

Assignment 3.3

Consider the training examples on slide 21.

- Apply them in reverse order to the Find-S-Algorithm.
- Apply them in reverse order to the Candidate-Elimination-Algorithm. State the changes of S and G in each step.

Training examples in reverse order:

$x_4 = \langle \text{Sunny} \quad \text{Warm} \quad \text{High} \quad \text{Strong} \quad \text{Cool} \quad \text{Change} \rangle +$
 $x_3 = \langle \text{Rainy} \quad \text{Cold} \quad \text{High} \quad \text{Strong} \quad \text{Warm} \quad \text{Change} \rangle -$
 $x_2 = \langle \text{Sunny} \quad \text{Warm} \quad \text{High} \quad \text{Strong} \quad \text{Warm} \quad \text{Same} \rangle +$
 $x_1 = \langle \text{Sunny} \quad \text{Warm} \quad \text{Normal} \quad \text{Strong} \quad \text{Warm} \quad \text{Same} \rangle +$

a) Find-S Algorithm:

- Initialize h to the most specific hypothesis in H
- FOR** each positive training instance x
FOR each attribute constraint a_i in h
IF 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
- OUTPUT** hypothesis h

By Find-S Algorithm:

$h_0 = \langle \emptyset, \emptyset, \emptyset, \emptyset, \emptyset, \emptyset \rangle$

$h_4 = \langle \text{Sunny} \quad \text{Warm} \quad \text{High} \quad \text{Strong} \quad \text{Cool} \quad \text{Change} \rangle$

$h_3 = \langle \text{Sunny} \quad \text{Warm} \quad \text{High} \quad \text{Strong} \quad \text{Cool} \quad \text{Change} \rangle$

$h_2 = \langle \text{Sunny} \quad \text{Warm} \quad \text{High} \quad \text{Strong} \quad ? \quad ? \quad \rangle$

$h_1 = \langle \text{Sunny} \quad \text{Warm} \quad ? \quad \text{Strong} \quad ? \quad ? \quad \rangle$

b) Candidate-Elimination Algorithm:

Initialize G to the set of the maximally general hypotheses in H

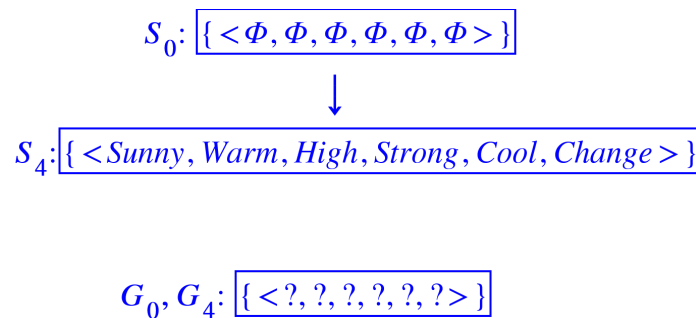
Initialize S to the set of the maximally specific hypotheses in H

For each training example, d , do

- If d is a positive example
 - Remove from G any hypothesis inconsistent with d
 - For each hypothesis s in S that is not consistent with d
 - Remove s from S
 - Add to S all minimal generalizations h of s such that
 - h is consistent with d , and some member of G is more general than h
 - Remove from S any hypothesis that is more general than another hypothesis in S
- If d is a negative example
 - Remove from S any hypothesis inconsistent with d
 - For each hypothesis g in G that is not consistent with d
 - Remove g from G
 - Add to G all minimal specializations h of g such that
 - h is consistent with d , and some member of S is more specific than h
 - Remove from G any hypothesis that is less general than another hypothesis in G

By Candidate-Elimination Algorithm:

Trace 1



Trace 2

$$S_4, S_3: \boxed{\{ \langle \text{Sunny}, \text{Warm}, \text{High}, \text{Strong}, \text{Cool}, \text{Change} \rangle \}}$$

$$G_3: \boxed{\{ \langle \text{Sunny}, ?, ?, ?, ?, ? \rangle \quad \langle ?, \text{Warm}, ?, ?, ?, ? \rangle \quad \langle ?, ?, ?, ?, \text{Cool}, ? \rangle \}}$$

$$G_4: \boxed{\{ \langle ?, ?, ?, ?, ?, ? \rangle \}}$$
Trace 3

$$S_3: \boxed{\{ \langle \text{Sunny}, \text{Warm}, \text{High}, \text{Strong}, \text{Cool}, \text{Change} \rangle \}}$$

$$\downarrow$$

$$S_2: \boxed{\{ \langle \text{Sunny}, \text{Warm}, \text{High}, \text{Strong}, ?, ? \rangle \}}$$

$$G_2: \boxed{\{ \langle \text{Sunny}, ?, ?, ?, ?, ? \rangle \quad \langle ?, \text{Warm}, ?, ?, ?, ? \rangle \}}$$

$$\uparrow$$

$$G_3: \boxed{\{ \langle \text{Sunny}, ?, ?, ?, ?, ? \rangle \quad \langle ?, \text{Warm}, ?, ?, ?, ? \rangle \quad \langle ?, ?, ?, ?, \text{Cool}, ? \rangle \}}$$
Trace 4

$$S_1: \boxed{\{ \langle \text{Sunny}, \text{Warm}, ?, \text{Strong}, ?, ? \rangle \}}$$

$$\nearrow \quad \uparrow \quad \nwarrow$$

$$\langle \text{Sunny}, ?, ?, \text{Strong}, ?, ? \rangle \quad \langle \text{Sunny}, \text{Warm}, ?, ?, ?, ? \rangle \quad \langle ?, \text{Warm}, ?, \text{Strong}, ?, ? \rangle$$

$$\nwarrow \quad \nearrow \quad \nwarrow \quad \nearrow$$

$$G_1: \boxed{\{ \langle \text{Sunny}, ?, ?, ?, ?, ? \rangle \quad \langle ?, \text{Warm}, ?, ?, ?, ? \rangle \}}$$