Survival of the Fittest Genome

AI Model Development

Time: 60 mins

Introduction

In this class, the student/s will learn to set sensor points in front of the car. Student/s will also learn to get the sensor information and navigate the car accordingly. The model will be trained until the car takes a lap around the track without hitting the sides. Student/s will learn to calculate the fitness of each genome created and find the fittest genome.

New Commands Introduced

• pygame.draw.rect	Draws a rectangle on the screen
• net.activate()	The neuron fires and takes up a positive value if the output value is above a specified threshold.

Vocabulary

- **Sensor** is a device that detects and reports physical properties such as distance, temperature, etc.
- **Feedforward neural network** is the simplest kind of neural network in which the connections do not form a cycle between the nodes.

Learning Objectives

Student/s should be able to:

- ***Recall*** how to add a car to a track and control it.
- ***Demonstrate*** how to create a model that would detect the track with sensors and keep the car within the track.
- ***Evaluate and calculate*** the fitness of a genome.
- ***Explain*** the steps required to create an AI model that navigates around a given track on its own.

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Activities

1. **Class Narrative:** *(2 mins)*

    - Brief the student/s that in this class they will learn to train multiple genomes of a model. They will learn to calculate the fitness of the genome based on the time for which it survives on the track without hitting the sides.

2. **Concept Introduction Activity:** *(5 mins)*

    - Let the student/s play the explore-activity to see how the genome trains itself until it successfully makes one lap around the track.
    - Using the slides, explain that the student/s will learn:
        - to set the sensors at equal distances from each other.
        - to get the information from the sensor to detect whether the car is running on the track or not
        - to calculate the fitness of a genome

3. **Activity 1: Set Sensor Points***(14 mins)*

    Teacher Activity: *(7 mins)*

    - Demonstrate how to calculate the midpoint of the car and set one sensor in front of the car.

    Student Activity: *(7 mins)*

    - Guide the student/s to use a for loop to set multiple sensors in front of the car at equal intervals

4. **Activity 2: Get Sensor Data***(12 mins)*

    Student Activity: *(12 mins)*

    - Guide the student/s to activate the model based on the sensor information returned.

5. **Activity 3: Calculate the Fitness of a Genome***(12 mins)*

    Student Activity: *(12 mins)*

    - Explain num_inputs have to be changed from 2 to 9 since there are 9 sensor points set on the car.
    - Guide the students on how to increase the fitness of a genome by 0.2 depending upon how long the genome survives on the track.

6. **Introduce the Post class project:** *(2 min)*

    - Use the concepts learned in the class to train a genome to help the flappy bird avoid the obstacles.

7. **Test and Summarize the class learnings:** *(5 mins)*

- Check for understanding through quizzes and summarize learning after respective missions.
- Summarize the overall class learning towards the end of the class.

8. **Additional activities:**
    - Encourage the student/s to try using only output to train the genome.
    - Encourage the student/s to control the acceleration of the car..

9. **State the Next Class Objective:** *(1 min)*
    - In the next class, student/s will learn to save the best-fit genome and test the genome model with a different track.

U.S. Standards:

CSTA: 2-AP-11, 2-AP-12, 2-AP-13, 2-AP-14, 2-AP-19

Links Table		
Activity	**Activity Name**	**Link**
Class Presentation	Survival of the Fittest Genome	https://s3-whjr-curriculum-uploads.whjr.online/e1498d54-5b82-4784-be23-7dfcf7773e27.html
Explore Activity	Survival of the Fittest Genome	https://github.com/Tynker-Computer-Vision/TNK-M10-PRO-C79-SAS-BP
Teacher Activity 1	Set One Sensor Point	https://github.com/Tynker-Computer-Vision/TNK-M10-PRO-C79-TAS-BP
Teacher Reference: Teacher Activity 1 Solution	Set One Sensor Point: Solution	https://github.com/Tynker-Computer-Vision/TNK-M10-PRO-C79-TAS
Student Activity 1	Set Sensor Points	https://github.com/Tynker-Computer-Vision/TNK-M10-PRO-C79-SAS-BP
Teacher Reference: Student Activity 1 Solution	Set Sensor Points: Solution	https://github.com/Tynker-Computer-Vision/TNK-M10-PRO-C79-SAS
Student Activity 2	Get sensor data	https://github.com/Tynker-Computer-Vision/TNK-M10-PRO-C79-SAS-BP
Teacher Reference: Student Activity 2 Solution	Get sensor data: Solution	https://github.com/Tynker-Computer-Vision/TNK-M10-PRO-C79-SAS
Student Activity 3	Calculate the Fitness of a Gnome	https://github.com/Tynker-Computer-Vision/TNK-M10-PRO-C79-SAS-BP
Teacher Reference: Student	Calculate the Fitness of a Gnome:	https://github.com/Tynker-Computer-Vision/TNK-M10-PRO-C79-SAS

Activity 3 Solution	Solution	
Student's Additional Activity 1	Use Single Output	https://github.com/Tynker-Computer-Vision/TNK-M10-PRO-C79-SAS-BP
Teacher Reference: Student's Additional Activity 1 Solution	Use Single Output: Solution	https://github.com/Tynker-Computer-Vision/TNK-M10-PRO-C79-SAS
Student's Additional Activity 2	Control the acceleration of the Car	https://github.com/Tynker-Computer-Vision/TNK-M10-PRO-C79-SAS-BP
Teacher Reference: Student's Additional Activity 2 Solution	Control the acceleration of the Car: Solution	https://github.com/Tynker-Computer-Vision/TNK-M10-PRO-C79-SAS
Post Class Project	Flappy Bird	https://github.com/Tynker-Computer-Vision/TNK-M10-PRO-C79-PCP-BP
Teacher Reference: Post Class Project Solution	Flappy Bird: Solution	https://github.com/Tynker-Computer-Vision/TNK-M10-PRO-C79-PCP