深蓝学院
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三维点云处理第一次作业

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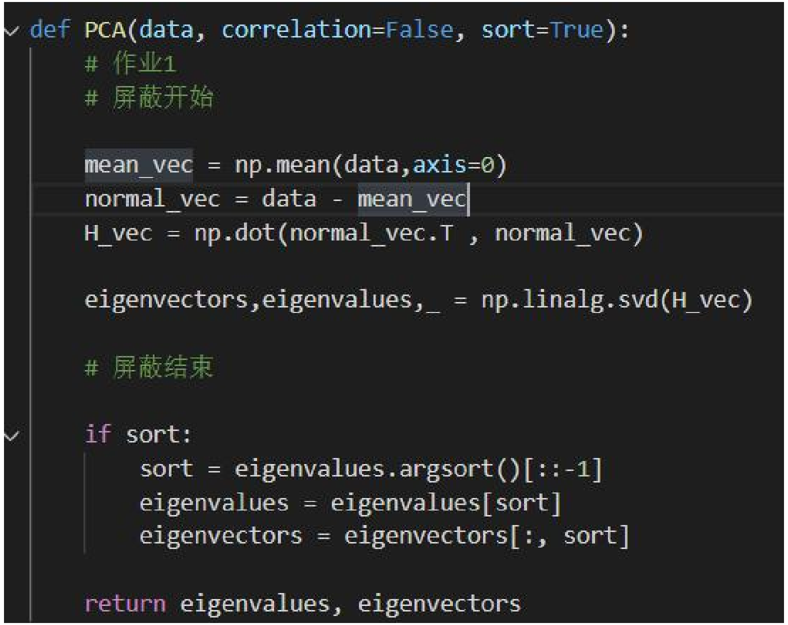
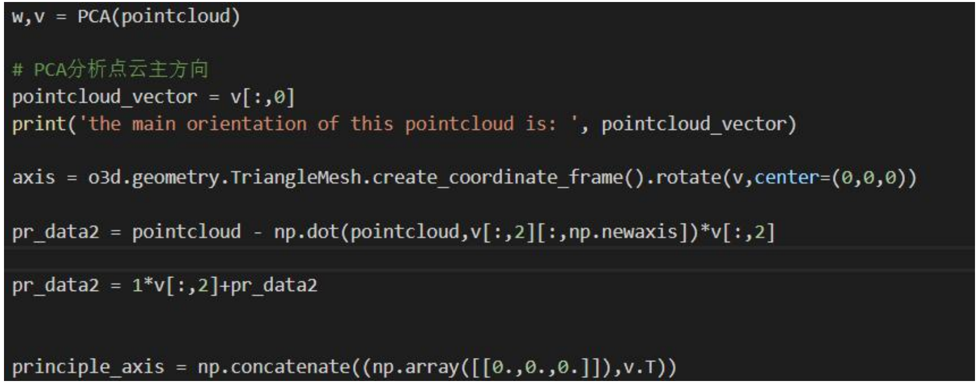
第一题

- 对点云数据进行PCA分析并进行投影可视化



```
def PCA(data, correlation=False, sort=True):
    # 作业1
    # 屏蔽开始

    mean_vec = np.mean(data,axis=0)
    normal_vec = data - mean_vec
    H_vec = np.dot(normal_vec.T , normal_vec)

    eigenvectors,eigenvalues,_ = np.linalg.svd(H_vec)

    # 屏蔽结束

    if sort:
        sort = eigenvalues.argsort()[::-1]
        eigenvalues = eigenvalues[sort]
        eigenvectors = eigenvectors[:, sort]

    return eigenvalues, eigenvectors
```

