

Bootstrapping Ontology Evolution with Multimedia Information Extraction



IST 6th Framework Programme - FP6-027538 Project



The facts

- STREP, IST-2004-2.4.7 "Semantic-based Knowledge and Content Systems"
- Start: March 1, 2006
- End: February 28, 2009
- Budget: € 5.075.678
- EU Funding: € 3.150.000
- More than 40 people active in the project
- Project portal: <http://www.boemie.org/>



Consortium



- Inst. of Informatics & Telecommunications, NCSR "Demokritos" (SKEL & CIL), Greece (Coordinator)
- Fraunhofer Institute for Media Communication (NetMedia), Germany
- Dip. di Informatica e Comunicazione, University of Milano (ISLab), Italy
- Inst. of Telematics and Informatics CERTH (IPL), Greece
- Hamburg University of Technology (STS), Germany
- Tele Atlas SA, The Netherlands



Vision

- Pave the way towards automation of the knowledge acquisition process from multimedia content.
- Break new ground by introducing and implementing the concept of evolving ontologies for multimedia.
- Make domain-specific semantic webs feasible with limited human effort.

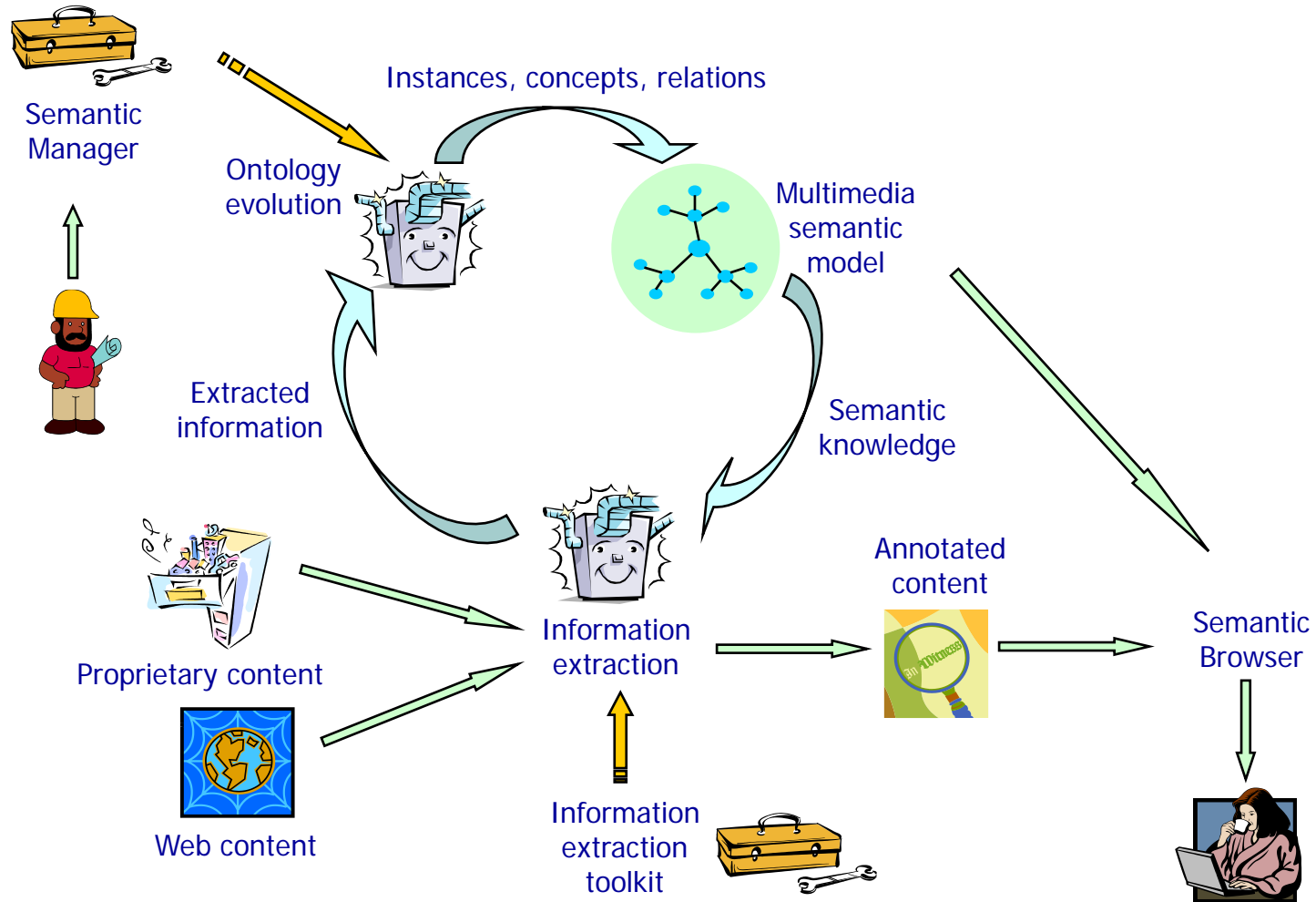
Objectives

- Providing technology to represent and evolve domain-specific ontologies for multimedia.
- Moving from low-level, general-purpose, single-modality feature extraction towards semantic, multimedia analysis.
- Robust and scalable ontology-driven multimedia content extraction through ontology evolution.

Approach

- Driven by domain-specific ontologies, BOEMIE information extraction systems aim to identify high-level semantic features in image, video, audio and text and fuse these features for optimal extraction.
- The ontologies are continuously populated and enriched using the extracted semantic content.
- This is a bootstrapping process, since the enriched ontologies are in turn used to drive the multimedia information extraction system.

