

UNIX511NZA Assignment 02

Name	Aryan Khurana
Email	akhurana22@myseneca.ca
Student ID	145282216
Professor	Mohammed Nooruddin
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Screenshots

Starting the Log Server

```
aryank1511@aryanubuntu:~/Desktop/UNIX511-Seneca/_assignments/a2/server$ ./LogServer
1. Set the log level
2. Dump the log file here
0. Shut down
```

Showing all logs right now and the file being empty since we haven't started the logger yet

```
aryank1511@aryanubuntu:~/Desktop/UNIX511-Seneca/_assignments/a2/server$ ./LogServer
1. Set the log level
2. Dump the log file here
0. Shut down
2
Press any key to continue:
1. Set the log level
2. Dump the log file here
0. Shut down
```

```
server_log.txt U x
_assignment > a2 > server > server_log.txt
1 |
```

Starting the logger

```
PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS  SERIAL MONITOR
○ aryank1511@aryanubuntu:~/Desktop/UNIX511-Seneca/_assignments/a2$ ./travel
Logger initialized, listening on port 8081
```

Showing all logs from the logger by opening the server log text file (one new log every one second)

```
server_log.txt U X
_assignments > a2 > server > server_log.txt
110 Tue Dec 3 17:56:14 2024 DEBUG TravelSimulator.cpp:main:72 Drove the cars
117 Tue Dec 3 17:56:15 2024 DEBUG TravelSimulator.cpp:main:43 Added the fuel
118 Tue Dec 3 17:56:15 2024 DEBUG TravelSimulator.cpp:main:55 Set the efficiency
119 Tue Dec 3 17:56:15 2024 WARNING Automobile.cpp:addFuel:30 The grey 2013 Toyota Corolla is full of gas. Discarding the res
120 Tue Dec 3 17:56:15 2024 WARNING Automobile.cpp:addFuel:30 The red 2012 Honda Civic is full of gas. Discarding the rest...
121 Tue Dec 3 17:56:15 2024 WARNING Automobile.cpp:addFuel:30 The blue 2008 Chevrolet Impala is full of gas. Discarding the r
122 Tue Dec 3 17:56:15 2024 WARNING Automobile.cpp:addFuel:30 The black 2016 Cadillac Escalade is full of gas. Discarding the
123 Tue Dec 3 17:56:15 2024 DEBUG TravelSimulator.cpp:main:61 Added the fuel again
124 Tue Dec 3 17:56:15 2024 DEBUG TravelSimulator.cpp:main:72 Drove the cars
125 Tue Dec 3 17:56:16 2024 DEBUG TravelSimulator.cpp:main:43 Added the fuel
126 Tue Dec 3 17:56:16 2024 ERROR Automobile.cpp:drive:45 The black 2016 Cadillac Escalade has no gas left in the tank
127
128 Tue Dec 3 17:56:16 2024 DEBUG TravelSimulator.cpp:main:55 Set the efficiency
129 Tue Dec 3 17:56:16 2024 WARNING Automobile.cpp:addFuel:30 The grey 2013 Toyota Corolla is full of gas. Discarding the res
130 Tue Dec 3 17:56:16 2024 WARNING Automobile.cpp:addFuel:30 The red 2012 Honda Civic is full of gas. Discarding the rest...
131 Tue Dec 3 17:56:16 2024 WARNING Automobile.cpp:addFuel:30 The blue 2008 Chevrolet Impala is full of gas. Discarding the r
132 Tue Dec 3 17:56:16 2024 DEBUG TravelSimulator.cpp:main:61 Added the fuel again
133 Tue Dec 3 17:56:16 2024 DEBUG TravelSimulator.cpp:main:72 Drove the cars
134 Tue Dec 3 17:56:17 2024 DEBUG TravelSimulator.cpp:main:43 Added the fuel
135 Tue Dec 3 17:56:17 2024 DEBUG TravelSimulator.cpp:main:55 Set the efficiency
136 Tue Dec 3 17:56:17 2024 WARNING Automobile.cpp:addFuel:30 The grey 2013 Toyota Corolla is full of gas. Discarding the res
137 Tue Dec 3 17:56:17 2024 WARNING Automobile.cpp:addFuel:30 The red 2012 Honda Civic is full of gas. Discarding the rest...
138 Tue Dec 3 17:56:17 2024 WARNING Automobile.cpp:addFuel:30 The blue 2008 Chevrolet Impala is full of gas. Discarding the r
139 Tue Dec 3 17:56:17 2024 WARNING Automobile.cpp:addFuel:30 The black 2016 Cadillac Escalade is full of gas. Discarding the
140 Tue Dec 3 17:56:17 2024 DEBUG TravelSimulator.cpp:main:61 Added the fuel again
141 Tue Dec 3 17:56:17 2024 DEBUG TravelSimulator.cpp:main:72 Drove the cars
142 Tue Dec 3 17:56:18 2024 DEBUG TravelSimulator.cpp:main:43 Added the fuel
143 Tue Dec 3 17:56:18 2024 ERROR Automobile.cpp:drive:45 The black 2016 Cadillac Escalade has no gas left in the tank
144
145 Tue Dec 3 17:56:18 2024 DEBUG TravelSimulator.cpp:main:55 Set the efficiency
146 Tue Dec 3 17:56:18 2024 WARNING Automobile.cpp:addFuel:30 The grey 2013 Toyota Corolla is full of gas. Discarding the res
147 Tue Dec 3 17:56:18 2024 WARNING Automobile.cpp:addFuel:30 The red 2012 Honda Civic is full of gas. Discarding the rest...
148 Tue Dec 3 17:56:18 2024 WARNING Automobile.cpp:addFuel:30 The blue 2008 Chevrolet Impala is full of gas. Discarding the r
149 Tue Dec 3 17:56:18 2024 DEBUG TravelSimulator.cpp:main:61 Added the fuel again
150 Tue Dec 3 17:56:18 2024 DEBUG TravelSimulator.cpp:main:72 Drove the cars
151 Tue Dec 3 17:56:19 2024 DEBUG TravelSimulator.cpp:main:43 Added the fuel
152 Tue Dec 3 17:56:19 2024 ERROR Automobile.cpp:drive:45 The blue 2008 Chevrolet Impala has no gas left in the tank
153
```

