Agentic AI in Healthcare

1 September 2025

Keynote Address

INFOCOMM MEDIA DEVELOPMENT AUTHORITY

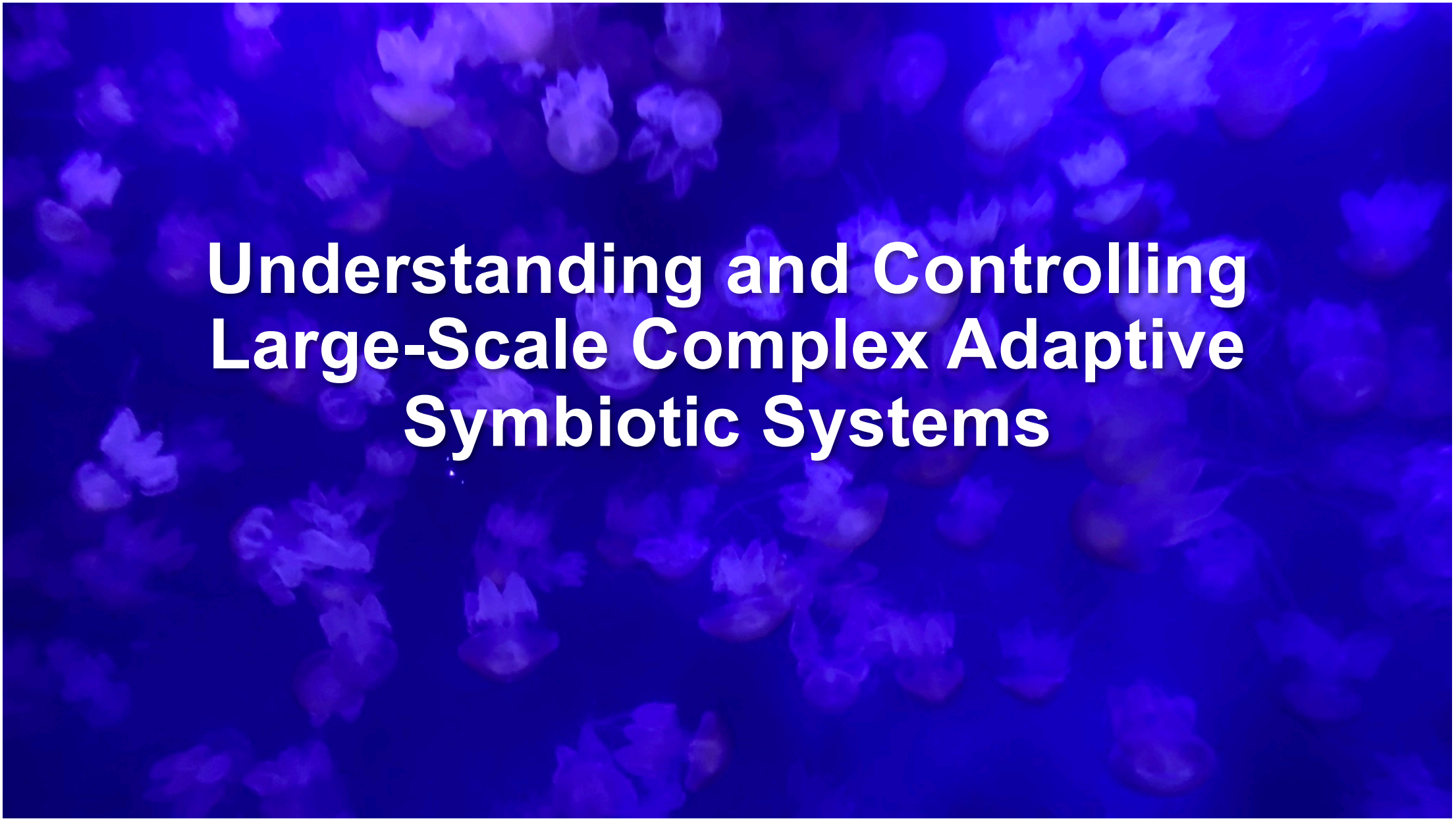
Dr. Hiroaki Kitano, CEO, SBX Corporation

Dr. Hiroaki Kitano's diverse career spans leadership and academia. He is President & CEO of SBX Corporation, President of the Systems Biology Institute, and a Chief Technology Fellow at Sony Group Corporation.

Dr Kitano also leads as President & CEO of Sony Computer Science Laboratories and is a Professor at the Okinawa Institute of Science and Technology. He received his Ph.D. in computer science from Kyoto University.

Agentic AI in Healthcare Industry

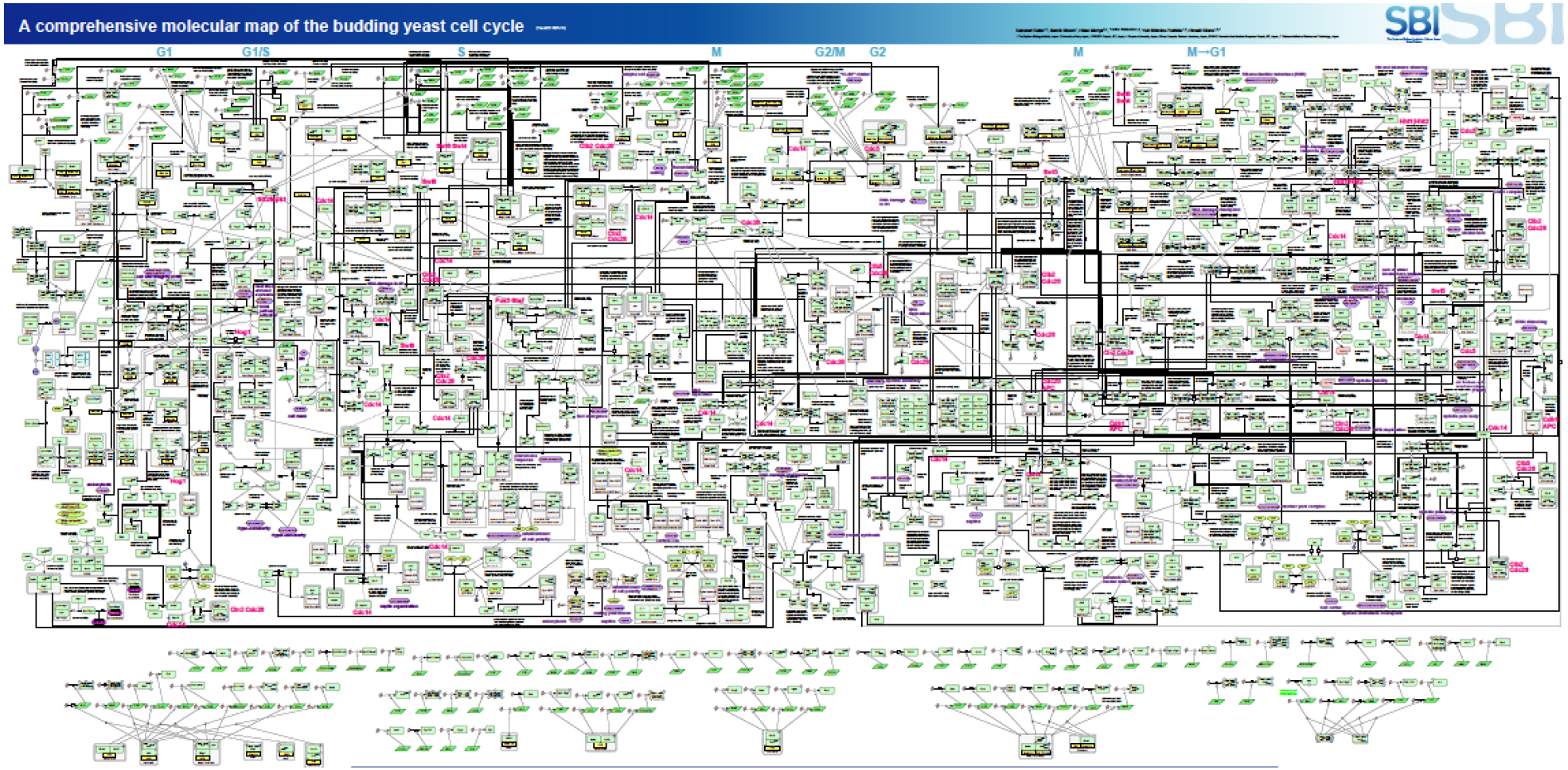
Hiroaki Kitano


Understanding and Controlling
Large-Scale Complex Adaptive
Symbiotic Systems


Biological Systems
Intelligent Systems
Financial Systems
Socio-Industrial Systems

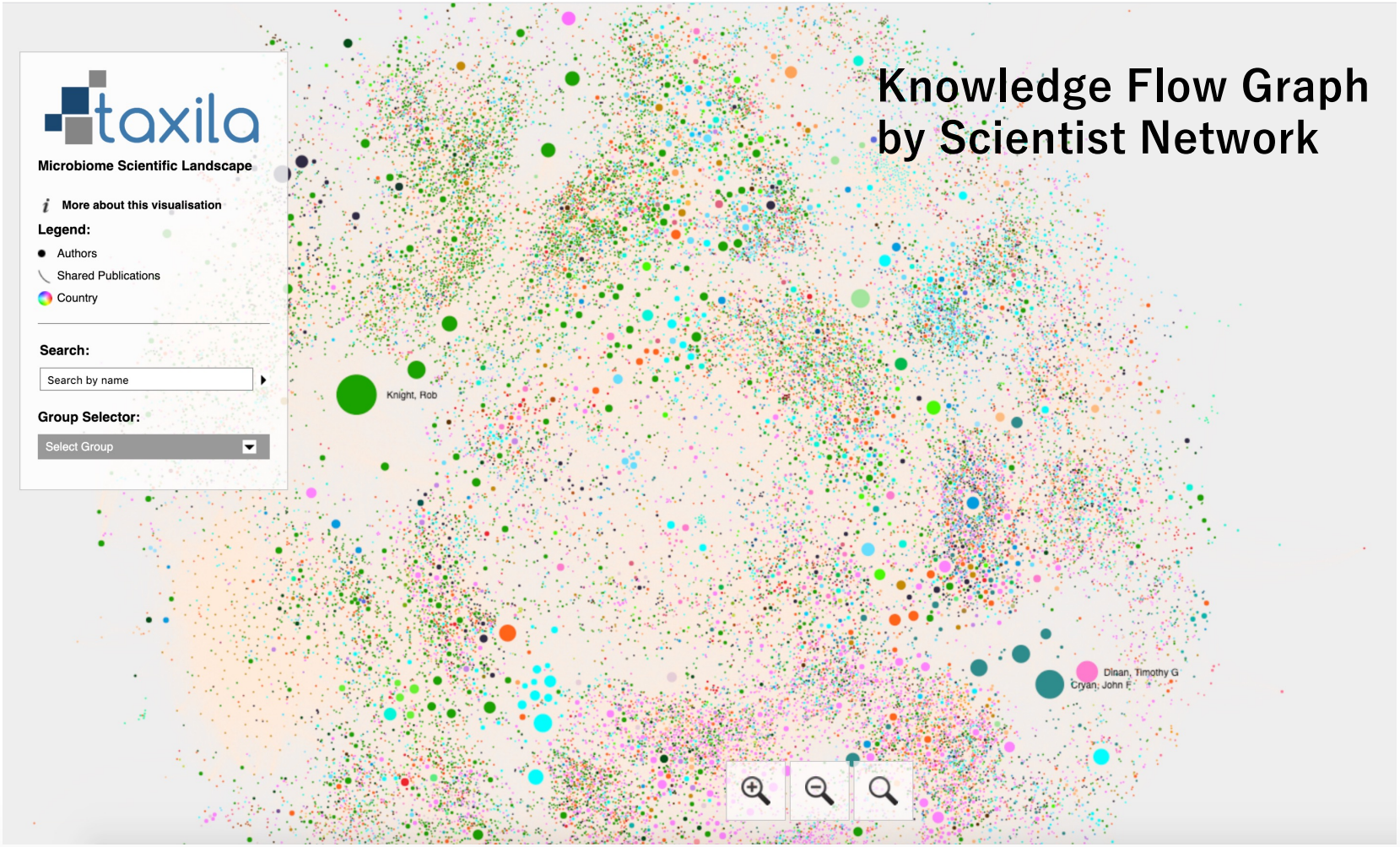
Scientific Front

Yeast Cell Cycle



Kaizu, K., et al., Molecular Systems Biology, 6:415, 2010

Complex Network of Knowledge Flow



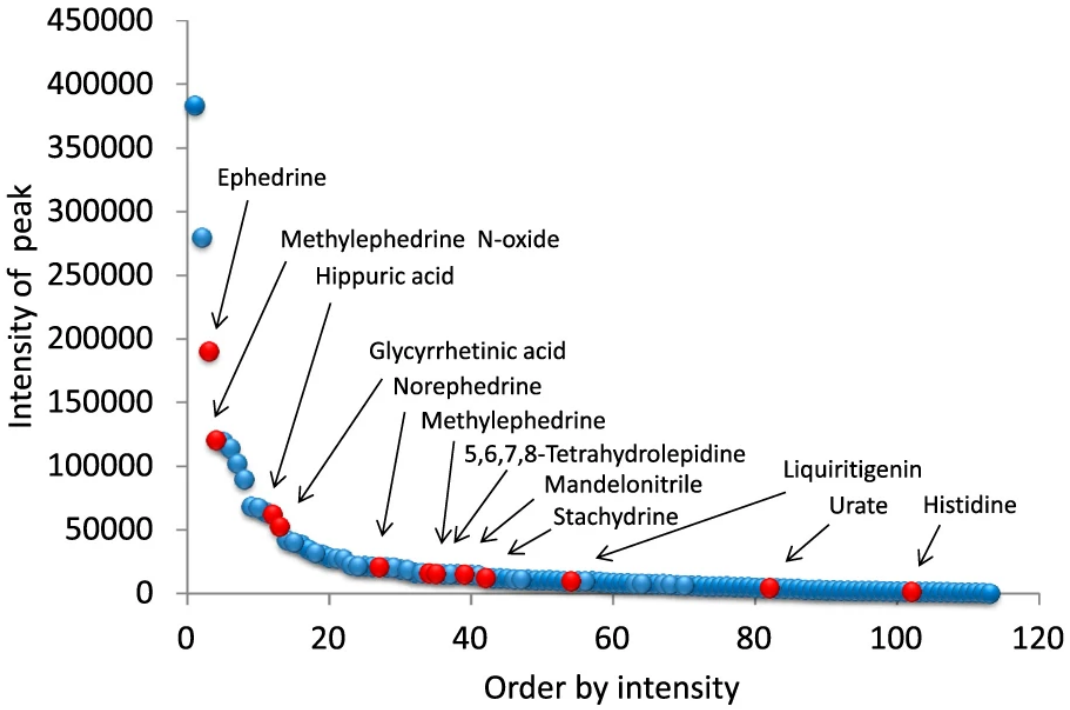
Microbiome research landscape by the Systems Biology Institute

Long-tail in Business

Source: Brynjolfsson, Hu, and Smith, "Consumer Surplus in the Digital Economy," *Management Science*, November 2003.

