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Summary: A survey of our joint research work with Maria Serna on uncertain systems is presented in this paper. The study was originally motivated by a wish to understand the behaviour of a large web application when some of its component parts were subject to external attack (resulting in component degradation or even failure). In the absence of a priori failure information it is possible to constrain system behaviour between the best and worst possible outcomes.

Uncertain, multi-component systems can be modelled by orchestrations; an orchestration is a computation which operates in a globally-accessible, multi-user environment. When executed it calls a number of web-services and co-ordinates their responses. The behaviour of computations in web-environments can be highly uncertain: external web-services may be subject to periodic denial of service attacks and network failures, resulting in delayed, or even null, responses.

The reliability of an orchestration can be measured by assessing either the completeness of its behaviour (the number of computed results) or its response time (execution time). The behaviour of a system is assessed prior to execution (ex-ante) by modelling an unreliable web-environment as a parameterised uncertainty profile \( U \). The parameters of \( U \) bound the extent of behavioural damage that can occur to an orchestration in a faulty environment. Informally speaking \( U \) provides a blurred snapshot of operating conditions. An uncertainty profile \( U \) can be assessed using a two player angel/daemon (a/d) zero-sum game \( \Gamma(U) \): player a is motivated to maximise the behaviour of the orchestration whereas player d has the opposite intent. Uncertainty profiles have been applied to design a resilient matrix-product cloud application. The approach has also been applied to situations in social sciences, such as short-time macroeconomics (the IS-LM model) and voting games.

MSC:

68M11 Internet topics
91A80 Applications of game theory
91B64 Macroeconomic theory (monetary models, models of taxation)

Keywords:

uncertainty; uncertainty profiles; zero-sum games; angel/daemon games; matrix product; short-time macroeconomic models; voting games

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