Densify Point Clouds Sprint 3

By Group A2_9: Chris, Risa, and Brian

Sprint 3 Tasks

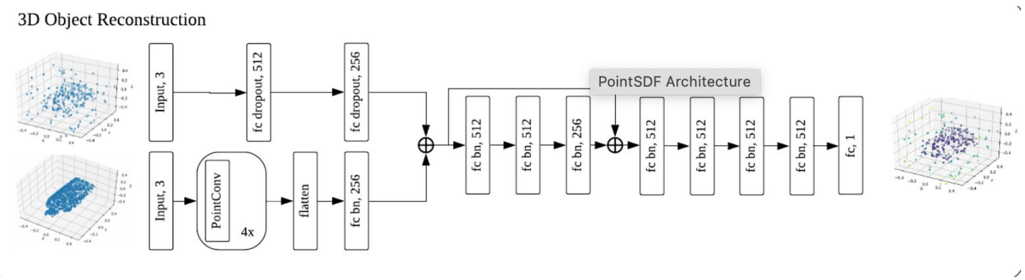
- Continue researching papers and finding a paper that we can feasibly reproduce
    - Find frameworks that we can utilize from these papers
- Keep working on testing our development software
    - Test advanced tutorials on torch-3d
    - Install pytorch 3d and PCL locally
    - Install open3d and test tutorials
- Start working on theoretical ML module in pytorch 3d

