Bayesian Node Scoring

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Miner Scoring - Beta Distribution

The updated scoring mechanism relies on a Baysian approach to score the reliability of miners in the Storb network, much like Storj [1]. They model their storage node audit process as being a binomial random variable with an unknown probability of success p[0,1], with each challenge being an independent Bernoulli Trial, the conjugate prior and posterior of which is the beta distribution Beta(,). We use the mean of the beta distribution as our Bayes estimator, $P = \frac{\alpha+x}{\alpha+\beta+n}$. Under the assumption that a miner responds to each challenge successfully, we arrive at the Bayes estimate of the success probability $P = \frac{\alpha+n}{\alpha+\beta+n}$. A forgetting factor $\lambda = 0.99$ is also involved in the process, to assign more consequential weight to the outcomes of newer challenges so that more established miners are heavily disincentivized from suddenly becoming unresponsive. Each miner begins with an initial α and initial β (we set them to 500 and 1000 respectively). Each time a miner succeeds to respond to a request the miner's α increases and it's β decreases, and vice versa if a miner fails to respond (Figure 1). Miners are periodically scored given their updated alpha and beta values (Figure 2).

GET_NEW_ALPHA_BETA(α, β, λ, w, S):

1 $v = 1$ **if** S **else** 0 // S indicates if the request was a success
2 $\alpha' = \lambda * \alpha + w * \frac{1+v}{2}$ // we set λ, the forgetting factor, to be 0.99
3 $\beta' = \lambda * \beta + w * \frac{1-v}{2}$
4 **return** α', β'

Figure 1: How new α and β values are obtained

SCORE_MINER(α_i, β_i):

1 score $= \frac{\alpha_i}{\alpha_i+\beta_i}$ // score for miner i
2 **return** score

Figure 2: Calculating miner score

The forgetting factor λ plays a very important role in the scoring process, it's effect being that we assign more weight to the outcomes of newer challenges so that more established miners are heavily disincentivized from suddenly becoming unresponsive (Figure 3).

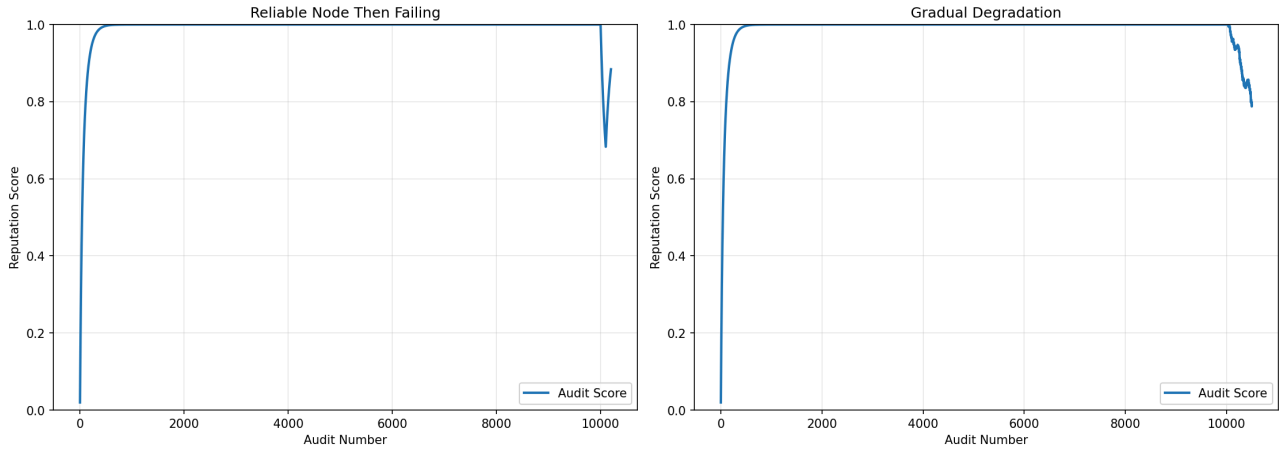

Figure 3: A visualization highlighting the effect of the forgetting factor λ. Notice how suddenly missing a few consecutive requests (left) has a heavy impact on the score of a node.