PMLDL'21. Project Proposal

Student Information

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Proposal

The idea

The project will be focused on generating 3D objects with GANs. The idea is similar to the following implementation. The biggest problem in this area of study is to generate big objects. There are two basic approaches: voxel-based models [1] and point-cloud-based models [2]. Voxel-based models focus on local features but can not work with large 3D objects. Point-cloud-based models are more efficient, but work better with global rather than local features. Thus, the more complex idea is to combine both approaches [3].

Obstacles

The main obstacle is to find a way to extract features from a 3D model [7]. Liu, Z. [7] uses VB-Net as a feature extractor. Sitzmann, V. [1] created their own feature extractor called DeepVoxels. Both of them are voxel-based, nevertheless, I hope to find something related to point cloud features extraction.

Datasets

So far, I've found two good datasets: PartNet and ShapeNet. The first one is being actively updated.

Applications

Procedural Content Generation

PCG is an actively developing research area ever since the game became popular [4, 5]. The purpose is to generate as much unique and good (this metric must be measurable) content for games, e.g., caves [6]. Terrains and other large objects are huge and hideous to generate, so the research

community is always looking for a way to overcome it. Even if it's easy to generate one cave, they must not be repeated - the players don't want to see the same cave over and over again. They must be believable, walkable through and always unique. In some games, the objects are also required to be reproducible in case the game engine will need to rerender the object.

Extensions

One possible extension of the project is to create a way to generate smooth transitions from one 3D object to another, even if they have different topology. It can be achieved if we represent the objects with voxels.

Since I am not sure I will be able to include this idea in my project, I will not discuss it any further in this document.

GitHub repository

The link to my GitHub (so far empty) repository for thi.

References

[1] Sitzmann, V. (2018, December 3). *DeepVoxels: Learning Persistent 3D Feature Embeddings*. ArXiv.Org. https://arxiv.org/abs/1812.01024

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[3] Liu, Z. (2019, July 8). *Point-Voxel CNN for Efficient 3D Deep Learning*. ArXiv.Org. https://arxiv.org/abs/1907.03739

[4] Togelius, J., Champandard, A. J., Lanzi, P. L., Mateas, M., Paiva, A., Preuss, M., & Stanley, K. O. (1998). *Procedural Content Generation: Goals, Challenges and Actionable Steps*. https://core.ac.uk/download/pdf/55245659.pdf

[5] *Search-Based Procedural Content Generation: A Taxonomy and Survey*. (2011, September 1). IEEE Journals & Magazine | IEEE Xplore. https://ieeexplore.ieee.org/abstract/document/5756645

[6] Mark, B., Berechet, T., Mahlmann, T., & Togelius, J. (2015). Procedural Generation of 3D Caves for Games on the GPU. *FDG*.

[7] Liu, Z. (2020). *VB-Net: Voxel-Based Broad Learning Network for 3D Object Classification*. MDPI. https://www.mdpi.com/2076-3417/10/19/6735/htm