Indian Institute of Technology Ropar

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Flappy Bird by SVM,GAN

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Abstract

Controls of complex, multi degree of freedom systems or controls of systems with unknown dynamics have been pushing the limit of traditional control laws.This report adopts machine learning methods of Support Vector Machines(SVM) Linear, Gaussian Kernel and Neural Networks based on Genetic Algorithm using iteration value for solving control methods of 'Flappy Bird' without knowing Dynamics of System.
We have tested on various models and varying amount of difficulty of Game to Test differences ,Advantages and Disadvantages of various models. All Results and complete model Description has been discussed below.

Motivation

With the increasing popularity of autonomous vehicle, unmanned aerial vehicle, humanoid robots and etc., new methods of controlling complex system to avoid object are points of interests among control engineers. Many classical control methods are based on accurate models or concrete knowledge to derive dynamics of systems and corresponding control laws. For complicated or unknown dynamics systems, classical control methods are not very efficient and new systematic methods are needed to solve such problems. Machine learning draws much attention in last decades and is well applied in many areas such as shopping recommendation systems, computer vision, speech recognitions and etc. Applying Machine learning to solve complicated control problems is investigated in this paper.
We suppose that games are ideal environments to carry out our tests. So "FLAPPY BIRD" is chosen to discuss various machine learning algorithms
The game "Flappy Bird" is a side-scrolling mobile game, which was a very popular in early 2014. The objective is to direct a flying bird, named "Faby", which moves continuously to the right between sets of pipes. If "Faby" touches the pipes, the game ends. Each time the player taps the screen, the bird briefly flaps upwards; if the screen is not tapped, the bird falls to the ground due to gravity, which also ends the game. The game has all necessary features: a moving object and obstacles. The game itself is repetitive, hard and addictive. The goal is to achieve autonomous flying of birds travelling between pipes. When and whether to flap is determined by control methods and Machine Learning algorithms.

Related Works

There is no such research paper on this game.But many Student references project are present.Many of them are on Reinforcement learning.We have adopted different methods of learning by Decision Tree,SVM and Genetic Algorithms.

DataSet

Scenario is as follows Bird has been given an maximum upward velocity,gravity is setup for sytem and distance between

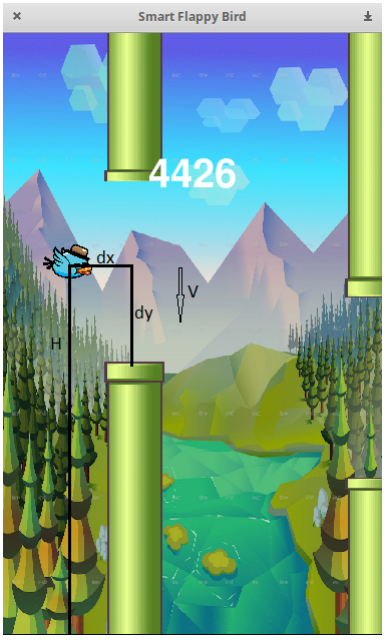

Figure 1: Features Selected

pipes are setup.Now Bird has to make decision to flap or not flap at given position to cross the barrier.
DataSet is generated by human trials and Data generated by genetic algorithm bird after it is well trained.LinearSVM and Guassian Kernel SVM are tested. Features Selected are as follows :-

- V :- Velocity of bird in downward direction.
- △x :- Distance from nearest pipe
- △y :- Vertical Distance from pipe
- △h :- Height at which bird is present

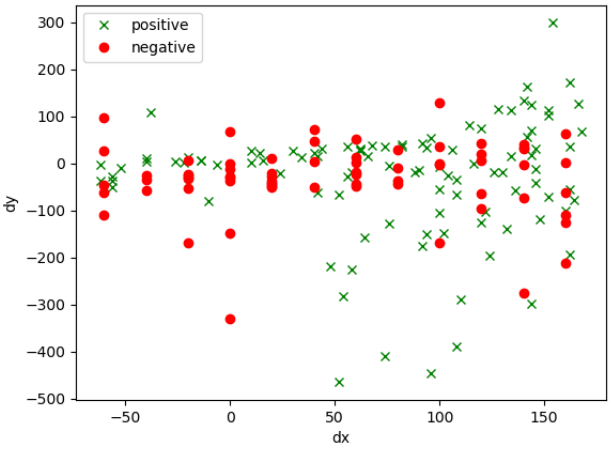

Figure 2: DataSet Representation

SVM Model

The training set of the problem is not linearly separable in the feature space of raw data. The SVM maps the input vectors into highdimensional feature space and gives the maximum margin hyper plane. SVM with a linear kernel is adopted and liblinear library[2] is used to implement SVM algorithm. The problem is constructed in the following way

