Name Mashiat Mustaq

Student ID 1705005

OFFLINE 1-REPORT

**BFS Runtime:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Vertices** | **Edges** | **Adjacency Matrix Runtime(nanoseconds)** | **Adjacency List Runtime (nanoseconds)** |
| 1000 | 1000 | 3114000 | 800 |
| 2000 | 3121100 | 336300 |
| 4000 | 3121700 | 948900 |
| 8000 | 3127000 | 1395400 |
| 16000 | 3127900 | 1455000 |
| 32000 | 4685600 | 1545630 |
| 64000 | 4684000 | 1565000 |
| 2000 | 2000 | 9372800 | 40200 |
| 4000 | 12494300 | 883500 |
| 8000 | 12497200 | 1132900 |
| 16000 | 12497400 | 1565400 |
| 32000 | 14059000 | 1559000 |
| 64000 | 12500100 | 1565200 |
| 128000 | 14061800 | 1562100 |
| 256000 | 20310900 | 4689800 |
| 4000 | 4000 | 32805700 | 80230 |
| 8000 | 42177600 | 1121900 |
| 16000 | 48426700 | 1555000 |
| 32000 | 48429400 | 1562500 |
| 64000 | 49985300 | 1558800 |
| 128000 | 54671800 | 3124600 |
| 256000 | 54674800 | 4686400 |
| 512000 | 64047500 | 9372800 |
| 1024000 | 79665900 | 20304900 |
| 8000 | 8000 | 144871400 | 202400 |
| 16000 | 204636400 | 1562400 |
| 32000 | 215570700 | 1565200 |
| 64000 | 201312700 | 1562100 |
| 128000 | 215574300 | 4686700 |
| 256000 | 208156100 | 6248700 |
| 512000 | 210398100 | 10934900 |
| 1024000 | 215574700 | 20310800 |
| 2048000 | 249941400 | 42846300 |
| 4096000 | 331172800 | 82796600 |
| 16000 | 16000 | 404500500 | 1562200 |
| 32000 | 715085200 | 3124600 |
| 64000 | 828475800 | 4687000 |
| 128000 | 826368900 | 5583000 |
| 256000 | 822145300 | 6251000 |
| 512000 | 838132900 | 12497100 |
| 1024000 | 829812200 | 24994100 |
| 2048000 | 821440400 | 43739700 |
| 4096000 | 854420200 | 84355200 |
| 8192000 | 994579600 | 169503500 |
| 16384000 | 1253901700 | 321799300 |

1. **What is the impact on runtime if we keep |V| unchanged and double |E| for adjacency list? Why is it so?**

When |V|<<|E|, the runtime almost doubles when we keep |V| unchanged and double |E| for adjacency list. Otherwise, it stays relatively the same.

Since the runtime for BFS on adjacency list is around n+m, where n is |V| and m is |E|, then if m>>n then the effect of doubling the edge almost doubles the runtime otherwise it stays the same.

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Since the runtime for BFS on adjacency list is around n+m, where n=|V| and m=|E|, then if n>>m, the effect of doubling the vertices doubles the runtime.

1. **What is the impact on runtime if we keep |V| unchanged and double |E| for adjacency matrix? Why is it so?**

Since the runtime for BFS on adjacency matrix is around n2 where n=|V|, the runtime almost remains the same, if we keep |V| unchanged and double |E| for adjacency matrix.

1. **What is the impact on runtime if we keep |E| unchanged and double |V| for adjacency matrix? Why is it so?**

Since the runtime for BFS on adjacency matrix is around n2 where n=|V|, the runtime almost fourfolds if we keep |E| unchanged and double |V| for adjacency matrix.

1. **For the same |E| and |V|, why are the runtimes for adjacency list and adjacency matrix representation different? Which one is higher and why?**

For the same |E| and |V| the runtimes of adjacency matrix and adjacency list are very different, since the runtime for adjacency list is around n+m and for adjacency matrix is around n2 where n=|V| and m=|E|. When n is huge, the runtime of adjacency matrix is higher than adjacency list since the time complexity of adjacency matrix increases by order of n2 where adjacency list increases by order of n+m.