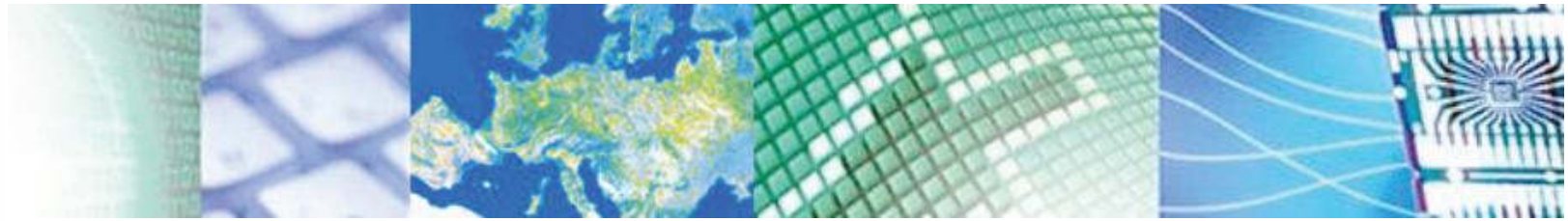

CHIST-ERA Projects Seminar
Topic Human Language Understanding – Grounded Language Learning

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FUTURE & EMERGING TECHNOLOGIES scheme

Introduction: Topic description

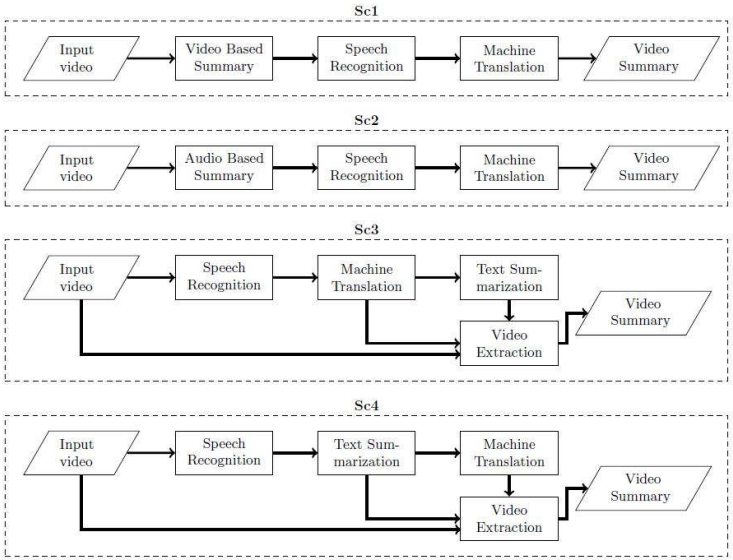
- **The goal:**
  - ✓ Ground language learning in the perceptual, emotional and sensorimotor experience of the system
- **Why:**
  - ✓ To model high-level, semantic & pragmatic knowledge in a robust way, from varied data, considering situational context
- **How:**
  - ✓ Multidisciplinary approach: combine human language processing with related fields such as developmental robotics or cognitive science.
  - ✓ Evaluation
    - **Well defined metrics and protocols to measure progress**

Introduction: 6 Projects of the topic

- **AMIS** (AGH Poland, DEUSTO Spain, LIA France, LORIA France)
- **ATLANTIS** (VUB Belgium, LATTICE France, OFAI Austria, SONY France, UPF Spain)
- **IGLU** (UMONS Belgium, Lille1 & INRIA Bordeaux France, UNIZAR Spain, KTH Sweden, MILA Umontréal & Usherbrooke Québec)
- **M2CR (**CVC Barcelona Spain, LIUM Le Mans France, MILA UMontréal Québec)
- **MUSTER** (ETH Zurich (CH), KU Leuven (BE), University of the Basque Country (SP), Sorbonne Universite (FR))
- **ReGROUND** (KU Leuven Belgium, Koç University Turkey, Örebro University Sweden)

Access Multilingual Information opinionS (AMIS)

- Partners: **LORIA** (France), AGH (Poland), DEUSTO (Spain), LIA (France)
- Challenge:
  - ✓ Understanding a foreign video by summarizing



