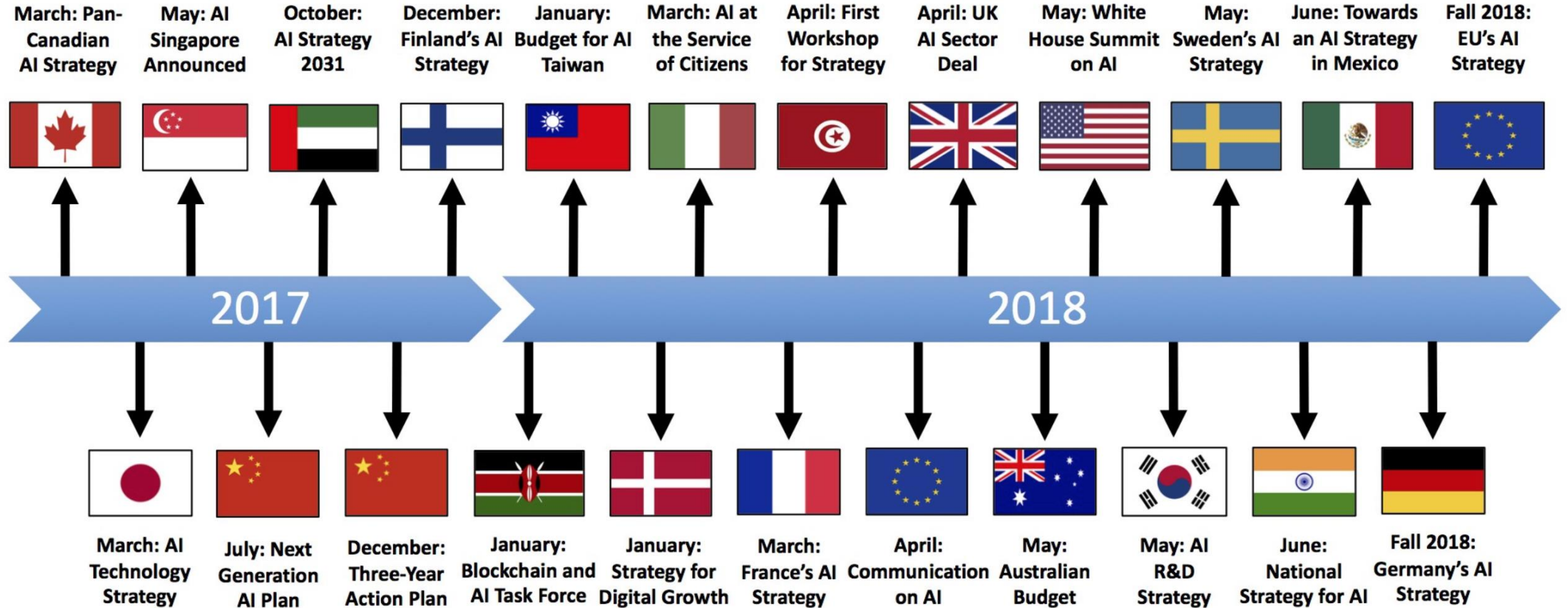# From Data to Economic Value

Like many potentially impactful technologies, the positive economic impact of Artificial Intelligence (AI) is challenged by both strategic and practical misunderstandings. **Line of sight from science to value is required to help achieve positive impact.**

Speaker: Randy Goebel,

Alberta Machine Intelligence Institute, Edmonton, Canada

Volkswagen Data Lab, Munich, Germany

Federal AI Strategy Development

March: Pan-Canadian AI Strategy

May: AI Singapore Announced

October: AI Strategy 2031

December: Finland's AI Strategy

January: Budget for AI Taiwan

March: AI at the Service of Citizens

April: First Workshop for Strategy

April: UK AI Sector Deal

May: White House Summit on AI

May: Sweden's AI Strategy

June: Towards an AI Strategy in Mexico

Fall 2018: EU's AI Strategy

2017

2018

March: AI Technology Strategy

July: Next Generation AI Plan

December: Three-Year Action Plan

January: Blockchain and AI Task Force

January: Strategy for Digital Growth

March: France's AI Strategy

April: Communication on AI

May: Australian Budget

May: AI R&D Strategy

June: National Strategy for AI

Fall 2018: Germany's AI Strategy

World Ranking (CSRankings.org)

CSRankings: Computer Science Rankings

CSRankings is a metrics-based ranking of top computer science institutions around the world. **Click on a triangle** (▶) to expand areas or institutions. **Click on a name** to go to a faculty member's home page. **Click on a pie** (the ⬤ after a name or institution) to see their publication profile as a pie chart. **Click on a Google Scholar icon** (📰) to see publications, and **click on the DBLP logo** (🐦) to go to a DBLP entry.

