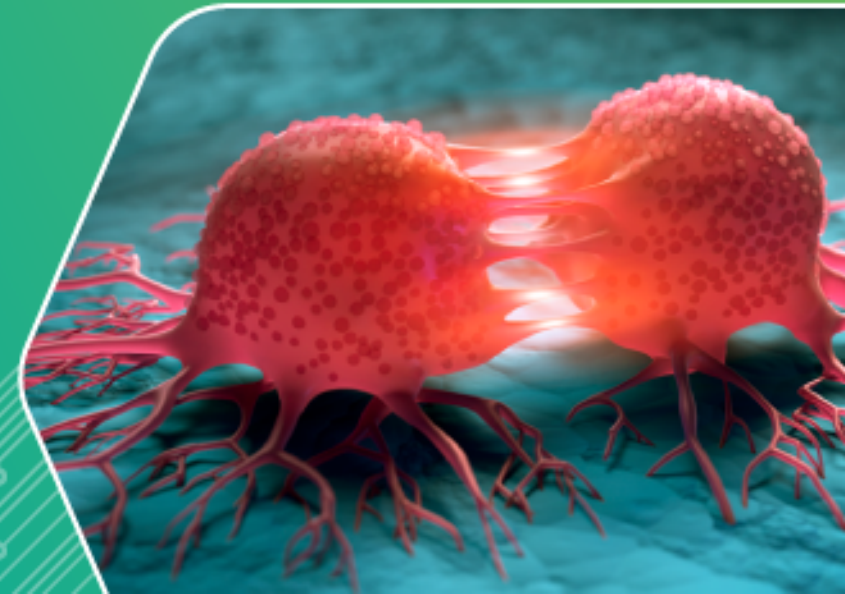
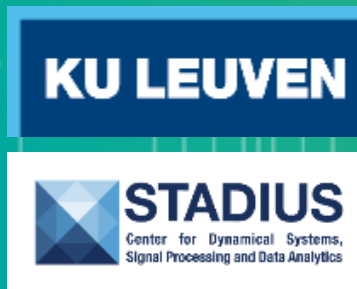




Advancing Cancer Care
by Leveraging AI
in Medicine

Artificial intelligence, machine learning and clinical data mining

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What is Artificial Intelligence and Machine Learning?



- Artificial intelligence

- “Intelligence” as demonstrated by a machine unlike ‘natural (animal, human) intelligence’
- Mimic the human mind in ‘cognitive functions’ and ‘problem solving’
- Mimic = by massive computing power, exploiting tsunami of data
- Interdisciplinary: mathematics, computer and information science, psychology, linguistics, ...
- Emotionality ? (Self-)consciousness ?

- Machine Learning

- Computer algorithms that ‘improve’ their performance through experience/data processing
- Supervised (e.g. by providing classification labels) or unsupervised (e.g. data reduction)
- Interdisciplinary: mathematics, statistics, numerical optimization, ...
- Training and validation data
- Generalization ? Transfer Learning ?

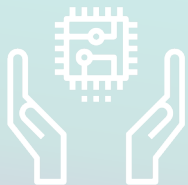




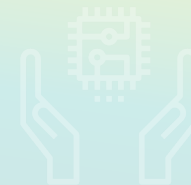
AI: Why now ?



