
Wrap-up MLN
Cognitive Systems
2020 edition
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cognitio

PSI 3560 – COGNITIVE SYSTEMS

Wrap-up MLN

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LIFE & COGNITION

Course Syllabus (what we did)

Comments on general aspects of life & cognition (real & artificial)

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Syllabus

PART F – Foundations (about 2 weeks each topic)

- Foundational concepts of cognitive science (F1/F2)
  - Perception, cognition, learning, consciousness, attention, emotions, language, decision making, action planning, etc.…
- Selected topics about brain and mind (F3/F4)
  - Memory, brain organization and functionalities, representation.
- Neuroscience (F5/F6)
  - The neural basis of cognitive processes and information representation and processing
  - Neuroimaging and experimental methods in neuroscience
- Social cognition (F7/F8)
  - Communication, language, emotion
- General approaches to cognitive modelling (F9/F10)
  - Dynamic systems approach, embodied cognition, embedded cognition and ecological approach, enactive approach
- Evolution and development (F11/F12)
  - Life and the emergence of cognition, developmental aspects of cognition.

Syllabus

PART T – Techniques (about 2 weeks each topic)

- The concept of cognitive system and the nature of cognition (T1/T2)
  - Cognitive agents, natural versus artificial cognition, cognitive systems, machine learning and AI, paradigms of cognition, examples of cognitive systems and applications.
- Modelling cognition (T3/T4)
  - The computational approach to cognitive modelling, representation and processes, the nature of the cognitive problem, autonomy, knowledge and conceptual systems
- Artificial Intelligence and cognitivism (T5/T6)
  - The symbolical approach, symbol systems, artificial general intelligence.
- Machine learning and the connectionism (T7/T8)
  - Statistical learning, traditional neural network approach, deep learning, advanced networks
- Adaptive systems (T9/T10)
  - Adaptation, cellular automata, artificial life, morphogenesis
- Cognitive architectures (T11/T12)
  - Classes of cognitive architectures, examples, cognitive robotics

Life & Cognition

- Scientific observation
  - Biology / Neuroscience
  - Psychology

- Some levels of manipulation
  - Bio-Medical procedures
  - Interventions (surgeries)
  - Medications (bio chemical adjustments)

Life & Cognition

- Attempts to build artificial biological beings
  - Artificial organs
    - So far, mechanical instead of biological
  - Tissues ?
  - Genetic handling
    - Molecular biology
  - Recent resurgence of some cells
    - Nature Article | Published: 17 April 2019
    - Restoration of brain circulation and cellular functions hours post-mortem

Life & Cognition

- Attempts to build artificial bon-biological beings (artificial / virtual)
  - Searching fundamental aspects of life & cognition
  - Searching for theories of life & cognition
    - Foundations
  - Other substrates (non-biological) may provide some support
    - Engineered
    - Emergent

Scientific Foundations

- Dynamic Systems (adaptive systems)
  - Support provided by
    - Mathematical principles
    - Physical principles
  - Behavior of complex systems
    - Emergence
- Artificial Intelligence
  - Cognitivist approaches
  - Enactive approaches
- Artificial Life

Philosophical Considerations

- Philosophy of Mind

- Philosophy of Language

Computer Science – Engineering

- Proof of concepts – modeling & testing
  - Tools supporting a better understanding of many phenomena related to life and cognition
    - Simulators

- Instruments
  - Tools providing assistance to get deeper and better understanding of real life & cognition
    - CT / MR / fMR / EEG ....
  - Tools providing assistance to humans in many tasks
    - Tools
      - Intelligent decision assistance
      - Automatic recognition - classification
    - Robots
      - Acting as experts in industrial fields
      - Attempts to build humanoids

Artificial Life & Artificial Cognition

- Attempts to model, simulate and create artificial life and cognition
  - Mostly focusing on particular issues
  - Tools supporting a better understanding of many phenomena
    - Cognitive tools
  - Building artificial agents
    - Cognitive robots

Artificial Life & Artificial Cognition

- Attempts to model and simulate life and cognition
  - Reassembling the real (natural) existent forms of life and cognition
    - Robots
  - Just applying underlying principles to conceive and implement other forms of artificial beings
    - Able to perform intelligent actions
    - Able to learn from environment and from relationship with other beings (humans, real, artificial)
      - Attending some goals:
        - » elderly people assistance

Huge set of opportunities

- Identifying necessities / opportunities
- Asking which human / animal abilities are required or expected to deal with them
- Searching for their fundamental concepts (to be used to support further developments)

Huge set of opportunities

- Proposing artificial system where such abilities
  - can be embedded
  - or can evolve spontaneously
- Designing such systems
- Stablish the right conditions for such developments
  - Progressive refinements
- Implementing them
- Testing and refining

Challenges

- Diversity of aspects expected in most cases
  - How to identify and organize them
  - How to design a system integrating them
- There are many advances
  - We are trying to get better understanding about ourselves
- But our knowledge is still superficial
  - So far, we did not solve the puzzle
  - We are not still able to design truly artificial beings
  - But we can get there

Challenges

- Hard Problems
  - Qualia
  - Subjectivity
  - Grounding
  - Beings Evolution
  - Self Development
  - Consciousness

Discussion

- Questions?
- Students reflections about the discussions conducted through this course
- Most intriguing ideas?
  - Those hard to understand!
- Next steps?

This is all

Next week: exam (8:00)

Other two weeks: students projects presentations