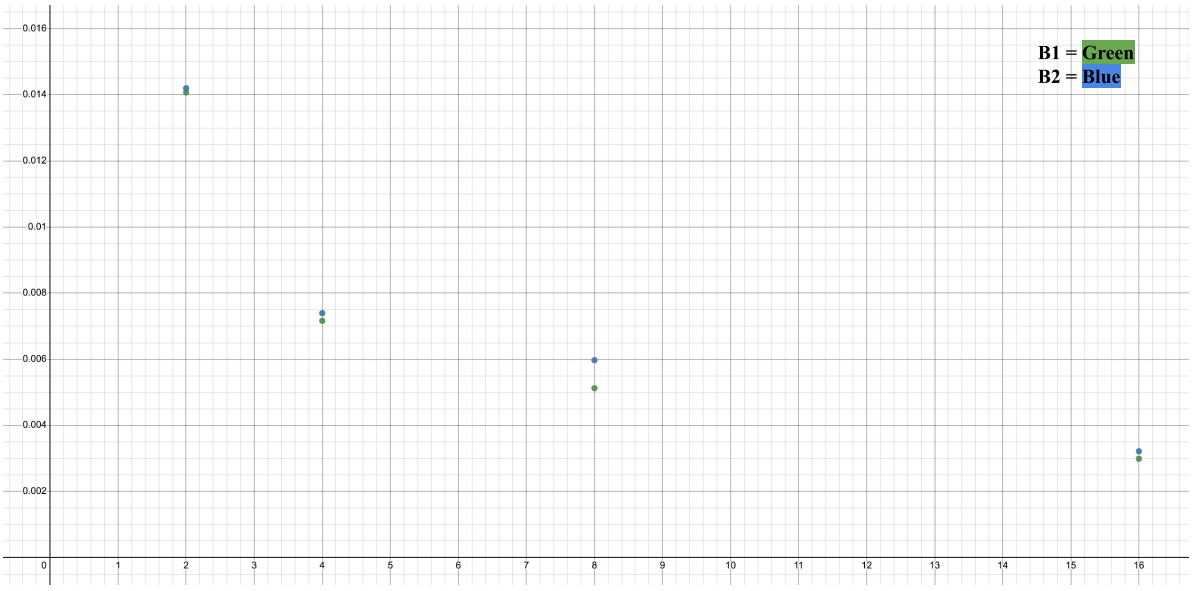
**CS 131 Lab 3**
**Andy Tran**

| "word" | 2 | 4 | 8 | 16 |
|---|---|---|---|---|
| B1 | 0.0140841 | 0.00729239 | 0.0058887 | 0.0030373 |
| B2 | 0.0141029 | 0.0077192 | 0.0060062 | 0.0032566 |

| "the" | 2 | 4 | 8 | 16 |
|---|---|---|---|---|
| B1 | 0.01414 | 0.00714625 | 0.00370799 | 0.00297047 |
| B2 | 0.0142157 | 0.00725711 | 0.0058859 | 0.00320398 |

| "a" | 2 | 4 | 8 | 16 |
|---|---|---|---|---|
| B1 | 0.0139893 | 0.00704855 | 0.0057741 | 0.00295906 |
| B2 | 0.0142851 | 0.00720306 | 0.00602267 | 0.00318263 |

**Processes vs Time**




**Through the data and the graph, the number of processes affects the runtime. As the number of processes increases, the runtime decreases. This could be due to more work being split amongst the number of processes so each process has less work that can be done in parallel.**

**1. MPI Reduce Topology**

**The implementation of MPI Reduce Topology is to take the elements in the specified buffer from each process and use an MPI Operation to combine it together while keeping its placement. So if the buffer was an array that each process had, every element of index i would be combined together with the specified MPI Operation and so on. And if there is only one element in the buffer for each process then MPI Reduce would use its MPI Operation to get the result. And this result would be given to a specified root process.**

**2. Ring Topology Runtime Effects**

**The Ring Topology affects the runtime because each process would have to send intermediate results back to the previous process and onward until process 0. So this affects runtime because each time a message is sent and received, it takes time and with more processes that time adds up even if the processing time decreases. So for N processes, Ring Topology would have to send N-1 messages, whereas Reduce Topology still only has one MPI_Reduce call.**

**3. Ring Topology Faster Than Reduce Topology**

**There can be cases where the Ring Topology may be faster than the Reduce Topology when the time to pass messages is close or better than reducing. It would be when the number of messages is small, as we see the difference in B1 and B2 especially with 2 processes, which had the smallest difference compared to the other number of processes. So the Ring Topology can be faster than Reduce Topology when the number of processes are low.**

**4. Number of Processes and Number of Messages Passed**

| **Processes:** | **2** | **4** | **8** | **16** |
|---|---|---|---|---|
| **Messages** | **1** | **3** | **7** | **15** |