

The Future of Informatics

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How can Informatics be a new fundamental science?

What's the pedigree of this at Edinburgh?

What good has this done lately?

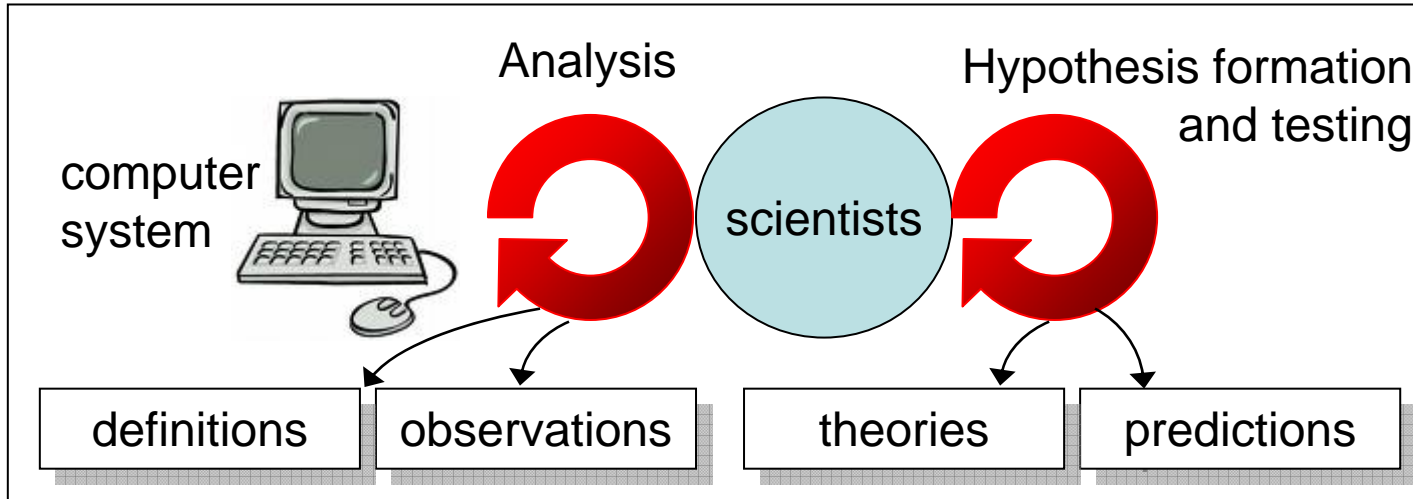
What's carrying us forward?

I'm talking from a personal viewpoint, although I believe these personal views should be widely held.