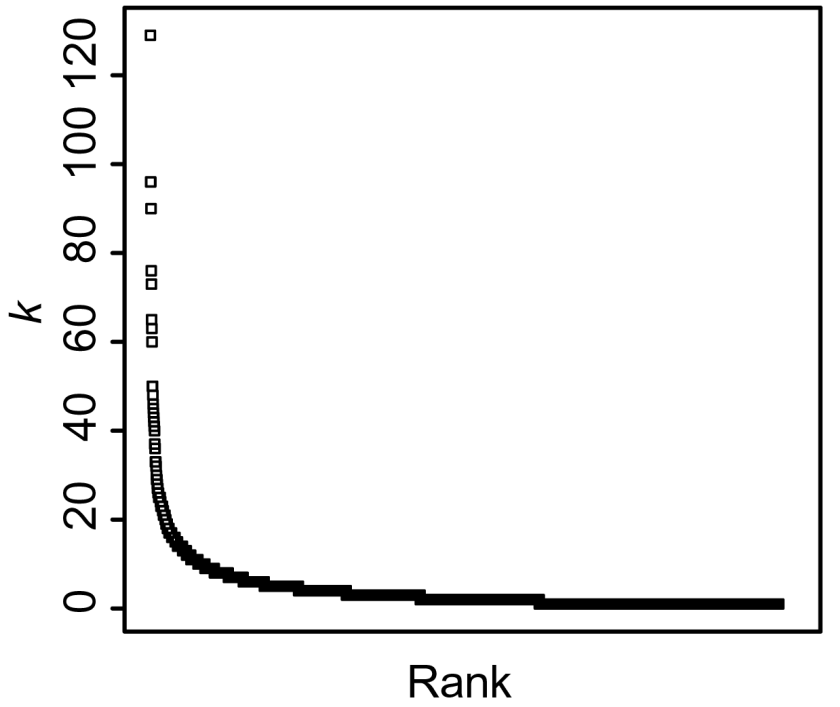
Long-tail in Biology

Kampo Traditional Herbal Medicine



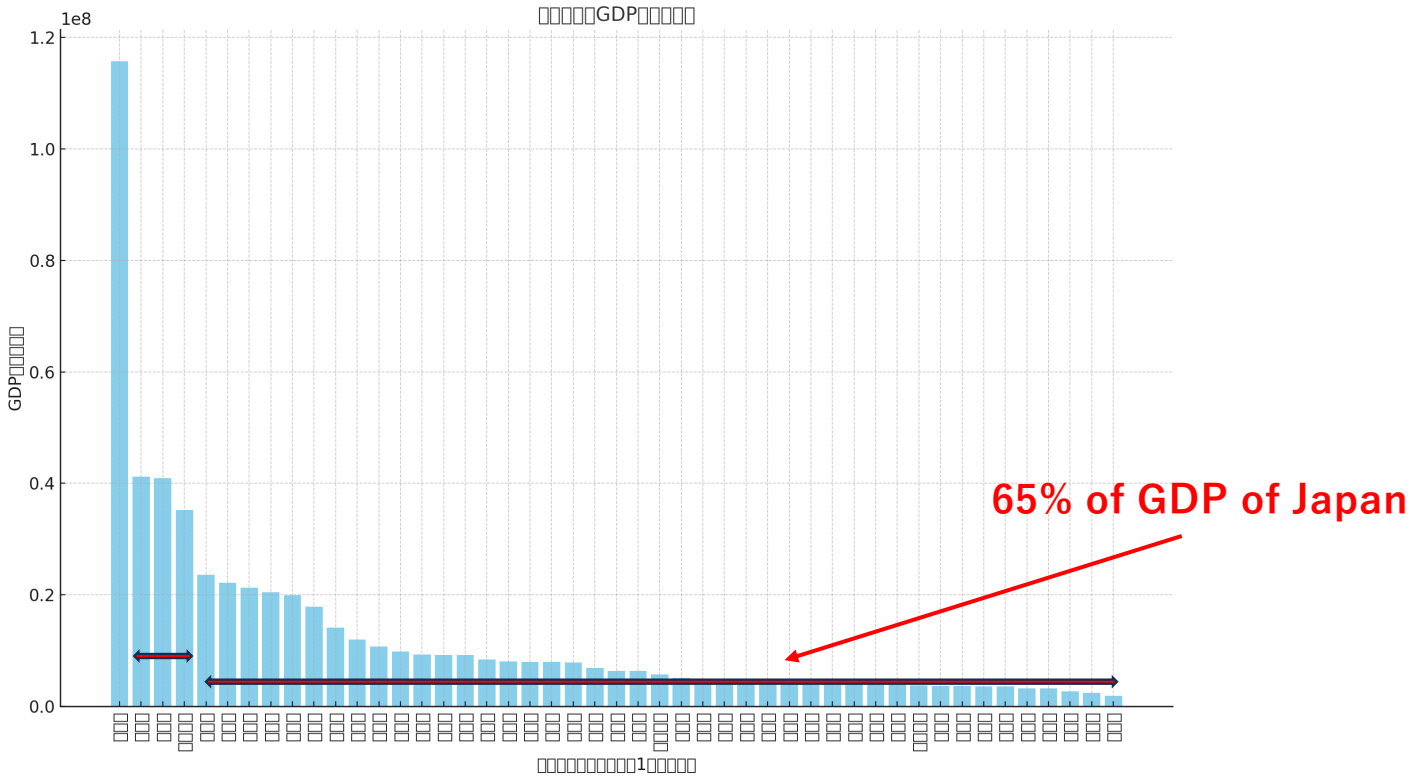
Nishi, A. et al., Deconstructing the traditional Japanese medicine “Kampo”: compounds, metabolites and pharmacological profile of maoto, a remedy for flu-like symptoms, *npj Systems Biology and Applications,* volume 3, Article number: 32 (2017)

Human Protein Interaction Network

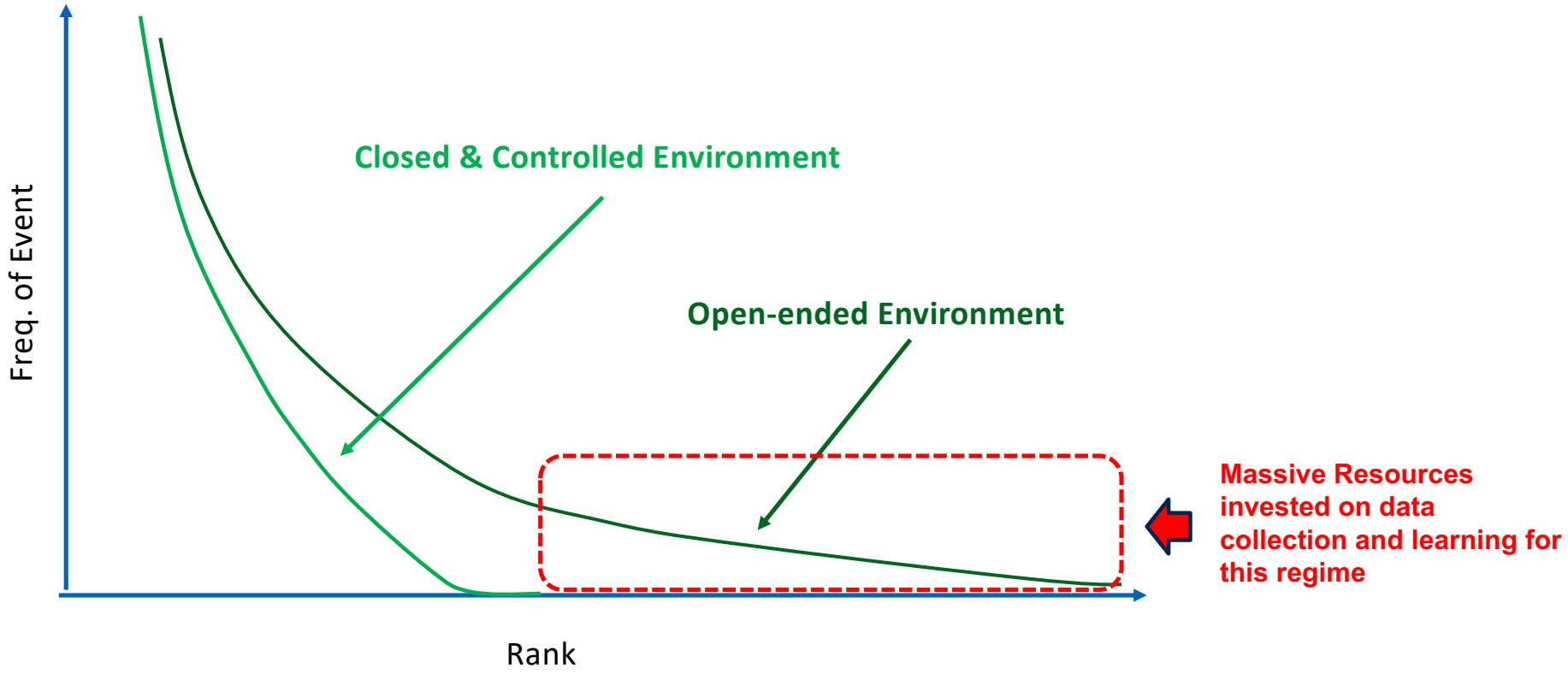


Hase T, Tanaka H, Suzuki Y, Nakagawa S, Kitano H (2009) Structure of Protein Interaction Networks and Their Implications on Drug Design. PLoS Comput Biol 5(10): e1000550.

Long-tail of Prefecture GDP in Japan



Long-tail distribution



Grand Challenges in AI

完全情報問題 (Complete Information Problems)

1997年　チェス
1997 Chess

2014年　将棋
2014 Shogi

2016年　囲碁
2016 Go

実物理世界問題 (Physical Real World Problems)

