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CHIST-ERA Projects Seminar

Day 2, Cross Topics

Human Language Understanding: Grounding Language Learning

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Bern, April 29th, 2016



FUNDING OPPORTUNITIES from the
FUTURE & EMERGING TECHNOLOGIES scheme





Introduction: Topic description

❖ The goal:

- ✓ Ground language learning in the perceptual, emotional and sensorimotor experience of the system

❖ Why:

- ✓ To model high-level, semantic & pragmatic knowledge in a robust way, from varied data, considering situational context

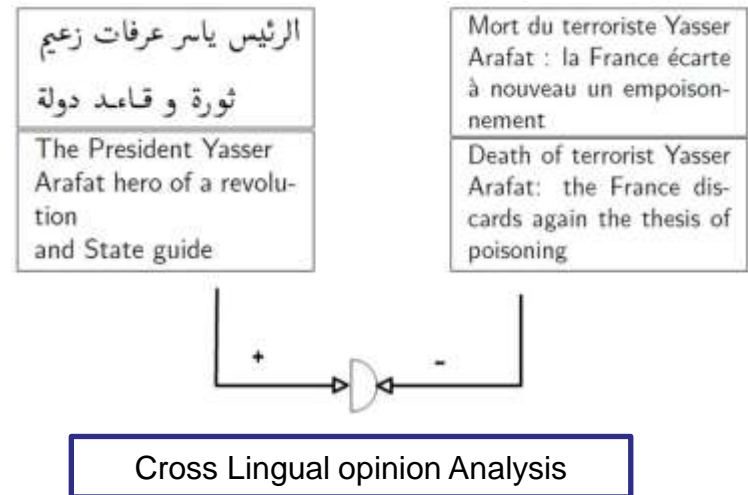
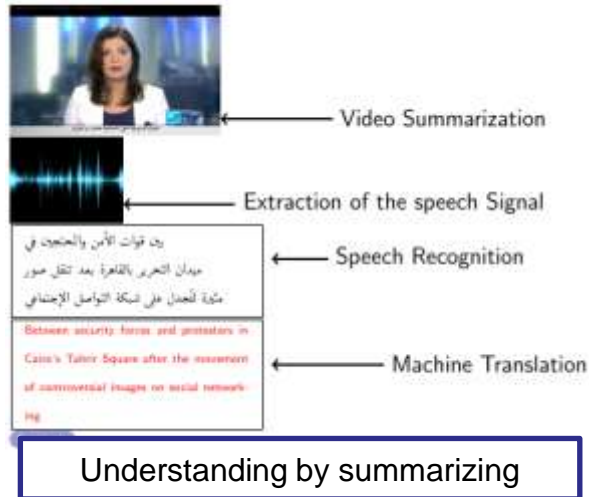
❖ How:

- ✓ Multidisciplinary approach: combine human language processing with related fields such as developmental robotics or cognitive neuroscience.
- ✓ Well defined metrics and protocols to measure progress

Introduction: Projects of the topic

Acronym	Role	NFO	Institution	Project Investigator
AMIS	P	NCN	AGH University of Science and Technology	Mikolaj Leszczuk
AMIS	C	ANR	Université de Lorraine - LORIA	Kamel Smaïli
AMIS	P	ANR	Université d'Avignon LIA	Juan-Manual Torres-Moreno
AMIS	P	MINECO	DEUSTO	Begoña García-Zapirain
ATLANTIS	C	FWO	VUB AI Lab	Ann Nowé
ATLANTIS	P	ANR	SONY FRANCE	Remi van Trijp
ATLANTIS	P	MINECO	IBE-UPF	Luc Steels
ATLANTIS	P	ANR	LATTICE-CNRS	Thierry Poibeau
ATLANTIS	P	FWF	OFAI	Brigitte Krenn
IGLU	C	FRQNT	Université de Sherbrooke	Jean Rouat
IGLU	P	VR	KTH Royal Institute of Technology	Giampiero Salvi
IGLU	P	FRQNT	Univ. De Montreal	Aaron Courville
IGLU	P	FNRS	University of Mons / Numediart Research Institute	Thierry Dutoit
IGLU	P	ANR	Université de Lille 1	Olivier Pietquin
IGLU	P	ANR	Inria Bordeaux Sud-Ouest / Flowers Team	Manuel Lopes
IGLU	P	MINECO	Universidad de Zaragoza	Luis Montesano
M2CR	P	FRQNT	Université de Montréal / LISA	Yoshua Bengio
M2CR	C	ANR	Université du Maine / LIUM	Loïc Barrault
M2CR	P	MINECO	Computer Vision Center	Joost van de Weijer
MUSTER	C	FWO	KU Leuven	Marie-Francine Moens
MUSTER	P	SNSF	ETH Zurich	Luc Van Gool
MUSTER	P	MINECO	University of the Basque Country (UPV/EHU)	Aitor Soroa
MUSTER	P	ANR	University Pierre et Marie Curie (UPMC) Paris	Patrick Gallinari
ReGROUND	P	TUBITAK	Koç University	Deniz Yuret
ReGROUND	C	FWO	KU Leuven	Luc De Raedt
ReGROUND	P	VR	Örebro University	Alessandro Saffiotti

