

THINKLab

Artificial Intelligence and Innovation in Healthcare

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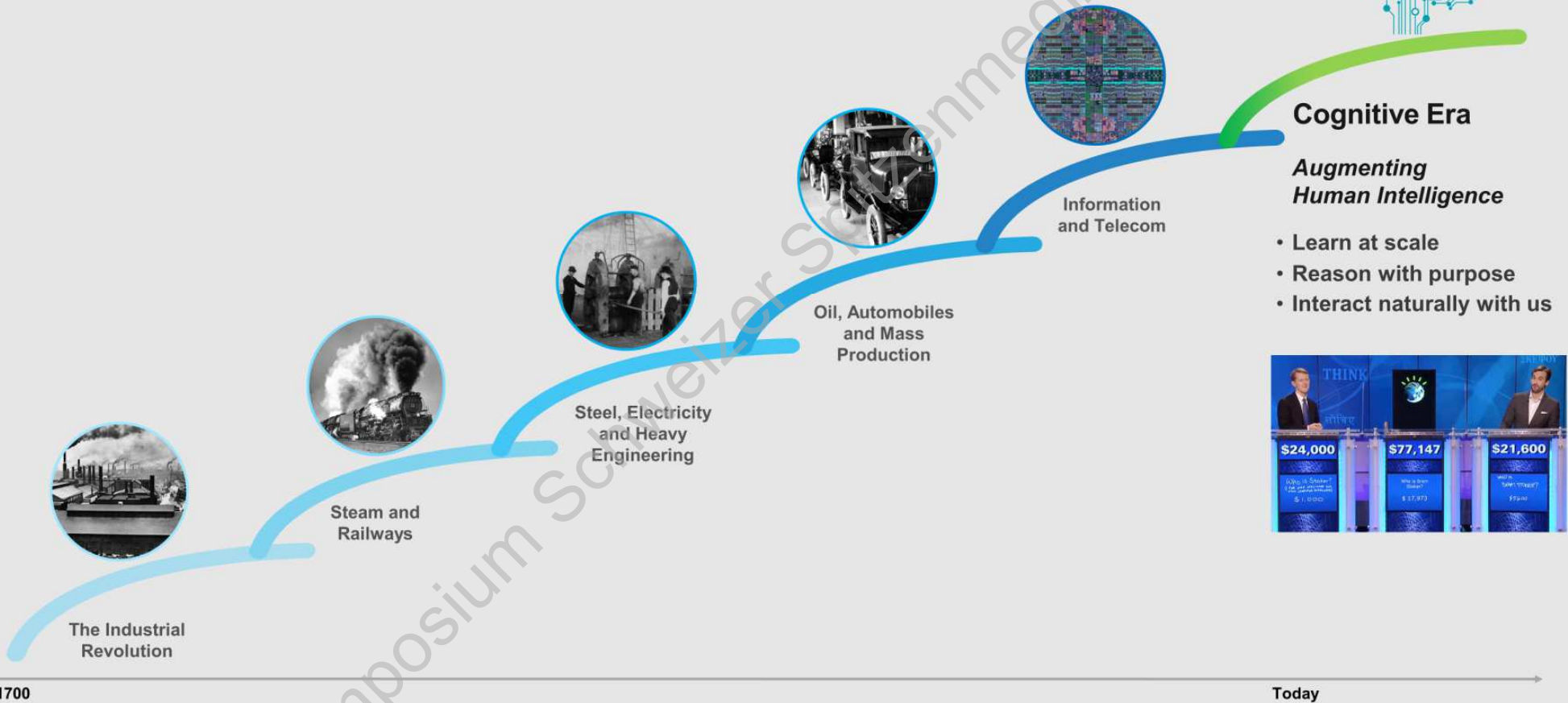