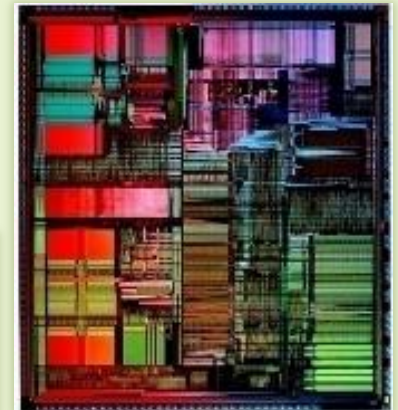
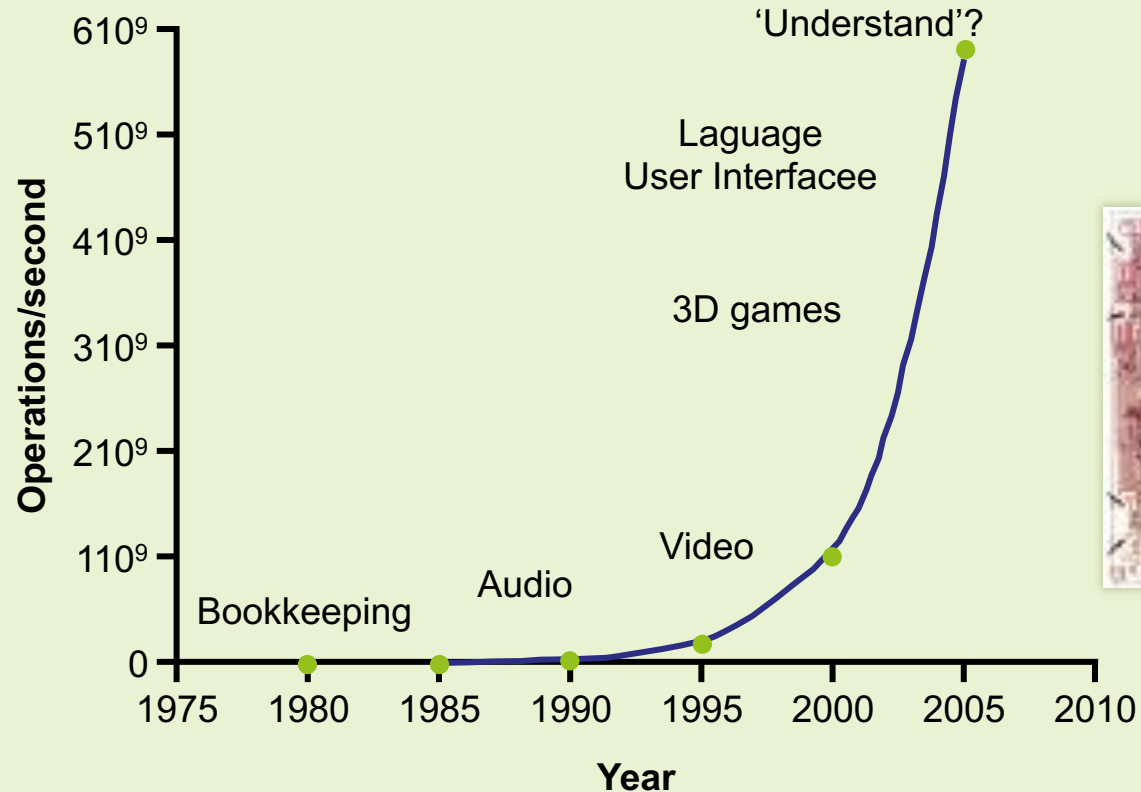
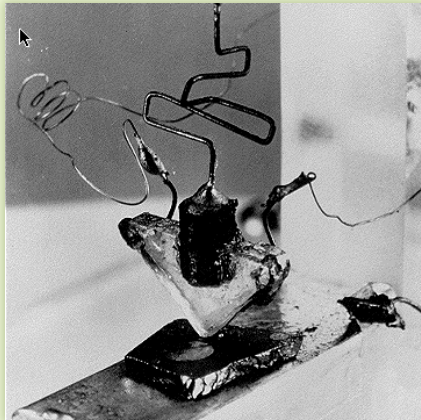
Some clinical examples



Future opportunities



The 3rd industrial revolution: Transistors and Very Large Scale Integration (VLSI): Moore's law !