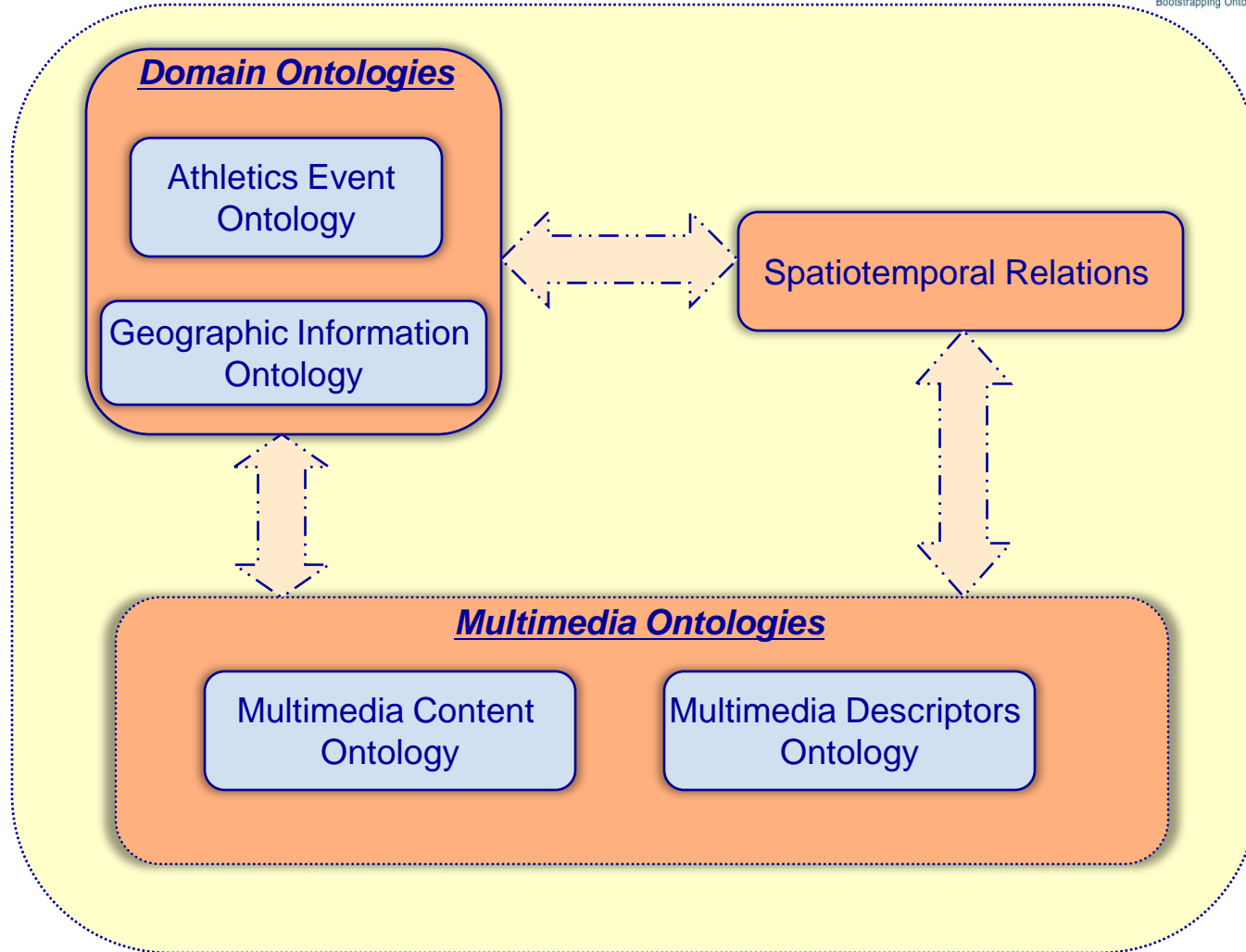
Approach



Multimedia semantic model

- A geographic ontology, e.g. about landmarks.
- An event ontology, e.g. about athletics events.
- Multimedia content and descriptor ontologies
- Potential contribution:
 - Uncertainty in concept descriptions.
 - Spatial and temporal relations.
 - Efficient (leightweight) representation.

