Version Space Problem 1

Reference: E. Rich, K. Knight, "Artificial Intelligence", McGraw Hill, Second Edition.
http://www.cc.gatech.edu/classes/cs3361_97_winter/learning.txt

Problem 1:

Learning the concept of "Japanese Economy Car"

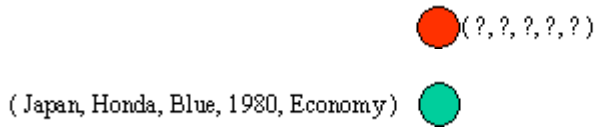
Features: (Country of Origin, Manufacturer, Color, Decade, Type)

Origin	*Manufacturer*	*Color*	*Decade*	*Type*	*Example Type*
Japan	Honda	Blue	1980	Economy	Positive
Japan	Toyota	Green	1970	Sports	Negative
Japan	Toyota	Blue	1990	Economy	Positive
USA	Chrysler	Red	1980	Economy	Negative
Japan	Honda	White	1980	Economy	Positive

Solution:

1. **Positive Example**: (Japan, Honda, Blue, 1980, Economy)

Initialize G to a singleton set that includes everything. Initialize S to a singleton set that includes the first positive example.	G = { (?, ?, ?, ?, ?) } S = { (Japan, Honda, Blue, 1980, Economy) }

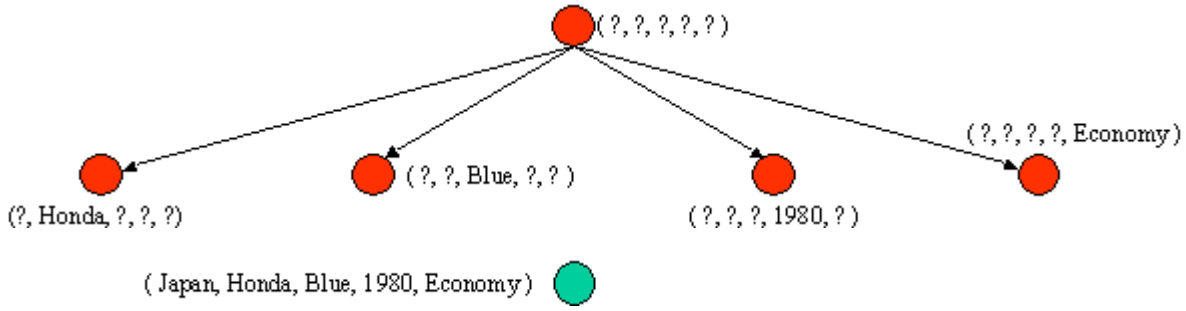


These models represent the most general and the most specific heuristics one might learn.
The actual heuristic to be learned, "Japanese Economy Car", probably lies between them somewhere within the version space.

2. **Negative Example**: (Japan, Toyota, Green, 1970, Sports)

Specialize G to exclude the negative example.

G =	{ (?, Honda, ?, ?, ?), (?, ?, Blue, ?, ?), (?, ?, ?, 1980, ?), (?, ?, ?, ?, Economy) }
S =	{ (Japan, Honda, Blue, 1980, Economy) }

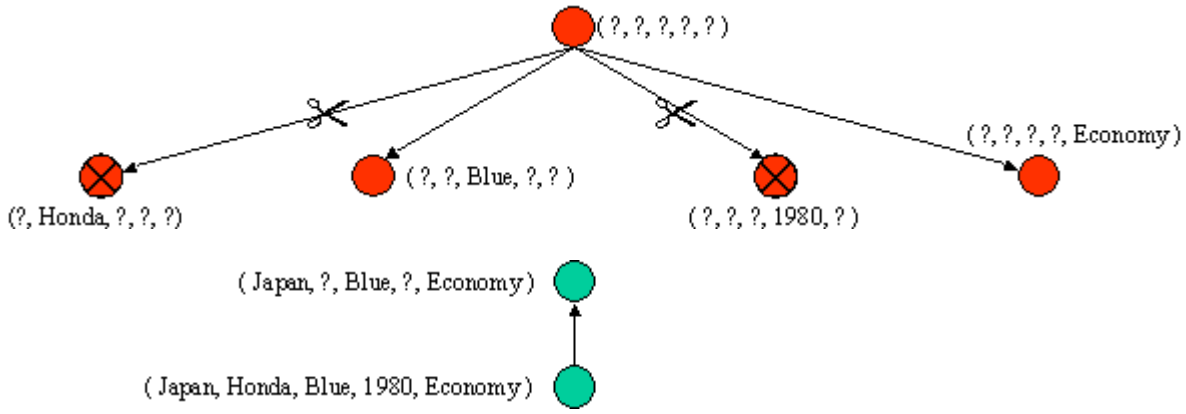


Refinement occurs by generalizing S or specializing G, until the heuristic hopefully converges to one that works well.