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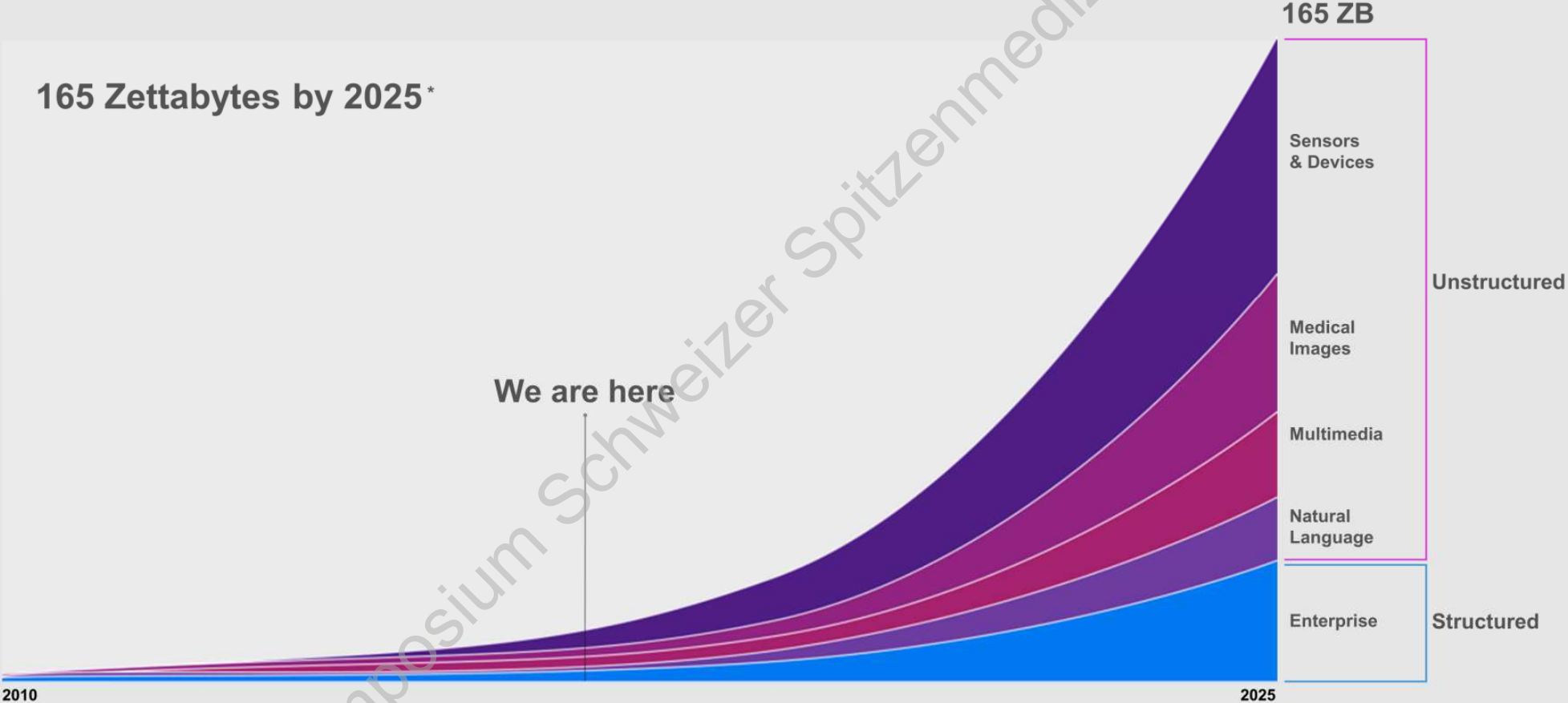
The next revolution is to **augment human cognition**



