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Date: 4-6/19

Course: CS-344 Artificial Intelligence

Instructor: Professor VanderLinden

Assignment: Final Project

**Project Draft #1 – Vision Statement**

**Project Domain:**

Utilize machine learning in the identification of 3d models as a type of object. Given the 3d model as numerical data stored in a file, extract feature vectors from the file and use them to train the model to predict what kind of object it is. For example, take the 3d model of a rock, insert its vertices and faces as the inputs for a neural network, and output that it has been identified as the 3d model of a rock.

Use the results of the training to classify unknown 3d models as objects of a known type. From there, implement the machine learning model as a real-time artificial intelligence system for NPC (non-player characters) in a RPG (role-playing) or MMORPG (massively online role playing game) to increase the player’s level of immersion and simulate a more realistic world.

**Framing the Problem (from Google Crash Course):**

The machine learning model should be able to correctly identify whether the 3d model is a particular type of object – rock, plant, animal, human, etc.

The ideal outcome is such that the model predicts with 90%+ accuracy the correct type of object that the 3d model corresponds to among a batch of predictions.

The success metric is that the probability value for the correct label is the highest among all object types labels (using softmax).

The model is deemed a failure if the probability value for the correct label is not the highest among all object type labels.

The output of the machine learning model will be an array of probabilities, providing confidence values in how sure the model is that the 3d model is that type of object. The values should sum to a total of 1.

The model needs to obtain the results in real-time. The results will be used to implement a NPC (non-player character) AI system in any RPG or MMORPG. This will allow the NPC’s to recognize objects in the game world and react accordingly.

**Formulating the Problem (from Google Crash Course):**

The problem is best suited to the use of a multi-class single label classification training model.

Simplifying, the training model should output for each class the probability that the 3d model belongs to that class. This process should be performed for all classes that define all possible object types.

Data:

JSON or other file format containing all the relevant data to mathematically define a 3d model.

All relevant data for the inputs can be extracted from the 3d model’s associated 3d model file.

* Inputs:
  + Input 1: Vertex Positions – the (x, y, z) coordinates defining the location of each vertex.
  + Input 2: Vertex Normals – the (x, y, z) coordinates of the vectors defining the normal of each vertex.
  + Input 3: Vertex Texture Coordinates – the (x, y, z) coordinates of the coordinates defining the mapping of a material type to each vertex.
  + Input 4: Faces – the vertices and vertex order that define each polygonal face.
  + Input 5: Material Name: the string defining the name of the material.
    - One-hot encode to define from pre-generated list of possible materials.
* Outputs:
  + Rock
  + Vehicle
  + Plant
  + Animal
  + Human
  + Other

We should initially start with:

* Input 1: Vertex Positions
* Input 2: Faces
* Input 3: Material Name

Resources:

<https://github.com/timzhang642/3D-Machine-Learning>

Links to various datasets containing 3d models.

Links to research conducted on 3D Machine Learning.