Multimedia semantic model

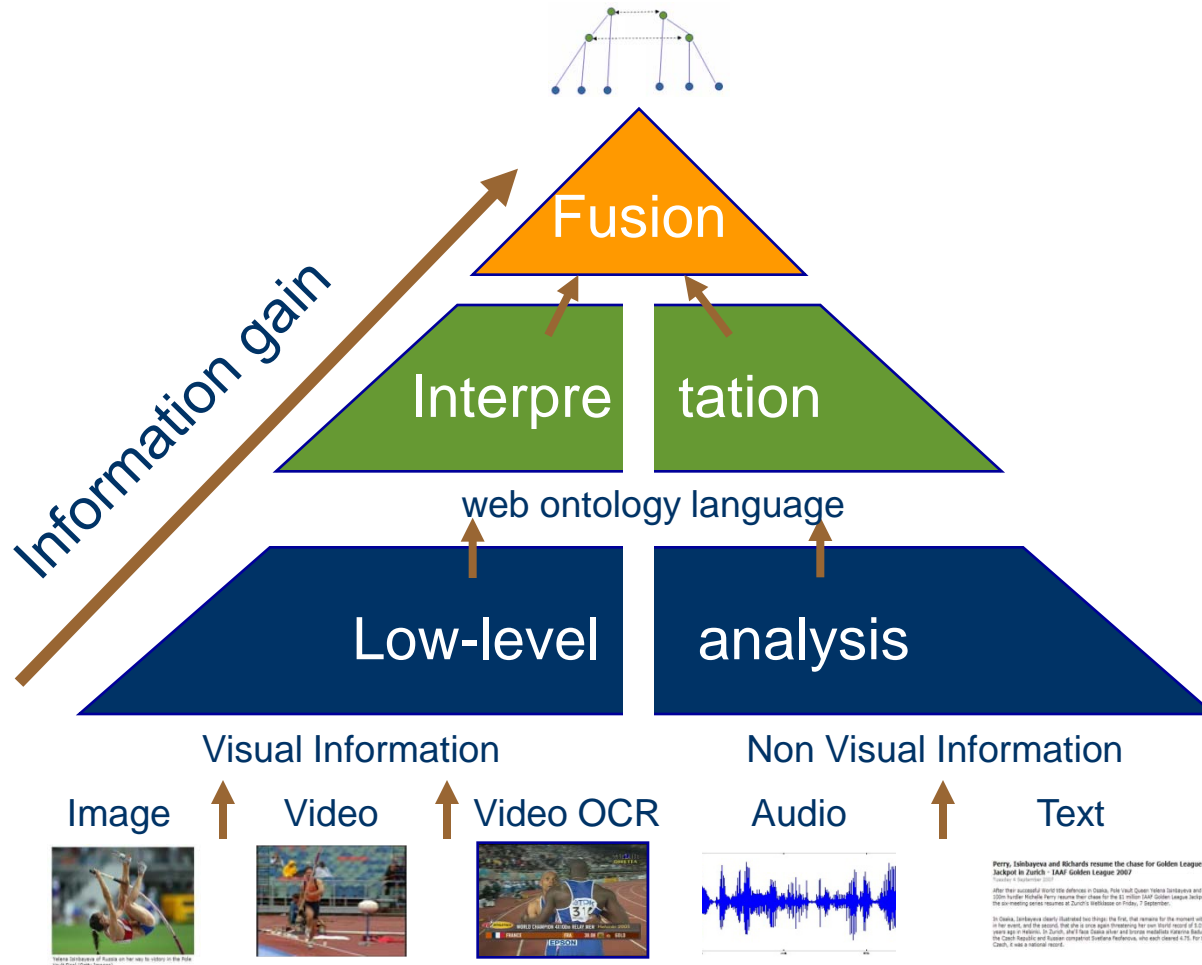


Semantics extraction

- Emphasis on fusion of multiple modalities, using reasoning and handling uncertainty.
- Contribution to the state of the art in visual content analysis, due to its richness and the difficulty of extracting semantics.
- Non-visual enriches semantic annotation through fusion.
- Two dominating content formats: Web pages with images and video (mainly proprietary).



Semantics extraction

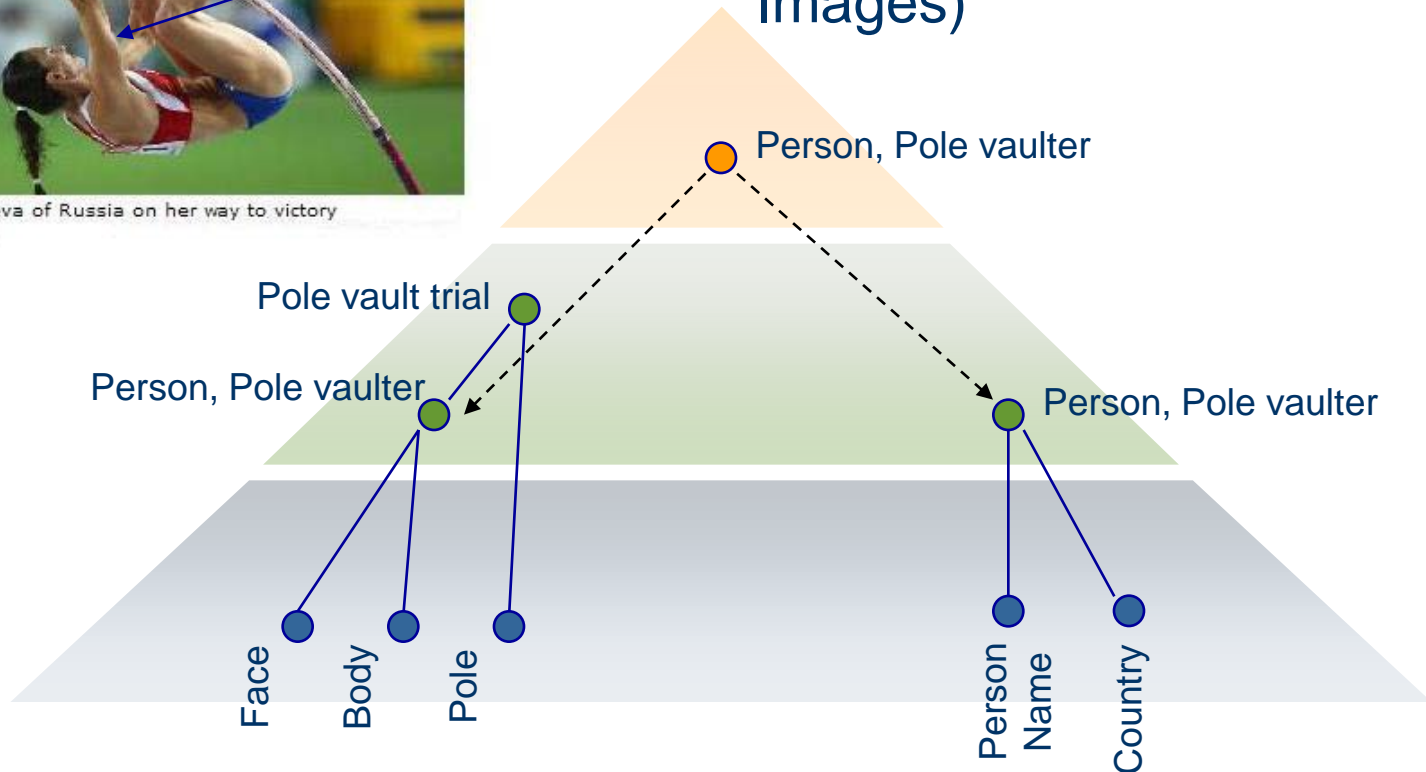


Semantics extraction



Yelena Isinbayeva of Russia on her way to victory (Getty Images)