PCA分析

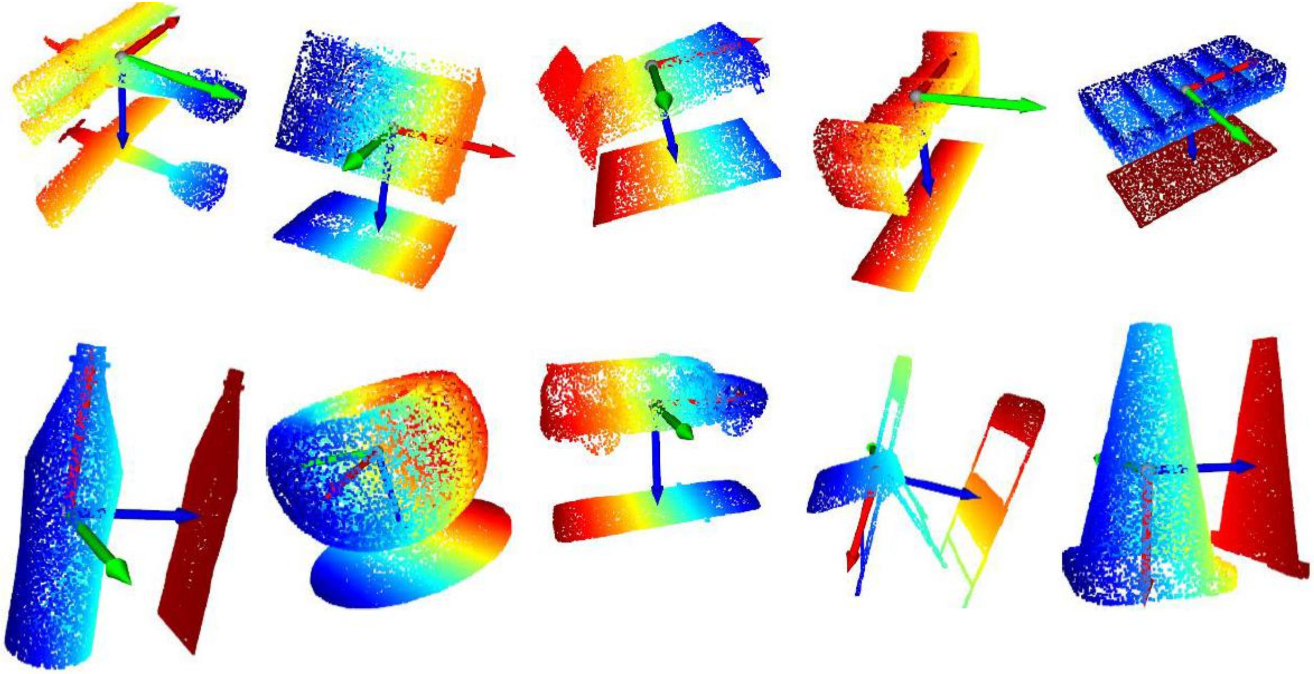


```
w,v = PCA(pointcloud)

# PCA分析点云主方向
pointcloud_vector = v[:,0]
print('the main orientation of this pointcloud is: ', pointcloud_vector)

axis = o3d.geometry.TriangleMesh.create_coordinate_frame().rotate(v,center=(0,0,0))

pr_data2 = pointcloud - np.dot(pointcloud,v[:,2][:,np.newaxis])*v[:,2]

pr_data2 = 1*v[:,2]+pr_data2


principle_axis = np.concatenate((np.array([[0.,0.,0.]]),v.T))
```

