



13 April 1967

Proposal for Research
SRI No. ESU 67-39

SURVEY OF ARTIFICIAL INTELLIGENCE

Mr. Donald K. Pollock
Acting Head
Information Systems Branch
Office of Naval Research
Room 4208, Main Navy Building
Washington, D. C. 20360

Dear Mr. Pollock:

This is a proposal to survey the field of artificial intelligence. The work will be performed by Dr. Nils J. Nilsson of the Artificial Intelligence Group, Applied Physics Laboratory. The end product of the proposed research would be a report in which the major techniques and subject matter of artificial intelligence are presented and explained in a coherent and logical manner.

I BACKGROUND

Much progress has been made in artificial intelligence since Minsky's excellent survey article^{1*} of 1961. Some of this recent work has been briefly described in two subsequent surveys;^{2,3} however, no satisfactory expository source exists to gather all of this work together for the benefit of researchers entering the field.

Two different types of survey reports could be written. One might review all of the important or classic heuristic programs so far written. Articles on many of these, such as Samuel's Checker Playing Program, Slagle's Symbolic Integration Program, and Tonge's Assembly-Line Balancing Program, appear in Feigenbaum and Feldman's excellent volume.⁴ A

* References are given at the end of this proposal.

second type of survey would not attempt to present case studies; rather, it would concentrate on exposition of the essential fundamental principles underlying a wide variety of heuristic programs and capable of broad application. It is the second type of survey report that we propose here.

Actually, the extent to which there is a large body of fundamental ideas in artificial intelligence is itself not clearly understood as yet. One subgoal of this project would be to study this question and report on those ideas found to have broad significance. Certainly, such ideas as are involved in tree search and pruning, description sorting, theorem proving, game playing, and question answering appear to be of fundamental importance and deserve to be explained thoroughly and clearly.

II PLAN OF WORK

The proposed survey work will start with a thorough search of the important literature. The writer hopes to have frequent discussions with many artificial intelligence researchers personally known to him while the survey is in its formative stages.

It is expected that it will be desirable to explain several artificial intelligence computer programs in some detail as an expository aid. Unfortunately, many of the written programs are not well suited for pedagogic purposes (their design emphasizing efficiency, special tricks, etc.). For this reason, it will probably be necessary to sketch out some "fictitious" programs to illustrate important points. An example of such a pedagogic program is that developed by Strachey for playing checkers.⁵

Every effort will be made to begin the actual task of writing the survey report early in the project. Writing catalyzes organization of material, and the major reason for this project is to organize the subject matter of this field. It is hoped that some early versions of the written material could be employed as supplementary reading for a course in Artificial Intelligence regularly given in the Computer Science Department of Stanford University.

III PERSONNEL

The proposed work will be conducted by Dr. Nils J. Nilsson of the Applied Physics Laboratory. His biography follows.

Nilsson, Nils J. - Head Artificial Intelligence Group
Applied Physics Laboratory

Dr. Nilsson has been on the staff of Stanford Research Institute since August 1961 where he has participated in and led research in pattern recognition, learning machines, and artificial intelligence. He has taught courses on learning machines at Stanford University and at

University of California, Berkeley. McGraw-Hill published, in March 1965, a monograph by Dr. Nilsson describing recent theoretical work in learning machines.

Dr. Nilsson received an M.S. degree in Electrical Engineering in 1956 and a Ph.D. degree in 1958, both from Stanford University. While a graduate student at Stanford, he held a National Science Foundation Fellowship. His field of graduate study was the application of statistical techniques to radar and communication problems.

Before coming to SRI, Dr. Nilsson completed a three-year term of active duty in the U.S. Air Force. He was stationed at the Rome Air Development Center, Griffiss Air Force Base, New York. His duties entailed research in advanced radar techniques, signal analysis, and the application of statistical techniques to radar problems. He has written several papers on various aspects of radar signal processing. While stationed at the Rome Air Development Center, Dr. Nilsson held an appointment as Lecturer in the Electrical Engineering Department of Syracuse University.

Dr. Nilsson is a member of Sigma Xi, Tau Beta Pi, the Institute of Electrical and Electronics Engineers, and the Association for Computing Machinery.

IV REPORTS

A final report will be written giving the results of the survey.

V ESTIMATED TIME AND CHARGES

The time required to complete this work and report its results is 13 months. Work could begin immediately. A detailed cost estimate for the proposed work is attached.

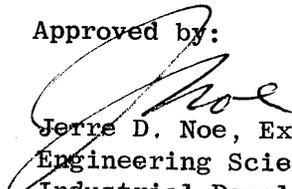
VI CONTRACT FORM

It is requested that any contract resulting from this proposal be written on a cost-plus-fixed-fee basis.

VII ACCEPTANCE PERIOD

This proposal will remain in effect until 1 July 1967. If consideration of this proposal requires a longer period, the Institute will be glad to consider a request for extension of time.

Approved by:


Jerre D. Noe, Executive Director
Engineering Sciences and
Industrial Development

Respectfully submitted:


Nils J. Nilsson, Head
Artificial Intelligence Group
Applied Physics Laboratory

REFERENCES

1. M. Minsky, "Steps Toward Artificial Intelligence," Proc. IRE (January 1961).
2. E. Feigenbaum, "Artificial Intelligence Research," IEEE Trans. Info. Theory, Vol. IT-9 (October 1963).
3. R. J. Solomonoff, "Some Recent Work in Artificial Intelligence," Proc. IEEE, Vol. 54, No. 12 (December 1966).
4. E. Feigenbaum and J. Feldman (Eds.), Computers and Thought (McGraw-Hill Book Co., New York, 1963).
5. C. Strachey, "System Analysis and Programming," Scientific American, pp. 112-124 (September 1966).

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COST ESTIMATE

Personnel Costs

Sr. Professional,	6 man-months @	[REDACTED]	[REDACTED]
Editor,	1/4 man-month @	[REDACTED]	[REDACTED]
Secretary,	1/2 man-month @	[REDACTED]	[REDACTED]
Total Direct Labor			
Payroll Burden @ 18.5% of Total Direct Labor*			
Total Salaries and Wages			
Overhead @ 90% of Total Salaries and Wages*			
TOTAL PERSONNEL COSTS			

Direct Costs

Travel: Air Fare, 2 trips to East Coast		
@ [REDACTED] trip	\$	[REDACTED]
Subsistence, 6 days @ [REDACTED] day		[REDACTED]
SDS 940 Computer charges for testing of pedogogic programs		[REDACTED]
Shipping and Communications		[REDACTED]
Report Costs		[REDACTED]
Total Direct Costs		[REDACTED]
Total Estimated Costs		[REDACTED]
Fixed Fee		[REDACTED]
TOTAL ESTIMATED COST PLUS FIXED FEE		[REDACTED]

* The rates quoted are those currently approved for billing and estimating purposes. It is requested that contracts provide for provisional reimbursement at rates acceptable to the Contracting Officer subject to retroactive adjustment to fixed rates negotiated on the basis of historical cost data. Included in payroll burden are such costs as vacation and sick leave pay, social security taxes, and contributions to employee benefit plans.