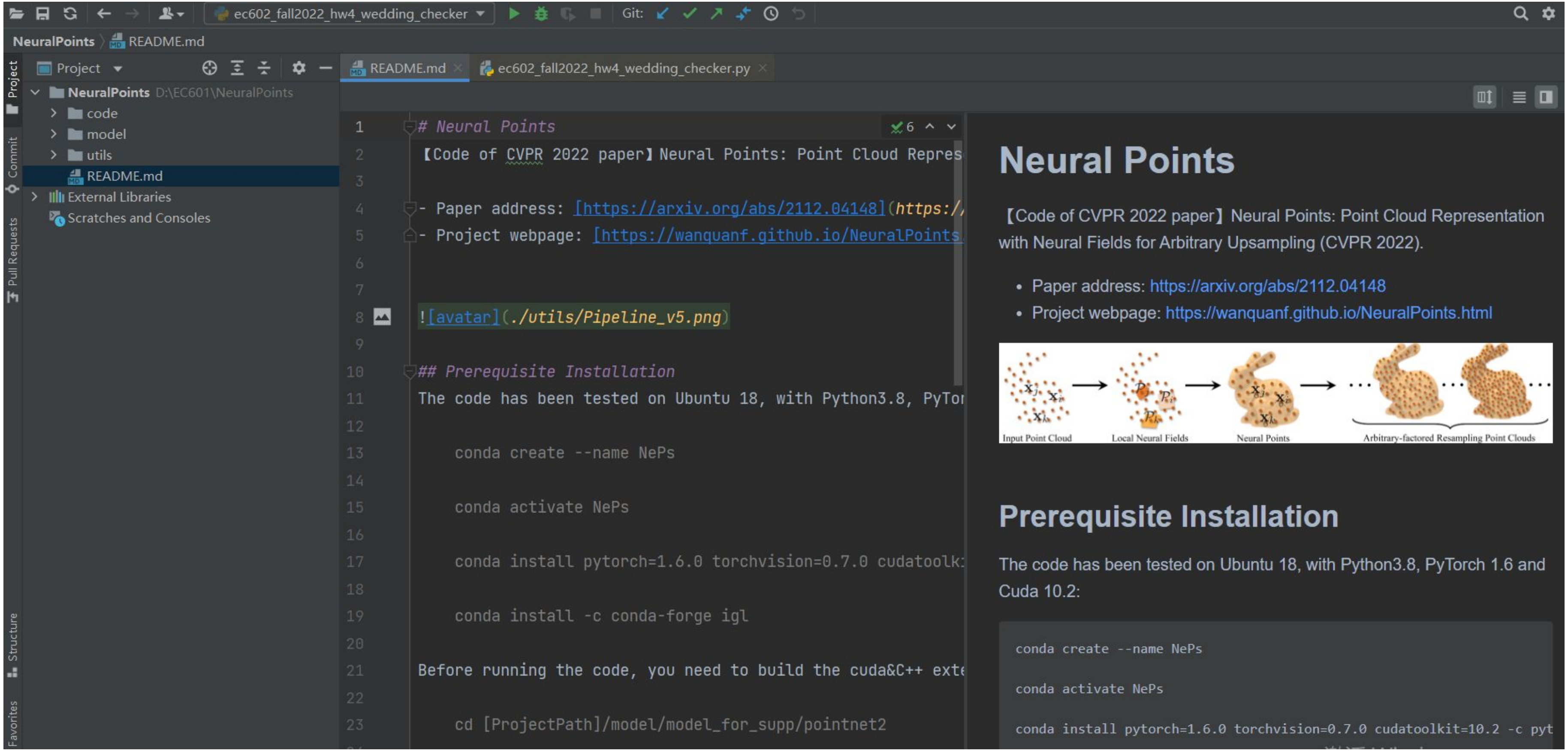
Accomplishments

- Our Team found an interesting paper that implemented their own deep learning model to classify sparse point clouds into denser objects.
- The paper also had the framework they developed under github called PointSDF

Research Finding - PointSDF

- **PointSDF - Signed Distance Function**
  - Directly regresses signed distance functions from point clouds
  - Providing geometrically rich input and output
- **Distance Prediction**
  - Implicitly encode geometry by introducing the point cloud embedding from PointSDF





```
# Neural Points
【Code of CVPR 2022 paper】Neural Points: Point Cloud Repres

- Paper address: [https://arxiv.org/abs/2112.04148](https://
- Project webpage: [https://wanquanf.github.io/NeuralPoints.


![avatar](./utils/Pipeline_v5.png)

## Prerequisite Installation
The code has been tested on Ubuntu 18, with Python3.8, PyTor

    conda create --name NePs

    conda activate NePs

    conda install pytorch=1.6.0 torchvision=0.7.0 cudatoolk

    conda install -c conda-forge igl

Before running the code, you need to build the cuda&C++ exte

    cd [ProjectPath]/model/model_for_supp/pointnet2
```

Neural Points

【Code of CVPR 2022 paper】Neural Points: Point Cloud Representation with Neural Fields for Arbitrary Upsampling (CVPR 2022).

- Paper address: https://arxiv.org/abs/2112.04148
- Project webpage: https://wanquanf.github.io/NeuralPoints.html

