

Assignment 6 - Vinodh Kumar Sunkara, Yahoo Inc.

Problem: Given images of a street, AI agent has to blur the faces and license plates from the imagery. This is a feature of google maps and street view. Members of the public also regularly contribute images of exterior and interior locations to Google Maps. This content is collected and owned by these individual contributors. We don't want to blur these images but we want to blur only images owned by the Google. I'm designing an AI agent for this purpose which uses the concept of "Learning by Correcting Mistakes".

Background: Google developed own algorithms in-house for this purpose. They first built a training data set from thousands of faces from different cities. Google's detector used a primary high-recall sliding window detector and a secondary high-precision low sensitivity detector. They combine results into secondary stages where the scores are assigned and faces identified. For license plates, they use similar technique after dividing EU and US plates. I'll explore license plate detection as part of this assignment using a simple AI agent that uses the concept of "Learning by Correcting Mistakes".

Learning by Correcting Mistakes:

When an agent reaches a decision and decision turns out to be incorrect or sub-optimal, it finds the reason for mistake and corrects it's own knowlege/reasoning so that same mistake is never made. In our problem statement, if agent detects some non-license plate object as a license plate and based on feedback, it revisits the knowledge/reasoning and corrects it. We use explanation-based learning to represent the knowledge, isolate the mistakes, explain the mistakes and correct the explanation appropriately to fix them.

Knowledge Concepts

An AI agent should have prior knowledge of a few concepts to build explanation for detecting a license plate that's supposed to be blurred. We can blur only license plates from images that are owned by Google. So, we need concepts to know what a google's possession is, what a license plate is, and also what image snippets are dimmable/able to be blurred.

Google's possession

Google's possession is marked by a "Google Maps" or "Street View" attribution icon.

A License Plate

License plate is a rectangular region with predominantly white and black colors. License plate should be dimmable. License plates have stickers attached sometimes.

Dimmable Piece

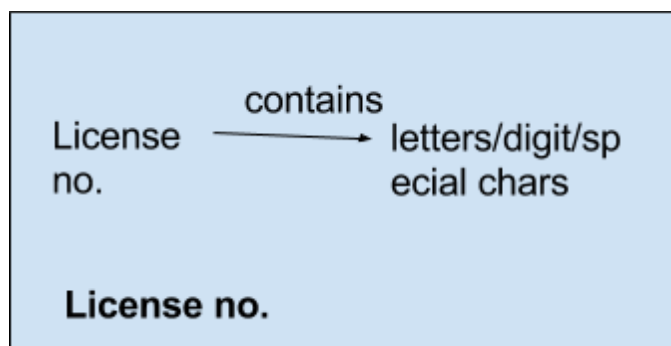
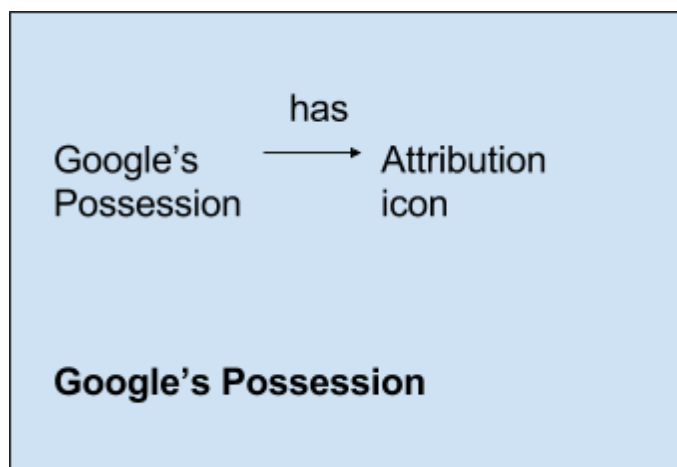
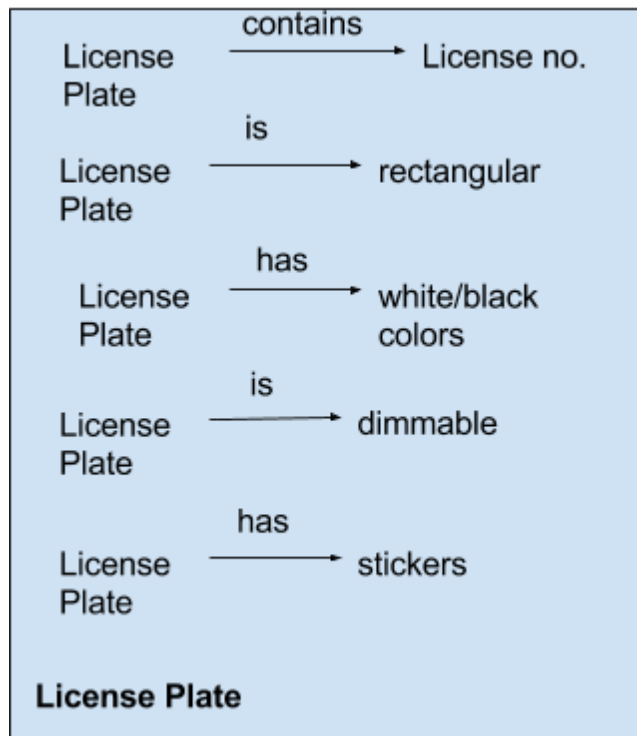
Any portion of image which is Google's possession is dimmable. It can be blurred to save privacy of people.

