Abduction in Classification Tasks

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M. Atzori, P. Mancarella, F. Turini

{atzori,paolo,turini}@di.unipi.it

Dipartimento di Informatica

Università di Pisa, Italy

Goal

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- Abductive Interpretation of Decision Trees

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- $P \cup \Delta \cup Ic$ is consistent.

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- Knowledge Base
- Observations
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We obtain a framework able to answer *abductive queries* starting from the induced data

The Process

Induced Tree

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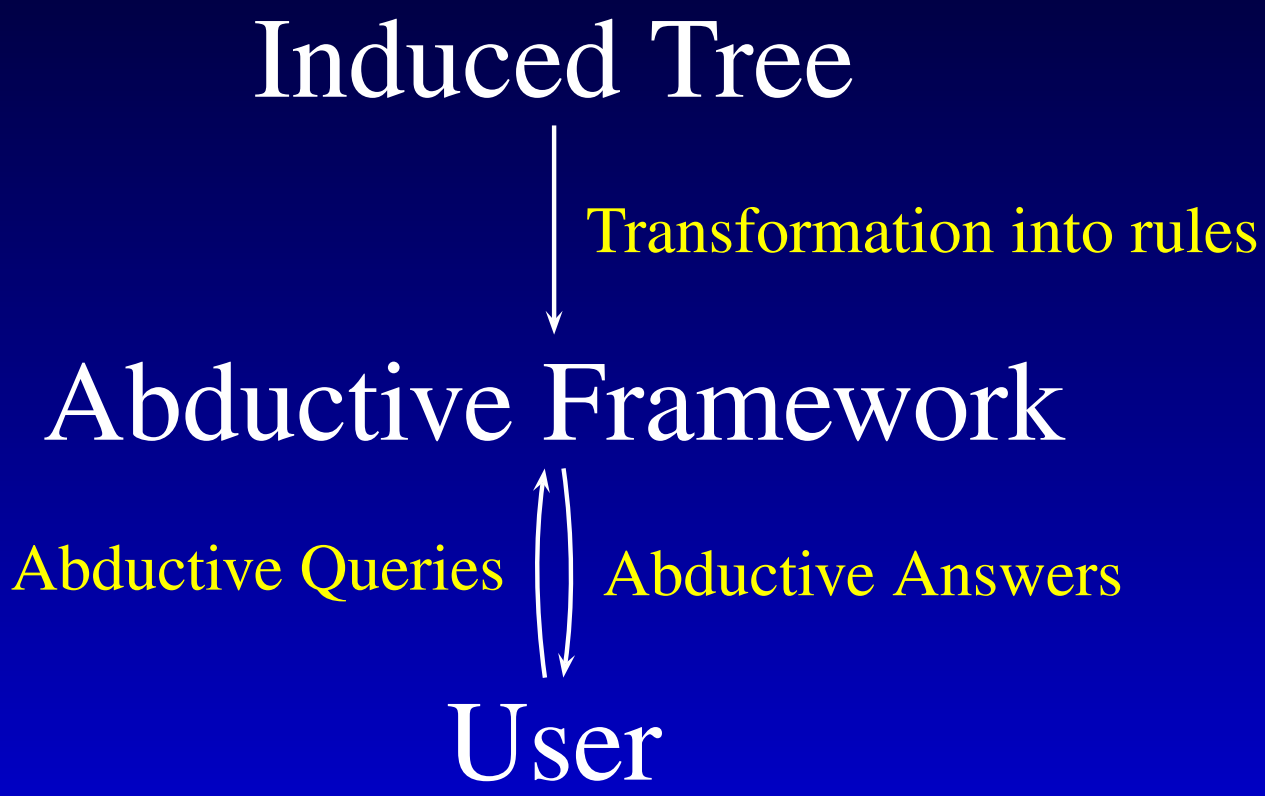
Transformation into rules

Abductive Framework

The Process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- better classification *(by adding domain specific knowledge as integrity constraints)*
- the reason why an instance belongs to a particular class *(by adding knowledge about the instance and then a simple abductive query)*
- a set of attributes whose values should be changed in order to obtain a different class *(by finding differences between two similar results of different goals)*

