# CIDL Project Proposal

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**Problem:**
Just like our vision, cameras can easily distinguish shapes, colors, and quickly identify the type of object based on such information. However, lighting and weather conditions or shadows can lead to reduced visibility and miss-classification. This is why, in combination with the camera, a LiDAR sensor is often used in order to be able to model up a very precise 3D depiction of the surrounding environment. In real world applications, sensor fusion algorithms are then used to bring together inputs from multiple sensors, to form a single model of the surroundings.

**Solution:**
Train, test and compare different models to perform classification using RGB images and Point Clouds.

**Dataset: ShapeNet** (https://shapenet.org)
In particular, the plan is to use ShapeNetSem, a smaller, more densely annotated subset of ShapeNet consisting of 12,000 3D models spread over a broader set of 270 categories. For each of the 3D models it provides:

- OBJ format of the 3D mesh **(to be used to train the model for Point Cloud Classification)**;
- associated metadata (linked to an appropriate synset in WordNet);
- pre-rendered screenshots of each model from 6 canonical orientations (front, back, left, right, bottom, top), and another 6 "turn table" positions around the model **(to be used to train the model for RGB images Classification);**


As shown, for each 3D object there multiple (13) renderings with textures and the .obj file which can be used to parse the point cloud.

**Tasks:**

- **Task 0: State-of-the-art review**
  - Review the state-of-the-art Deep and Shallow neural networks used to perform Point Cloud classification.
- **Task 1: Dataset Preprocessing**
  - Prepare raw data to be loaded as `tf.data.Dataset`;
  - Reduce the number of categories using macro-categories;
- **Task 2: Training from scratch**
  - Develop, train, test and evaluate a model from scratch to classify RGB images.

    - Develop, train, test and evaluate a model from scratch to classify Point Clouds.
- **Task 3: Pre-trained state-of-the-art model**
    - Train, test and evaluate state-of-the-art model from scratch to classify RGB images:
        - VGG16, VGG19, ResNet-50, Inception, DenseNet, Mobilenet.
    - Train, test and evaluate state-of-the-art model from scratch to classify Point Clouds:
        - PointNet,  ResNet-50, Inception, Mobilenet.