FP6 Overview
Cognitive Systems

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I'll be presenting you…

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FP6: **where FP7 "Challenge 2 - Cognitive Systems, Interaction, Robotics" derives from**

Results: **Overview of the projects funded in FP6**

Future: **Moving from FP6 to FP7**

My Experience

Involved in EU R&D since 1993!

- Environmental Management
- Risk and Emergency Management
- Security
- Medical Devices & Telecare
- Web 2.0 and Web Services

Over 15 projects as a partner and 3 as a project co-ordinator. (Average funding in FP6 projects of €300KEuro)

Expert for the EC in FP5, FP6, eTEN evaluations and reviews

CogSys: Some history (1)

2000:

Cognitive Vision Systems - *towards machines that 'see'*

emphasis on: robust and versatile systems

from application-specific to generalised solutions

from constrained to real world environments

approach:

from low-level processing & robustness of individual components to a systems approach where *all* components - including high-level cognitive functionalities - have a role to play in assuring robustness

working across areas, combining biological vision, AI, computer vision,…

CogSys: Some history (2)

2002:

Where to take the field?

Developments in AI and cognitive neuroscience

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Hardware development

- 1980s: cheap, small processors ⇒ ubiquitous computing
- 1990s: cheap, small lasers ⇒ ubiquitous communications
- 2000s: cheap, small sensors ⇒ ubiquitous perception ??

-link interconnected computational world with real physical world

-if these perceptually-enabled systems could understand and act?

CogSys: Some history (3)

2002:

Cognitive Systems – *towards machines that 'understand'*

- not just vision, but perception
- systems that can act/interact
- real world environments
- maintain emphasis on interpretation (exclude complex mechanical manipulation, control etc.)
- need for embodiment?
- work across areas – computer vision, linguistics, AI, robotics, neuroscience, psychology, philosophy,..

What are we talking about?

Cognitive systems – artificial systems combining perception, action, reasoning, learning and communication

- may derive inspiration from biological intelligence
- exhibit generalisation - cover diverse set of tasks and domains.
- need for a scientific foundation – new concepts & methods, experimental validation, theoretical contributions,
- provide an enabling technology for robotics & automation, natural language understanding, man-machine interaction, etc
- emphasis is on systems and on *interrelation* between functions and not component methods for specialised tasks

Features of cognitive systems

Will require convergence of action, perception and reasoning

- Action: control, communication/interaction, change of internal system state
- Perception: may provide models, lead to selection of behaviours, execution of actions
- Reasoning - often required for coordinating perception and action: for selecting transformations, behaviours, plans; adapting plans, generating new plans

And to be general, a cognitive system must learn

- Many types of reasoning & learning; many forms of representation.

Research on Cognitive Systems

should lead to fundamental insights on:

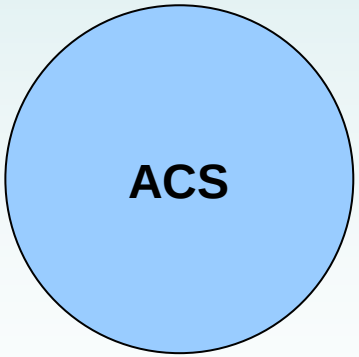
- The nature of cognition - requirements, properties,..
- Architectures for cognition – what to model, representations, concurrent processes, memory, integration, autonomy,..
- Perception – need to distinguish top-down & bottom-up processes
- Learning – what modes of learning; learning categories, competences, concepts, affordances; integrating new & old knowledge/skills coherently
- Autonomous Systems – varieties, mechanisms, requirements
- Social Interaction – communication, cooperation, competition
- Goals – specification, learning

Cognition in FP6 Research Rationale

*"By promoting research into systems that have **cognitive functions normally associated with people or animals** and which exhibit a high degree of robustness in coping with **unpredictable situations**, we seek to overcome limitations of today's computers, robots, and other man-made creations to handle simple everyday situations with common sense and to work without pre-programming in natural surroundings, while maintaining and possibly improving the quality of their services."*