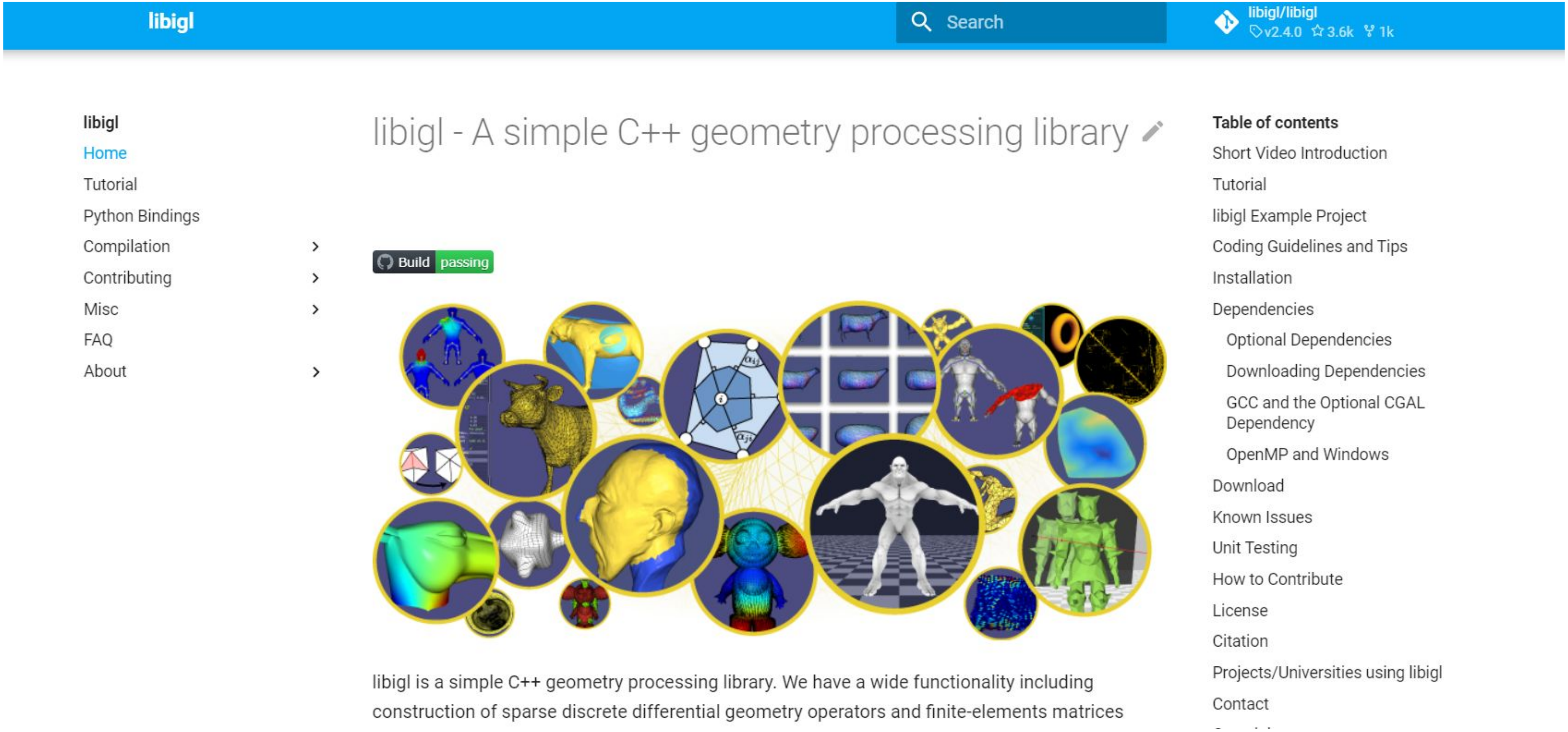
Prerequisite Installation

The code has been tested on Ubuntu 18, with Python3.8, PyTorch 1.6 and Cuda 10.2:

```
conda create --name NePs

conda activate NePs

conda install pytorch=1.6.0 torchvision=0.7.0 cudatoolkit=10.2 -c pyt
```



libigl - A simple C++ geometry processing library

libigl is a simple C++ geometry processing library. We have a wide functionality including construction of sparse discrete differential geometry operators and finite-elements matrices

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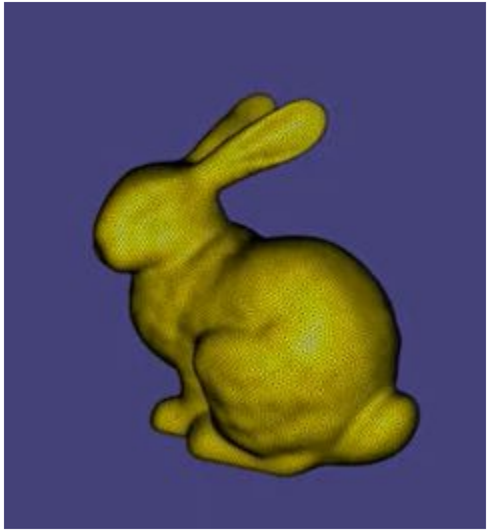