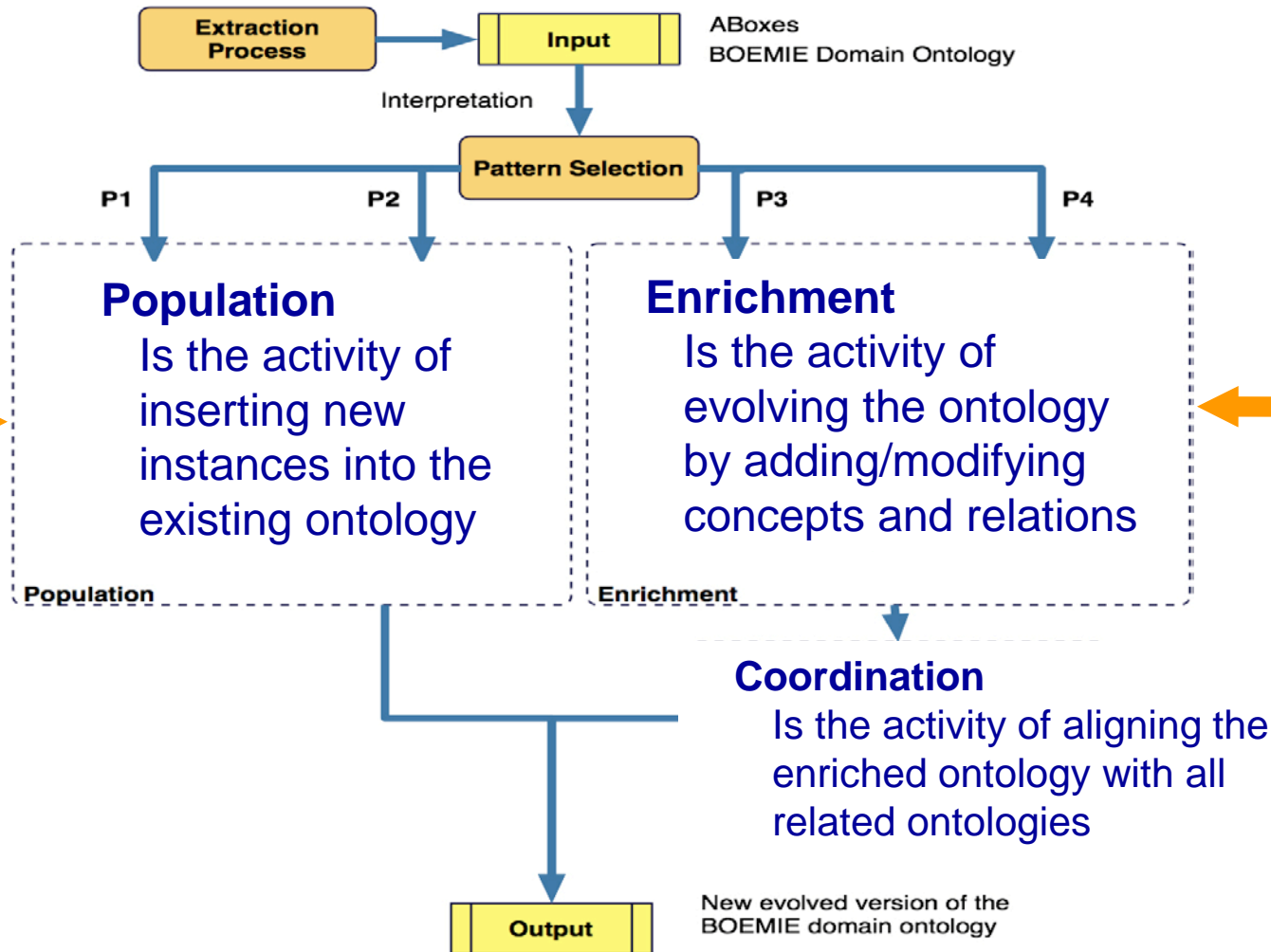
Yelena Isinbayeva of Russia on her way to victory (Getty Images)



Ontology evolution

- Ontology population from multimedia content.
- Combination of reasoning and statistics for enrichment and coordination.
- Matching and coordination support for population and enrichment.