An Example: Training Set

Outlook	Temperature	Humidity	Wind	Class
Sunny	Hot	High	Weak	No
Sunny	Hot	High	Strong	No
Overcast	Hot	High	Weak	Yes
Rainy	Mild	High	Weak	Yes
Rainy	Cool	Low	Weak	Yes
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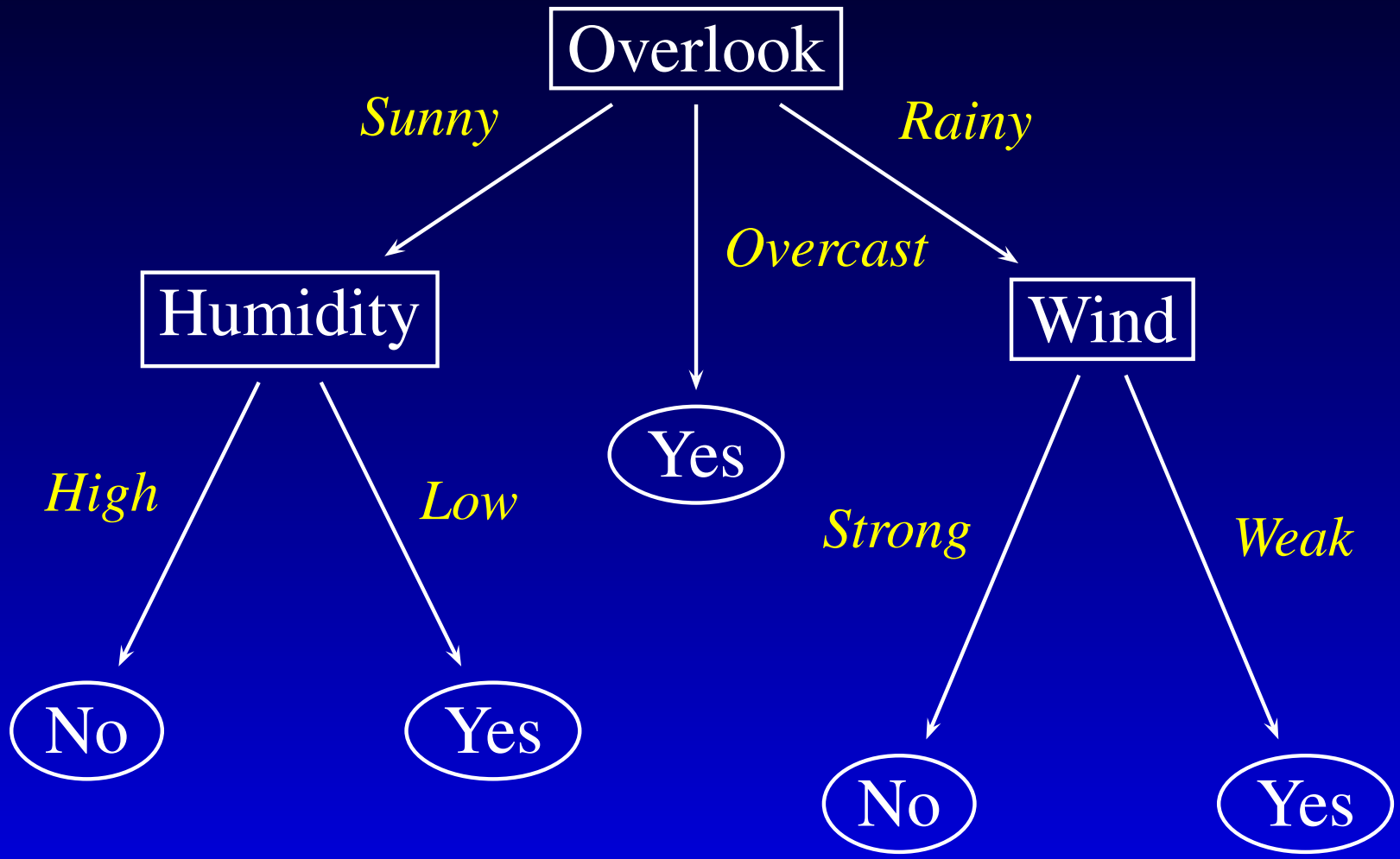

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- our extra knowledge arises from knowledge sources different from the ones which provide the training set