将点云进行投影可视化

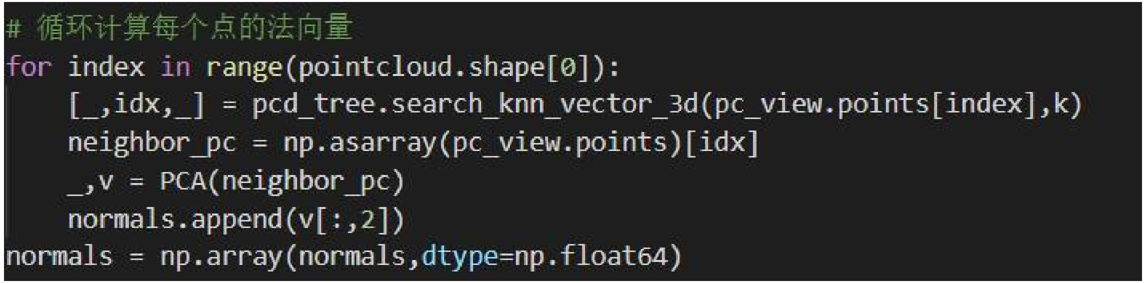
第一题

- 对点云数据进行PCA分析并进行投影可视化

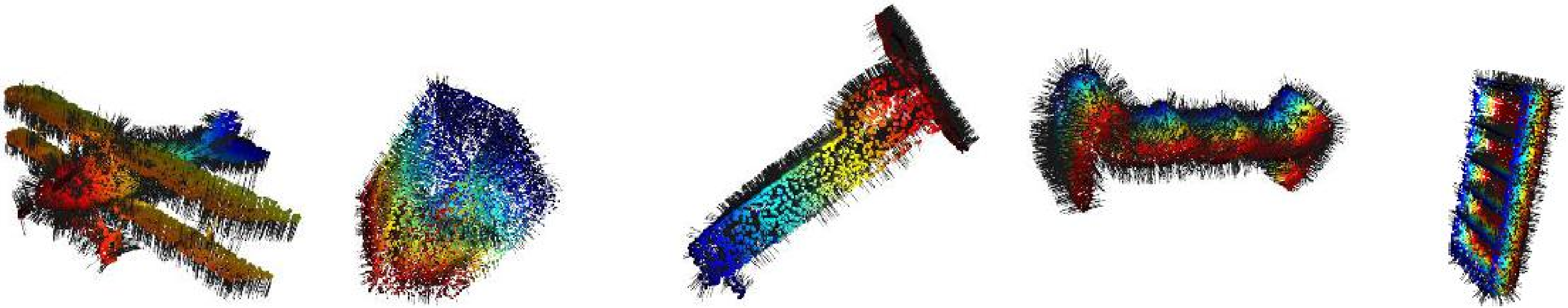


第一题

- 利用PCA分析进行法向量估计



```
# 循环计算每个点的法向量
for index in range(pointcloud.shape[0]):
    [_,idx,_] = pcd_tree.search_knn_vector_3d(pc_view.points[index],k)
    neighbor_pc = np.asarray(pc_view.points)[idx]
    _,v = PCA(neighbor_pc)
    normals.append(v[:,2])
normals = np.array(normals,dtype=np.float64)
```