1700

Today

Data is growing exponentially and demands **new approaches**



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*Source IDC. IBM projections based on analyst report



Unstructured data — “dark data” — accounts for 80% of all data generated today.

Symposium Schweizer Sportmedizin 2017

Cognitive computing uses **all types of data**

Own data

- Customer records
- Transactional systems
- Predictive models
- Institutional expertise
- Operational systems



External data

- News
- Events
- Social media
- Weather
- Geospatial information



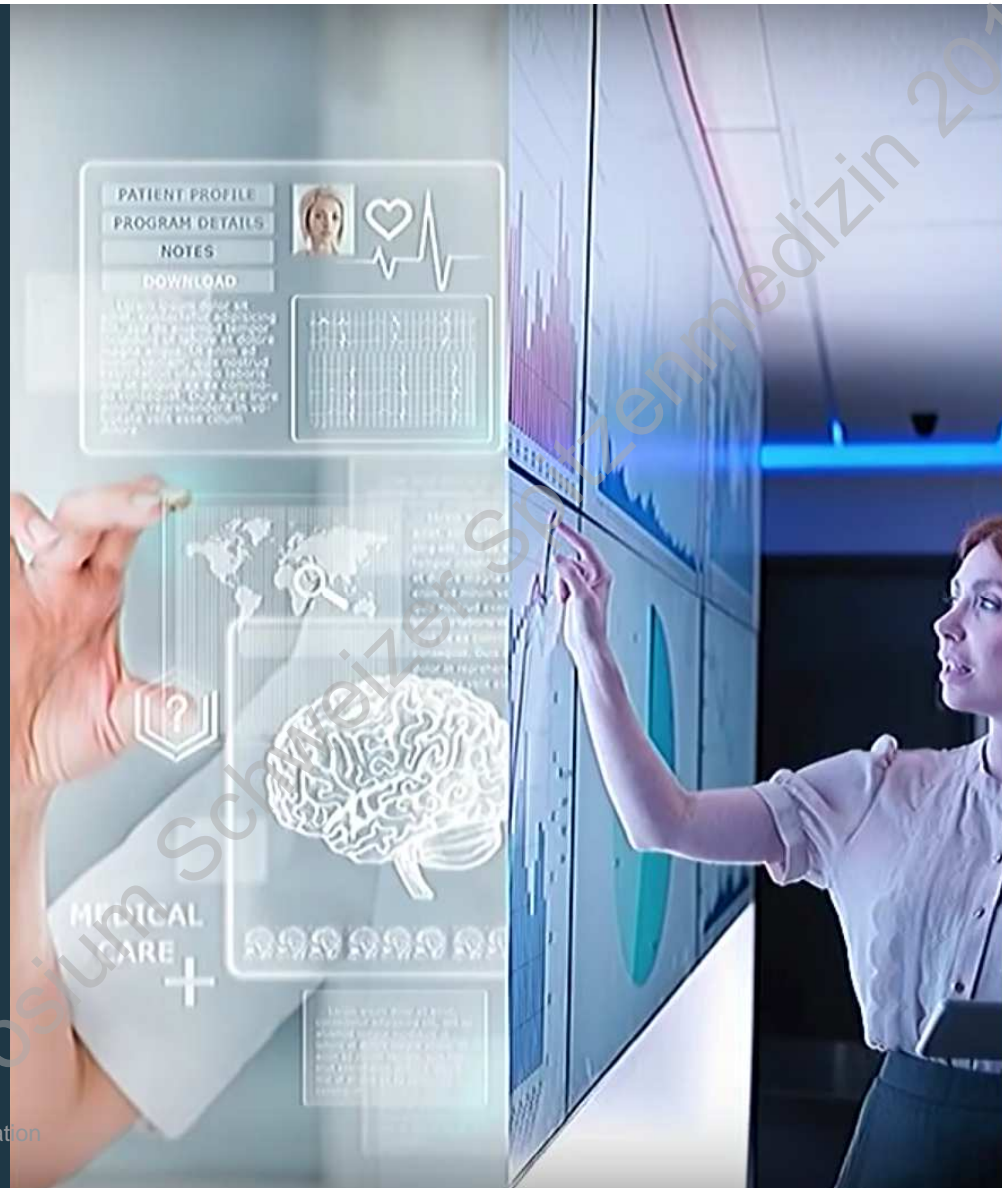
Arriving data

- Internet of Things (IoT)
- Sensory data
- Images
- Video

Structured and active

Unstructured and dark

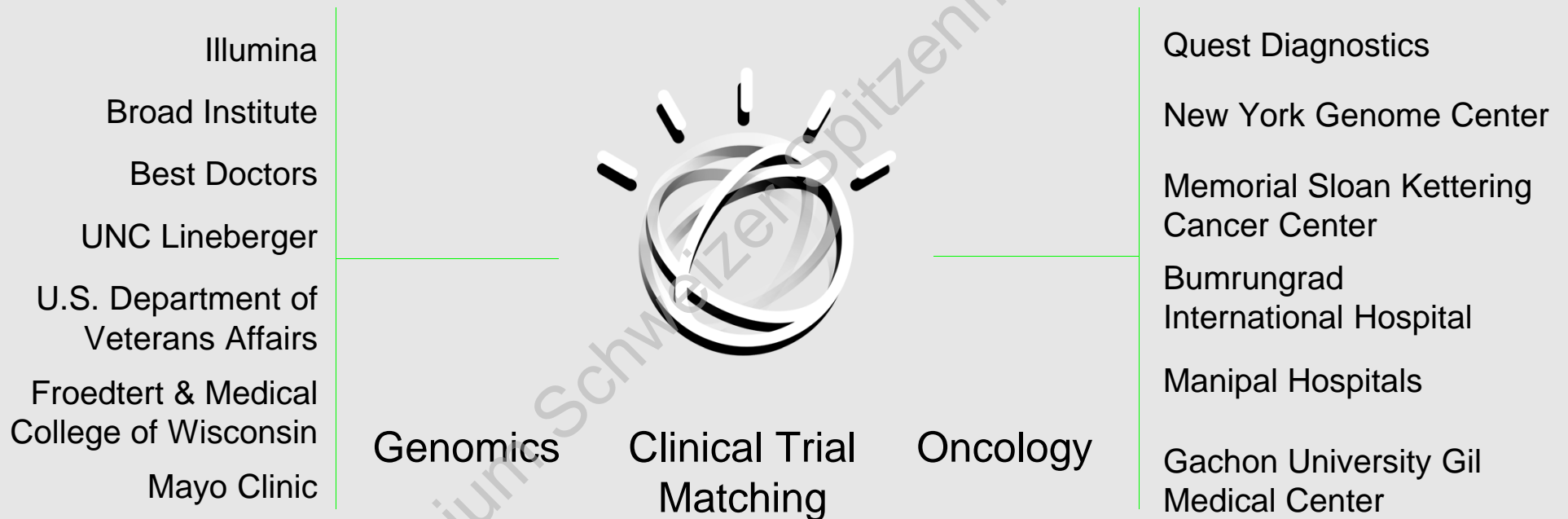
Cognitive systems must learn at scale, reason with purpose, and interact with humans naturally.