- ❖ **AMIS:** Access Multilingual Information opinionS
 - ✓ Goals: (1) Understanding / summarize video in a foreign language;
 - (2) Cross-lingual opinion analysis
- ❖ **Distinctive features**
 - ✓ Collaborative architecture for understanding a video



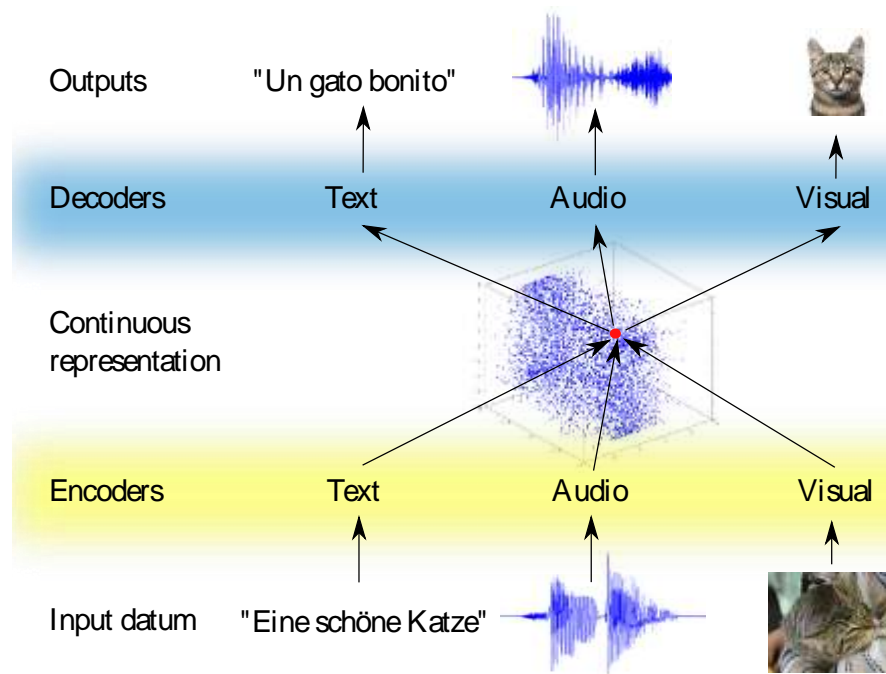
- ❖ **Partners:** LORIA (France), AGH (Poland), DEUSTO (Spain), UA (France)

❖ M2CR

- ✓ Goal: Define an common architecture for continuous representation of multimodal and multilingual data
 - To perform several NLP tasks (ASR, MT, HLU)
 - Using deep neural networks

❖ Distinctive features

- ✓ Unified architecture
- ✓ Multilinguality
- ✓ Multimodality



- ❖ **Partners:** MILA (Montreal, Québec), LIUM (Le Mans, France), CVC (Barcelona, Spain)

- ❖ **Muster:** Multimodal processing of Spatial and Temporal Expressions
 - ✓ Goal: Exploit visual input coupled with textual modality for learning semantic **representations for the recognition of objects and actions, and their spatial and temporal relations**