Cognition in FP6

*Research on the construction of **artificial cognitive systems** than can interpret information (images, text, speech, video footage) and other forms of sensor data, and act purposefully and autonomously towards achieving goals.*

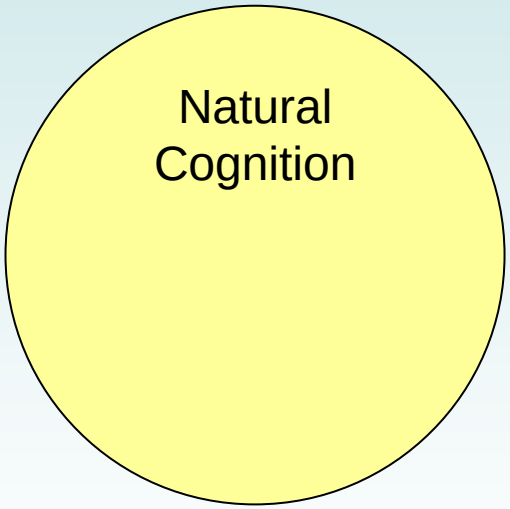


"These systems should learn and develop through individual or social interaction with their environment."

Cognition in FP6

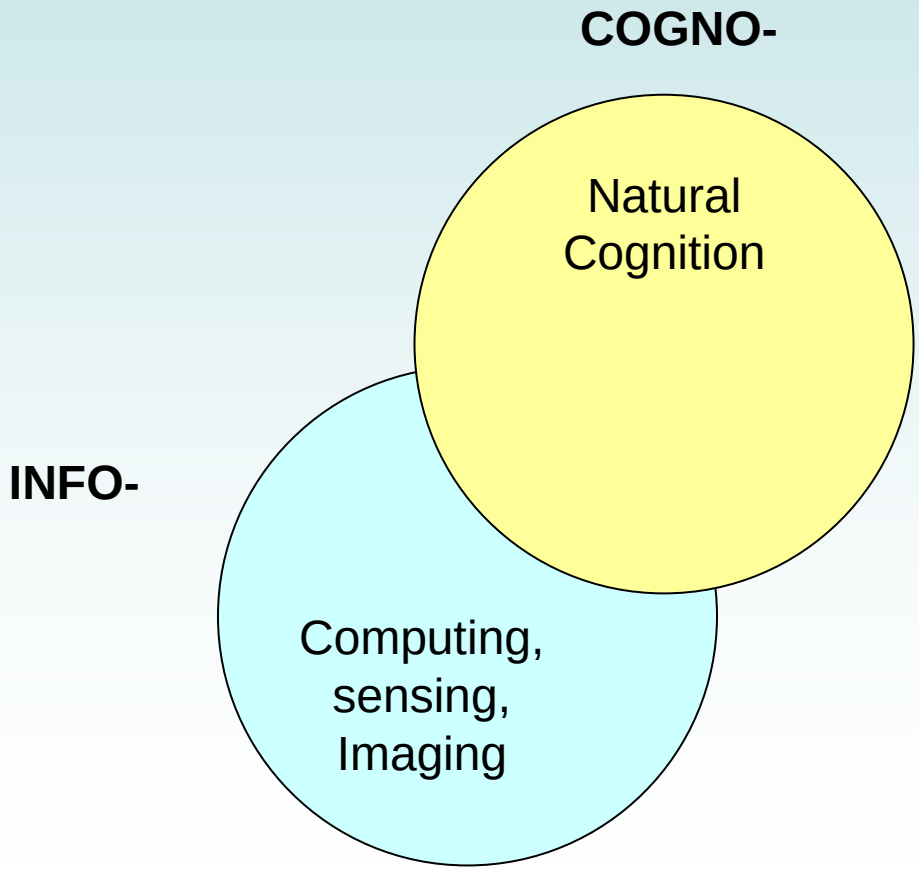
"…work should provide an enabling technology that applies across domains such as natural language understanding, image recognition, automated reasoning and decision support…"

