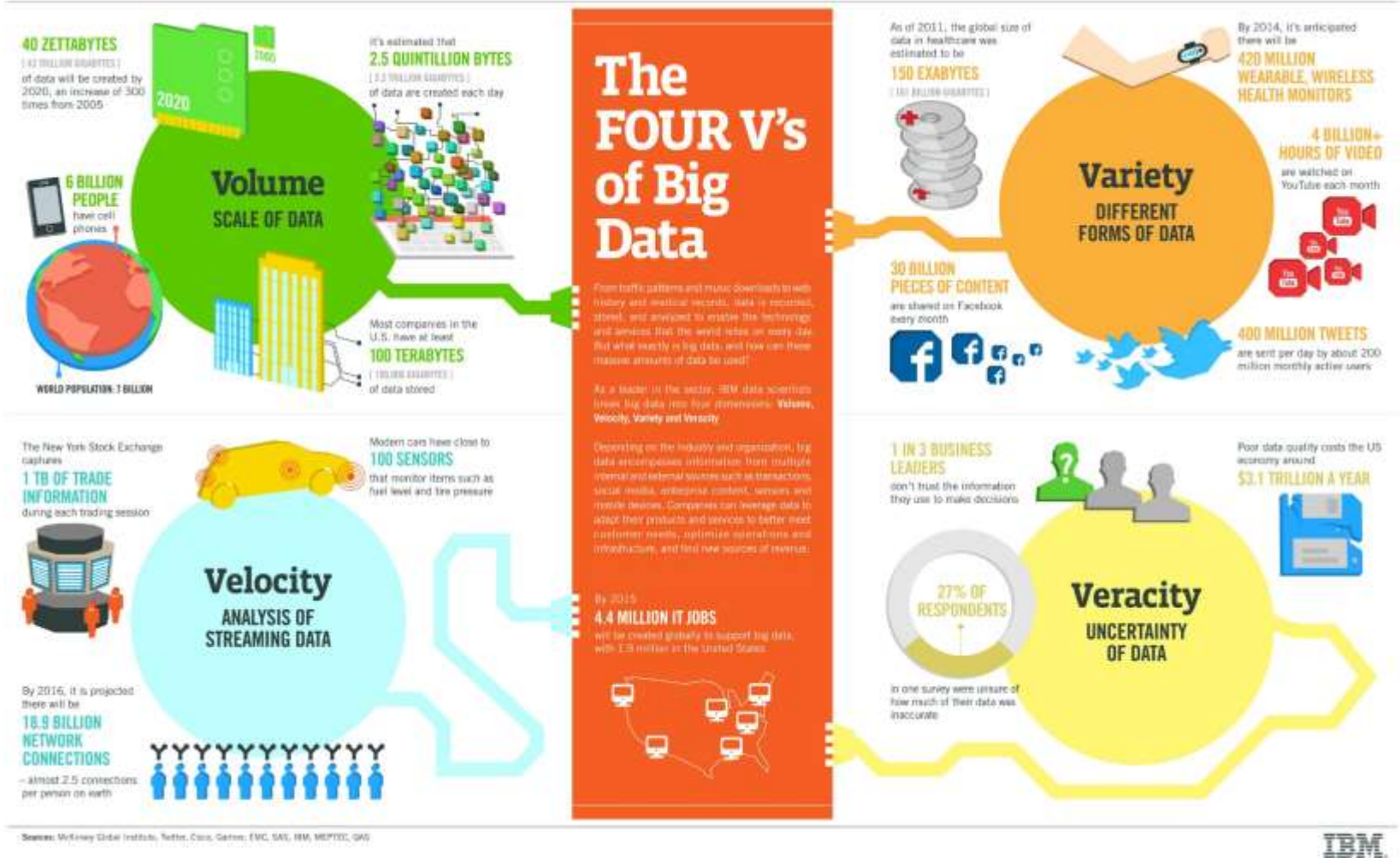

MESOS
docker
pandas
matplotlib
python
SciPy
NumPy
Numba
DASK

RUN LAB MEASUREMENTS
EMPOWERED BY TECHNOLOGY

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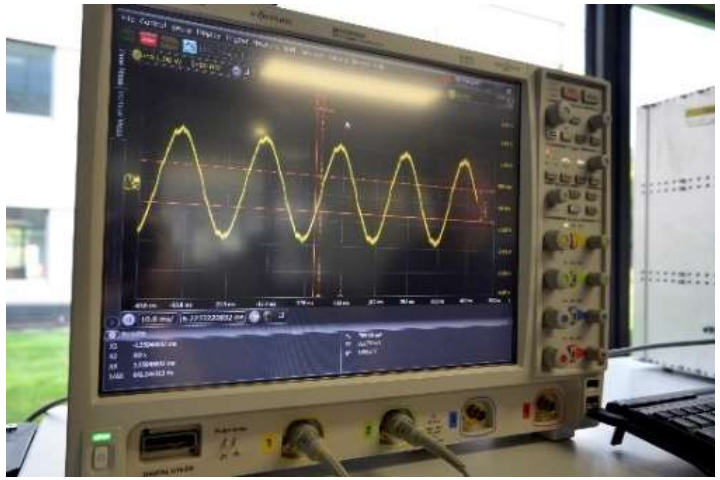

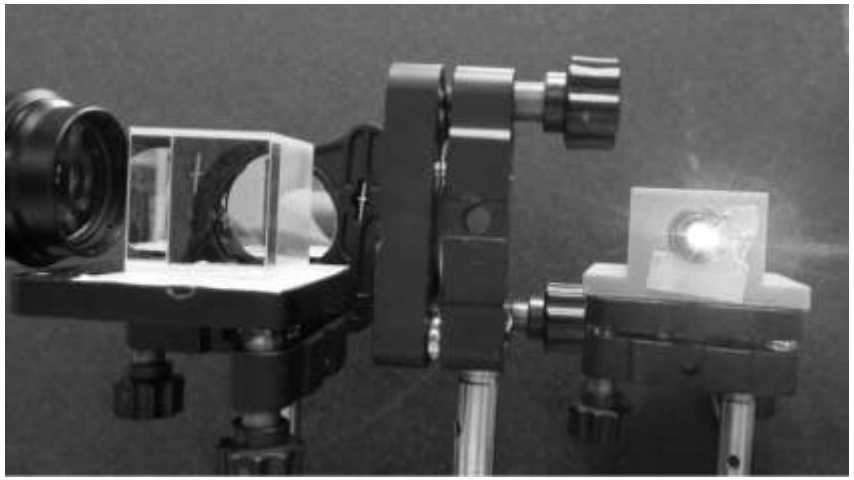
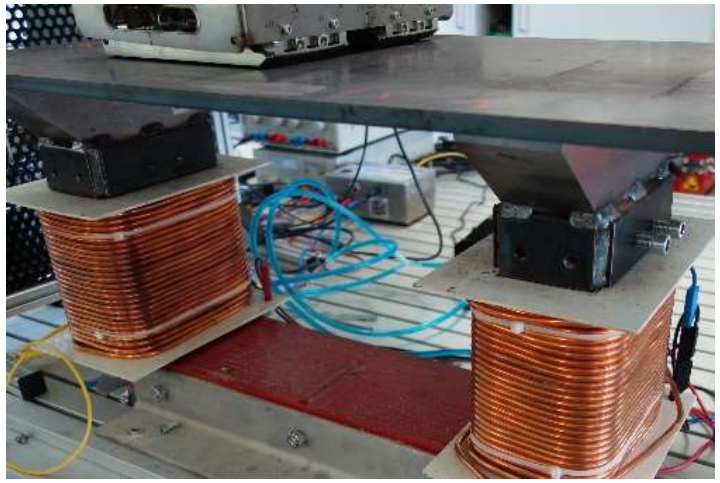

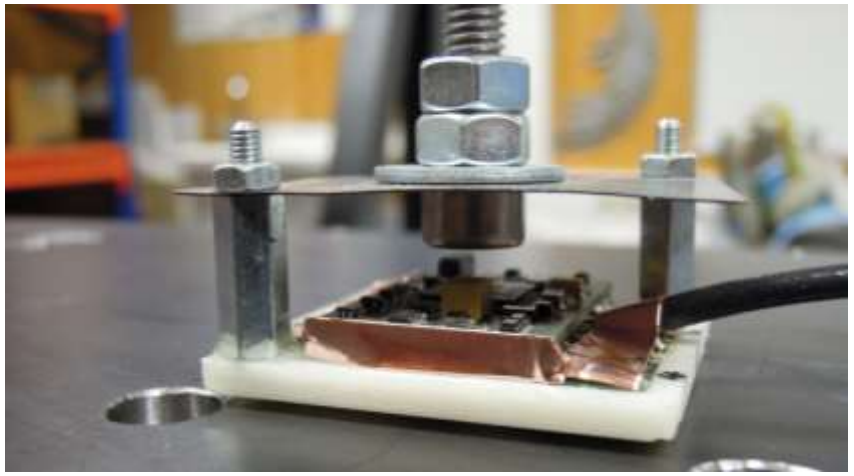

RAPID PROTOTYPING OF IDEAS
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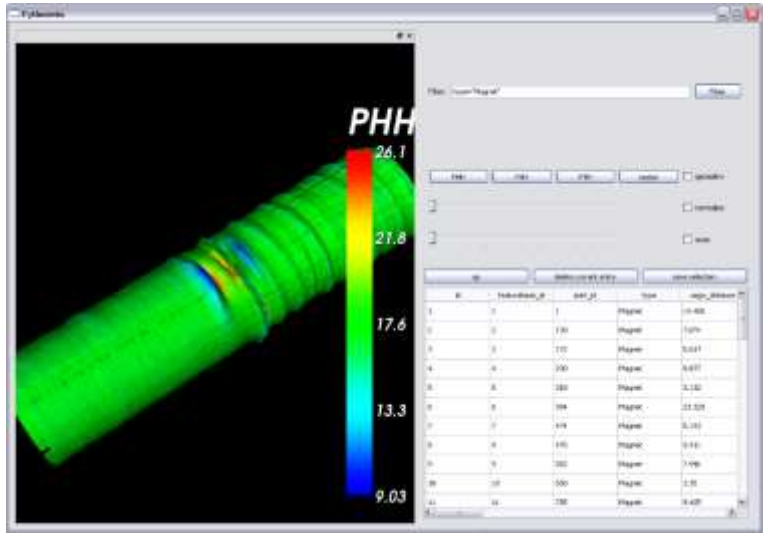

