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# A Computing Roadmap of Digital Ecosystems

From metaphor towards paradigm

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# Digital Ecosystems

**Metaphor:** *"A figure of speech in which a word or phrase is applied to an object or action to which it is not literally applicable."*, Oxford Dictionary

## Digital Ecosystems

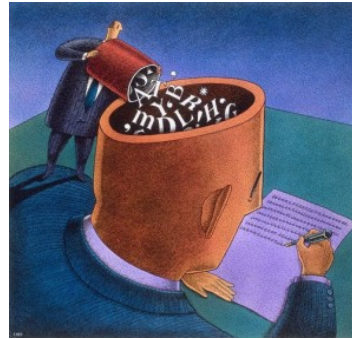
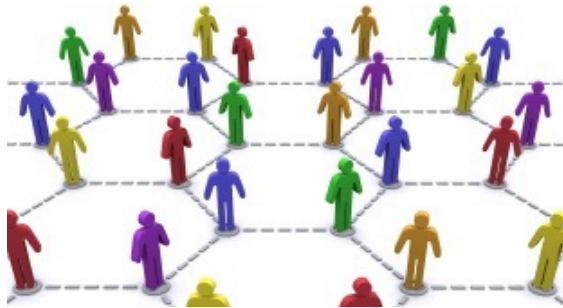


Focus: Computing areas and their interventions

**Roadmap?**

**Paradigm:** *"A world view underlying the theories and methodology of a particular scientific subject."*, Oxford Dictionary

# Metaphors

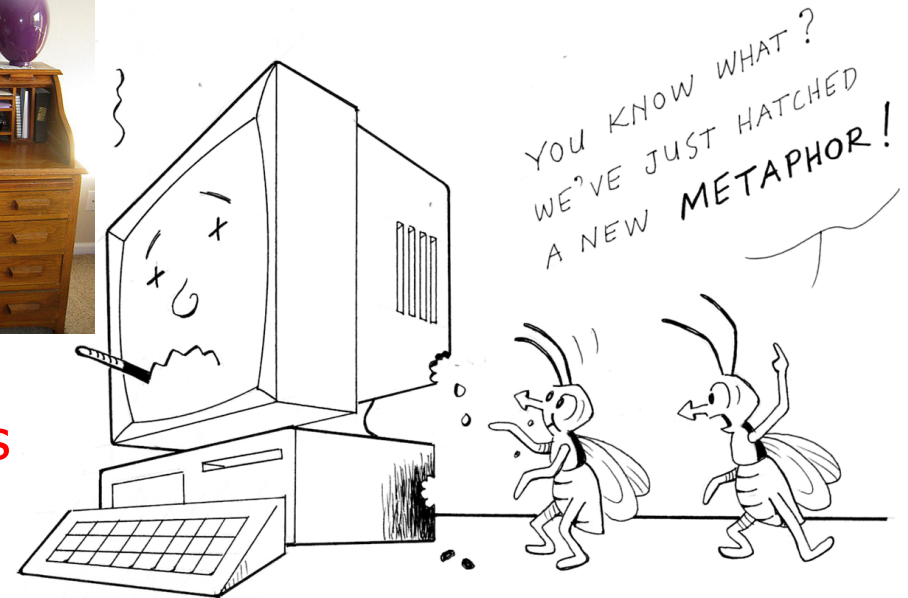
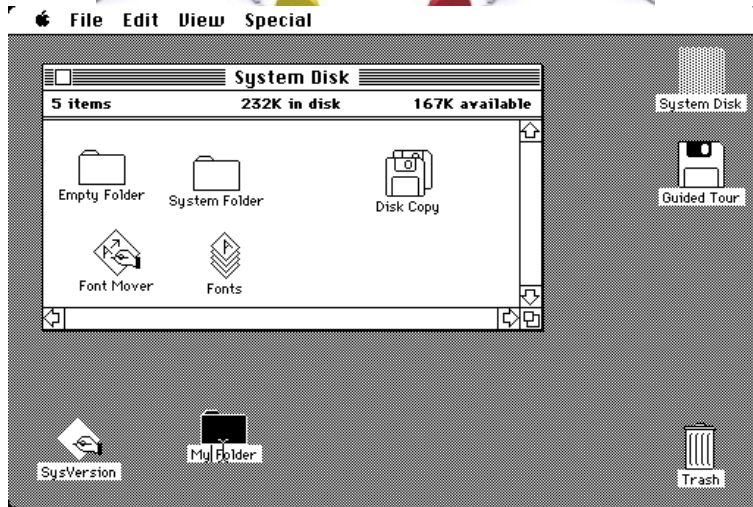


