Artificial General Intelligence

7. Communication and Socialization

Dr. Pei Wang

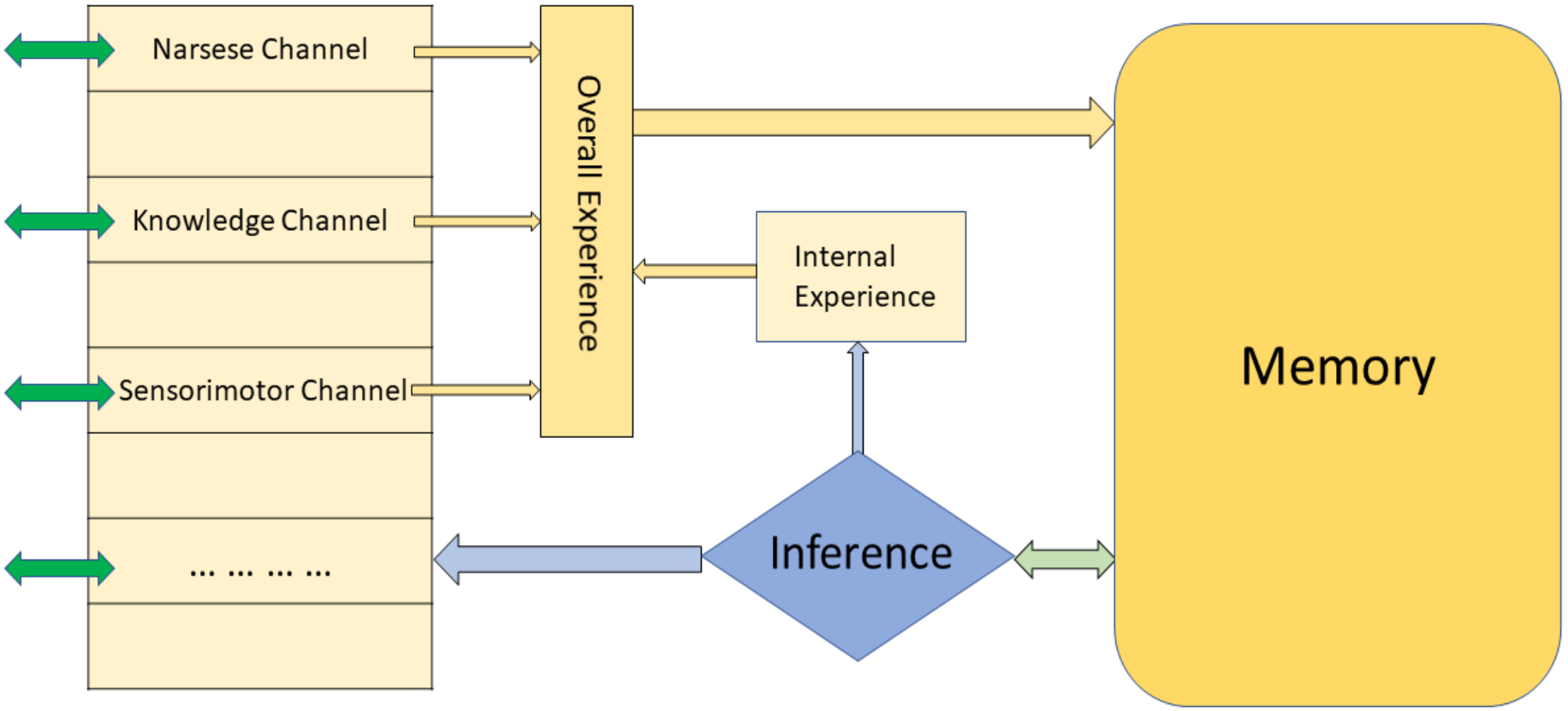
Dr. Patrick Hammer

Dr. Robert Johansson

Digital Futures (KTH, SU, RISE)

Stockholm, Fall 2022

NARS architecture



Experience

Overall, NARS has several types of experience:

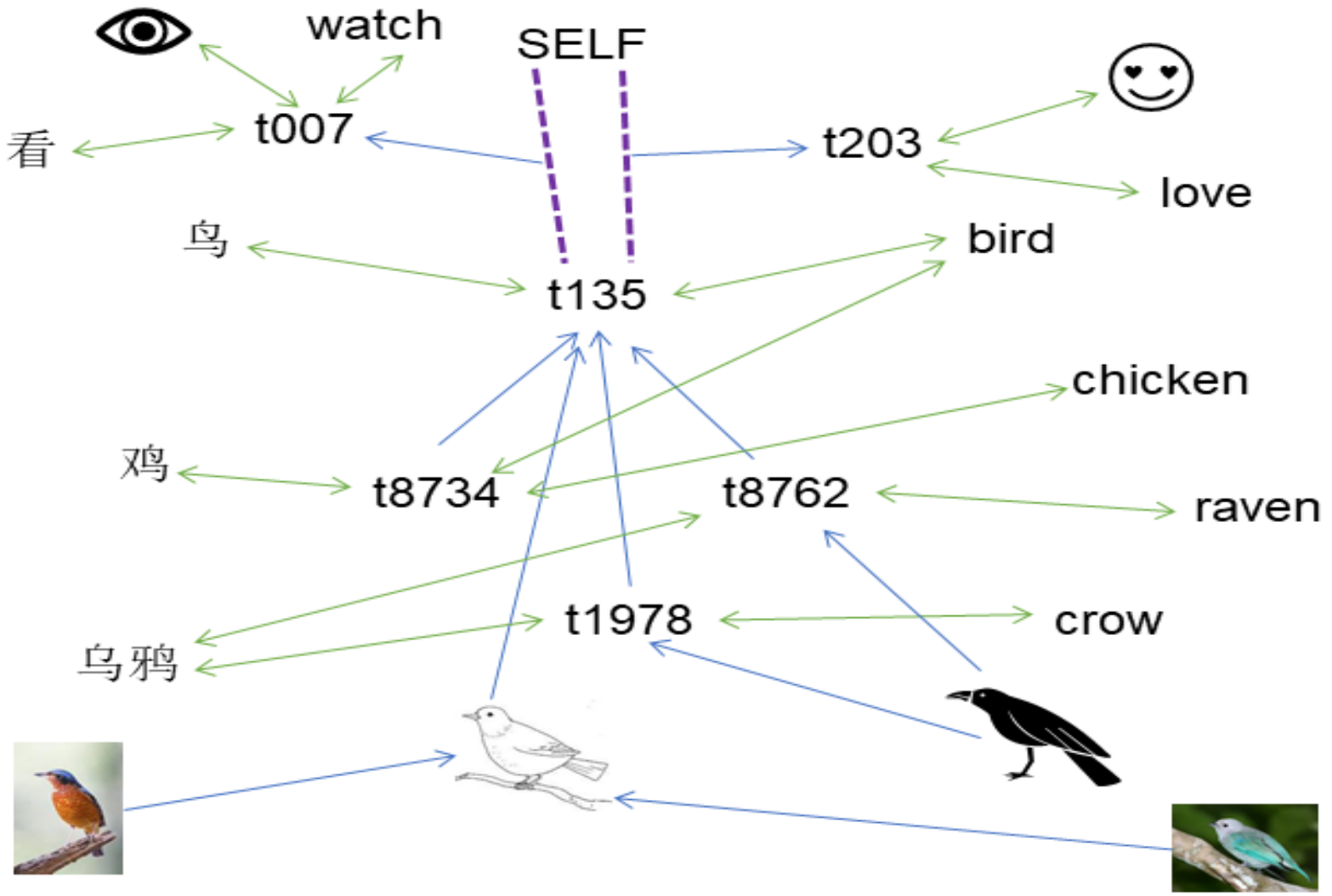
- External sensorimotor devices that directly interact with the outside environment
- Internal sensorimotor mechanism for self-awareness and self-control
- Communication with a (human or machine) in a (convention-based) language (Narsese, computer languages, human languages)

Language and communication

In intelligent systems like NARS, languages serve two major functions

- Internal representation: providing basic structures and connections among concepts to systematically represent tasks and knowledge
- External communication: supporting common conventions between linguistic items (words, phrases, sentences, …) and (compound) terms

Knowledge representation



Natural language processing

In NARS, communication languages are processed roughly in the stages of

1. **Pragmatics**: goal-driven, speech acts
2. **Semantics**: words as symbols of concepts
3. **Syntax**: linguistic structures for compound terms

NLP is carried out by reasoning, and a language is learned as other types of knowledge

Understanding

- In NARS, "to understand an input sentence" means to process it as a task
- The sentence is gradually converted into Narsese sentences, added into memory, and processed in forward reasoning
- The result of understanding shows in the change in memory, and depends on other tasks and knowledge

Nature and nurture

The behavior of NARS depends on its

1. **design**: grammar rules, inference rules, memory structure, attention mechanism
2. **configuration**: hardware, sensorimotor, parameters, preloaded tasks and knowledge
3. **experience**: history of interactions with the environments

The system's *intelligence* vs. *problem-solving abilities*

Education

- The system's learning process and results can be both facilitated and constrained by *education*, which decides the system's early experience
- Education gradually forms the system's primary *desires*, *beliefs*, *skills*, *priorities*, and *concepts*
- Modes of learning:
  - *tutoring* (with real-time *feeding*, *testing*, *feedback*, ...)
  - *reading* (with pre-specified *content*, *order*, *timing*, ...)
  - *exploring* (with given *problems*, *reinforcement*, ...)

Socialization

- After a dedicated education period, the system is still constantly influenced by its interactions with other systems
- The social knowledge obtained can be *descriptive* or *normative*, in the context of *human-machine* and *inter-machine* interactions
- In the process, some *subjective beliefs* will grow into *objective* (*inter-subjective*) *knowledge*

Collective intelligence

Considering a group of NARS implementations that communicate with each other

- With a shared design but separate configuration and experience, each *individual* will develop its own goals, beliefs, skills, and concepts
- The *group* as a whole may be considered as an AGI with its goals, beliefs, skills, and concepts that are related to those of the individuals, but cannot be fully reduced to them

Forms of adaptation

Adaptation can be studied at the level of

- **individual**, where changes come mainly from its own experience (*intelligence*)
- **group**, where changes come mainly from the interactions of individual (*collective intelligence*)
- **species**, where changes come mainly from sources other than experience (*evolution*)

These processes have similarities and differences

Suggested Readings

- Wikipedia, Cognitive linguistics
- Pei Wang, Natural Language Processing by Reasoning and Learning
- Pei Wang, From NARS to a Thinking Machine
- Pei Wang, A General Theory of Intelligence, Chapter 5-6