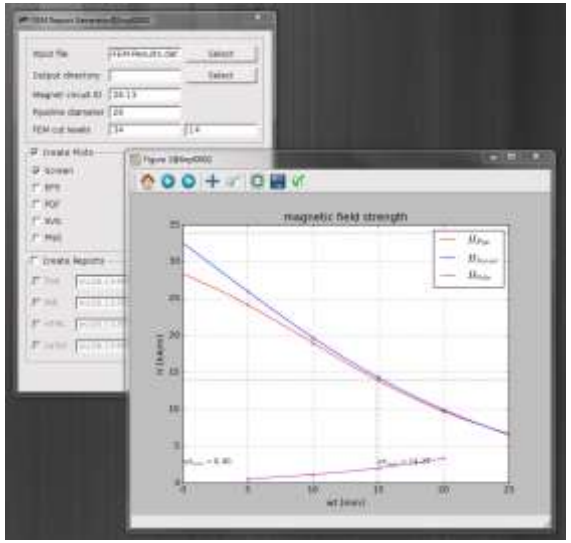

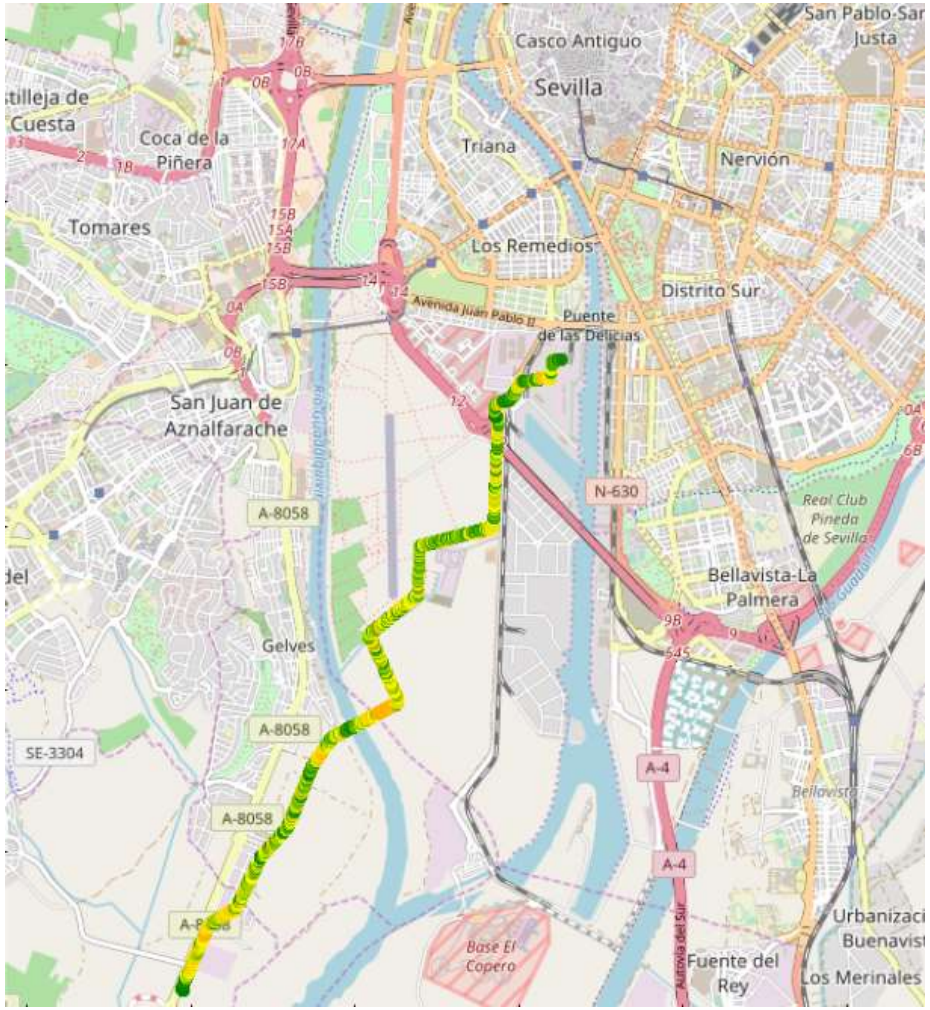

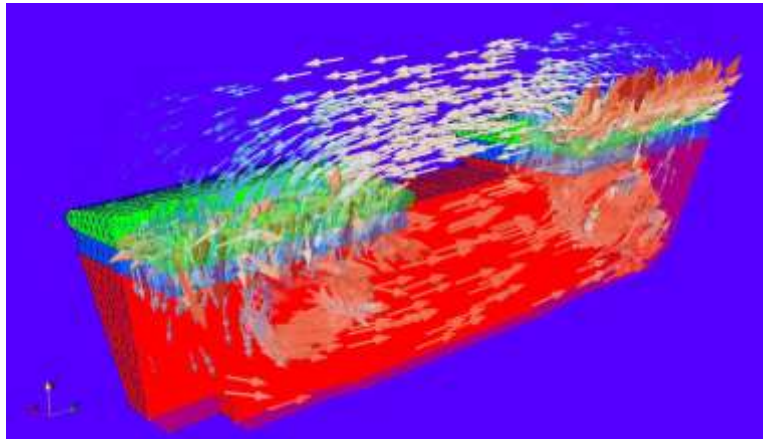

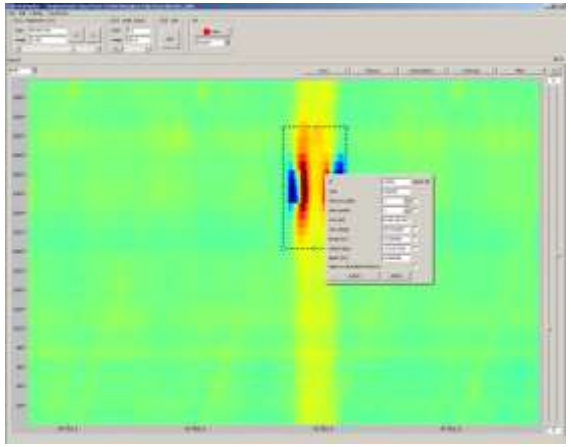

BIG DATA APPLICATIONS & STORAGE
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ROSEN & DATA SCIENCE
EMPOWERED BY TECHNOLOGY

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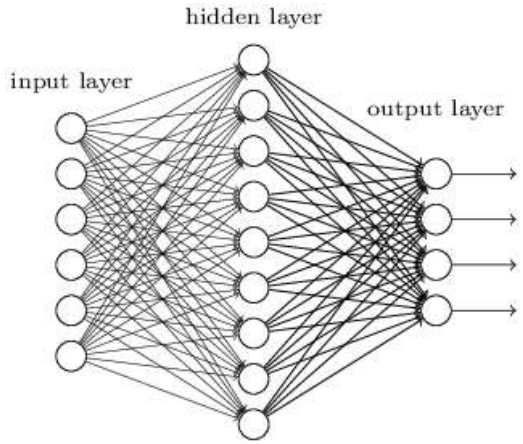
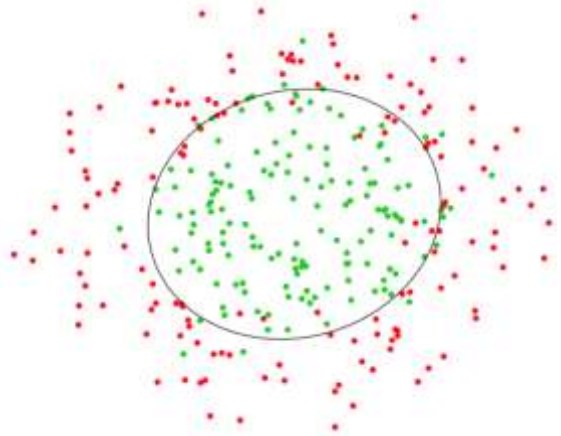
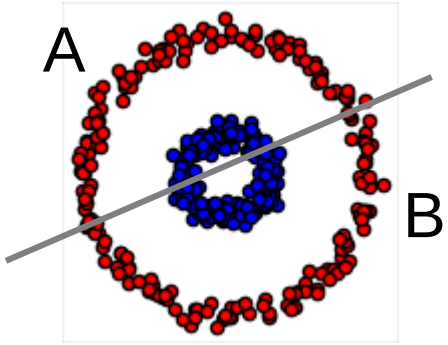
- difficult and a bit of a sad story in our industry
- ROSEN not the first to make use of A.I.
- Competitor spent a lot of money for NN approach
- suffered from “overfitting”

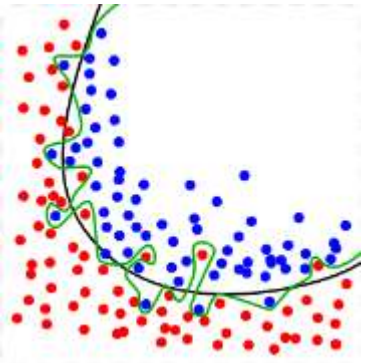




Result was an **epic fail** leaving many **doubts** in the industry.