Showing all logs from the logger by dumping them on the terminal using option 2 of the server C++ code (one new log every one second)

```
PROBLEMS    OUTPUT    DEBUG CONSOLE    TERMINAL    PORTS    SERIAL MONITOR
Tue Dec 3 17:56:20 2024 DEBUG TravelSimulator.cpp:main:61 Added the fuel again
Tue Dec 3 17:56:20 2024 DEBUG TravelSimulator.cpp:main:72 Drove the cars
Tue Dec 3 17:56:21 2024 DEBUG TravelSimulator.cpp:main:43 Added the fuel
Tue Dec 3 17:56:21 2024 ERROR Automobile.cpp:drive:45 The black 2016 Cadillac Escalade has no gas left in the tank

Tue Dec 3 17:56:21 2024 DEBUG TravelSimulator.cpp:main:55 Set the efficiency
Tue Dec 3 17:56:21 2024 WARNING Automobile.cpp:addFuel:30 The grey 2013 Toyota Corolla is full of gas. Discarding the res
Tue Dec 3 17:56:21 2024 WARNING Automobile.cpp:addFuel:30 The red 2012 Honda Civic is full of gas. Discarding the rest...
Tue Dec 3 17:56:21 2024 WARNING Automobile.cpp:addFuel:30 The blue 2008 Chevrolet Impala is full of gas. Discarding the r
Tue Dec 3 17:56:21 2024 DEBUG TravelSimulator.cpp:main:61 Added the fuel again
Tue Dec 3 17:56:21 2024 DEBUG TravelSimulator.cpp:main:72 Drove the cars
Tue Dec 3 17:56:22 2024 DEBUG TravelSimulator.cpp:main:43 Added the fuel
Tue Dec 3 17:56:22 2024 DEBUG TravelSimulator.cpp:main:55 Set the efficiency
Tue Dec 3 17:56:22 2024 WARNING Automobile.cpp:addFuel:30 The grey 2013 Toyota Corolla is full of gas. Discarding the res
Tue Dec 3 17:56:22 2024 WARNING Automobile.cpp:addFuel:30 The red 2012 Honda Civic is full of gas. Discarding the rest...
Tue Dec 3 17:56:22 2024 WARNING Automobile.cpp:addFuel:30 The blue 2008 Chevrolet Impala is full of gas. Discarding the r
Tue Dec 3 17:56:22 2024 WARNING Automobile.cpp:addFuel:30 The black 2016 Cadillac Escalade is full of gas. Discarding the r
Tue Dec 3 17:56:22 2024 DEBUG TravelSimulator.cpp:main:61 Added the fuel again
Tue Dec 3 17:56:22 2024 DEBUG TravelSimulator.cpp:main:72 Drove the cars
Tue Dec 3 17:56:23 2024 DEBUG TravelSimulator.cpp:main:43 Added the fuel
Tue Dec 3 17:56:23 2024 ERROR Automobile.cpp:drive:45 The black 2016 Cadillac Escalade has no gas left in the tank

Tue Dec 3 17:56:23 2024 DEBUG TravelSimulator.cpp:main:55 Set the efficiency
Tue Dec 3 17:56:23 2024 WARNING Automobile.cpp:addFuel:30 The grey 2013 Toyota Corolla is full of gas. Discarding the res
Tue Dec 3 17:56:23 2024 WARNING Automobile.cpp:addFuel:30 The red 2012 Honda Civic is full of gas. Discarding the rest...
Tue Dec 3 17:56:23 2024 WARNING Automobile.cpp:addFuel:30 The blue 2008 Chevrolet Impala is full of gas. Discarding the r
Tue Dec 3 17:56:23 2024 DEBUG TravelSimulator.cpp:main:61 Added the fuel again
Tue Dec 3 17:56:23 2024 DEBUG TravelSimulator.cpp:main:72 Drove the cars
Tue Dec 3 17:56:24 2024 DEBUG TravelSimulator.cpp:main:43 Added the fuel
Tue Dec 3 17:56:24 2024 ERROR Automobile.cpp:drive:45 The blue 2008 Chevrolet Impala has no gas left in the tank

