

Big Data: Open Questions

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National Center for Supercomputing Applications
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Education:

- Executive MBA University of Illinois at Urbana-Champaign , May 2002
- Ph.D., Physics University of Illinois at Urbana-Champaign, May 1985
- M.S. , Physics University of Illinois at Urbana-Champaign , October 1981
- M.Sc., Physics Bangalore University, India, June 1974
- B. Sc., Physics, Math Bangalore University, India, June 1972

● Background

- Astrophysics
- Neutron Star Structure

- General Interests

- Institutional Collaborations
- Health Informatics

● HPC Background

- At NCSA since inception
- Cyberinfrastructure
- Societal Impact of Cyberinfrastructure
- High-end computing
- Computational Science

DATA COMES from EVERYWHERE

Life and Nature

Humans and Environment

Arts and Humanities

Business and Commerce

Manufacture and Production

Observation and Experiment

Instrumentation and Sensors

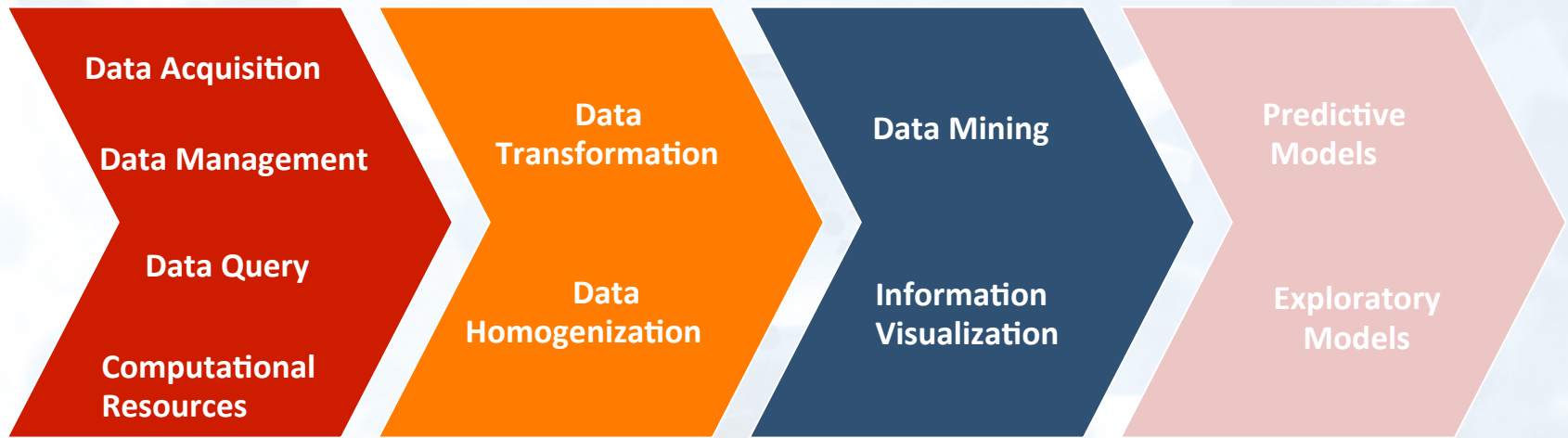
Computations and Simulation

Analysis & Feedback and Optimization

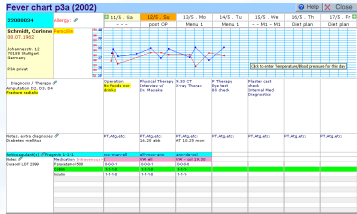
Social Media and Entertainment

Internet of Things

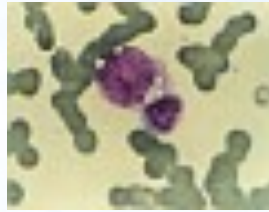
INFORMATION BASED SCIENCE



Data Integration



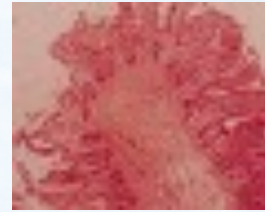
Electronic Medical Record



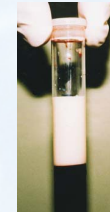
Hematology



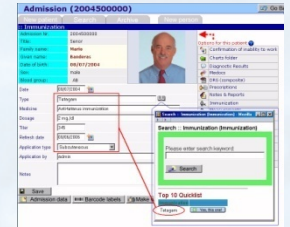
Oral Pathology



Histopathology



Blood tests



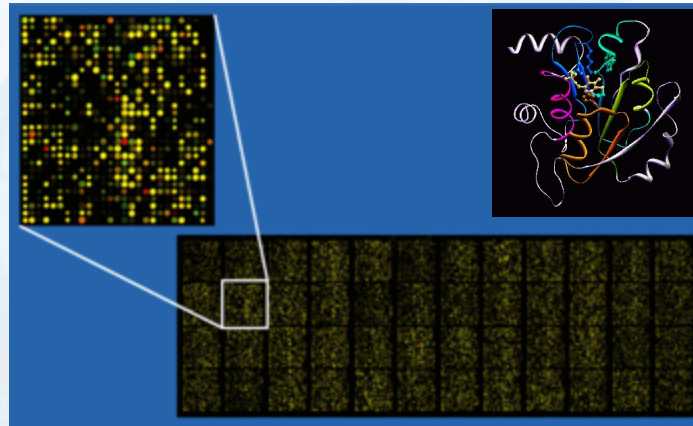
Electronic Healthcare Record



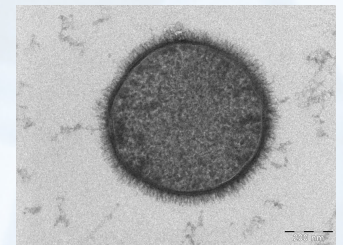
X-ray



Image of acute arterial embolism



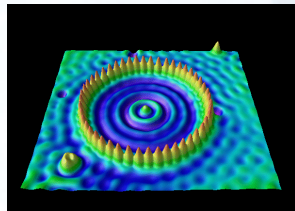
Microarray



Transmission electron microscopy



CT finding, **Epithelial carcinoma of the ovary**



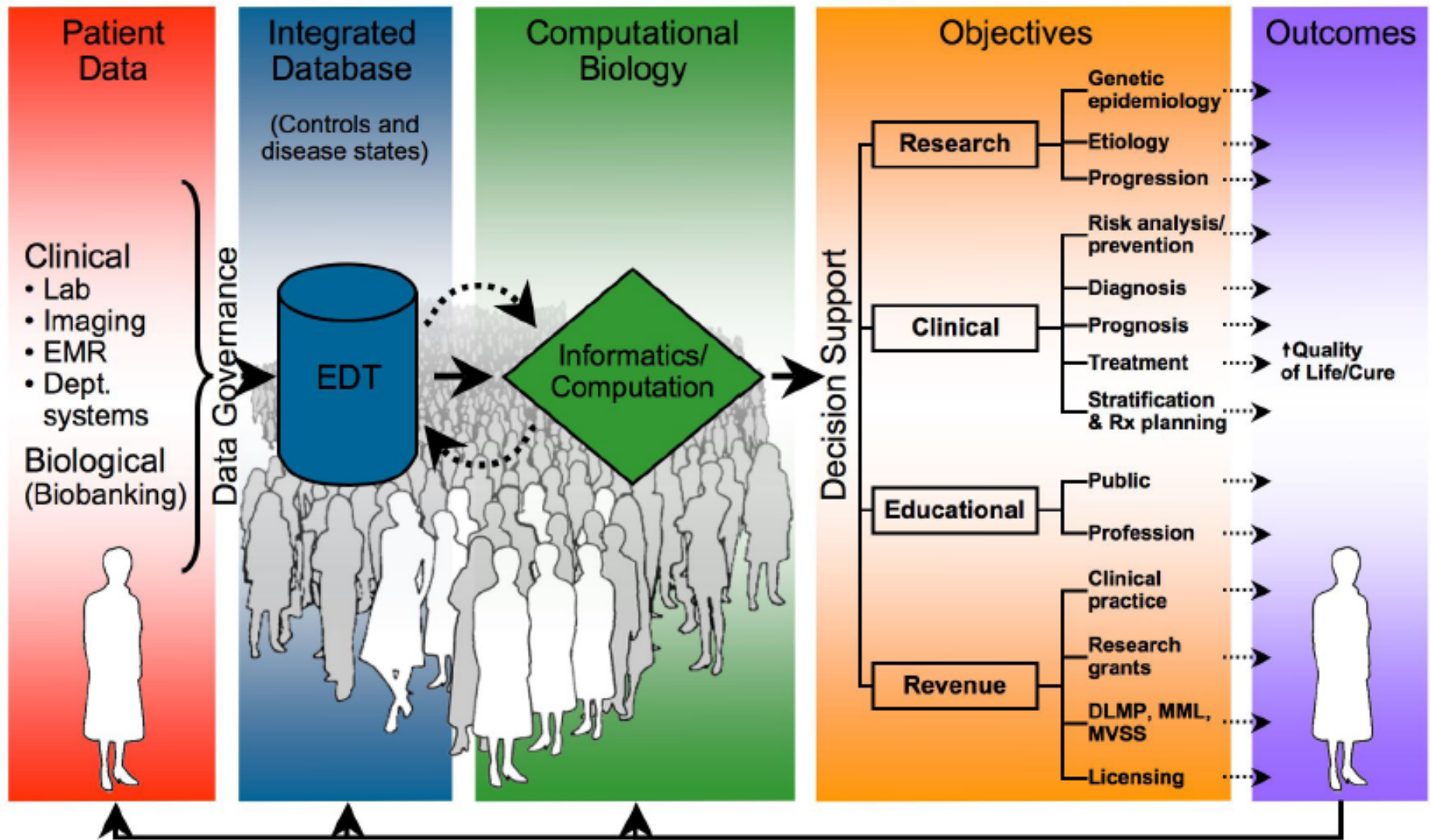
Scanning Tunneling Microscopy

Atomic force microscope (AFM)



