ITI Cognitive Engineering

Module 2: connecting the brain

Overview

General question: how does the brain connect with the environment ?

- artificial agents
  - seeing
  - acting
  - communicating
- smart objects
  - situated objects
  - design strategies
  - navigation

- decision
  - preferences and biases
  - the evolutionary social brain
- ethics
  - nudges, moral robots

Artificial agents 1

(Emmanuel Dupoux/Pascal Mamassian, 12 sept 2014)

guest speaker: Olivier Marre, Institut de la vision

Visual perception

- topics
  - retina
  - cortical visual processing
  - signal detection theory and psychophysics
  - visual uncertainty and Bayesian modelling
- contents
  - neural coding and decoding in the visual system
  - functional models of retinal processing
  - retinal implants and visual restauration
  - 3D vision
- biblio
  - Gregory R.L. (1997). Eye and Brain: The Psychology of Seeing (5th ed), Oxford University Press.
  - Hubel, D.H. (1995). Eye, Brain, and Vision. Henry Holt and Co.

Artificial agents 2

(Emmanuel Dupoux/Benoit Girard)

Neuro-inspired robotics

- topics
  - embodied AI, embodied computational neuroscience
  -

- contents
  - sensors: from electrophysiology to hardware
  - control architectures:
  - actuators
- biblio
  - Braitenberg, V. (1986). *Vehicles: Experiments in synthetic psychology*. MIT press.

Artificial agents 3

(Emmanuel Dupoux)

Conversational agents: from speech to meaning.

or, Deconstructing SIRI

- Topics
  - speech features
  - phonetic units
  - language models
  - parsing
- Contents
  - global architecture (probabilistic framework, lattice reranking)
  - overview of algorithms (signal processing, HMM, Baum-Welch, CYK)
  - evaluating automatic systems against human performance
  - supervised versus unsupervised learning (infant learning)
- Biblio
  - S. Pinker - the Langage Instinct
  - D. Jurafsky & J. Martin - Speech and Language Processing

Smart objects 1

(Roberto Casati, 3 oct 2014)

Things that make us smart

- Contents
  - A theoretical framework: the engineering of cognitive advantages
  - Information enhancers, external memories, situated representations, cognitive bridges, information shunts, inferential shortcuts.
- Case studies
  - notations, maps, diagrams… and proposals for improving on some of them
- Biblio
  - Casati, R., Pasquinelli, E. Is the subjective feel of "presence" an uninteresting goal? J. Vis. Lang. Comput. 16(5): 428-441 (2005)
  - Students are invited to look up the research blog www.mangrovia-collective.org and to (1) pick up a case for discussion in class (2) post a comment of max 1000 characters (e.g. a question, a suggestion, a research proposal)

Smart objects 2
(Roberto Casati, 10 oct 2014)

Guest speaker - tentative (G. Puccetti, Visual Design, NYU Abu Dhabi)

Smart objects for wayfinding

- Contents
    - Primitive navigation vs Assisted navigation
    - Low and hi-tech, from the trail affordance to the map to the GPS
    - Visual constraints and social constraints
- Case studies
    - Muscat vs Paris; the universality of sign systems; color; the Sans Serif predicament; pragmatic effects.
- Biblio

Tversky, B., Agrawala, M., Heiser, J., Lee, P., Hanrahan, P., Phan, D., Stolte, C., Daniel, M.-P.: Cognitive Design Principles for Automated Generation of Visualizations. In: Allen, G.L. (ed.) Applied Spatial Cognition: From Research to Cognitive Technology, Lawrence Erlbaum Associates, Mahwah (2006)

Smart objects 3

(Roberto Casati/Guillaume Thibault, 17 oct 2014)

Improving complex (indoor, multi-floored) environments

- Contents
  - Spatial memory, wayfinding : what do we know in flat-land that can help in studying complex environments?
  - Experimental infrastructure (Saclay)
  - (more with Giuseppe Attoma)
- Cases studies
  - Some complex environments, with EDF's cases
- Biblio
  - Jeffery et al. Navigating in a three-dimensional world. Behavioral Brain Science (2013)
  - Janzen & Van Turrenhout. Selective neural representation of objects relevant for navigation. Nature (2004)
  - Google Maps : https://www.google.fr/maps/

Connecting brains 1
(Mikaël Cozic/Philippe Mongin, 24 oct)

Preferences and decisions

- topics
  - How people should/do evaluate options and their consequences ?
  - How people should/do deal with uncertain options ?
- contents
  - Basic model of decision making (optimal choice on the basis of well-structured preferences)
  - Expected utility theory for choice under uncertainty
  - Empirical 'anomalies' w.r.t. the basic model (biases such as framing effects or preference reversals) and expected utility theory (Allais' paradox)
- biblio
  - Kreps, D. (1988) *Notes on the Theory of Choice*, Westview Press
  - Gilboa, I. (2010) *Rational Choice*, Cambridge, Mass: Cambridge UP
  - Kahneman, D. & Tversky, A. (2000) *Choice, Value and Frames*, Cambridge, Mass: Cambridge UP

Connecting brains 2
(Nicolas Baumard, 31 oct)

The evolutionary approach to social cognition

- topics
  - Emotions and reasoning
  - Cooperation and fairness
  - Biological basis of preferences
- contents
  - Proximate explanations and evolutionary explanations
  - Evolution and cooperation: models and experiments
  - proper function and actual function
- biblio
  - Pinker, S. Comment fonctionne l'esprit
  - Pinker, S. Comprendre la nature humaine
  - Boyer, P. Et l'homme créa les dieux

Connecting brains 3
(Alexis Tsoukias/Gabriella Pigozzi, 07 nov)

Aiding to decide

- topics
  - How to improve decisions?
  - What does make an aide convincing, legitimate and useful?

- contents
  - Decision aiding process as construction of consensual shared cognitive artifacts.
  - Values, likelihoods and opinions and their subjective dimension.
  - Axiomatic, algorithmic and pragmatic aspects of decision aiding.
  - Human based and computer based assistance to decision making.
  - Mathematical and logical problems in aggregating preferences, judgements and information.
  - Convincing to act: robust recommendations with respect to scenarios, parameters and adversaries.

- biblio

Bouyssou D., Marchant Th., Perny P., Pirlot M., Tsoukiàs A., Vincke Ph., 2000, Evaluation and Decision Models: a critical perspective, Kluwer Academic, Dordrecht.

Bouyssou D., Marchant Th., Pirlot M., Tsoukiàs A., Vincke Ph., 2006, Evaluation and Decision Models: stepping stones, Springer-Verlag, Berlin.

Grossi D., Pigozzi G., 2014, Judgment Aggregation: A Primer, Morgan & Claypool, 2014.

Ethics of Cognitive Engineering

(Mikael Cozic/Daniel Andler, 24 oct)

nudges

- topics
    - liberal paternalism
    - biases and individual welfare
- contents
    - survey of some examples (default options, Save More Tomorrow, RECAP, etc)
    - philosophical discussion of nudges: are they defensible ? Do they comply with 'libertarian paternalism' ?
- biblio
    - Thaler, R.H. & Sunstein, C.R. (2008). Nudge: Improving Decisions about Health, Wealth, and Happiness
    - Sunstein, C.R. (2014) *Why Nudge ? The Politics of Libertarian Paternalism*, Yale UP
    - Hausman, D. & Welch, B. (2010) "Debate: To Nudge or Not to Nudge", *The Journal of Political Economy*, 18(1), pp. 123-136

general discussion