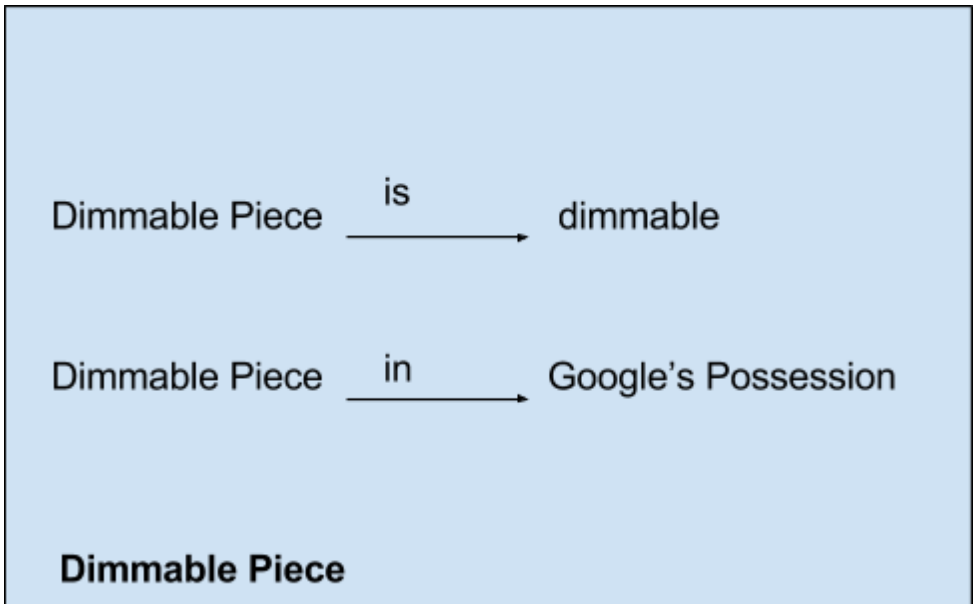
License no.

Contains a string of letters or digits or special characters

Knowledge Representations

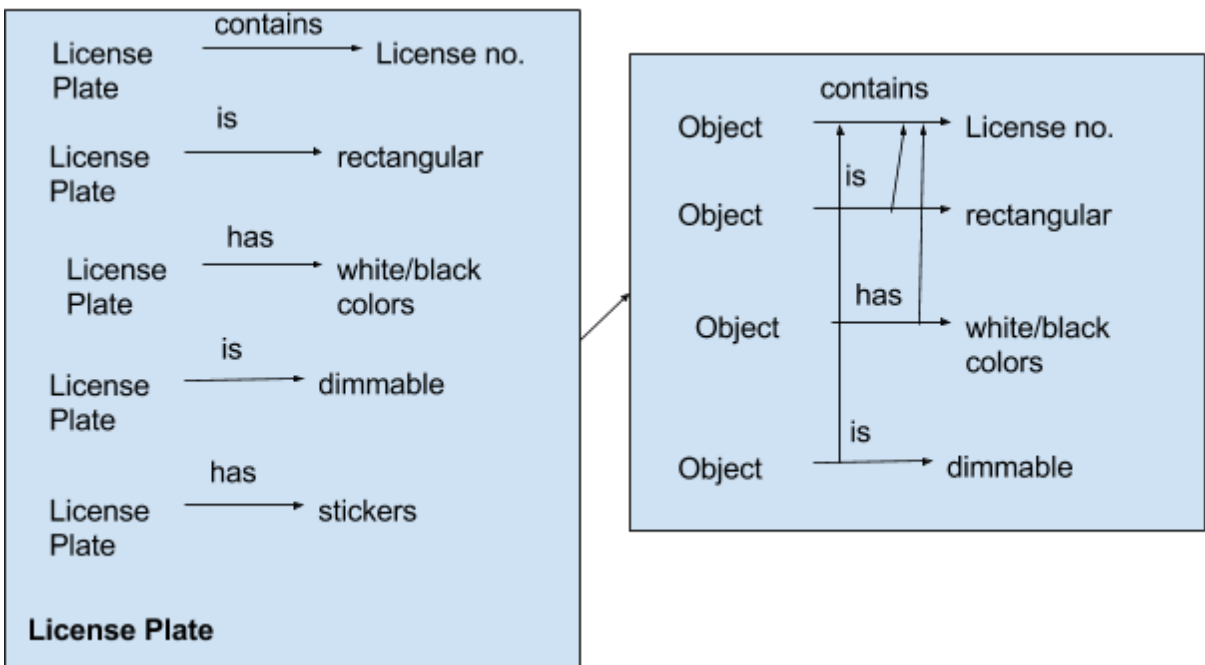
From above concepts, we can have the knowledge representations as follows before we detect the license plate to blur.