Rank institutions in [the world ⇕] by publications from [2000 ⇕] to [2018 ⇕]

All Areas [off | on]

AI [off | on]
- ▶ Artificial intelligence ☑
- ▶ Computer vision ☐
- ▶ Machine learning & data mining ☑
- ▶ Natural language processing ☐
- ▶ The Web & information retrieval ☐

Systems [off | on]
- ▶ Computer architecture ☐
- ▶ Computer networks ☐
- ▶ Computer security ☐
- ▶ Databases ☐
- ▶ Design automation ☐
- ▶ Embedded & real-time systems ☐
- ▶ High-performance computing ☐
- ▶ Mobile computing ☐
- ▶ Measurement & perf. analysis ☐
- ▶ Operating systems ☐
- ▶ Programming languages ☐
- ▶ Software engineering ☐
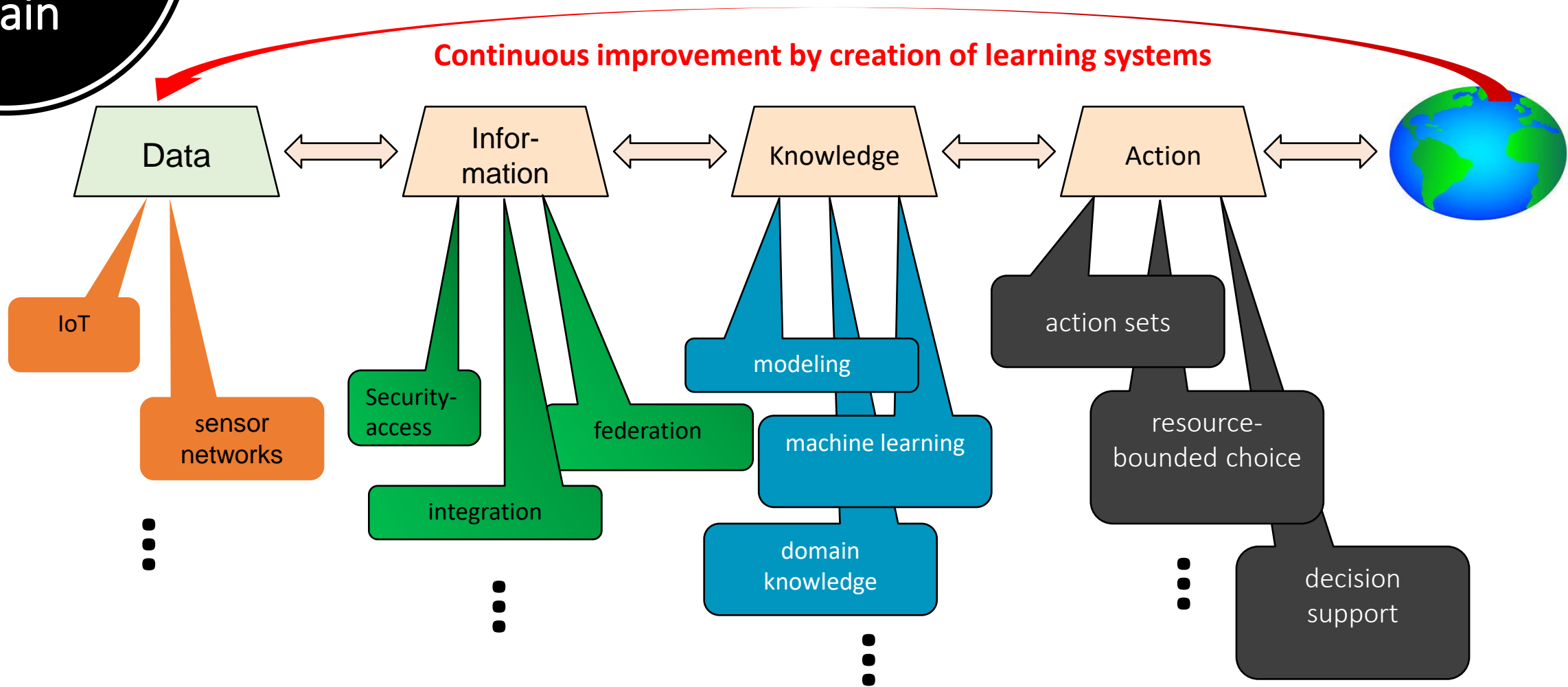
#	Institution	Count
1	▶ Carnegie Mellon University ⬤	134.8
2	▶ Tsinghua University ⬤	79.9
3	▶ University of Alberta ⬤	63.6
4	▶ Cornell University ⬤	58.3
5	▶ Technion ⬤	56.4
6	▶ Massachusetts Institute of Technology ⬤	49.3
7	▶ University of Texas at Austin ⬤	46.9
8	▶ HKUST ⬤	46.0
9	▶ University of California - Berkeley ⬤	45.3
10	▶ University of Massachusetts Amherst ⬤	42.7
11	▶ University of Michigan ⬤	42.6
12	▶ University of California - Los Angeles ⬤	41.9
13	▶ Stanford University ⬤	41.6
14	▶ Georgia Institute of Technology ⬤	40.4
15	▶ University of Oxford ⬤	39.2
16	▶ University of Toronto ⬤	38.3