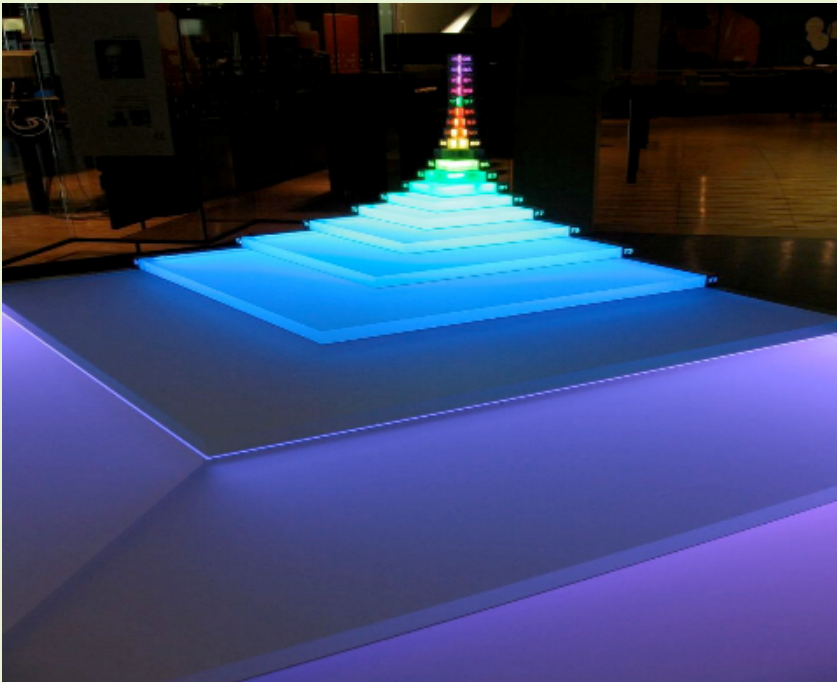
Processing power of chips: x 2 every 18 months = 56 % per year !



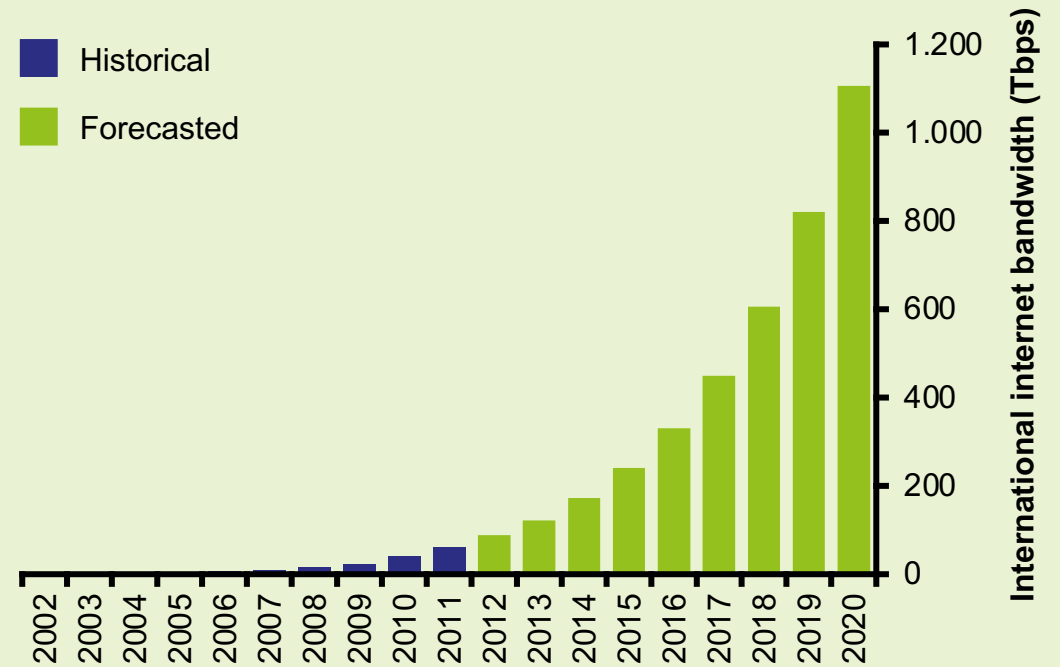
Also bandwidth and connectivity grow exponentially



Connectivity and bandwidth explosion¹



Bandwidth and connectivity evolve exponentially²



1. <http://claretownhill.typepad.com/weblog/2009/06/counting-down-to-the-end-of-moores-law.html> (Accessed Feb 2021)
2. <http://arstechnica.com/business/2012/05/bandwidth-explosion-as-internet-use-soars-can-bottlenecks-be-averted> (Accessed Feb 2021)