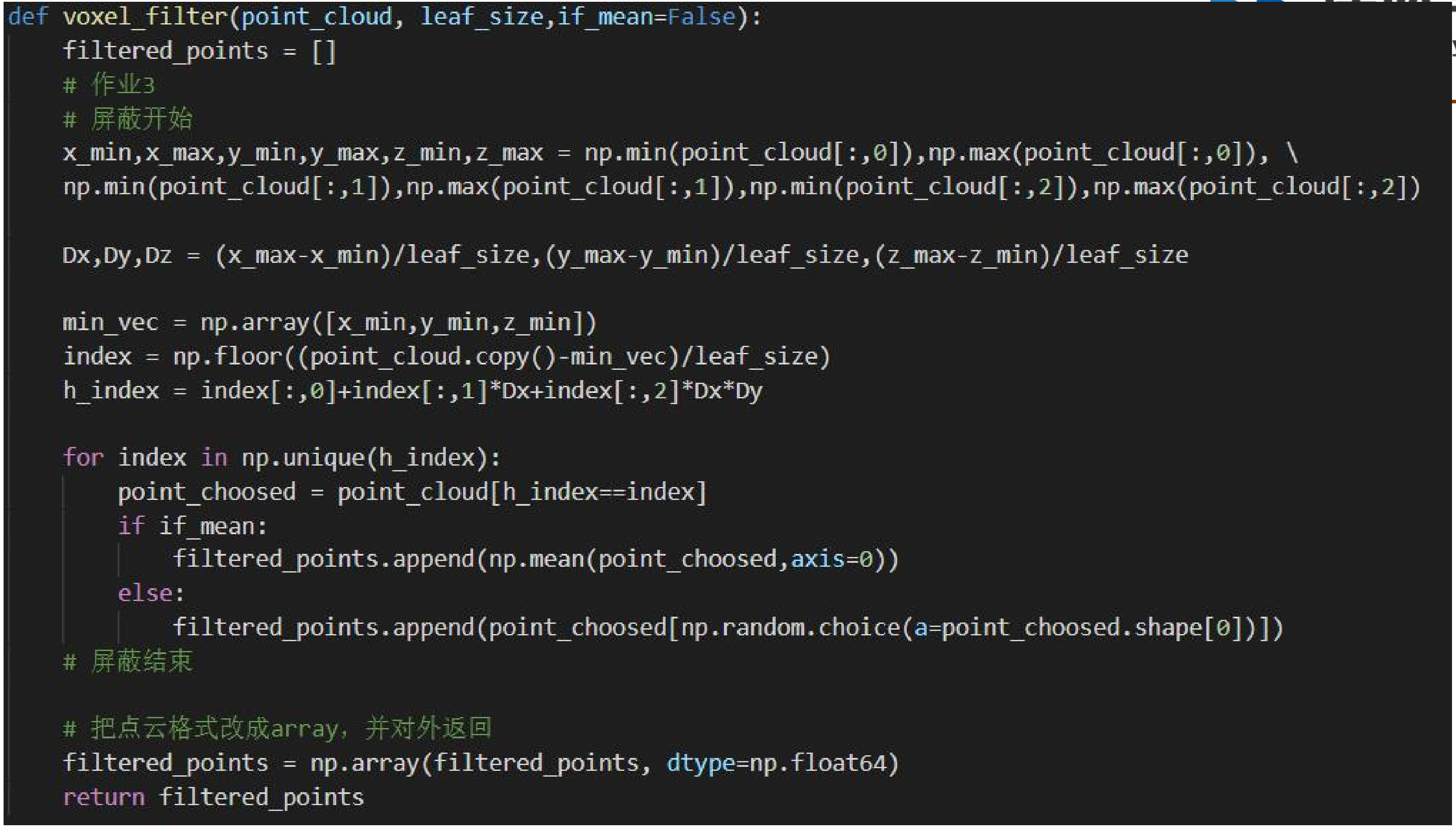


第二题

- 体素式滤波

1. Numpy数组支持逻辑数组直接访问,不用进行sort类似的操作

2. 注意使用向量化编程的思想（类似matlab），少用for循环，可以加快速度



```
def voxel_filter(point_cloud, leaf_size,if_mean=False):
    filtered_points = []
    # 作业3
    # 屏蔽开始
    x_min,x_max,y_min,y_max,z_min,z_max = np.min(point_cloud[:,0]),np.max(point_cloud[:,0]), \
    np.min(point_cloud[:,1]),np.max(point_cloud[:,1]),np.min(point_cloud[:,2]),np.max(point_cloud[:,2])

    Dx,Dy,Dz = (x_max-x_min)/leaf_size,(y_max-y_min)/leaf_size,(z_max-z_min)/leaf_size

    min_vec = np.array([x_min,y_min,z_min])
    index = np.floor((point_cloud.copy()-min_vec)/leaf_size)
    h_index = index[:,0]+index[:,1]*Dx+index[:,2]*Dx*Dy

    for index in np.unique(h_index):
        point_choosed = point_cloud[h_index==index]
        if if_mean:
            filtered_points.append(np.mean(point_choosed,axis=0))
        else:
            filtered_points.append(point_choosed[np.random.choice(a=point_choosed.shape[0])])
    # 屏蔽结束

    # 把点云格式改成array，并对外返回
    filtered_points = np.array(filtered_points, dtype=np.float64)
    return filtered_points
```