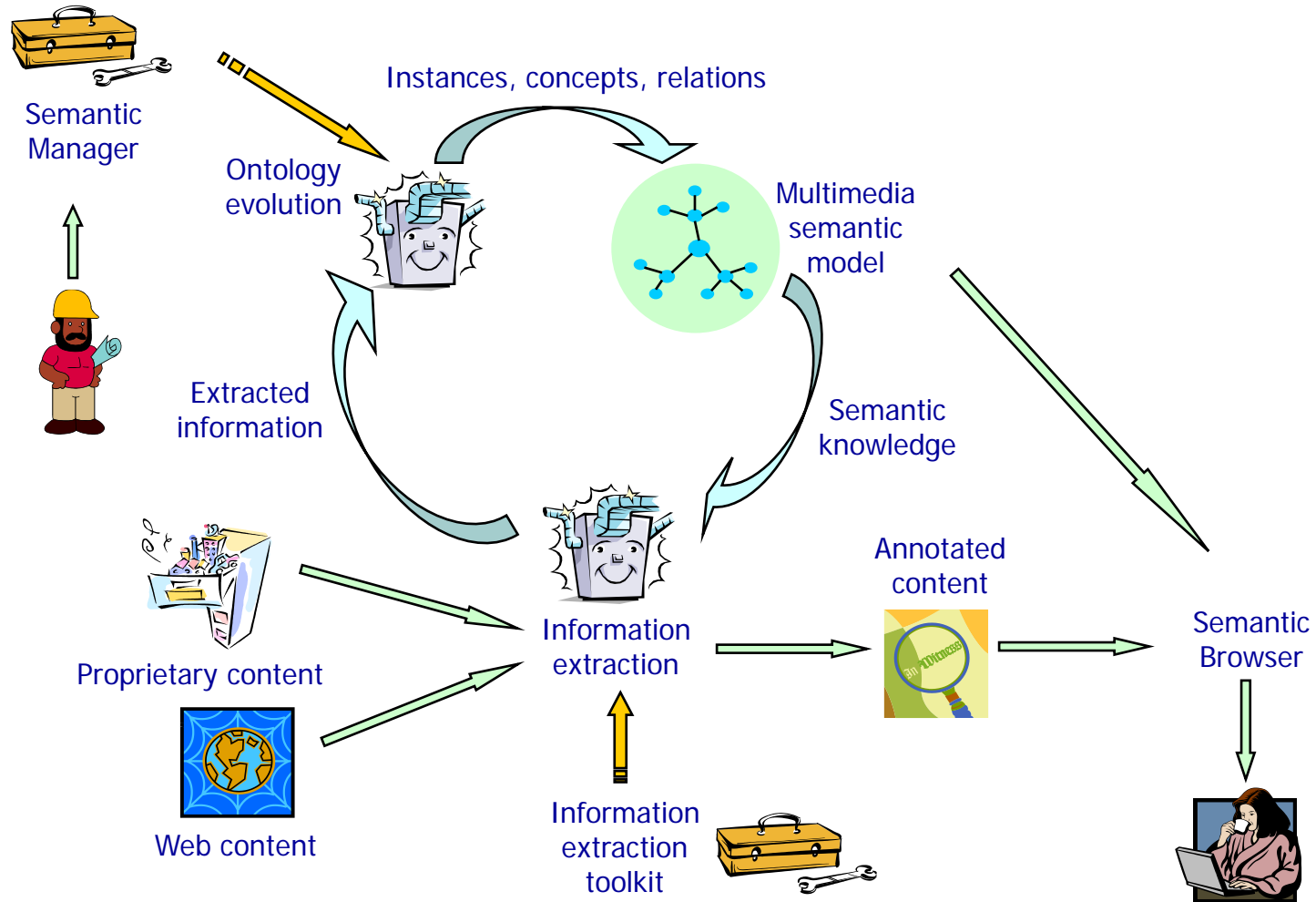
Ontology evolution



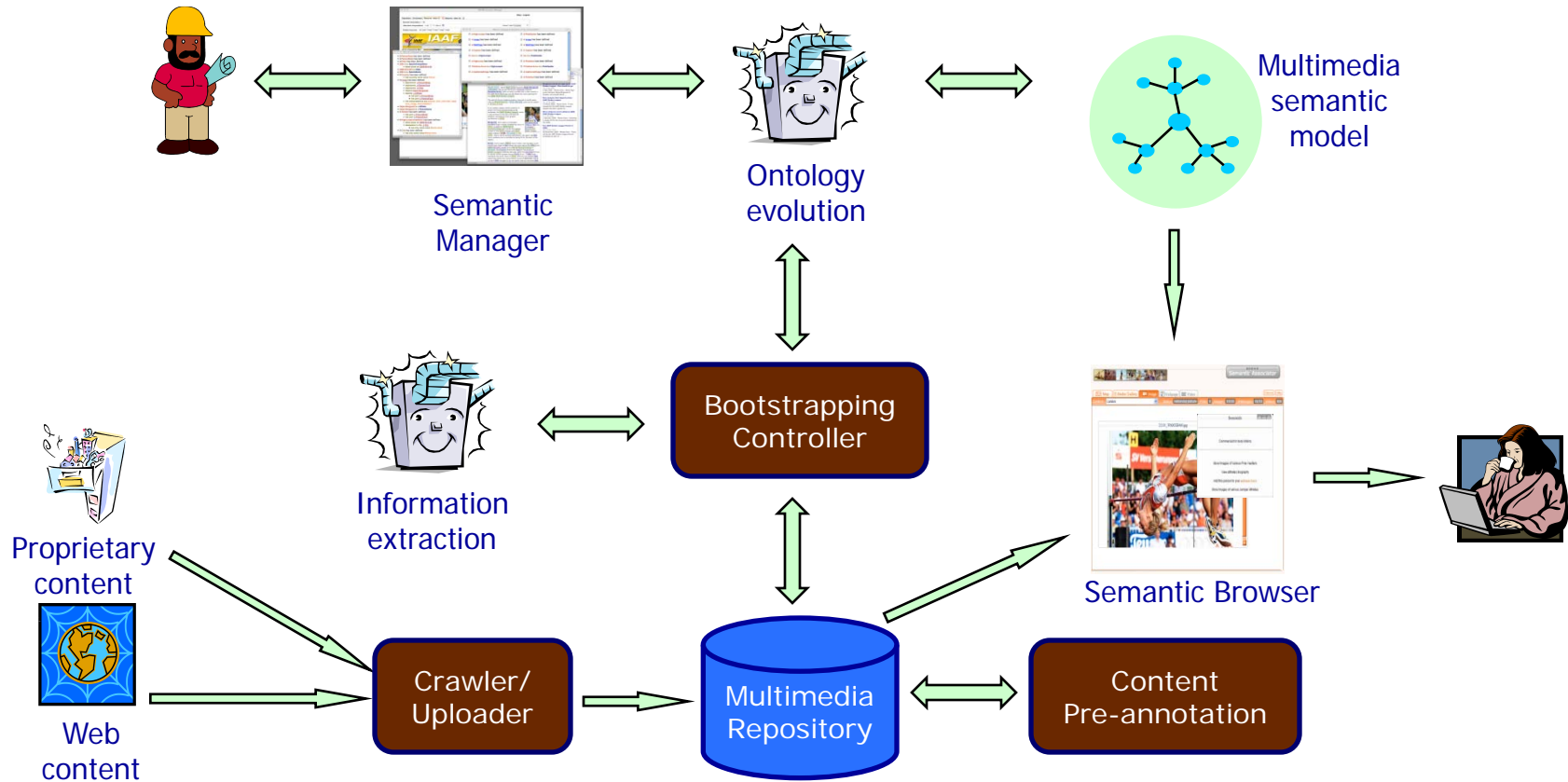
System integration

- Implementation of the bootstrapping process, integrating semantic extraction and ontology evolution, through the semantic model.
- Crawling for content collection and content quality assessment.