However, the idea was good, only the **time wasn’t right**.





CHALLENGES IN MACHINE LEARNING
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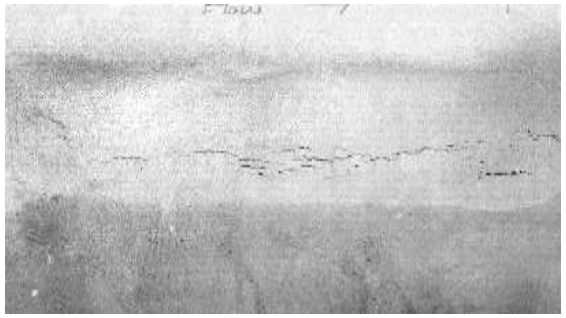
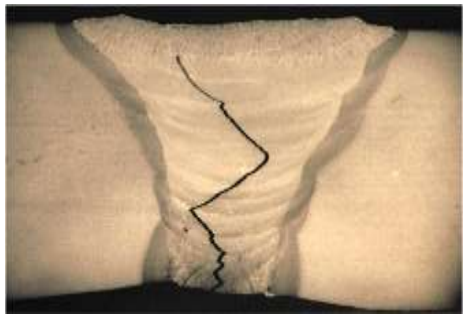
The success of machine learning is most significantly based on the **volume of ground truth information** which can be used for training the algorithms.

You need to have **large amounts of test samples** covering every important aspect which needs to be considered to have influence.

That usually means you want thousands of anomalies at hand in the laboratory for performing measurements.

At that time it just **wasn't possible**.



SITUATION TODAY
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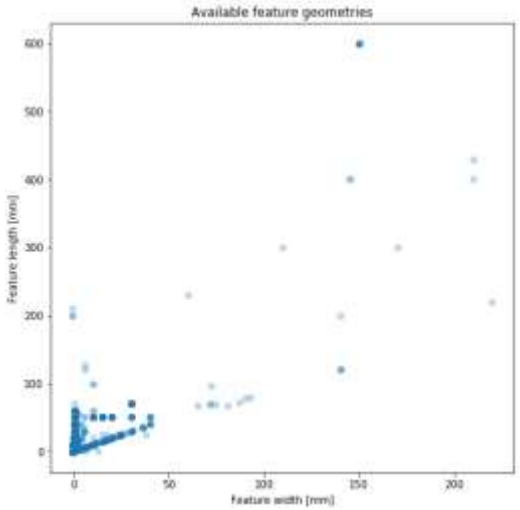
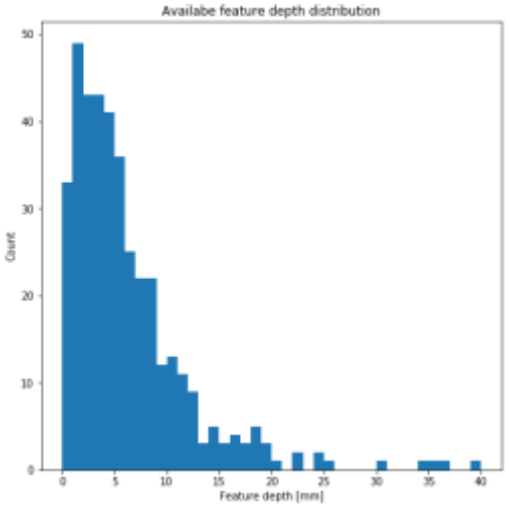
Today the situation slightly changed.

- Hundreds of samples available in the lab
- More than a thousand features
- Majority is artificial
- Still few real samples

We’re on the way to build a good and reliable base!

It’s really challenging though!





SMART WAYS TO FILL GAPS
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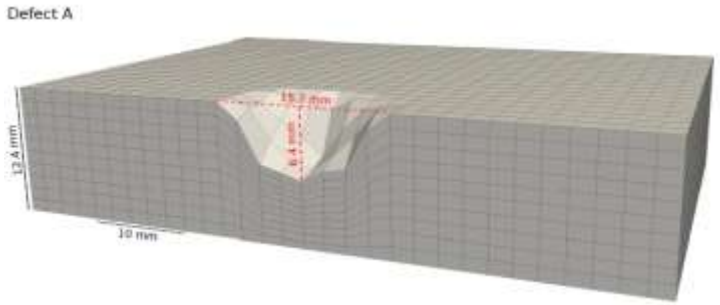
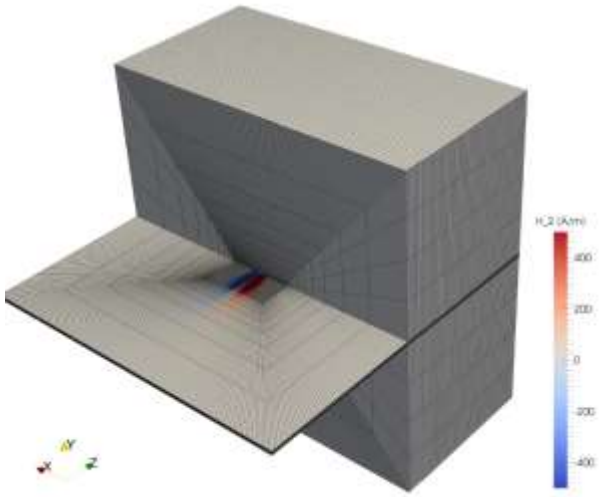
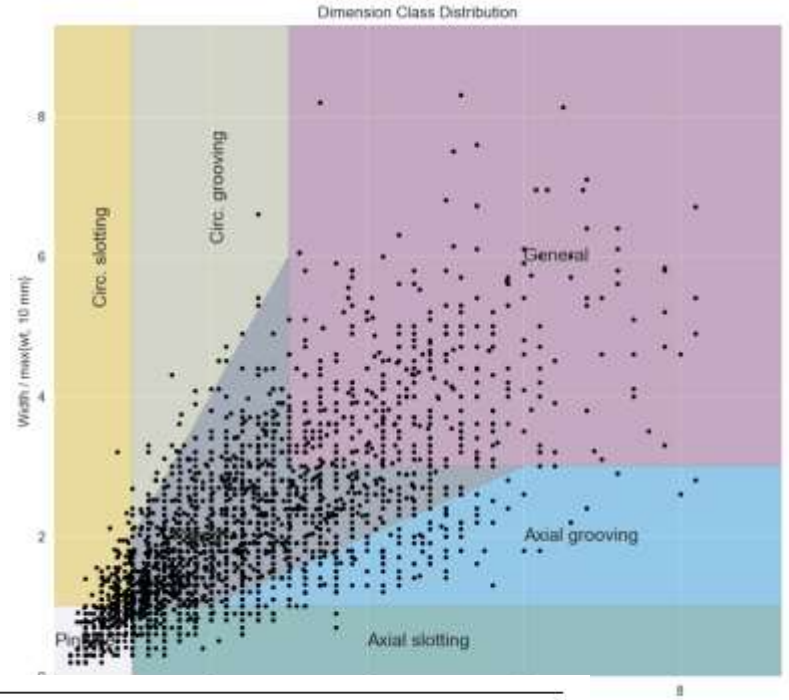




But we have found very **clever ways** to **fill** the **gaps** by simulations and modeling



	Artificial	Scan
Number of FEM simulations	275707	594139
Background magnetization range [kA/m]	10.0 – 30.0	10.0 – 35.0
Wall thickness range [mm]	4.0 – 30.0	4.0 – 30.0
Length range [mm]	4.0 – 49.0	4.0 – 100.0
Width range [mm]	4.0 – 49.0	4.0 – 103.0
Depth range [%]	10.0 – 95.0	9.7 – 97.8

Table 2: Overview of FEM simulation statistics.

IMPROVED TESTING
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Testing field:

- Area of 30.000 square meters
- Houses more than 6500 meters of test pipelines
- 2100 pipe segments with a diameter of 3“ to 56“
- Performance of 500 pull and 400 pump tests every year

- Winch has been specifically developed for ROSEN Group
- Up to 20 tons of pulling force at a maximum of 7 meters per second

CIRCUMVENTING PITFALLS
EMPOWERED BY PEOPLE

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Preventing errors from the past

- Thoughtful start of that technology.
- Choosing appropriate strategies
- **Most valuable** however is **human experience**.
- We don’t like black boxes!
- Reinforcement learning. Every decision based on the great experience of our data evaluation experts helps to increase overall quality.

WE TAKE PYTHON & DATA SCIENCE SERIOUSLY
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We've done a one week course recently with an external trainer to further develop our skills.

