Certainly the notion of a classifier system is appealing — how could roving bands of mating, reproducing, fighting, and dying rules fail to captivate our collective imagination?


Classifier systems are a quagmire — a glorious, wondrous, and inviting quagmire, but a quagmire nonetheless.


Classifier systems are stuck.


Chapter Outline

The general idea of a classifier system and its tripartite structure have already been introduced in §1.5. We begin this Chapter by briefly outlining various types of classifier systems and reviewing the representation of rules in them. Following this we proceed to describe two classifier systems, accuracy-based XCS and its strength-based twin SB–XCS, in detail sufficient to allow implementation. We make a brief empirical comparison of them in §2.5, and will conduct more extensive comparisons and experiments in later Chapters. Throughout the thesis these two systems will be used as references in our reasoning about strength and accuracy-based systems.
Classifier systems were invented by John Holland in the 1970s. The first published work on LCS appeared in 1976 [121]; the first report of an implemented system, Cognitive System 1 (CS-1), appeared in 1978 [128]. Classifier systems developed from Holland's earlier work on adaptive systems [117, 118], schemata processors [119], the broadcast language [120], and genetic algorithms [120]. See [95] Chapter 7 for a short LCS prehistory.

In 1996 Cribbs and Smith [62] suggested a classifier systems renaissance was underway, with new representations, credit assignment algorithms and rule discovery methods being considered. The five years since then have seen further developments in these and other areas, prompting Goldberg [126] to refer to a classifier systems renaissance again in 2000. Analysis of LCS publication trends [150], the emergence of an annual LCS workshop, and anecdotal evidence all support the suggestion of a renaissance.

Classifier systems are suitable for both reinforcement and supervised learning tasks (see §C.1). Most LCS research has been concerned with reinforcement learning tasks (e.g., [128, 31, 293, 298]), although some of the most impressive results have been in supervised learning (or essentially supervised learning) tasks (e.g., [29, 134, 224]). In addition, LCS have been used for machine discovery [246, 247] and to automate the building of simulations of complex systems [233]. Application areas include the study of multiagent systems (e.g., [102, 104, 103, 192, 43, 88, 231, 232, 55, 44, 217, 18, 45, 84, 176, 114, 116, 115, 137]), economics (e.g., [177, 170, 241, 285, 291, 186, 87, 195, 83, 44, 45, 18, 169, 171, 227, 86]), autonomous robotics (e.g., [80, 78, 69, 57, 105, 81, 58, 26, 85, 76, 106, 107, 79, 59, 194, 228, 74, 47, 46, 72, 62, 77, 71, 281, 28, 196, 261, 110, 144]), and cognitive modelling (e.g., [216, 230, 111]). Recently there has been particular interest in applying classifier systems to data mining (e.g., [134, 224]).

For introductory material on LCS see [124, 40, 95, 41, 181, 8, 187, 113], of which Goldberg's 1989 book [95] provides the most gentle introduction. Online resources on LCS include the LCS Web [15], the LCS Mailing List [133], the LCS Bibliography [153], and the Electronic Archive of LCS publications [154].

Broad surveys of LCS research are relatively few. The 1989 paper by Wilson and Goldberg [315] is now somewhat dated, but still valuable. Following on from this, Lanzi and Riolo survey LCS research from 1989–1999 in [167]. Midway between these two lies Fogarty, Carse and Bull's 1994 survey [89]. Chapter 2 of [14] provides historical information on LCS research. Surveys of particular subjects within the LCS field include Fogarty, Ireson and Bull's 1995 survey of industrial and commercial LCS applications [90], Wilson's 1999 survey of the state of XCS research [312], Barry's surveys of work on hierarchical LCS [10, 14] and Bonarini's survey of work on Fuzzy LCS [27].