自動走行
Self-Driving

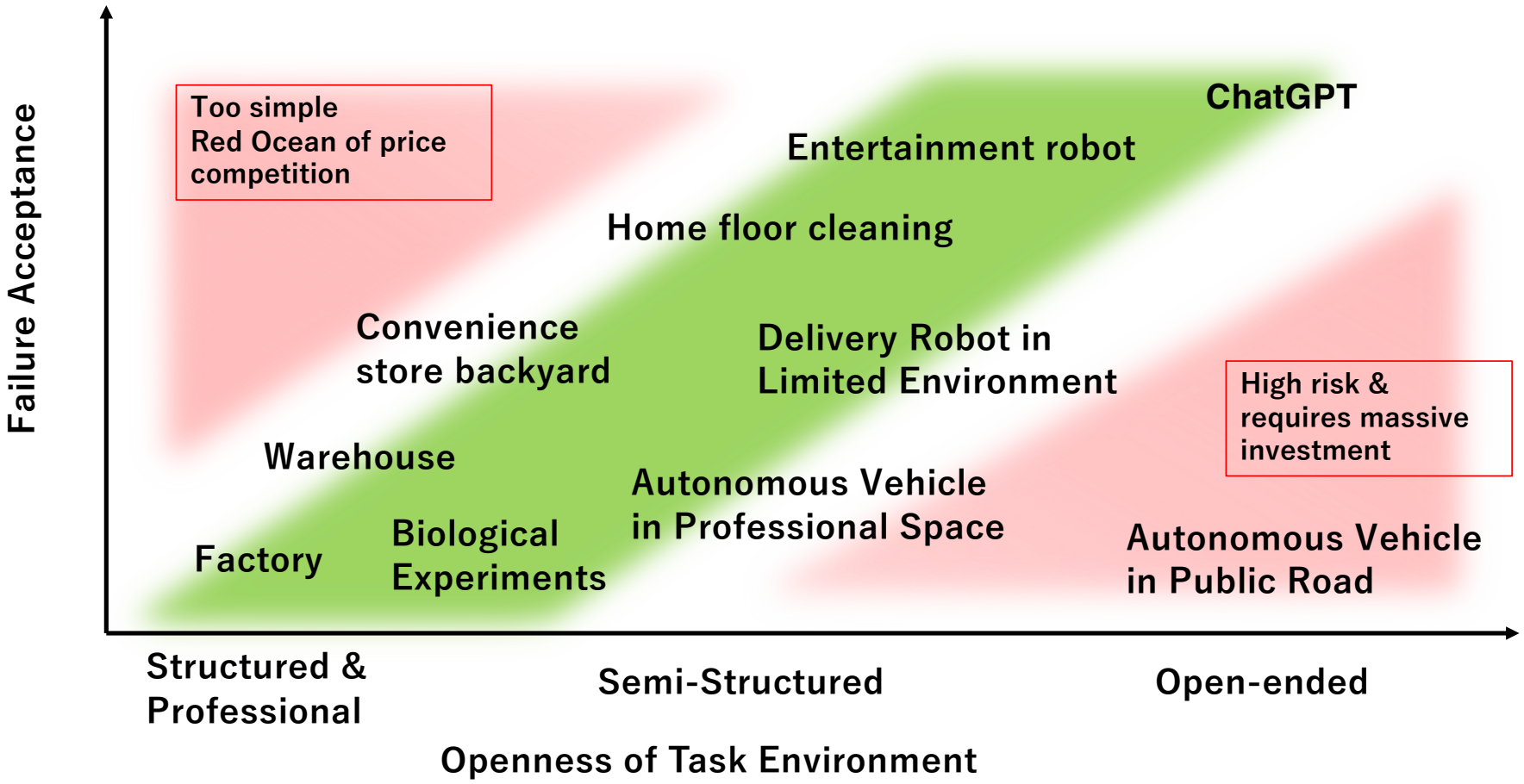
DARPA Grand Challenge

RoboCup

サッカー
Soccer

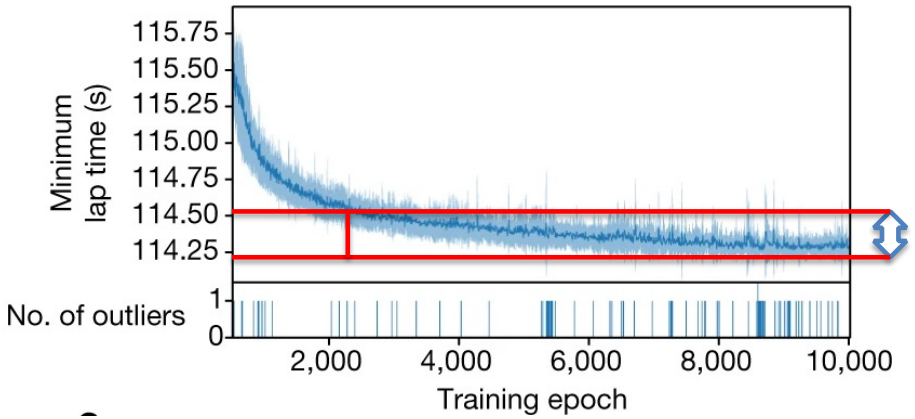
The Grand Challenge (darpa.mil)
RoboCup Federation official website

Autonomous Robot Application Landscape



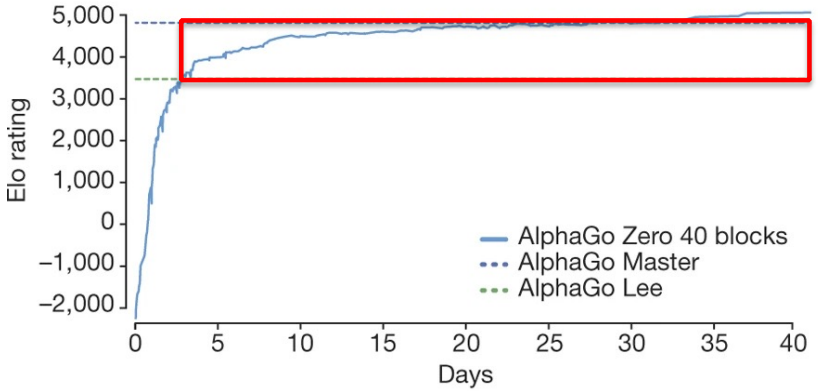
Performance vs. Training Time

GT Sophy



Wurman, P.R., Barrett, S., Kawamoto, K. *et al.* Outracing champion Gran Turismo drivers with deep reinforcement learning. *Nature* **602**, 223–228 (2022). https://doi.org/10.1038/s41586-021-04357-7

AlphaGo Zero

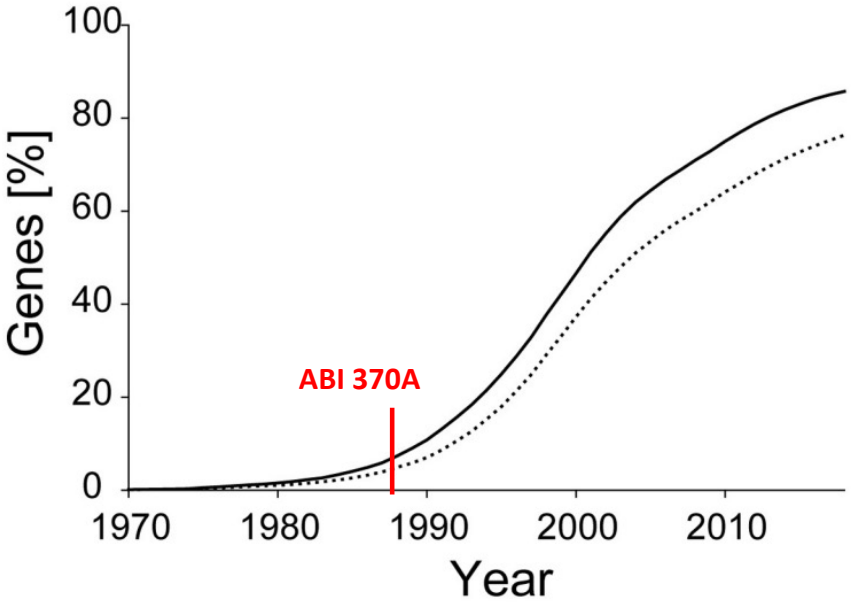


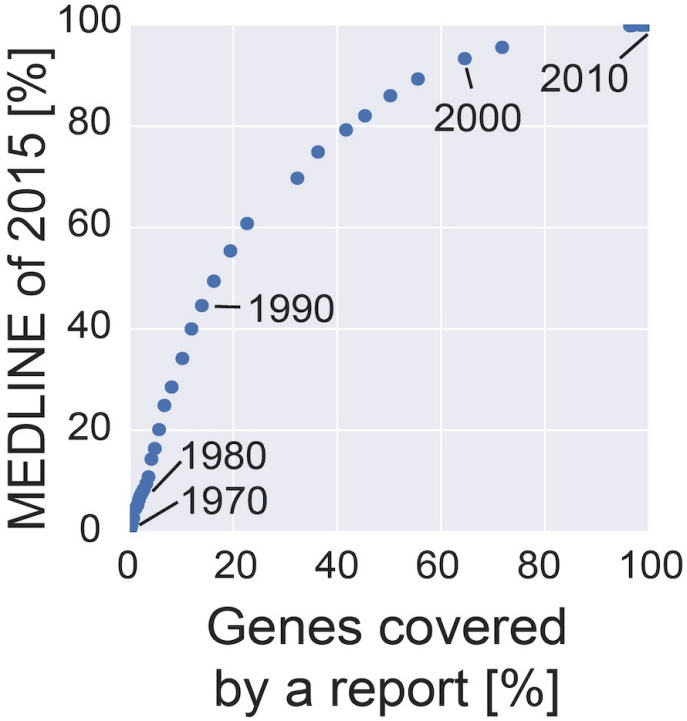
Silver, D., Schrittwieser, J., Simonyan, K. *et al.* Mastering the game of Go without human knowledge. *Nature* **550**, 354–359 (2017). https://doi.org/10.1038/nature24270

80% of the cost will spend on improving the last 5% of performance

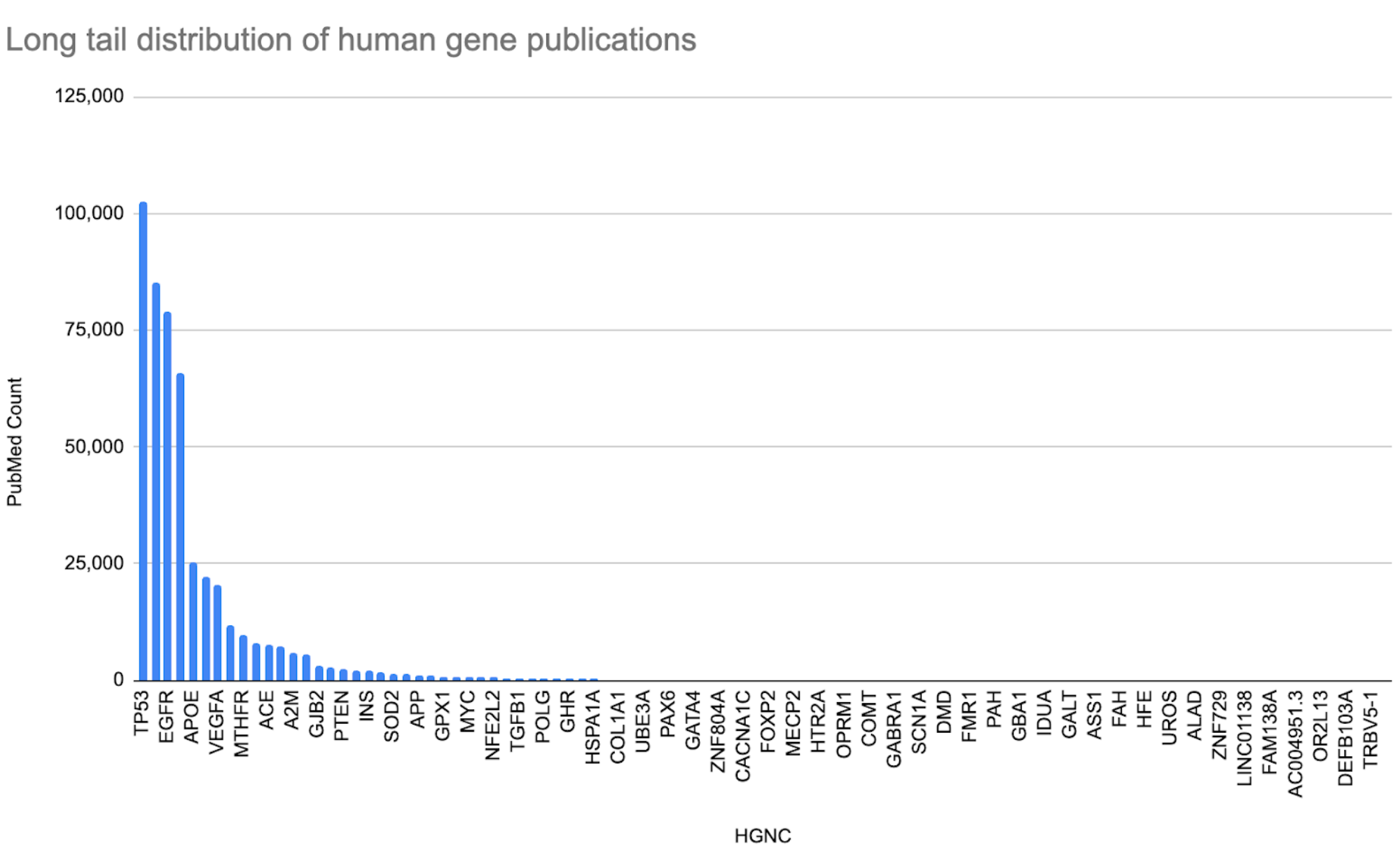
Deployment strategy reflecting this reality is critical