ANACONDA

- Addressed more than 60 developers and 30 managers
- Many more to come

HISTORICAL DEVELOPMENT
EMPOWERED BY PYTHON

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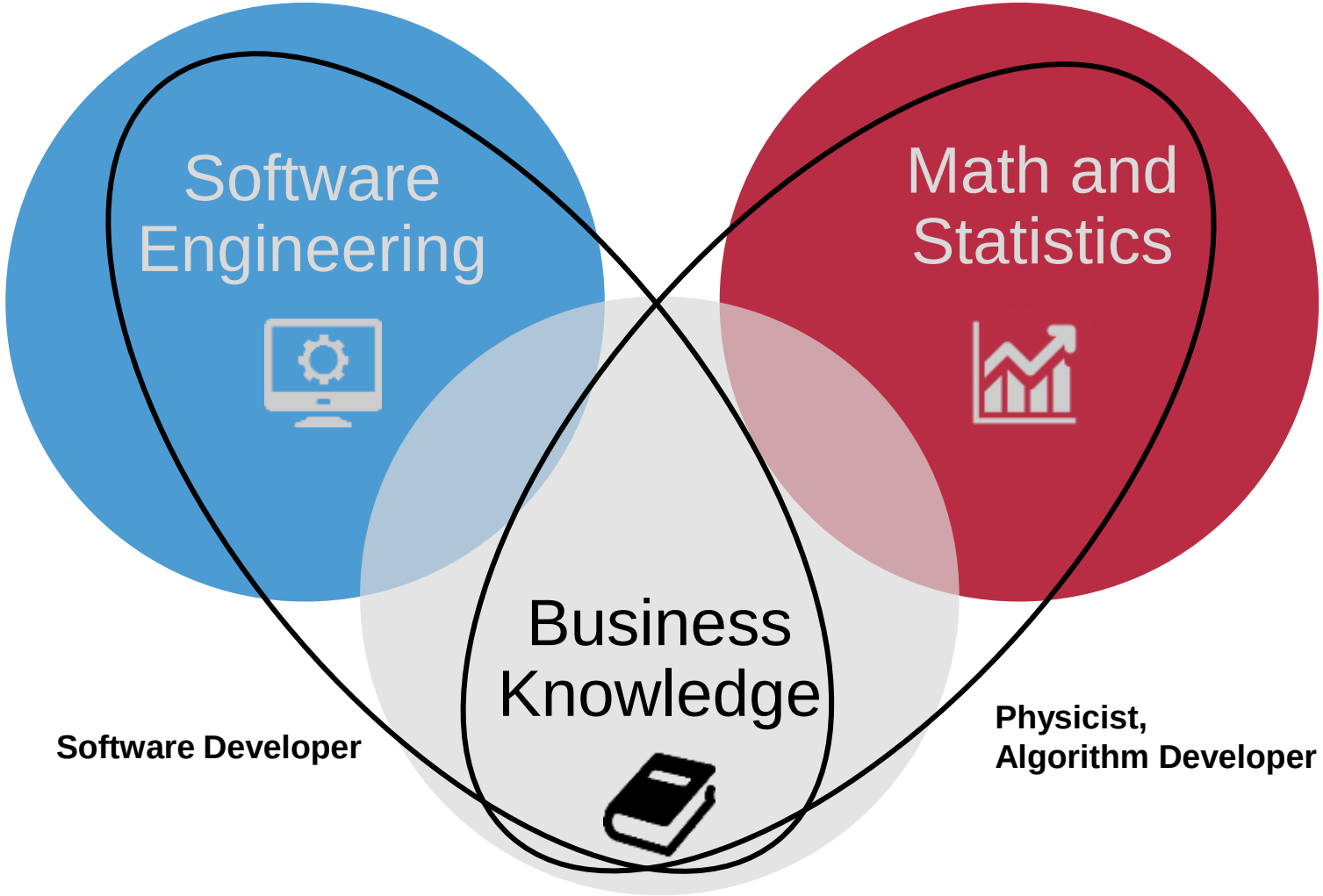

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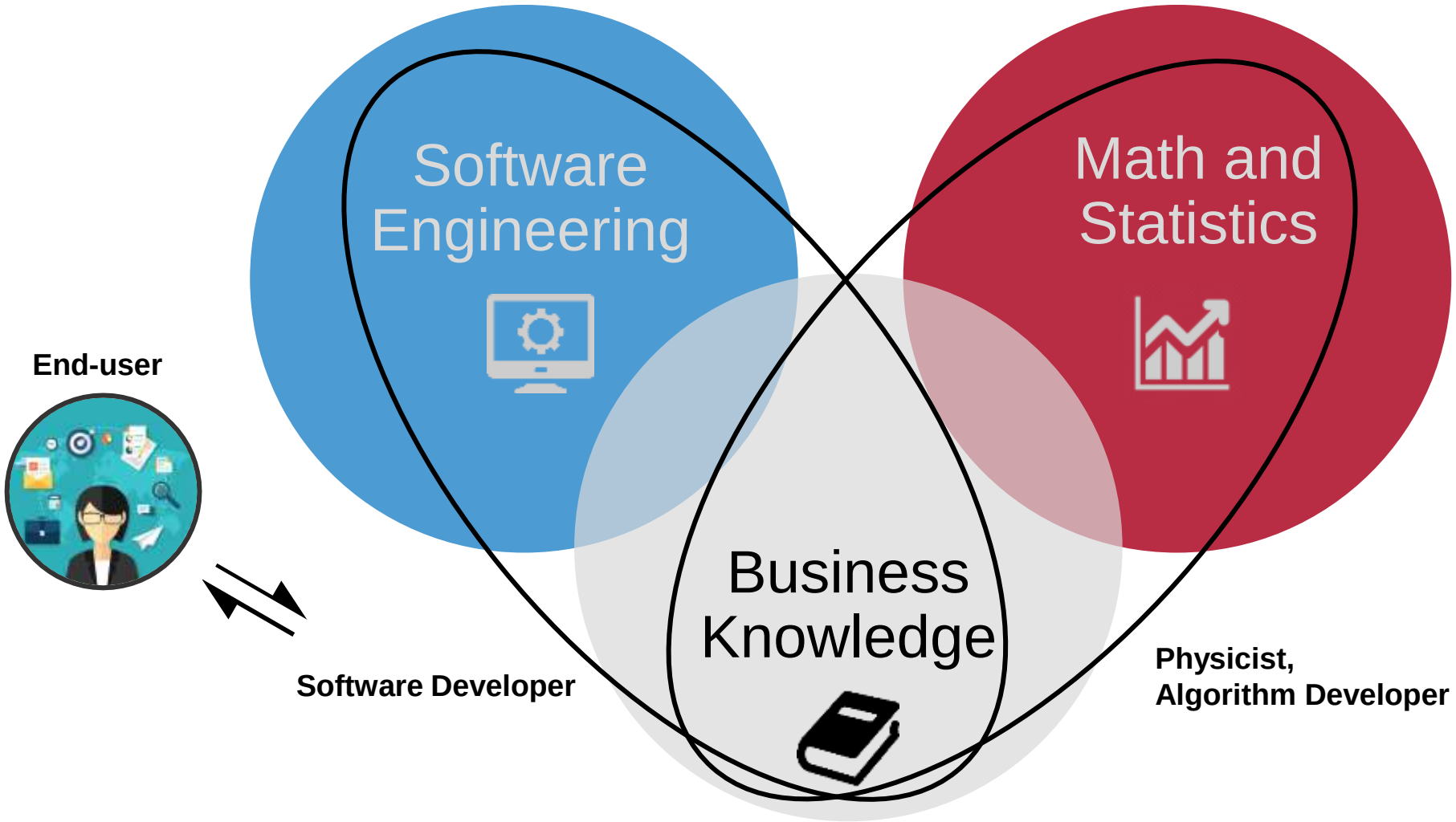
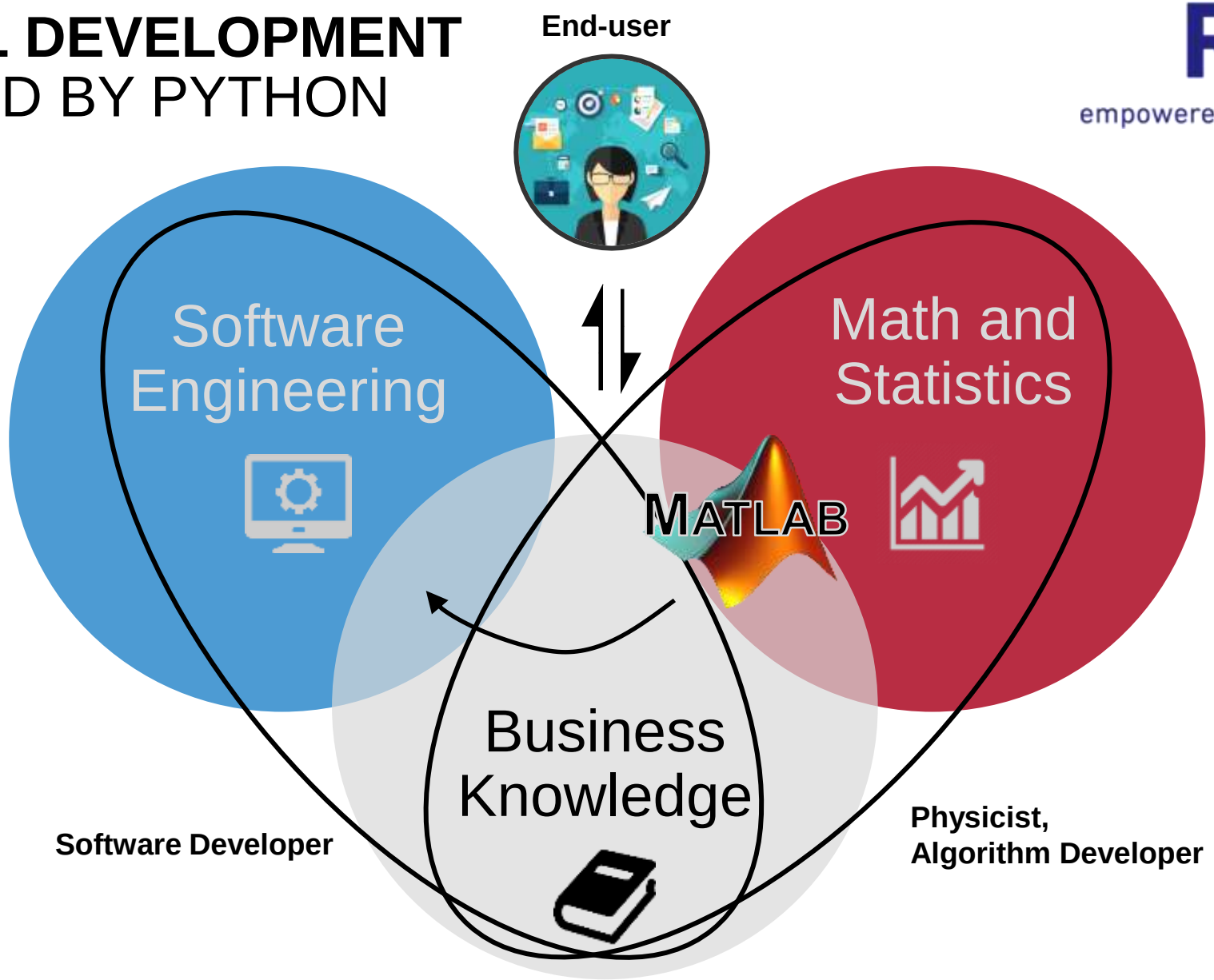