❖ Distinctive features

- ✓ Visual modality to help understand language
- ✓ New paradigm:
 - **processing linguistic phenomena related to objects, actions, space and time in language**
- ✓ Evaluation on a series of semantic tasks



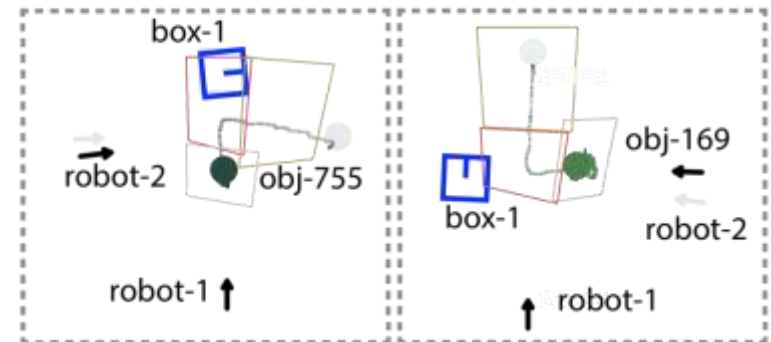
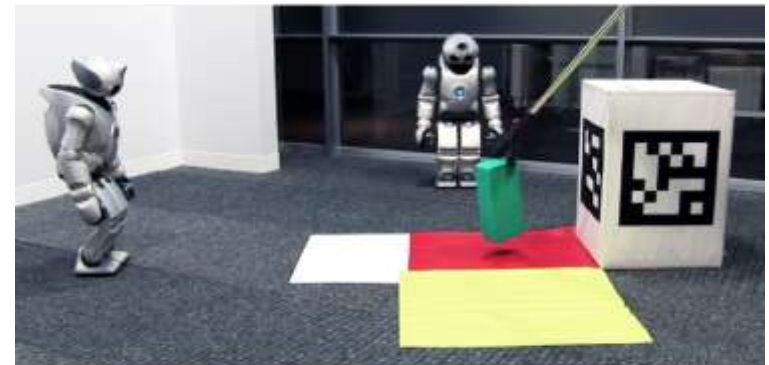
- ❖ **Partners:** KU Leuven (Be), ETH Zurich (Ch), UPMC – Paris (Fr), U. Basque Contry (Spain)

❖ **ATLANTIS:** Artificial Language Understanding in Robots

- ✓ Goal: Synthesize the major transitions in the emergence of languages using agent-based computational models

❖ **Distinctive features**

- ✓ task-based grounded learning
 - object reference and navigation
- ✓ reversible language processing
 - parsing and production
- ✓ empirical corpora as a blueprint for computational models



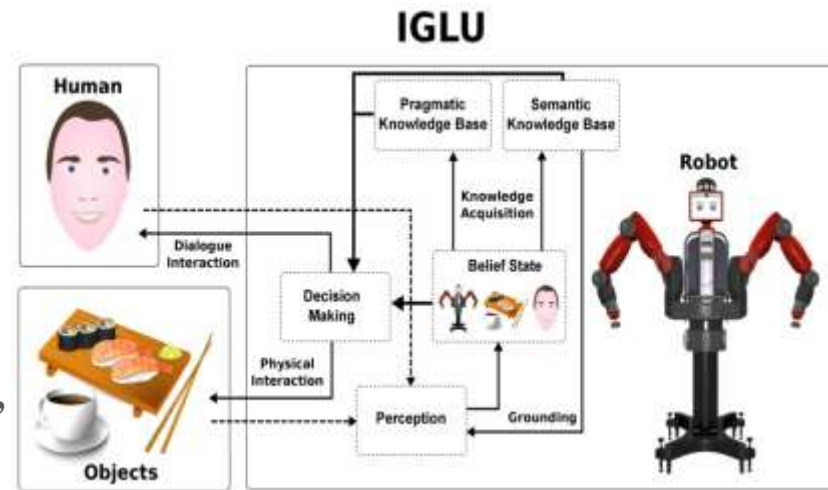
- ❖ **Partners:** Vrije Universiteit Brussel (AI Lab), Austrian Research Institute for Artificial Intelligence, Universitat Pompeu Fabra (IBE), Lattice-CNRS, Sony Computer Science Lab