The "Big Data" value chain

Continuous improvement by creation of learning systems

Data — Infor-mation — Knowledge — Action

IoT

sensor networks

Security-access

federation

integration

modeling

machine learning

domain knowledge

action sets

resource-bounded choice

decision support

Data Science Workflow

Key success requirements:

1. **access to data**
2. **data domain expertise**, including how to measure potential value for related business processes, and
3. **data scientists** committed to work with the data domain experts to achieve improvements in domain expert defined key performance indicators.

Define Objectives

- Confirm access to appropriate data
- Define clear domain specific KPIs

Data Capture & Curation

- Acquire data from original sources (e.g. sensors or legacy systems)
- Ensure possibility for continuous capture, correction, and adjustment

Data Analysis

- Perform data analysis to explore data value potential

E.g,. time series cycles, principle component analysis, data labelling/annotation requirements

Data Model Generation

- experiment with alternative model generation techniques

E.g., logistic regression, support vector machines (SVM), deep learning, Reinforcement Learning, condition-action rules, etc.

Data Model Interaction

- Create Interactive Dashboard for Domain Experts
- Design Evaluation Experiments to Measure performance against KPIs

Interaction, Feedback, and Adjustment as required

Where does data science apply?
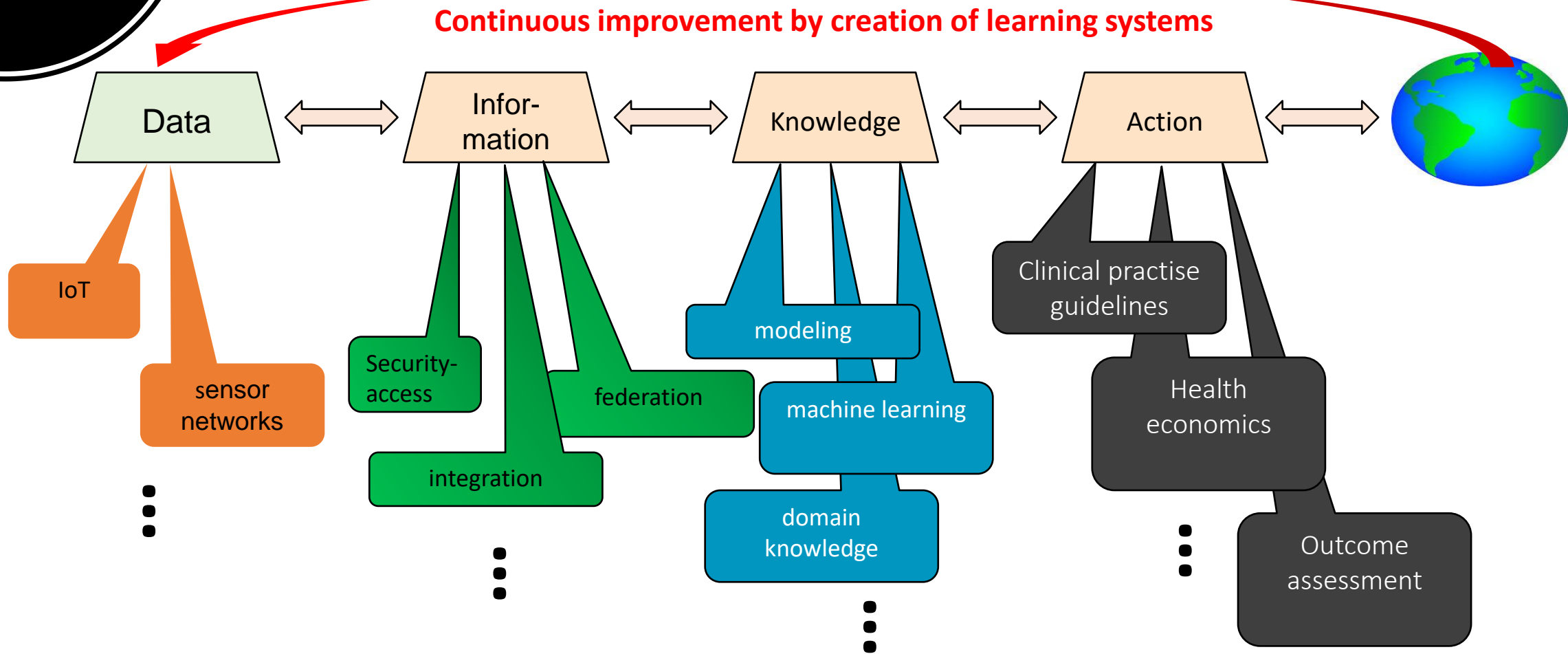
Precision Health

- Personal and public (health) data
- Repertoire of changing intervention choices
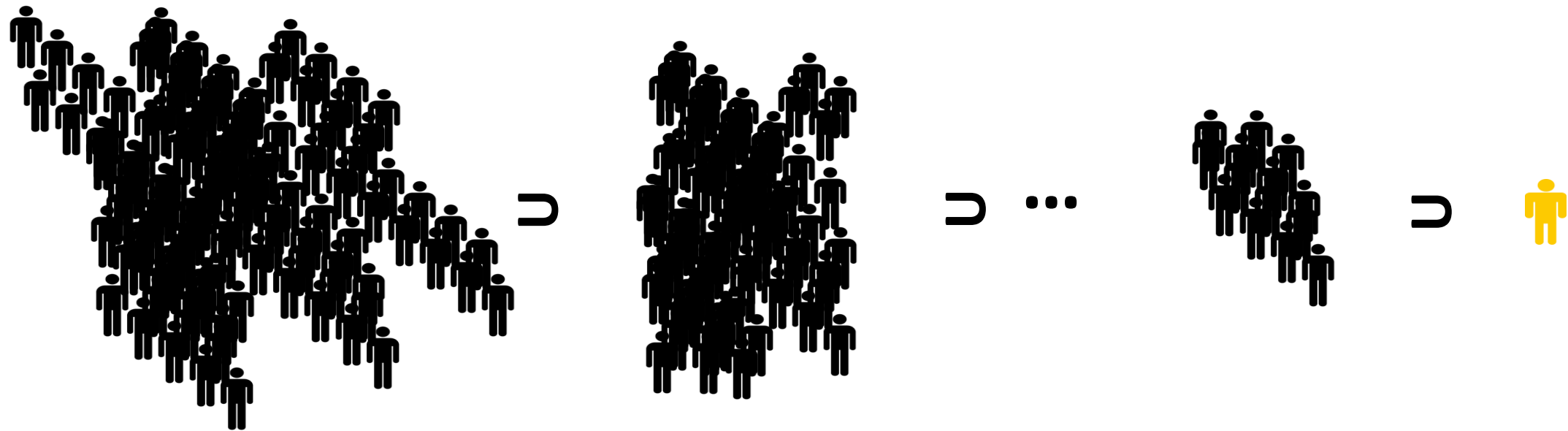- Feedback loop for intervention outcomes.