HISTORICAL DEVELOPMENT
EMPOWERED BY PYTHON



CURRENT DEVELOPMENT
EMPOWERED BY PYTHON

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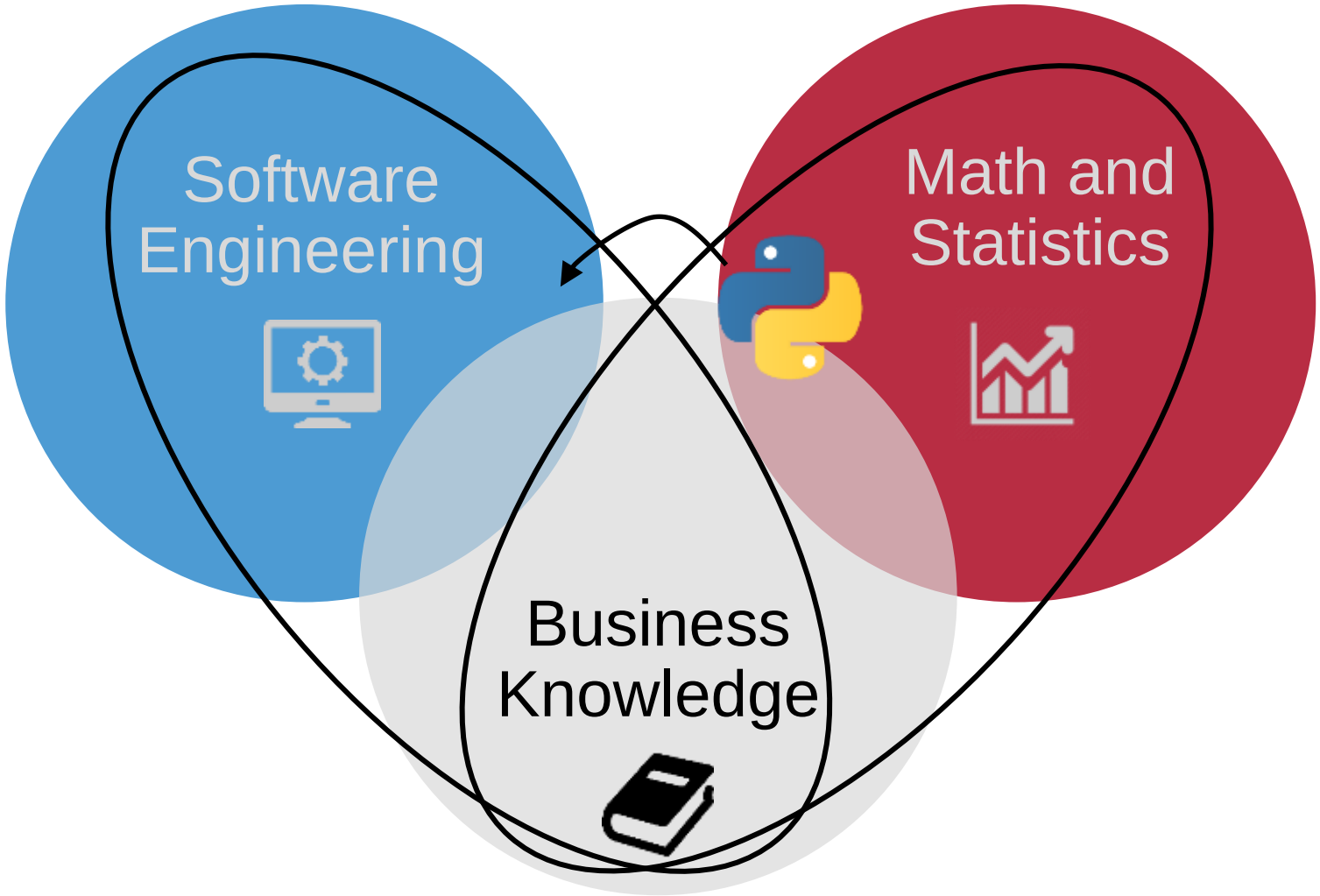

CURRENT DEVELOPMENT
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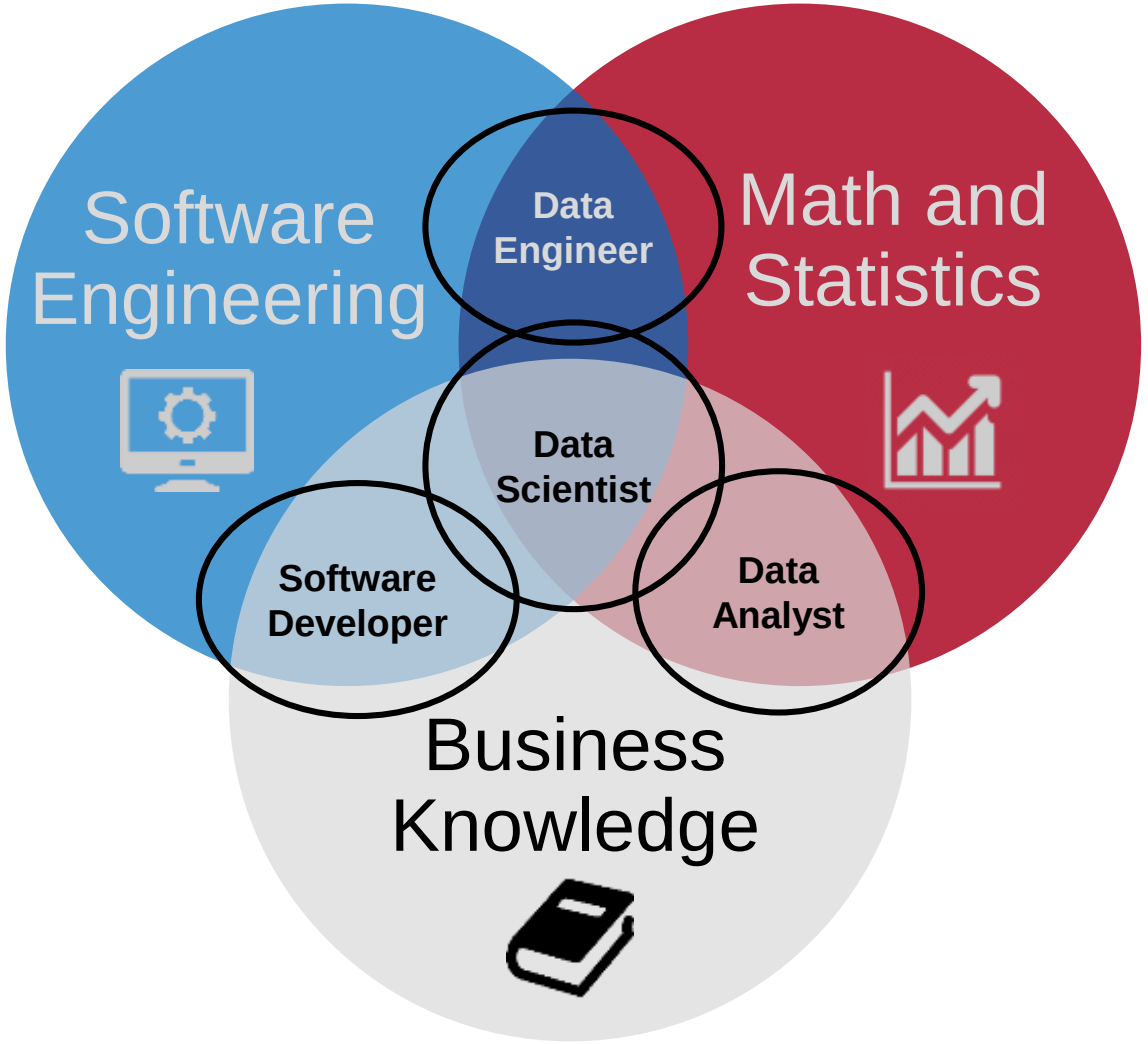

