

Maximum Joint Entropy and Information-Based Collaboration of Automated Learning Machines

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We are working to develop automated intelligent agents, which can act and react as learning machines with minimal human intervention. To accomplish this, an intelligent agent is viewed as a question-asking machine, which is designed by coupling the processes of inference and inquiry to form a model-based learning unit. In order to select maximally-informative queries, the intelligent agent needs to be able to compute the relevance of a question. This is accomplished by employing the inquiry calculus, which is dual to the probability calculus, and extends information theory by explicitly requiring context. Here we consider the interaction between two question-asking intelligent agents and note that there is a potential information redundancy with respect to the two questions that the agents may choose to pose. We show that the information redundancy is minimized by maximizing the joint entropy of the questions, which simultaneously maximizes the relevance of each question while minimizing the mutual information between them. Maximum joint entropy is therefore an important principle of information-based collaboration, which enables intelligent agents to efficiently learn together.