Inspiration

Intuition

Educational value

Multidisciplinary concepts



Oversimplifications

Misconceptions

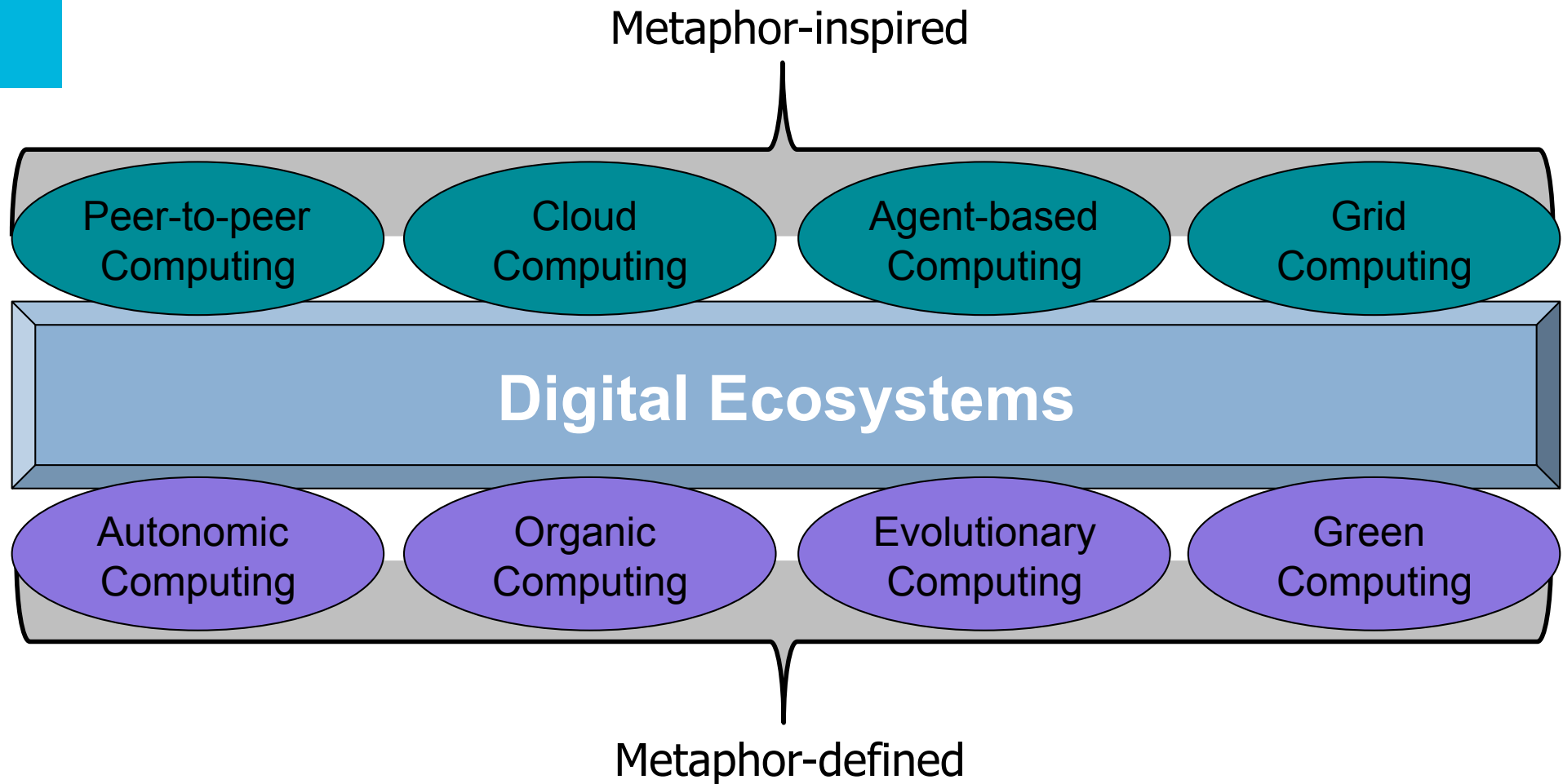
Conceptual problems



# Metaphors (Cont.)

How are metaphors used in **computing areas** of digital ecosystems?