CURRENT DEVELOPMENT
EMPOWERED BY PYTHON

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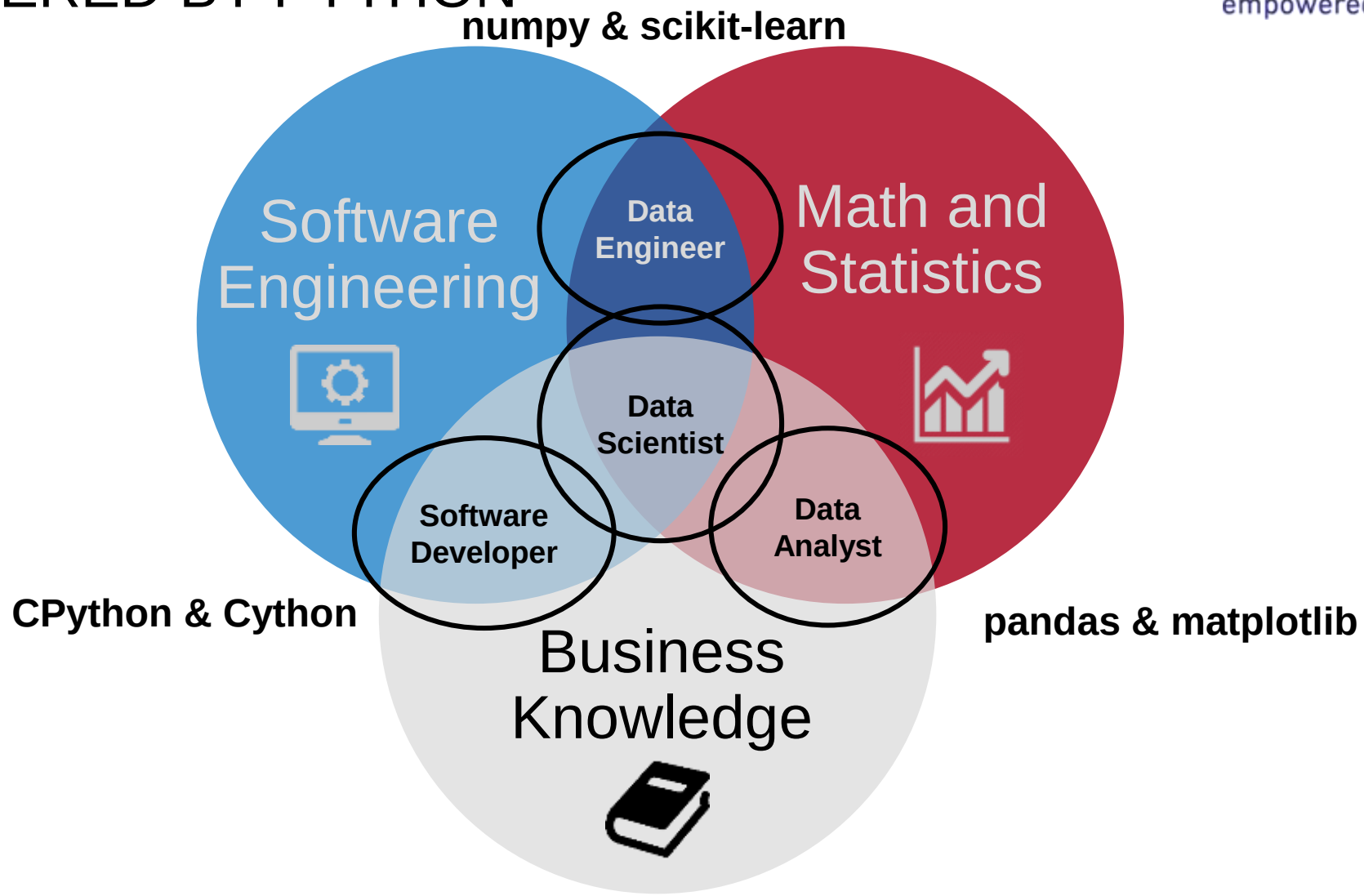

CURRENT DEVELOPMENT
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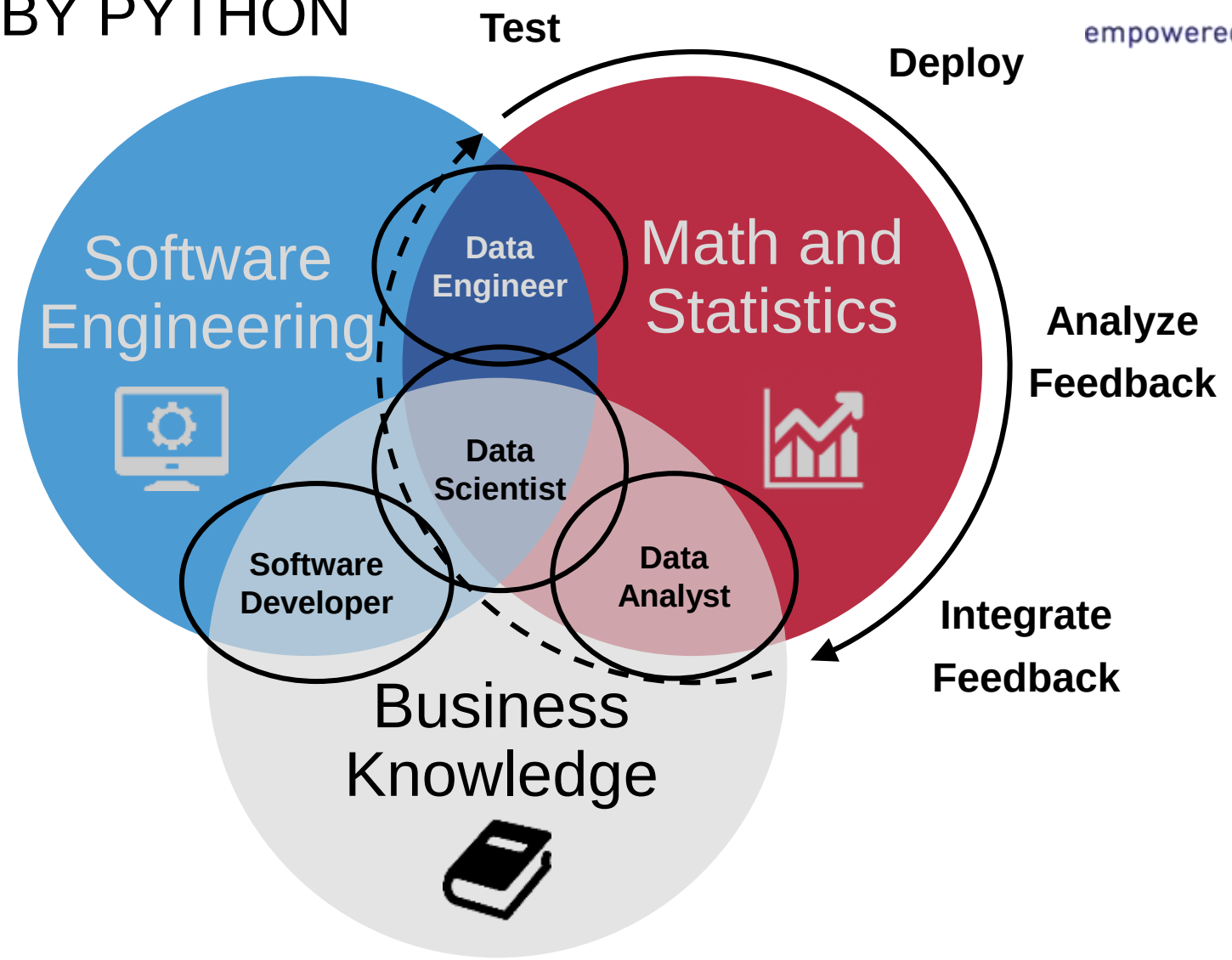

