Nature-inspired Smart Information Systems

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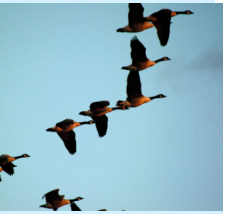
Nature-inspired Smart Information Sys
A Co-ordination Action (CA) under FP6 IST FET

16.01.2007 – Neuro-iT.net Workshop



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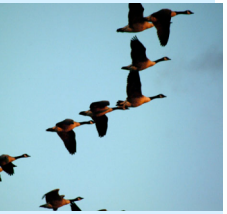
Setting the Scene

- ERUDIT Fuzzy Reasoning (NoE 94-00)
- EUNITE Intelligent Technologies (NoE 01-04)
- NiSIS Learning from Nature (CA 04-07)



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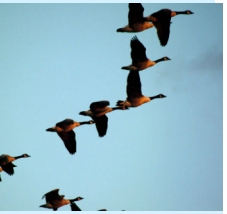
Overall Mission Aims

To co-ordinate multi-disciplinary studies and resear
endeavours into the development and utilisation o
intelligent paradigms (bio, social,...) in advanced inform
systems design.



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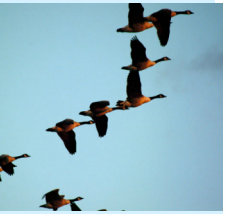
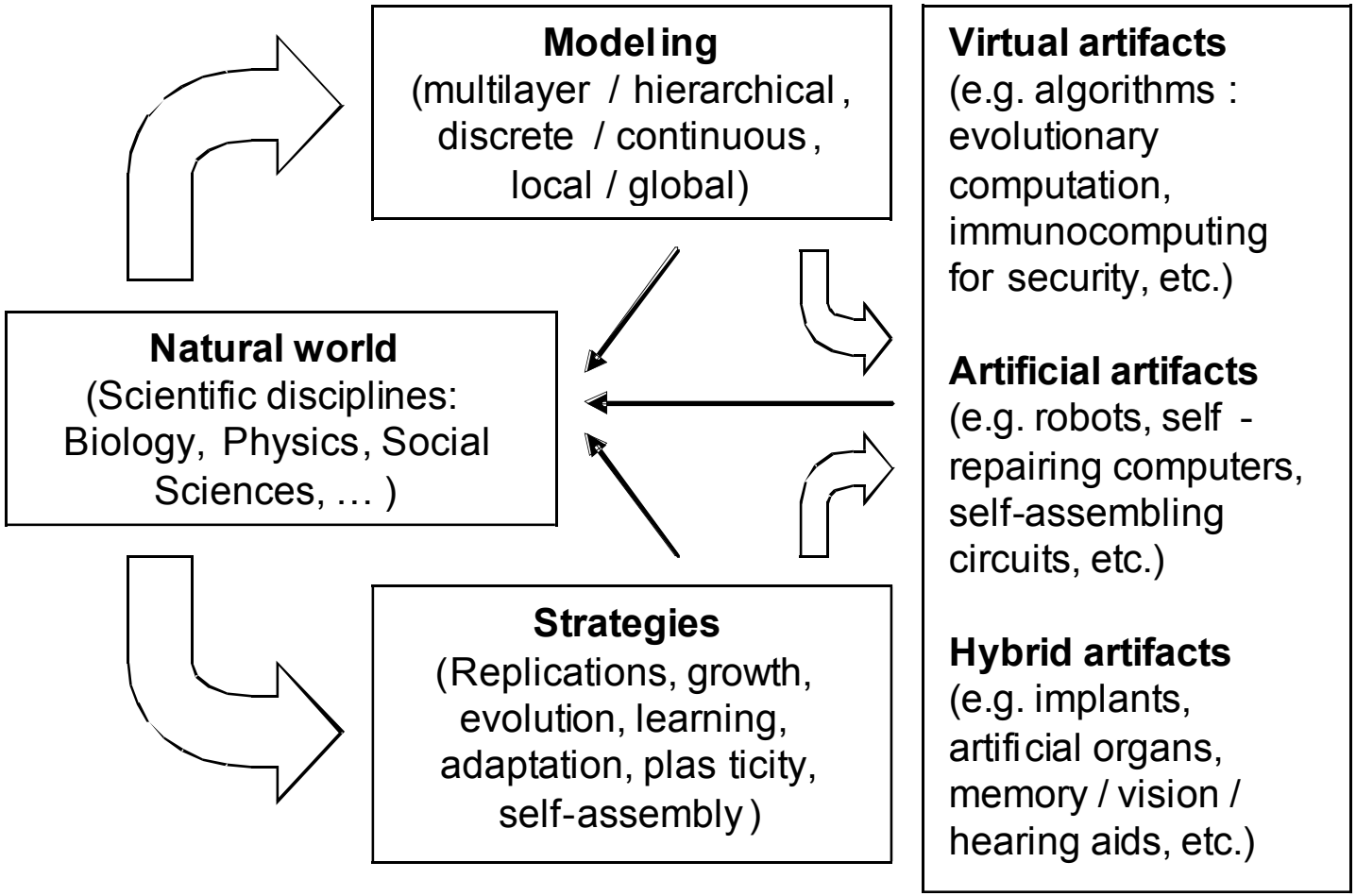
Main Objectives

