

MACHINE LEARNING FOR COMPUTER ENGINEERING

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Chapter 1

Introduction

This book intends to be a resource to be used for studying and researching of machine learning in computation, particularly in computer engineering. It is directed into developing and explaining computer code, and mathematics operations necessary for those who wish to enhance their abilities on this field. It is oriented as well for image recognizing and classification, although it studies algorithms that can be generically useful on other machine learning recognition or classification. The code part here is not directed to be used in projects out of the box, but rather to produce a trail map to understand and to master the development from the basis. The motivation comes from my work as an assistant professor for the Computer Engineering graduation at Universidade Severino Sombra (USS), located in Vassouras, Rio de Janeiro. The code will be build on JAVA, the language mostly adopted on the before mentioned course.

1.1 Some concepts about machine learning

Machine learning, also called automatic learning, according to Arthur Samuel in 1959, gives computers the ability to learn without being explicitly programmed[1].

Andrew NG seems to rather saying: ...without being *apparently* explicitly programmed[2, 3].

Take a little child, for example. One points objects to them, and says things like: - “Look, a dog!”, and then, - “There, a car!”, and so on. A little while further, the child begins to mention the objects when they see them. The child

learned the name of the objects and is able to classify the objects to a certain extent.

Some aspects of the learning process must be observed:

- One just shows the object and labels it.
- No particular characteristics of the object must be taught (a car has wheels, a dog has eyes and mouth, ...).
- The child is able to recognize up to some extent different objects of the same class (several branches of cars, with different color, size and shape, several kinds of dogs, races are pretty different).

Computer codes are sets of instructions. The instructions are very strict, they are operations applied on numerical data, like, - "add those and put it there", - "compare those and decide what to do based on the result", - "repeat this operations until ...", and so on. It is an easy task to teach to a child how to recognize a car, one just points and label. But maybe it is not so easy to teach a computer to do the same thing expressing specific computer language instructions. This will be discussed in a more profound way further in our classes. One can try to express properties of a car components that can leads to its correct recognition, like, it must have wheels, a shape of some form ... just thinking about it will show how hard this task is. Maybe we can say we know to recognize a car, but, we don't know how we do it. Some outbreak brain functioning theories states that our brains have specialized areas to process stuff, and several of this areas are out of the conscious parts of our brains. So, we can do it (by receiving in our sentient part of the brain results of processing done in the unconscious part of our brains), but we don't know how we do it.

Computer scientists have try to take several approaches to perform object recognition, in the most general field of artificial intelligence. There has been some success in characteristics segmentation, but with poor generalization effects. There is where automatic learning has recently deserving special efforts, and has given some promising results. We will see that a recognition algorithm does it works by automatically selecting some characteristics, but, as they evolve, we have no idea what characteristics it is selecting. (Usually, a huge amount, and also, a huge blend of them, not necessarily something as evident as wheels, corners and wind shields).

1.2 About object parts

- “WE HEAR ABOUT SHARKS ATTACKING HUMANS BY MISTAKEN THEM FOR SEALS. SO, YOU ARE USING YOUR BLACK DIVING SUIT, AND A SHARKS CLASSIFIES YOU AS A, NO OFFENSE, SEAL?”

We mentioned before that machine learning code can perform their task without previous definition of the characteristics, or parts of the object will be accounted for recognizance and classification. But it is obvious that we recognize objects, like cars and dogs, by their characteristics. What is not obvious is what are the better characteristics that will enhance our chances of success.

Bibliography

- [1] Wikipedia, Machine Learning, https://en.wikipedia.org/wiki/Machine_learning, visited in April 15, 2017
- [2] Coursera, <https://pt.coursera.org/learn/machine-learning>, visited in April 14, 2017
- [3] Andrew NG, <http://www.andrewnng.org/>, visited in April 14, 2017