Gorgias: Argumentation in Practice

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Argumentation
for
Cognitive Computing

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PART 1

Why Argumentation?

Argumentation
Foundations of Cognitive AI

- **Argumentation – Foundational Links:**
  - Cognition/Human Reasoning
  - Formal Logic as Argumentation Logic
  - Induction/Machine Learning
  - Explainability
  - Persuasion
  - Ethics

Human like Systems

Why Argumentation?

- **Argumentation is native to human reasoning**
  - **Cognitive Psychology - Mercier & Sperber**
  - **Behaviour Economics – Thaler, Kanehman**
    - **"Humans are not rational"**
- **Knowledge captured as arguments**

Logical Reasoning

Why Argumentation?

- **Formal Logic in terms of Argumentation**
  - **"Infomalizing Formal Logic"**
  - **Argumentation unifies strict/formal and informal reasoning**
- **Argumentation is the primary notion of reasoning.**

Argumentation-based Reasoning

Formal … … … Informal Reasoning

Flexibility of Argumentation

Syllogistic Challenge 2017

- **Formalize and automate the ordinary – common sense – human syllogistic reasoning.**
- **Cognitive Models evaluated on unseen data gathered from 140 human reasoners on the full set of 64 cases of Aristotelian Syllogisms.**
- **Argumentation approach based on formal and informal argument schemes.**
- **Argumentation performs very well in the challenge.**

Learning/Induction

Why Argumentation?

- **Learned Knowledge ⇔ Argument schemes**
  - **Learned associations/rules are not necessary links but provide arguments to support links**
  - **This view addresses old philosophical questions with induction**

Learning & Reasoning

Why Argumentation?

- **Integration of Connectionism and Symbolism**
  - **Conceptualization Phase: Organization of Learned Information into Concepts & their Associations.**
  - **Then this leads to two processes of:**
    - **Recognition of (cases of) Concepts**
    - **Propagation of this recognition to other associated concepts**
      - **Argumentation is naturally linked to this propagation of knowledge**
- **Argumentation gives a Model of Cognitive Processing on top of Machine Learning.**

Explainability

Why Argumentation?

- **Arguments explicitly support a conclusion or claim or decision**
  - **And the rejection of other alternatives by defending against counter-arguments**
- **Explainable AI**
  - **EU law for the Protection of Natural Persons**

Persuasion

Why Argumentation?

- **Gorgias: Methods of Persuasion**
  - **Force – Seduction – Reason**
- **Argumentation: Vehicle of Seduction**

ETHICS

Why Argumentation?

- **Transparency & Accountability**
- **Morality through self and social dialectic argumentation process**

PART 2

Computational Argumentation

What is Argumentation?

- **Intelligence: build on connectionist hardware**
  - **This hardware can be build by Machine Learning**
  - **To use effectively the hardware we need a higher-level process: This is Cognition.**
  - **Cognition's main task: To handle conflicts**

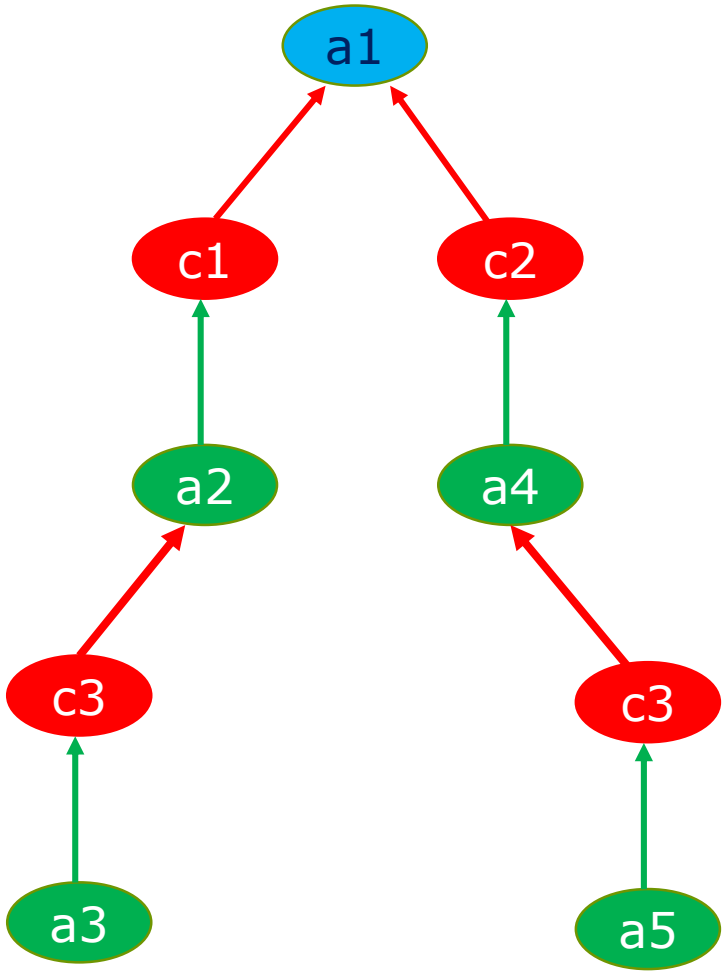
- **Argumentation provides a mediator layer on top of the connectionist hardware for Cognition.**