Different Architectures for AMIS

Arabic Source Video

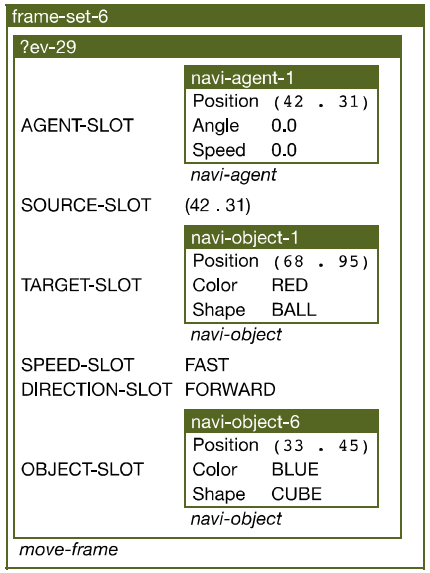
A summarized Video subtitled in English

Artificial language understanding in robots (ATLANTIS)

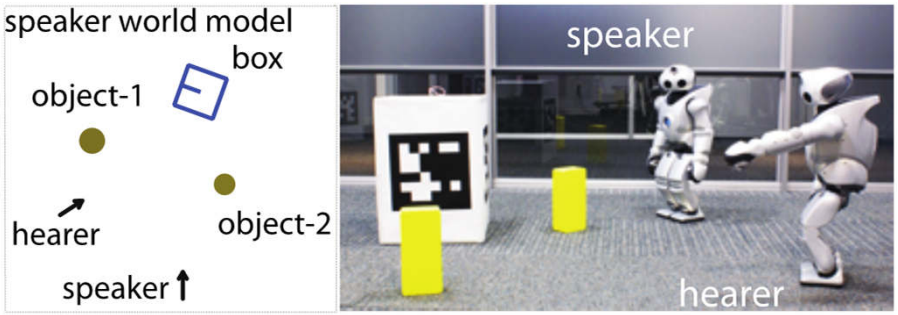
Synthesize the major transitions in the emergence of languages using agent-based computational models

- **Object reference scenario**: draw attention to objects and/or their properties and spatial relations
- **Spatial reference scenario**: describe a particular path of movement