Tue Dec 3 17:56:24 2024 ERROR Automobile.cpp:drive:45 The black 2016 Cadillac Escalade has no gas left in the tank

Tue Dec 3 17:56:24 2024 DEBUG TravelSimulator.cpp:main:55 Set the efficiency
Tue Dec 3 17:56:24 2024 WARNING Automobile.cpp:addFuel:30 The grey 2013 Toyota Corolla is full of gas. Discarding the res
Tue Dec 3 17:56:24 2024 WARNING Automobile.cpp:addFuel:30 The red 2012 Honda Civic is full of gas. Discarding the rest...
Tue Dec 3 17:56:24 2024 DEBUG TravelSimulator.cpp:main:61 Added the fuel again
Tue Dec 3 17:56:24 2024 DEBUG TravelSimulator.cpp:main:72 Drove the cars
Tue Dec 3 17:56:25 2024 DEBUG TravelSimulator.cpp:main:43 Added the fuel
Tue Dec 3 17:56:25 2024 DEBUG TravelSimulator.cpp:main:55 Set the efficiency
Tue Dec 3 17:56:25 2024 WARNING Automobile.cpp:addFuel:30 The grey 2013 Toyota Corolla is full of gas. Discarding the res
Tue Dec 3 17:56:25 2024 WARNING Automobile.cpp:addFuel:30 The red 2012 Honda Civic is full of gas. Discarding the rest...
Tue Dec 3 17:56:25 2024 WARNING Automobile.cpp:addFuel:30 The blue 2008 Chevrolet Impala is full of gas. Discarding the r
Tue Dec 3 17:56:25 2024 WARNING Automobile.cpp:addFuel:30 The black 2016 Cadillac Escalade is full of gas. Discarding the r
Tue Dec 3 17:56:25 2024 DEBUG TravelSimulator.cpp:main:61 Added the fuel again
Tue Dec 3 17:56:25 2024 DEBUG TravelSimulator.cpp:main:72 Drove the cars
Tue Dec 3 17:56:26 2024 DEBUG TravelSimulator.cpp:main:43 Added the fuel
Tue Dec 3 17:56:26 2024 ERROR Automobile.cpp:drive:45 The black 2016 Cadillac Escalade has no gas left in the tank

Tue Dec 3 17:56:26 2024 DEBUG TravelSimulator.cpp:main:55 Set the efficiency
Tue Dec 3 17:56:26 2024 WARNING Automobile.cpp:addFuel:30 The grey 2013 Toyota Corolla is full of gas. Discarding the res
Tue Dec 3 17:56:26 2024 WARNING Automobile.cpp:addFuel:30 The red 2012 Honda Civic is full of gas. Discarding the rest...
Tue Dec 3 17:56:26 2024 WARNING Automobile.cpp:addFuel:30 The blue 2008 Chevrolet Impala is full of gas. Discarding the r
Tue Dec 3 17:56:26 2024 DEBUG TravelSimulator.cpp:main:61 Added the fuel again
Tue Dec 3 17:56:26 2024 DEBUG TravelSimulator.cpp:main:72 Drove the cars
Tue Dec 3 17:56:27 2024 DEBUG TravelSimulator.cpp:main:43 Added the fuel
Tue Dec 3 17:56:27 2024 DEBUG TravelSimulator.cpp:main:55 Set the efficiency
Tue Dec 3 17:56:27 2024 WARNING Automobile.cpp:addFuel:30 The grey 2013 Toyota Corolla is full of gas. Discarding the res
Tue Dec 3 17:56:27 2024 WARNING Automobile.cpp:addFuel:30 The red 2012 Honda Civic is full of gas. Discarding the rest...
Tue Dec 3 17:56:27 2024 WARNING Automobile.cpp:addFuel:30 The blue 2008 Chevrolet Impala is full of gas. Discarding the r
Tue Dec 3 17:56:27 2024 WARNING Automobile.cpp:addFuel:30 The black 2016 Cadillac Escalade is full of gas. Discarding the r
Tue Dec 3 17:56:27 2024 DEBUG TravelSimulator.cpp:main:61 Added the fuel again
Tue Dec 3 17:56:27 2024 DEBUG TravelSimulator.cpp:main:72 Drove the cars
Press any key to continue:
```