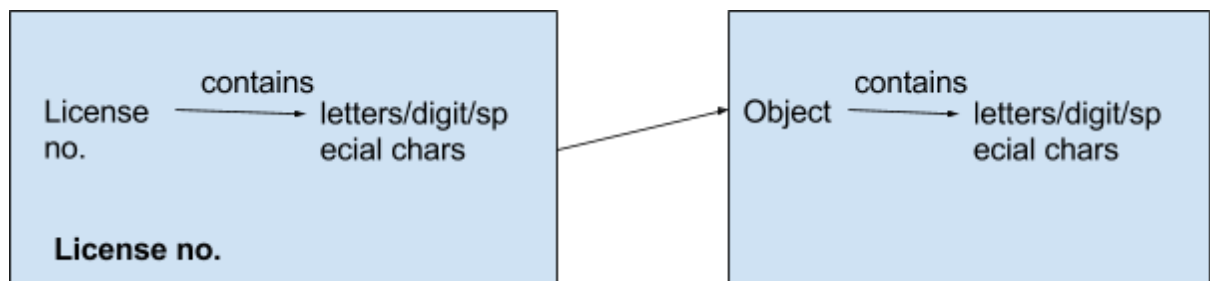
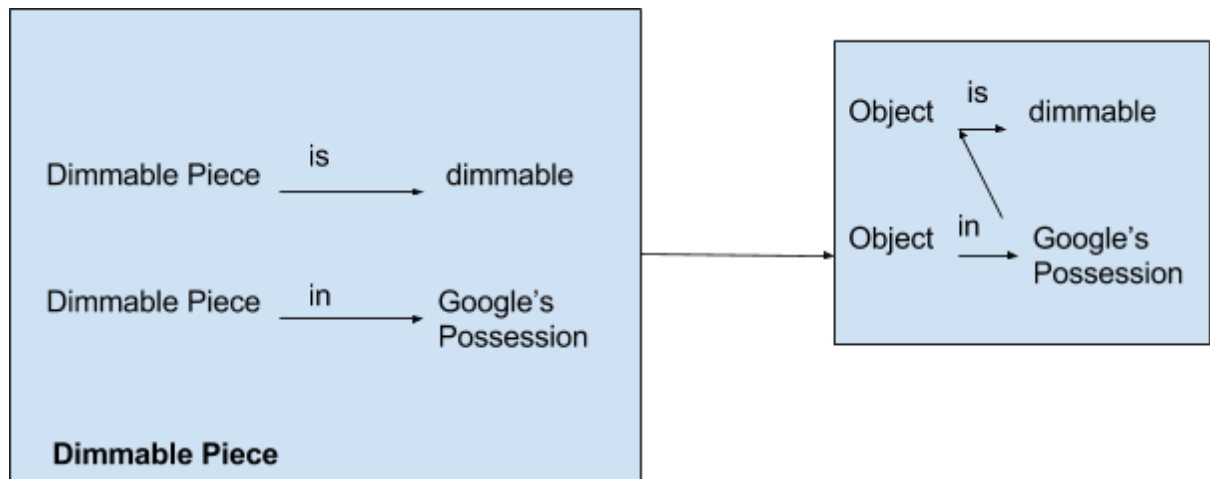
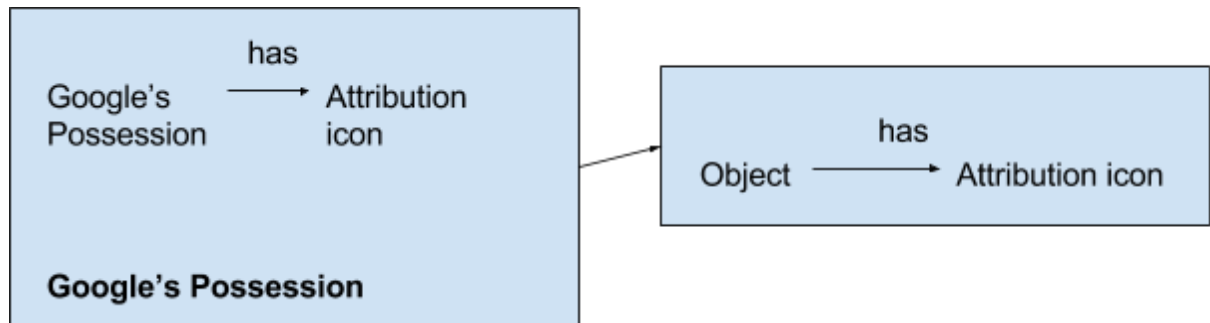