- Demonstration of added value for the content provider (semantic content management) and the end user (semantic content browsing)!

System integration



System integration



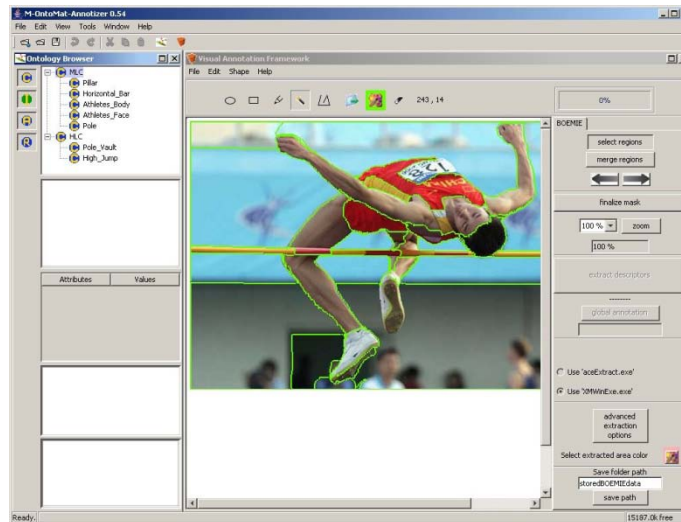
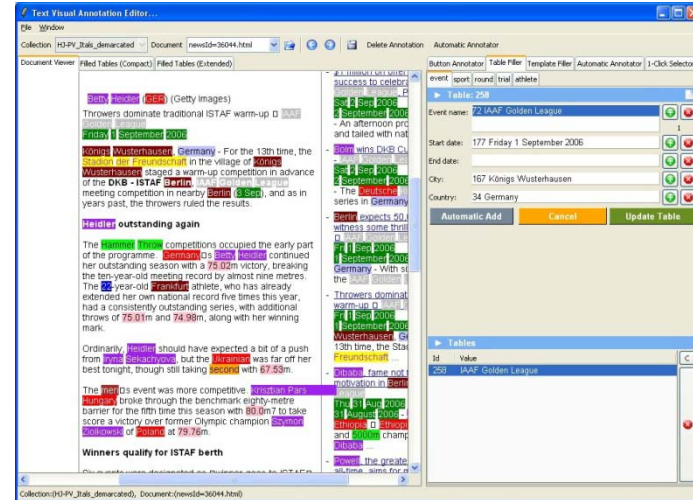
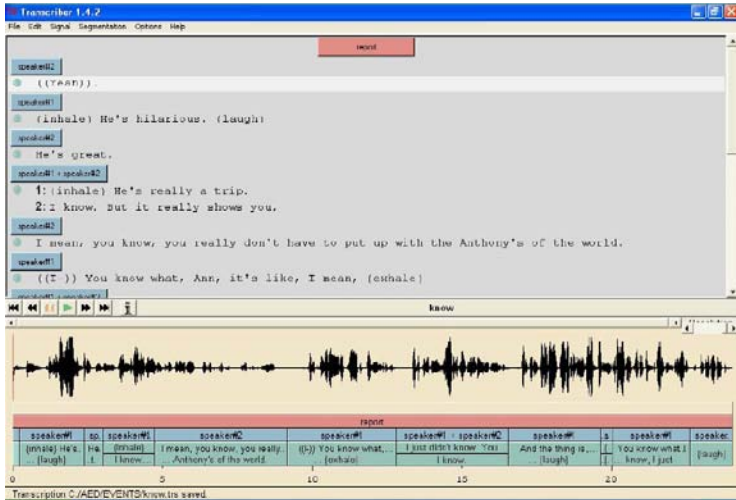
Achievements



