Concept learning

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Amir Shokri

Concept learning

FIND-S

Candidate Elimination

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FIND-S

FIND-S :: Find Maximally Specific Hypothesis

1. Initialize h to the most specific hypothesis in H
2. For each positive training instance x
    - For each attribute constraint a_i in h
        - If the constraint a_i in h is satisfied by x
        - Then do nothing
        - Else replace a_i in h by the next more general constraint that is satisfied by x
3. Output hypothesis h

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FIND-S

Example	Color	Toughness	Fungus	Appearance	Poisonous
1	Green	Soft	No	Wrinkled	Yes
2	Green	Soft	Yes	Smooth	No
3	Brown	Hard	No	Smooth	Yes
4	Green	Soft	Yes	Smooth	No
5	Orange	Soft	Yes	Wrinkled	Yes

$h_0 = < \emptyset , \emptyset , \emptyset , \emptyset >$

$h_1 = <$ green, soft, no, wrinkled $>$

FIND-S

Example	Color	Toughness	Fungus	Appearance	Poisonous
1	Green	Soft	No	Wrinkled	Yes
2	Green	Soft	Yes	Smooth	No
3	Brown	Hard	No	Smooth	Yes
4	Green	Soft	Yes	Smooth	No
5	Orange	Soft	Yes	Wrinkled	Yes

h_2 = < green, soft, no, wrinkled >

h_3 = < ?, ?, no, ? >

FIND-S

Example	Color	Toughness	Fungus	Appearance	Poisonous
1	Green	Soft	No	Wrinkled	Yes
2	Green	Soft	Yes	Smooth	No
3	Brown	Hard	No	Smooth	Yes
4	Green	Soft	Yes	Smooth	No
5	Orange	Soft	Yes	Wrinkled	Yes

h_4 = < ?, ?, no, ? >

h_5 = < ?, ?, ?, ? >

Candidate Elimination

he key idea in the CANDIDATE-ELIMINAION algorithm, is to output a description of the set of all hypotheses consistent with the training examples.

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Candidate Elimination

Example	Color	Toughness	Fungus	Appearance	Poisonous
1	Green	Soft	No	Wrinkled	Yes
2	Green	Soft	Yes	Smooth	No
3	Brown	Hard	No	Smooth	Yes
4	Green	Soft	Yes	Smooth	No
5	Orange	Soft	Yes	Wrinkled	Yes

$S_0 = < \emptyset , \emptyset , \emptyset , \emptyset >$

$G_0 = < ?, ?, ?, ? >$

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Candidate Elimination

Example	Color	Toughness	Fungus	Appearance	Poisonous
1	Green	Soft	No	Wrinkled	Yes
2	Green	Soft	Yes	Smooth	No
3	Brown	Hard	No	Smooth	Yes
4	Green	Soft	Yes	Smooth	No
5	Orange	Soft	Yes	Wrinkled	Yes

S_1 = < green, soft, no, wrinkled >

G_1 = < ?, ?, ?, ? >

Candidate Elimination

Example	Color	Toughness	Fungus	Appearance	Poisonous
1	Green	Soft	No	Wrinkled	Yes
2	Green	Soft	Yes	Smooth	No
3	Brown	Hard	No	Smooth	Yes
4	Green	Soft	Yes	Smooth	No
5	Orange	Soft	Yes	Wrinkled	Yes

S_2 = < green, soft, no, wrinkled >

G_2 = < ?, ?, no, ? > < ?, ?, ?, wrinkled>

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Candidate Elimination

Example	Color	Toughness	Fungus	Appearance	Poisonous
1	Green	Soft	No	Wrinkled	Yes
2	Green	Soft	Yes	Smooth	No
3	Brown	Hard	No	Smooth	Yes
4	Green	Soft	Yes	Smooth	No
5	Orange	Soft	Yes	Wrinkled	Yes

S_3 = < ?, ?, no, ? >

G_3 = < ?, ?, no, ? >

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Candidate Elimination

Example	Color	Toughness	Fungus	Appearance	Poisonous
1	Green	Soft	No	Wrinkled	Yes
2	Green	Soft	Yes	Smooth	No
3	Brown	Hard	No	Smooth	Yes
4	Green	Soft	Yes	Smooth	No
5	Orange	Soft	Yes	Wrinkled	Yes

S_4 = < ?, ?, no, ? >

G_4 = < ?, ?, ?, ? >

Candidate Elimination

Example	Color	Toughness	Fungus	Appearance	Poisonous
1	Green	Soft	No	Wrinkled	Yes
2	Green	Soft	Yes	Smooth	No
3	Brown	Hard	No	Smooth	Yes
4	Green	Soft	Yes	Smooth	No
5	Orange	Soft	Yes	Wrinkled	Yes

$S_5 = < ?, ?, ?, ? >$

$G_5 = < ?, ?, ?, ? >$

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Candidate Elimination

Example	Color	Toughness	Fungus	Appearance	Poisonous
1	Green	Soft	No	Wrinkled	Yes
2	Green	Soft	Yes	Smooth	No
3	Brown	Hard	No	Smooth	Yes
4	Green	Soft	Yes	Smooth	No
5	Orange	Soft	Yes	Wrinkled	Yes

h = < ?, ?, ?, ? >

Candidate Elimination

Example	Size	Color	Shape	Class/Label
1	big	red	circle	No
2	small	red	triangle	No
3	small	red	circle	Yes
4	big	blue	circle	No
5	small	blue	circle	Yes

$S_0 = < \emptyset , \emptyset , \emptyset , \emptyset >$

$G_0 = < ?, ?, ?, ? >$

Candidate Elimination

Example	Size	Color	Shape	Class/Label
1	big	red	circle	No
2	small	red	triangle	No
3	small	red	circle	Yes
4	big	blue	circle	No
5	small	blue	circle	Yes

$S_1 = < \emptyset , \emptyset , \emptyset >$

$G_1 = <$ small, ?, ?$>$ $<$?, blue, ? $>$ $<$?, ?, triangle $>$

Candidate Elimination

Example	Size	Color	Shape	Class/Label
1	big	red	circle	No
2	small	red	triangle	No
3	small	red	circle	Yes
4	big	blue	circle	No
5	small	blue	circle	Yes

S_2 = < Ø , Ø , Ø >

G_2 = ~~<small, blue, ?>~~ <small, ?, circle> <?, blue, ?>,
<big, ?, triangle> ~~<?, blue, triangle>~~

Candidate Elimination

Example	Size	Color	Shape	Class/Label
1	big	red	circle	No
2	small	red	triangle	No
3	small	red	circle	Yes
4	big	blue	circle	No
5	small	blue	circle	Yes

S_3 = < small, red, circle >

G_3 = <small, ?, circle>

Candidate Elimination

Example	Size	Color	Shape	Class/Label
1	big	red	circle	No
2	small	red	triangle	No
3	small	red	circle	Yes
4	big	blue	circle	No
5	small	blue	circle	Yes

S_4 = < small, red, circle >

G_4 = <small, ?, circle>

Candidate Elimination

Example	Size	Color	Shape	Class/Label
1	big	red	circle	No
2	small	red	triangle	No
3	small	red	circle	Yes
4	big	blue	circle	No
5	small	blue	circle	Yes

S_5 = <small, ?, circle>

G_5 = <small, ?, circle>

References

https://stackoverflow.com/questions/22625765/candidate-elimination-algorithm/22637185

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