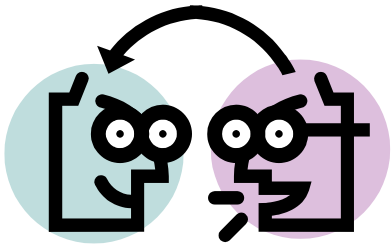
Panel Discussion

ECVision Summer School on Cognitive Vision
Thursday 28th August 2003



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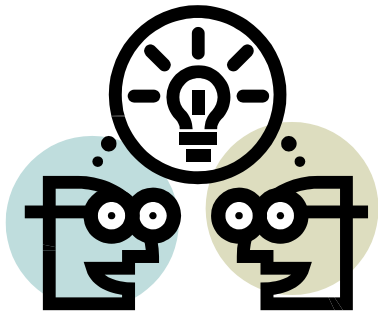

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Viewpoints on Cognitive Vision

Jim Little

- Cognitive vision entails
  - knowledge and scene representations
  - learning, interaction (with humans)
  - agent intentions (and intentional models)
- Need representations of the world so that one can reason about them
- This implies that we need
  - models (to represent situations, behaviours, categories, configurations)
  - robust perception and learning to build the models
  - robust reasoning capabilities to produce sensible communication with humans and/or its motoric interface

Viewpoints on Cognitive Vision

Bernd Neumann

- High-level scene interpretation
  - several objects,
  - behaviours,
  - temporal and spatial relations and events,
  - qualitative (non-geometric) descriptions,
- involving inferred facts (in the absence of visible/observable information)
- Interpretations are based on conceptual knowledge and experience about the world (top down processing)
- Embodied vision is not always necessary

Viewpoints on Cognitive Vision

Goesta Granlund

- The purpose of cognitive systems is to produce a response to input stimulus
- Context is as important as the percepts
- An ability to *autonomously* adapt to the environment and its demands
- Systems must be able to learn from the environment (not just geometry, but also consequences and values)
- **The central mechanism is the perception-action feedback cycle where, in the learning phase, action precedes perception**

Viewpoints on Cognitive Vision

Goesta Granlund

- **Symbolic representations should be derived from the action output (not the perceptual interpretation)**
- Symbolic output should be viewed as primarily for communication
- Language is low in information content but works effectively *iff* it is received by a system with the right (similar) perception/action structure. In some sense, language indexes understanding in a second party ('it pushes the right buttons').

Viewpoints on Cognitive Vision

Goesta Granlund

- **The only way to acquire semantic information is through association or learning**
- This implies that, for the training phase at least, the system must be an embodied entity

