In this paper I shall discuss the problem of complexity of decision rules in the framework of machine complexity. In this way, we can actually have a conceptually well-structured discussion of what one might mean by "decision complexity" and we can study the bearing the issue of complexity might have on the foundational problems of Decision Theory. I shall take a decision rule to be a Finite State Machine (FSM), and I shall define an ideal Bayesian Decision Machine (BDM). I would like to stress that I am thinking of a "machine" as a mathematical object. I shall show how BDM will meet with complexity troubles and I shall argue that it is possible to deal with them by defining decision machines endowed with "information processors" which differ from each other according to different organizations of Long Term Memory (LTM). My main claim will be that "information processors" are procedures or algorithms which denote abstract objects, namely functions, and that, whatever the underlying architecture of LTM is, it must satisfy certain very general and formal conditions to guarantee the existence of "information processing" functions on it.

The most recent brand of Bayesian Theory put forward by Jeffrey (1983) is the unified theory of preference that attributes probabilities and utilities to the same objects, that is propositions. By a "proposition" Jeffrey means, drawing upon Carnap's (1947,1950) semantic theory, the following: a non-empty set of
sentences in the decision maker's language is a "state description" if it is a maximally consistent set of sentences, i.e. a set that does not contain sentences which logically contradict each other and such that it contains exactly one of each contradictory pair of sentences in the language. A state description is a "possible world". According to the semantics of natural languages developed by Montague (1974) and Kripke (1963, 1972), the meaning of a sentence can be thought of as the set of state descriptions or possible worlds in which it would be true. In this way we can define a "proposition" as a set of state descriptions or possible worlds and say that each sentence of the decision maker's language is to be assigned a proposition. The objects of desires and beliefs are propositions and not sentences in order to avoid the possibility of fooling the decision maker just by offering him a bet on different sentences expressing the same proposition. In other words, the prerequisite of rational decision making according to Bayesian Theory is the ability to understand the language in a very strong sense: as a matter of fact, requiring that the decision maker must bet on propositions and not sentences, amounts to say that he ought to recognize logically equivalent sentences, for logically equivalent sentences in Montague's semantics denote the same proposition, and only one. I identify, as usually, state descriptions or possible worlds with "elementary events" in mathematical Probability Theory, and propositions with "events". To the set \( \mathfrak{A} \) of elementary events and to the Boolean algebra \( \mathfrak{B} \) of subsets of \( \mathfrak{A} \), we add as another primitive term the preference relation "\( \preceq \)" and we get the relational system (r.s. for short) \( \langle \mathfrak{A}, \mathfrak{B}, \preceq \rangle \). The question whether, it does exist an expected utility function representing preferences on it, it has been answered in the positive by Bolker (1967), who formulated sufficient conditions when \( \mathfrak{B} \) is a complete and atomless Boolean