Optimal control of conditional processes

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In this talk, we consider the conditional control problem introduced by P.L. Lions in his lectures at the College de France in November 2016. As originally stated, the problem does not fit in the usual categories of control problems considered in the literature, so its solution requires new ideas, if not new technology. In his lectures, Lions emphasized some of the major differences with the analysis of classical stochastic optimal control problems and in so doing, raised the question of the possible differences between the value functions resulting from optimization over the class of Markovian controls as opposed to the general family of open loop controls. While the equality of these values is accepted as a "folk theorem" in the classical theory of stochastic control, optimizing an objective function whose values strongly depend upon the past history of the controlled trajectories of the system is a strong argument in favor of differences between the optimization results over these two different classes of control processes. The goal of the talk is to elucidate this quandary and provide elements of response to Lions' original conjecture.