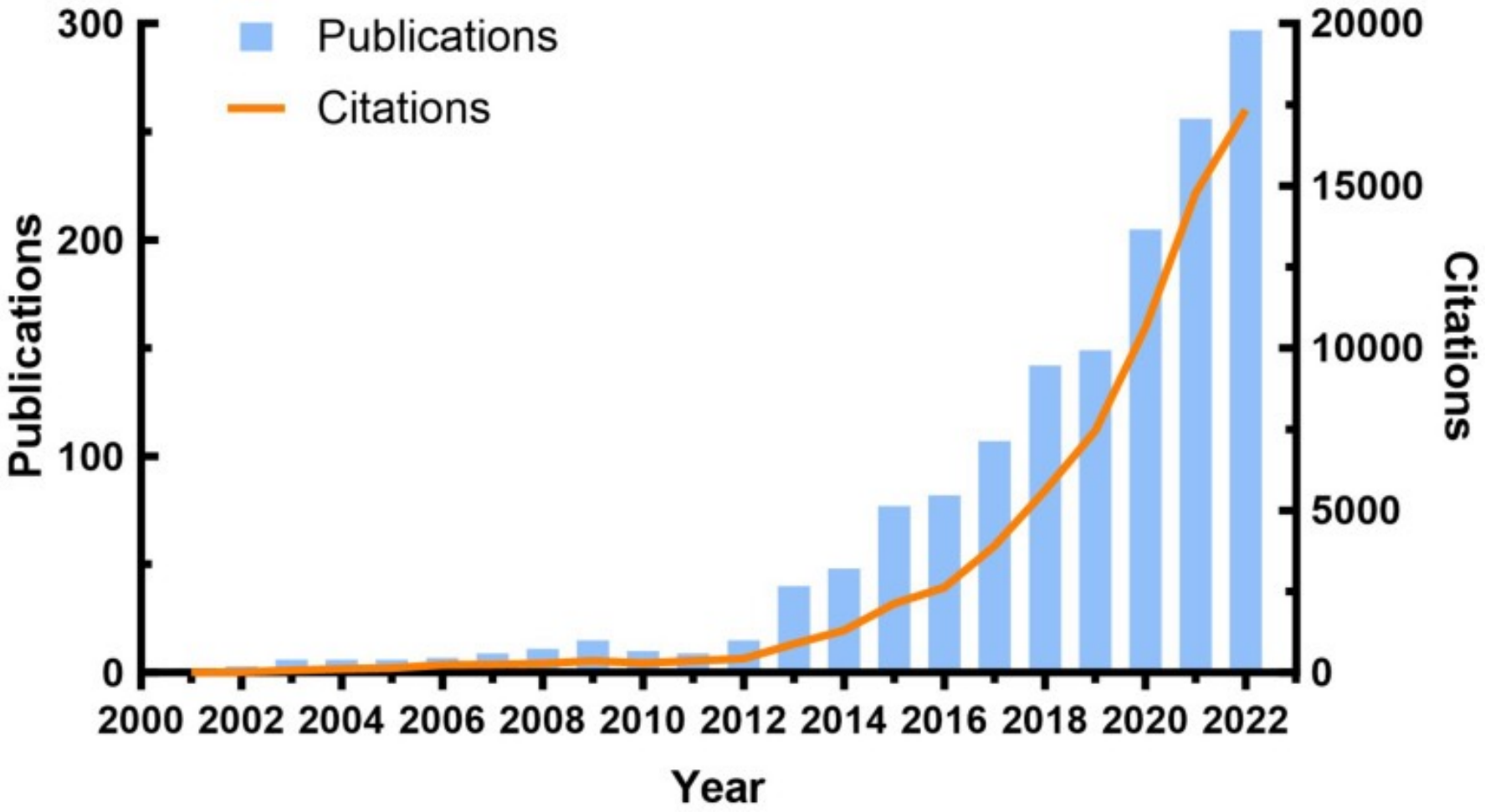
Research Coverage on Genes





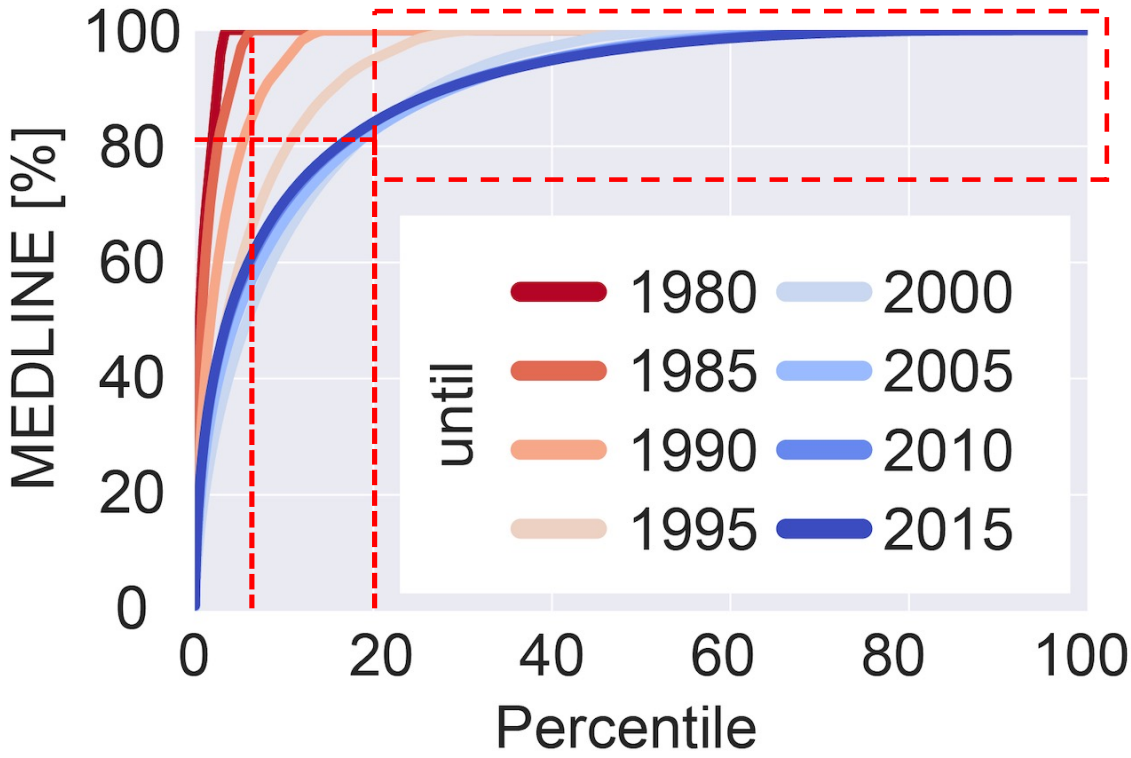
Thomas Stoeger, Martin Gerlach, Richard I. Morimoto, **Luís A. Nunes Amaral, Large-scale investigation of the reasons why potentially important genes are ignored, PLoS Biology, 18 Sept. 2018**


Long tail distribution of human gene publications
125,000
100,000
75,000
50,000
25,000
0
PubMed Count
TP53
EGFR
APOE
VEGFA
MTHFR
ACE
A2M
GJB2
PTEN
INS
SOD2
APP
GPX1
MYC
NFE2L2
TGFB1
POLG
GHR
HSPA1A
COL1A1
UBE3A
PAX6
GATA4
ZNF804A
CACNA1C
FOXP2
MECP2
HTR2A
OPRM1
COMT
GABRA1
SCN1A
DMD
FMR1
PAH
GBA1
IDUA
GALT
ASS1
FAH
HFE
UROS
ALAD
ZNF729
LINC01138
FAM138A
AC004951.3
OR2L13
DEFB103A
TRBV5-1
HGNC


Publications
Citations
300
200
100
0
Publications
20000
15000
10000
5000
0
Citations
2000 2002 2004 2006 2008 2010 2012 2014 2016 2018 2020 2022
Year

Emerging “Tail”

Back in 80s, almost 100% papers are on 5% on genes
In 2015, 80% of papers are on 20% of genes,
20% of papers are on 80% of genes

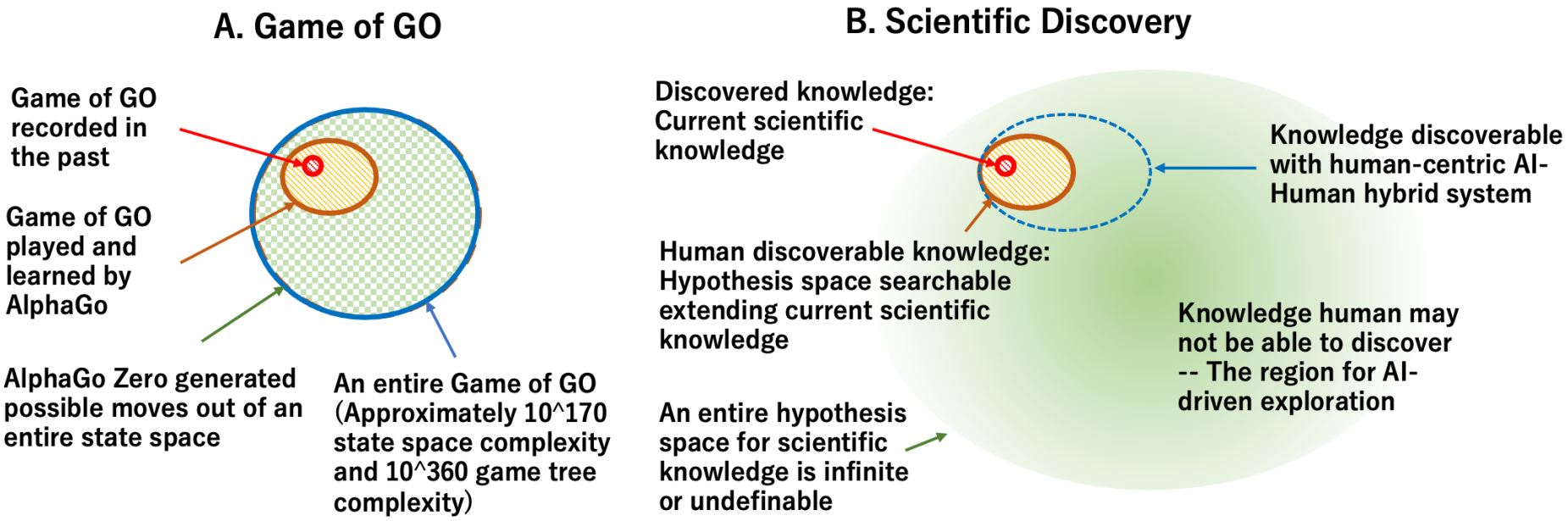


The Tail emerged in the Genomics Era

Reductionistic approach appeared to work well in the head region as most genes are highly dominant in the network

Thomas Stoeger, Martin Gerlach, Richard I. Morimoto, **Luís A. Nunes Amaral, Large-scale investigation of the reasons why potentially important genes are ignored, PLoS Biology, 18 Sept. 2018**

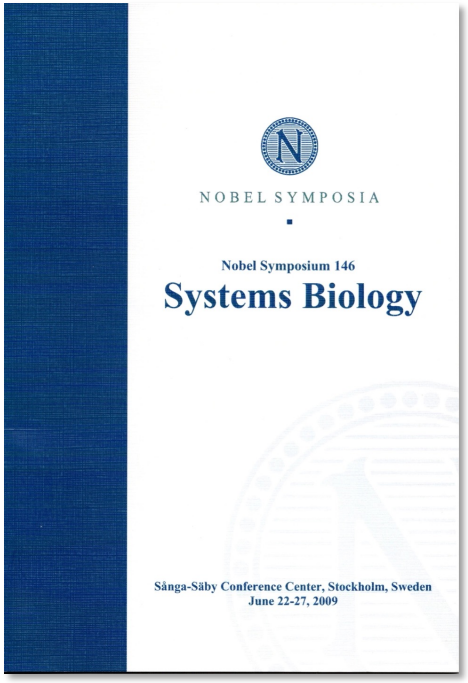
Scientific discovery is an open-ended problem

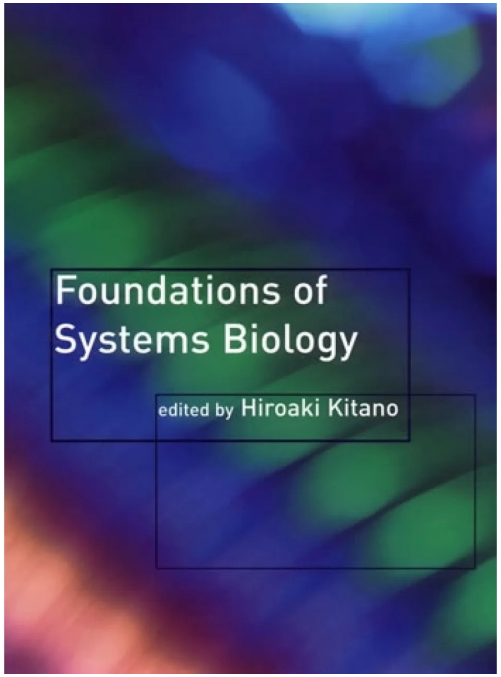


Kitano, H., “Nobel Turing Challenge: creating the engine for scientific discovery”, npj Systems Biology and Applications, 7 Article Number 29 2021

Systems Biology

Convergence of molecular biology, genomics, bioinformatics, control theory, information theory, engineering design, computer science, high-performance computing