CURRENT DEVELOPMENT
EMPOWERED BY PYTHON

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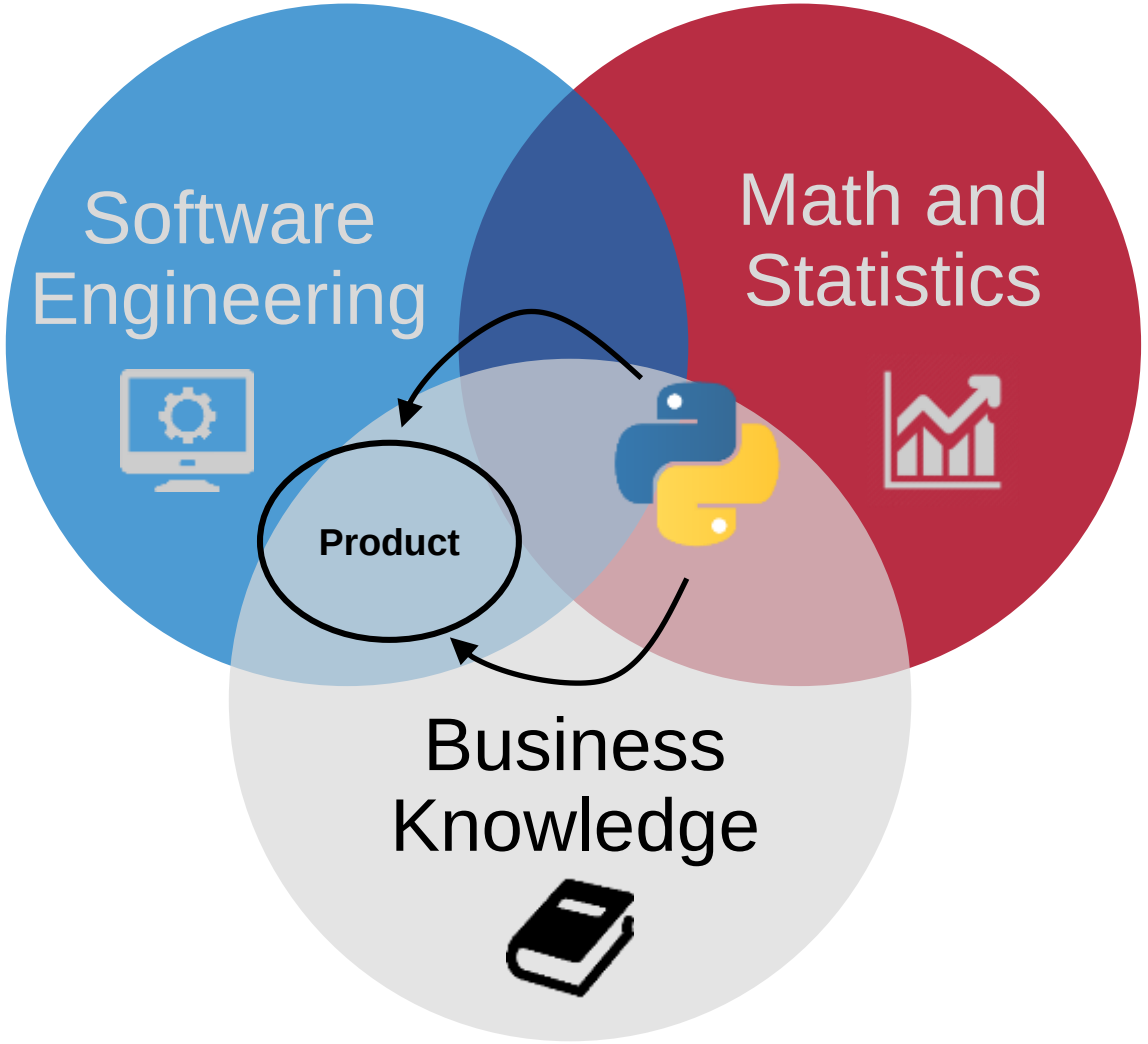

FUTURE DEVELOPMENT
EMPOWERED BY PYTHON

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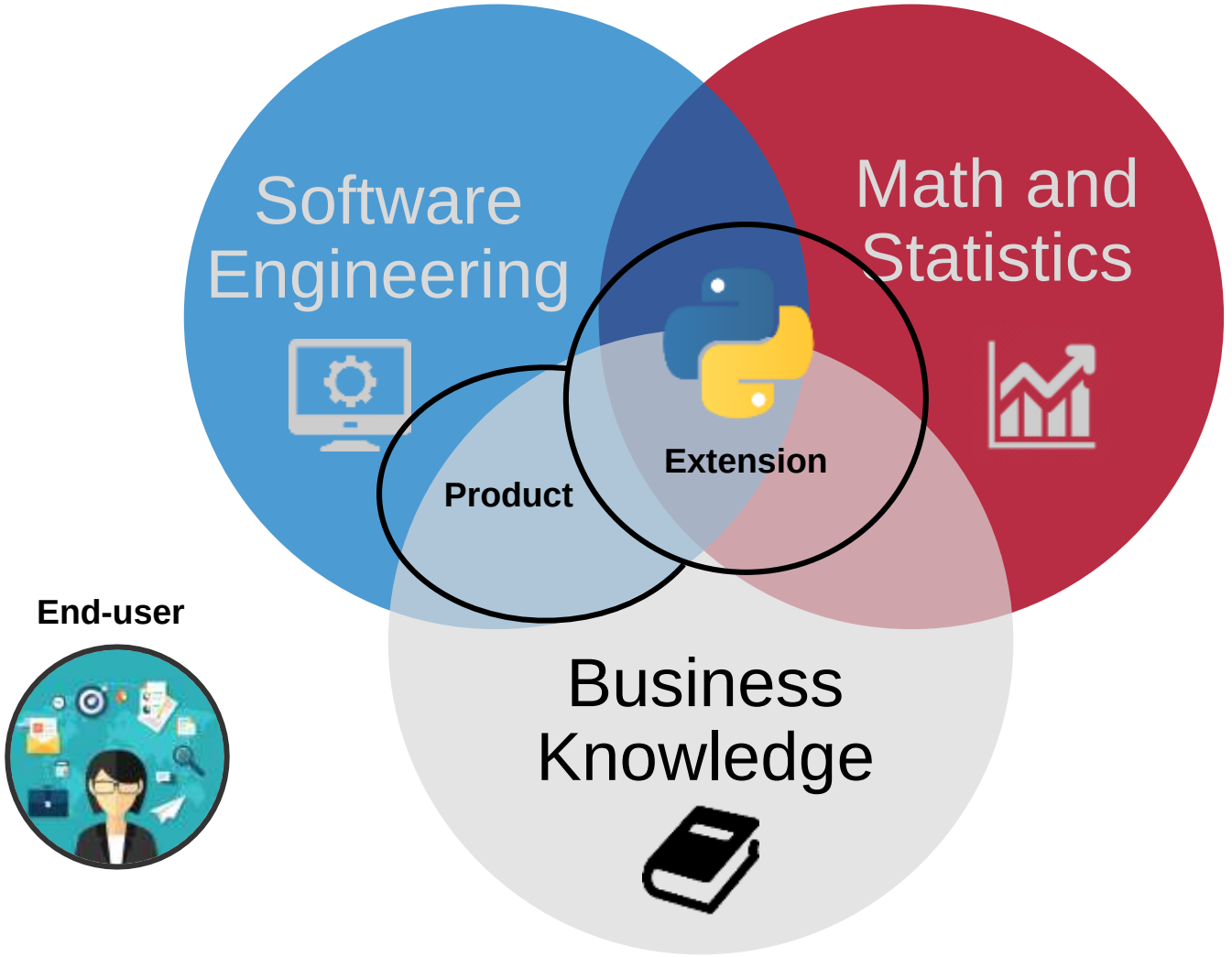

INFRASTRUCTURE
EMPOWERED BY TECHNOLOGY

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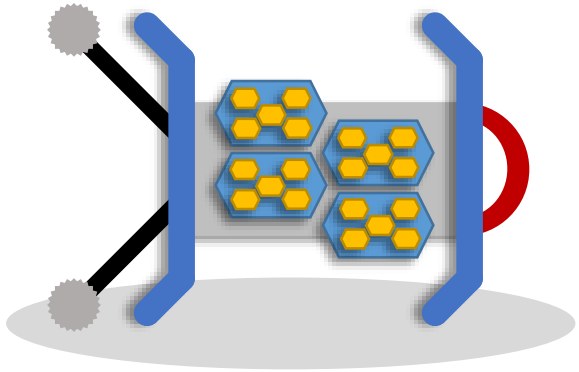
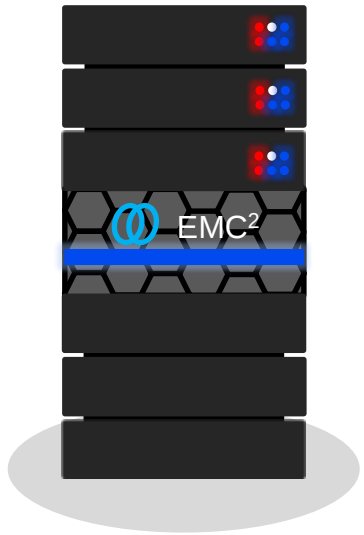
PIGs collect data



> 4PB data storage



INFRASTRUCTURE
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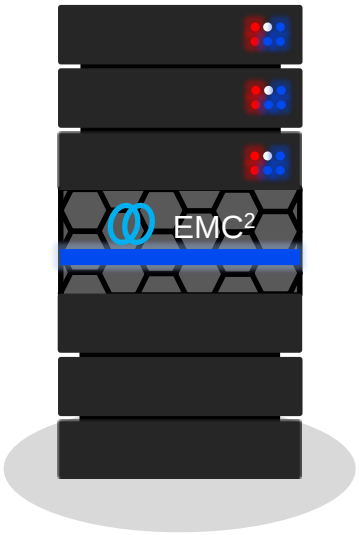

~ 25 active Data Scientists

~ 5 + n Software Developers

INFRASTRUCTURE
EMPOWERED BY PEOPLE

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~ 25 active Data Scientists

~ 5 + n Software Developers

5 specialized teams working on MVPs
1 team developing and maintaining a data warehouse
1 team supporting others and maintaining the infrastructure