Collaborating with clients across industries to solve hard problems

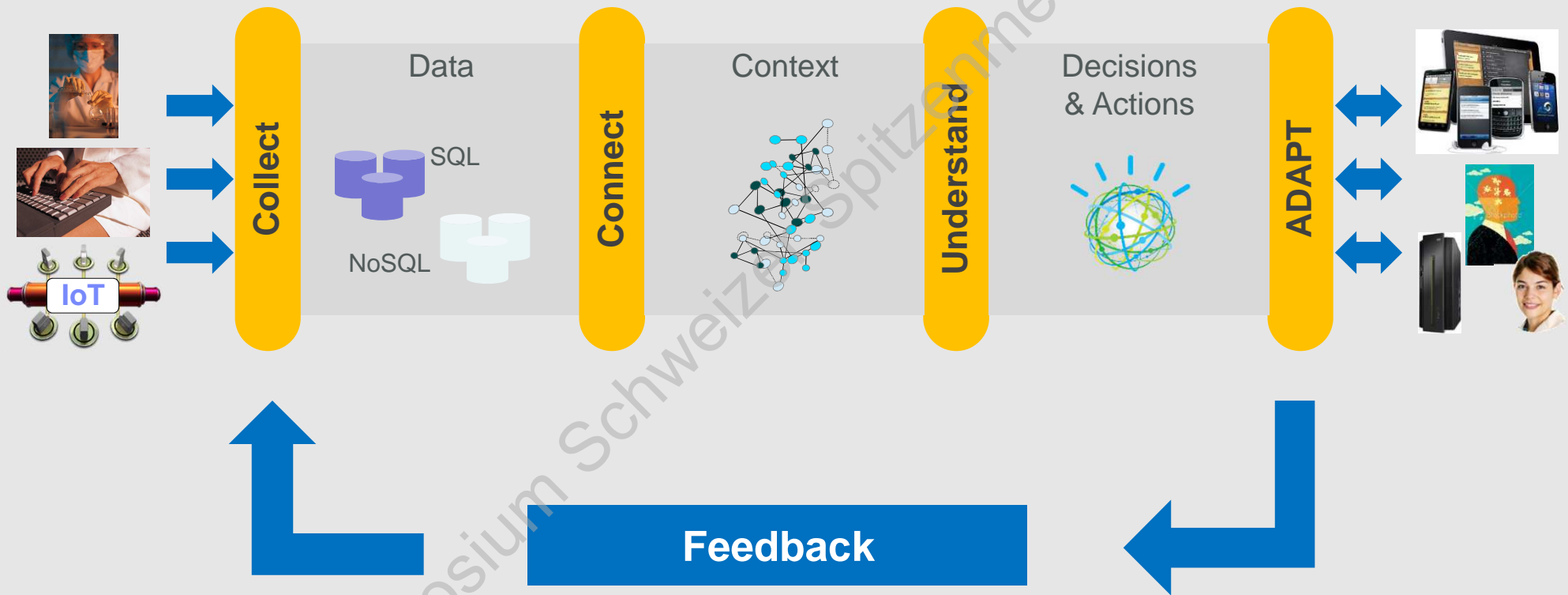


Empowering the Oncology Community for Cancer Care: 35+ Hospital Systems



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Cognitive decision support



Sample Patient Cases for Evaluation

Filter

Sort by:

Range: 1-10 Total: 49

1 2 3 ... 5

10 | 25 | 50 | All +

Bryan, Mr. Eric

Diagnosis: Colon Cancer, Gender: M, Age: 73, Patient ID#: Example 91505762-75fb-4a13-a336-25d641db57a6
Last Updated: 1/22/2015, 1:46:45 PM



Brown, Mrs. Christine

Diagnosis: Breast Cancer, Gender: F, Age: 64, Patient ID#: Example-gh36q7-g45h-ah1-4562sk7a
Last Updated: 1/22/2015, 1:46:37 PM



Cary, Mrs. Olivia

Diagnosis: Breast Cancer, Gender: F, Age: 67, Patient ID#: Example-gf56f5-hy67-a45b-ah1-cvgw89a
Last Updated: 1/22/2015, 1:46:18 PM



Jackson, Mr. Larry

Diagnosis: Colon Cancer, Gender: M, Age: 47, Patient ID#: Example fc8bf916-3486-4d81-9af8-dc411e898f47
Last Updated: 1/21/2015, 7:53:16 AM