Argumentation based Reasoning/Decision Making

- **Conclusion φ (or Decision O):**
  - **Argument for φ (or O)**
  - **No argument for ¬φ (or O′)**

- **"Good Quality" arguments:**
  - **Acceptable Arguments**
    - **Defend against all counter-arguments**

Dialectic Argumentation



PART 3

Argumentation Applications/Technology

Context of Approach:

Human like AI

- **Human like interaction** of systems:
  - With **users** when **using** the systems
  - **But also** with **"experts"** when **developing** the systems
- **Explainable AI.**

Argumentation in Gorgias

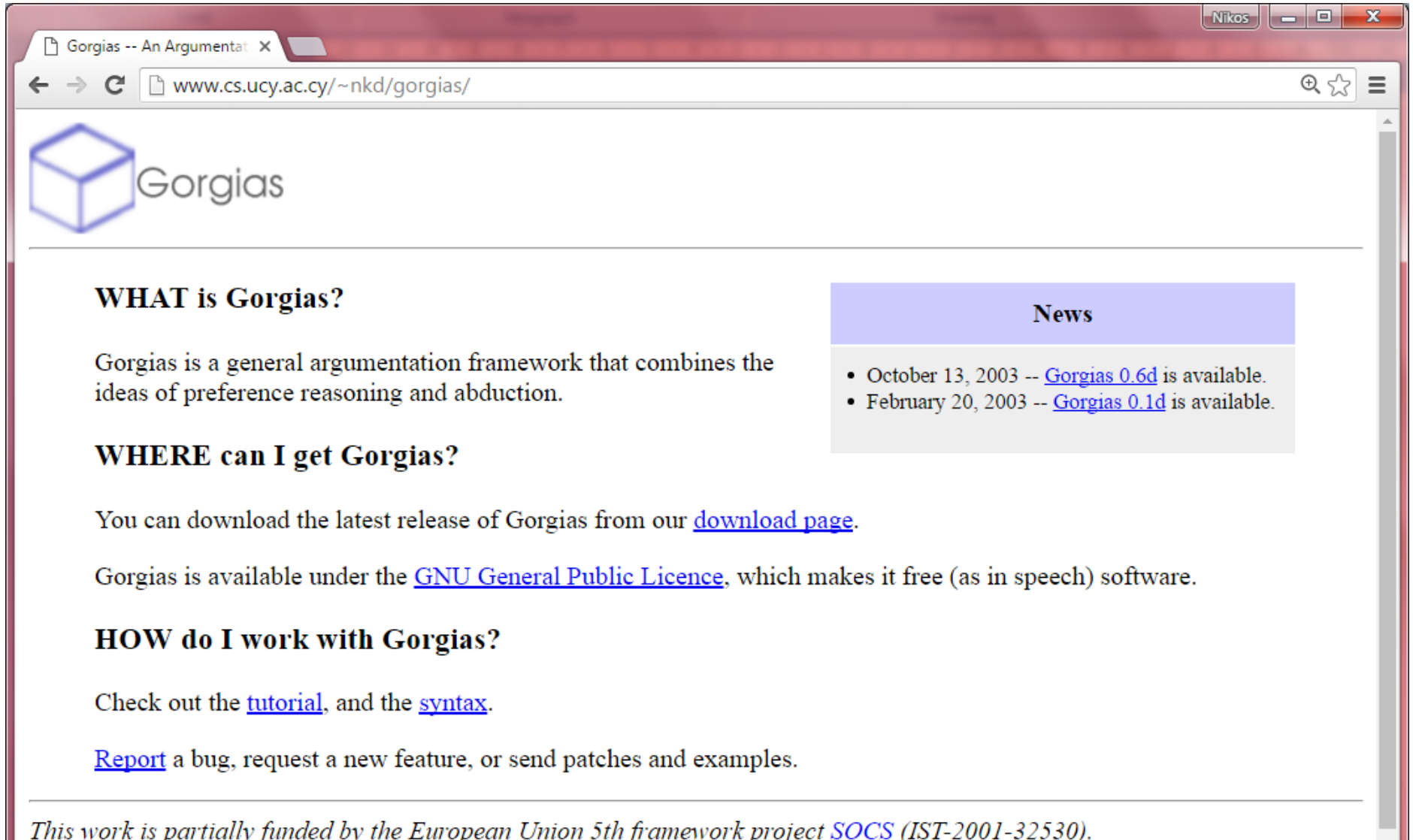
- **Preference-based argumentation framework of Gorgias**
  - Argument Schemes/Rules and Priority Argument Schemes (on rules)
    - Logic Programming with Negation as Failure (**LPwNF**)
    - Proposed in 1994 (KMD at ICLP94)