Changing the log level to error

```
Tue Dec 3 17:56:27 2024 DEBUG TravelSimulator.cpp:main:72 Drove the cars
Press any key to continue:
1. Set the log level
2. Dump the log file here
0. Shut down
1
Enter log level (0-DEBUG, 1-WARNING, 2-ERROR, 3-CRITICAL): 2
Sending command: Set Log Level=2
Sent 15 bytes
1. Set the log level
2. Dump the log file here
0. Shut down
```

Now the dump will only start showing error logs

```
PROBLEMS  OUTPUT  DEBUG CONSOLE  TERMINAL  PORTS  SERIAL MONITOR
Tue Dec 3 17:56:54 2024 DEBUG TravelSimulator.cpp:main:55 Set the efficiency
Tue Dec 3 17:56:54 2024 WARNING Automobile.cpp:addFuel:30 The grey 2013 Toyota Corolla is full of gas. Discarding the res
Tue Dec 3 17:56:54 2024 WARNING Automobile.cpp:addFuel:30 The red 2012 Honda Civic is full of gas. Discarding the rest...
Tue Dec 3 17:56:54 2024 DEBUG TravelSimulator.cpp:main:61 Added the fuel again
Tue Dec 3 17:56:54 2024 DEBUG TravelSimulator.cpp:main:72 Drove the cars
Tue Dec 3 17:56:55 2024 DEBUG TravelSimulator.cpp:main:43 Added the fuel
Tue Dec 3 17:56:55 2024 DEBUG TravelSimulator.cpp:main:55 Set the efficiency
Tue Dec 3 17:56:55 2024 WARNING Automobile.cpp:addFuel:30 The grey 2013 Toyota Corolla is full of gas. Discarding the res
Tue Dec 3 17:56:55 2024 WARNING Automobile.cpp:addFuel:30 The red 2012 Honda Civic is full of gas. Discarding the rest...
Tue Dec 3 17:56:55 2024 WARNING Automobile.cpp:addFuel:30 The blue 2008 Chevrolet Impala is full of gas. Discarding the r
Tue Dec 3 17:56:55 2024 WARNING Automobile.cpp:addFuel:30 The black 2016 Cadillac Escalade is full of gas. Discarding the
Tue Dec 3 17:56:55 2024 DEBUG TravelSimulator.cpp:main:61 Added the fuel again
Tue Dec 3 17:56:55 2024 DEBUG TravelSimulator.cpp:main:72 Drove the cars
Tue Dec 3 17:56:56 2024 DEBUG TravelSimulator.cpp:main:43 Added the fuel
Tue Dec 3 17:56:56 2024 ERROR Automobile.cpp:drive:45 The black 2016 Cadillac Escalade has no gas left in the tank

Tue Dec 3 17:56:56 2024 DEBUG TravelSimulator.cpp:main:55 Set the efficiency
Tue Dec 3 17:56:56 2024 WARNING Automobile.cpp:addFuel:30 The grey 2013 Toyota Corolla is full of gas. Discarding the res
Tue Dec 3 17:56:56 2024 WARNING Automobile.cpp:addFuel:30 The red 2012 Honda Civic is full of gas. Discarding the rest...