Lewis, Mrs. Samantha

Diagnosis: Rectal Cancer, Gender: F, Age: 68, Patient ID#: Example c10833e4-f4de-45ed-ae3a-941b36c93df9
Last Updated: 1/21/2015, 7:52:29 AM



Wu, Mrs. Alice

Diagnosis: Breast Cancer, Gender: F, Age: 66, Patient ID#: Example d04b4081-c268-43fb-9d69-c77e7d20daad
Last Updated: 1/20/2015, 1:40:41 PM



Bryan, Mr. Eric

Diagnosis: Colon Cancer, Gender: M, Age: 73, Patient ID#: Example 91505762-75fb-4a13-a336-25d641db57a6
Last Updated: 1/20/2015, 1:40:27 PM



Range: 1-10 Total: 49

1 2 3 ... 5

10 | 25 | 50 | All +

Medical Sieve

Working to transform Parkinson's disease care



1 in 1,000

expected to develop Parkinson's

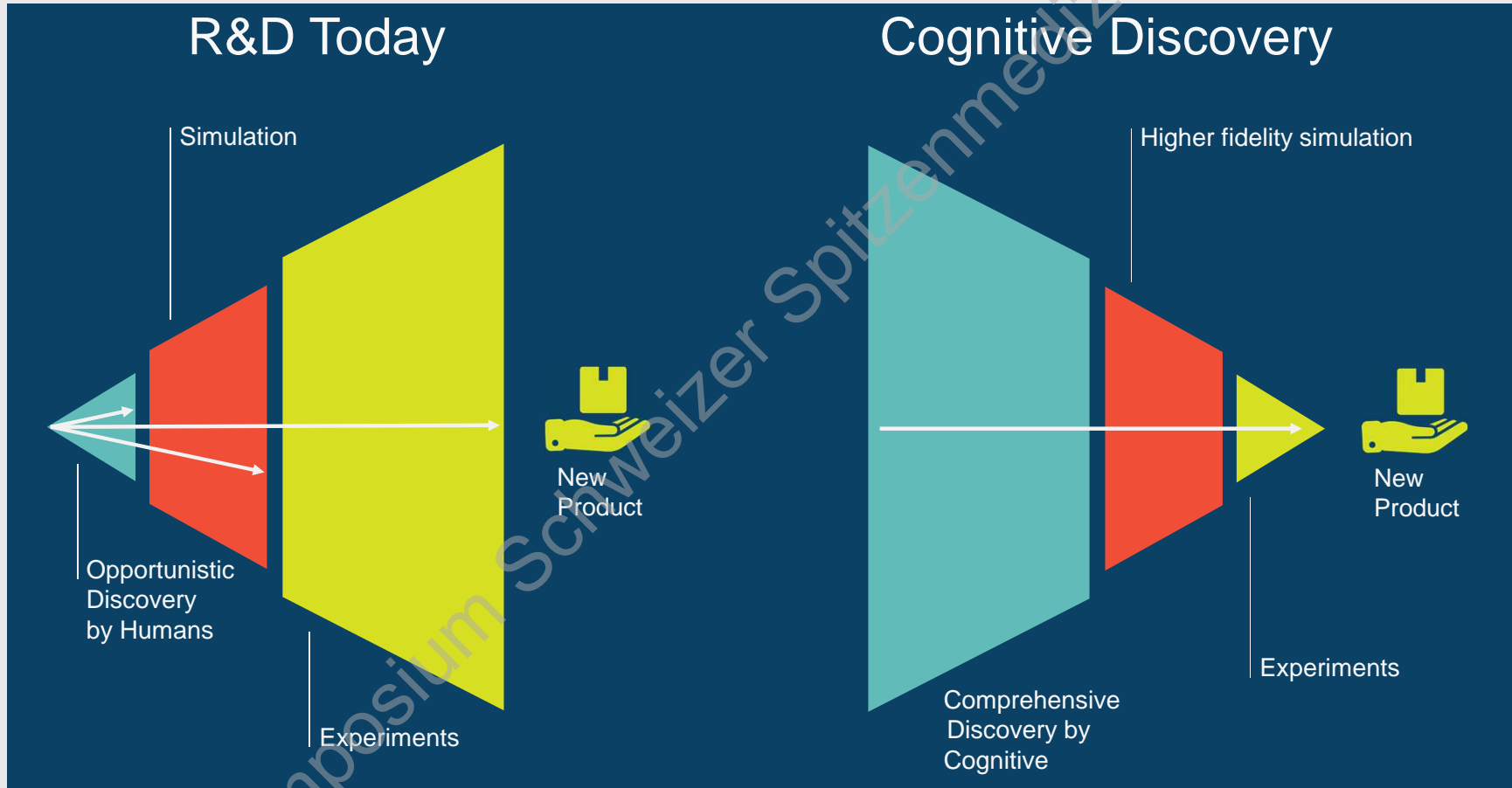
10%

are under 50 years of age

\$25 billion

in annual direct and indirect costs of care,
social payments and lost income

Research Assistant



The amount of medical knowledge continues to explode to the point where it will double every 73 days by the year 2020