❖ IGLU: Interactive Grounded Language Understanding

- ✓ Goal: Synthesize the major transitions in the emergence of languages using agent-based computational models

❖ Distinctive features

- ✓ Motor, physical & verbal interactions
- ✓ Metrics and evaluations of impacts of
 - being grounded/not grounded,
 - interacting/no interaction,
 - adaptation of the agent to new situations,
 - anticipation abilities of the agent,
 - assimilation of new knowledge



- ❖ **Partners:** Québec (Sherbrooke, Montréal), Sweden (KTH), France (Lille 1, INRIA), Spain (Zaragoza), Belgium (Mons), UK (Sheffield – not funded)

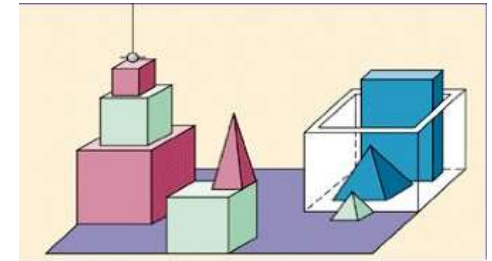
Introduction: Projects of the topic

❖ **ReGround:** Relational Symbol Grounding through Affordance learning

- ✓ Goal: From Winograd's SHRDLU to the real world

❖ **Distinctive features**

- ✓ multi-modal input (perception and language)
- ✓ take into account the context & environment; multiple objects and their relationships
- ✓ build on a notion of affordance from robotics



Put the blue pyramid on the block in the box



Bring me the tea pot and the sugar

❖ **Partners:** KU Leuven (Belgium), Koç University (Turkey), Örebro University (Sweden)



Introduction: Projects of the topic

	Multi-modal	Multi-lingual	Physical Robots	Actions	Relations	Open Data	Systematic Evaluation
AMIS	✓	✓				✓	✓
Atlantis	✓		✓	✓	✓	✓	✓
IGLU	✓		✓	✓		✓	✓
M2CR	✓	✓				✓	✓
Muster	✓			✓	✓	✓	✓
ReGround	✓		✓	✓	✓	✓	✓



❖ Scientific challenges & needs

- ✓ Heterogeneous data (multi-modal, multi-lingual)
- ✓ Many current techniques need sheer amount of data:
how to address this challenge?
 - **investigate techniques that only need few data ...**
 - eg: unsupervised / lightly supervised learning
 - **... or can use data from different sources independently**
 - eg: lifelong learning / autonomous learning
- ✓ How to transfer learned knowledge
across different contexts?



❖ Scientific challenges & needs

- ✓ How to connect data to actions?
 - **use data for action**
 - eg: anticipation, planning
 - **use action for data acquisition**
 - eg: sensor planning, perception focus
- ✓ How to evaluate an intelligent interactive system in real situations?
 - **what are the performance metrics?**
 - **how can we define benchmarks?**



- ❖ **Organizational challenges & needs – provide resources for:**
 - ✓ **Data**
 - **create bodies of annotated data**
 - ✓ **Evaluation**
 - **shared test facilities, standard challenges, evaluation campaigns**
 - ✓ **Common platform (hardware/software)**
 - **affordable, maintainable**



Possible roadmap for HLU

❖ Pressing needs (now)

- ✓ Robots (*and all sort of embedded agents*) will be pervasive
- ✓ If grounding is solved, we can interact naturally with them

❖ New opportunities (now)

- ✓ Common representations for multi-modal phenomena
- ✓ Availability of data, software, computation
- ✓ Better perception and actuation hardware

❖ Next step changes (from now to 2026)

- ✓ From learning from big data  To learning from small data
- ✓ From passive learning  To active learning
- ✓ From offline learning  To lifelong learning
- ✓ From observing  To acting
- ✓ From ad-hoc evaluation  To community benchmarks



❖ In addition to the excellent current work:

- ✓ Help to address the above organizational challenges
 - create bodies of annotated data
 - create shared test facilities / standard challenges
 - develop a common (hardware/software) platform
- ✓ Foster further multi-disciplinary interaction
 - eg: inter-disciplinary schools
 - eg: link with COST actions
 - eg: link with MSCA training networks
- ✓ Help with dissemination



Questions ?