Heart surgery

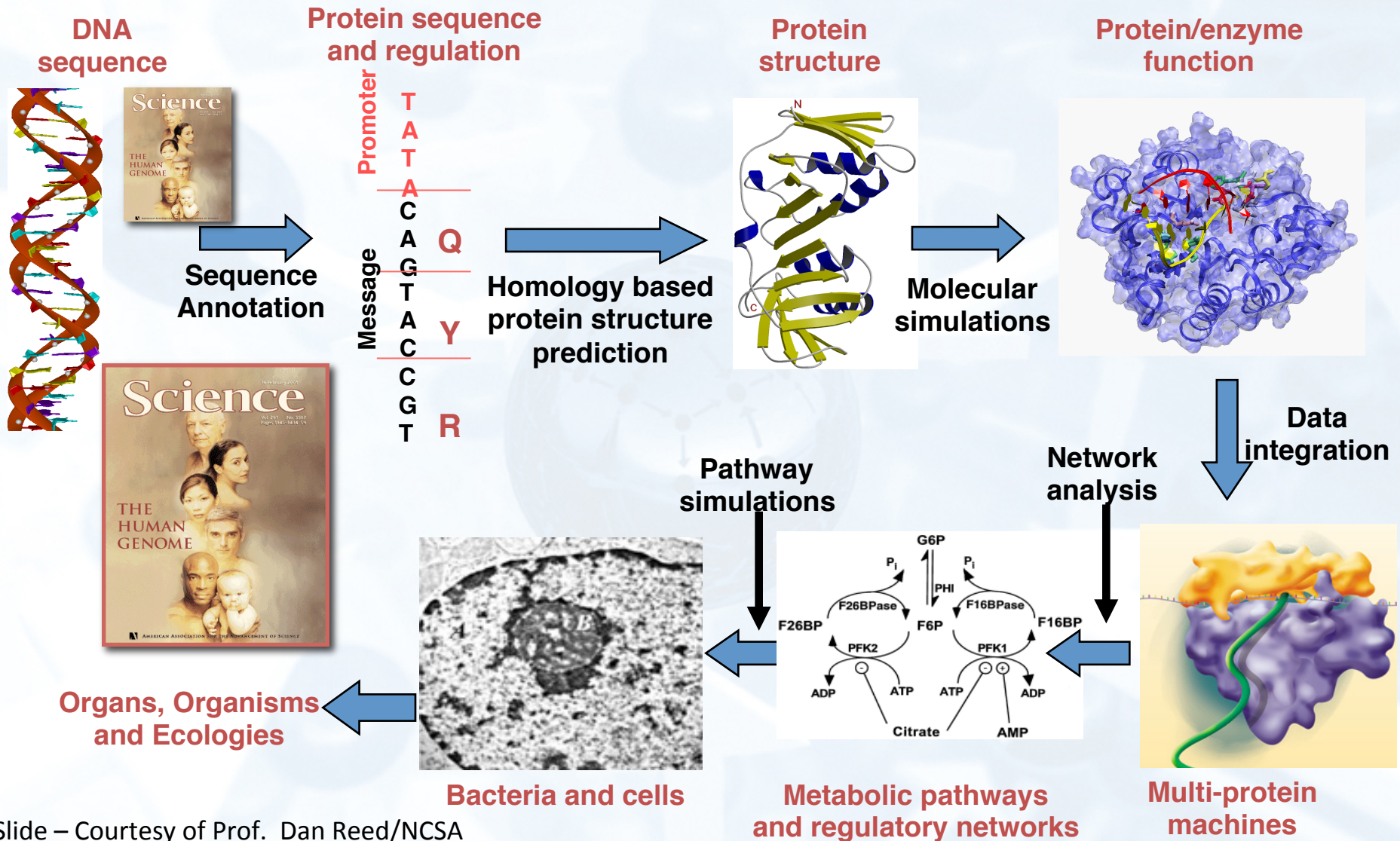
Information Based Medicine



COLLABORATIVE MEDICINE

- Information Based Medicine – *the convergence of engineering and technology, life sciences and IT towards the goals of scientific discovery, new drugs and treatment and revolution in health care, wellness and personal medicine.*
- Data Intensive and Multi-modal Information Access, Homogenization, Analysis, and Computational Thinking in the Service of Information Based Medicine
- The plan for a new Medical School at Urbana-Champaign that includes interdisciplinary research effort with multiple departments on campus in the University, in collaboration with Carle Foundation Hospital.
- Convergence of Nano-Bio-Info Technology

Systems Biology: Exaflop Challenges



Slide – Courtesy of Prof. Dan Reed/NCSA

Petascale to Exascale

- BDEC – Big Data and Extreme Scale Computing
 - www.exascale.org/bdec - 2014 February Meeting in Japan
 - Grand challenges and open questions relate to computing, software and applications research
 - Multi-country 'Coopetition' – USA, The European Union, China, Japan
- Convergence of nano, bio and informatics
- Next wave in computing
 - Quantum Computing
 - Biological Computing

Sectors with Greatest Big-Data Impacts

Healthcare
Public Sector
Retail
Manufacturing
ICT

Open Challenges

Advanced Manufacturing
Reliability Engineering
Process Engineering
Machine Learning