COGNO-



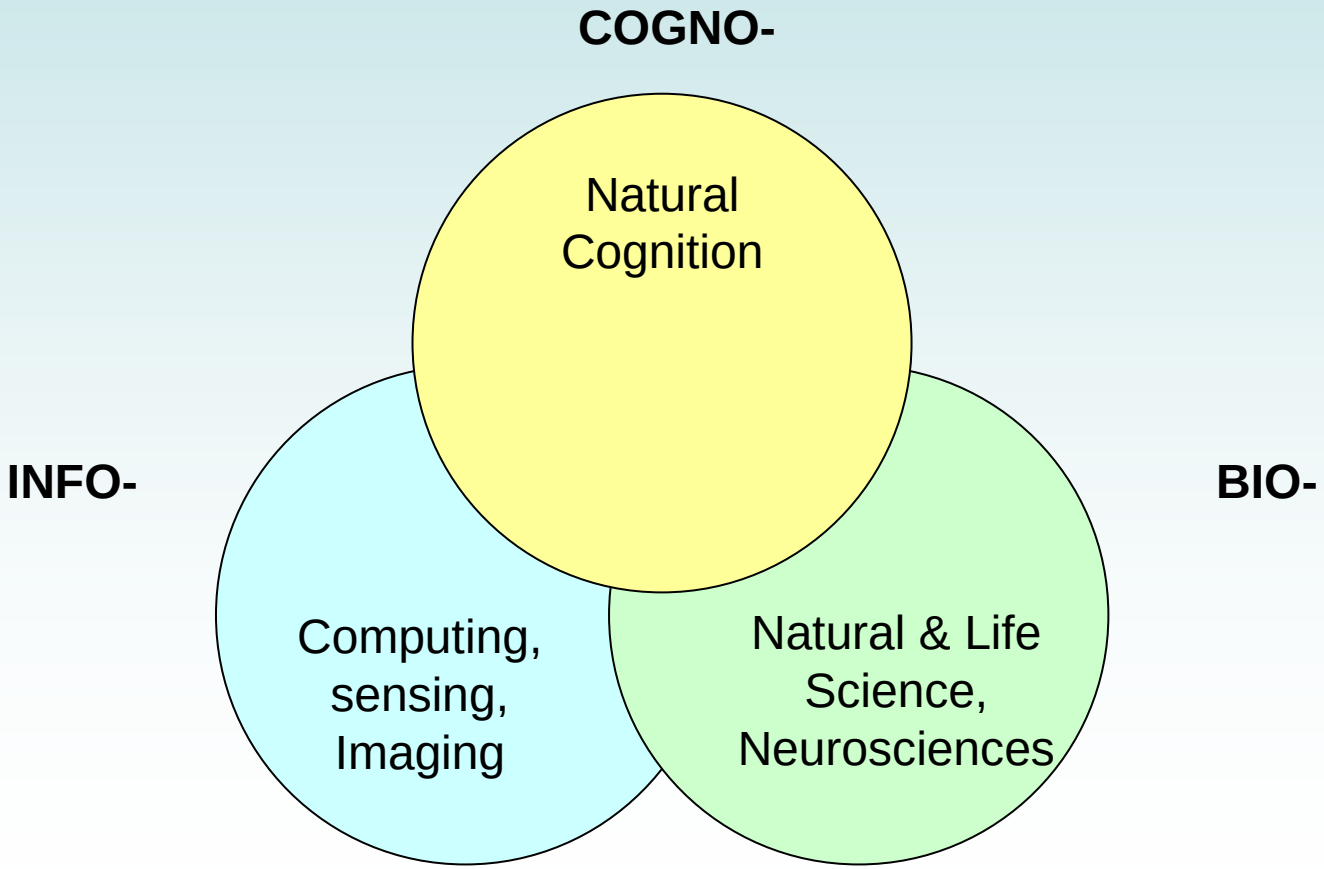
Cognition in FP6

"… robotics and automation, sensing and process control, and complex real-world systems"