INFRASTRUCTURE
EMPOWERED BY PEOPLE

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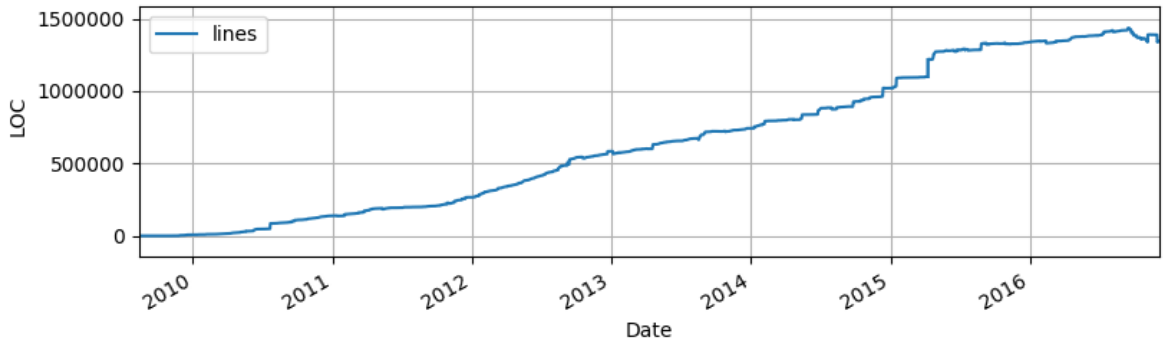
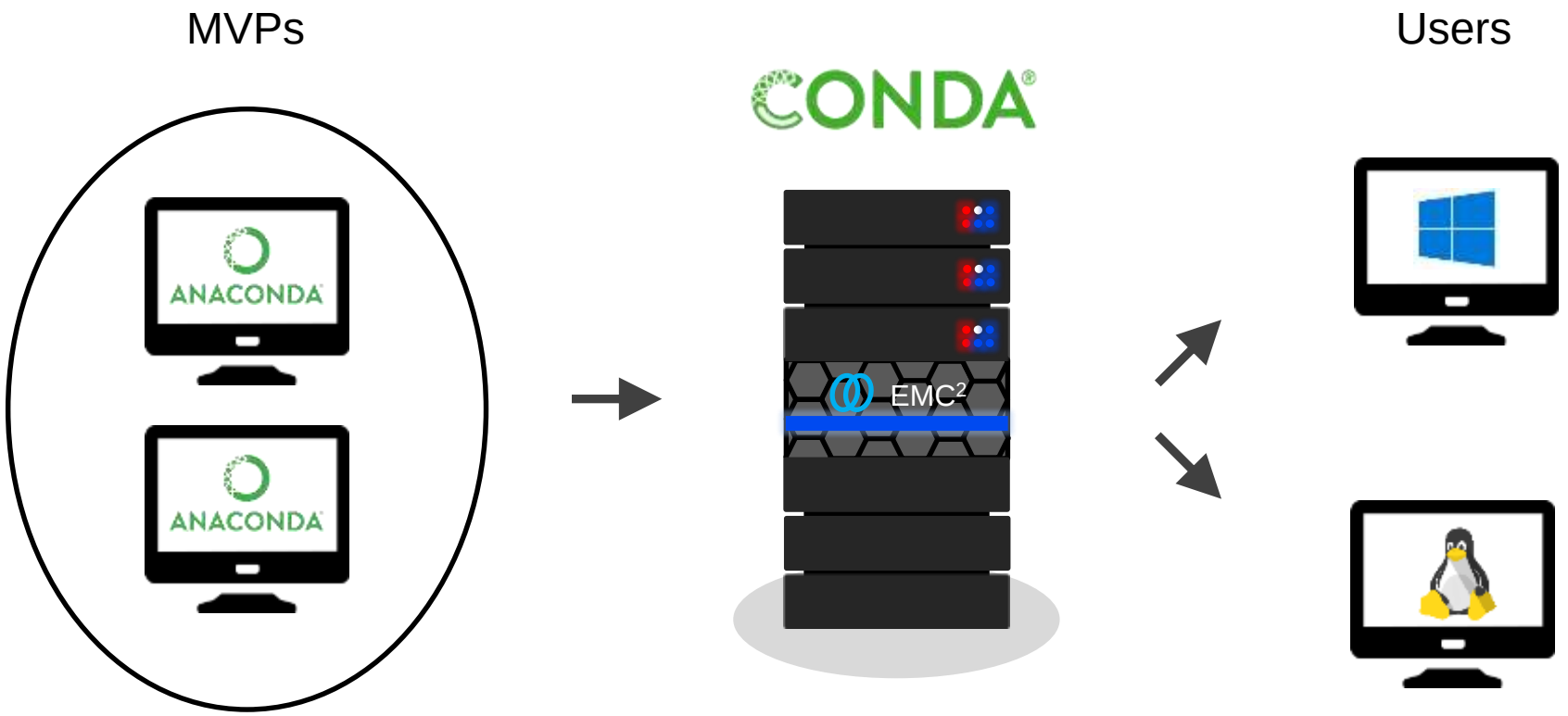


ANACONDA®

5 specialized teams working on MVPs
1 team developing and maintaining a data warehouse
1 team supporting others and maintaining the infrastructure

INFRASTRUCTURE
EMPOWERED BY TECHNOLOGY



INFRASTRUCTURE
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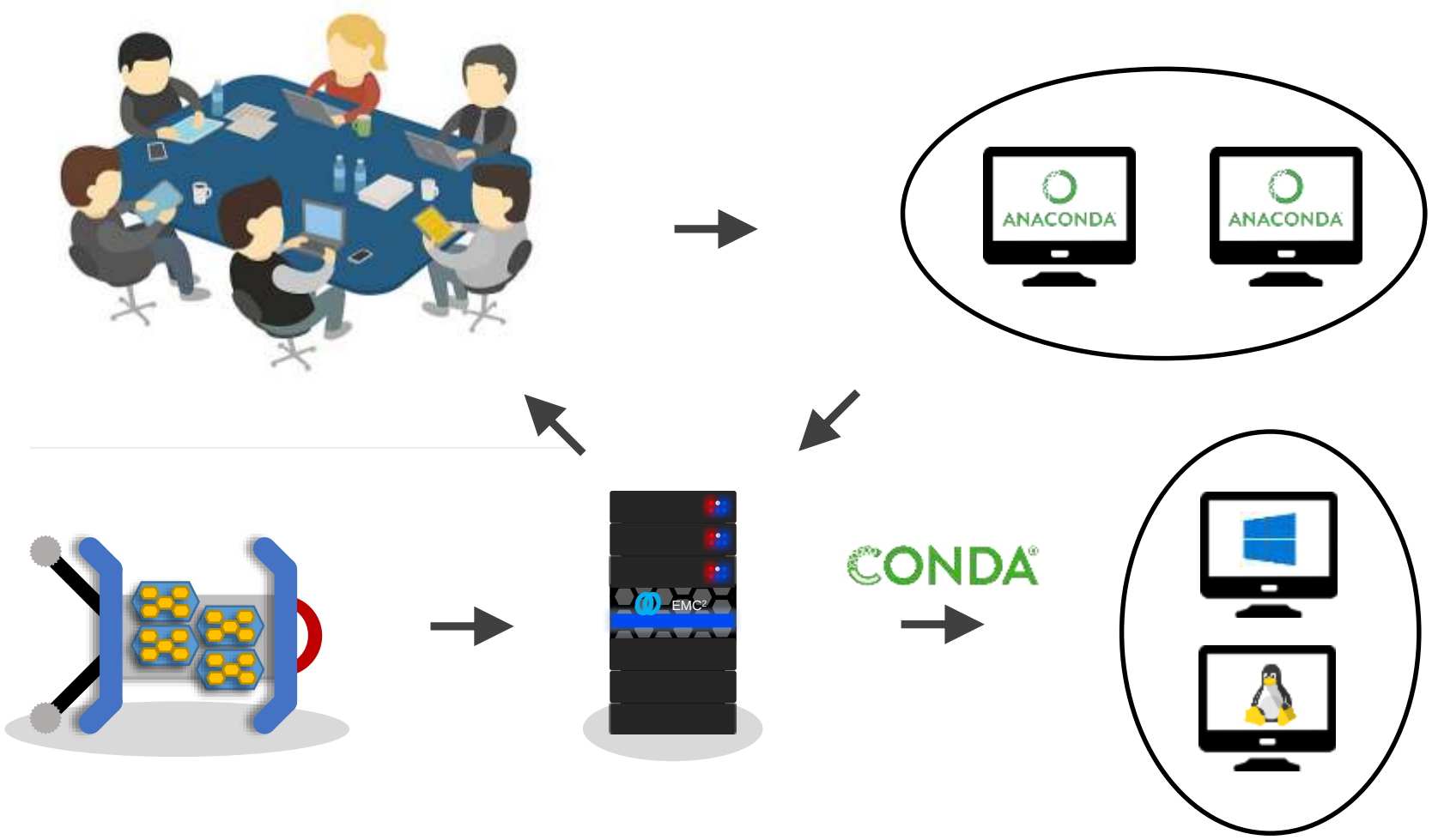

MESSAGE TO TAKE HOME
THE ZEN OF A HIDDEN CHAMPION

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If no solution exists. Create one and share it.
Think radical, but base on available tradition.
Respect available skills. They can support you.
Do not reinvent the wheel. Uses existing solutions as often as you can.
If it's not maintained. Consider maintaining it.
If it's not successful from the beginning. Be patient.
Success does not come over night. It's hard work.
Others have worked hard as well. Respect their contributions.
Do not consider Python to be the solution for everything.
But enjoy that it's available almost everywhere.
Be open.
Encourage discussion.
Get people involved.
Embrace diversity, you need it.

THANK YOU FOR JOINING THIS PRESENTATION.

www.rosen-group.com

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