Rust Final Project

I had to slightly alter my proposal because the other data set was not large enough to get a good idea of how the data was connected. I switch to a data set that only looks at Facebook data. I wanted to see how connected the data was and how connected the people were and what vertices are most connected. Using things like mean and median show connected the people are and how densely connected the data is. I will address the implications of the data on the graph's structure and connectivity.

The given results summarize the distances between different vertices in a graph, calculated using breadth-first search (BFS) from a specific starting vertex.

First, the mean is reported as 3.84. This figure indicates that, on average, vertices are relatively close to one another in terms of path length. Such a low mean distance suggests that the graph is well-connected, a feature often observed in social networks and other real-world graphs. This connectivity may facilitate the flow of information or interactions across the network.

The maximum distance between different vertices is reported as 7. This figure represents the longest shortest path between any two vertices in the graph and serves as an indication of the graph's diameter. A relatively low maximum distance implies that the graph is not particularly expansive in terms of path length. This compactness is characteristic of small-world networks, which often exhibit short path lengths despite having many nodes.

The median distance between different vertices is 4.00, which matches closely with the mean distance. This suggests a symmetric distribution of distances, with half of the distances between vertices being less than or equal to 4.00 and the other half being greater. Such a distribution points to a balanced structure within the network, where most vertices are connected through paths of moderate length.

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Mean distance between different vertices: 3.84
Maximum distance between different vertices: 7
Median distance between different vertices: 4.00
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The lowest 15 distances begin with a distance of 0 from the starting vertex, followed by many vertices at distances of 1 and 2. This pattern suggests the presence of a dense cluster of vertices around the starting point, indicating local connectivity or clustering. This phenomenon is common in real-world networks, where nodes tend to form tightly knit communities or clusters.

Conversely, the highest 15 distances are all equal to 7, representing the upper limit of distances in the graph. This uniformity in the highest distances suggests there is a group of vertices. They are not connected at all. These vertices might form a separate group or subgraph within the larger graph, pointing to potential segmentation or modularity in the network.

```
Vertex 0: Distance 0
Vertex 88: Distance 1
Vertex 141: Distance 1
Vertex 399: Distance 1
Vertex 464: Distance 1
Vertex 784: Distance 1
Vertex 967: Distance 1
Vertex 1380: Distance 1
Vertex 1527: Distance 1
Vertex 1684: Distance 1
Vertex 1752: Distance 1
Vertex 1907: Distance 1
Vertex 2011: Distance 1
Vertex 2095: Distance 1
Vertex 2310: Distance 1
The 15 distances with the highest values:
Vertex 4018: Distance 7
Vertex 3982: Distance 7
Vertex 3947: Distance 7
Vertex 3929: Distance 7
Vertex 3882: Distance 7
Vertex 3866: Distance 7
Vertex 3857: Distance 7
Vertex 3847: Distance 7
Vertex 3846: Distance 7
Vertex 3827: Distance 7
Vertex 3814: Distance 7
Vertex 3789: Distance 7
Vertex 3782: Distance 7
Vertex 3738: Distance 7
Vertex 3697: Distance 7
```