The internet consumes more bytes in 30 minutes than mankind grains of rice in a year

Grains of rice the world consumes annually:
27.5 quadrillion



Amount of data the world consumes every 30 minutes:
40.4 petabytes



1 million = 1 000 000
1 billion = 1 000 000 000
1 trillion = 1 000 000 000 000
1 quadrillion = 1 000 000 000 000 000

1 kB = 1 000
1 MB = 1 000 000
1 GB = 1 000 000 000
1 TB = 1 000 000 000 000
1 PB = 1 000 000 000 000 000

1 TB = large university library
= 212 DVD discs
= 1430 CDs
= 3 year music CD quality

The concept “Big Data” implies several “spheres”



What can we do with data driven algorithms ?

Data reprocessing, denoising, normalization



Clustering and classification; future detection; profiling



Relevance detection, ranking



Dynamic modelling, time series, longitudinal modelling



Decorrelation, modelling, (Kalman) filtering



Predictive analytics



Visualization



Heterogeneous data fusion



Prediction, processing and monitoring

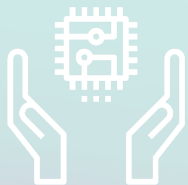




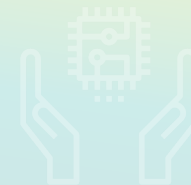
AI: Why now ?



Some clinical examples



Future opportunities



In the next 10 years, data science and software will do more for medicine than all the biological sciences together.”

- Vinod Khosla, Khosla Ventures

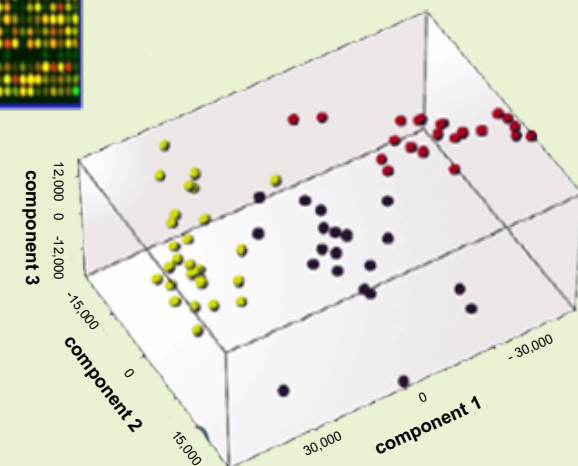
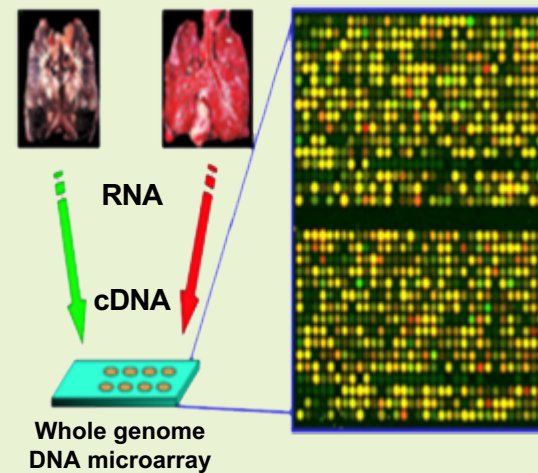
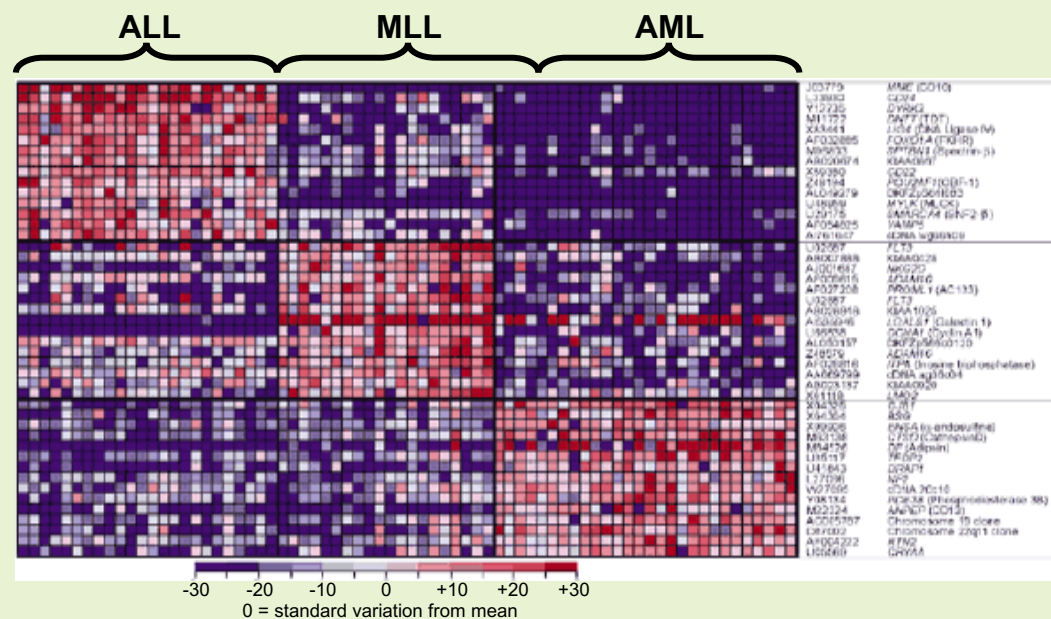


