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>A general purpose competition-based parallel activation paradigm for diagnostic reasoning has been formulated. to facilitate the task of formulating and testing this paradigm, a parallel activation model generator had also to be developed. Using the network specification language provided by this generator, a knowledge base for diagnosing faults in a prototype chemical processing plant was built to test the viability of the proposed approach as a practical diagnostic paradigm. Diagnosis of failures in process plants has been attempted in the past using conventional AI methodologies, which have raised several practical issues which need to be resolved before a viable automated tool can be built. (KR) ←

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Final Report

Grant NO: AFOSR-87-0335

A LOCALLY CONSTRAINED PARALLEL ACTIVATION MODEL FOR DIAGNOSTIC REASONING

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October, 1989

I.] Research

a) <u>Parallel Activation Paradigm for Diagnostic Reasoning</u>:

A general purpose competition-based parallel activation paradigm for diagnostic reasoning has been formulated. To facilitate the task of formulating and testing this paradigm, a parallel activation model generator had also to be developed. Using the network specification language provided by this generator, a knowledge base for diagnosing faults in a prototype chemical processing plant was built to test the viability of the proposed approach as a practical diagnostic paradigm [Kamran, 1989]. Diagnosis of failures in process plants has been attempted in the past using conventional AI methodologies, which have raised several practical issues which need to be resolved before a viable automated tool can be built. The prototype is currently undergoing extensive testing in order to study the dynamic characteristics of the network model, with the following specific aims:

1) Study the appropriateness of each stable state of the network in the context of its corresponding inputs. A stable state will be considered appropriate, if from each of the active output nodes of the network in a given case, one can reach at least one active input node that cannot be reached from another active output node.

2) Examine the effect of fan of a node on network stabilization times. The fan of a node is the number of connections it has to the rest of the network.

3) Examine the effect of the number of active input nodes on the network stabilization time.

4) Examine the effect of negative inout activations on the network stabilization time. A negative activation for a node denotes the absence of the concept represented by that node.

b) A Learning Paradigm For Causal Networks:

In the context of our parallel activation paradigm for diagnostic reasoning, Mr. Soh has been working on a unique approach to the temporal evolution of a causal network through an experience-based process called "episodic learning". The proposed learning model suggests, that besides the conscious phenomenon of skills refinement that occurs through tutoring and repeated practice with "domain knowledge" among diagnosticians, there is also an unconscious aspect to learning which seeks to identify the regularities or salient characteristics that come to exist among a population of input case scenarios. This "case knowledge" is subsequently used by diagnosticians to construct and modify conceptual dependencies, so as to render more plausible diagnoses in the future. Preliminary simulation results suggest, that the proposed learning paradigm presents an intuitively plausible characterization of the transition from a novice to an expert among human diagnosticians. The underlying network architecture that evolves through this approach introduces a new dimension to connectionist modeling, by clearly delineating the domain and case knowledge, in terms of the roles that are played by each during problem solving.

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