Deep parsing of scientific papers

Takes about 30 seconds on a laptop, 20,000 papers/week

Goal:

- Manage
- Parse
- Annotate
- Train/learn
- Convert

PDF documents into a semantic representation

J. HICKMAN AND Y. MISHIN
PHYSICAL REVIEW B 93, 224108 (2016)

FIG. 7. Typical order parameter profile used to calculate the GB width in a single snapshot. The blue points are raw values of the structure factor $S(z_i)$ and the red curve is the smoothed profile $\phi(z_i)$. The simulation was for the $\Sigma 5$ GB at 1200 K with the grain composition of 2.23 at.% Ag. The upper image shows the atomic positions projected along the [001] tilt axis normal to the page, with yellow points representing Cu atoms and blue points Ag atoms.

FIG. 8. Probability density functions $P(w_i)$ for different values of ΔM (in eV) computed for the $\Sigma 5$ GB at the temperature of 1000 K. The inset shows the segments $\psi(w)$ of the disjoining potential extracted from these functions. The curves are the normalized distributions predicted by the analytical disjoining potential.

profile could be alternatively used to calculate w . However, we chose to use the structural order parameter throughout this work to ensure consistency between the alloy and pure Cu simulations.³

The described calculation of w was repeated for all N_p snapshots saved in each simulation. The number of snapshots increased as the simulation condition approached the solidus line. From the entire set of GB widths obtained in a simulation, a histogram was constructed using the number of bins $2(N_p)^{1/2}$ (the Rice rule). The histogram was then scaled by the bin width and divided by N_p to obtain a discrete probability density function $P(w_i)$ normalized to unity of its midpoint Riemann sum. As an example, Fig. 8 shows a set of probability functions for the $\Sigma 5$ boundary at 1000 K. In total, twelve such sets were generated in this work (three GBs, three temperatures for the alloys, and one temperature set for pure Cu).

D. Calculation of the disjoining potential

As discussed in Sec. II C, the GB width distribution $P(w)$ is related to the disjoining potential $\Psi(w)$ by Eq. (20). Inverting this equation, we get

$$\Psi(w) = -\frac{k_B T}{\lambda} \ln P(w) + p_0^2 w + D, \quad (30)$$

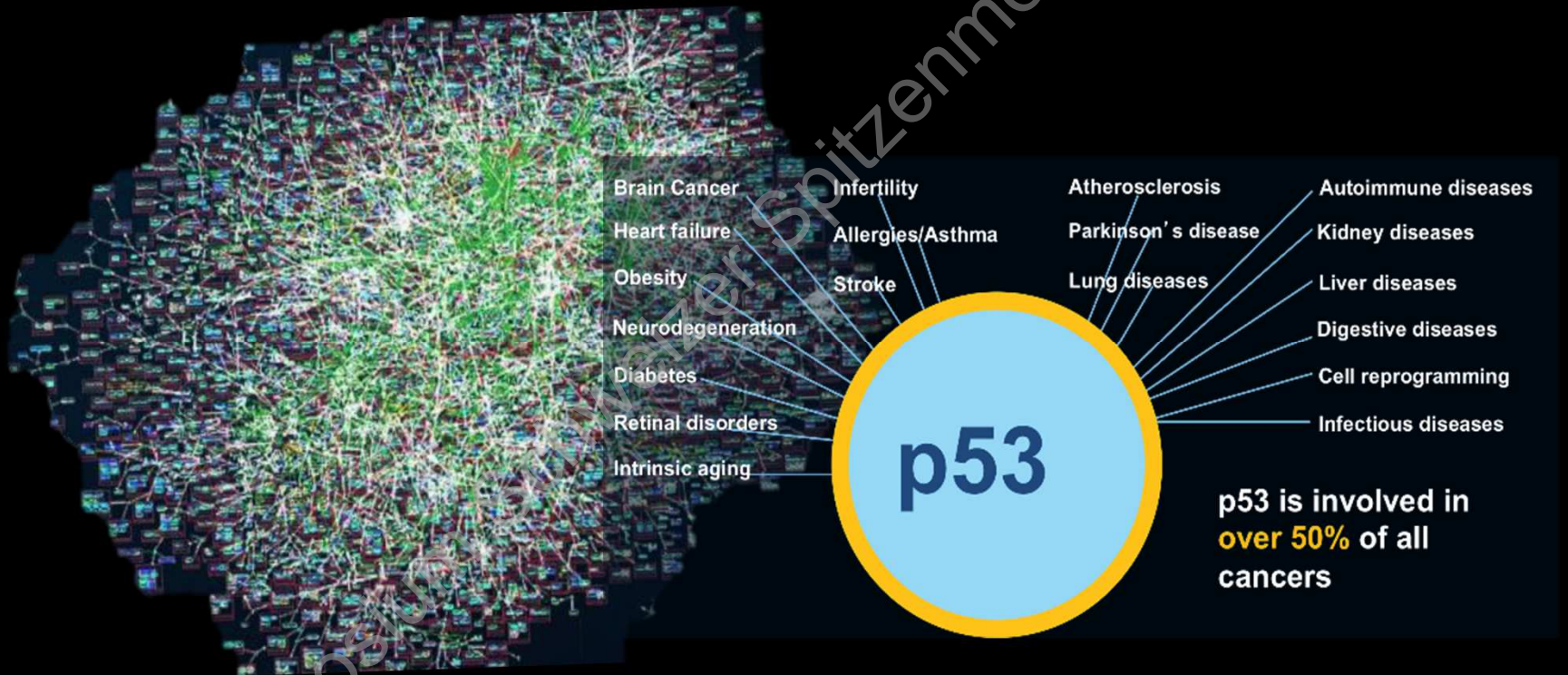
where D is the logarithm of the normalization coefficient. Recall that p_0^2 is given by Eq. (15) for pure Cu and by Eq. (12) for a Cu-Ag alloy, the superscript 0 being a reminder that this disjoining pressure is computed at the bulk solid-liquid equilibrium. The undercooling temperature