Example: DNA-chips + data processing: Genomic markers for leukaemia



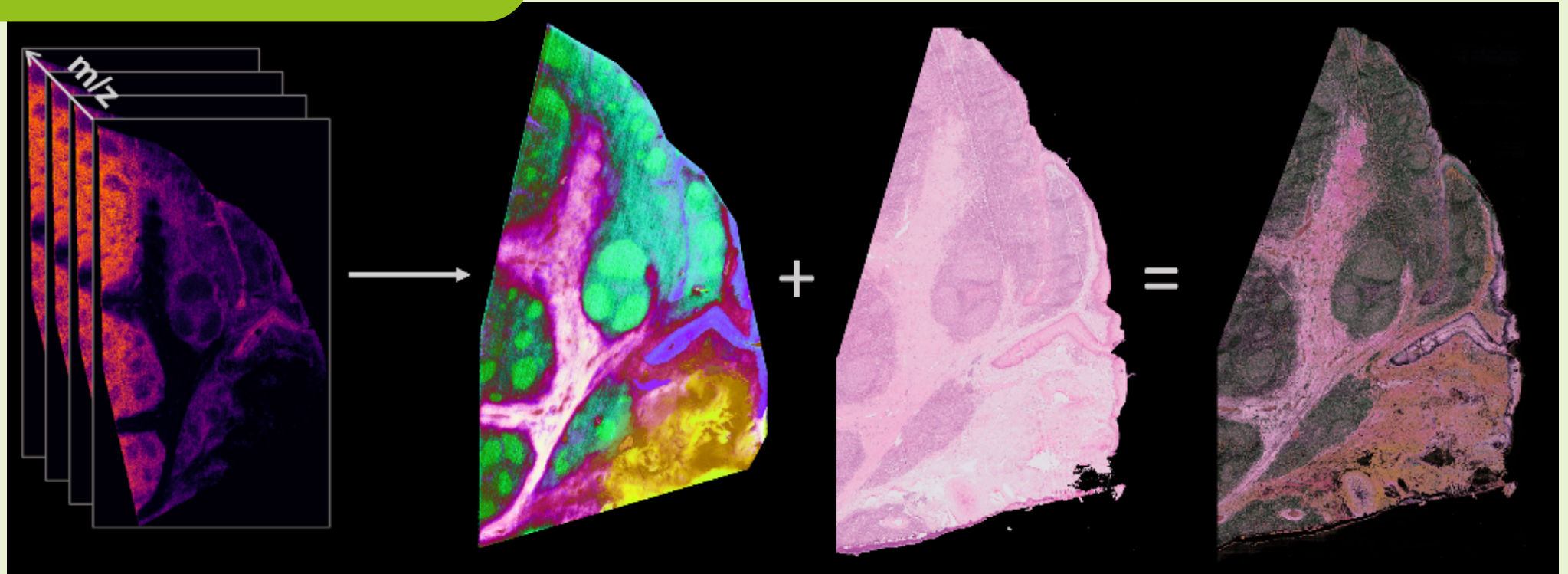
12,600 genes
72 patients

- 28 acute lymphoblastic leukaemia (ALL)
- 24 acute myeloid leukaemia (AML)
- 20 mixed linkage leukaemia (MLL)