- **Gorgias to formulate and study various AI problems**
  - Autonomous Agent (Goal Decision & Intra-agent Control)
  - Machine Learning (Non-monotonic learning)
  - Reasoning about Actions and Change (Event Calculus and Language E)
  - Narrative Comprehension
  - **Cognitive Systems/Assistants**

The Gorgias System (2003 -…)

- Builds acceptable arguments from expert knowledge/argument schemes.
- Realizes Decision Making through argumentation for application problems
- Flexible and Robust system
  - Incomplete, contextual and conflicting knowledge
  - Consideration of different (conflicting) view points
- Real-life applications since 2004

The Gorgias System



Real life Applications of Gorgias (2004- …)

- Ambient Intelligence: **Ambient Assisted Living (AAL)**
- Ambient Intelligence: **Pervasive Services and Conflict resolution in sensors**
- Business Computing: **Product Pricing**
- Business Computing: **Portfolio Construction**
- Network Security: **Management of Firewall Policies**
- Medical Informatics: **Deep Vein Thrombosis**

- PROSOCS platform for KGP agents: **Intra-agent control**

PART 3′

Developing Applications of Gorgias

Gorgias Application Approach

- **Knowledge as Argument Schemes via Scenarios**

- **Knowledge acquired by:**
  - **Elicited from Experts**
  - **Machine Learned**
  - **Hybrid Acquisition**