AI as a Transformative Technology

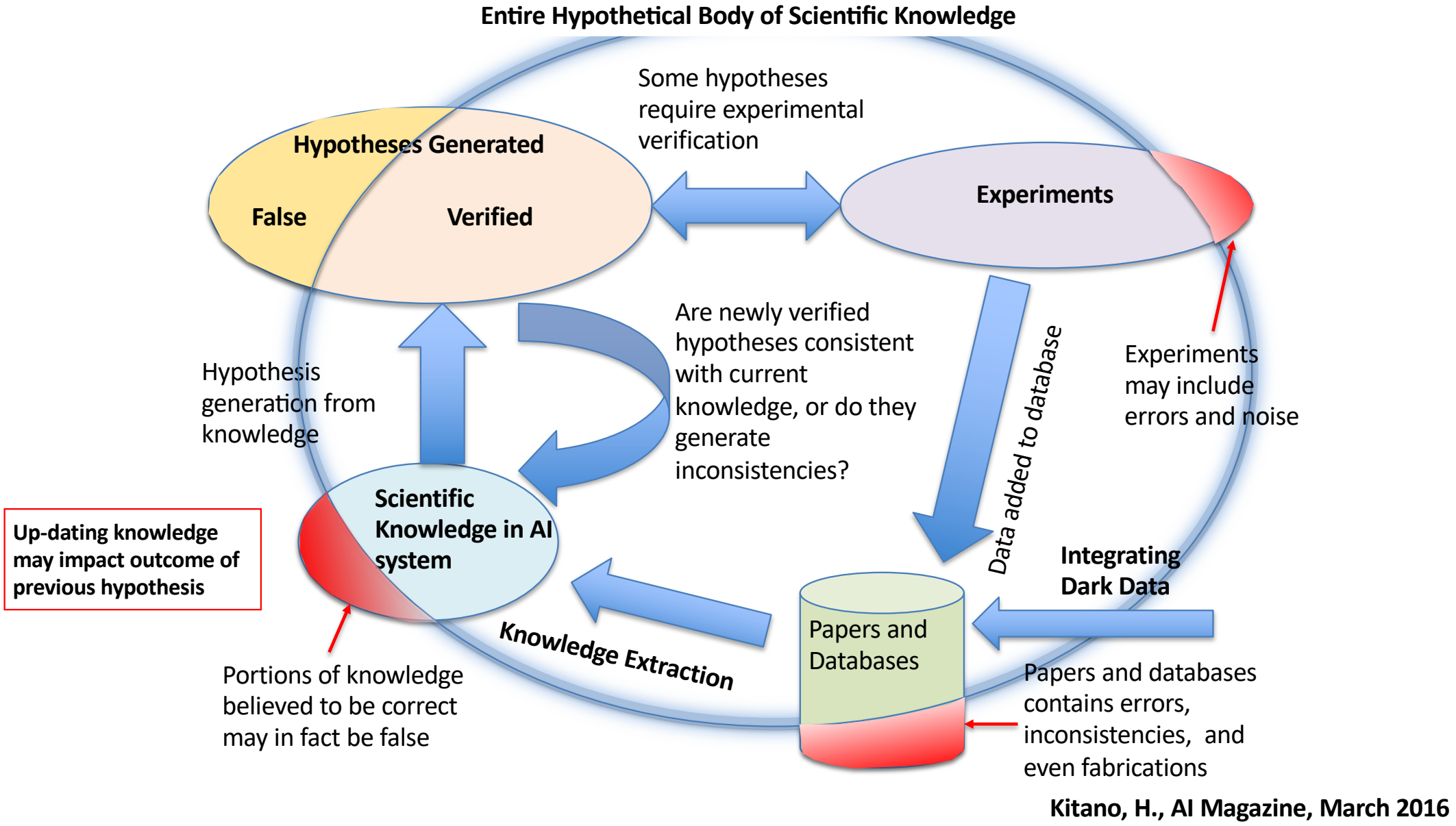
Where does AI impact most?

PRODUCTIVITY

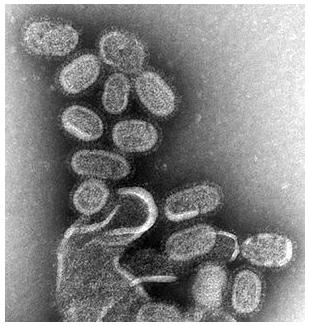
CREATIVITY

SCIENTIFIC DISCOVERY

Limits of Human Cognition


Entire Hypothetical Body of Scientific Knowledge
Some hypotheses require experimental verification
Hypotheses Generated
False
Verified
Experiments
Are newly verified hypotheses consistent with current knowledge, or do they generate inconsistencies?
Hypothesis generation from knowledge
Data added to database
Experiments may include errors and noise
Up-dating knowledge may impact outcome of previous hypothesis
Scientific Knowledge in AI system
Integrating Dark Data
Papers and Databases
Knowledge Extraction
Portions of knowledge believed to be correct may in fact be false
Papers and databases contains errors, inconsistencies, and even fabrications
Kitano, H., AI Magazine, March 2016

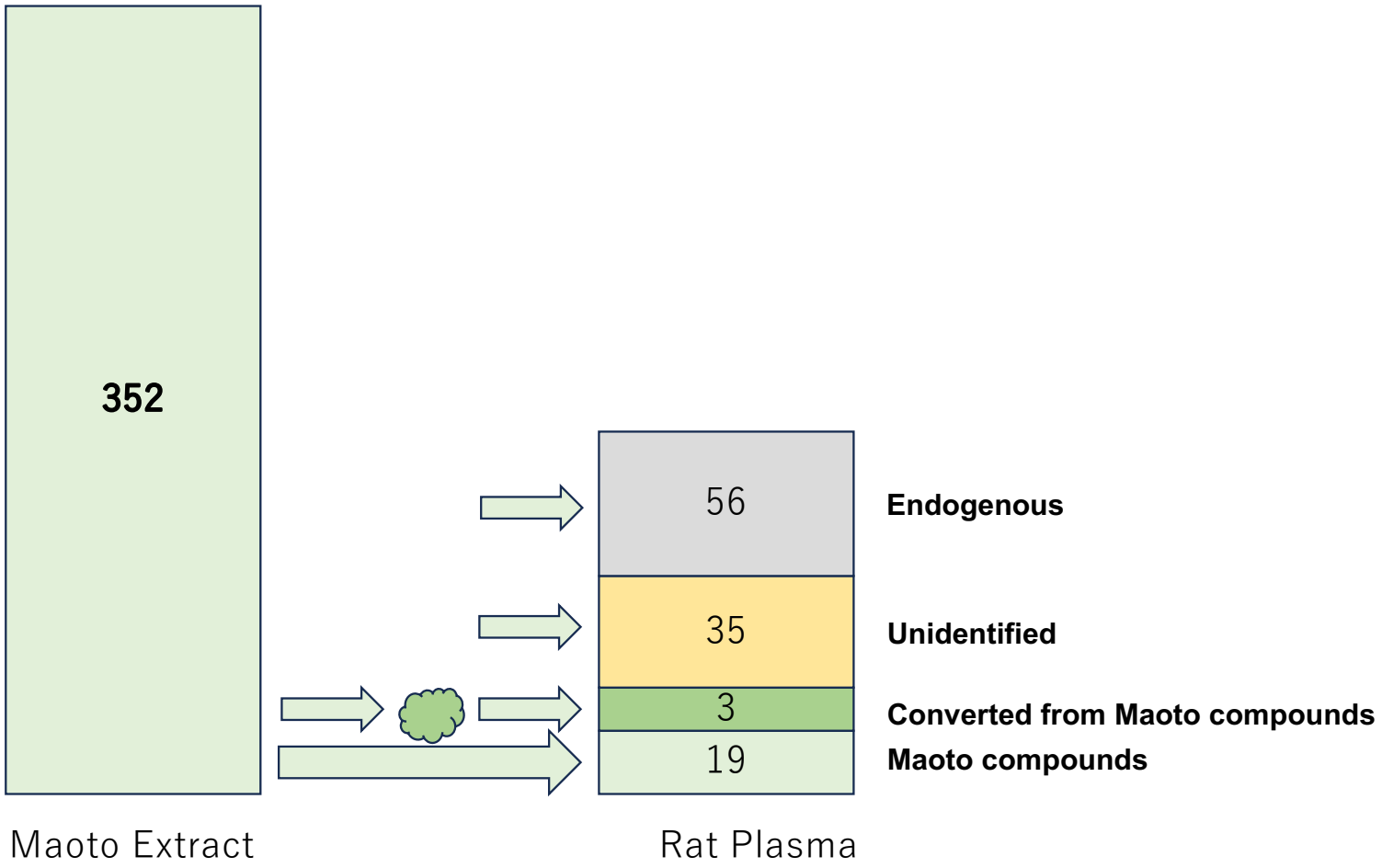
Efficacy of Maoto over Influenza
麻黄湯のインフルエンザへの効能



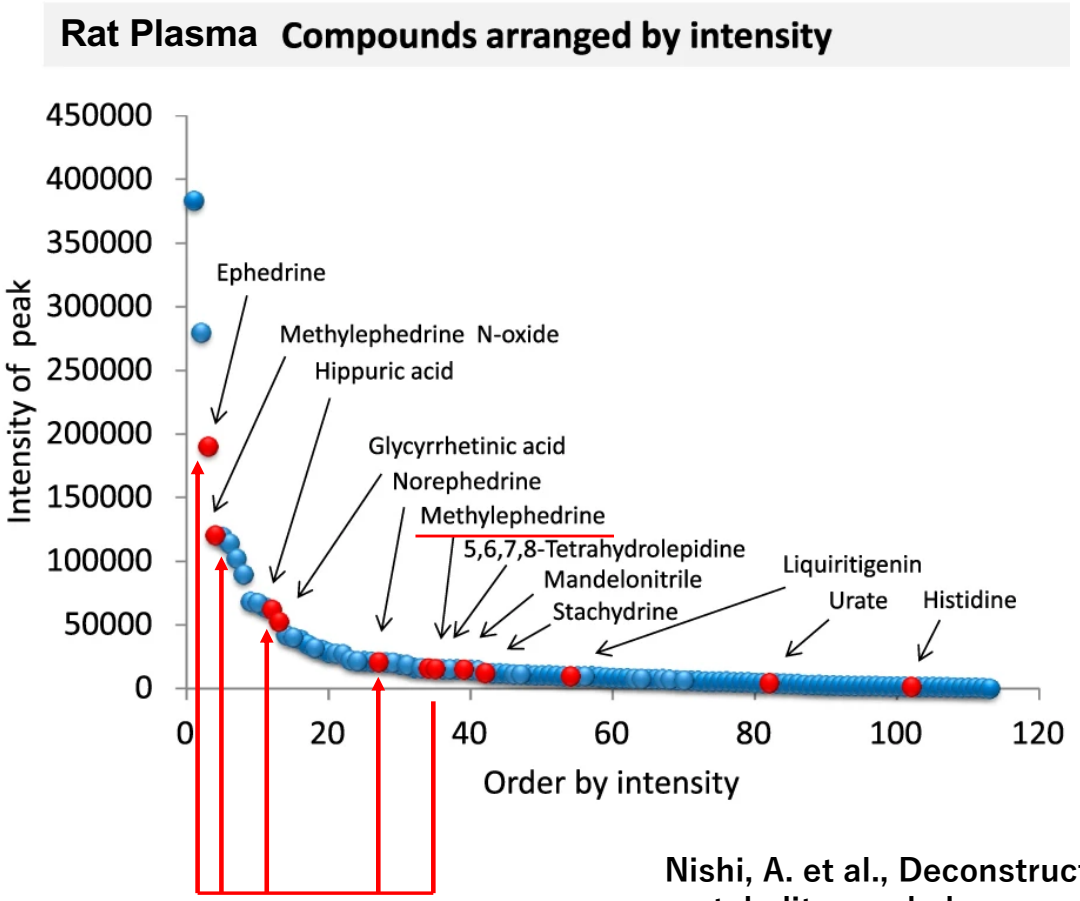
Influenza Virus

Rat

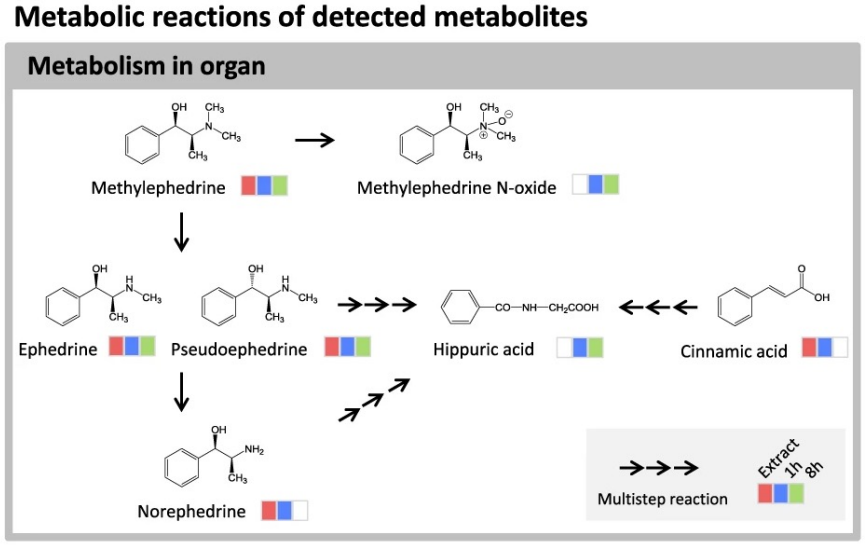
Detected Compounds in Rat Plasma after Maoto in-take



Multi-step conversion of ephedrine



メチルエフェドリンは、抗喘息薬として説明され、咳や鼻づまりの治療に使用される交感神経興奮薬です。日本を含む世界中で、さまざまな市販の咳止めや風邪薬に使用されていると報告されています。(wikipedia)