Knowledge Abstraction

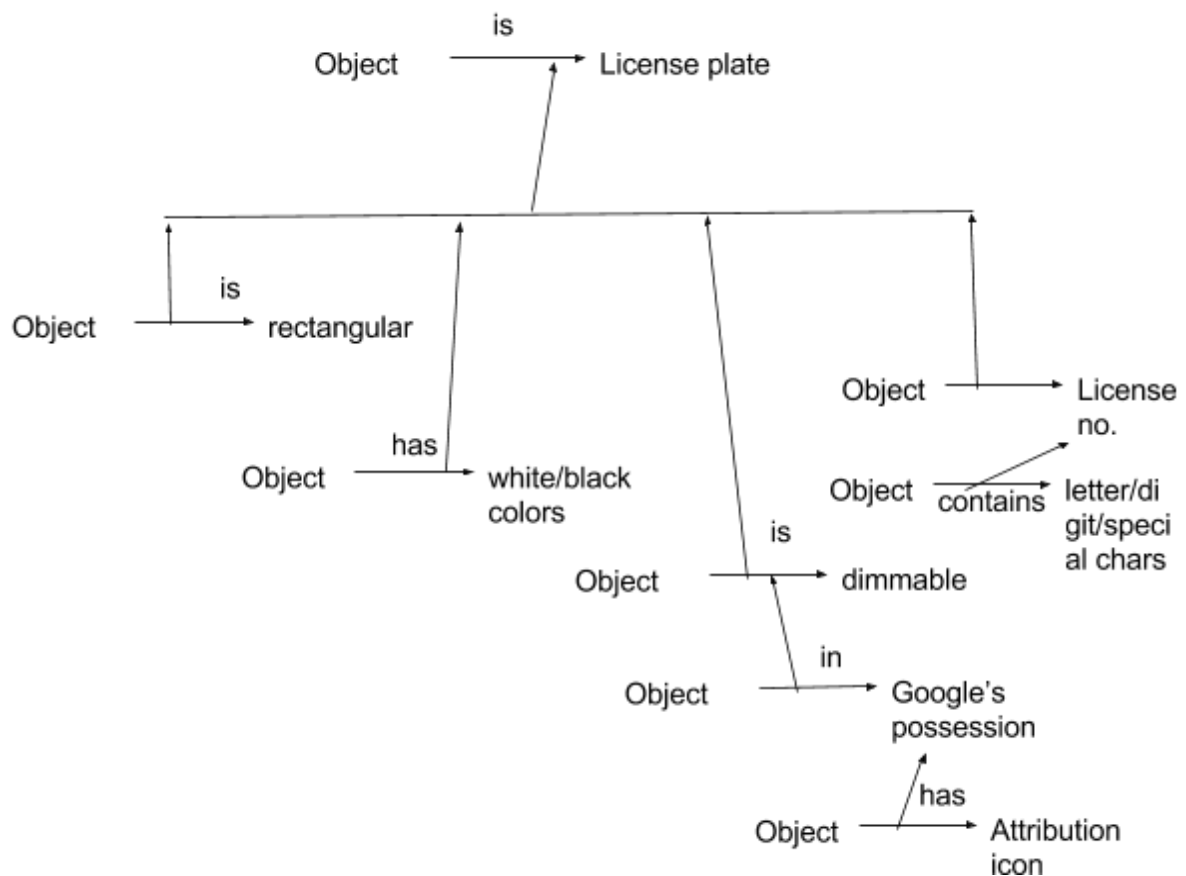
The AI agent will abstract some knowledge from the above knowledge representations of "License Plate", "Google's Possession", "License no." and "Dimmable Piece". Only the causality related knowledge is abstracted out leaving behind the simple things. The abstracted knowledge representations are as follows:





Explanation

AI agents constructs the explanation from the above abstractions as follows:

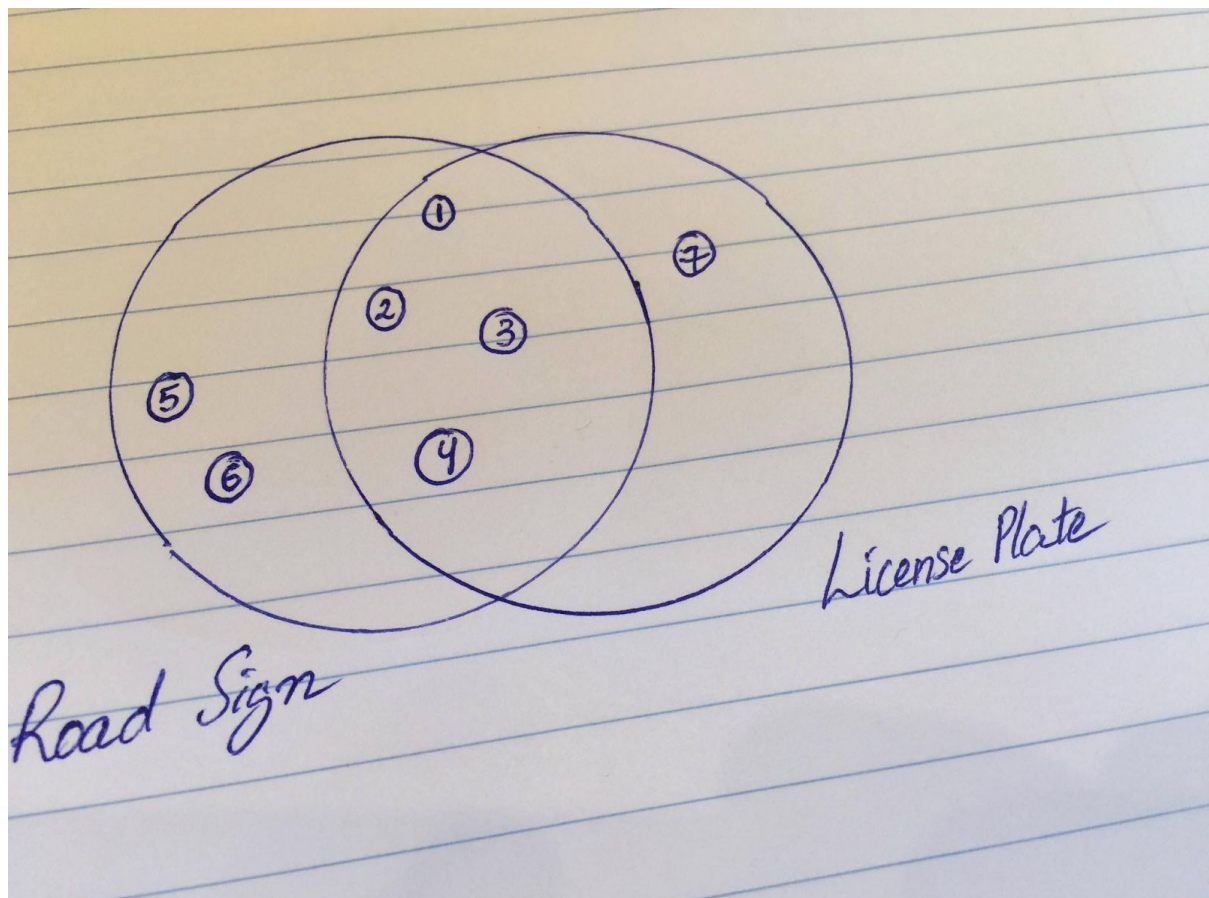


Detect Mistakes - Correct Explanation

Using the above explanation, agent detects the license plates out of images. When it operates on an image that's google's property, car license plate and a road sign are detected as license plates. Below is the image agent operated upon:



All the features of license plate and road sign are same as per above explanation. Below is the pie representation of actual features in both of them.



