STRUCTURAL PATTERN RECOGNITION

T. PAVLIDIS

PRINCETON UNIVERSITY 1974

durante mia visita, Franco Sirini

PRINCETON UNIVERSITY
Department of Electrical Engineering

STRUCTURAL PATTERN RECOGNITION

(Notes for EE509: Pattern Recognition and Learning Machines)

Chapter 1: Introduction

Chapter 2: Signal Description

September 1974

Chapter 1: INTRODUCTION

1.1 Introduction

Pattern Recognition by Computer was first considered in the 1950's. By that time digital programmable computers were performing tasks of great mathematical complexity, by far surpassing human abilities. Thus, it seemed reasonable that one should be able to program for such simple tasks as distinguishing a handprinted letter A from a handprinted letter B.

The problem turned out to be much more difficult than what people thought. It was only in the late sixties that multifont typewritten text could be read by machines and reading handprinted letters is still beyond the ability of present day technology. Similar difficulties were met in programming computers doing such tasks as solving simple puzzles, playing chess and a host of similar activities which are grouped under the heading of Artificial Intelligence.

In retrospect this is hardly surprising. There was indeed a major logical fallacy upon which the early optimism was based.

Machines are more powerful than humans in performing certain intellectual tasks.

Pattern recognition is an easy intellectual task (at least in most cases).

Therefore, machines ought to be able to do pattern recognition.

The trouble lies in the assignment of degrees of difficulty to intellectual tasks. There is little argument that the human brain is indeed some kind of a computer. But its structure and mode of operation are substantially different than those of present day digital computers. Certain superficial similarities exist but that is all. We will discuss these at a later section. The animal nervous system and the human brain in particular are results of a long evolutionary process and this resulted in an enhancement of their ability to perform tasks which have survival value.

Pattern recognition is one such task: Recognition of food, mate, enemy, etc. The same is true for problem solving; how to catch a prey or evade a predator, as well as for learning by experience. On the other hand, performing numerical calculations or solving differential equations has had no survival value, not at least before the last few centuries. Thus we have a computer (the human brain) and its peripheral equipment (sensory organs) which are best suited for pattern recognition, problem solving and learning by experience. No attention was paid by their designer (natural evolution) to their handling arithmetic functions or formal logic. Digital computers were designed specifically for the latter tasks. The fact that they do them better and faster than humans in no way implies that they should also do as well as humans in the tasks for which the human brain is best suited.

Thus there is no ground to expect that digital computers could do anything worthwhile in Pattern Recognition or Artificial Intelligence in general. <u>Not unless one express the problems of these fields in terms of mathematical problems which the machines are good at solving</u>.

However, in order to do this one must first understand the nature of each problem and express it in terms of a well defined structure. This brings us to the term Structural Pattern Recognition. This refers to the methodology of expressing pattern recognition problems in terms of conventional mathematical problems and techniques for solving the latter. In contrast to that one may attempt Ad-hoc Pattern Recognition where some more or less arbitrary measurements are used to express the problem in a quantitative way and then a general statistical technique is asked to make sense out of them.