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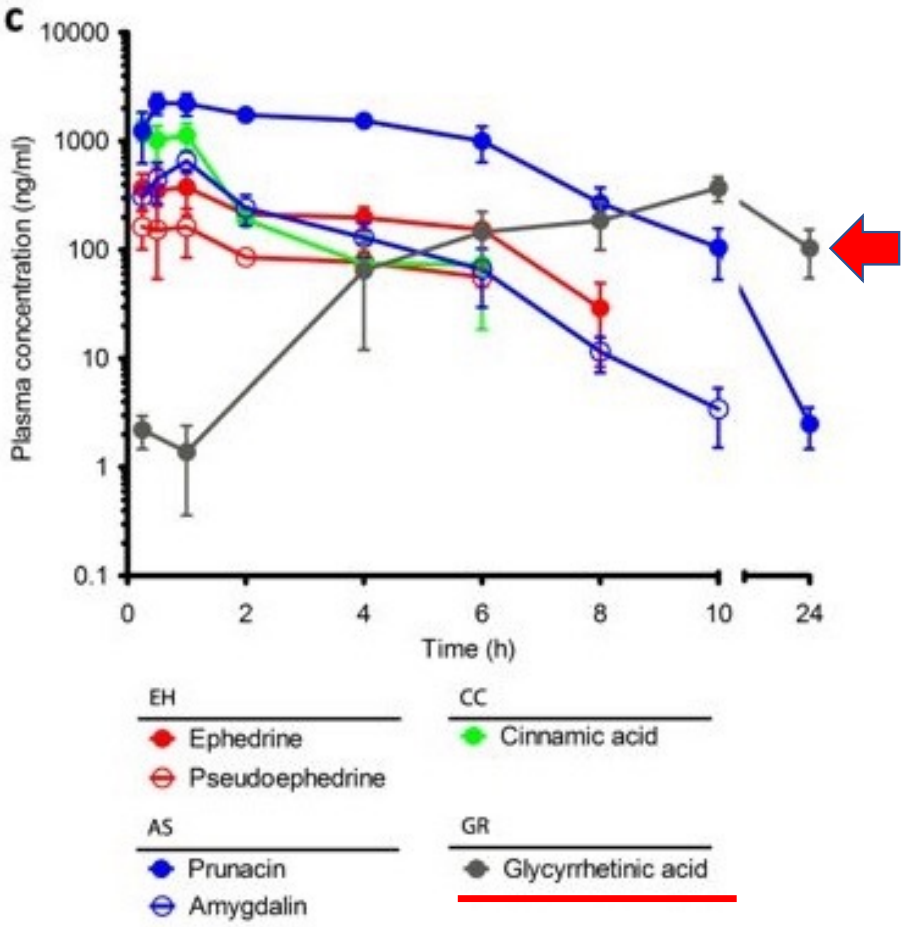
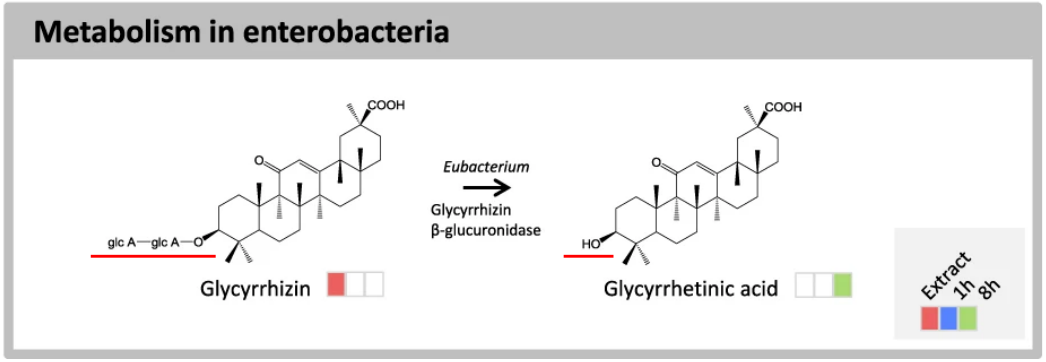
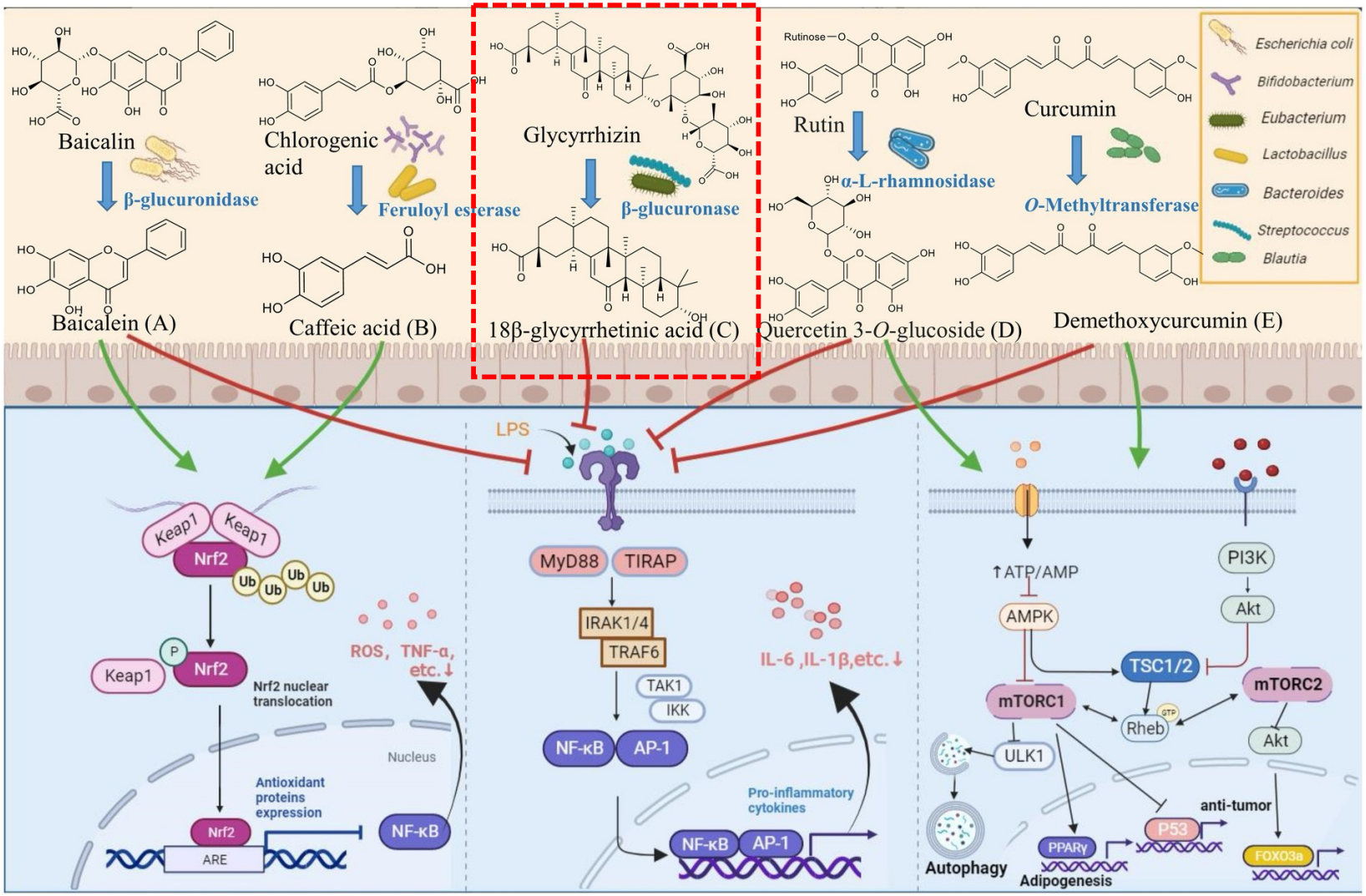




グリチルレチン酸（Glycyrrhetinic acid）は、甘草から得られるグリチルリチン酸を分解して生成されるテルペノイド誘導体です。抗炎症作用や抗アレルギー作用がある

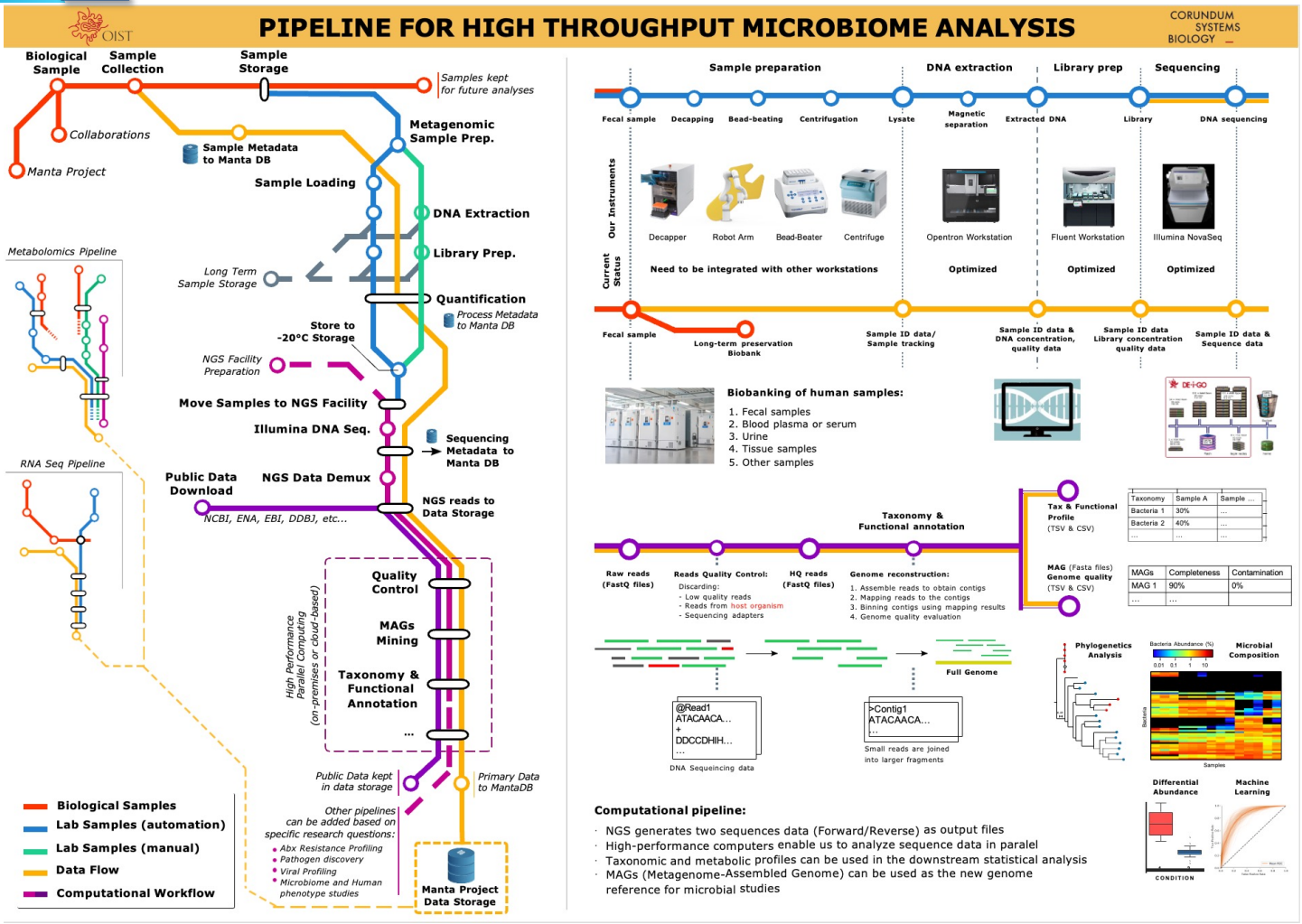
Nishi, A. et al., Deconstructing the traditional Japanese medicine “Kampo”: compounds, metabolites and pharmacological profile of maoto, a remedy for flu-like symptoms, *npj Systems Biology and Applications,* volume 3, Article number: 32 (2017)



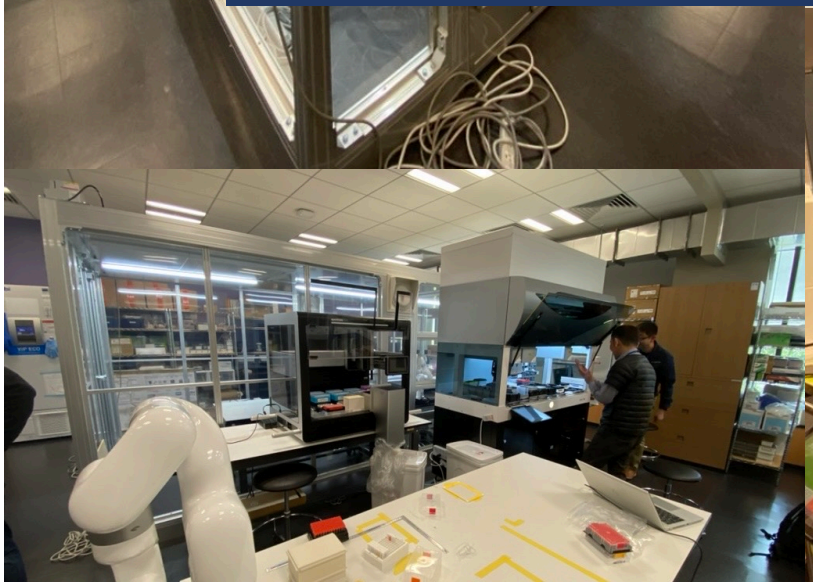
Zhao, Y., et al., Potential roles of gut microbes in biotransformation of natural products: An overview, Front. Microbiol., 29 September 2022, Sec. Food Microbiology, Volume 13 – 2022
https://doi.org/10.3389/fmicb.2022.956378

