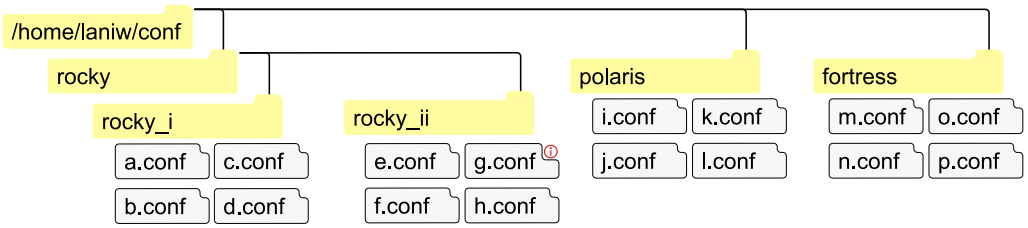
Rotating Index Load Balancer

Documentation



Fachhochschule Nordwestschweiz
Hochschule für Technik

Lani Wagner

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Introduction

This document serves as a documentation for the written implementation of a rotating index load balancer as described in the pre-production specification found at https://github.com/laniwfhnw/engw_specification/blob/main/engw_specification.pdf.

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1 Rotating Index Load Balancer Concept

To explain what the idea of a Rotating Index Load Balancer is, it is easiest to first explain what problem it solves with a simple example. Imagine a filesystem like the one shown in Figure 1. The goal is to provide a service that accepts analysis requests. These analysis requests are run over the system to calculate a result. The result is then returned to the requester. Imagine this service being an API, so there's not way of knowing when or how many requests we are going to get.

The simplest solution, once we get a request, would be to go through all of the files for one request and complete the analysis. Once all of the files have been included in the result we return the result. This works fine when there are not many requests coming in and the analyses do not need a long time to complete. A lot of the same operations are being done multiple times, though. Every time a file is read for one analysis and then another and then another the same operation is being performed. If the analysis requests come in at a similar time, relevant files can be read once to avoid expensive I/O operations.

The idea of reducing the amount of read operations $m \cdot n$ (where m is the number of analyses that each need to read n files) to n read operations is the main idea of a Rotating Index Load Balancer. Imagine an index that points to a file at all times, and that can rotate and point to all files in the filesystem. Every time it points to a file it reads that file and passes that data on to all the analyses. Once a request for an anlysis reaches the service, the service keeps track of the first file that analysis received. The service knows that the analysis has looked at all files when the index once again points to the file that the analysis started with.

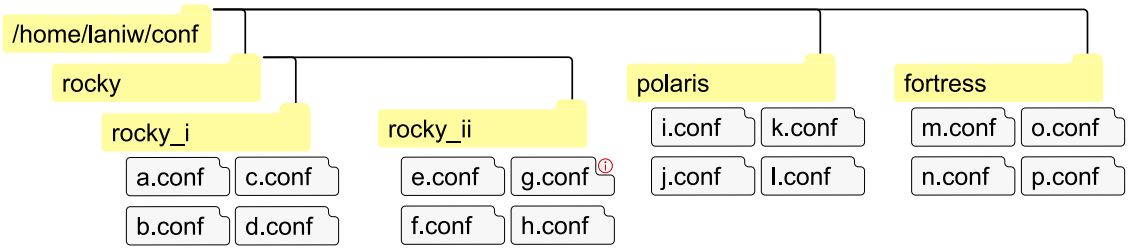

Figure 1: Visualization of a Rotating Index Load Balancer traversion through an example filesystem.

This paragraph describes an example execution using the filesystem in Figure 1. There are 16 different relevant configuration files. These files will be analyzed in three different ways. The first analysis A_1 determines the average length of the files (in lines). The second analysis A_2 determines the longest line in any of the files. Finally, the third analysis A_3 determines the size of those files (in bytes) that are two levels deeper than the root. At first the service is not doing anything because there are no active analyses running. Once the first analysis A_1 is requested, the index starts rotating and the file contents are analysed in A_1. The files `a.conf`, `b.conf`, `c.conf`, and `d.conf` are analysed without any other requests coming in. The request for analysis A_2 reaches the service right before the index points to `e.conf`, so `e.conf` is the first file A_2 analyses. A_3 comes in when the index points to `g.conf`. The contents of `g.conf` and `h.conf` are sent to all three analyses. The files `i.conf` through `p.conf` are only sent to analyses A_1 and A_2, since analysis A_3 does not care about those files. As soon as the index points to `a.conf` the second time the service knows that

analysis A_1 has been completed and it returns the result. The rotation continues without interruption until the index points to `e.conf`, at which point the result of analysis A_2 is returned. Now only analysis A_3 remains. It is still in the queue and receives the file contents of `e.conf` and `f.conf`. The result of analysis A_3 is returned as soon as the index points to `g.conf`. Now there are no more analyses in the queue, so the index rests at `g.conf` until another request arrives. The final state of the service is depicted in Figure 1.

This example does not illustrate what happens in certain special cases. For example the case that `g.conf` could get deleted during the rotation of $A_3$was not considered, so with our current approach there would be no way to know when to stop. For more detail on the exact implementation and how special cases are handled please take a look at the pre-production specification of the library[1].

2 Library Use

For a detailed description of the library interface refer to chapter two ("Design") of the Rotating Index Load Balancer pre-production specificiation[1].

2.1 Environment

Since this library is written in Java it can run on any operating system that can run the JVM. This library is ideally suited to run on a system with multiple cores. Every analysis can run on a separate thread as soon as the file contents of the current file have been loaded into memory. Ideally a host system with as many cores as possible would be running the analyses. For the ideal execution time this library should run on a system with enough RAM to run the application itself, hold the result of analyses and the largest file in the filesystem that the analyses are supposed to analyze.

2.2 Use Cases

This library is very well suited for a service that receives a lot of requests that need to analyze the same files over and over and over again with slightly different parameters each time. It can also be used in a very volatile filesystem (where file are getting deleted and created very regularly) although the accuracy of rotation completion and a little bit of performance will have to be sacrificed.

Absolutely no guarantees are made about the performance of this library. It is the responsibility of the developer implementing this technology to verify whether the use is appropriate.

[1] https://github.com/laniwfhnw/engw_specification/blob/main/engw_specification.pdf

3 Glossary

Term	Definition
Rotation	A single go around the list of files considered for analysis.
Rotation completion	Using the first file an analysis receives as the indication that all files in the filesystem have been considered.

Table 1: Glossary definitions.

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