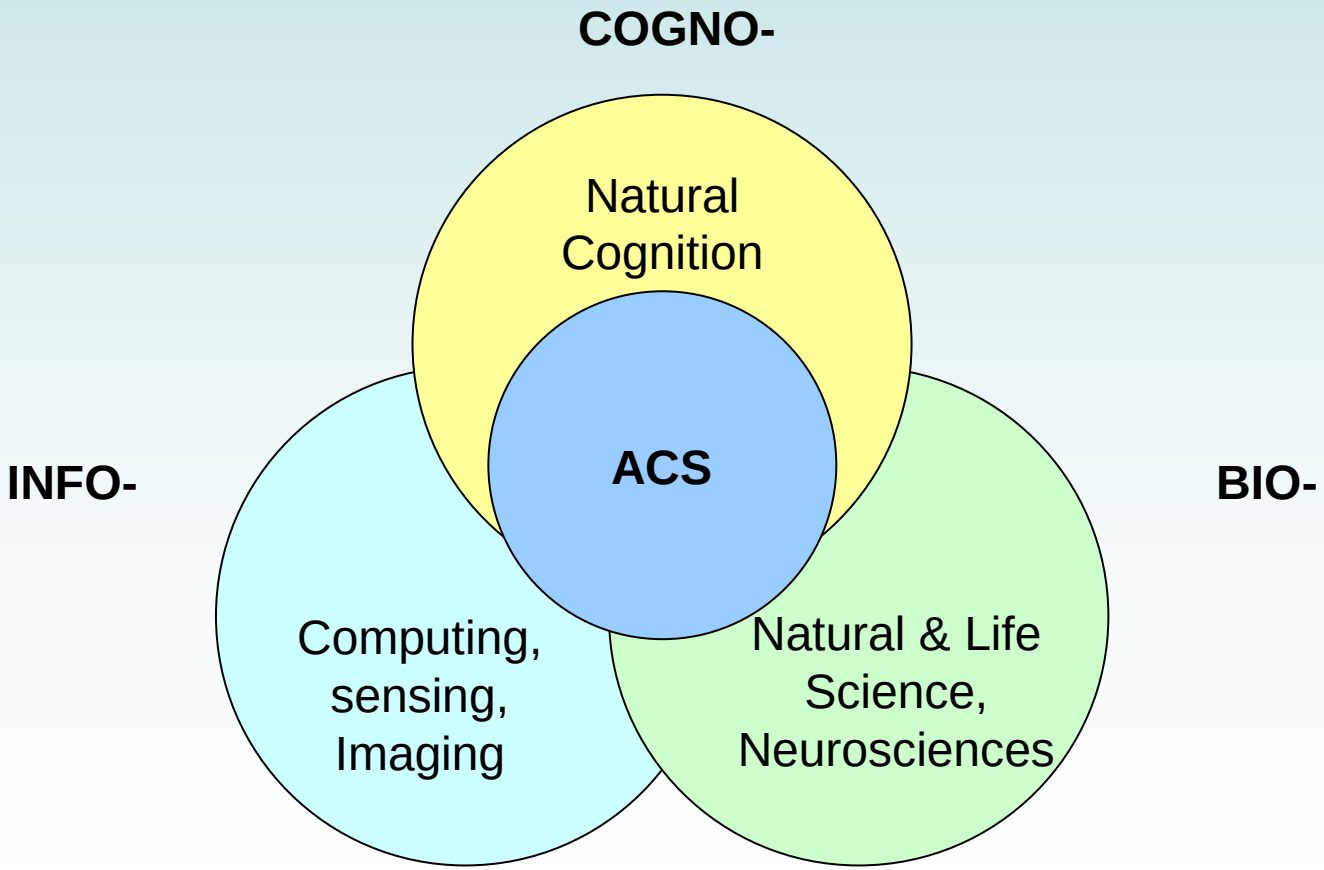
Cognition in FP6

"The work should furthermore borrow insights from the bio-sciences, and yield innovative insights about perception, understanding, interaction, learning and knowledge representation."