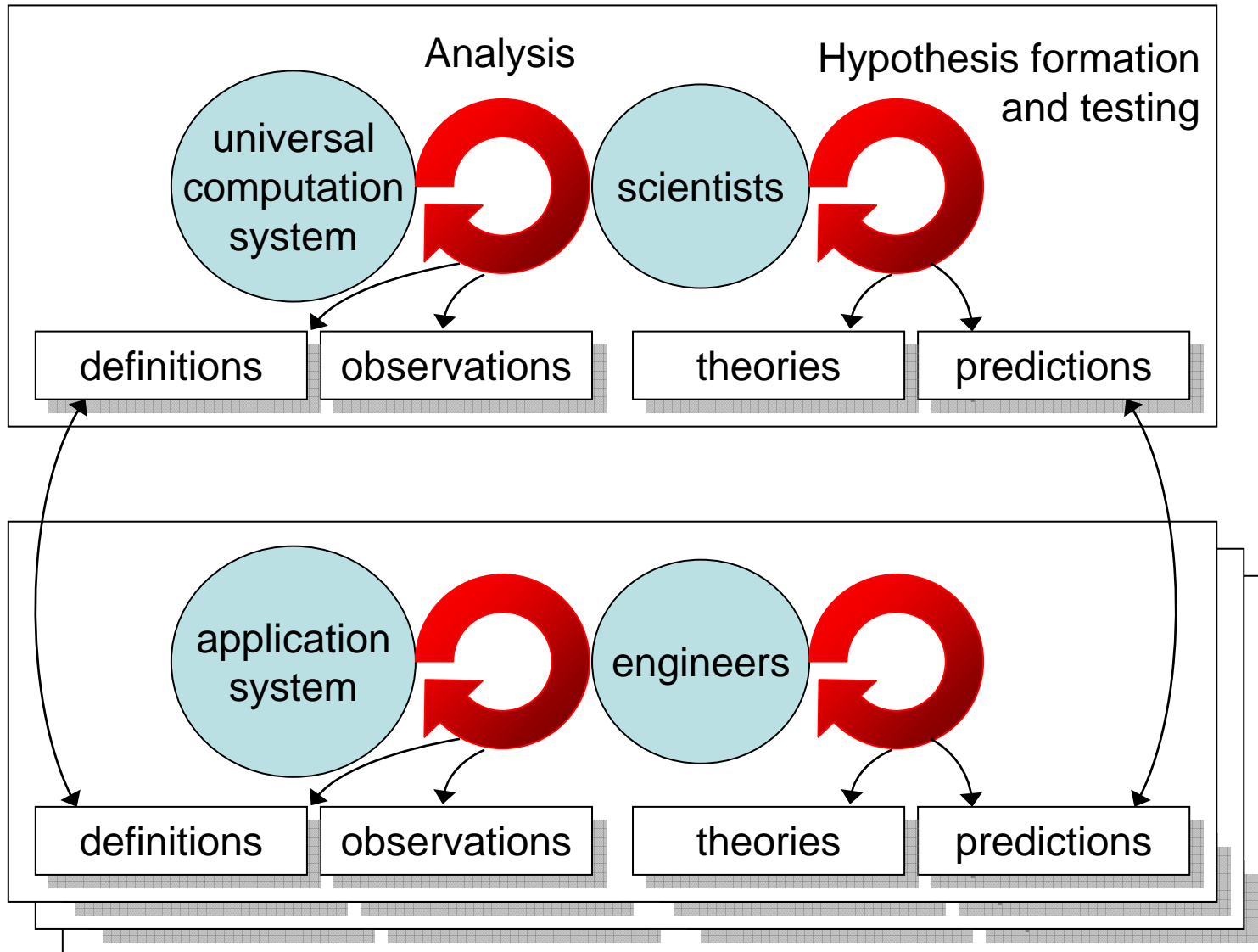


THE UNIVERSITY of EDINBURGH
informatics

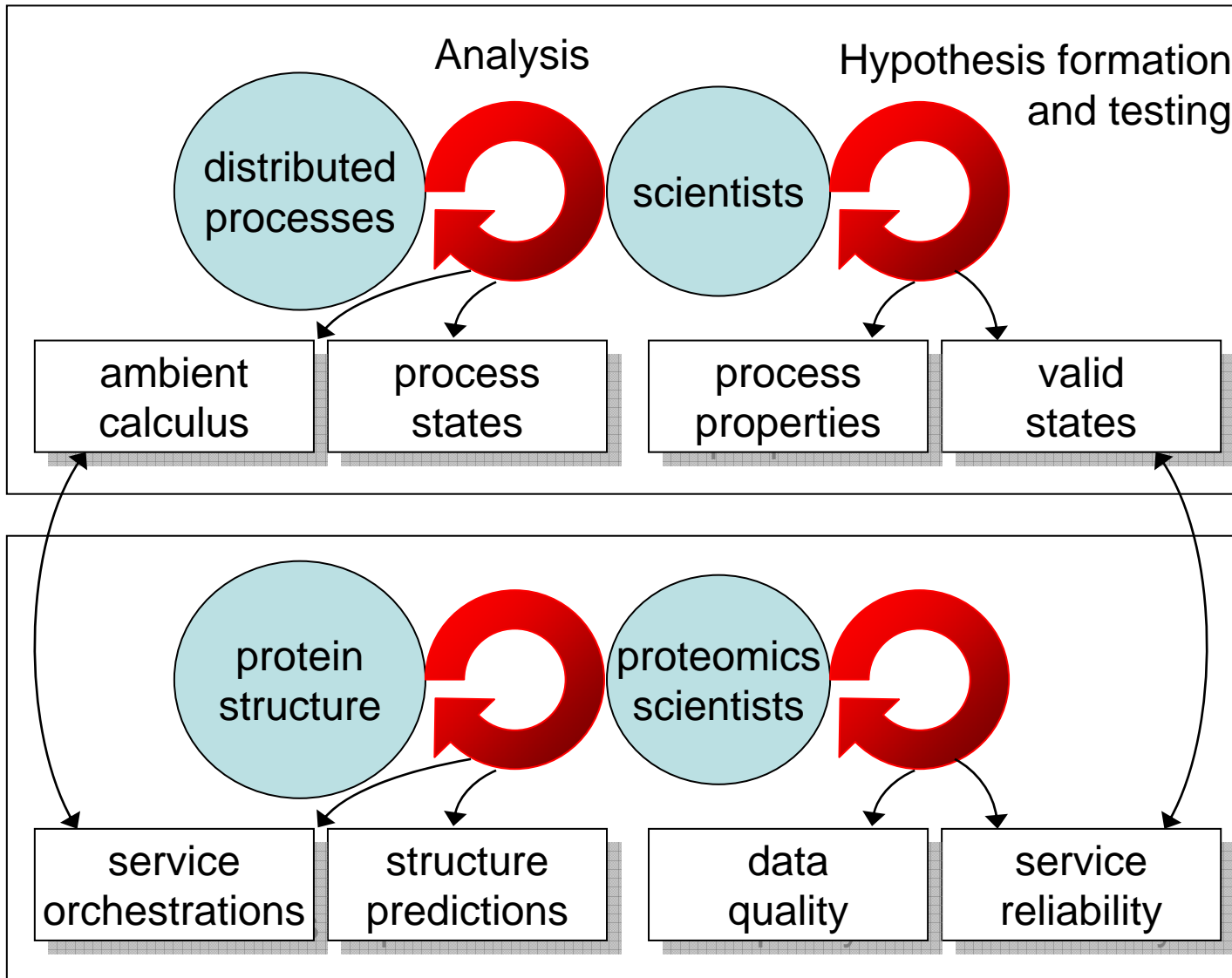
