Concept Learning پاسخ تکلیف مبحث

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1 Consider the instance space consisting of integer points in the x , y plane and the set of hypotheses H consisting of rectangles.

More precisely,

hypotheses are of the form $a \leq x \leq b$, $c \leq y \leq d$, where $a, b, c,$ and d can be any integers.

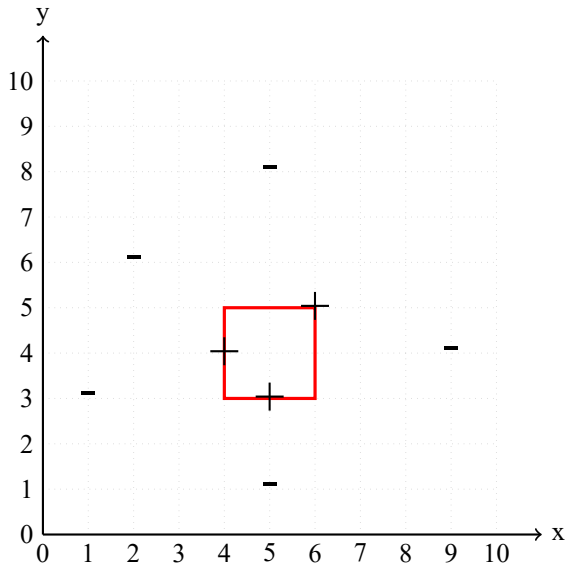
1.1 Consider the version space with respect to the set of positive (+) and negative (−) training examples shown below. What is the S boundary of the version space in this case? Write out the hypotheses and draw them in on the diagram.

Answer:

$$S = \{h\}$$

$$h : 4 \leq x \leq 6 \ , \ 3 \leq y \leq 5$$

The *red* rectangle is the S boundary :



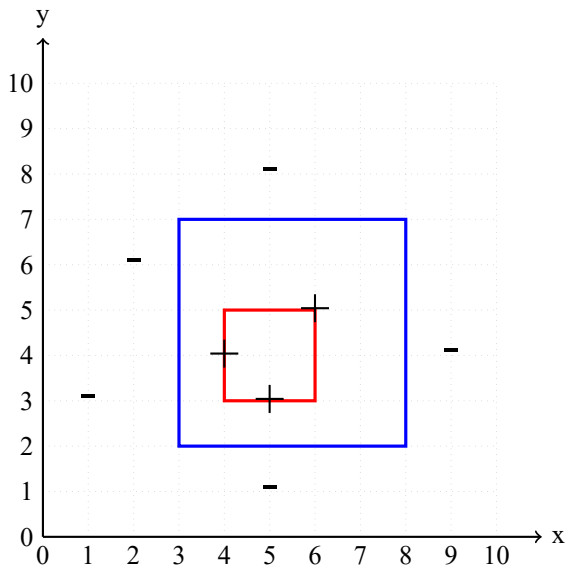
1.2 What is the G boundary of this version space? Write out the hypotheses and draw them in.

Answer:

$$G = \{h\}$$

$$h : 3 \leq x \leq 8 \ , \ 2 \leq y \leq 7$$

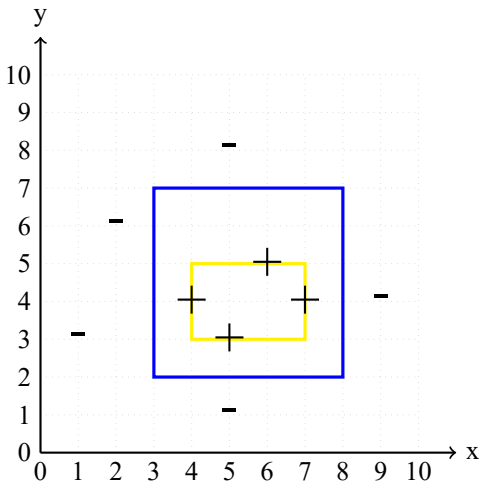
The *blue* rectangle is the G boundary :



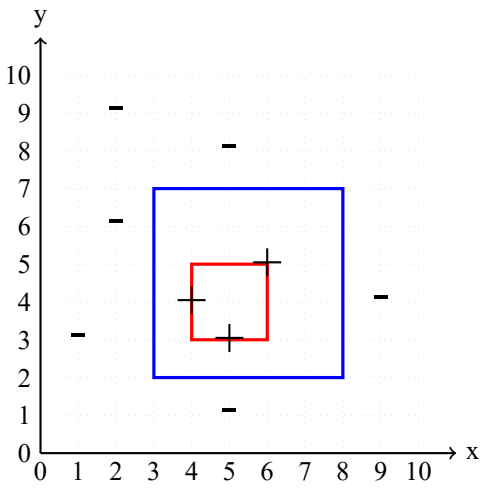
1.3 Suppose the learner may now suggest a new x , y instance and ask the trainer for its classification. Suggest a query guaranteed to reduce the size of the version space, regardless of how the trainer classifies it. Suggest one that will not.

Answer:

If $P = (7, 4)$ and $+$, then the S boundary will get larger and thus, the size of the version space will get smaller.



If point P is located outside G boundary and is $-$ (or is $+$ and inside the S boundary), it will not cause any changes to the size of the version space. e.g. $P = (2, 9)$



1.4 Now assume you are a teacher, attempting to teach a particular target concept (e.g.,

$$3 \leq x \leq 5, 2 \leq y \leq 9$$

). What is the smallest number of training examples you can provide so that the CANDIDATE-ELIMINATION algorithm will perfectly learn the target concept?

Answer:

I believe we need minimally 6 instances, 2 positive and 4 negative examples learn any hypothesis h **perfectly**.
In order to perfectly learn any hypothesis in this space:

$$\text{Version Space} = \{h\}$$

and for this to happen, G must be equal to S:

$$G = S$$