Cognition in FP6

Artificial Cognitive Systems (ACS) are at the junction of the cognitive, ICT, and natural sciences.



3 Call for proposals in FP6

IST Work Programme
Strategic Objective IST-2002 2.3.2.4 Cognitive Systems

- **Call2: Objective:** To construct physically instantiated or embodied systems that can perceive, understand ... and interact with their environment, and evolve in order to achieve human-like performance in activities requiring context-(situation and task) specific knowledge.
- **Call4: Objective:** To develop artificial systems that can interpret data arising from real-world events and processes (mainly in the form of data-streams from sensors of all types and in particular from visual and/or audio sources); acquire situated knowledge of their environment; act, make or suggest decisions and communicate with people on human terms, thereby supporting them in performing complex tasks.
- **Call6: Objective:** *(Advanced Robotics) ...* development of more intelligent, flexible, cost-effective, modular, safe, dependable, robust and user-driven robot systems. This will pave the way to the future massive introduction of robots in everyday human environments and their close cooperation with people

Results of FP6 (1)

- **euCOGNITION: European Network for the Advancement of Artificial Cognitive Systems**
- **EURON: European Robotics Research Network**

- BACS: Bayesian Approach to Cognitive Systems
- CASBLIP: Cognitive Aid System for Blind People
- CLASS: Cognitive-Level Annotation using Latent Statistical Structure
- COSPAL: Cognitive Systems using Perception-Action Learning
- COSY: Cognitive Systems for Cognitive Assistants
- DECISIONS-IN-MOTION: Neural Decision-Making in Motion
- DIRAC: Detection and Identification of Rare Audio-visual Cues
- eTRIMS: eTraining for Interpreting Images of Man Made Scenes
- GNOSYS: An Abstraction Architecture for Cognitive Agents
- HERMES: Human-Expressive Representations of Motion and their Evaluation in Sequence
- ICEA: Integrating Cognition, Emotion and Autonomy
- JAST: Joint-Action Science and Technology

Results of FP6 (2)

- MACS: Multisensory Autonomous Cognitive Systems
- MATHESIS: Observational Learning in Cognitive Agents
- MIAUCE: Multimodal Interactions Analysis and exploration of Users within a Controlled Environment
- MindRaces: from Reactive to Anticipatory Cognitive Embodied Systems
- PACO-PLUS: Perception, Action and Cognition through Learning of Object-Action Complexes
- PASCAL: Pattern Analysis, Statistical Modelling and Computational Learning
- POP: Perception On Purpose
- RASCALLI: Responsive Artificial Situated Cognitive Agents Living and Learning on the Internet
- ROBOT-CUB: Robotic Open-architecture Technology for Cognition, Understanding and Behaviours
- SENSOPAC: SENSOrimotor structuring of Perception and Action for emerging Cognition
- SPARK: Spatial-temporal patterns for action-oriented perception in roving robots

Results of FP6 (Advanced Robotics)