- Progress adaptive systems beyond curiosity
- Improve robustness via modularity, hierarchy etc.
- Embed systems dynamics understanding into intellig structures

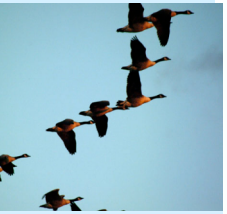
- Encourage cross-disciplinary team-based thinking
- Develop a Strategic Roadmap
- Provide Training, Education and Technology Transfe
- Encourage young researchers
- Cross-link to other relevant groups



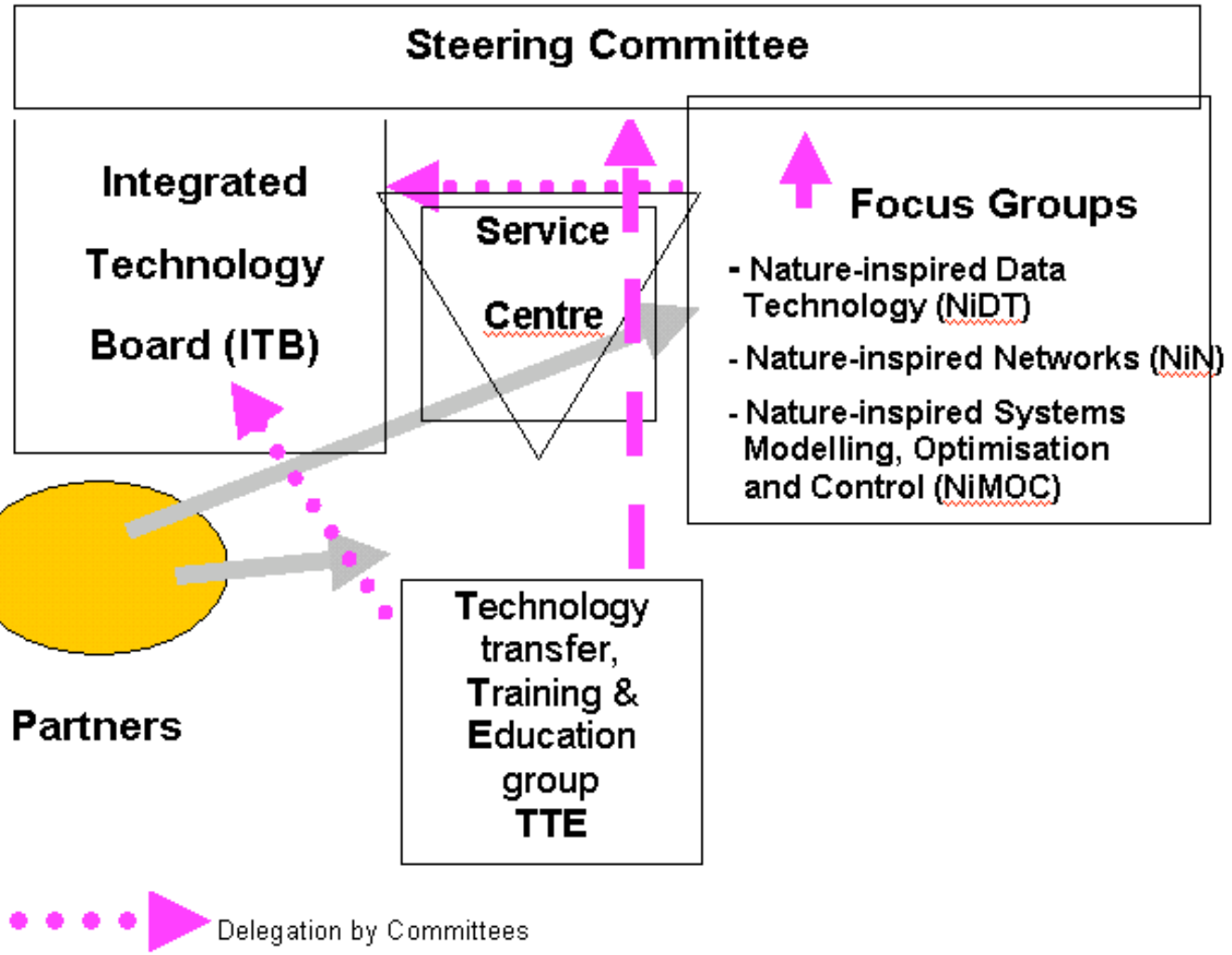
Inspiration from Nature

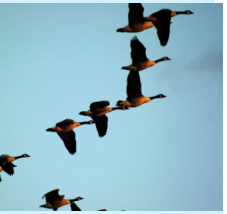


BTH – NiSIS Cooperation



Components in the Management Structure





Focus Groups

NiDT
Nature-inspired Data Technology

Chair: Davide Anguita
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Italy

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NiN
Nature-inspired Networks

Chair: Trevor Martin
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NiMOC
Nature-ins Modellin Optimization &

Chair: Reinhard G
Hans-Knoell Inst
Germany

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ITB
Integration Technology Board

Chair: Derek A. Linkens
