Assignment 3.3

Consider the training examples on slide 21.

a) Apply them in reverse order to the Find-S-Algorithm.

b) 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 = <Sunny Warm High Strong Cool Change> +
x_3 = <Rainy Cold High Strong Warm Change> -
x_2 = <Sunny Warm High Strong Warm Same> +
x_1 = <Sunny Warm Normal Strong Warm Same> +

a) **Find-S Algorithm:**

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 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*

By Find-S Algorithm:

h_0 = <∅,∅,∅ ,∅,∅,∅>

h_4 = <Sunny Warm High Strong Cool Change>

h_3 = <Sunny Warm High Strong Cool Change>

h_2 = <Sunny Warm High Strong ? ? >

h_1 = <Sunny Warm ? Strong ? ? >

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

$$S_0: \boxed{\{<\Phi, \Phi, \Phi, \Phi, \Phi, \Phi>\}}$$

$$\downarrow$$

$$S_4: \boxed{\{<Sunny, Warm, High, Strong, Cool, Change>\}}$$

$$G_0, G_4: \boxed{\{<?, ?, ?, ?, ?, ?>\}}$$

Trace 2

$$S_4, S_3: \boxed{\{<Sunny, Warm, High, Strong, Cool, Change>\}}$$

$$G_3: \boxed{\{<Sunny, ?, ?, ?, ?, ?> \; <?, Warm, ?, ?, ?, ?> \; <?, ?, ?, ?, Cool, ?>\}}$$

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

$$G_4: \boxed{\{<?, ?, ?, ?, ?, ?>\}}$$

Trace 3

$$S_3: \boxed{\{<Sunny, Warm, High, Strong, Cool, Change>\}}$$

$$\downarrow$$

$$S_2: \boxed{\{<Sunny, Warm, High, Strong, ?, ?>\}}$$

$$G_2: \boxed{\{<Sunny, ?, ?, ?, ?, ?> \; <?, Warm, ?, ?, ?, ?>\}}$$

$$\uparrow$$

$$G_3: \boxed{\{<Sunny, ?, ?, ?, ?, ?> \; <?, Warm, ?, ?, ?, ?> \; <?, ?, ?, ?, Cool, ?>\}}$$

Trace 4

$$S_1: \boxed{\{<Sunny, Warm, ?, Strong, ?, ?>\}}$$

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

$$<Sunny, ?, ?, Strong, ?, ?> \quad <Sunny, Warm, ?, ?, ?, ?> \quad <?, Warm, ?, Strong, ?, ?>$$

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

$$G_1: \boxed{\{<Sunny, ?, ?, ?, ?, ?> \; <?, Warm, ?, ?, ?, ?>\}}$$