Viewpoints on Cognitive Vision

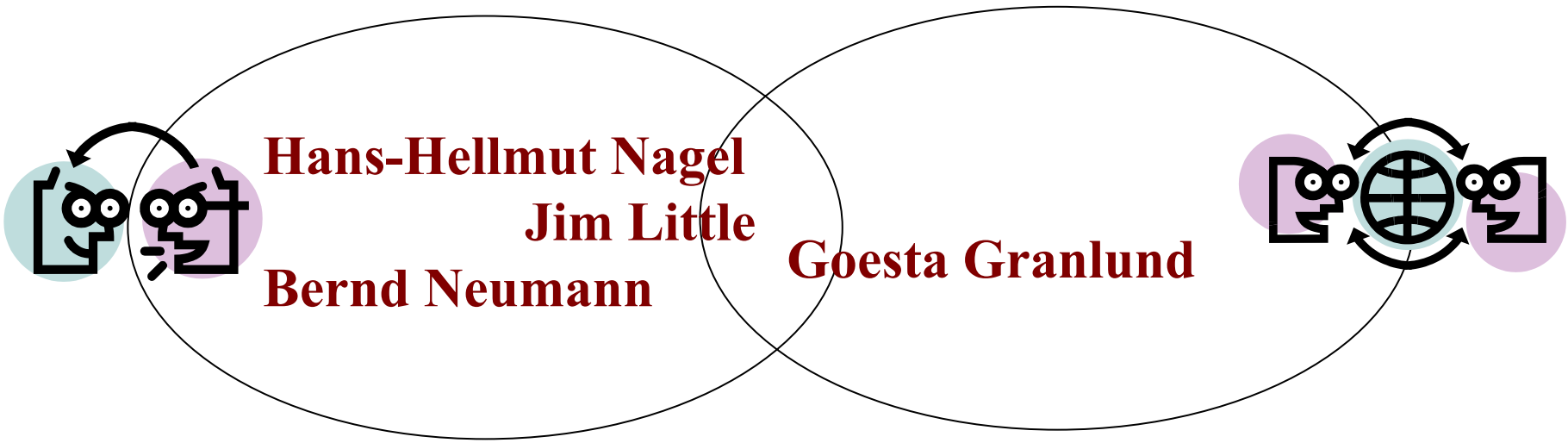
Hans-Hellmut Nagel

- Behavioural modeling is essential for scene interpretation
  - to be used as a form of top-down feedback of information to low-level analysis
- This behavioural analysis allows the generation of a synthetic image sequence
- A comparison between the SIS and the original image sequence, closes the loop, and enables a check for systematic corruption of information along this loop
- Thus, we use of constraints to render representational vision practicable in (almost) general-purpose computer vision.

Viewpoints on Cognitive Vision

Exploit user-models to render the vision problem tractable

System builds its own understanding; tractability emerges by exploratory learning



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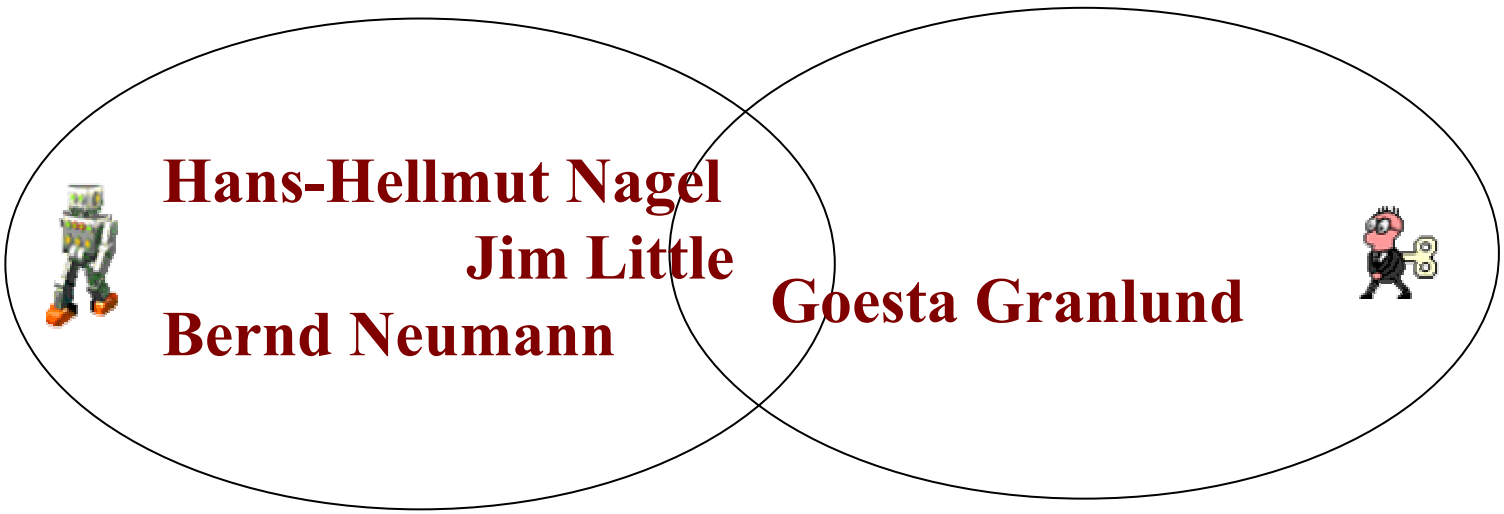


Questions!!!!

- **The nature of cognition:**
  - What makes a system cognitive?
  - What are the requirements for a cognitive system?
  - What properties characterise cognitive systems? What categories of cognitive tasks can be defined?
  - To what extent is embodiment necessary for cognitive systems?
  - To what extent are perception, reasoning, language, and embodied action necessary for cognition? Is action required to define perception?