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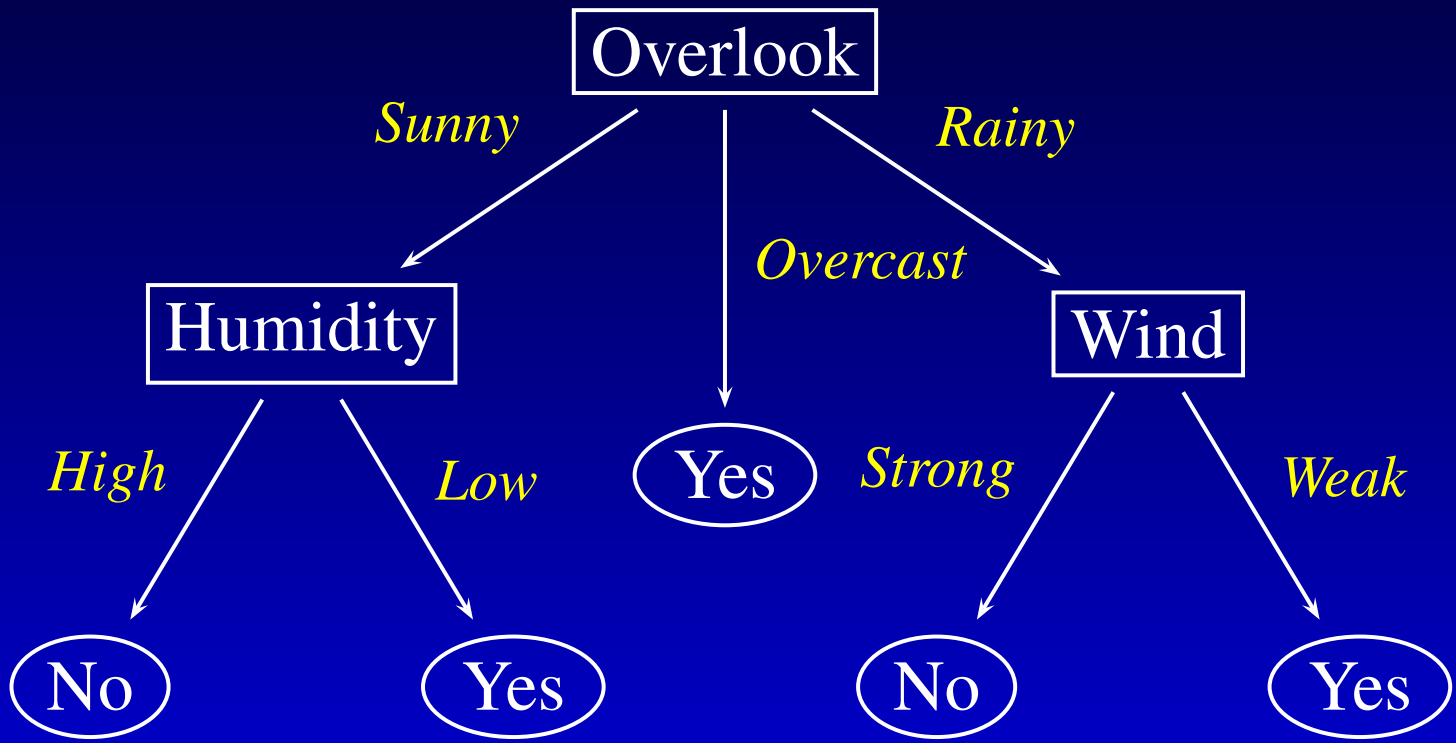

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$\Delta_e \cup \Delta_2 =$
$\{Overlook(Sunny), Wind(Strong), Humidity(High)\}$ is inconsistent $\Rightarrow \Delta_2$ is ruled out.

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$\Rightarrow$ *The abductive framework is at least as powerful as decision trees*

Implementation

We are testing the *Abduction framework* on decision trees obtained from *web log datasets*.

The abductive framework is automatically generated from the decision trees by a parser written in *Java*.

The abductive answers are obtained using *ACLP* (University of Cyprus) within the *Eclipse* Prolog.

`http://www.di.unipi.it/~atzori/DTAbduction`

Conclusions

- *Abductive reasoning* can be useful in the context of Classification, as a postprocessing step, for:
  - Improving effectiveness, when we deal with incomplete data and with external domain knowledge
  - Explaining results in order to get the reason of a classification
  - Answer abductive queries finding out how attribute values should be changed in order to get a different classification

Future Works

- We still need to insert abductive interpretation of decision trees into a *probabilistic* abductive framework, in order to get, for example, *support* and *confidence* of abductive answers
- Join together different data mining paradigms:
  - *Classification*, as already showed
  - *Association Rules*, as a way to automatically generate constraints from the training set
  - *Clustering*, finding similarities between rules and then, through abduction, showing the differences between rules in the same cluster