$$\min_{w} \frac{\| w \|^2}{2} \tag{1}$$

s.t

$$y^{(i)}(w^T x^{(i)} + b) \geq 1 \tag{2}$$

Two Kernels have been used Linear and Guassian Kernel.We could clearly see the difference by data set as Linear kernel is not seperable. SVM requires an extensive data Set for Training. Though after increasing difficulty of game we don't get good results.

Genetic Algorithm

- This network doesn't require Data as pre-requisite it evolves its model based on previous Observations.
- This model is complete AI it trains on itself without any prior information. It computation efficient.
- Due to Randomness model is not predictable.It may converge to local minima.To avoid it we have added Mutation.
- Sometimes it takes long time to tune parameters for model to learn.

Fitness Function :-

$$Fit = TotDist - NxtPipe \quad (3)$$

It is Total Distance Travelled till now minus Distance from next pipe.We have added this penalty parameter as tuning to our model.

Selection :-

We select top 1% birds from each generation.

CrossOver :-

- We select top 1% of Toppers and apply crossover.
- We randomly select 20% times any two toppers and apply crossover.
- To rest population give mutation data of toppers.

Our Model :-

- Neural Network consists of 1 Hidden Layer of 6 nodes. 4 - Input Nodes(+1), 6 Hidden Layer Nodes(+1), 1 Output Node.
- Sigmoid is used as activation.
- Initial Population 10, No. of Generations = 100.
- Weights are assign randomly in range (-1,1)
- Threshold of 0.5

Results and Discussion :- Result is defined on Number of pipes Crossed. As per our Observations Genetic Algorithm is best we found in all cases.Even if difficulty increases by more generations we can have almost ideal model trained.

- SVM Result in best Score 1123 pipes.
- LinearSVM results in 827 pipes.
- Genetic Algorithm 4468 pipes.

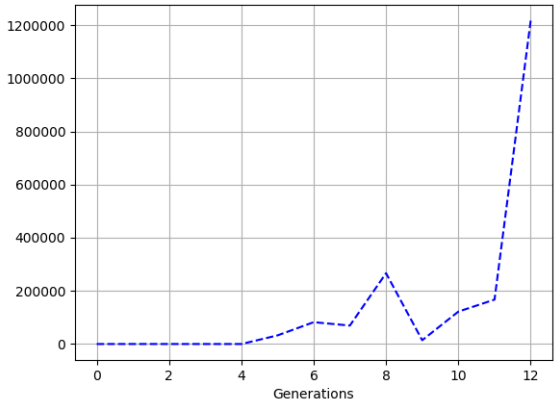

Figure 3: Fitness vs Generations

For Bad Results due to Linear SVM we know SVM needs a lot extensive

data,Any crux point loss would result in bad Score of SVM. Since Data was generated by Human and game which was very nicely trained doesn't give enough support vectors for Model to train easily.On other Hand GA gives best result due to it's randomness and Crossover methods.Sometimes it may take longer than expected for tuning of weights. Decision is not able to cross over 10 pipes it certainly not suited for high complexity classifier models.

Future Development :- We have faced some problems for all Models we studied , GA algorithm initial generations are highly random We may try to subdue this randomness for fast convergence. We may try changing Game Difficulties , choosing different parameters and study evolution of Birds in Genetic Algorithms. SVM requires very extensive dataSet. We may try to create a model which will turn as input to SVM .

Many Real life Project are based on System Control like Self-Driving Cars,Humanoid Robotics which could be studied by this algorithms.There are various different models for Flappy Bird like Reinforcement Learning, Deep Q Learning we will study this methods and their advantages and disadvantages over our Models.We may try Our Models on various Different Games like Snake Mania, Mario and explore in this Algorithms.

References :-

- Stanford Flappy Bird
- Blog on Genetic Algorithm

Complete Code of our implementation :-
https://github.com/girishkmr/flappy2

Youtube Link :- Vedio for GAN model