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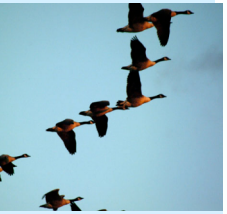
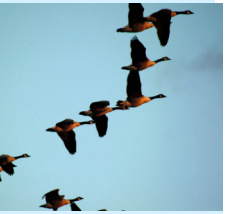


NiN: Types of network & problems

- fixed - phone, transport, supply / distribution, internet
- ad hoc - wearables, sensors, vehicles, process models, social
- mixed - mobile phone, wireless-fixed , markets
  - routing, robustness, resource allocation, capacity, autonomy (self repair, self c
    forecasting / diagnosis, efficiency, security, volatility, dynamic behaviour
- information networks - content focus
  - location, access, extraction, distribution, data quality, fusion, hyperlinks (text/vic
    recommenders, visualisation, clustering
- self-constructing networks - cell interactions
  - where does adaptation come from?
  - how to classify and model dynamic networks (graph theory)
  - how do “regulations” affect outcome?
  - How to design networks to achieve a desired behaviour



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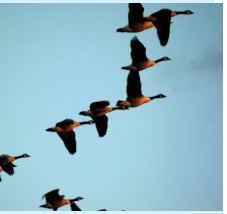
NiN: Nature - inspiration