Tue Dec 3 17:56:56 2024 WARNING Automobile.cpp:addFuel:30 The blue 2008 Chevrolet Impala is full of gas. Discarding the r
Tue Dec 3 17:56:56 2024 DEBUG TravelSimulator.cpp:main:61 Added the fuel again
Tue Dec 3 17:56:56 2024 DEBUG TravelSimulator.cpp:main:72 Drove the cars
Tue Dec 3 17:56:57 2024 DEBUG TravelSimulator.cpp:main:43 Added the fuel
Tue Dec 3 17:56:57 2024 DEBUG TravelSimulator.cpp:main:55 Set the efficiency
Tue Dec 3 17:56:57 2024 WARNING Automobile.cpp:addFuel:30 The grey 2013 Toyota Corolla is full of gas. Discarding the res
Tue Dec 3 17:56:57 2024 WARNING Automobile.cpp:addFuel:30 The red 2012 Honda Civic is full of gas. Discarding the rest...
Tue Dec 3 17:56:57 2024 WARNING Automobile.cpp:addFuel:30 The blue 2008 Chevrolet Impala is full of gas. Discarding the r
Tue Dec 3 17:56:57 2024 WARNING Automobile.cpp:addFuel:30 The black 2016 Cadillac Escalade is full of gas. Discarding the
Tue Dec 3 17:56:57 2024 DEBUG TravelSimulator.cpp:main:61 Added the fuel again
Tue Dec 3 17:56:57 2024 DEBUG TravelSimulator.cpp:main:72 Drove the cars
Tue Dec 3 17:56:58 2024 ERROR Automobile.cpp:drive:45 The black 2016 Cadillac Escalade has no gas left in the tank

Tue Dec 3 17:56:59 2024 ERROR Automobile.cpp:drive:45 The blue 2008 Chevrolet Impala has no gas left in the tank
Tue Dec 3 17:56:59 2024 ERROR Automobile.cpp:drive:45 The black 2016 Cadillac Escalade has no gas left in the tank
Tue Dec 3 17:57:01 2024 ERROR Automobile.cpp:drive:45 The black 2016 Cadillac Escalade has no gas left in the tank
Tue Dec 3 17:57:03 2024 ERROR Automobile.cpp:drive:45 The black 2016 Cadillac Escalade has no gas left in the tank
Tue Dec 3 17:57:04 2024 ERROR Automobile.cpp:drive:45 The blue 2008 Chevrolet Impala has no gas left in the tank
Tue Dec 3 17:57:04 2024 ERROR Automobile.cpp:drive:45 The black 2016 Cadillac Escalade has no gas left in the tank
Tue Dec 3 17:57:06 2024 ERROR Automobile.cpp:drive:45 The black 2016 Cadillac Escalade has no gas left in the tank
Tue Dec 3 17:57:08 2024 ERROR Automobile.cpp:drive:45 The black 2016 Cadillac Escalade has no gas left in the tank
Tue Dec 3 17:57:09 2024 ERROR Automobile.cpp:drive:45 The blue 2008 Chevrolet Impala has no gas left in the tank
Tue Dec 3 17:57:09 2024 ERROR Automobile.cpp:drive:45 The black 2016 Cadillac Escalade has no gas left in the tank

Press any key to continue:█
```