This is the output of the adjacency list that basically describes what different vertices are directly connected. Below is a snippet of this. In the case of this data set this means that the people represented by the vertices are connected with the other vertices. There are clearly some that are more connected than others.

```
Vertex 3989: 2427 2425 1925 3567 1196 2069 1654 3207 1296 1759 859 1114 3676 830 2942 2527 352 1744 2679 92 17 1345 2417 951 2467 2653 1334 1588 83
Vertex 3990: 2425 1798 3567 823 1784 2471 2549 3746 1351 1196 3447 1958 438 3500 1303 2038 2072 1922 3664 3698 2172 2258 3277 1416 2559 3904 1445 1405 948 2461 1423 1616 2308 1396 2656 1568 1884 3773 2736 2513 186
4 3032 1587 3333 739 869 2712 2032 3927 554 1456 3438 2285 3506 2095 2034 4013 1099 2985 1744 515 3180 526 1748 17 3540 254 1850 474 3142 2234 1839 2055 2857 3078 2056 3578 923 3155 2896 1732 1206 1823 3382 1997 3
27 3817 2478 2467 2653 3250 3851 1334 2802 3617 2535 269 1021 3848 2266 2613 2193 1818 2638 652 3401 1723 2716
Vertex 3991: 3335 3038 2844 1546 1060 1261 620 484 2577 3535 1957 2618 525 32 3971 3484 2944 3648 1811 2238 332 696
Vertex 3992: 1696 2492 3932 2077 586 2531 1931 925 3585 3610 683 1443 1434 264 3011 1056
Vertex 3993: 3335 1013 3912 3331 3017 177 1449 2676 2131 2719 3125 2264 2195 3347 237 1498 1620 2118 4022 3146 2190 2443 852 3332 2401 2882 634 3118 165 3847 19 820 3818 527 3059 1704 1319 3718 2858 2829 744 2117
3880 2473 3366 1495 3895 2275 135 2599 1636 2835 2672 195 2565 136 1183 3487 297 743 412 2185 4016 471 3780 1185 2677 2525 1453 508 1987 3613 1227 3252 1882 997 1388 2406 229 865 3003 1791 25 920 681 3651 105 1451
1486 3616 2119 3872 2007 3288 3376 261 145 615 591 1702 203 1749 399 1220 783 2047 2990 2808 3678 418 2519 335 1435 2548 2678 3964 3179 2919 3205 3154 1608 2659 1666
Vertex 3994: 3239 187 537 141 2684 531 636 3463 1984 2373
Vertex 3995: 1645 968 3853 672 1239 2764 3328 1172 3574 4015 1975 976 3944 2331 2777 1084 3727 3284 778 2812
Vertex 3996: 3335 2719 3122 16 35 3494 1226 1469 2672 1175 1918 3049 3529 2583 3350 3508 1290 2568 3798 3373 2795 2701
Vertex 3997: 3335 1830 95 3641 1837 2543 3581 612 2615
Vertex 3998: 2425 3073 3228 1934 3703 2833
Vertex 3999: 2425 1589 3703 2562 3454
Vertex 4000: 3335 3213 1631 966 1901
Vertex 4001: 3239 2487 1057 2847 3677 1017 2362 856 3066 2484 4026 674 3405 1984
Vertex 4002: 3239 1057 3985 3557 3507 3355 1576 3156 3019 187 2349 1698 2707 4027 2648 2534 325 3893 999 657 2629 3157 2684 2340 538 442 2317 3687 383 3775 2360 1004 946 460 3699 2484 1003 3463 1929 402 1705 1097
2706 3405 1888 448 1594
Vertex 4003: 3239 2205 905 2485
Vertex 4004: 3335 1683 1256 1287 3894 3882 3001 851 2184 1947 988 2752 3806 3974 1020 3961 2426 3005 1281 1752 429 3344 3040 2245 418 3159 2280 2972 1205
Vertex 4005: 968 313 3565 822 2617 3486 632 2321 2386 3489 397 2035 648 3172 1786 140 178 2850 2306 3592 353 1371 160 756 2452 2328 1444 103 3292 2103 691 2744 2083 196 2019 1225 3869 2708 2817 3944 2289 485 2595
1904 2939 3735 2733 1018 2331 2928 2623 2984 3368 3131 2109 1477 1286 2931 3284 1002 2812 3587
Vertex 4006: 3136 496 2654 2544 2841 534 3476 1398 3031 643 1692 3510 1539
Vertex 4007: 968 2576 1955 924 1689 2136 353 2969 1178 4015 244 978 184 2704 3869 1117 347 3153 2225 1414 2125 1502 2142 446 741 2457 3875 1853
Vertex 4008: 968 3451 242
