

UBINET/SI5: Performance Evaluation of Networks

Homework 2

To be returned on 24 September 2024 at 9 am

Homeworks are a personal effort. Copied solutions will get 0 for a grade.

2.1 A functional database

A database can be in one of five states: idle (I), read operation (R), add operation (A), update operation (U), and delete operation (D) such that $\mathcal{E} = \{I, R, A, U, D\}$. The IT department has observed that the database remains idle for a time that is exponentially distributed with parameter μ_I . Read, add, update and delete operations all require an exponentially distributed time to complete, with respective parameters μ_R , μ_A , μ_U , and μ_D . It has been observed that a read operation is followed by either an update or a delete, with equal chances. After being idle, the database handles a read request or add request with equal probabilities. After an update, a delete or an add operation, the database becomes idle.

1. Explain why the database's state can be described by a continuous-time Markov chain.
2. Write the infinitesimal generator.
Draw the transition rate diagram.
3. Is this CTMC ergodic? Explain why.
4. Compute the stationary distribution. (It may be helpful to use the notation $\frac{1}{C} = \frac{4}{\mu_I} + \frac{2}{\mu_R} + \frac{2}{\mu_A} + \frac{1}{\mu_U} + \frac{1}{\mu_D}$.)
5. What is the utilization rate of this database?
6. The power consumption of the server storing the database is 10 W when the database is idle, 60 W when read operations are ongoing, and 70 W with all write operations (add, update or delete). What is the expected power consumption in the stationary regime?
7. According to you, if one looks to minimize the power consumption, which operation better be optimized?
Explain your reasoning.