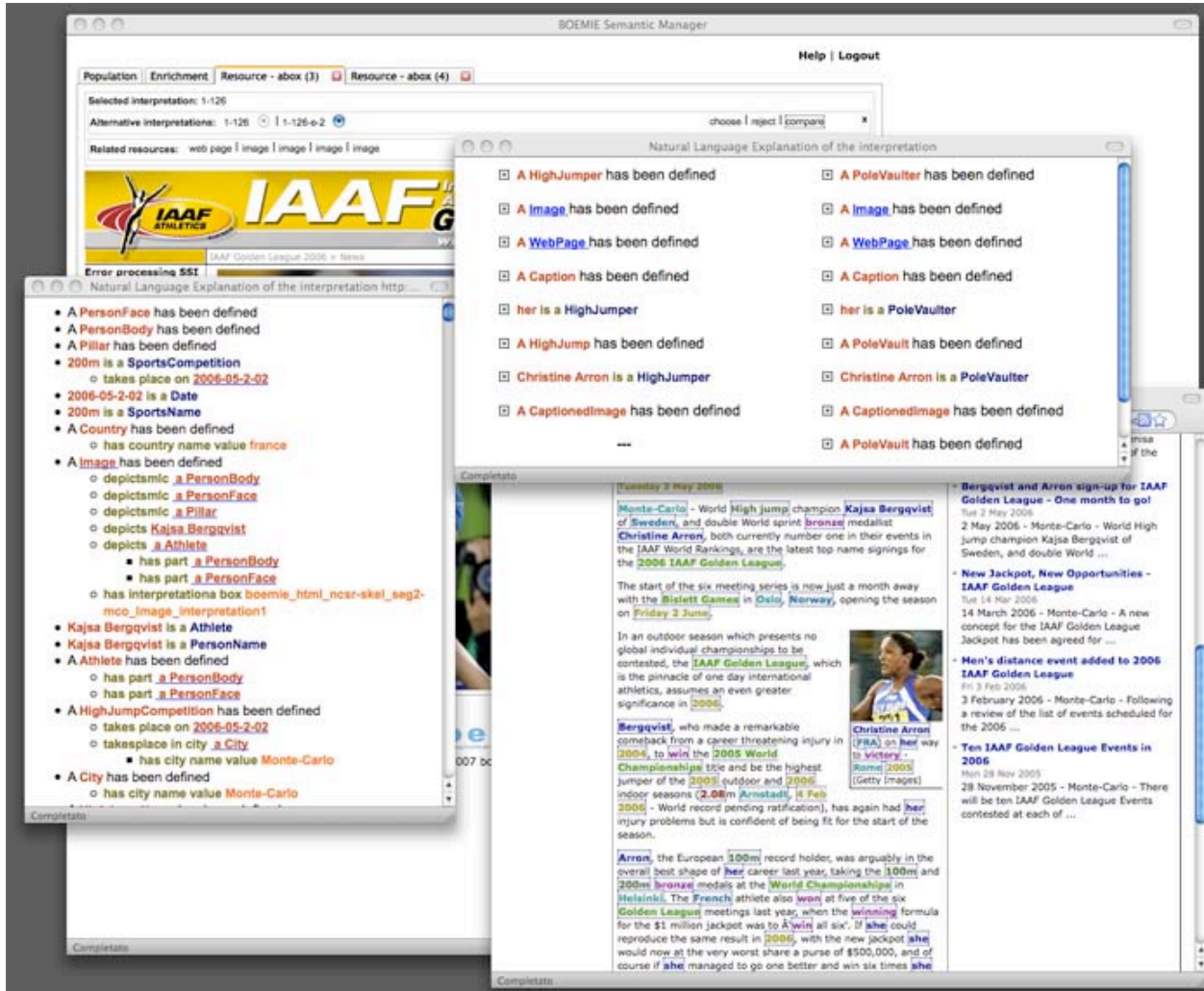
- Multimedia, geographic and athletics ontologies, integrated into a common BOEMIE semantic model.
- Novel extraction methods for images, video, audio, video OCR, integrated into the extraction toolkit.
- Advanced reasoning techniques for multimedia interpretation, based on abductive methods.
- Innovative ontology population, enrichment and coordination techniques, integrated into the ontology evolution toolkit.
- Advanced content management system, implementing the bootstrapping process.
- Prototype to be evaluated by external users.
- User-friendly annotation tools for each modality.
- Large annotated corpus for various modalities.



Annotation Tools



BOEMIE semantic manager



The screenshot displays the BOEMIE Semantic Manager interface. The main window shows a news article from the IAAF website titled "IAAF Golden League 2006". The article text includes: "Monte-Carlo - World High Jump champion **Kajsa Bergqvist** of Sweden, and double World sprint **bronze** medalist **Christine Arron**, both currently number one in their events in the IAAF World Rankings, are the latest top name signings for the 2006 IAAF Golden League. The start of the six meeting series is now just a month away with the **Bislett Games** in Oslo, Norway, opening the season on Friday 2 June. In an outdoor season which presents no global individual championships to be contested, the IAAF Golden League, which is the pinnacle of one day international athletics, assumes an even greater significance in 2006. **Bergqvist**, who made a remarkable comeback from a career threatening injury in 2004, to win the 2005 World Championships title and be the highest jumper of the 2005 outdoor and 2006 indoor seasons (2.08m **Arnstadt, 4 Feb 2006** - World record pending ratification), has again had her injury problems but is confident of being fit for the start of the season. **Arron**, the European 100m record holder, was arguably in the overall best shape of her career last year, taking the 100m and 200m bronze medals at the World Championships in Helsinki. The French athlete also won at five of the six Golden League meetings last year, when the winning formula for the \$1 million jackpot was to 'win all six', if she could reproduce the same result in 2006, with the new jackpot she would now at the very worst share a purse of \$500,000, and of course if she managed to go one better and win six times she