Support Actions		
-EUROP Technology Platform	***-CARE***	*-SAGEM, France*
-Standards tool-kits	***-RAWSEEDS***	*-Politecnico di Milano, Italy*
-Benchmarking	***-ROSTA***	*-Fraunhofer IPA, Germany*
Robot Dexterity		
	-EsBirro	*-CSIC, Spain*
-Manipulation, locomotion, steady-hand etc	***-ACRO-BOTER***	*-Budapest University of Technology and Economics, Hungary*
	-AccuRobAs	*-Karlsruhe University, Germany*
Co-operating / swarming robots.		
	-µDrones	*-CEA –LIST, France*
	-Guardians	*-Sheffield Hallam University, UK*
-Inspection, assistance, cleaning.	***-Viewfinder***	*-Sheffield Hallam University, UK*
environmental monitoring etc.	***-CommRob***	*-Technische Universität Wien*
	-Robo-Swarm	*-Tallinn Univof Technology, Estonia*
-Applications in public spaces	***-Dustbot***	*-ScuolaSuperioreSant'Anna, Italy*
(hospitals, urban, roads, shops, airports).	***-IRPS***	*-CS Systèmesd'Information, FR*
	-IWARD	*-Fraunhofer IAO, Germany*
	-URUS	*-Univ. Politècnicade Cataluña, Spain*
Human –Robot dialogue / interfacing		
	-INDIGO	*-Foundation for Research and Technology, Hellas –Greece*
-Bio-mimicry, child developmental aids,	***-IROMEC***	*-ARC Seibersdorf Research, Austria*
socially-situated integration, safety-driven design,.	***-FeelixGrowing***	*-Univ. Hertfordshire, UK*
affordable home navigation platforms etc.	***-PHRIENDS***	*-University of Pisa, Italy*
	-Robots@home	*-Technische Universität Wien*

FP6 projects' fact sheets

http://cordis.europa.eu/ist/cognition/projects.htm

- Contact details of the coordinator
- List of partners involved
- Project website
- Project objectives
- Methodolgy
- Expected outcomes

Vision from FP6 to FP7

(From a slideset by Franco Mastroddi given at Imperial College 17 Jan 2007)

Today

- Robots operating in ‘modelled’, ‘structured’ and ‘constrained’ environments
  - industrial robots
  - ‘programmed’ service robots
- Basic understanding of computational representations of cognitive processes
  - first applications in cognitive vision
- Human-machine interactions that are rather static / passive
  - unable to adapt to human behaviours and to empower humans in their interactions

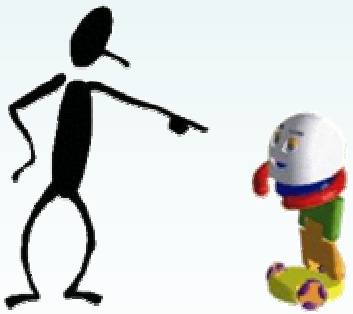
5 – 10 years

- Robots, machines and systems exhibiting advanced behaviour
  - operating with gaps in knowledge
  - operating in open-ended env.s
  - operating in dynamic / frequently changing environments
- Machines and systems that understand their users / context
  - learning from observation
  - adapting to context
- Systems that analyse and understand multimedia and multimodal digital information
  - all senses, gestures, natural language – ‘human-in-the-loop’

What do we mean by Cognition-Interaction-Robotics?

(From a slideset by Franco Mastroddi given at Imperial College 17 Jan 2007)

- C-I-R revolves around the key concept of machine systems which can interact robustly, in open-ended, (mainly) physical environments, with smart sensorimotor, cognitive / intelligent / natural / intuitive features.
- Such systems could be:
  - robots
  - embedded in everyday machines
  - dedicated devices (e.g. cameras, sensors)
  - Physical Interfaces etc



Moving to FP7

Only 1 Objective **“Cognitive Systems, Interaction, Robotics”**

- systems pertaining to **any of these areas** must be capable of responding intelligently and largely **autonomously** to gaps in their knowledge and to situations or contexts that have not been specified in their design (that is, they must be **robust** and **flexible**);
- artificial systems ought to be **more effective** in improving their performance and **more natural** in **dealing** with people – where dealing with people is a requirement; and
- progress, in any of these areas, towards systems with the above characteristics can only be achieved by developing and adopting **new engineering principles and approaches**, based on largely **common** but as yet not fully explored scientific grounds.

Thank you very much for your time

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