MANTA Project: full automation of multi-omics analysis

Phase-I: Meta-Genome Analysis System



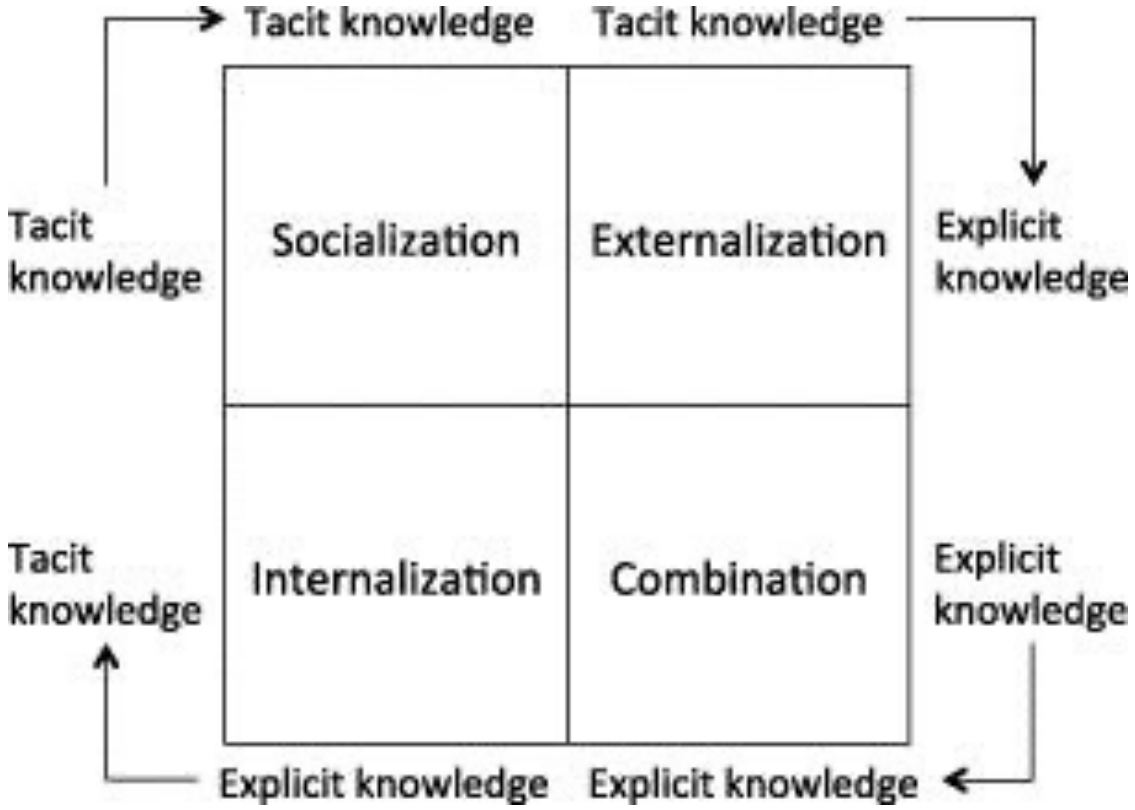
Fully Automated Meta-Genome Analysis



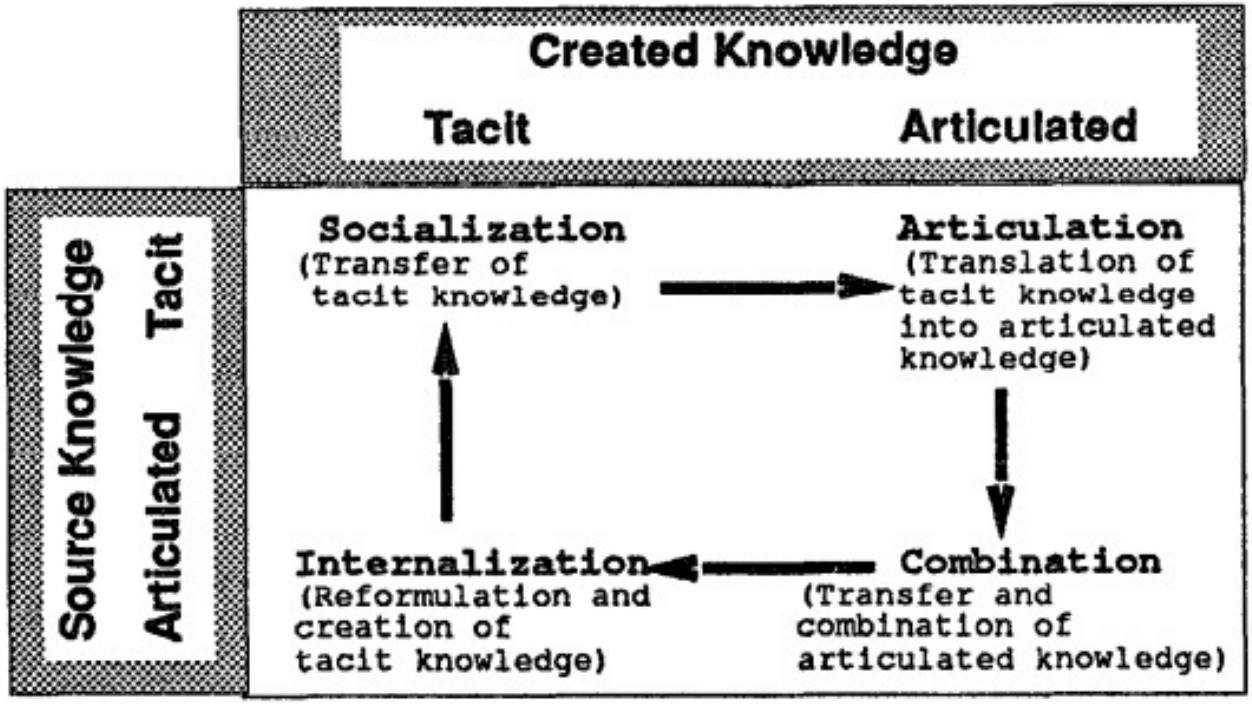

MCA
Climate neutral

Organizational Front

Nanaka’s Theory of Organizational Knowledge Sharing

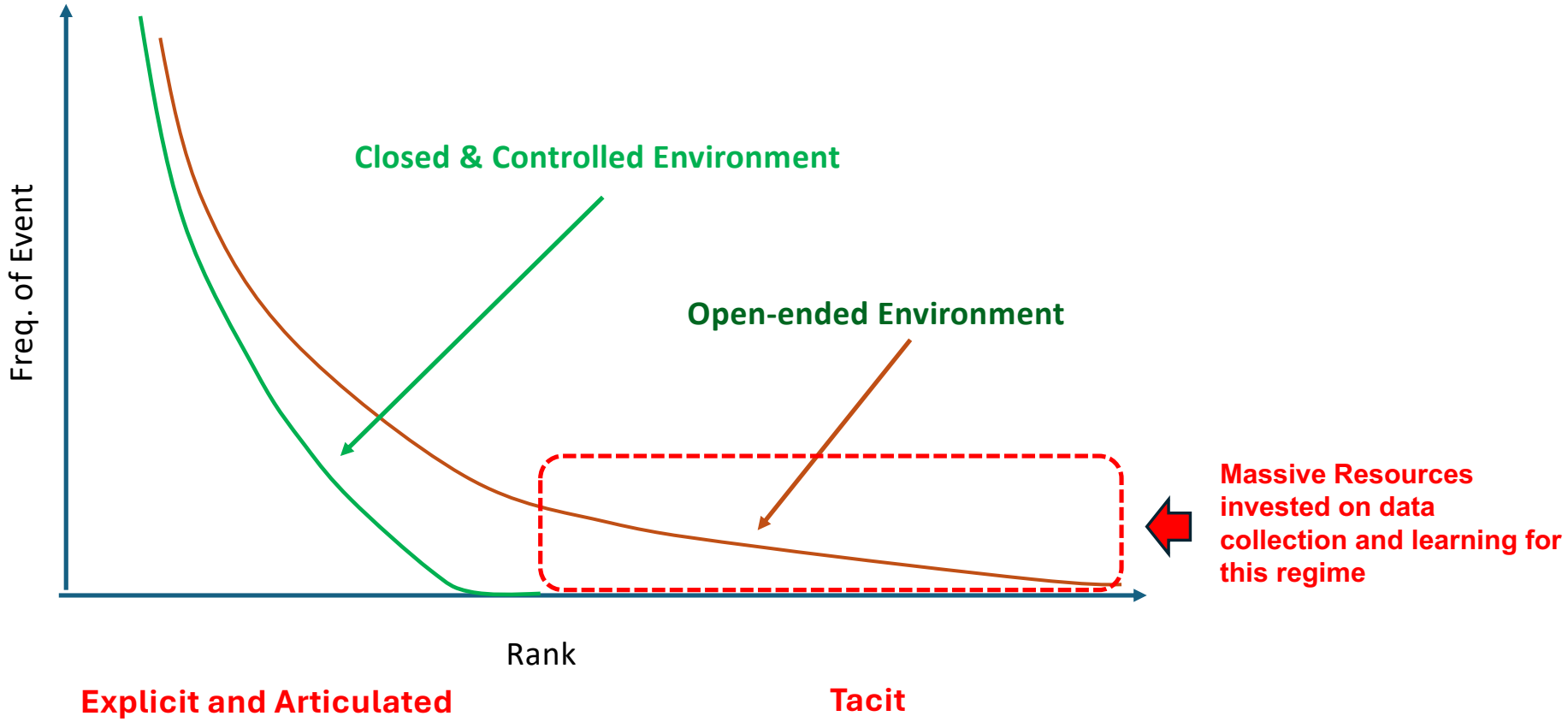


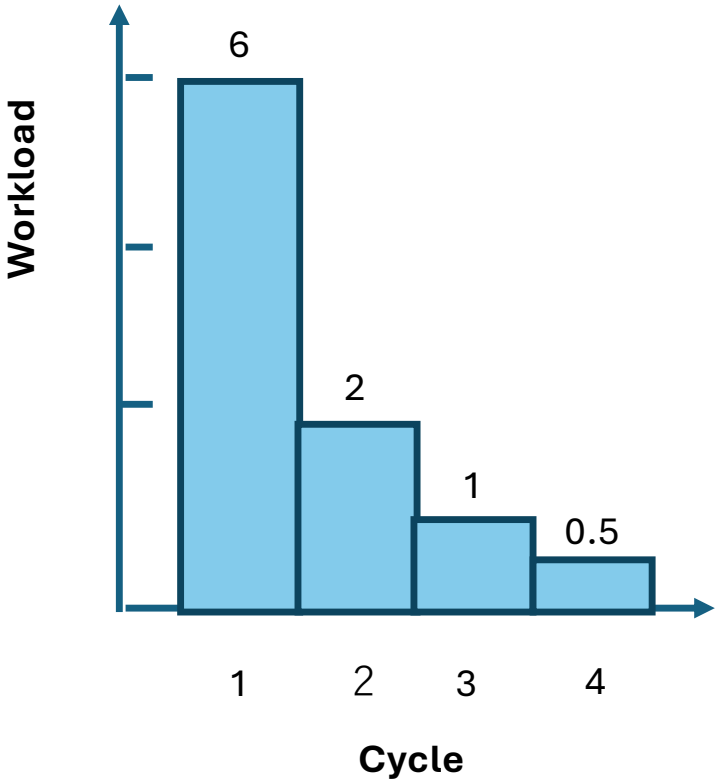
Process of Organizational Knowledge Creation

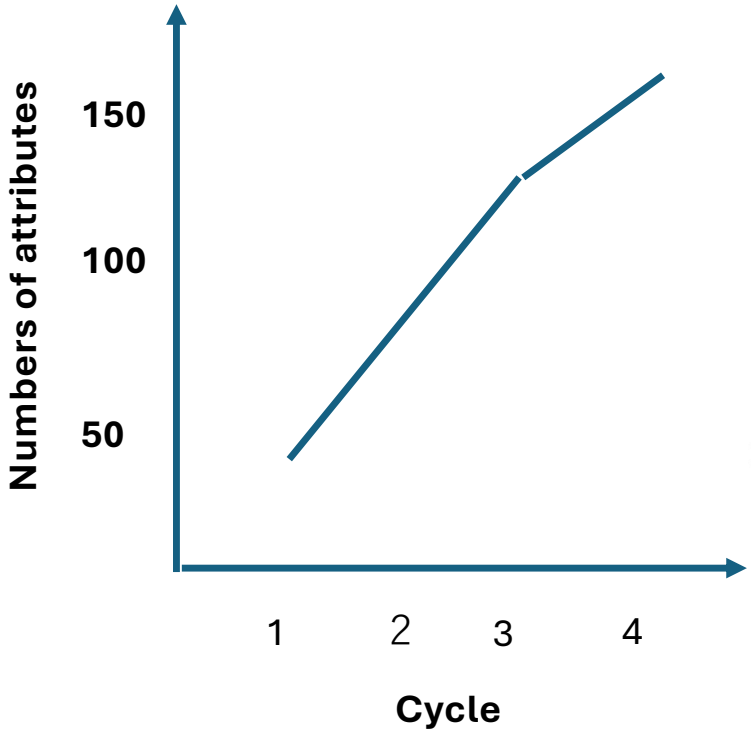


Kitano, H., et al., "Building Large-Scale and Corporate-Wide Case-Based Systems: Integration of Organizational and Machine Executable Algorithms," AAAI-92, 1992

