Objectives

- Understand and model the AIMD algorithm utilizing MathWorks® MATLAB
- Determine the effects of varying:
  - The additive increase parameter
  - The multiplicative decrease parameter
  - The number of users
  - Network capacity

AIMD in Action

Assume that two users are sharing a network. The first user starts at 30% of the optimal network capacity and the second user starts at 60% of the optimal capacity. Since their sum of 90% is below the optimal network capacity of 100%, a constant amount \( a \) is added to the users’ transmission rates (additive increase). As a result, the users’ shared throughput is now greater than the optimal network bandwidth. Therefore the users’ transmission rates are reduced by a multiplicative factor \( b \) (multiplicative decrease), returning the shared throughput below the optimal network bandwidth. In the next iteration, transmission rates will be increased by \( a \), and so on.

![AIMD in Action](image1.png)

This setup was modeled in MATLAB, outputting both graphical and numerical results.

Results

Code was written in MATLAB to do the following:

- Simulate AIMD on a 2-user network with graphical and numerical results
- Create a table showing any desired range of parameters and resulting network performance
- Simulate AIMD and give performance statistics with an unlimited number of users

Case Study

An experiment was run in order to examine the effects of changing parameters \( a \) and \( b \) following a sudden increase in network traffic.

- Control group: Users did not change \( a \) and \( b \) in response to increase in network traffic.
- Experimental groups: Users responded to increase in traffic by changing \( a \) and \( b \).
- 15 iterations of increase/decrease in transmission rates were observed.
- Initially there were 4 users on the network, with initial additive increase factor \( a = 35 \) and initial multiplicative decrease factor \( b = 0.5 \).
- After 5 iterations, the number of users was increased to 7, and thus the load on the network suddenly increased.

The following results were observed:

- Time \( t \) for the users to converge toward an equally shared load
- Smoothness \( s \) of the oscillations, indicative of efficiency

Results of the Control Group and eight Experimental Groups:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Exp. 1</th>
<th>Exp. 2</th>
<th>Exp. 3</th>
<th>Exp. 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>( a )</td>
<td>35</td>
<td>35</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>( b )</td>
<td>0.5</td>
<td>0.7</td>
<td>0.3</td>
<td>0.7</td>
</tr>
<tr>
<td>( x_{init} )</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

For Further Information

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Acknowledgements

Math 610: Projects in Applied Mathematics

Analysis of the “Additive Increase Multiplicative Decrease” Model for Congestion Avoidance

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