There are some common features between road sign and license plate. Few features are independent to both. The numbers in figure correspond to following features:

Common features between road sign and license plate:

1. Is Rectangular
2. Contains License no.
3. Is Dimmable (Piece of google's possession - image)
4. Has white/black colors

Features only in road sign:

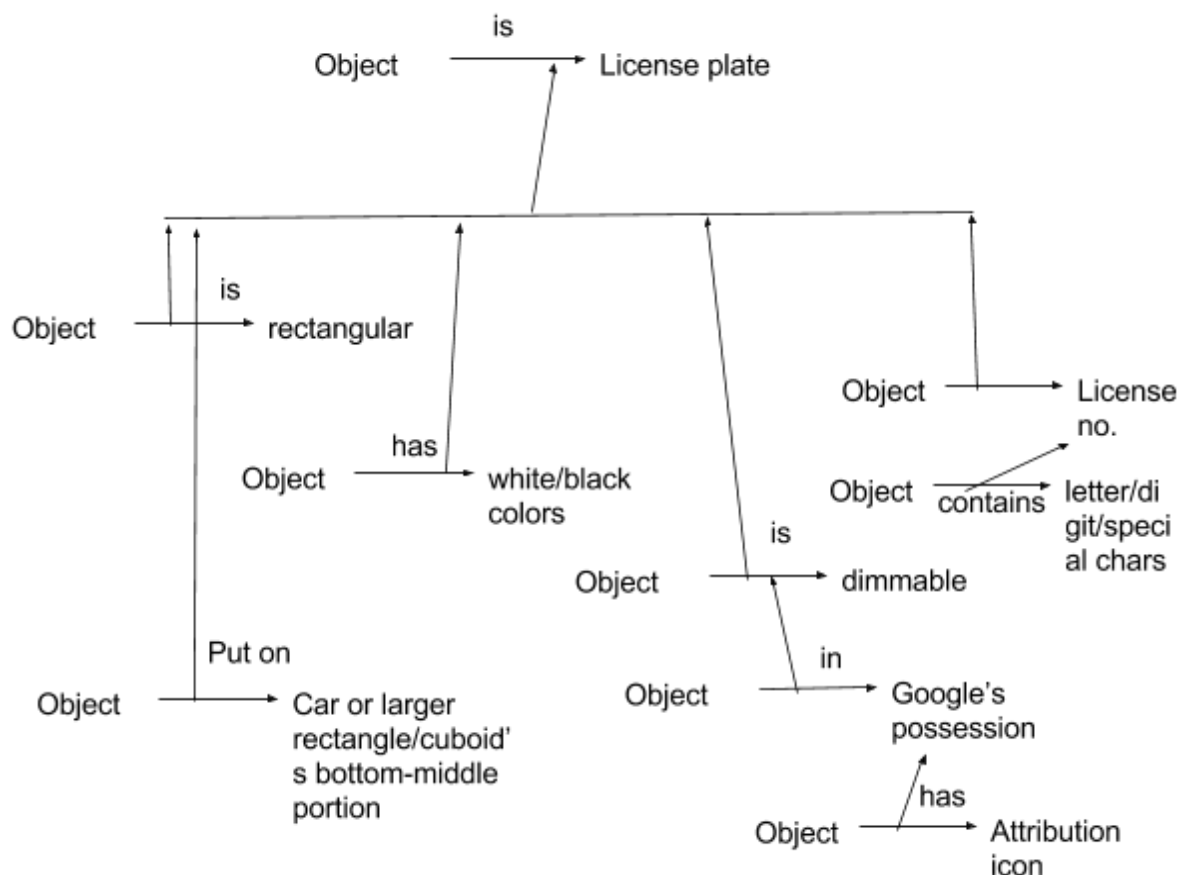
5. Put to a pole
6. Put around road edge

Features only in license plate:

7. Put on a car bottom-middle

We can correct this mistake by extending our explanation to omit the road sign. We will add the feature 7 to explanation that can omit the road sign thereby avoiding similar false positives in future. We could also extend feature 2 about license no., to have a restriction that allows only the valid license numbers and not the small strings present on road signs.

Corrected explanation is as follows:



Conclusion:

We have shown one way of correcting the mistake. We could use different other features different between license plate and road sign to rectify the mistake and extend explanation accordingly. This way we avoid repeating same mistakes again in agent operation. However, this is a very naive sample to solve this problem using the concept of "Learning by Correcting Mistakes". Google in real should have much advanced algorithms to attain this detection with utmost accuracy.