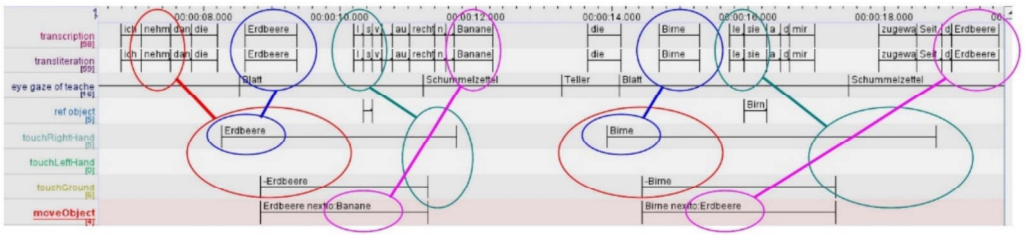
Execute motion frames



Grounded language games



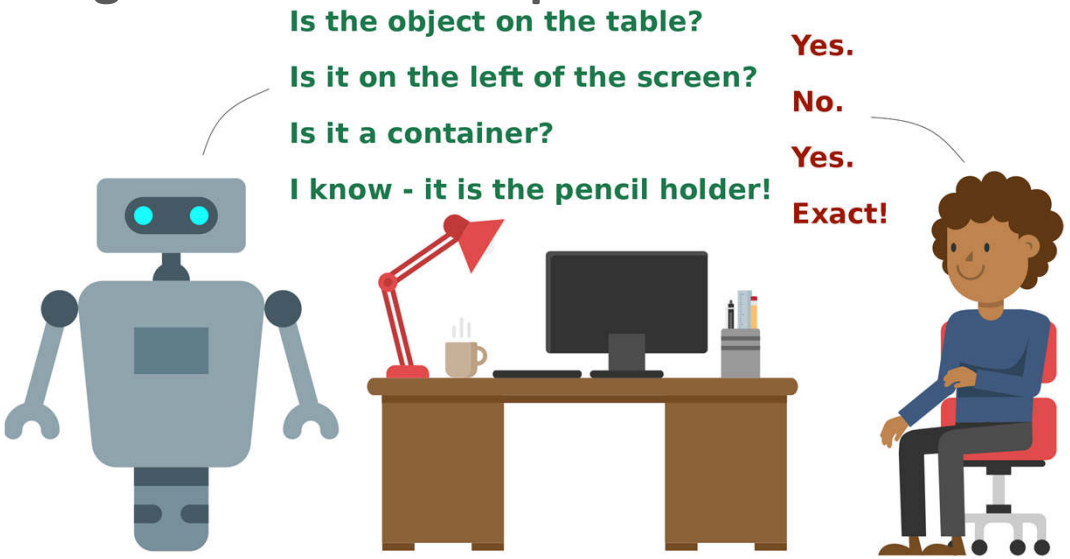
Multi-modal task description corpus



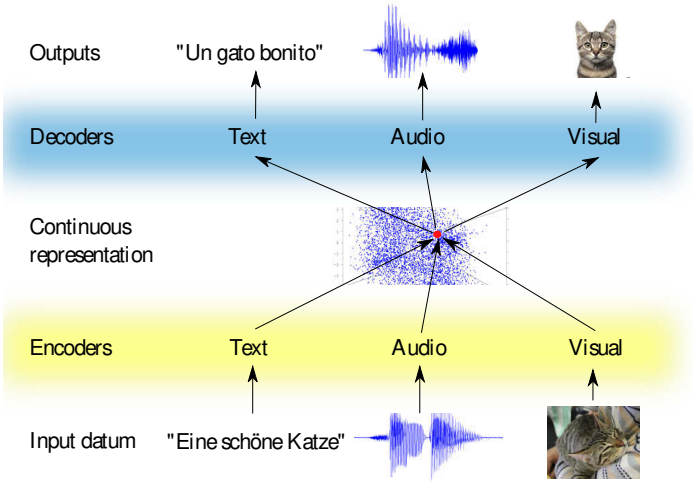
Interactive Grounded Language Understanding (IGLU)

Language learning and grounding through dialogue and interaction in multimodal environments.

- Goal-oriented visual and dialogue tasks (GuessWhat?!).
- Evaluation frameworks of language-learning cognitive agents for dialogue (HoME – 3D multimodal simulator) and incremental learning (Multimodal Human Robot Interaction dataset).
- Integration of developed algorithms on multiple humanoïd robotic platforms.



M2CR: Multimodal Multilingual Continuous Representations for HLU

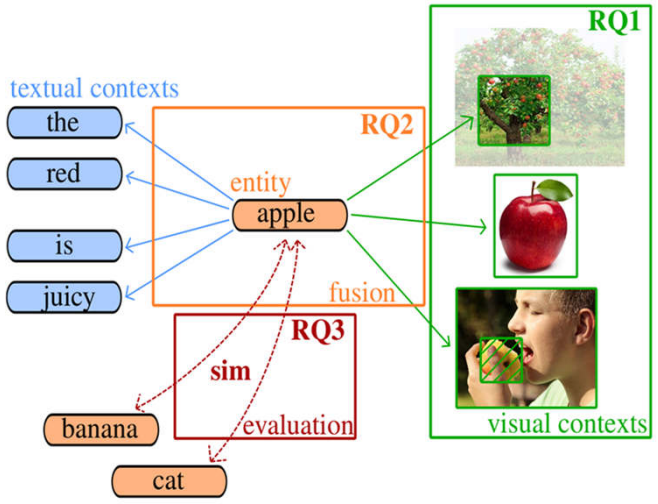


- **Goal**
  - ✓ Design a unified deep architecture
  - ✓ Address major HLU tasks
  - ✓ Multiple languages and modalities
- **Achievements:**
  - ✓ Pure neural MT, ASR and SLU systems
  - ✓ Image to image translation (sharing encoders and decoders)
  - ✓ Multimodal Machine Translation and Image description
- **Ongoing:**
  - ✓ Multi-task systems using multiple modalities
- **Next:**
  - ✓ Corpus targeting specific (linguistic or visual) aspects (e.g. gender agreement)
  - ✓ Integrate encoders and decoders into a single NN
- **Partners:** CVC (Barcelona, Spain), LIUM (Le Mans, France), MILA (Montreal, Québec)

MUSTER

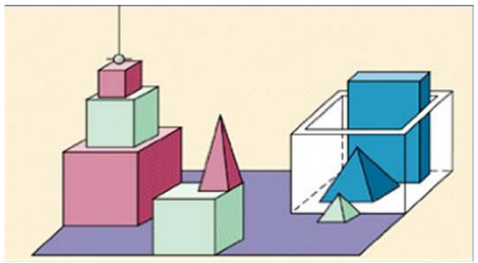
KU Leuven (Be), ETH Zurich (Ch), SU – Paris (Fr), U. Basque Contry (Spain)

