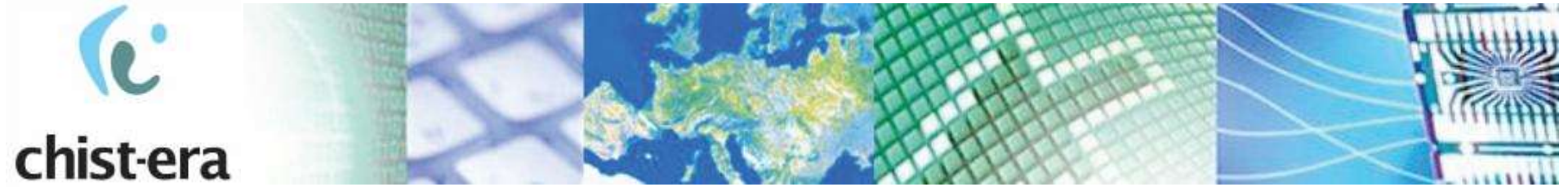

CHIST-ERA Projects Seminar
Day 2, Cross Topics
Human Language Understanding:
Grounding Language Learning

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Alessandro Saffiotti ***(Örebro University, Sweden)***

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Introduction: Topic description

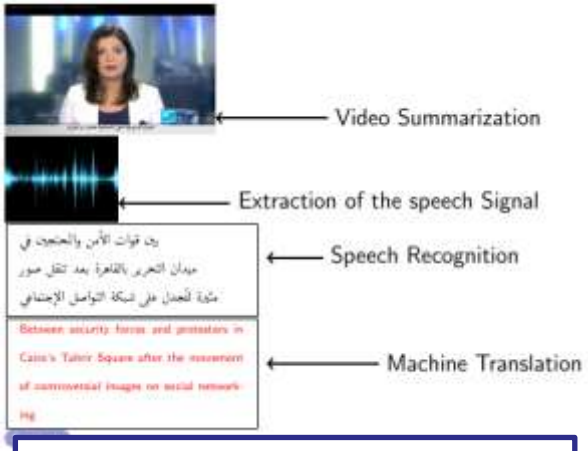
- **The goal:**
  - ✓ Ground language learning in the perceptual, emotional and sensorimotor experience of the system
- **Why:**
  - ✓ To model high-level, semantic & pragmatic knowledge in a robust way, from varied data, considering situational context
- **How:**
  - ✓ Multidisciplinary approach: combine 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

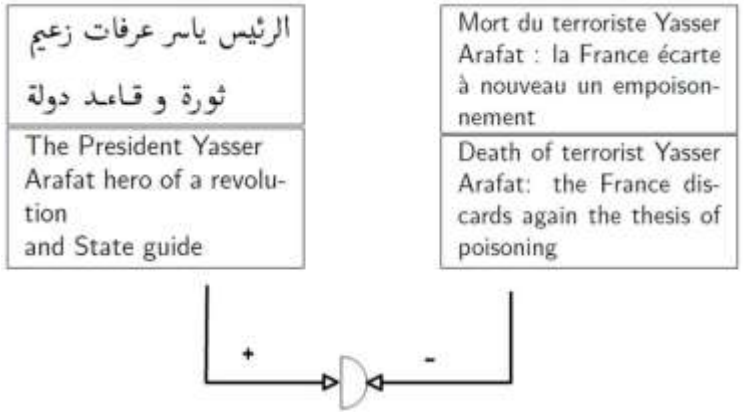
Acronym	Role	NFO	Institution	Project Investigator
AMIS	P	NCN	AGH University of Science and Technology	Mikolaj Leszczuk
AMIS	C	ANR	Université de Lorraine - LORIA	Kamel Smaïli
AMIS	P	ANR	Université d'Avignon LIA	Juan-Manual Torres-Moreno
AMIS	P	MINECO	DEUSTO	Begoña García-Zapirain
ATLANTIS	C	FWO	VUB AI 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