- disease transmission - epidemic
- ageing
- genetic programming, genetic algorithms, etc
- search - ant colony methods
- learning - reinforcement, Bayes nets
- adaptivity / self-organisation
- neural nets, agent-based systems
- swarm intelligence, flocking
- emergent properties (e.g. cellular automata) - global vs local behaviour
- multi-scale similarities
- multi-function components - organism development, information networks
- economic systems - regulatory systems
- organisational adaptation, social networks



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NiMoC: Contribution of life sciences advanced information systems

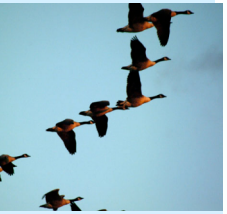
- Network architectures
- Modularisation
- Hierarchical structure

Already established in IT

- Repair

- Spatial organisation
  - compartimentation
  - domains
  - multi-functionality of protein complexes
  - structure - function relationships

Potential for novel featur
and applications in IT



Living cells perform

Biochemical reactions

- Catabolic reactions
  - Conversion of substrates into small molecules
  - Generation of free energy
- Anabolic reactions
  - Biosynthesis of complex molecules
    - biocatalytic entities
    - structural elements
    - storage substances

Information processing

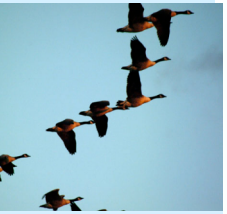
Regulatory networks

- Control of chemical reac
- Temporal and spatial coordination of reaction

Signal transduction networks

- Communication with environment and other ce
- overcome starvation (exogen and endogen)

Spatial organisation of indidua reactions - compartiment



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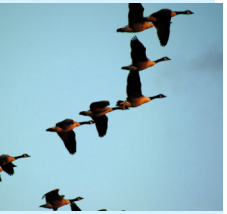
NiDT: Problems related to Data Technolo

- Missing / partial data
- Noisy / uncertain data
- Heterogeneous data
- High dimensionality
- Spatial and temporal issues (e.g. delays)
- Hierarchy / structure
- Representation / Coding
- Compression
- Data flooding