3. **Positive Example**: (Japan, Toyota, Blue, 1990, Economy)

Prune G to exclude descriptions inconsistent with the positive example. (Prune = ✂)
Generalize S to include the positive example.

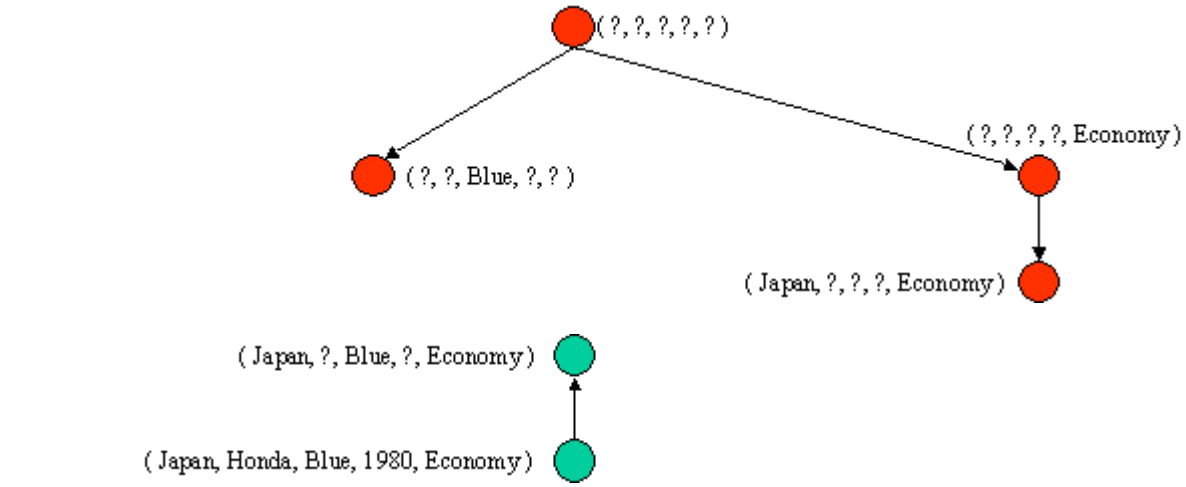
G =	{ (?, ?, Blue, ?, ?), (?, ?, ?, ?, Economy) }
S =	{ (Japan, ?, Blue, ?, Economy) }



4. **Negative Example**: (USA, Chrysler, Red, 1980, Economy)

Specialize G to exclude the negative example (but stay consistent with S)

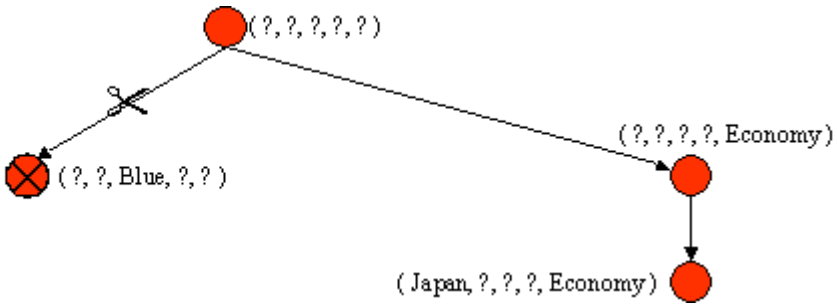
G =	{ (?, ?, Blue, ?, ?), (Japan, ?, ?, ?, Economy) }
S =	{ (Japan, ?, Blue, ?, Economy) }

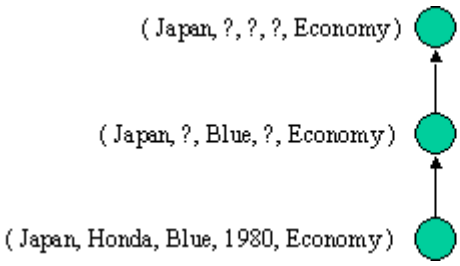


5. **Positive Example**: (Japan, Honda, White, 1980, Economy)

Prune G to exclude descriptions inconsistent with positive example.
Generalize S to include positive example.

G = { (Japan, ?, ?, ?, Economy) }
S = { (Japan, ?, ?, ?, Economy) }





G and S are singleton sets and S = G.
Converged.
No more data, so algorithm stops.