CV Project Iteration 1

First Evaluation

Brief Project Description

- 3D Point Cloud Reconstruction of an object from a single image.
- Previous works were:
  - Volumetric Representation
  - From multiple image data
- Novelty from previous work:
  - Do don’t make strong assumptions over the shape or the environment lighting conditions
- Problem : We have only a single image and multiple 3D point cloud configurations are possible
- Ambiguity in ground truth
- Not same as other 3D reconstruction problems due to the ambiguity

Expected Challenges

- Ground truth ambiguity
- No unique annotations
- The loss function is to be designed considering the above
- Multiple possible solutions for the same problem as we have only one point of view
- Therefore, customised design of Neural network required

Problems and Notations

- **Goal -** Single 2D image (RGB or RGBD) to complete 3D shape

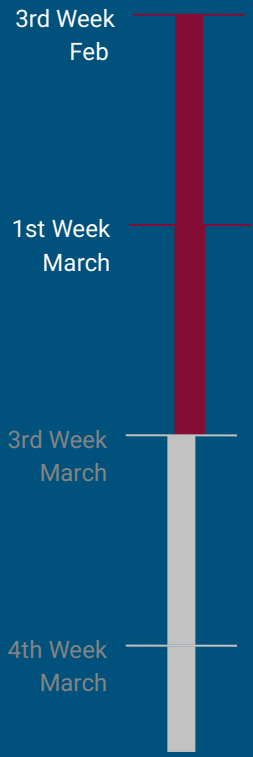
  $S = \{(x_i, y_i, z_i)\}^{N}_{i=1}$, N is predefined constant, N = 1024 seems sufficient

- The ground truth is a probability distribution P(./I) over the shapes possible for input I i.e. for given image the output 3D points come with a probability
- So, we train the Neural Network as a conditional sampler from P(./I)
  - $S = G (I, r, \theta)$
  - Θ - n/w parameter
  - $r \sim N(O, I)$ - It is a random variable to perturb the input

Approach

- Neural Network(NN) is built Conditional Generative Network (CGAN)
- Versions of the NN's described in Paper:
  - Vanilla Version
  - Two Branch Prediction Version
  - Hourglass Version
- Loss Function:
  - Earth Mover Distance (EMD)
  - Chamfer Distance (CD)
- Modelling the uncertainty of the ground truth:
  - Using min function as a wrapper to the loss function
  - By a conditional Variational Autoencoder

Expected TimeLine



- Understanding CGAN
- Understanding designing of NN

- Data Set Collection [CAD and Real]
- [Debugging]
- Implementation and Report on Performance of **Vanilla version**

- Implementation and Report on Performance of **Two branch prediction version**

- **Final Report** and outputs
- Presentation

Expected Learnings

- Learn and implement Conditional Generative Network
- Understanding 3D Convolution Network
- Implementation and Deployment of Neural Network
- Designing and Implementation of Custom Loss functions
- Working with TensorFlow and Cuda
- NN’s for 3D points reconstruction from single image

Important Links!

- Link to Paper
- State of the Art for 3D reconstruction from single Image as of 2019 Mesh R-CNN by FAIR ICCV 2019.