8Lab
Stochastic analysis: probabilistic/continuous-stochastic logic from model checking to simulation

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a.a. 2023/2024

One slide sum-up on Stochastic Analysis

Concepts

- logics is the proper tool to capture system properties, their meaning, and their verification
- the transition from TS to DTMC and then to CTMC should be followed at the logic level
- this is: LTL/CTL, then PCTL, and then CSL
- in CSL we essentially estimate the overall probabilities of paths satisfying certain properties (U,X,F,G)

On verification

- model-checking: smart intelligent exploration of (finite) state space, exact result
- approximate model-checking: smart partial exploration of state space, with approximate result (ϵ, δ)
- simulation: draw of few runs/paths, especially for complex simulations

Tools

- need performance, hence, ad-hoc tools
- PRISM (symbolic modelchecker), will see Alchemist as a general simulator

Starting point and goals

References

- 08-repo: from virtuale (`https://github.com/mviroli/asmd23-public-models`)
- PRISM, to install (`https://www.prismmodelchecker.org/`)

General goals

- get acquainted with using multiple simulation to analyse CTMCs
- get acquainted with PRISM model checker
- play with SPN in PRISM
- play with DAP model presented in lesson 07

Tasks

PRISM

- Make the stochastic Readers & Writers Petri Net seen in lesson work: perform experiments to investigate the probability that something good happens within a bound
- Play with PRISM configuration to inspect steady-state proabilities of reading and writing (may need to play with options anche choose "linear equations method")

PRISM-VS-SCALA

- Take the communication channel example, and perform comparison of results between PRISM and our Scala approach
- Write Scala support for performing additional experiments and comparisons (e.g., *G* formulas, steady-state computations)

LARGE-SCALE-DESIGN

- Get acquainted with the simulations and the code for DAP and DAPGossip
- Implement and simulate a system where gossip-like broadcasts are used to send a message and get a reply from a node
- Can you perform a statistical experiment to estimate time of reply?

LLM-STOCHASTIC-ANALYSIS

- PRISM is rather well known, and perhaps LLMs know it. Can LLMs understand the meaning of a stochastic property? Can they solve (very) simple modelchecking? Can they preview what a simulation can produce?