Software Engineering
Sociotechnical Systems

Issues Common to All Sectors

Big Science/Commerce/Government Services

Big Data – Integration, Provenance, Value addition,
Discovery, Customization of outcomes

Access & Transparency vs Privacy & Security

Data Policies

Enabling Collaborations

Encouraging and Rewarding Innovations

Disruptive New technologies

Big Data Analytics

Leveraging talent pool +

Addressing Shortage of Talent Pool and Skilled Labor

Implications for Policy Makers

Build Human Capital

Promote Incentives for Data Sharing

Develop Policies for Protecting Privacy and Security

Establish Effective IP Framework for Innovation

Accelerate R&D

Invest in ICT infrastructure

Recommendation as a must read:

May 2011 McKinsey Global Institute's Report!

Additional Information

More details are online at

http://www.mckinsey.com/Insights/MGI/Research/Technology_and_Innovation/Big_data_The_next_frontier_for_innovation

<http://ncsa.illinois.edu/enabling/software>

www.exascale.org/bdec

cacm.acm.org/blogs/blog-cacm/166121-leaping-the-exacale-chasm

<http://www.pewinternet.org/2014/05/14/internet-of-things/>

I am acknowledging collaborators and colleagues for portions of slides re-used from my NCSA days.

Thank you!

Concluding Thought

Data to Knowledge to Wisdom

‘Transformation’ to ‘Greater Good!’



“That’s one small step for [a] man, one giant leap for mankind”

– *Neil Armstrong*