Stopping the logger using CTRL + C

```
● aryank1511@aryanubuntu:~/Desktop/UNIX511-Seneca/_assignments/a2$ ./travel
Logger initialized, listening on port 8081
^CThe grey 2013 Toyota Corolla has 43.8 left in the tank
The red 2012 Honda Civic has 44.2 left in the tank
The blue 2008 Chevrolet Impala has 42.5 left in the tank
The black 2016 Cadillac Escalade has 37.5 left in the tank
○ aryank1511@aryanubuntu:~/Desktop/UNIX511-Seneca/_assignments/a2$ █
```

Stopping the log server using one of the input options

```
Press any key to continue:
1. Set the log level
2. Dump the log file here
0. Shut down
0
○ aryank1511@aryanubuntu:~/Desktop/UNIX511-Seneca/_assignments/a2/server$ █
```


Stopping the log server using CTRL + C

```
aryank1511@aryanubuntu:~/Desktop/UNIX511-Seneca/_assignments/a2/server$ ./LogServer
1. Set the log level
2. Dump the log file here
0. Shut down
^Caryank1511@aryanubuntu:~/Desktop/UNIX511-Seneca/_assignments/a2/server$
```

Questions

1. What are syslog and rsyslog? Specifically, name three features of syslog / rsyslog and compare them to your embedded debug logging. Will there be any overlap of information?

Answer) Syslog is basically a standard way to collect and manage logs from different systems, making it easy to keep track of what's going on across multiple machines. Rsyslog is an upgraded version of syslog with extra features, like better performance and more protocol support.

When we talk about features, here are a few that stand out:

- First, there's **centralized logging**, where logs from various systems can be collected in one place for easy monitoring.
- Then, **log filtering** lets you sort logs based on their severity level (like errors, warnings, or informational logs) and route them accordingly.
- **Log rotation** is another important feature that prevents log files from getting too large by automatically archiving or trimming old logs.

Now, comparing this to embedded debug logging, there is some overlap. Both methods are used to gather logs, but the focus is different. Embedded debug logging is typically used for detailed, temporary logs to help developers troubleshoot specific issues on embedded devices.

On the other hand, syslog/rsyslog is used for larger, system-wide log management, often in a production environment. You wouldn't usually have the kind of granular, real-time debugging information in syslog that you would in embedded logs, so while the purpose is similar, the scale and level of detail are different.

