Using a neural network on "Coders Strike Back"

because why not

By bleuj

16 June 2016

Using a neural network on "Coders Strike Back"

By bleuj

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Gathering data from a good bot

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A light decent runner...

Supervised learning on a good runner bot using a neural network. Using a neural network on "Coders Strike Back"

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A light decent runner...

- Supervised learning on a good runner bot using a neural network.
- Constrained memory use of the neural network.

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What we try to achieve here

A light decent runner...

- Supervised learning on a good runner bot using a neural network.
- Constrained memory use of the neural network.
- ▶ Low time cost with the neural network bot (to make all of this slightly less useless).

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Given a data set of inputs and associated outputs, machine learning and statistics techniques can help to generalize a data set. Using a neural network on "Coders Strike Back"

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- Given a data set of inputs and associated outputs, machine learning and statistics techniques can help to generalize a data set.
- ► Here we will try to imitate a bot.

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- Given a data set of inputs and associated outputs, machine learning and statistics techniques can help to generalize a data set.
- ▶ Here we will try to imitate a bot.
- We must choose inputs and outputs to imitate a reference bot.

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- Given a data set of inputs and associated outputs, machine learning and statistics techniques can help to generalize a data set.
- ▶ Here we will try to imitate a bot.
- We must choose inputs and outputs to imitate a reference bot.
- ► Then the neural network will be a function to generalize the data gathered about the reference bot.

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- Given a data set of inputs and associated outputs, machine learning and statistics techniques can help to generalize a data set.
- ▶ Here we will try to imitate a bot.
- We must choose inputs and outputs to imitate a reference bot.
- ► Then the neural network will be a function to generalize the data gathered about the reference bot.
- Neural networks are one of many methods to do that.

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Main parts of the work

▶ 1 - Coding a good normal bot.

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- ▶ 1 Coding a good normal bot.
- 2 Using a simulator to generate data to learn.

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Main parts of the work

- ▶ 1 Coding a good normal bot.
- ▶ 2 Using a simulator to generate data to learn.
- ▶ 3 Learning the data on a neural network.

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- ▶ 1 Coding a good normal bot.
- ▶ 2 Using a simulator to generate data to learn.
- ▶ 3 Learning the data on a neural network.
- ▶ 4 Importing the neural network on CodinGame.

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▶ Bot that minimizes the distance to run, with a depth of 8.

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- ▶ Bot that minimizes the distance to run, with a depth of 8.
- ▶ Minimization done with simulated annealing heuristic.

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- ▶ Bot that minimizes the distance to run, with a depth of 8.
- ▶ Minimization done with simulated annealing heuristic.
- ► Extra points for reaching checkpoints early, for having some speed, and good angles at the end.

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- ▶ Bot that minimizes the distance to run, with a depth of 8.
- Minimization done with simulated annealing heuristic.
- Extra points for reaching checkpoints early, for having some speed, and good angles at the end.
- Does not care about the opponent.

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Simulating things and creating data outside of CodinGame

Simulating things and creating data outside of CodinGame

Visualization to verify your bot seems correct outside of CodinGame (I use Qt).

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Simulating things and

creating data outside of CodinGame

Simulating things and creating data outside of CodinGame

- Visualization to verify your bot seems correct outside of CodinGame (I use Qt).
- ▶ Lots of simulations are run with random checkpoint positions, random speed and angles (speed and pod angles), picked out data from there.

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Simulating things and creating data outside of CodinGame

- Visualization to verify your bot seems correct outside of CodinGame (I use Qt).
- Lots of simulations are run with random checkpoint positions, random speed and angles (speed and pod angles), picked out data from there.
- ▶ Data saved with C++ ofstream.

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► The inputs should be invariant by translation and rotation, because it doesn't restrict you, and otherwise there's useless extra difficulty to learn.

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- ► The inputs should be invariant by translation and rotation, because it doesn't restrict you, and otherwise there's useless extra difficulty to learn.
- ► The inputs must take into account at least the 2 next checkpoints.

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- ► The inputs should be invariant by translation and rotation, because it doesn't restrict you, and otherwise there's useless extra difficulty to learn.
- ► The inputs must take into account at least the 2 next checkpoints.
- Outputs are simply: chosen angle difference, and thrust choice.

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- ► The inputs should be invariant by translation and rotation, because it doesn't restrict you, and otherwise there's useless extra difficulty to learn.
- ► The inputs must take into account at least the 2 next checkpoints.
- Outputs are simply: chosen angle difference, and thrust choice.
- ▶ Normalizing everything (for example between 0 and 1) helps a lot the learning part of the Neural network.

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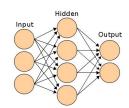
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Neural network architecture



► The function defined by a neural network is easy to understand with a picture.



