Given : Multiple objects are randomly arranged in a heap
Objective : Sequentially grasp and transport each into a packing bin

Challenges :

•Reliable Robotic Grasping is challenging due to imprecision in sensing and actuation.

•Difficult to infer object shapes from point clouds due to sensor noise, obstructions and occlusions when objects are placed in heaps

•For deep learning model, time cost of collecting physical data too high

Ideas:

•We model bin picking with Partially Observable Markov Decision process : States of heaps, point cloud observations, rewards

•Train on synthetic datasets of grasps and point clouds

•It is possible to grasp a diverse set of objects from clutter using Deep CNNs.

•Consider modeling uncertainty during dataset generation to learn a policy for rapid bin picking from a single view point

•Modelling bin picking as a sequence of 3D objects in heap with noisy point cloud observations using POMDP

•Deep neural networks trained on large datasets can predict grasp positions to a very high accuracy

•DexNet - Dataset of 6.7 million point cloud objects

•GQCNNs- Grasp Quality Convolutional Neural Networks : Rapidly predicts the success of grasps from depth images

•Grasps are specified as planar position, angle and depth of a gripper relative to and RGB-D Sensor

Assumptions:

•Camera is mounted on a stationary position to capture the top view of the heap

•Gripper motion can occlude camera view

•Point cloud of one object selected as X for CNN

•Gripping position selected as y for CNN

•We perform 3D Point Cloud Segmentation

Process :
Generating the synthetic dataset for heap, Tools : NDDS, Dex-Net

1.3D CAD Models generate

2.Sampling from 3D CAD Models : NDDS / Dex-Net

3.Generate heaps of models using Dynamic simulation of dropping action

4.Heap state Target Specification, Tools : NDDS, Dex-Net

5.3D Point cloud

6.3D Point cloud segmentation

7.Specify target object to pick from the heap- Grasp Generation, Tools : Dex-Net, Isaac-Sim, iGibson, Gazebo

8.Define a trajectory that reaches the object without occlusions

9.Gripping action so as not to damage it

10.Policy between Gripping action and point cloud

11.Reward if successful transfer of object.

12.Choose the heap state/ point of object as X and gripping position as y for a CNN only for which reward is 1. Feeding the heap and grasp dataset to a CNN, Tools : Dex-Net (GQCNN used)

13.Feed to CNN

14.Predict trajectories for new heaps

15.Simulate the bin picking process, Tools : Gazebo, Isaac-Sim, iGibson, Neurorobotics