2. Name five features of syslog-ng.

Answer) Syslog-ng takes logging a step further with some cool features:

- **Flexible Log Routing:** You can direct logs to different destinations based on their content or source, giving you more control over how and where logs are sent.
- **Multithreading:** This means it can handle multiple logs at once, which is super helpful for systems with high log volumes and improves overall performance.
- **Log Encryption:** Syslog-ng supports encrypting log messages in transit, making it more secure, especially for sensitive log data.
- **Database Integration:** You can send logs directly to a database, which is really useful for running queries on logs or storing them long-term.
- **Log Parsing and Enrichment:** It has the ability to parse logs and add extra information or context, which helps in understanding the log data better and making it more actionable.

3. Name five ways syslog-ng is an improvement over syslog/rsyslog.

Answer) Syslog-ng improves on traditional syslog and rsyslog in several key ways:

- **Advanced Routing:** Unlike syslog, which has basic routing capabilities, syslog-ng lets you route logs based on their content, which allows for a more tailored logging setup.
- **Multithreading:** Syslog-ng handles multiple log messages in parallel, so it can handle much higher log volumes and improve system performance.
- **Log Parsing:** It allows you to extract more useful information from logs, which syslog and rsyslog don't do as easily.
- **Security:** Syslog-ng supports encryption, so your logs are secure while being transmitted, which is an advantage over syslog, which doesn't have built-in encryption support.
- **Flexible Storage:** Syslog-ng can send logs to a variety of destinations, including databases, which is something syslog and rsyslog lack. This makes log storage and querying much more efficient.

4. Consider a Log Server that has to manage embedded logs for a massive amount of processes on a massive amount of machines. Name three ways the server could manage the connections to each process.

Answer) When you have to handle logs from so many processes and machines, managing those connections becomes a huge challenge. Here are a few ways to tackle it:

- **Load Balancing:** You can distribute incoming log connections across multiple servers to ensure no single server gets overwhelmed. This helps with scalability and reduces the risk of downtime.
- **Log Aggregation:** The server can use an aggregation strategy, where logs from different machines and processes are grouped together before being processed. This way, the server doesn't need to handle each log individually.
- **Connection Pooling:** By pooling connections, the server can reuse existing connections for new log data instead of constantly opening new ones. This reduces the overhead and speeds up the logging process.

5. Consider a Log Server that has to manage embedded logs for a massive amount of processes on a massive amount of machines. With such a large amount of data in the logs, name three ways a user could extract useful information from them (be general).

Answer) With so much data flowing through the logs, finding the useful bits can be a real challenge. Here's how a user might go about it:

- **Log Filtering:** By setting up filters based on keywords, severity levels, or specific processes, users can narrow down logs to just what's needed, making it easier to spot issues.
- **Data Aggregation:** Aggregating logs to find patterns or trends across different systems can help in identifying system-wide issues or frequent errors that need attention.
- **Log Parsing and Structuring:** Once logs are parsed, users can extract meaningful insights, like performance metrics or error rates, which are far more useful than raw log data. This can help prioritize where to focus efforts for troubleshooting or optimization.

6. Explain how gdb could be used on a Linux machine to attach to a process and get thread information. Is this also useful in debugging?

Answer) Using **gdb** (GNU Debugger) on a Linux machine, you can attach it to a running process by using the command `gdb -p <PID>`, where `<PID>` is the Process ID of the application you're interested in. Once attached, gdb allows you to inspect and manipulate the process in real-time.

To get thread information, you can use commands like `info threads` within gdb, which will show you all the threads running in the process. You can then switch between threads using the `thread <num>` command to inspect them individually.

This is incredibly useful for debugging, especially when you're dealing with multi-threaded applications. It lets you pause the program, examine the state of each thread, and pinpoint issues like deadlocks, race conditions, or unexpected behavior in specific threads, all of which can be tricky to debug using just application logs.