³As indicated in Sec. II A, the GB width w is defined as the distance between two dividing surfaces in the solid-liquid interfaces satisfying the condition $\bar{N} = 0$. The described practical definition of w through the order parameter profile need not satisfy this condition and constitutes an approximation. The larger w , the more accurate this approximation becomes.

224108-10

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Cognitive Discovery

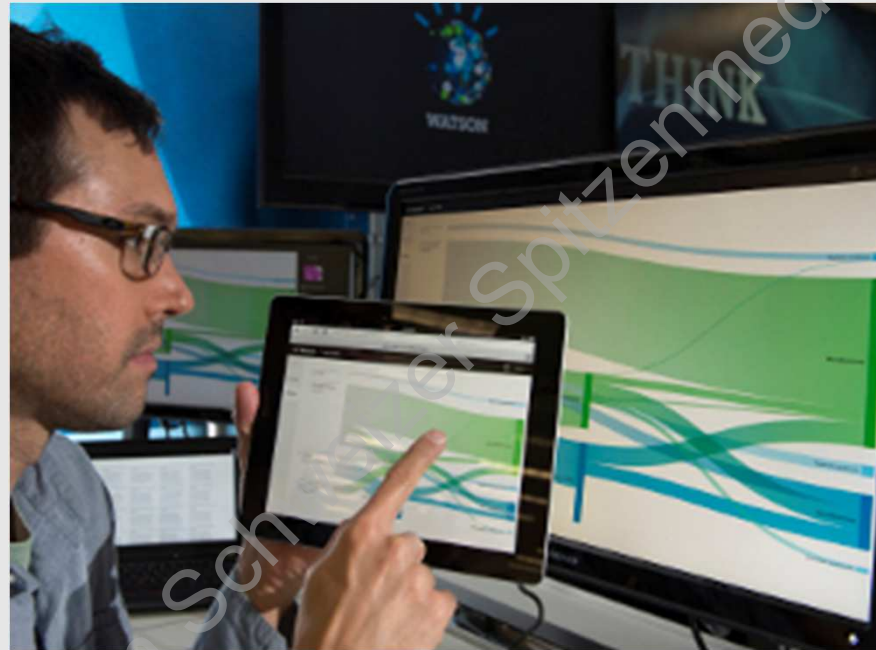


Implications for academic education and professional development in medicine

Implications can be identified on various levels

- Leveraging AI for personalized learning and teaching
- Training how to work with the AI system (e.g. when to trust an algorithm and when to trust the own intuition, asking the right questions)
- Enhancing human core competencies to optimize partnership of men and machine for the benefit of the patients (Digital humanism)
- Developing methods to cultivate critical thinking
- Developing a new research approach
- ...

Cognitive Tutor for medical students at Humanitas University



Personalized study platform through the choice of content, simulations, feedback and insights with the level of knowledge of the individual student, through a simple interface as an app.