Vertex 4009: 3335 3100 837 1256 1897 1287 1854 3894 762 1425 2390 1672 2 3836 1956 168 3498 844 2450 3534 4031 3736 1074 3247 226 1281 1452 1419 701 3822 821 878 137 1702 1525 2091 1901 173
Vertex 4010: 968 3451 3877 3473 1273 2805 1664 320 242 638 131
Vertex 4011: 968 2594 1212 2464 2320 1282 144 3903 958 1430 1642
Vertex 4012: 2425 738 2431 1851 2722 3150 3695 2297 2069 1849 2326 859 588 3173 3167 1420 351 81 2201 763 212 2964 134 90 3539 3575 758 1761 2895 2902 2159 2044 3434 3127 1229 1742 2521 2046 72 243 23 2653 2166 13
18 2572 3711 2318 2888 3069 1566 2823
Vertex 4013: 2425 1940 1798 3567 823 1784 2816 3831 2549 1351 1196 3447 1958 2768 3500 1922 3664 3698 2172 2258 3845 1416 3904 651 3349 1405 948 2461 1979 3409 1878 1423 1616 1396 2656 1568 3773 2203 2736 2513 505
3032 1587 869 3890 2712 2032 2688 3927 554 1456 3438 2285 2095 2034 2528 2725 1099 1209 1744 515 30 3180 526 1748 175 3343 3540 254 3142 1839 2059 3078 2056 3578 2896 1206 1823 3627 327 3990 3832 1583 2478 1859 2
467 678 3737 2853 3250 3851 1169 2435 1703 1180 1762 1334 2486 3617 2227 2178 963 2535 269 3848 2266 2613 1818 2638 734 3401 1723 3542
Vertex 4014: 1696 3137 2385 66 3189 2218 2502 1046 2358 2058 1609 2540 1891 1994 3296 3413 3561 3526 1802 3287 3672 3785 1285 936 3608 2022 2912 497 427 3011 3396 2558 2787 461 2476 2294 2616 2518 1554 3930 594 24
18 2843 2470 2878
Vertex 4015: 1950 968 3853 2576 1955 672 1689 3338 4007 2735 3995 3833 1172 3528 2969 1178 978 581 3869 1117 347 2225 3632 2125 2777 446 3465 1084 3284 3875 2164 518
Vertex 4016: 3335 3912 3017 177 3269 2676 2719 3125 2264 2866 2195 3993 237 1620 4022 3146 2190 2443 3547 1267 3332 634 3847 1088 223 1319 3718 744 2473 1495 3553 2275 135 2599 2835 2672 3094 2538 2374 1822 136 11
83 471 1185 2677 2054 2525 2239 3613 3252 3769 997 1388 2406 172 1290 3003 1791 681 3322 3651 1486 2007 3288 1702 203 1749 783 1542 2047 2808 2548 2678 3964 2919 3205 539 1608 1288
Vertex 4017: 3335 1059 3344 1476
Vertex 4018: 2425 945 1179 3563 1899 2069 2937 890 933 4023 3692 3703 3186 2137 1159 2456 3393 3164
Vertex 4019: 1341 2427 2510 2425 2840 2431 3612 3567 2053 3138 3934 753 2722 1196 3690 1712 438 3838 3589 97 2297 2160 2364 2069 3133 3285 788 2780 1268 2759 1845 1296 1759 1573 2326 1090 859 961 3152 3967 588 233
2 2815 633 2747 2920 1114 1988 780 3072 351 1741 3751 102 2607 1584 547 323 3446 3676 2942 3671 3185 2268 750 2030 3071 2527 1790 1934 1614 3398 352 423 1132 3315 111 1127 2365 2679 133 671 2159 17 1238 798 1767 1
345 2417 1617 3653 710 2143 2893 3661 3928 1753 1441 3029 3297 990 1766 1997 3437 1027 2890 861 1263 1990 2792 1243 3490 833 724 3147 2864 3851 1800 1588 1048 2749 83 3326 3701 1513 2557 3523 2003 3090
Vertex 4020: 968 3145 1151 924 677 2408 38 178 687 2627 3256 3789 1444 2592 3923 2910 607 2626 1322 1406 855 1197 2652 518 965
Vertex 4021: 968 2366 2361 1271 3356 883 2894 1116 542 3888 169 1557 68 1708 69 1467 316 1262
Vertex 4022: 3335 509 1776 3912 3331 3017 177 3269 2314 1808 2115 3445 1449 3618 2676 2131 2719 1123 746 3673 1892 3289 1991 2264 2195 3347 3993 2263 237 3233 1498 1620 2118 556 2220 3146 2190 2443 309 1879 1192 2
31 3547 1258 3332 2401 1826 209 792 2882 634 1661 1219 165 2422 19 820 3818 223 921 527 1633 2214 498 3059 1327 1058 2455 1036 3282 387 1026 1385 1319 63 3718 2858 3203 2829 2126 2117 3880 2473 679 1495 2868 3895
