Chapter 97
Historical Evolution of Deep Learning Applied to Computer Vision

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ABSTRACT

Artificial intelligence (AI) as a field of study has grown exponentially in recent years, as has applications in a multitude of fields. Within it, deep learning techniques have shown truly impressive results on all kinds of pattern recognition tasks during the last decade, and their impact will only continue to grow. To understand the virtues and weaknesses of this technology, it may be beneficial to look back at the technological advances within the field of AI and, more specifically, of computer vision and neural networks, where the ideas that gave rise to what is now known as deep learning were first developed. That is why the main objective of this chapter is to give as complete a vision as possible of the history of this technology, throughout its nearly 80 years of development. By reviewing the scientific publications that brought progress in this area of research in chronological order, this chapter will elucidate the origins of the main components of neural networks and will highlight the main contributors in this field, as well as the factors that resulted in setbacks and advances.

INTRODUCTION

Artificial intelligence (AI) as a field of study has grown exponentially in recent years, as has its application in a multitude of fields. Within it, the term deep learning encompasses a group of specific machine learning models, algorithms, and techniques which, especially during the last decade, have shown truly impressive results on all kinds of pattern recognition tasks and have positioned themselves as the most popular and effective in certain application domains. This technology is now used in many applications in industry for a higher level of automation and robotization and in fields such as automated

control, automotive, healthcare, retail, or surveillance. The advances in this field have increased greatly in recent years and will continue to grow in the future.

To understand the virtues and weaknesses of deep learning, it may be beneficial to look back at the technological advances within the field of artificial intelligence and, more specifically, of neural networks and computer vision, where the ideas that gave rise to what is now known as deep learning were first developed. That is why the main objective of this chapter is to give as complete a vision as possible of the history of this technology, while explaining its main concepts and their origins in approachable terms.

This article will give and exhaustive review of the most important scientific publications in the history of neural networks applied to computer vision, explaining their successive innovations and highlighting the most notable contributors in the field. Through the retelling of eighty decades of history, this article will explain how neural networks went from their conception and origins in the middle of the last century as part of the nascent field of artificial intelligence, through a period of decadence in the 1970s where other modelling and training techniques took prevalence in computer vision, and finally to the advances in both hardware and network design in the twenty-first century which caused deep learning to become the dominant paradigm for computer vision tasks and extend its applications to many other domains.

The chapter is structured in the following sections. The first Background section briefly reviews the general history of the related fields of computer vision and machine learning, which happened parallelly and interconnectedly to the history of neural networks. Then, the main Focus of the Chapter will be to explore de evolution of neural networks as they emerged from the field of computer vision, dedicating a subsection to each decade in eighty years of history, from the first artificial neurons introduced in the 1940s, until their explosion in popularity in the 2010s, and, finally, how deep neural networks have gone beyond their initial purpose of image classification tasks and have evolved to be applied to many other types of input data and in many diverse domains. The section on Solutions and Recommendation will present some challenges that are still present in deep neural network models and some of the methods researchers are developing to tackle them. The final section dedicated to the Future of the field will address the rapid changes that the field of AI has been going through in recent years with the proliferation of General Purpose AI systems and the growing debate in the public discourse about the effects of this technology on society.

BACKGROUND

Computer vision is a field of research that has been studied for decades and has had applications in many diverse areas. It encompasses a large number of different techniques, including image processing, pattern recognition, machine learning and computer-generated graphics. The main objective of computer vision tasks is the extraction of information from images stored in a digital format. The tasks that comprise this field can be relatively simple such as the detection of the edges of the shapes present in an image, or more complex such as the classification of images or the detection, location and segmentation of objects present in the images. During its history, this discipline has developed thanks to both improvements in the hardware necessary for generating higher quality digital images, for storing them,

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