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MACHINE INTELLIGENCE 1

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WITH A PREFACE BY
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PREFACE

Machine intelligence is a term of art which embraces a considerable range of concepts at differing levels of sophistication and arising in a variety of different contexts. Synonyms or near-synonyms are Artificial Intelligence and Mechanisation of Thought Processes. All three are suggestive terms which invite us to explore an area of science and technology which was virtually beyond our reach before the advent of the high speed electronic computer but is now seen to be full of promise and excitement. It is true that the mechanisation of logical and arithmetical operations is not a new idea, as the names of Stanhope and Babbage remind us. But the Stanhope "Demonstrator" had a built-in program of logical operations and Babbage's computer was thought of simply as a calculator. One essential ingredient of the modern notion of Machine Intelligence is the idea of a program or the combination of a mechanism and a program which has the capability to optimise its operation through time and may thus be said to "learn" from experience how to function if not faultlessly at least in an acceptable manner.

This idea carries us conceptually far beyond the simple feed-back mechanisms, like the mechanical governor and the thermostat, which have been familiar for more than a century, and their present-day and much more sensitive and complex successors. The essential difference lies in the ability to store and retrieve information in the course of the operating sequence in such a way as to optimise the outcome towards some predetermined goal. Solving a puzzle, playing a game against an opponent and controlling an industrial process are examples of thought processes which have been shown to be susceptible to mechanisation, although even the first two present formidable difficulties even in apparently simple cases. The difficulties increase with attempts to construct programs of a more sophisticated kind for such purposes as pattern recognition, language translation or theorem proving. We may expect that the more "intellectual" the task the greater the difficulty of programming an acceptable analogue of it will be.

This volume reports the proceedings of the first Annual Machine Intelligence Workshop organised by Dr Donald Michie and his Experimental

Programming Unit in the University of Edinburgh in September 1965. The contributions, by workers from a number of different centres of research, cover a wide range of projects in Machine Intelligence which are now being actively pursued and together give a very clear picture of the state of the art at the time of the meeting. The second Annual Workshop has already taken place and will be reported in due course. This is a field of immense potential, both theoretical and practical, and the contribution which the Workshop can make to its development by the stimulus it imparts and the publication of its proceedings is to be warmly welcomed and commended.

SIR EDWARD COLLINGWOOD, F.R.S.

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INTRODUCTION

There is no more powerful attractant to the passer-by than a sign-board saying "Men at Work". Let a man begin to dig a hole in the ground, and he will before long have collected twenty onlookers. Let him be joined by nine colleagues, and the crowd swells to two hundred. So also with our scientific symposia and congresses: the perspiration of the few is converted into the inspiration of the many, and we would be foolish not to recognise how vital a part this plays in the advancement of science.

But sometimes there is a feeling that a gap exists between the large formal symposium and the laboratory *tête à tête*. It was towards this gap that we aimed the first Machine Intelligence Workshop, which provided the material for this book. Participants were as far as possible limited to active contributors in the field. The results were striking and pleasurable. Each one plunged in without inhibition; no one flagged; the end of the week found the Workshop exhausted but happy.

In a sense machine intelligence existed when the first abacus was invented, for no one would deny that even elementary arithmetic involves processes of intelligent thought. What, then, is the new factor? The vital distinction, we think, is between the machine as an aid and the machine as a prime mover. Computer aids to the thinking of the mathematician, the designer and the practical planner tend initially to be restricted to the relatively slavish roles of fact retrieval, routine computation and display of results: the *strategy* remains wholly the user's. The distinctive aim of machine intelligence within the general field of computer science is artfully to encroach on this preserve, annexing to the machine's domain more and more of the human's elusive aptitudes—his ability to handle non-numerical data structures of all kinds, to generate and apply data-description schemata, to learn from past experience to abstract features common to different problems, to devise and apply criteria of "relevance", to use approximate and intuitive arguments, to construct general rules from particular instances and to define concepts *via* examples. In their general gist these phrases from the language of everyday life are clear enough to us. Yet in reality almost everything about them is

vague, ill-defined and subjective. To replace them with exact and unambiguous definitions as the basis of well-understood procedures engineered with known limits of error is the target on which machine intelligence research concentrates its fire.

It is a pleasure to release this first of our annual succession of salvos, and to thank Messrs. Oliver & Boyd for their finger on the trigger.

N. L. COLLINS
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