3553 2275 819 135 2599 1636 3614 3022 2672 1412 195 1365 2538 2374 3762 2565 138 524 1822 136 2236 1183 2500 3487 297 3521 4016 3780 1185 3793 2677 2054 2412 1919 2525 1453 1545 2354 2239 2611 1613 3613 1227 3252
1882 1009 816 891 997 1388 2406 229 25 920 681 2782 488 3322 2064 676 3651 105 1486 3616 3166 2119 3872 2763 2007 3376 2111 145 615 591 1702 1749 1549 987 399 1220 2568 783 1402 2990 236 418 2519 3263 335 1435 254
8 2678 1873 3208 2555 3964 3179 2919 2649 3205 3941 747 3154 1608 1530 2659 3694 1666 584 1215 2685
Vertex 4023: 2425 945 1179 3563 1899 2069 2937 3312 890 3692 3186 2137 2723 800 2456 3393 4018 1043
Vertex 4024: 1427 1207 3136 1768 3650 3485 1799 2378 3237 132
Vertex 4025: 342 3813 647 2216 3530 2356 3772
Vertex 4026: 3239 1057 2109 3557 3355 3156 187 2349 2847 3058 4001 2707 1841 1053 3258 918 999 2124 3677 2644 1317 1555 469 3157 856 104 2340 538 3725 1112 1004 946 3060 3066 2484 531 455 1497 636 3463 1924 402 37
99 2650 3984
Vertex 4027: 3239 1057 3557 3507 3355 3000 3156 2698 187 2349 2707 1455 2534 2738 3258 163 3893 537 2124 2303 3740 141 2629 3157 856 4002 2684 2340 1004 946 460 2484 531 636 3463 402 1705 448 3545 1594
Vertex 4028: 1696 1600 3067 497
Vertex 4029: 968 510 876 1273 2379
Vertex 4030: 968 2189 520 1042 1793 3328 3493 2324 3423 779 56 1015 1558 929 3712
Vertex 4031: 3335 3100 2603 1565 837 3900 1256 1897 1287 1854 3894 385 3882 2135 3001 762 132 2390 851 2 2801 1947 4009 1847 3836 1956 168 3498 1610 2752 3534 4033 3 3974 1890 3736 1074 1236 2208 2961 3961 1452 22
73 3344 1595 701 2671 3822 1887 2614 3028 821 1266 878 2718 2267 868 137 1827 1525 2091 3159 908 173
Vertex 4032: 1683 1223 55 1427 1207 2934 1054 230 1148 2329 1694 2641 3257 2235 837 3425 3308 3518 740 2913 2145 771 1276 367 2604 1287 2575 2520 417 93 1125 1926 530 3885 1085 2382
Vertex 4033: 3335 3100 1565 1207 837 3900 1256 1897 1287 3894 385 3882 2135 3001 762 851 1847 2752 3534 4031 1074 1236 3961 3420 1452 1419 1595 635 917 3028 878 2718 3159 1978
Vertex 4034: 1696 2385 1700 1815 631 2058 650 2628 2319 1609 1891 224 3854 3684 150 3306 2912 3652 1397 2476 2367 514 594
Vertex 4035: 3239 3355 3070 383 3744 2373
Vertex 4036: 3239 467 1683 3136 837
Vertex 4037: 1683 3100 1565 55 3728 3268 1054 3392 1694 2641 1523 3812 3140 1768 837 452 1912 98 3558 2913 1814 3767 1256 1897 1809 211 2145 2604 93 1854 1142 922 3720 530 3885 3642 385 2971
Vertex 4038: 670 113
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In summary, the data reveals a graph with a relatively small mean and median distance, indicative of a dense and well-connected network. The graph's compact diameter, represented by the maximum distance, suggests a high degree of connectivity, typical of small-world networks. The clustering around the starting vertex and the consistent maximum distance of 6 among the highest distances hint at the presence of localized communities and potentially isolated groups of vertices. These insights provide a comprehensive understanding of the graph's overall connectivity, density, and potential community structure, which can be valuable for further analysis and interpretation within the context of real-world networks.

If this code is rerun the answers for the mean, median and max might slightly differ based on the chosen start vertex.