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Hypothesis Search and Inductive bias-ID3

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HYPOTHESIS SPACE SEARCH

- As with other inductive learning methods, ID3 can be characterized as searching a space of hypotheses for one that fits the training examples. The hypothesis space searched by ID3 is the set of possible decision trees
- ID3 performs a simple-to- complex, hill-climbing search through this hypothesis space, beginning with the empty tree, then considering progressively more elaborate hypotheses in search of a decision tree that correctly classifies the training data. .
- The evaluation function that guides this hill-climbing search is the information gain measure

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HYPOTHESIS SPACE SEARCH

- 1D3's hypothesis space of all decision trees is a complete space of finite discrete-valued functions, relative to the available attribute
- Because every finite discrete-valued function can be represented by some decision tree, ID3 avoids one of the major risks of methods that search incomplete hypothesis spaces (such as methods that consider only conjunctive hypotheses): that the hypothesis space might not contain the target function.
- ID3 maintains only a single current hypothesis as it searches through the space of decision trees.
- By determin- ing only a single hypothesis, ID^ loses the capabilities that follow from explicitly representing all consistent hypotheses. For example, it does not have the ability to determine how many alternative decision trees are con- sistent with the available training data, or to pose new instance queries that optimally resolve among these competing hypotheses

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HYPOTHESIS SPACE SEARCH

- ID3 in its pure form performs no backtracking in its search. Once it,se- lects an attribute to test at a particular level in the tree, it never backtracks to reconsider this choice.
- ID3 uses all training examples at each step in the search to make statistically based decisions regarding how to refine its current hypothesis. This contrasts with methods that make decisions incrementally, based on individual train- ing examples (e.g., FIND-S or CANDIDATE-ELIMINATION).
- One advantage of using statistical properties of all the examples (e.g., information gain) is that the resulting search is much less sensitive to errors in individual training examples. ID3 can be easily extended to handle noisy training data by mod- ifying its t

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INDUCTIVE BIAS

- Given a collection of training examples, there are typically many decision trees consistent with these examples. Describing the inductive bias of ID3 there- fore consists of describing the basis by which it chooses one of these consis- tent hypotheses over the others.
- Which of these decision trees does ID3 choose?
- It chooses the first acceptable tree it encounters in its simple-to-complex, hill- climbing search through the space of possible trees.
- Roughly speaking, then , the ID3 search strateg
  1. selects in favor of shorter trees over longer ones
  2. selects trees that place the attributes with highest information gain closest to the root.

Approximate inductive bias of ID3: Shorter trees are preferred over larger trees

A closer approximation to the inductive bias of ID3: Shorter trees are preferred over longer trees. Trees that place high information gain attributes close to the root are preferred over those that do not.

THANK YOU

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