Introduction: Projects of the topic

- **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



Understanding by summarizing



Cross Lingual opinion Analysis

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

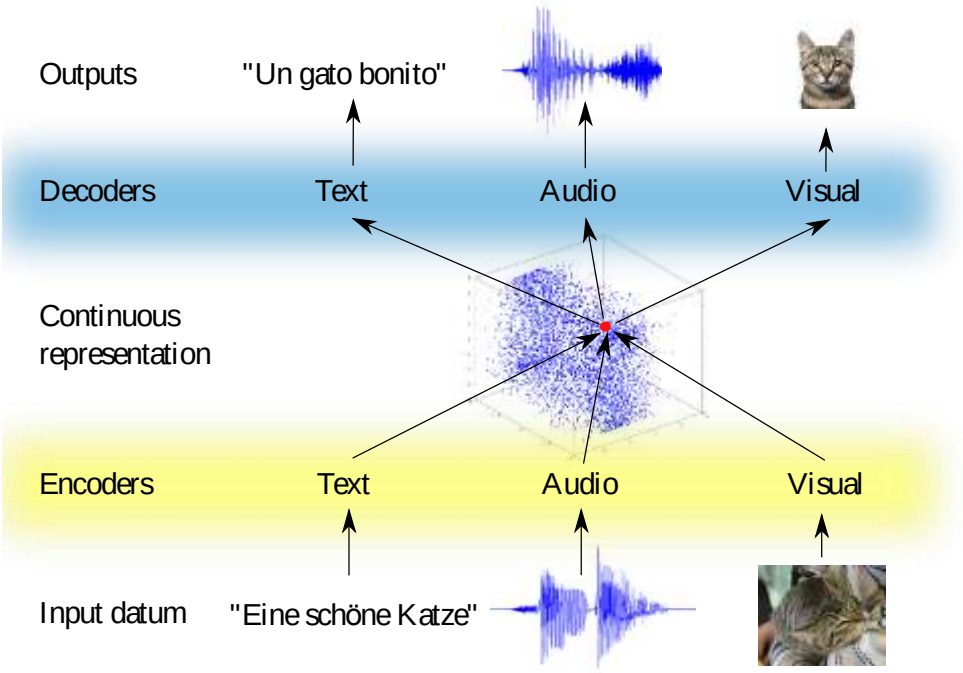
Introduction: Projects of the topic

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

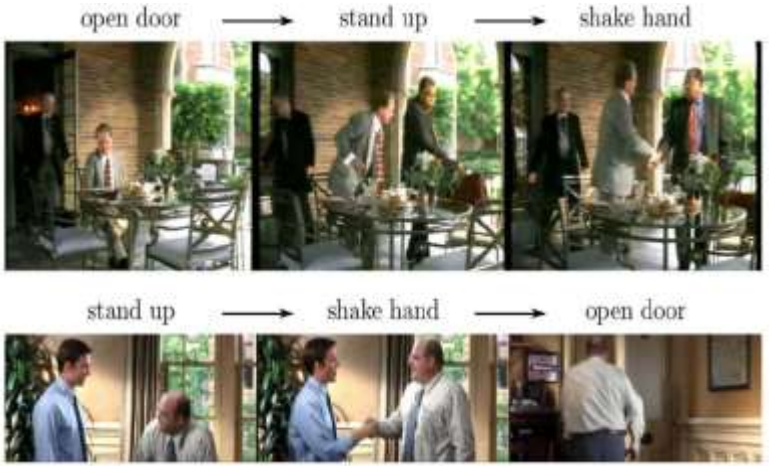


- **Partners:** MILA (Montreal, Québec), LIUM (Le Mans, France), CVC (Barcelona, Spain)