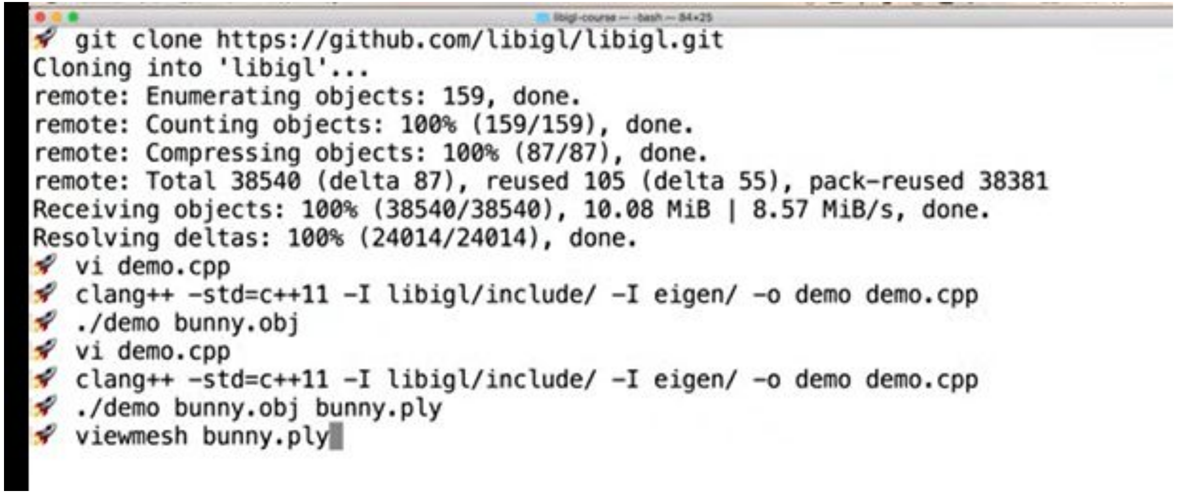

```
🚀  git clone https://github.com/libigl/libigl.git
Cloning into 'libigl'...
remote: Enumerating objects: 159, done.
remote: Counting objects: 100% (159/159), done.
remote: Compressing objects: 100% (87/87), done.
remote: Total 38540 (delta 87), reused 105 (delta 55), pack-reused 38381
Receiving objects: 100% (38540/38540), 10.08 MiB | 8.57 MiB/s, done.
Resolving deltas: 100% (24014/24014), done.
🚀  vi demo.cpp
🚀  clang++ -std=c++11 -I libigl/include/ -I eigen/ -o demo demo.cpp
🚀  ./demo bunny.obj
🚀  vi demo.cpp
🚀  clang++ -std=c++11 -I libigl/include/ -I eigen/ -o demo demo.cpp
🚀  ./demo bunny.obj bunny.ply
🚀  viewmesh bunny.ply
```