Value judgement
Dilemmas
Intuition
Dreaming
Creativity
Design
Empathy
Holistic perception
Generalization
Abstraction
Common sense
Critical thinking

Deep learning
Pattern discovery
Statistical reasoning
Large-scale math
Locating Knowledge
Fact checking
Eliminating bias
Endless capacity
Total recall

Principles for the Sustainable Development of AI

Purpose

Augment human intelligence, rather than replace it

Transparency & Trust

- When and for what purposes is AI being applied?
- Which sources of data and expertise create an insight?
- Prevent Bias and Misuse: AI systems need to be as transparent as possible (data sets, algorithms)
- How to embed values?

Economic Opportunity & Societal Implications

- Skills and knowledge to perform the work that will emerge in a cognitive economy
- Fundamental transformations in the way we live and work
- Legal and governance implications of AI



Partnership on AI
to benefit people and society

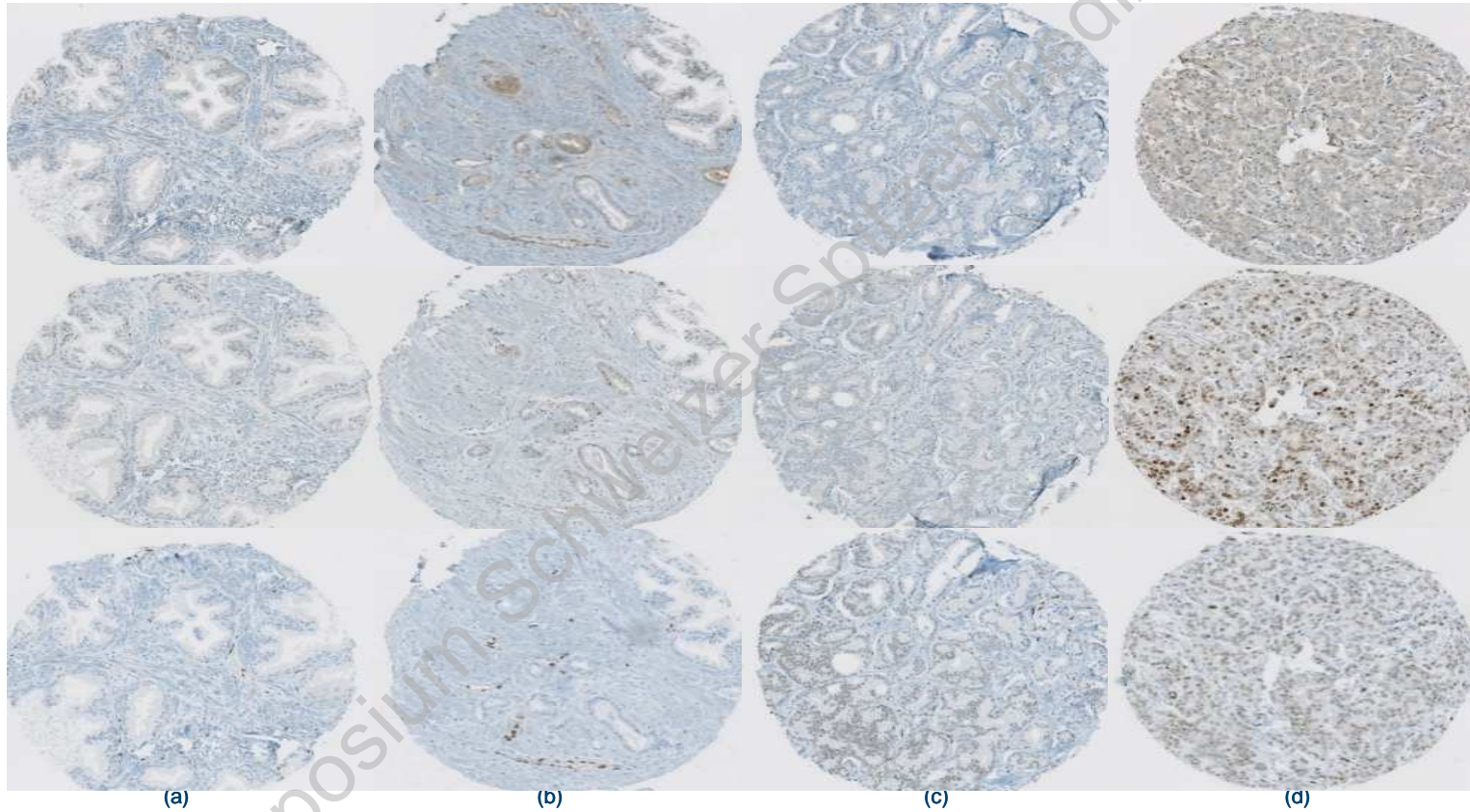
outthink limits

Digital Pathology


PTEN

P53

ERG



IHC prostate images of (a) normal, (b) GS=3+3, (c) GS=3+4/4+3 (d) GS=4+5



Cognitive systems are creating a new partnership between humans and computers that ***enhances, scales and accelerates*** human ***expertise and discovery.***



Thank You!