Proof of Concept: Scenic Route Application

# Proposition

Is it possible to make a sports application designed primarily for running or perhaps cycling which can create a sort of scenic route based on a user’s interests with the help of Machine Learning algorithms.

# Why?

Traditionally when we talk about distance we think about GPS or GIS to calculate the most optimal or fastest route for us. But what if we actually don’t want the fastest route but actually want to see some countryside, some monuments or other POI’s. Well this is where machine learning comes in.

# Machine Learning Summary

Since I had no prior knowledge of AI (learning) algorithms before I took on this challenge, I had to spend a lot of time researching about machine learning and how it could be applied properly to create such a scenic route.

When I started my research, I was surprised as to how deeply integrated machine learning was in our society. You can find it in our emailing applications to filter out spam, there’s self-driving cars and also all the algorithms Google and co use to determine a user’s interest to display ads and whatnot based on clicks, search results, etc.

Generally machine learning revolves around making predictions with the help of data, be it big chunks or small chunks, obviously the more data the more accurate but the process will take longer. Data basically goes through algorithm which analyses the data and produces and further trains a set model based on all the data entered. It’s different than the traditional way of programming where we give strict and static programming instructions to our systems with all the if and while loops.

In machine learning there’s two types of techniques: supervised and unsupervised learning. Supervised learning is the technique where we enter data with a value (and certain features) we know we want our model to be able to predict as opposed to unsupervised learning where we want to find clusters of data which are alike. Machine learning always uses the same workflow: first it is important to ask yourself the correct question, second thing you need is data, third you’re going to have to select the algorithm suited for your use case, fourth you will have a training model that came out of the data analysis with the help of the algorithm and lastly you will have to test your model with additional data and enhance the model where needed.

# How?

I’m sure there’s different ways and solutions to go about this, since I’m only a beginner I’ll give my take on it based on a week’s research.

Say we needed to make such a scenic route between two locations on Google Maps. As always with machine learning we need data, the first question to ask is of course what kind of data we need and how accurate we want our model to be. In machine learning you have certain algorithms that can recognize patterns in images which is what we will use here. Since we will make a scenic route we need a lot of images but prior to that we probably want a trained model beforehand collecting images so we already have some kind of prediction. Reason why we’d need a model beforehand is because we need a way to know what kind of image we’re looking at so we can link or connect it to POI’s (images in this sense) between the two locations. When we process and classify these images we could for example label them with numbers: 1 for coastal images, 2 for forest images, 3 for cultural buildings and so on. We can link the user interest or input, dependant on how we will determine what the user wants to do or likes, to the images that were classified from our POI’s on the map between the two locations.

So our first step is to find out how to get images from in between two locations, there’s a couple ways to do this: one of them would be to start scraping Google Streetview which is possible because each image has a panorama id attached to it which we can use for labeling, second is to get info from POI’s on Google Maps in a certain radius, again dependant on how accurate we want our app to be (maybe based on user input) which again we can use for labeling and lastly we can scrape data from external websites like Instagram, Tripadvisor and Flickr.

Before we start gathering the images, we need to determine how we will setup this ‘scenic’ route: how long does the user want his trip to be (so we can calculate the radius to search POI’s in) and what kind of POI’s does the user prefer (countryside, sea, cultural buildings, etc). Just so our scraper/crawler (depending on how we want to fetch our images) can get to work and get all the images for us.

Then when we have gathered our images we can proceed to let our machine learning algorithm analyze it, in this case it will be a recognition algorithm that will inspect the pixels of the images. Once our images have been labeled with the help of our standard model we can use the user input/preferences to let an artificial neural network (ANN) determine what POI’s the user will like. When we know which images the user likes it just becomes a matter of calculating the most optimal route between a few of the top POI’s (depending on how long the user wants the trip to be etc.) which we call the travelling salesman problem.

We could solve this by simply bruteforcing through every possibility, but this is obviously ludicrous for your performance etc. There is an algorithm in machine learning called genetic algorithm which will be great for finding an almost perfect route in a short amount of time. The way the route is calculated is by taking a random route at first and then continuously comparing it with other solutions of the route through applying two techniques that genetic algorithms use: crossover and mutation, a crossover is basically a reordering or a recombination of two sets of information by breaking each set down in 2 or more segments and interchanging these segments between the two with the restriction of not duplicating prior sets of information and mutation is the technique where after a crossover you will change single bits of data to a different value to have more possibilities to check for. We could simply use Google Maps to calculate the most optimal route between a set amount of points (10 is the max) but as curious as we are, I wanted to dig into it myself.

When the neural network has figured out what images are interesting to the user we can start adding markers on Google Maps and mold them into a route which basically concludes the theoretical process of this Proof of Concept.

# Sources

<https://www.pluralsight.com/>

<https://www.udemy.com/>

<http://www.digitaleng.news/de/supervised-machine-learning/>

<https://blog.everlaw.com/2015/08/06/cabs-and-machine-learning/>

<https://www.forbes.com/sites/bernardmarr/2016/12/08/what-is-the-difference-between-deep-learning-machine-learning-and-ai/#5954b75326cf>

<http://machinelearningmastery.com/what-is-deep-learning/>

<http://www.randalolson.com/2015/03/08/computing-the-optimal-road-trip-across-the-u-s/>

<https://www.analyticsvidhya.com/blog/2017/04/comparison-between-deep-learning-machine-learning/>

<https://www.coursera.org/learn/machine-learning/lecture/Ujm7v/what-is-machine-learning>

<http://www.popsci.com/article/science/algorithm-maps-most-beautiful-route-where-youre-going>

<http://infolab.stanford.edu/~ullman/mmds/book.pdf>

<https://www.promptcloud.com/data-scraping-vs-data-crawling/>

<https://andrewpwheeler.wordpress.com/2015/12/28/using-python-to-grab-google-street-view-imagery/>

<https://medium.com/@ageitgey/machine-learning-is-fun-part-3-deep-learning-and-convolutional-neural-networks-f40359318721>

<https://developer.clarifai.com/quick-start/>

<https://en.wikipedia.org/wiki/Selection_(genetic_algorithm)>

<https://www.reddit.com/r/codingtrain/comments/6906pe/98_genetic_algorithm_improved_pool_selection_the/>

<https://p5js.org>

<https://stackoverflow.com/questions/20459172/what-does-the-mutation-rate-actually-refer-to-in-a-genetic-algorithm>

# Logs

**3-8/08**

* Brush up on Python (since a lot of ML is traditionally written in Python)
* Researching and compiling data about machine learning
  + How does Google calculate optimal paths?
  + Course on Pluralsight and Udemy
  + What is Machine Learning used for these days?
  + Supervised vs unsupervised learning
  + What is Deep Learning
* Data-Scraping vs Data-Crawling
  + What’s the difference between the two
  + When to use what
* Data-Mining

**9-11/08**

* Documenting the proposition, why did I choose it?
* What is Machine Learning?
* How will we go about this proposition (theoretically)?
* Artificial Neural Networks (ANN), what are they?
* Basic Exercises in Python about ML
* Looking into Clarifai
* How to calculate the most optimal path between a number of set points with machine learning
  + Bruteforcing?
  + Using genetic algorithms (selection/mutation/crossover) in a JS drawing example with P5.js
  + Looking more into selection, multiple pool selection and fitness functions/values
* How to process and classify images with a machine learning recognition algorithm
  + Small test in python to showcase further implementation for proposition