The interface also shows several windows with semantic interpretations:

- Natural Language Explanation of the interpretation:**
 - A HighJumper has been defined
 - A Image has been defined
 - A WebPage has been defined
 - A Caption has been defined
 - her is a HighJumper
 - A HighJump has been defined
 - Christine Arron is a HighJumper
 - A CaptionedImage has been defined
 - A PoleVault has been defined
 - A Image has been defined
 - A WebPage has been defined
 - A Caption has been defined
 - her is a PoleVault
 - A PoleVault has been defined
 - Christine Arron is a PoleVault
 - A CaptionedImage has been defined
 - A PoleVault has been defined
- Error processing 551:**
 - A PersonFace has been defined
 - A PersonBody has been defined
 - A Pillar has been defined
 - 2006 is a SportsCompetition
 - takes place on 2006-05-2-02
 - 2006-05-2-02 is a Date
 - 2006 is a SportsName
 - A Country has been defined
 - has country name value france
 - A Image has been defined
 - depictsmic a PersonBody
 - depictsmic a PersonFace
 - depictsmic a Pillar
 - depicts Kajsa Bergqvist
 - depicts a Athlete
 - has part a PersonBody
 - has part a PersonFace
 - has interpretation box boemie_html_ncsr-skel_seg2-mco_image_interpretation1
 - Kajsa Bergqvist is a Athlete
 - Kajsa Bergqvist is a PersonName
 - A Athlete has been defined
 - has part a PersonBody
 - has part a PersonFace
 - A HighJumpCompetition has been defined
 - takes place on 2006-05-2-02
 - takesplace in city a City
 - has city name value Monte-Carlo
 - A City has been defined
 - has city name value Monte-Carlo

BOEMIE semantic browser

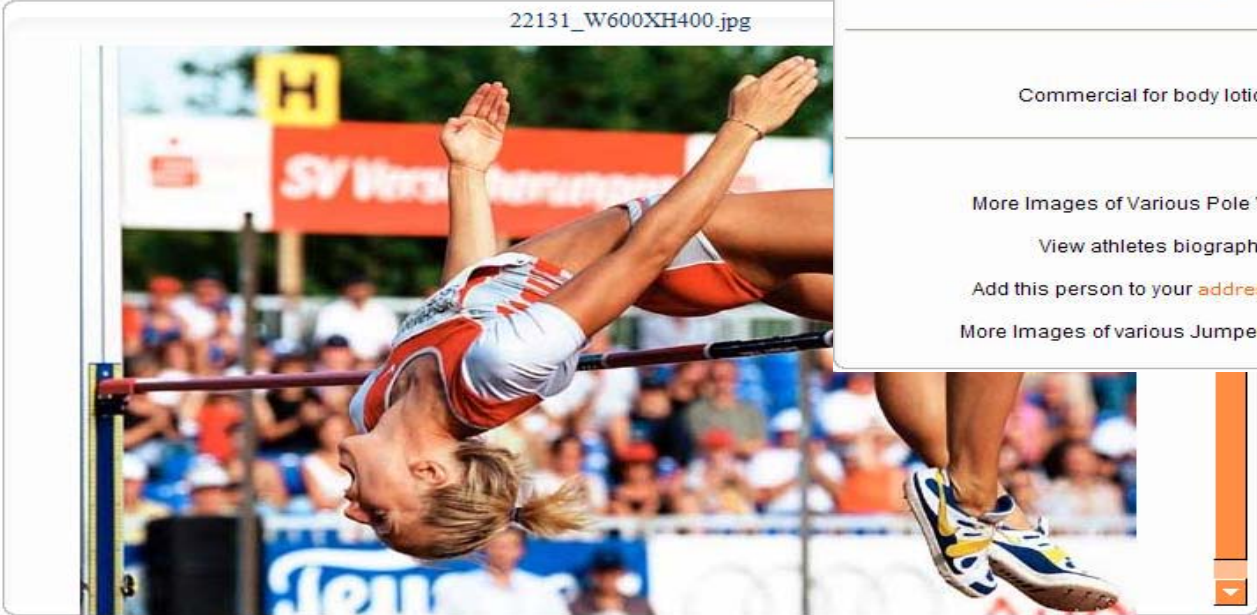


BOEMIE
Semantic Associator

Map Media Gallery Image Webpage Video Options Help

Context: London Status: retrieving picture POIs: 2 Images: 15/15 Webpages: 13/13 Videos: 8/8

22131_W600XH400.jpg



Boemieinfo

- Commercial for body lotions
- More Images of Various Pole Vaulters
- View athletes biography
- Add this person to your [address book](#)
- More Images of various Jumper Athletes

Challenges

- Generic/large-scale recognition in images and video
- Computationally efficient interpretation of extracted information (from mid- to high-level concepts).
- Domain-independent fusion of multiple modalities.
- Hybrid approaches to fused interpretation.
- Discovery of new object types (mid-level concepts).
- Learning new high-level concepts, relations and interpretation rules.
- Human-friendly presentation and definition of new knowledge.

Challenges

- Domain-independent and computationally efficient ontology matching.
- Effective use of external resources in concept definition.
- Intelligent, efficient and user-friendly semantic applications.
- Seamless integration of semantic applications in current working practices (e.g. content production and management).
- Engineering of an efficient and transparent integrated extraction and evolution system that combines many heterogeneous components.

<http://www.boemie.org/>

George Paliouras
(paliourg@iit.demokritos.gr)