Traditional Computer Science



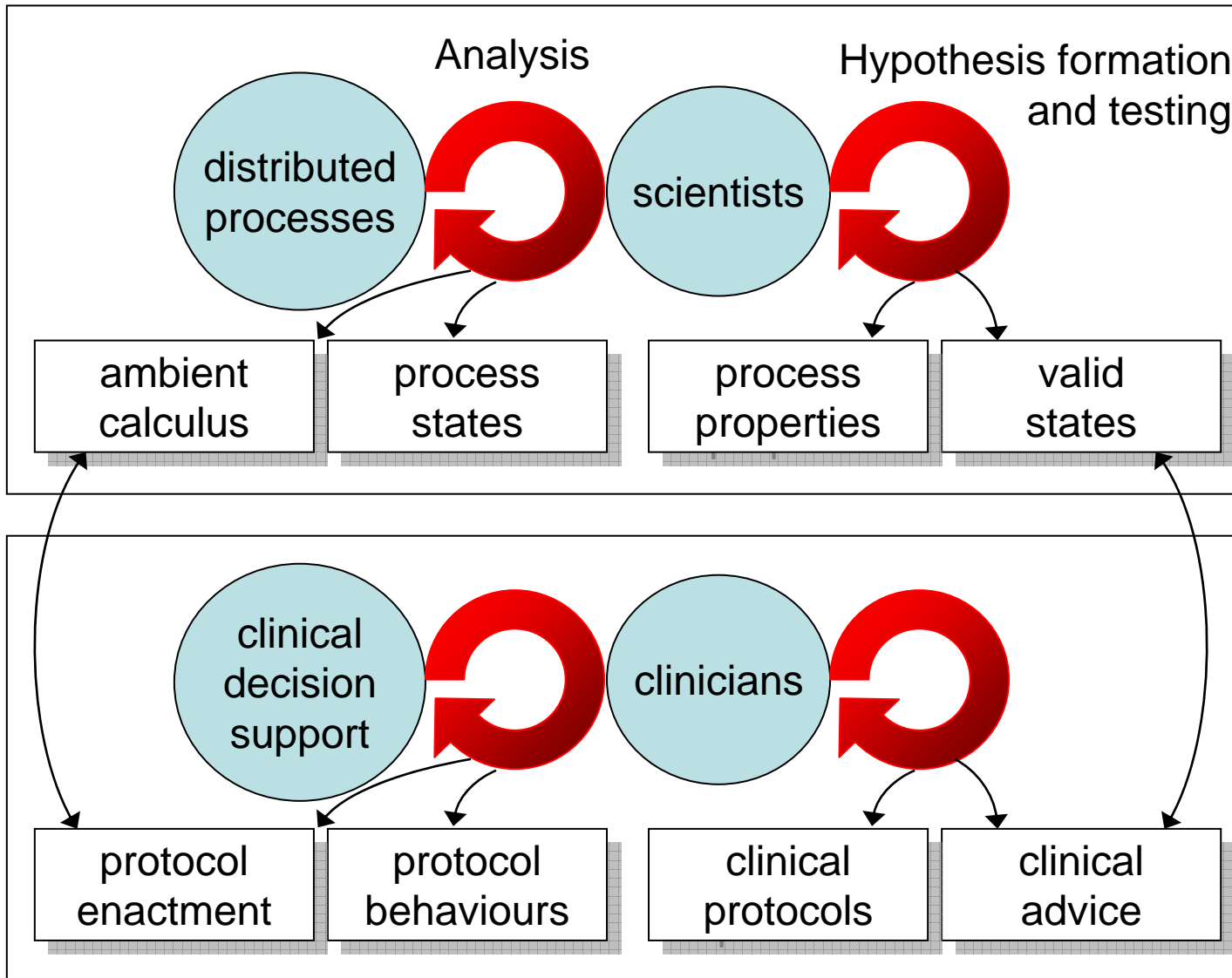
Broader View of Informatics