Long-tail distribution







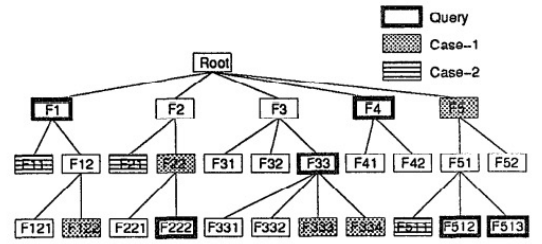


Figure 5: Examples of Feature Selections by User

Kitano, H., et al., “Building Large-Scale and Corporate-Wide Case-Based Systems: Integration of Organizational and Machine Executable Algorithms,” AAAI-92, 1992

Case-Method

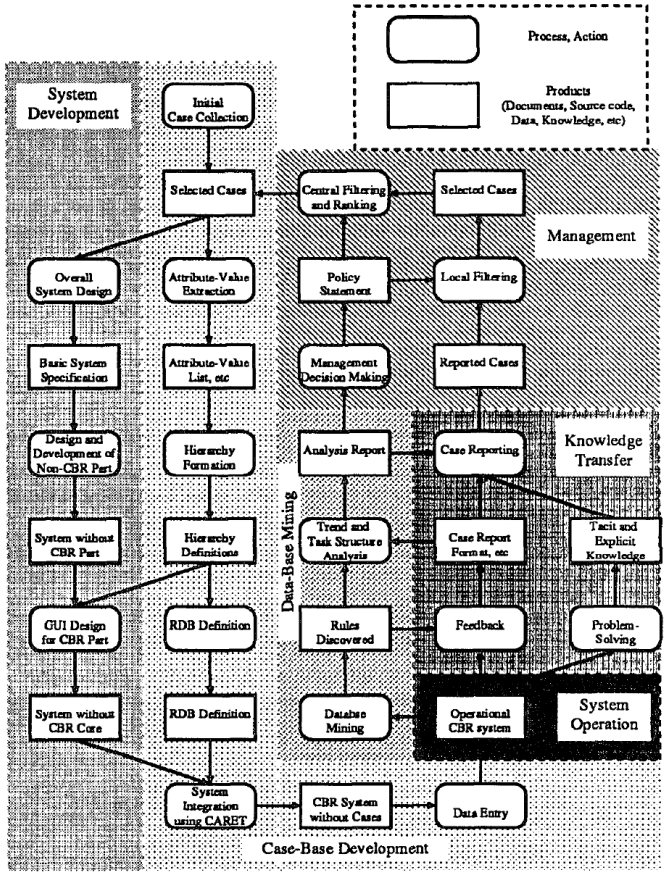


Figure 1: Case-Method Cycle

Kitano, H., et al., “Case-Method: Methodology for Building Large-Scale Case-Based Systems,” AAAI-93, 1993

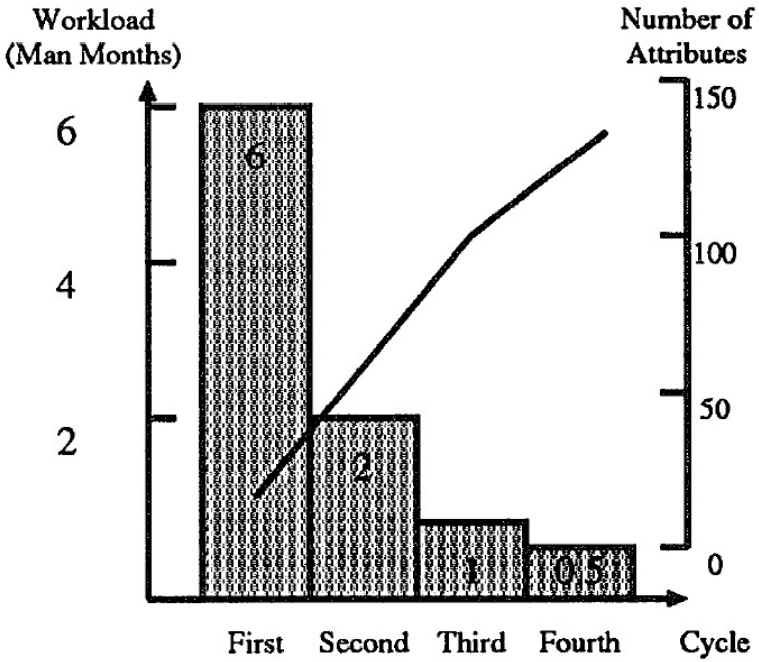


Figure 3: Case-Base Building Workload

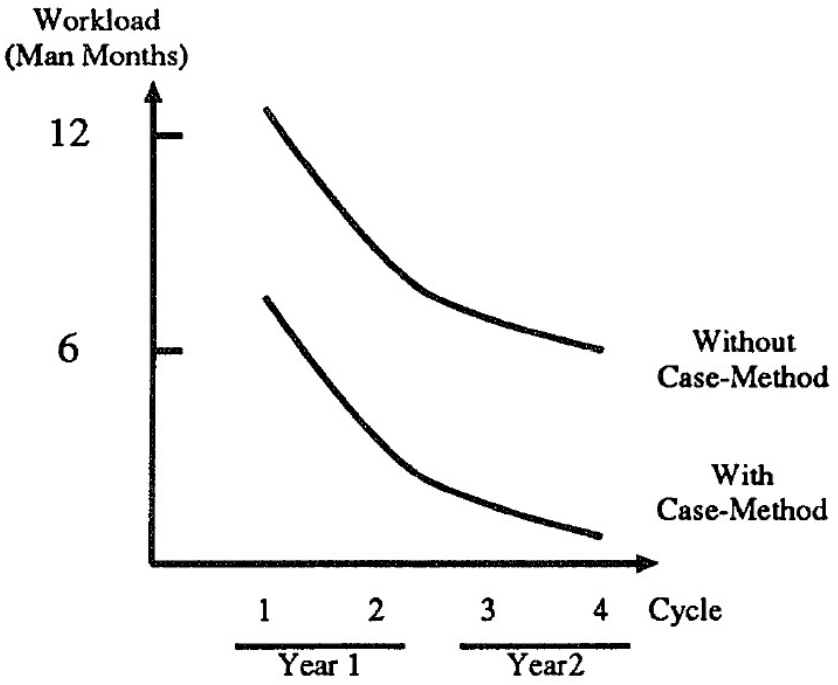


Figure 4: Total Workload

Kitano, H., et al., "Case-Method: Methodology for Building Large-Scale Case-Based Systems," AAAI-93, 1993

Disha

Platform for supply side of health

Disha (दिशा)
means
"direction"
and
"path"

Dealing with long-tail tacit knowledge

- **Clarity & Consistency**
- **Transparency**
- **Controlled Autonomy**

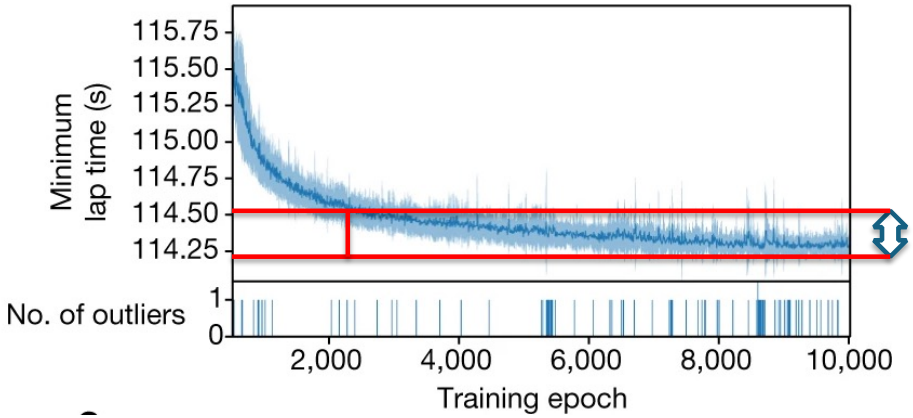
Composite mechanisms for the event and their outcome – Less likely to be a single point failure – more likely to be combinatorial failure

Multiple Agentic Roles

- Observer Agent
- Predictor Agent
- Optimizer Agent
- Coordinator Agent

Continual Learning is Critical for Agentic AI

GT Sophy



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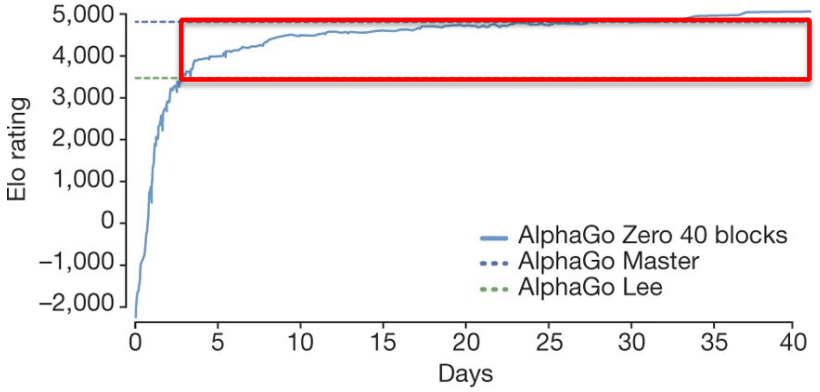
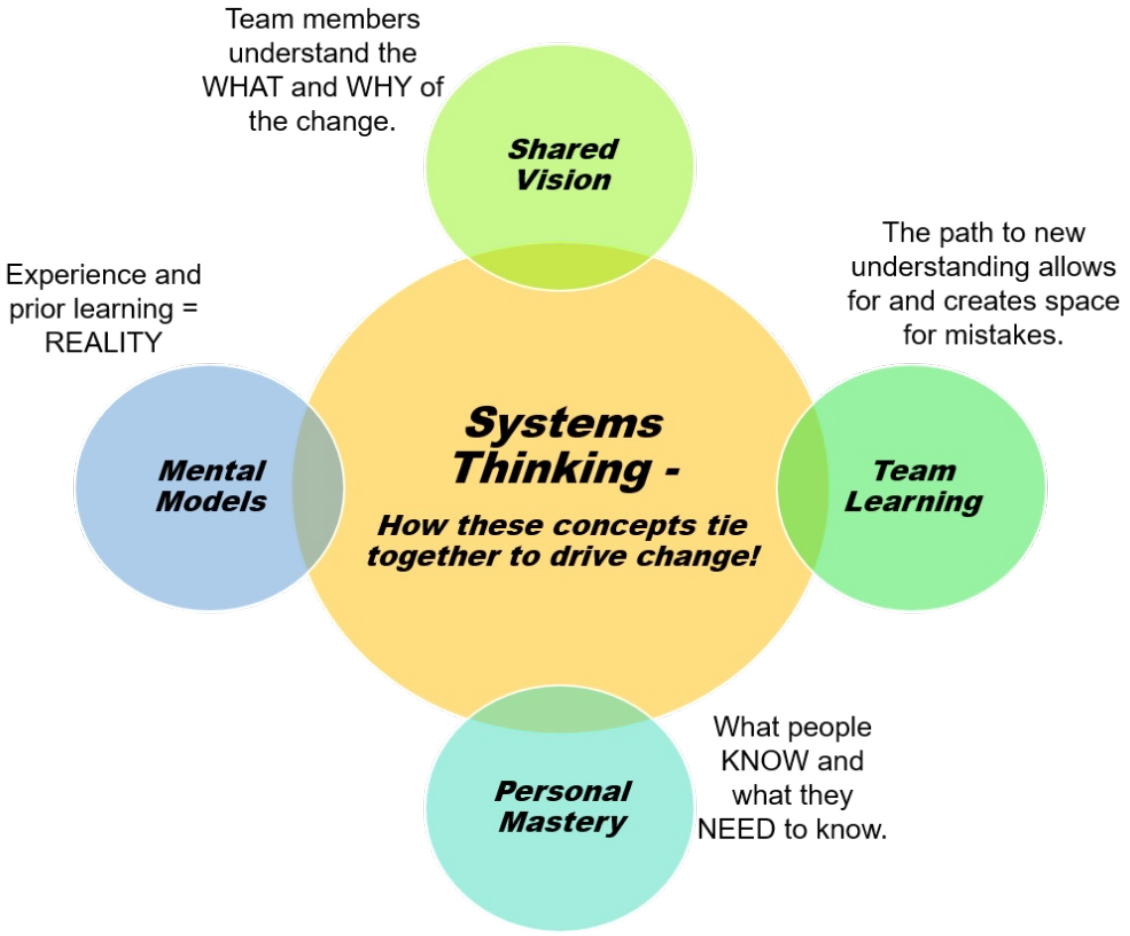
AlphaGo Zero



Silver, D., Schrittwieser, J., Simonyan, K. *et al.* Mastering the game of Go without human knowledge. *Nature* **550**, 354–359 (2017). https://doi.org/10.1038/nature24270

Learning Organization (by Peter Senge)



Healthcare Industry as a training ground for Agentic AI

Transparent, Clear & Consistent

Continual Learning & Organizational Design

Agentic AI – Human Relationship

AI Agent Learning & Learning Organization

THANK YOU