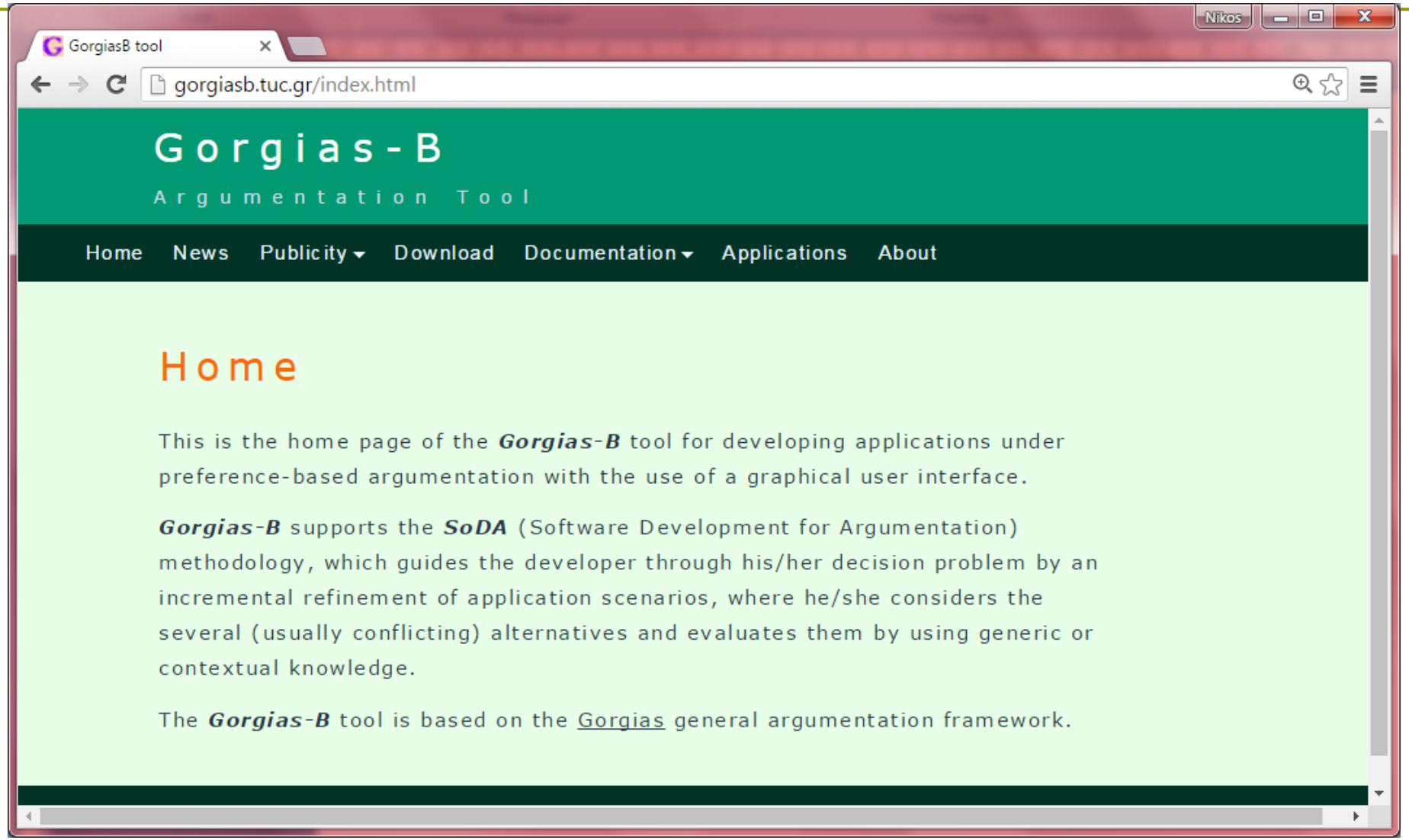
- **Knowledge types:**
  - **Expert**
  - **Common Sense**
  - **Personal biases**

Gorgias Applications Methodology (SoDA)

Application guidelines/policy in (structured) Natural Language or from Machine Learning.

- Extract information in terms of (typical) scenarios and contextual refinements of these.
- Hierarchies of scenario preferences – directly in the high-level application language.
- Argumentation representation in GORGIAS code.

Gorgias-B: Authoring Scenario Preferences



Medical Data Access/Sharing

- **Problem:** Decide **Level of Access** according to **user** and **current circumstances**

- **There are 6 Access Levels (Read & Write)**
  - **Full Access**
  - **Read Only Access**
  - **Suspended Access**
  - **Partial Access**
  - **Restricted Read Access**
  - **No Access**

Law 138(I)/2001: Personal Data Protection
Law N. 1(I)/2005: Patient Rights

«**Generally, no one has access** to medical files. [**But**] The owner **has** full access **unless high emotional impact**.»