Example: Mass spectrometry imaging + 3D tensor data processing: high resolution cancer detection

MSI dataset: 500 000 pixels x 8000 m/z
30 Gb

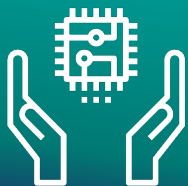




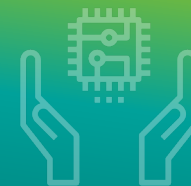
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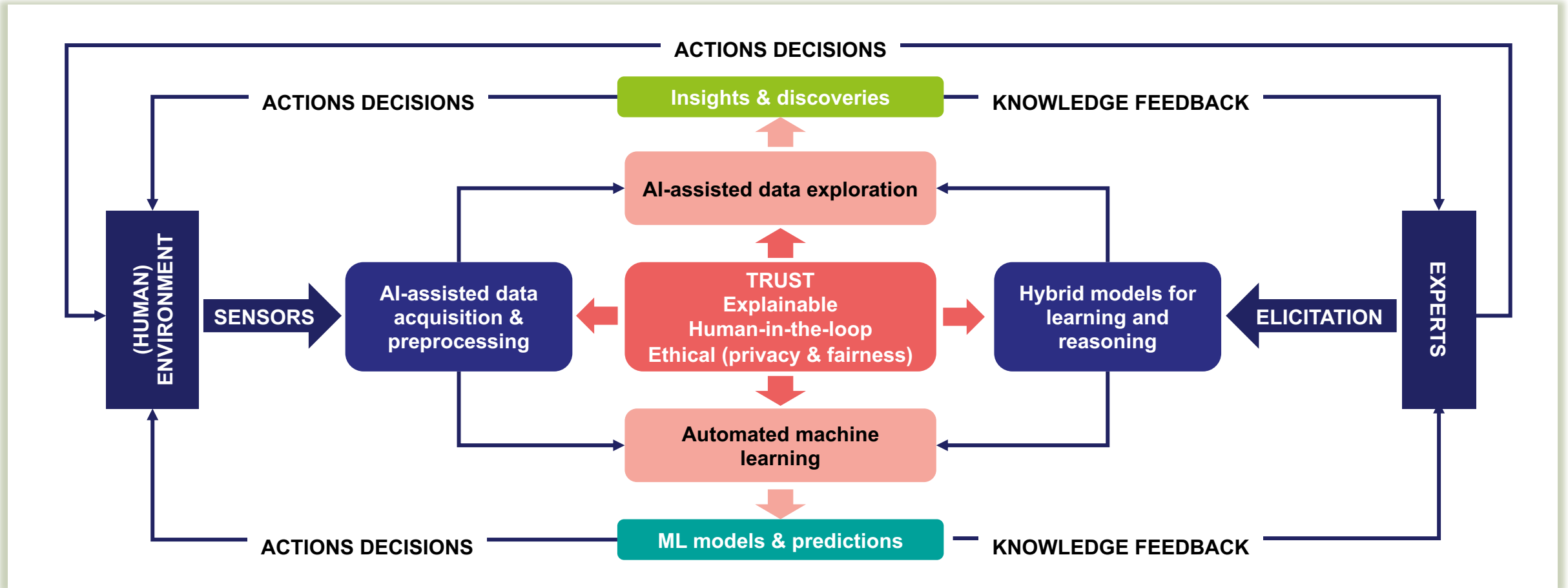
Some clinical examples



Future opportunities



Clinical Decision Support Systems with expert-in-the-loop



Sharing data on a need to know basis: Privacy-preserving mining and machine learning