第二题

- 体素式滤波

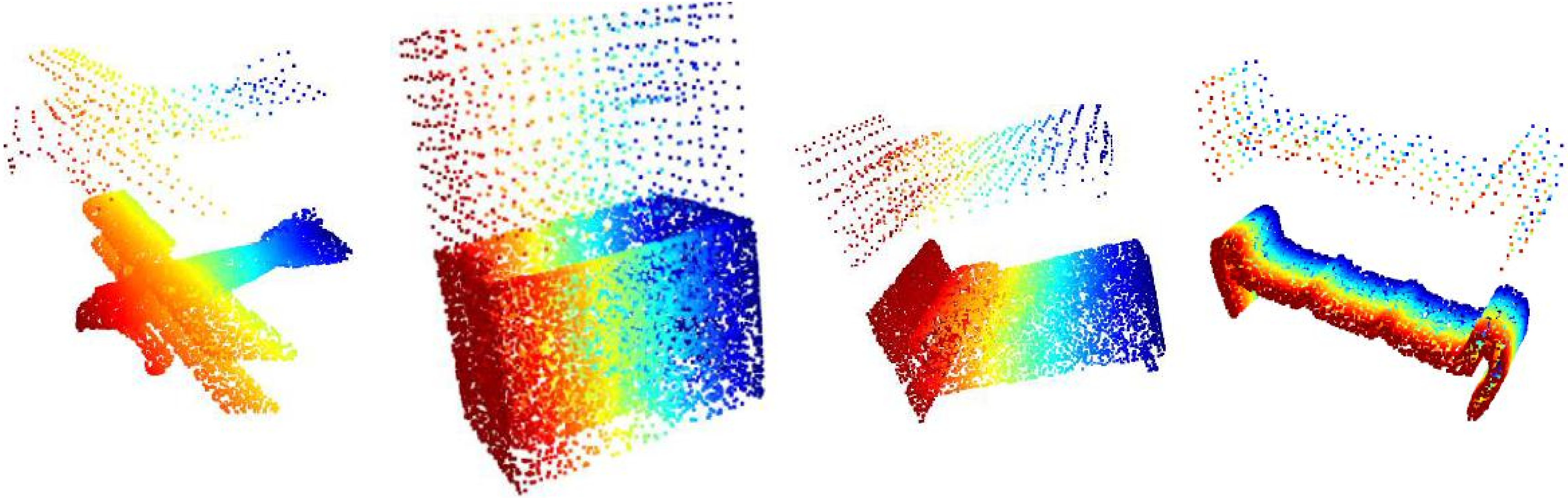


图 1.4 Centroid Method

第二题

- 体素式滤波

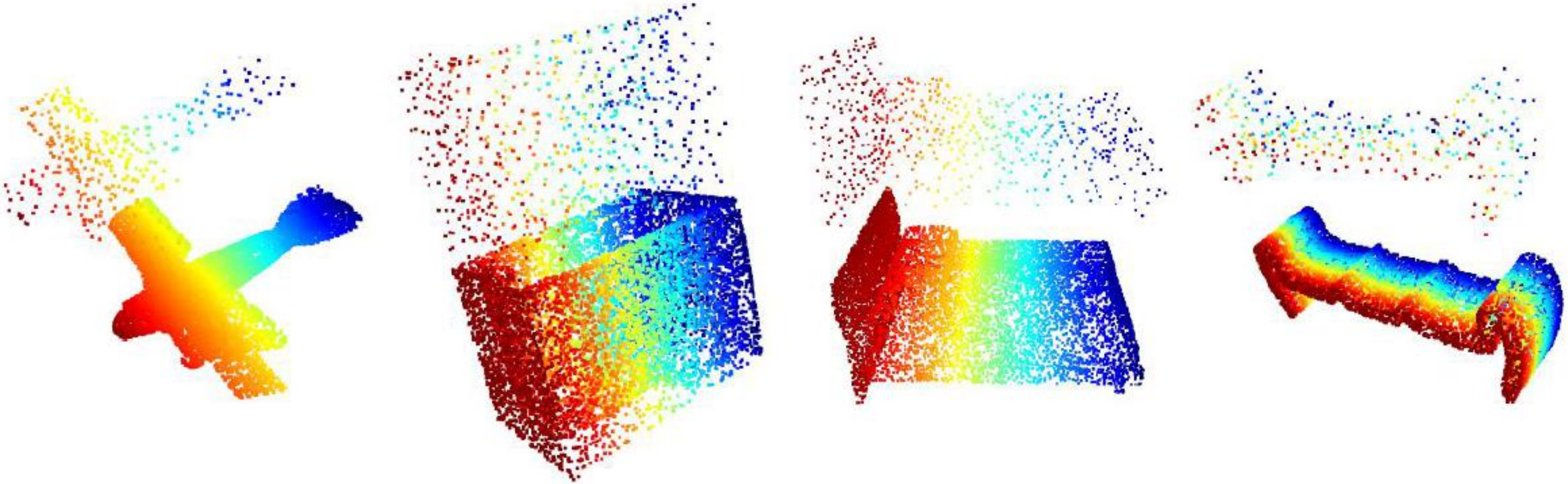


图 1.5 Random Method

在线问答

Q&A

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感谢各位聆听

Thanks for Listening

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