# Computing Areas



# Computing Interventions

Cloud Computing

Agent-based Computing

Peer-to-peer Computing

Network architectures

Software architectures

Grid Computing

System optimization

Resource virtualization

Autonomic Computing

Energy efficiency

Green Computing

Environmental sustainability

Organic Computing

Evolutionary Computing



# Current Practice

Multidisciplinary research

A wide range of applications

Impact on different socio-technical and business domains

Overlap in concepts, contributions and interventions

Limited awareness and coordination

# Roadmap







# Proposition #1

*Digital ecosystems are more (and less) than biological ecosystems.*



# Proposition #2

*Digital ecosystems require both metaphor-inspired and metaphor-defined computing areas.*



# Proposition #3

*There is a major overlap in the concepts, objectives, contributions and interventions of computing areas of digital ecosystems.*



# Proposition #4

*Digital ecosystems require a self-awareness and coordination of computing contributions and interventions.*

# Proposition #4 - Example

**Green Computing:** *Which types of machines are required?*

**P2P Computing:** *How important is decentralization and P2P communication?*

**Organic Computing:** *How can the system self-organize its interactions?*

**Autonomic Computing:** *Is software able to self-manage trade-offs between performance, energy consumption and carbon footprints?*

Design of an efficient and environmental-friendly data center

**Grid Computing:** *Which methods can be applied for the computation of these trade-offs?*

**Agent-based Computing:** *Which software models realize these methods?*

**Evolutionary Computing:** *Are the achieved solutions optimum?*

**Cloud Computing:** *How does the user access the services of such a data center?*



# Proposition #5

*Digital ecosystems can potentially become a collaborative research environment or platform of computing areas.*



# Conclusions and Challenges

Computing areas of digital ecosystems use metaphors in different ways

The use of effective metaphors in digital ecosystems is challenging

Awareness and coordination are required

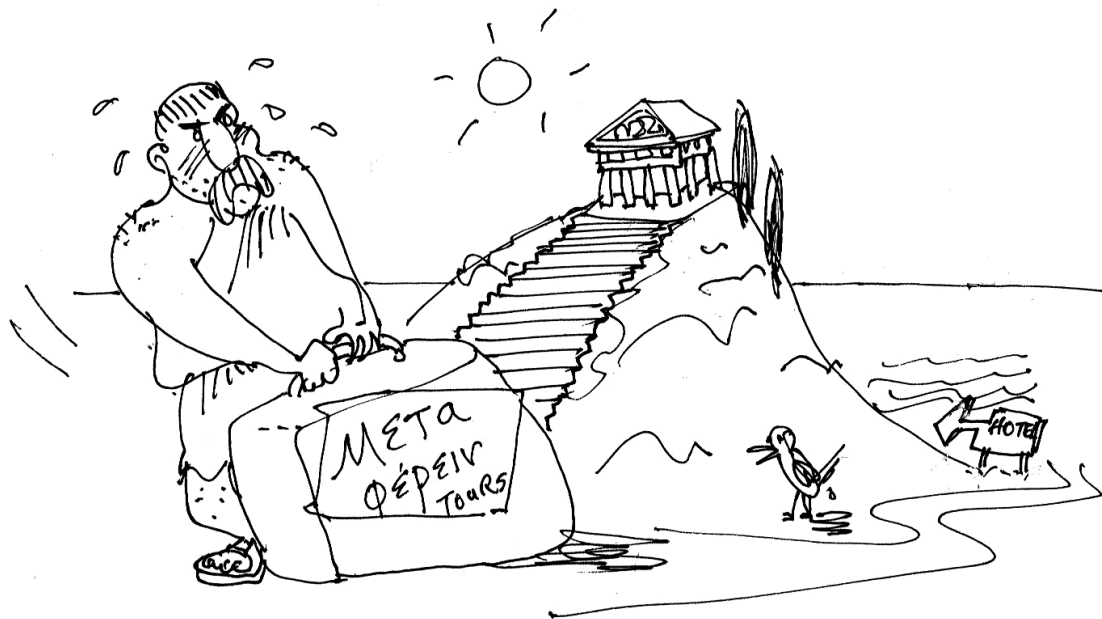
A **collaborative research environment** towards  
the **digital ecosystem paradigm** is promising

# Questions?

## More information

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Meta=change + phora=carry