Distributed Systems Part II
Exercise Sheet 5

Quiz

1 The Resilience of a Quorum System

a) Does a quorum system exist, which still works although all nodes of a specific quorum fail? Give an example or prove its nonexistence.

b) Consider the nearly all quorum system, which is made up of $n$ different quorums, each containing $n - 1$ servers. What is the resilience of this quorum system?

c) Can you think of a quorum system that contains as many quorums as possible? Note: the quorum system does not have to be minimal.

Basic

2 A Quorum System

Consider a Quorum System with 7 nodes numbered from 001 to 111, where each three nodes fulfilling $x \oplus y = z$ constitute a quorum. In the following picture this quorum system is represented: All nodes on a line (such as 111, 010, 101) and the nodes on the circle (010, 100, 110) form a quorum.

a) Of how many different quorums does this system consist and what are its work and its load?

b) Calculate its resilience $f$. Give an example where this quorum system does not work anymore with $f + 1$ faulty nodes.
3 Uniform Quorum Systems

Definitions:
- **s-Uniform**: A quorum system $\mathcal{S}$ is *s-uniform* if every quorum in $\mathcal{S}$ has exactly $s$ elements.
- **Balanced access strategy**: An access strategy $Z$ for a quorum system $\mathcal{S}$ is *balanced* if it satisfies $L_Z(v_i) = L$ for all $v_i \in V$.

Claim: An $s$-uniform quorum system $\mathcal{S}$ reaches an optimal load with a balanced access strategy\(^1\).

a) Describe in your own words, why this claim is true.

b) Prove the optimality of a balanced access strategy on an $s$-uniform quorum system.

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\(^1\)Use the assumption that a balanced access strategy exists.