

# Paper Review for the Computer Science Research Course and the Second Exam

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## 1 Introduction

This paper review report is provided based on the requirement of the computer science research course provided by the Graduate Center of the City University of New York during the 2017 Fall Semester. The main objective of this course is helping the PHD candidates to prepare their second exam and identify their thesis topic as early as possible [1].

In this report the papers related to the object classification, object detection and object semantic segmentation for the 2D and 3D objects will be discussed. As most of the state of the art algorithms used for those tasks are based on the deep convolutional neural networks, the important papers related to the deep neural networks will also be discussed in this article.

The structure of this article is described bellow: The papers related to the theory part of the deep learning will be discussed in the second session. In the third session, the papers in the 2D object classification will be discussed. In session 4, the 2D object detection papers will be studied. At the same time, an interesting and more challenge related to the 2D image procession or computer vision will be discussed in session 5 which is the 2D object semantic segmentation. In the rest part of this article, the similar tasks in 3D will be discussed as the final goal of this paper review is finding some possible approaches to improve the current 3D computer vision algorithms based on the state of the are 2D computer vision algorithms.

## 2 Deep Learning Theory

### 2.1 Approximation with Artificial Neural Networks [2]

In order to build the mathematical theory of the artificial neural networks, several papers are published in the 20 century. In this paper one main contribution is the universal approximation theorem with proof. The universal approximation theorem claims [2] that the standard multilayer feed-forward networks with a single hidden layer that contains finite number of hidden neurons, and with arbitrary activation function are universal approximators in  $C(R^m)$ . The universal approximation theorem is one of the important theoretical support for the artificial neural networks. However, at that time as the huge size labeled data sets are not available, the updated algorithms haven't been invented and also the limited computation power, these ideas can not be verified.

### 2.2 Approximation Capabilities of Multilayer Feedforward Networks [3]

The unique value of the Kurt Hornik (1991) [3] paper is it showed that it is not the specific choice of the activation function, but rather the multilayer feedforward architecture itself which gives neural networks the potential of being universal approximators. This is an important contribution which is the foundation for the current state of the art deep learning architecture such as VGG 16 [4] and resnet [5] [6] [7] [8] [9] [10] [11] [12] [13]

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