Questions are taken from the European Commission document expanding on the call for proposals in cognitive systems;
See www.ecvision.info/news/CS-Support_Document-v2.pdf

Questions!!!!

- **Architectures for cognition:**
  - What architectural models can be used to design cognitive systems?
  - How can perception, action, learning, communication and self-description and self-awareness be integrated?
  - What is the nature and function of memory?
  - Can we build systems that are auto-descriptive, auto-critical, auto-regulating and auto-healing?

Questions!!!!

- **The nature of knowledge:**
  - What kinds of informational states, memory and knowledge are useful to identify?
  - How can knowledge enable generation of new knowledge.
  - What are the roles and nature of spatial, temporal and causal concepts?
  - What is the role of language in cognition and of cognition in language?
  - How can meaning be characterised?

Questions!!!!

- **Perception:**
  - Is action necessary for perception?
  - How can affordances be learned and perceived?
  - Is the distinction between top-down and bottom-up processes useful in perception?
- **Learning:**
  - How can a system learn of competences, affordances, categories and concepts?
  - What are the different modes of learning needed in a cognitive system?
  - How can new knowledge or skills be integrated coherently with old knowledge or skills without compromising the stability of the system?

Questions!!!!

- **Autonomous systems:**
  - What are the varieties and mechanisms of autonomy?
  - What is required for a system to be autonomous?
  - What is the relation between cognitive systems and autonomous systems?
  - To what extent are emotions and other affective states and processes necessary for autonomy?

Questions!!!!

- **The notion of Self:**
  - What does it mean for an artificial system be aware?
  - What is the functional role of consciousness in an artificial system?
- **Social Interaction:**
  - How do considerations of communication, cooperation, and competition impact on cognition?

Questions!!!!

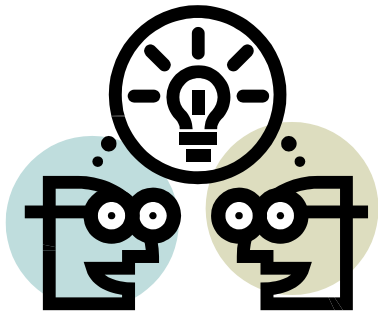
Goals:

- How can goals be identified to a cognitive system?
- How does language impact on goal specification?
- Can cognitive systems be instructed to achieve goals and at what level and in what manner?
- Can goals be specified at all or must they be learned?

More Questions!!!!

For Goesta Granlund

- The action/perception learning cycle: association of proprioceptive information with exteroceptive information
- Can it be updated continuously (unsupervised continuous learning)?
- Can it capture temporal variations, i.e. behaviours?
- The linkage matrix seems to represent the system's understanding / knowledge of **its** world. How can we interact with this knowledge base (to communicate with it, to give it goals, to give it helpful information)?



