

# Artificial General Intelligence

## 6. Operations and Goals

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# Events, operations, and goals

- Event: statement with time-specific truth-value
- Time specification
  - Relative: sequential and parallel events
  - Absolute: system clock (inference cycles)
  - Conceptual: terms with time-related meaning
- Operation: event realizable by the system
- Goal: event to be realized by the system (as task)
- Influence of logic programming

# Reasoning on events

- Consider logical and temporal factors in parallel
- Prediction/explanation as temporal implication:  
$$precondition = / > postcondition$$
- Procedural knowledge (schema):  
$$(precondition, operation) = / > consequence$$
- Classical conditioning and operant conditioning:  
hypotheses generating, testing, and revising
- Confident hypotheses become knowledge

# Causal reasoning

- Causal knowledge: most reliable predictive relation, represented as predictive *implication* or *equivalence*, with domain-specific requirements
- Multiple ways to establish causal knowledge:
  - temporal induction (“association”)
  - active experiment (“intervention”)
  - hypothetical deduction (“counterfactual”)
- Their differences are relative and quantitative

# Goals and desires

- Initial goals are either implanted or imposed from the outside by the designers and users
- Derived goals are generated via backward inference until operations are reached
- The coexistent goals are not necessarily consistent with each other
- The *desire-value* of an event summarizes its relationship with the goals, and highly desired events become *active* goals

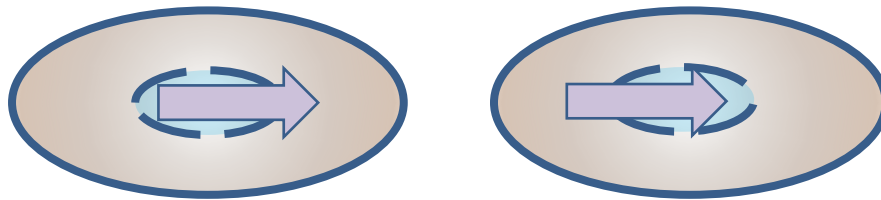
# Operations

- Operations can be either internal (built-in and executed by NARS) or external (registered and executed by a connected device)
- In principle, NARS can connect with any software or hardware as a plug-in tool
- External operations are converted to device-specific commands with return values
- NARS is being used to control robots and virtual characters with various “bodies”

# Perception

Perception recognize temporal-spatial relations,

- generates *subjective* beliefs
- are *active* behaviors
- are *unified* with cognition



S, shift(3, 0), T)  $\rightarrow$  left\_arrow

$S \rightarrow \text{rectangle}, T \rightarrow \text{triangle}$

To be used with machine learning tools and sources (Yolo, ImageNet, ...)



# Hierarchical composition

- Like other terms, complicated operations and perceptions are represented by compound terms
- Compound terms are evaluated with priority values summarizing factors including
  - its innate features (simplicity, truth-value, ...)
  - its number of occurrence in experience and usefulness in task processing
  - its relevance to the current situation



# Mental operation

- Some internal operations directly work on the system's reasoning process
- This *internal sensorimotor mechanism* is similar to the *external* one, except it's abstract and general
- Self-awareness: entering selected events into internal experience
- Self-control: intervening the system's inference procedures

# Feeling and emotion

- Roughly speaking, for an event
$$\textit{satisfaction-value} = 1 - |\textit{desire-value} - \textit{truth-value}|$$
- Overall feelings of the system:  
*satisfaction, alertness, busyness, well-being*
- The *desire-value* of other (non-event) terms are determined by its correlated *satisfaction*
- Complex emotions are formed from the basic ones and influence resource-allocation

# Consciousness

- Internal experience is incomplete and uncertain
- The system's self-description is different from third-person descriptions of its internal events
- Conscious and unconscious thinking processes follow the same logic
- Free will and causality co-exist as different perspectives
- AGI systems will be emotional and conscious, but not exactly like human in their contents

# Suggested Readings

- Bernardo Pires, [Try Logic Programming -- A gentle introduction to Prolog](#)
- Alva Nöe, [Action in Perception](#)
- Jean-Marc Fellous, Michael A. Arbib, [Who Needs Emotions?: The Brain Meets the Robot](#)
- Pei Wang, [Perception in NARS](#)
- Pei Wang, Non-Axiomatic Logic, Chapter 11-13
- Pei Wang, Rigid Flexibility, Chapter 5