Precision Law

Precision Education

Precision Democracy

The data value chain in medicine

Continuous improvement by creation of learning systems

Data — Information — Knowledge — Action

- IoT
- sensor networks

- Security-access
- integration
- federation

- modeling
- machine learning
- domain knowledge

- Clinical practise guidelines
- Health economics
- Outcome assessment

Data and "Personalized" Medicine

Towards personalized medicine …

Data and Precision Medicine

1p, 19q

-1p, -19q
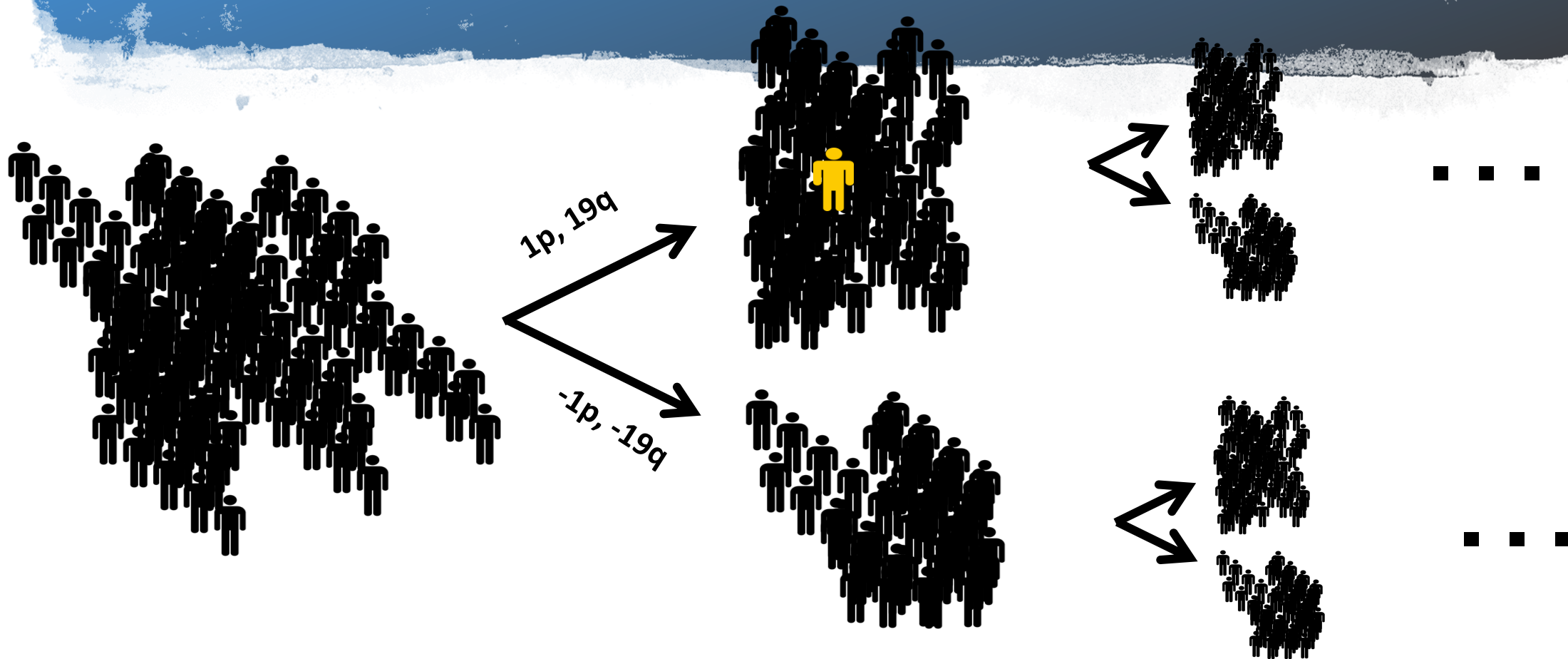
Towards precision medicine …

Image-based glioma biopsy

- Input:
- - ?? labeled cases

- Method:
- compute S-transform frequency spectrum for each pixel, the average over all directions to get 1D spectra for each tumor;
- build multi-frequency classifier based on these labeled cases
- in these measurement results, BLUE 30 co-deleted 1p/19q, GREEN 24 intact 1p/19q
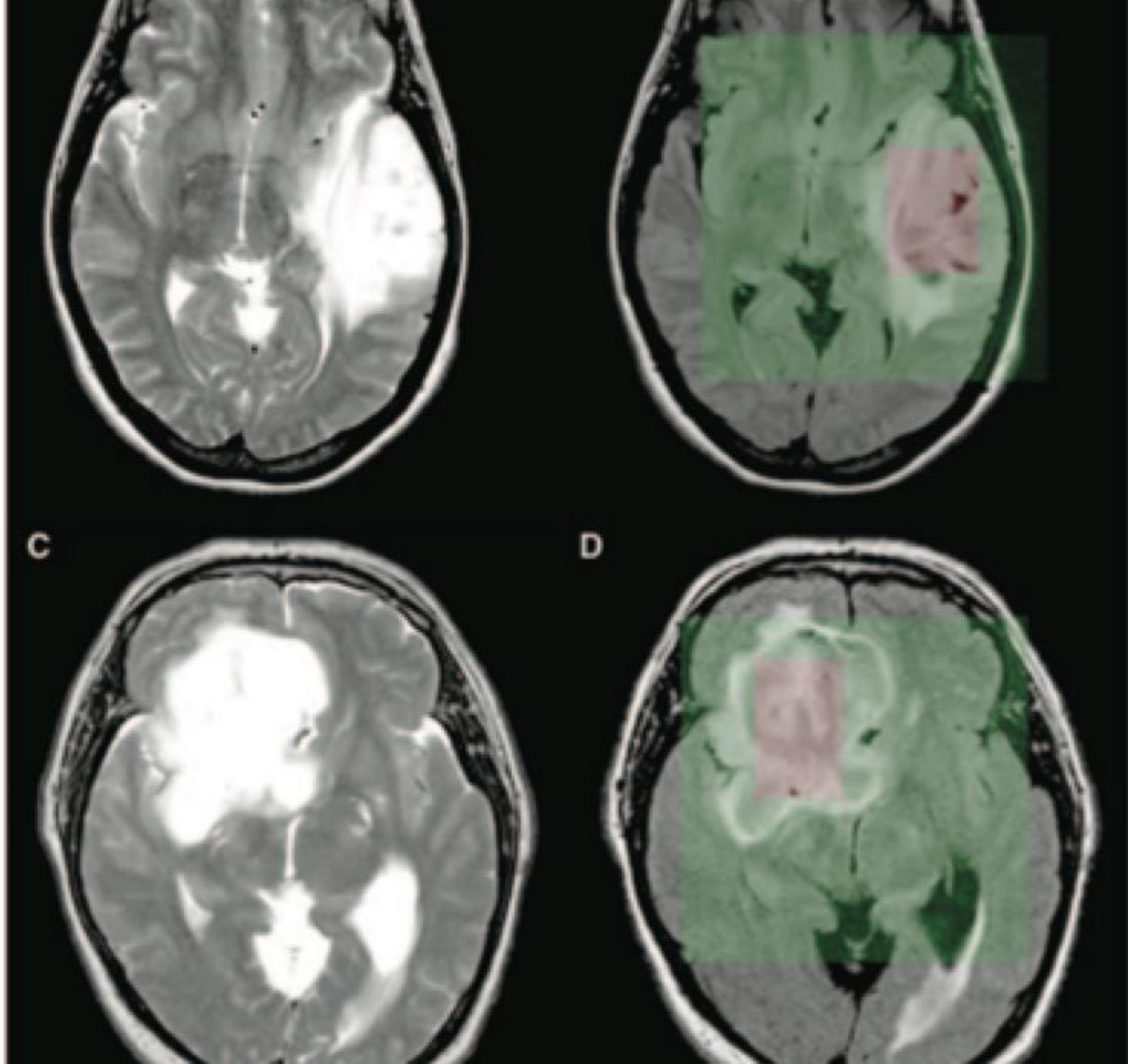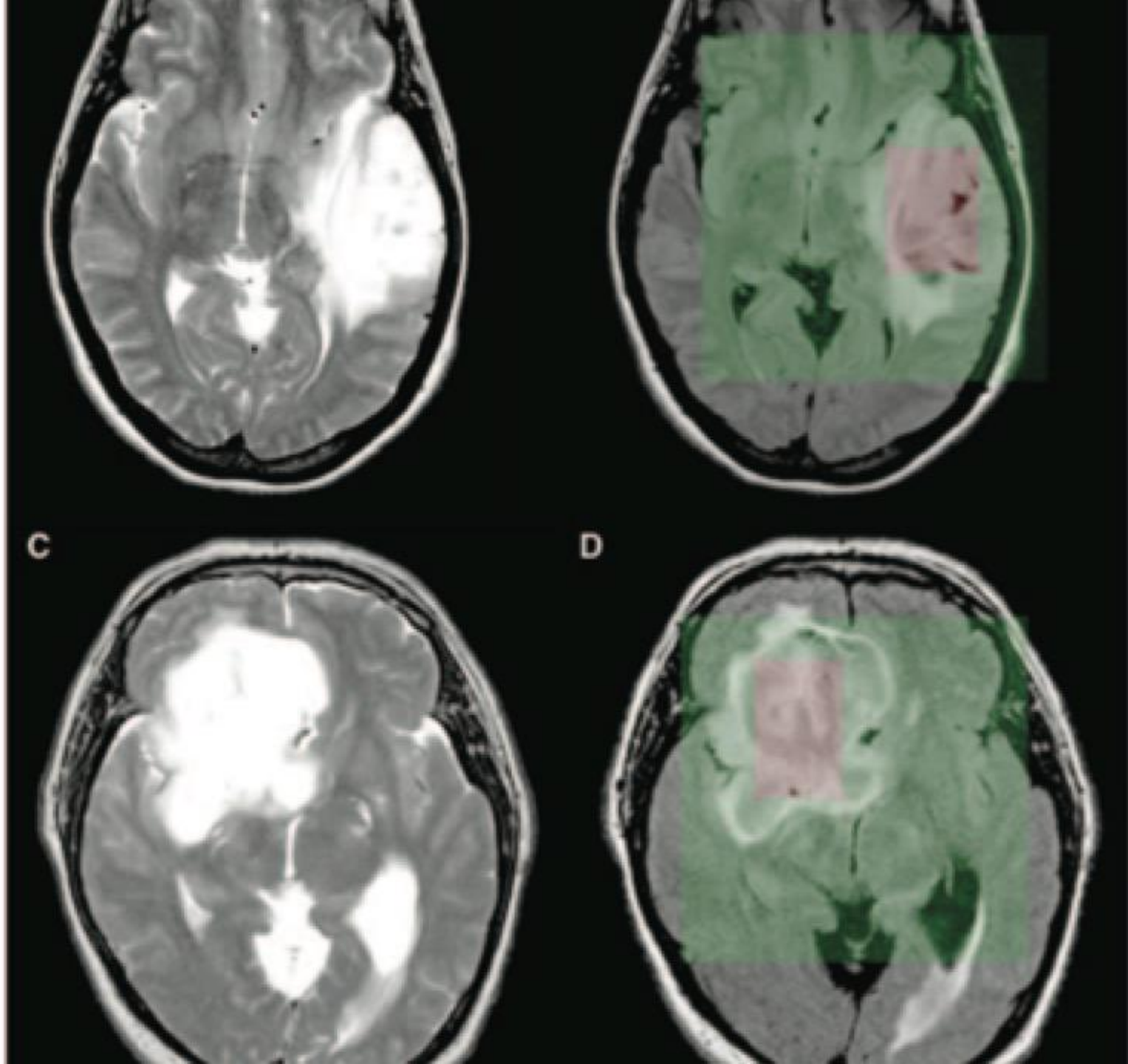
- Results:
- - 95-96% accurate

Image-based glioma biopsy

- Input:
- - 55 labeled cases

- Method:
-   compute S-transform frequency spectrum for each pixel, the average over all directions to get 1D spectra for each tumor;
-   build multi-frequency classifier based on these labeled cases
-   in these measurement results, BLUE 30 co-deleted 1p/19q, GREEN 24 intact 1p/19q

- Results:
- - 95-96% accurate

Summary

Keeping abreast of AI Science to quickly develop and apply AI technologies

- Strengthen connections between science and industry
- Keep attention on social impact of AI and emerging societal values

Economic Value of AI – like anything, what's the ROI?

- Based on identifying and extracting models which support business models and economic KPIs

Impact obtains from connecting good research and good business expertise

- Access to (good) data
- Access/collaboration with domain experts
- Collaboration/commitment of data scientists