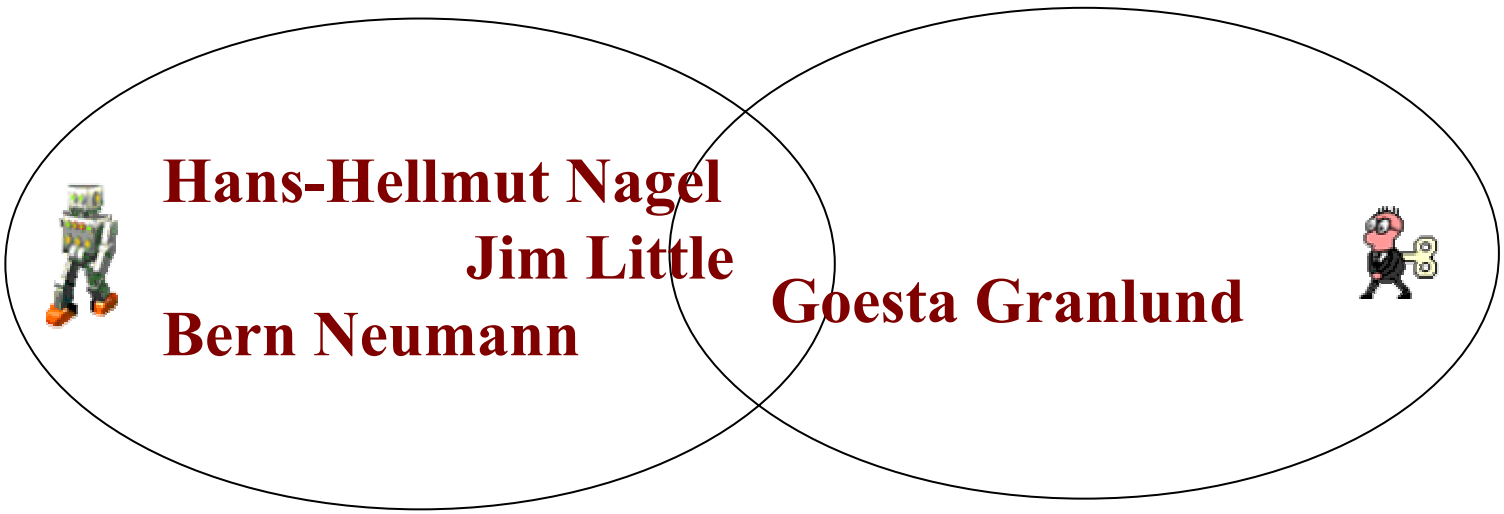
Panel Discussion

Conclusion

Viewpoints on Cognitive Vision

Exploit user-models to render the vision problem tractable

System builds its own understanding; tractability emerges by exploratory learning



Viewpoints on Cognitive Vision

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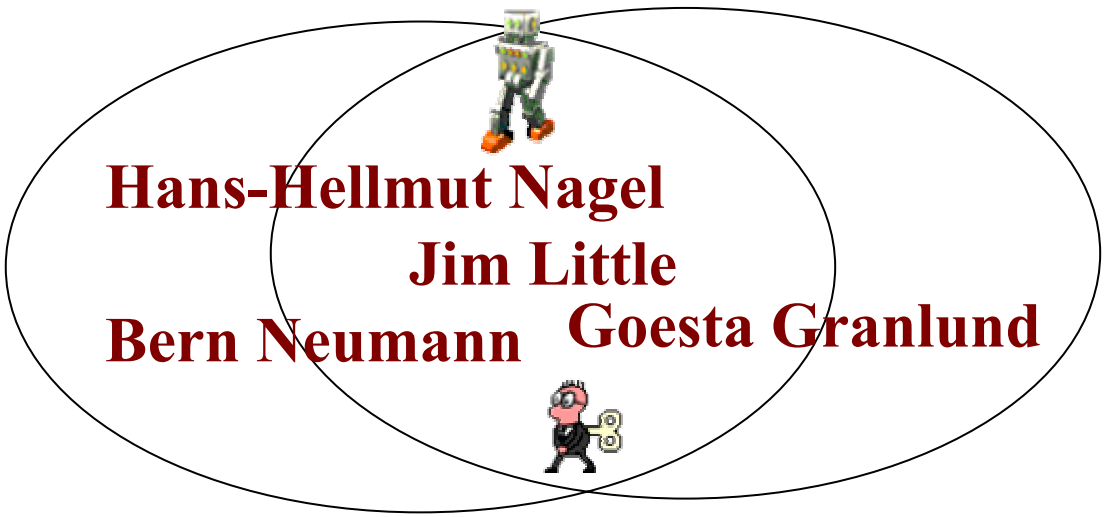

Viewpoints on Cognitive Vision

- Why?
- Both work with descriptions of the world
  - Observer/programmer based
  - System based

Viewpoints on Cognitive Vision

- But ... now both are based on
  - models which draw on learning
    - data-generated
    - adaptively-refined)
  - real-time interaction (video)
  - robust low level vision
  - context-based attention

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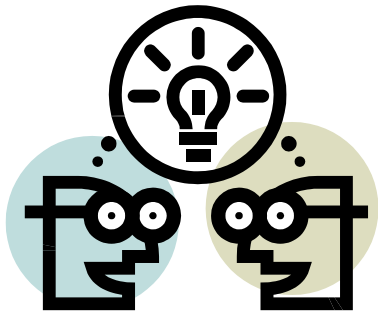

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