Final Project

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Simulation Parameters

Parameter	Value
Burstiness Values	1.1, 1.3, 2, 5, 10, 20, 30, 70, 100
Simulation Time	10^3 seconds
Period Print (periodPrintLR)	10^3 samples
Block Size	10^1 packets

Table 1: Simulation parameters.

Project Structure

The main simulation entry point is `main.py`, which parses command-line arguments and invokes the `Simulation.run_simulation` method. The simulation logic is implemented in `Simulation.py`, which contains the `Simulation` class to run simulations, save results, and display a progress bar. Global variables, such as `periodPrintLR` and `blockSize`, are defined in `Globals.py`.

Traffic sources are defined in separate classes. `ConstantSource.py` implements a source with a constant transmission rate, `PoissonSource.py` models Poisson-distributed traffic, and `BurstySource.py` handles highly bursty traffic with ON/OFF patterns. The queueing behavior is managed by `QueueClass.py`, which simulates the infinite capacity queue.

For distributed simulations, `DistributedSimulation.py` enables deployment and execution of simulations across multiple machines using SSH and SCP. Results are stored as CSV files in the `results/` directory and analyzed using the `plotResults.ipynb` notebook, which generates visualizations of the data.

Results

Figure 1 shows the average response times of the three traffic sources as the burstiness of the video traffic increases. The Poisson source (data traffic) and constant source (voice traffic) maintain nearly identical average response times throughout all burstiness values. However, as the burstiness increases, their response times rise slightly due to the increased competition for queue resources.

The bursty source (video traffic) is the most affected by burstiness. Its response time grows almost linearly with increasing burstiness, reaching approximately 0.07 time units when the burstiness value is 100. This behavior makes sense because increasing burstiness causes more data to be sent within shorter intervals, overloading the queue. Furthermore, the bursty source is most impacted as it inherently sends many packets simultaneously during ON periods, exacerbating the load on the queue.

The confidence intervals for the response times are shown in Table 2, as they are not very visible in Figure 1. As burstiness increases, the confidence intervals become wider, reflecting greater variability in the response times. This variability aligns with the increased intensity and

clustering of data arrivals in bursty traffic patterns, which can lead to fluctuations in queueing delays.

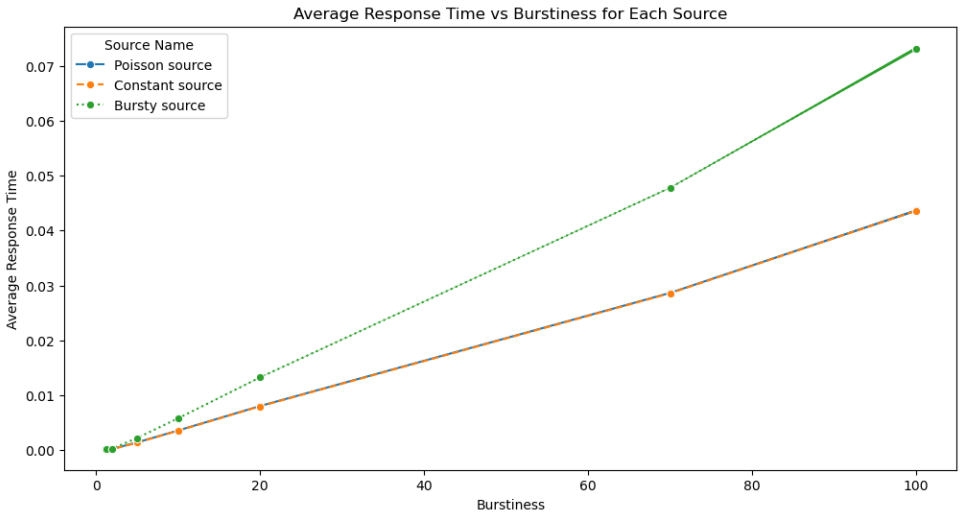

Figure 1: Average Response Time vs. Burstiness for each traffic source.