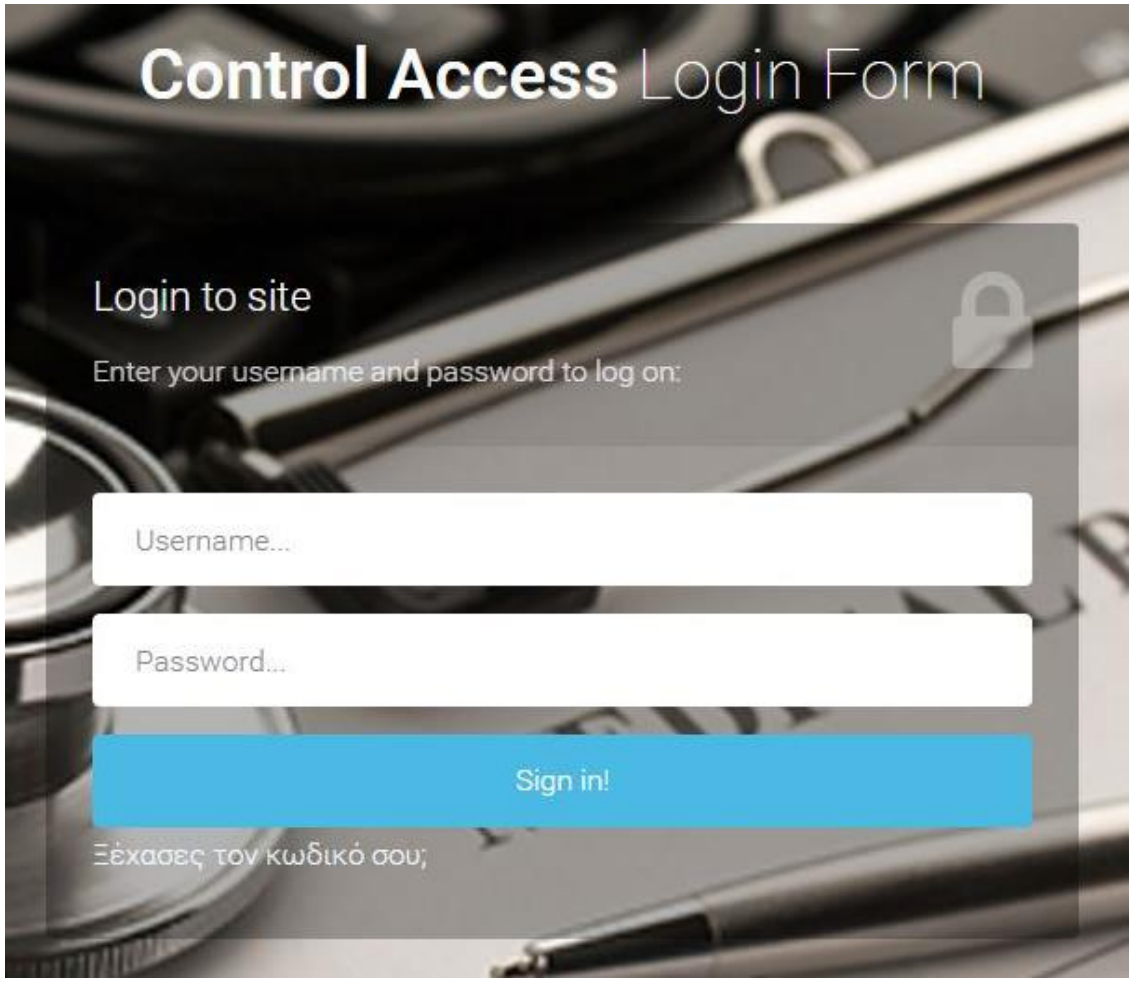
Medical Data Access: MEDICA

- **MEDICA:**

  http://medica.cs.ucy.ac.cy

- **Demo Online**

- **Pilot evaluation**



Gorgias-NL

Ultimate Goal - Example

Cognitive On-line Shopping Assistant

"The quality of food is very important for me. I like to eat organic food. I am not diabetic but I like to avoid sugary foods. I prefer not to eat red meat except for special occasions. When possible try to economize."

"The fish last night was very good. I would have liked a bigger portion."

Gorgias-NL

Simple Example

"Normally, discard coupons. If a coupon is related to my wish list, save it unless it is expensive. If it offers a large discount, save it. Discard the coupons that are out-of-date."

Eye Clinic Cognitive Assistant

- **Provides a first level support to patients at the reception of the clinic:**
  - Finds **most expertly probable** diseases
  - Able to recognize the possibility of **severe/urgent** diseases
  - Suggests **extra information/tests** needed to **focus** on the **probable disease**.

On-going Applications

- **DIABETICA, OPHAMOLOGICA, Care Assistant**
- **STROKE Diagnosis Support**
  - **Tight Integration of Argumentation in the Machine Learning process.**
- **COGNITIVE Assistants:**
  - **Tourist, Calendar, Purse Assistant**
  - **Social Media (Twitter) Assistant**

Conclusions - Summary

Gorgias Argumentation Technology

- **Principled problem solving from expert or learned knowledge via argumentation logical inference/propagation**
- **SoDA Methodology for facilitating the elicitation of expert/user knowledge**
- **Gorgias Tools to support the automatic acquisition/authoring of expert knowledge into argumentation software**

Gorgias Argumentation Technology

Cognitive Systems

- **Natural User Interaction**
  - **High-level (natural) interface language**
  - **Human like interaction:**
    - **Through explanation and dialogues**

- **Flexibility and Robustness of systems**
  - **Incomplete, contextual and conflicting knowledge**
  - **Consideration of different (conflicting) view points**

THE Conclusion

Argumentation provides a mediator layer on top of the mind's connectionist biological hardware for Cognition

Argumentation on top of Machine Learning for Cognitive Computing.

Gorgias

Greek Sophist c.485 — c.380 BCE

Thanks