Introduction: Projects of the topic

- **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

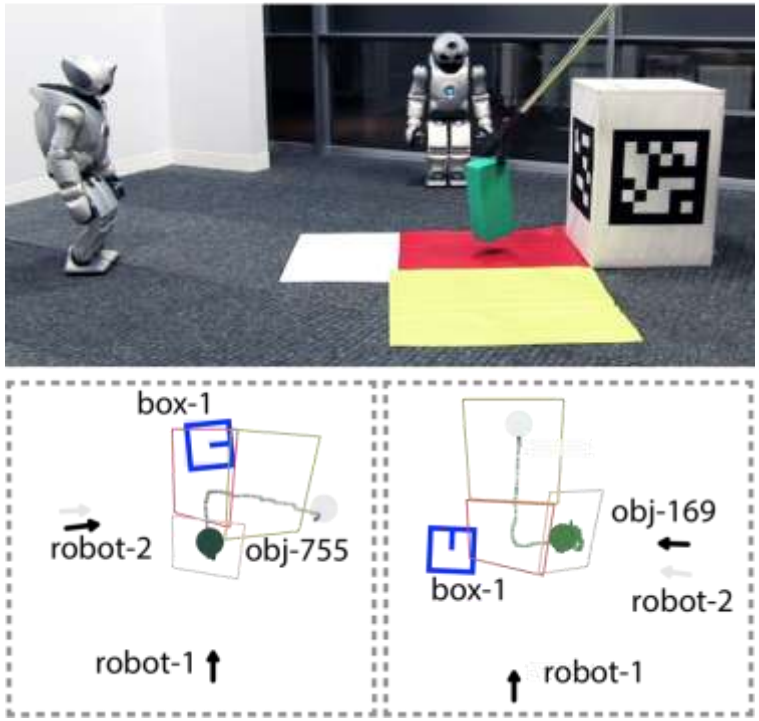


- **Partners:** KU Leuven (Be), ETH Zurich (Ch), UPMC – Paris (Fr), U. Basque Contry (Spain)

Introduction: Projects of the topic

- **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

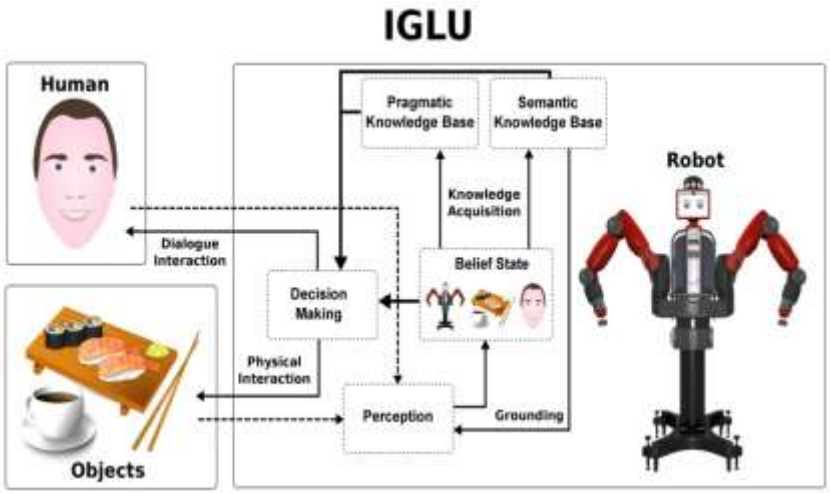


- **Partners:** Vrije Universiteit Brussel (AI Lab), Austrian Research Institute for Artificial Intelligence, Universitat Pompeu Fabra (IBE), Lattice-CNRS, Sony Computer Science Lab

Introduction: Projects of the topic

- **IGLU:** Interactive Grounded Language Understanding
  - ✓ Goal: Synthesize the major transitions in the emergence of languages using agent-based computational models

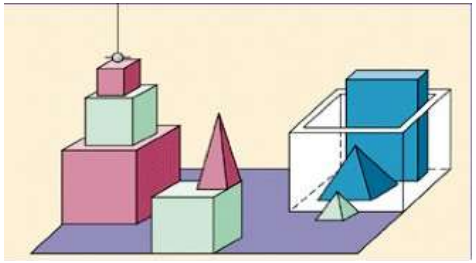
- **Distinctive features**
  - ✓ Motor, physical & verbal interactions
  - ✓ Metrics and evaluations of impacts of
    - **being grounded/not grounded,**
    - **interacting/no interaction,**
    - **adaptation of the agent to new situations,**
    - **anticipation abilities of the agent,**
    - **assimilation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



Put the blue pyramid on the block in the box

- **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

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	✓		✓	✓	✓	✓	✓

Upcoming challenges and needs (1/3)

- **Scientific challenges & needs**
  - ✓ Heterogeneous data (multi-modal, multi-lingual)
  - ✓ Many current techniques need shear 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?

Upcoming challenges and needs (2/3)

- **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?**

Upcoming challenges and needs (3/3)

- **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, maintenable**

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

Role of the CHIST-ERA support

- **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

Questions ?