Figure 2 illustrates the variation in response times for each burstiness value using boxplots. This figure highlights the emergence of significant outliers, particularly for the bursty traffic, at higher burstiness values. These outliers seem to follow an exponential distribution, reflecting the ON/OFF behavior of the bursty source. Despite the presence of outliers, there is a noticeable concentration of response times around the mean, which increases linearly as burstiness grows.

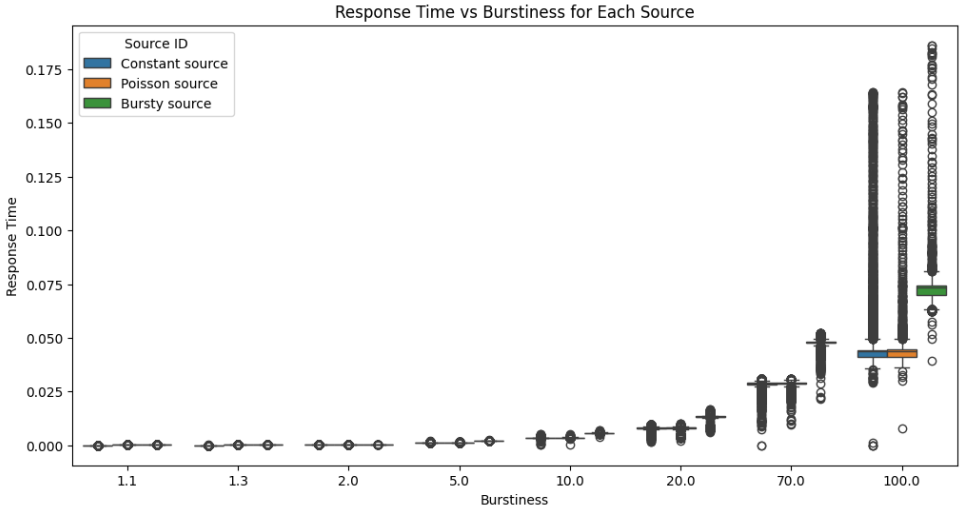

Figure 2: Response Time vs. Burstiness for each traffic source (boxplot).

Appendix

Source ID	Burstiness	Avg Resp Time	Source Name	CI Lower	CI Upper
1	1.1	0.000143	Poisson source	0.000143	0.000143
1	1.3	0.000152	Poisson source	0.000152	0.000152
1	2.0	0.000247	Poisson source	0.000247	0.000247
1	5.0	0.001424	Poisson source	0.001424	0.001425
1	10.0	0.003595	Poisson source	0.003593	0.003597
1	20.0	0.008051	Poisson source	0.008036	0.008067
1	70.0	0.028656	Poisson source	0.028622	0.028689
1	100.0	0.043652	Poisson source	0.043430	0.043874
2	1.1	0.000098	Constant source	0.000098	0.000098
2	1.3	0.000107	Constant source	0.000107	0.000107
2	2.0	0.000202	Constant source	0.000202	0.000202
2	5.0	0.001380	Constant source	0.001380	0.001381
2	10.0	0.003547	Constant source	0.003546	0.003548
2	20.0	0.007998	Constant source	0.007990	0.008005
2	70.0	0.028586	Constant source	0.028570	0.028603
2	100.0	0.043616	Constant source	0.043507	0.043725
3	1.1	0.000145	Bursty source	0.000145	0.000145
3	1.3	0.000159	Bursty source	0.000159	0.000159
3	2.0	0.000310	Bursty source	0.000310	0.000310
3	5.0	0.002224	Bursty source	0.002224	0.002225
3	10.0	0.005803	Bursty source	0.005800	0.005805
3	20.0	0.013262	Bursty source	0.013234	0.013290
3	70.0	0.047796	Bursty source	0.047732	0.047860
3	100.0	0.073169	Bursty source	0.072844	0.073494

Table 2: Response times with confidence intervals for each source and burstiness value.