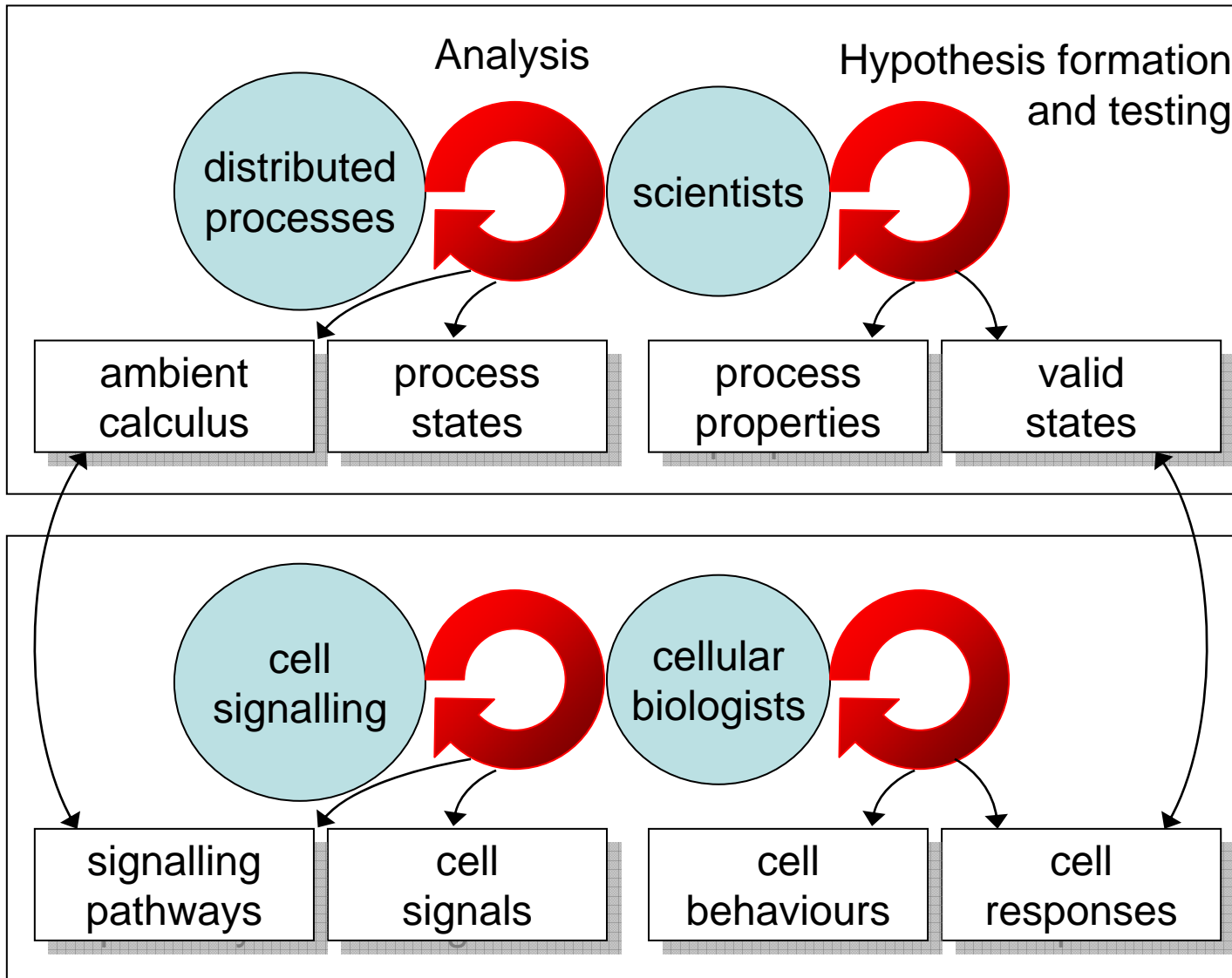
Example (1)



Example (2)



Example (3)



Classical Period (1965-1984)

Growing roots:

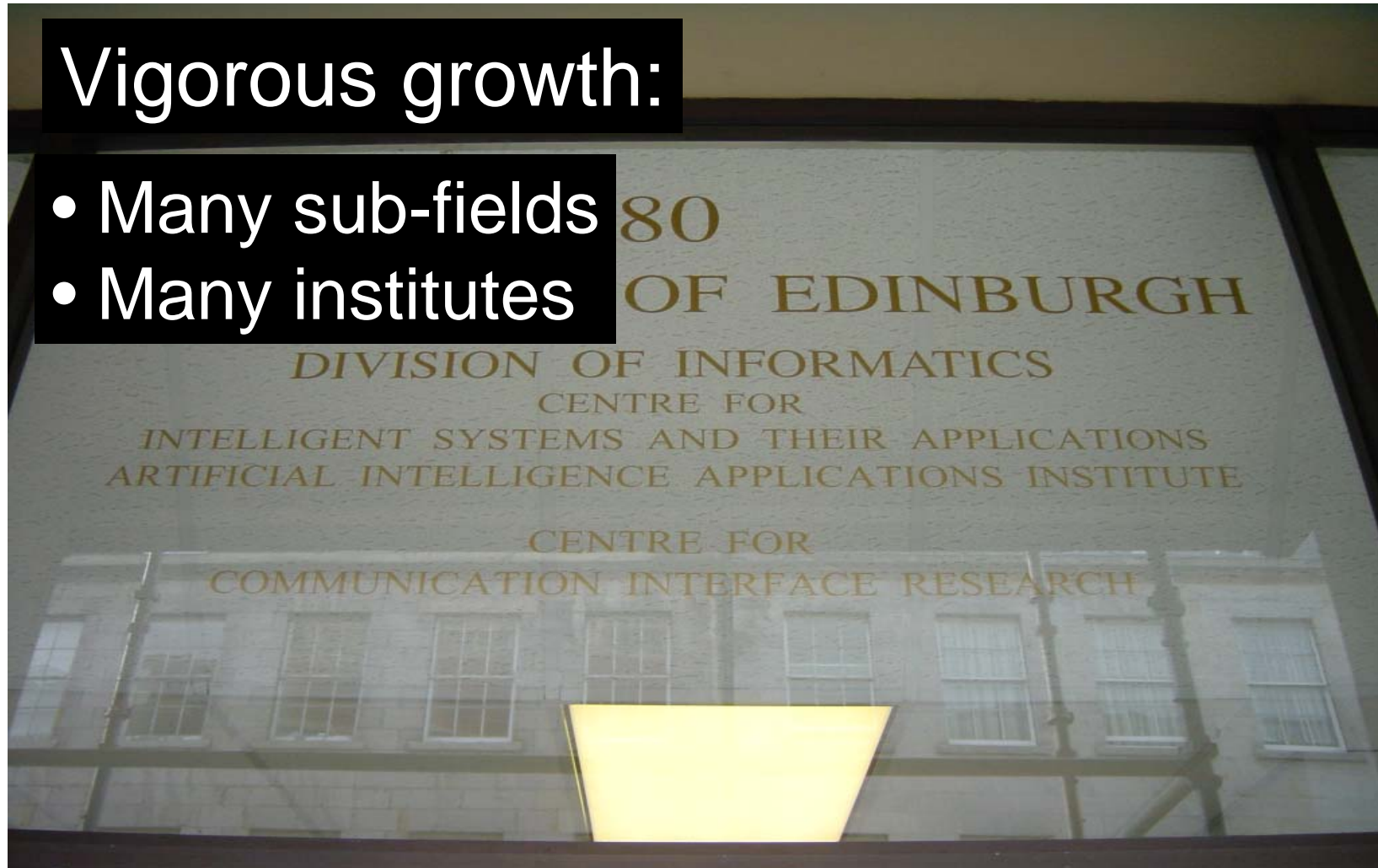
- State
- Logic



Eclectic Period (1985-1999)

Vigorous growth:

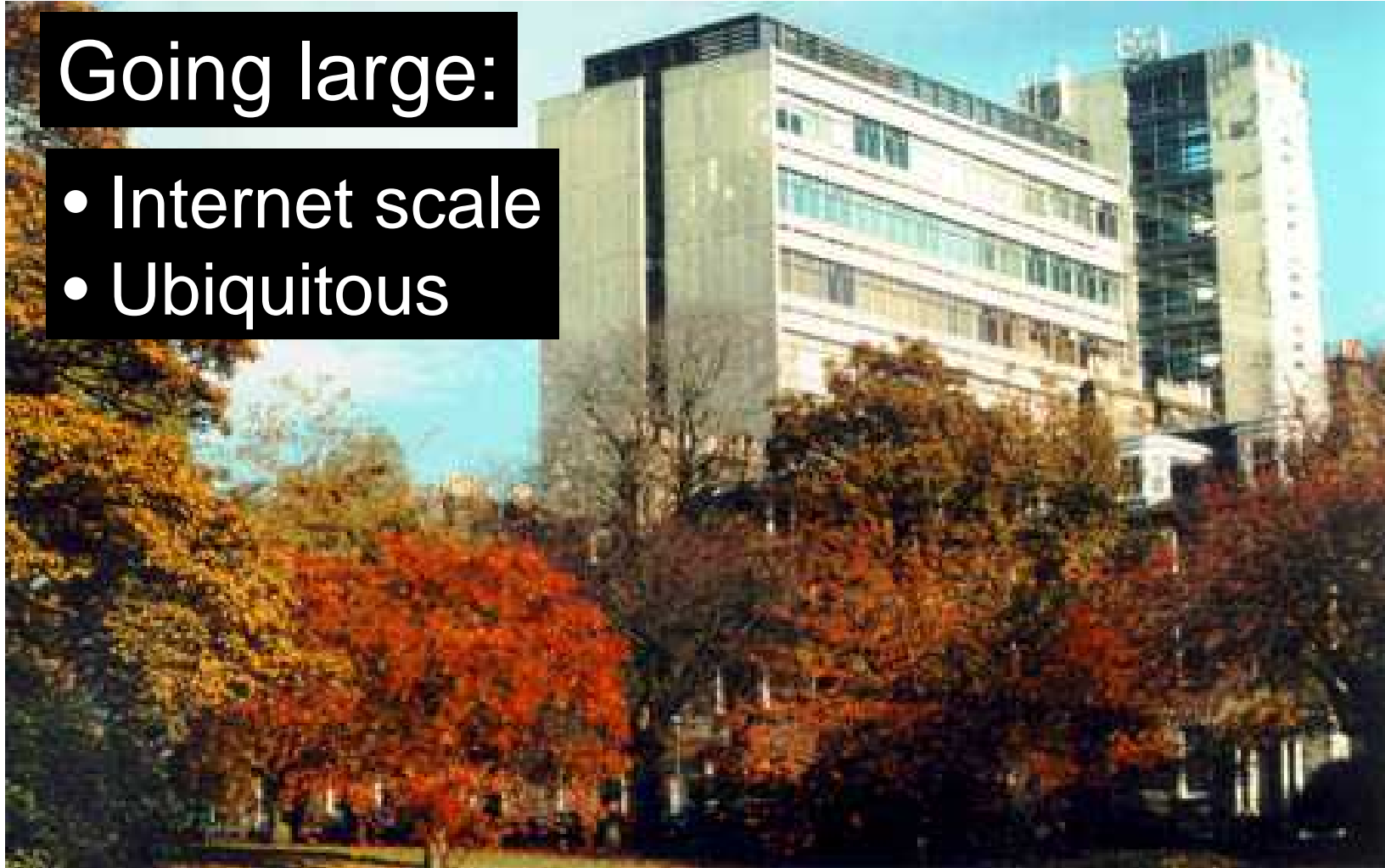
- Many sub-fields
- Many institutes



Modern Period (2000-2007)

Going large:

- Internet scale
- Ubiquitous



Post-Modern Period (2008+)

Open minimalism:

- Common core
- Computational scholarship
- Symbiosis with other sciences



Examples of Recent Impact

Data	XML databases
Types	Java generic types
Transformation	Iterative compilation
Parsing	Combinatory Categorical Grammar
Synthesis	Festival modular speech synthesis toolkit
Learning	Gaussian processes
Planning	Proof planning
Concurrency	Algorithmic skeletons for parallel computation
Perception	3D imaging
Control	Humanoid robotics
Adaptation	On-demand multipath routing for ad hoc networks
Design	Design of high-performance low-power micro-architectures
Complexity	Game theory

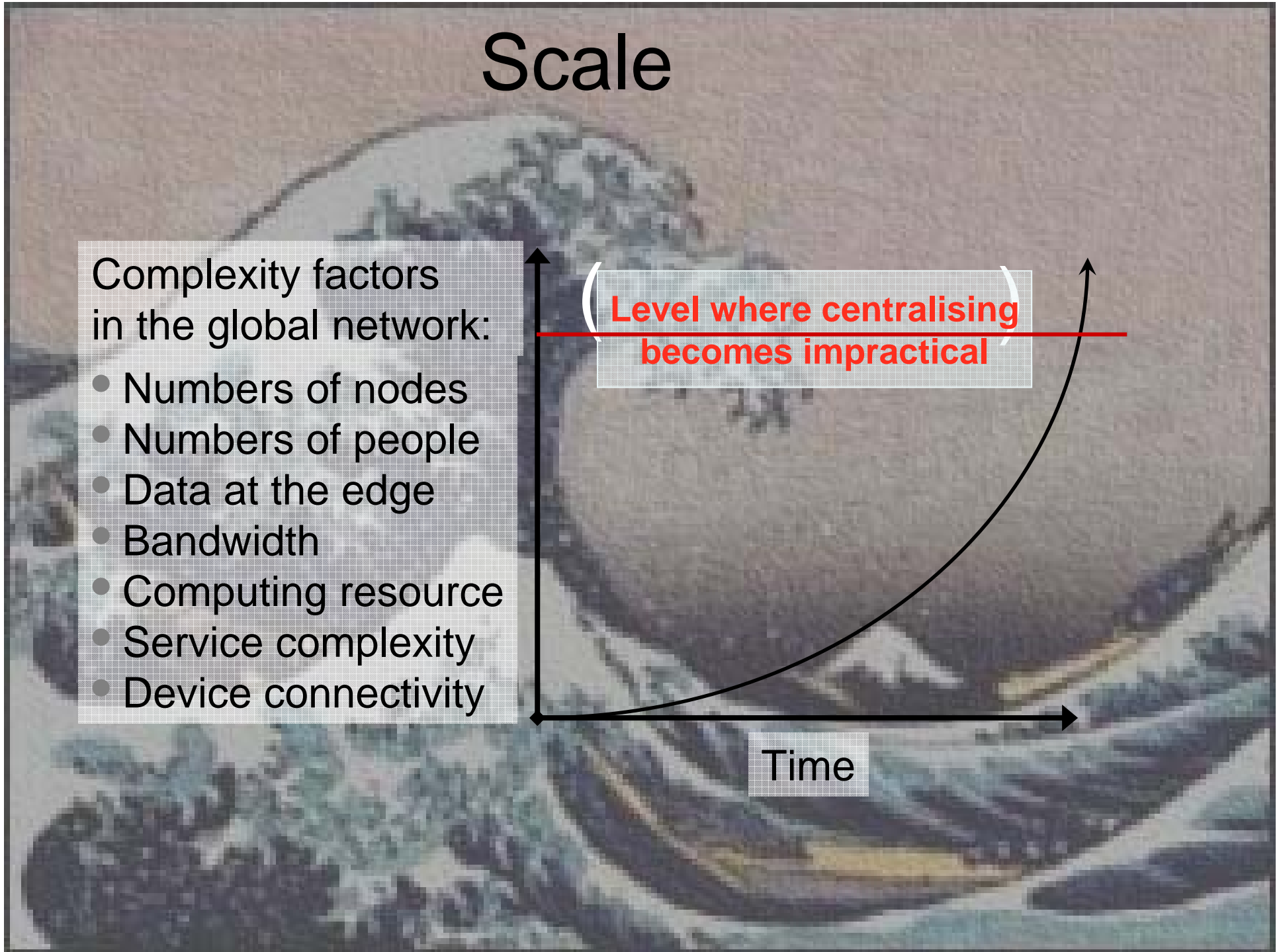
Scale

Complexity factors
in the global network:

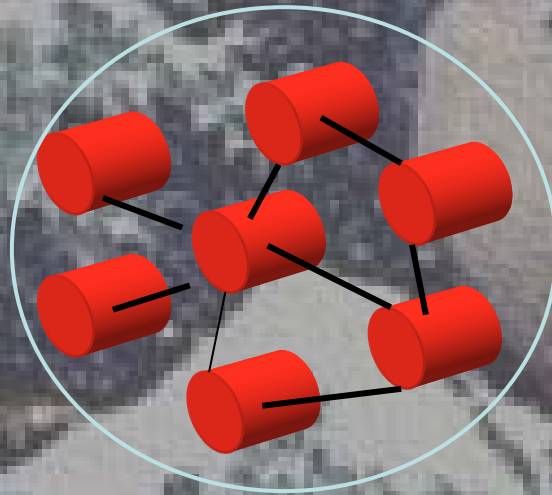
- Numbers of nodes
- Numbers of people
- Data at the edge
- Bandwidth
- Computing resource
- Service complexity
- Device connectivity

**Level where centralising
becomes impractical**

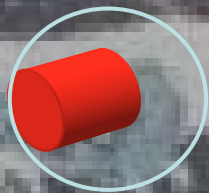
Time



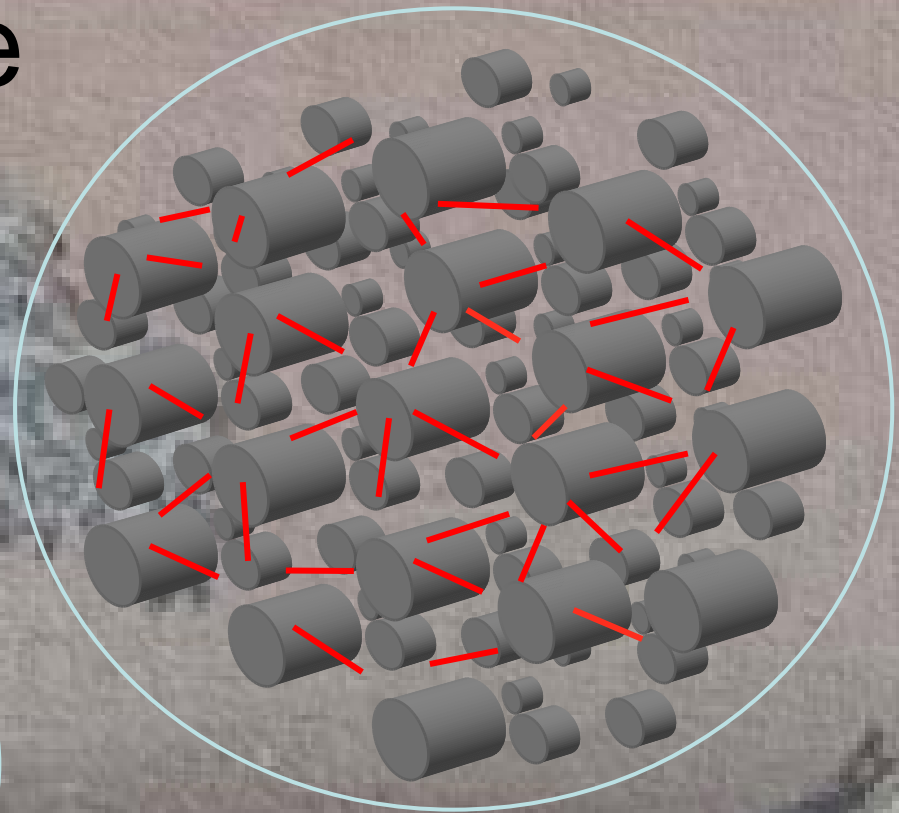
An Effect of Scale on Theory



Hybrid architecture
Semantics across architecture



Semantics of single knowledge base



Open system of reasoners
Semantics via interactions

1990

2010

An Effect of Scale on Applications

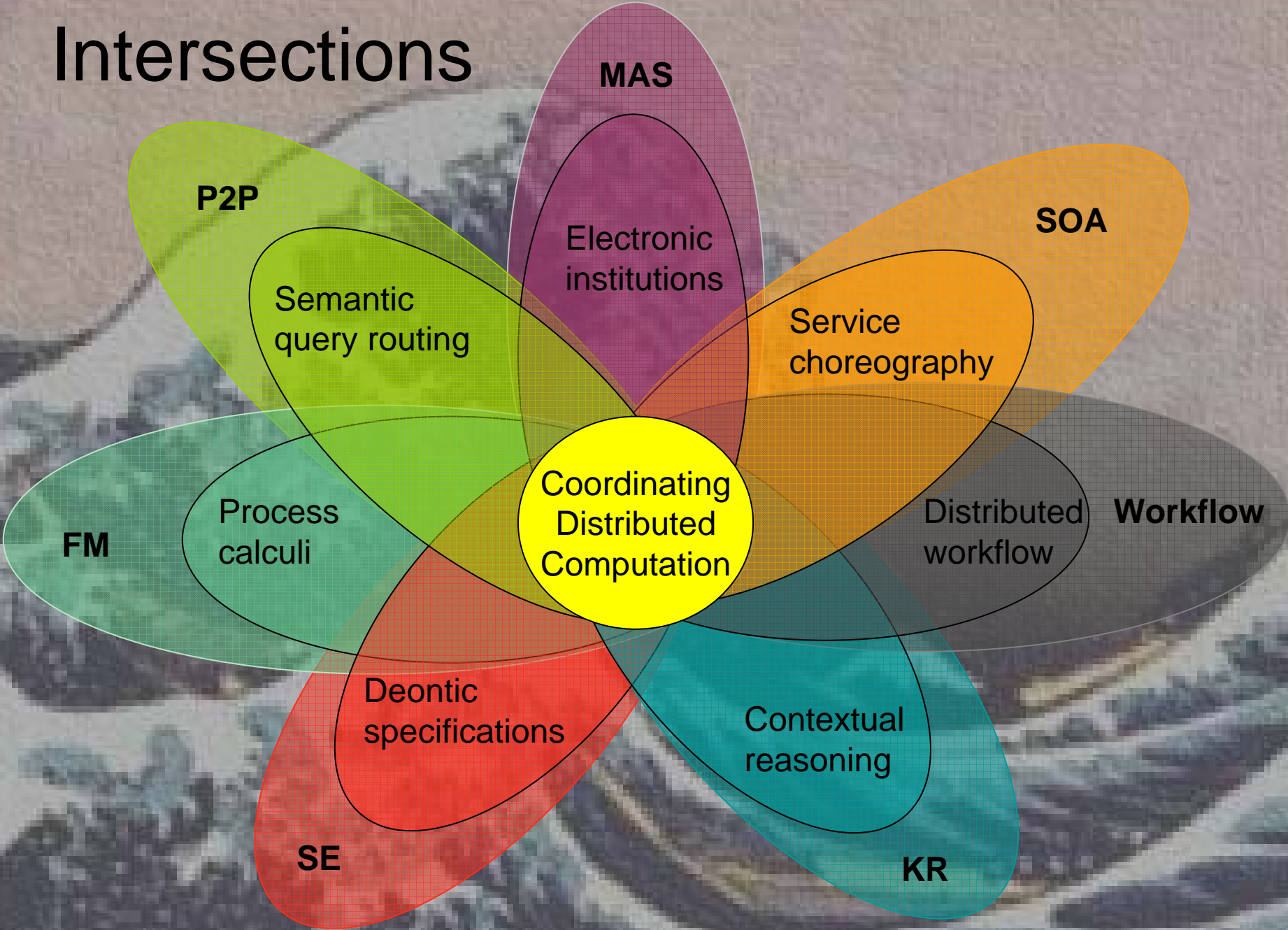
Opportunities

- Automation is necessary to get most things to work.
- Lack of background knowledge for reasoners isn't a showstopper.
- New internet environments bridge physical and virtual worlds.

Problems

- Many traditional algorithms don't scale.
- Traditional boundedness assumptions no longer apply.
- No single sub-field matches these new environments.

Intersections



Examples of Responses to Scale

Using scale as a fulcrum

Statistical machine translation; Web as a corpus

Peer to peer

Agent systems; Web service choreography

Guarantees in open systems

Proof carrying code

Provenance of data

Digital curation

Statistical complexity

Random structures and algorithms

Scale-driven Application Challenges

- Healthcare: We know that centralised architectures can't scale to the demands of current healthcare. Can decentralised architectures?
- Emergency response: Every device that can communicate could potentially be used in coordinating emergency responses. How?
- Data analysis: The Large Synoptic Survey Telescope will produce 30 TB of data per night. What is the architecture of the system(s) to analyse this data set?

The Future of Informatics

Informatics is a fundamental science because it makes sense to study the information (and information processing characteristics) of every natural system. It is a new science because the core methods for doing this aren't in the domain of traditional sciences.

We (including you as alumni) supplied a substantial part of the foundations for this; not only the technical stuff but the ethos that allowed the science to mature.

In the process we've been useful, to our fellow scientists and to society. As we have gained confidence in our own science we have been better able to engage with others.

We are now being carried forward by critical mass we've obtained (size does matter in this respect) and by the sheer scale of the problems for which an informatics approach is the only solution.