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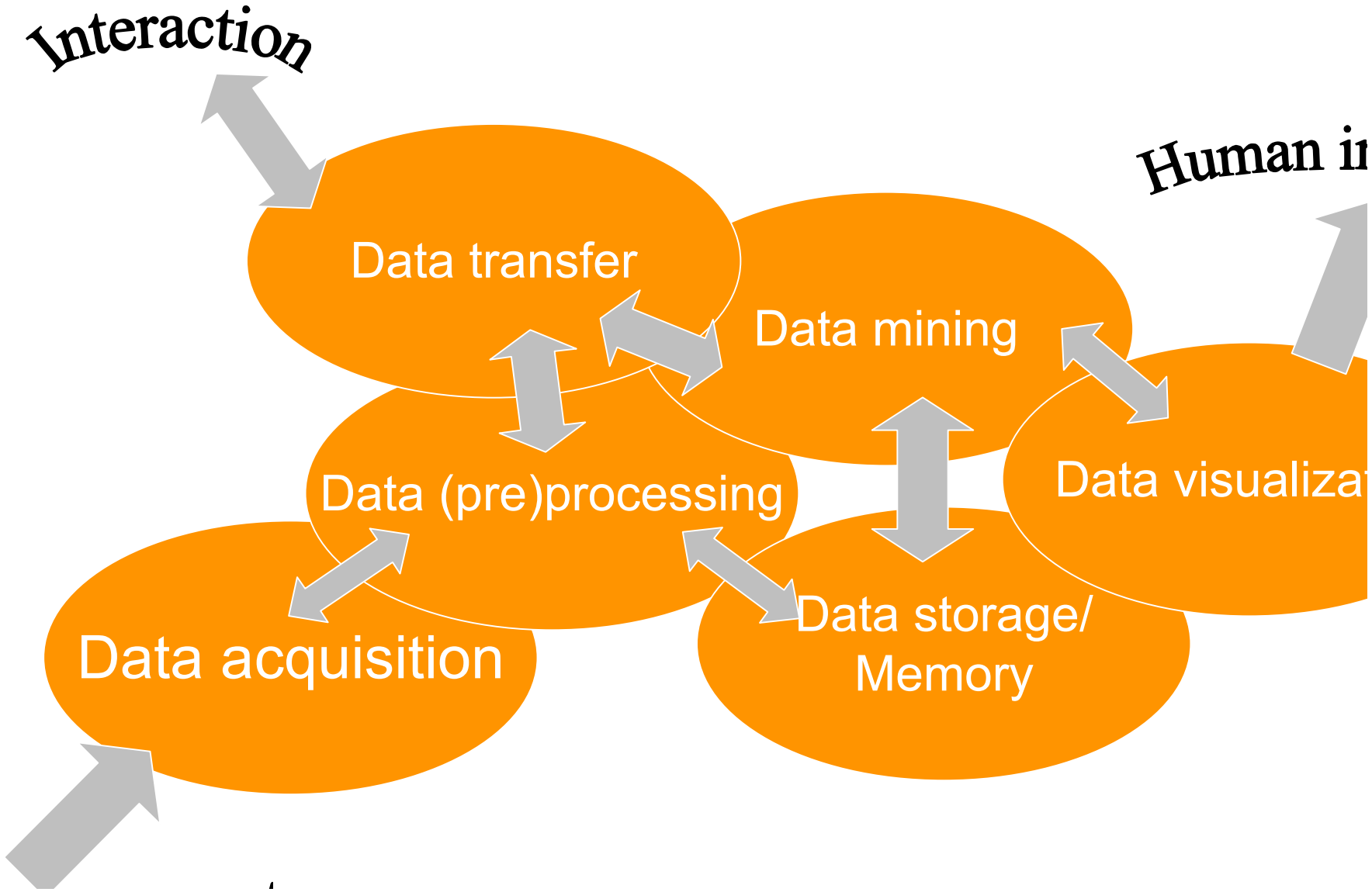
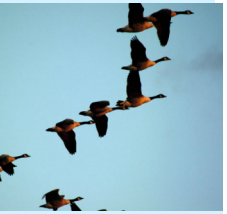
NiDT: Data Technology – Information flo





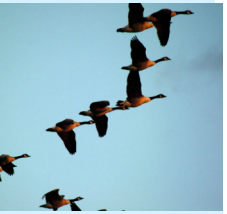
Task Forces

The following Task Forces have been executed during October 2005 – September 2006 and final repo will be available soon:

NISSPI – Nature-inspired Self healing Soft Sensors for Process Industry Leader: Berendsen, Monika	**The origin of adaptability in natural networks** Leader: Monk, Nicholas	**Nature-inspired Cooperative Strategies for Optimization** Leader: David Pelta
Nature-inspired Monitoring and Control Leader: Bayer, Karl	**Potential Nature-inspired Aspects in Information Networks** Leader: Nürnberger, Andreas	**NICOLE – Nature-inspired Combinatorial Machine Learning** Leader: Anguita, Davide

The following new Task Forces have been accepted and started on 01 October, 2006:

Multitasking of Liver Tissues Leader: Sebastian Zellmer	**Physically-inspired Artificial Learning Models (PIALM)** Leader: Dymitr Ruta	**Sparking New Ideas through Brain-like Association Networks** Leader: Michael R. Berthold
Immune System-inspired Health Monitoring of Machinery using the Danger Theory Leader: Jens Strackeljan	**Nature-inspired Methods for Local Pattern Detection** Leader: Thomas Seidl	**Nature-inspired Robustness** Leader: Rüdiger Brause



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www.nisis.de