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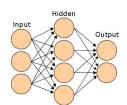
network function Neural network architecture

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Importing the neural network



- ► The function defined by a neural network is easy to understand with a picture.
- Values go from inputs to outputs as follows: when you are on an arrow you are multiplied by a weight, on a neuron the value is the sum of the values that arrive. When you leave a hidden neuron, you apply a non linear function (for example tanh).



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▶ I only use one hidden layer.

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- ▶ I only use one hidden layer.
- ▶ I use bias (neurons always equal to one).

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- ▶ I only use one hidden layer.
- ▶ I use bias (neurons always equal to one).
- ► The hidden layer is a rectified linear unit (ReLU) layer (Found its implementation on stack overflow).

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- ▶ I only use one hidden layer.
- ▶ I use bias (neurons always equal to one).
- ► The hidden layer is a rectified linear unit (ReLU) layer (Found its implementation on stack overflow).
- ▶ Data saved with C++ ofstream.

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► A neural network function relies on a lot of parameters (weights), and you have to optimize them so that it best fits a data set.

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- ► A neural network function relies on a lot of parameters (weights), and you have to optimize them so that it best fits a data set.
- It's quite tricky to optimize (back-propagation, stochastic gradient descent...), especially if you don't want to change all your code if you add a layer or something like that.

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Learning a neural

network function

- ► A neural network function relies on a lot of parameters (weights), and you have to optimize them so that it best fits a data set.
- It's quite tricky to optimize (back-propagation, stochastic gradient descent...), especially if you don't want to change all your code if you add a layer or something like that.
- There are lots of libraries to do that.

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Learning a neural

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- A neural network function relies on a lot of parameters (weights), and you have to optimize them so that it best fits a data set.
- It's quite tricky to optimize (back-propagation, stochastic gradient descent...), especially if you don't want to change all your code if you add a layer or something like that.
- There are lots of libraries to do that.
- ▶ I use PyBrain on Python (first one that worked for me).

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- ► A neural network function relies on a lot of parameters (weights), and you have to optimize them so that it best fits a data set.
- It's quite tricky to optimize (back-propagation, stochastic gradient descent...), especially if you don't want to change all your code if you add a layer or something like that.
- There are lots of libraries to do that.
- ► I use PyBrain on Python (first one that worked for me).
- ▶ It's very simple to use after reading the short tutorial on its website, but quite slow.

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- ► A neural network function relies on a lot of parameters (weights), and you have to optimize them so that it best fits a data set.
- It's quite tricky to optimize (back-propagation, stochastic gradient descent...), especially if you don't want to change all your code if you add a layer or something like that.
- There are lots of libraries to do that.
- ► I use PyBrain on Python (first one that worked for me).
- ▶ It's very simple to use after reading the short tutorial on its website, but quite slow.
- ▶ Data produced with C++ code is opened with file = open('mydata.txt','r') and file.readline().

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- ► A neural network function relies on a lot of parameters (weights), and you have to optimize them so that it best fits a data set.
- It's quite tricky to optimize (back-propagation, stochastic gradient descent...), especially if you don't want to change all your code if you add a layer or something like that.
- There are lots of libraries to do that.
- ► I use PyBrain on Python (first one that worked for me).
- ▶ It's very simple to use after reading the short tutorial on its website, but quite slow.
- Data produced with C++ code is opened with file = open('mydata.txt','r') and file.readline().
- ► Saving the weights was a little tricky with PyBrain (a post on stack-overflow helped me).

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► The functions to create the inputs of the data set are used again here.

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- ► The functions to create the inputs of the data set are used again here.
- ► Weights arrays are read from 4 very ugly 1-dimensional arrays that are created by the python code, and that are just copy-pasted every time.

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- ▶ The functions to create the inputs of the data set are used again here.
- ▶ Weights arrays are read from 4 very ugly 1-dimensional arrays that are created by the python code, and that are just copy-pasted every time.
- ▶ New arrays are something more understandable.

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- ▶ The functions to create the inputs of the data set are used again here.
- ▶ Weights arrays are read from 4 very ugly 1-dimensional arrays that are created by the python code, and that are just copy-pasted every time.
- ▶ New arrays are something more understandable.
- Carefully implemented neural network on CodinGame using the definition/architecture of the neural network.

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Now we have a bot ready to compete with others

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Checking the result

Checking the result

- Now we have a bot ready to compete with others
- ► The bot may fail to cross many checkpoints, so it can be a good idea to reduce checkpoint radius in simulation

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Checking the result

Checking the result

- Now we have a bot ready to compete with others
- ▶ The bot may fail to cross many checkpoints, so it can be a good idea to reduce checkpoint radius in simulation
- Another trick is to exaggerate thrust and angle difference given by the neural network.

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