- **MUSTER – Mu**ltimodal processing of **S**patial and **T**emporal Exp**R**essions
  - ✓ Multi-modal embeddings for text (word & sentence level)
  - ✓ Understanding & evaluation for various HLU tasks
- **Main results so far**
  - ✓ Multimodal word representations leveraging images (context, appearance, spatial information)
  - ✓ Multimodal tasks (e.g. visual sentence similarity, query-biased video summary)
  - ✓ Study of the properties of multimodal representations
- **Valorisation**
  - ✓ 13 publications
  - ✓ 4 Datasets produced for evaluating the quality of representations
  - ✓ Tools (annotations, benchmarks, and models)

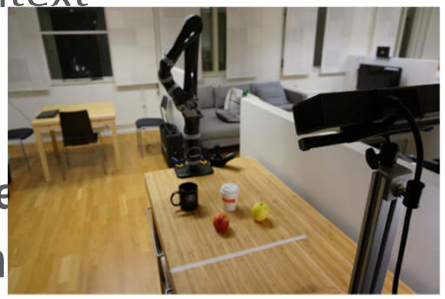


Relational Symbol Grounding through Affordance learning (ReGround)

- **Main ideas**
  - ✓ Associate symbols in language with referents in an environment
  - ✓ Goal: From Winograd's SHRDLU to the real world, here kitchen environment
- **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
    - potential actions in objects in the environmental context
- **Results so far**
  - ✓ Anchoring + relational affordances
    - **Link perception of physical world to object propertie**
  - ✓ Identification of position in NLP (symbol groundin



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)

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Introduction: Projects of the topic

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

What we learned so far

- At the beginning we were looking to very wide solutions and approaches but realized that we had to focus on more specific goal oriented tasks
- CHIST-ERA HLU created a new research community [HLU-master class 10-11 April 2018, ~ 10 workshops + others planned]
- 3 years is short we would like to find a way to keep the HLU community alive.

Produced databases

- AMIS: Video database, 3 languages, 300 hours (100 per langage)
- ATLANTIS: Manual annotation of multimodal task description
- IGLU: 3 databases and 1 3D multimodal simulator
- M2CR: 1 multilingual, multi-modal (image and text descriptions in 4 languages)
- MUSTER: Dataset on spatial similarity for word pairs, Web-image dataset (2.5 M images), visual Word Sense Disambiguation, Visual semantic textual similarity
- ReGROUND: 2 artificial data generators for instruction following (infinite)

Upcoming challenges and needs (1/3)

- **Scientific challenges & needs**
  - ✓ How to combine low level neural approaches with higher level reasoning?
  - ✓ Many current techniques need large amounts of data: how to address this challenge?
    - **investigate techniques that only need few data ...**
      - e.g: unsupervised / weakly supervised learning
  - ✓ How to improve the transfer between modalities across different contexts?
  - ✓ Evaluation is always a challenge

Upcoming challenges and needs (2/3)

- **Scientific challenges & needs**
  - ✓ How to connect data to actions?
    - **use data for action**
      - e.g: anticipation, planning
    - **use action for data acquisition**
      - e.g: 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**
  - ✓ Exchange data, software components, knowledge
    - **Make public the outputs of the inititiative**
      - Workshops, summer school, …
      - HLU Website listing the facilities developed by the projects
        - **e.g. data sharing, platforms produced by the partners**

Remaining challenges and needs - SWOT

- **Strengths**
  - ✓ Large multimodal datasets are starting to be available usually developed by communities or large groups
  - ✓ Deep Learning as a common framework for different modalities is convenient
- **Weaknesses**
  - ✓ Deep Learning is not enough
  - ✓ Relevant multi-modal data not yet always available
  - ✓ Copyright and distribution of corpora
- **Opportunities**
  - ✓ Needs from industry – hopefully
  - ✓ Common practices, component and data reuse, availability of data, software, computation
  - ✓ Common representations for multi-modal phenomena
  - ✓ Better perception and actuation hardware (robots)
- **Threats**
  - ✓ Ethics – use of technology by companies
  - ✓ Research driven by some companies

Remaining challenges and needs

- **Challenges**
  - ✓ **Combining neural implementations and high-level reasoning**
  - ✓ Transfer knowledge from different contexts
  - ✓ Incremental learning with limited data
  - ✓ Integrating different approaches
- **In progress**
  - ✓ Evaluation of the different systems that have been built in the projects

Questions

Questions ?