Fig.2 CVPR 2022 Neural Points

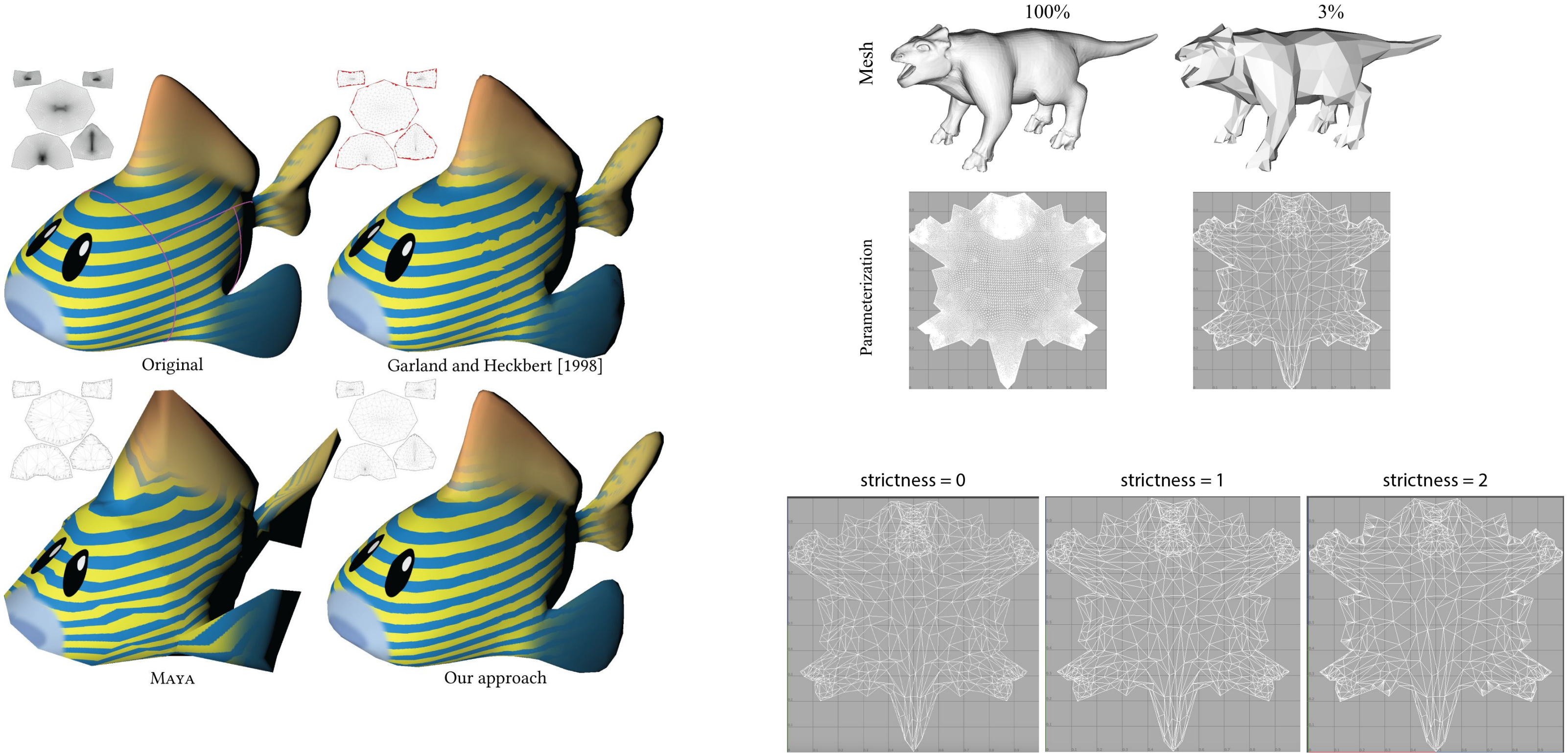
Original
Garland and Heckbert [1998]
Maya
Our approach
100%
3%
Mesh
Parameterization
strictness = 0
strictness = 1
strictness = 2

Fig.3 Libigl

Research Finding

- **Superpixel Method**
  - Only performs a decent result under certain environmental conditions
  - Cannot present all the possible variations in an image, may deliver wrong/missing spots
- **Markov Random Field(MRF)**
  - Pixelwise optimization
  - Pair up the neighbor points/pixels to compute a certain 3D surface
- **Semantic Labeling**
  - Mapping elements on the image such as color and texture to a 3D plane normal
- **Multiple Segmentation Method**
  - Obtaining a higher accuracy by analyze the advantages of each single elements

Set Backs

- We had serious trouble trying to install torch-3d and pytorch 3d using the SCC
  - Our team worked in tandem with IT but we didn't have much luck getting these libraries to function as intended
    - The closest we got was getting pytorch 3d to use CPU
- We also had trouble installing pytorch 3d locally
  - I tried to install Pytorch 3d locally on Linux but it didn't work out due to graphic driver issues
    - Im currently in the process of installing pytorch 3d using a conda environment

Sprint 4 Tasks

- Install PointSDF locally and test their framework
  - Have a demo showcasing the PointSDF framework
- Continue Paper Research
  - Diagram a model for our ideas on how to optimize the frameworks ML component
- Continue trying to get pytorch 3d working
  - Work with Osama to check if the SCC has correctly installed the software and test example
  - Continue trying to install locally
  - (Reach goal) Have a demo showcasing pytorch 3d