A Granular Computing Paradigm for Concept Learning

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Outline

- Concept learning
- Granular computing
- A model for concept learning
- Applications
What is concept learning?

- What is a concept?
  - Basic unit of human thought
  - The classical view: intension & extension

- A concept is a triplet:
  - (name, intension, extension),
  - (natural language, description, example)

(c, i(c), e(c)) or (g, i(g), e(g))

“intension” comes from logic, it indicates the internal content of a term or concept that constitutes its formal definition
The classical view of concepts

A concept

name: “dog”

descriptions of “dog”

intension:
- bites
- barks
- four legs
- loyalty
- man’s best friend

extension:
How do humans learn a concept?

- Two tasks of concept learning
  - Describe a concept by its intension
  - Derive relations between concepts

- An example:

  Intension of known concept ➔ Intension of new concept

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How do machines learn a concept?

- Learn **classification rules**
- An example:
  - Weekend=Yes and Raining=No ➔ Canoeing = Yes
  - Weekday=Yes ➔ Canoeing = No

- A classification tree:
Granular computing

- Multi-level, multi-view granular structures

- Why do we need it?
  - Construct a set of granules with meaningful structures for learning effective rules
A model for concept learning

- Main idea: Using known concepts to approximate the unknown concept

- Three basic steps:
  1. Construct a family of known concepts
  2. Construct a good partition or covering for approximation
  3. For a known concept \((c, i(c), e(c))\) and an unknown concept \((g, i(g), e(g))\), if \(e(c) \subseteq e(g)\) then \(i(c) \Rightarrow i(g)\)
How do machines learn a single concept?

An unknown concept C

Known concepts
A partition-based learning strategy

Fig. (1) Learning the unknown concept

Fig. (2) A partition with finer granules

Fig. (3) A partition with coarser granules

Fig. (4) The maximal general solution
A covering-based learning strategy

Fig. (1) Learning the unknown concept

Fig. (2) A covering with finner granules

Fig. (3) The maximal general solution
Applications

A dancing spider robot,
University of Arizona

Cancer diagnosis,
University of Wisconsin

http://hplusmagazine.com/2010/02/15/can-he-make-dancing-hexapod-robot-happy/

Reference

Questions?

Thank you

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