Report:

Problems done on a Dell Latitude 7420.

Problem 1:

Size = 100:

|  |  |  |  |
| --- | --- | --- | --- |
| Thread count | Number of correct answers | Number of wrong answers | Average time in seconds |
| 1 | 100 | 0 | 0.000110 |
| 2 | 16 | 84 | 0.000130 |
| 4 | 30 | 70 | 0.000225 |
| 8 | 27 | 73 | 0.000272 |
| 16 | 10 | 90 | 0.000441 |
| 32 | 15 | 85 | 0.000848 |
| 64 | 22 | 72 | 0.000930 |

Size = 10,000

|  |  |  |  |
| --- | --- | --- | --- |
| Thread count | Number of correct answers | Number of wrong answers | Average time in seconds |
| 1 | 100 | 0 | 0.000202 |
| 2 | 12 | 88 | 0.000210 |
| 4 | 12 | 78 | 0.000240 |
| 8 | 30 | 70 | 0.000342 |
| 16 | 20 | 80 | 0.000554 |
| 32 | 18 | 82 | 0.000951 |
| 64 | 25 | 75 | 0.001030 |

Size = 100,000

|  |  |  |  |
| --- | --- | --- | --- |
| Thread count | Number of correct answers | Number of wrong answers | Average time in seconds |
| 1 | 100 | 0 | 0.000925 |
| 2 | 20 | 80 | 0.000827 |
| 4 | 37 | 63 | 0.000700 |
| 8 | 30 | 70 | 0.000925 |
| 16 | 12 | 88 | 0.000891 |
| 32 | 15 | 85 | 0.001097 |
| 64 | 9 | 91 | 0.001243 |

Size = 1,000,000

|  |  |  |  |
| --- | --- | --- | --- |
| Thread count | Number of correct answers | Number of wrong answers | Average time in seconds |
| 1 | 100 | 0 | 0.007850 |
| 2 | 10 | 90 | 0.006740 |
| 4 | 6 | 94 | 0.005290 |
| 8 | 3 | 97 | 0.005397 |
| 16 | 4 | 96 | 0.005621 |
| 32 | 10 | 90 | 0.005936 |
| 64 | 9 | 91 | 0.005260 |

Size = 10,000,000

|  |  |  |  |
| --- | --- | --- | --- |
| Thread count | Number of correct answers | Number of wrong answers | Average time in seconds |
| 1 | 100 | 0 | 0.054580 |
| 2 | 6 | 94 | 0.048236 |
| 4 | 5 | 95 | 0.032360 |
| 8 | 2 | 98 | 0.034352 |
| 16 | 3 | 97 | 0.037550 |
| 32 | 1 | 99 | 0.038247 |
| 64 | 4 | 96 | 0.039281 |

Size = 100,000,000

|  |  |  |  |
| --- | --- | --- | --- |
| Thread count | Number of correct answers | Number of wrong answers | Average time in seconds |
| 1 | 100 | 0 | 0.35 |
| 2 | 0 | 100 | 0.30 |
| 4 | 2 | 98 | 0.25 |
| 8 | 3 | 97 | 0.21 |
| 16 | 1 | 99 | 0.27 |
| 32 | 1 | 99 | 0.283 |
| 64 | 0 | 100 | 0.2984 |

Size = 1,000,000,000

|  |  |  |  |
| --- | --- | --- | --- |
| Thread count | Number of correct answers | Number of wrong answers | Average time in seconds |
| 1 | 100 | 0 | 4 |
| 2 | 1 | 99 | 2.52 |
| 4 | 0 | 100 | 2.123 |
| 8 | 0 | 100 | 2.41 |
| 16 | 0 | 100 | 2.70 |
| 32 | 0 | 100 | 2.79 |
| 64 | 0 | 100 | 2.821 |

In this case, upon increasing the input size the time for one thread also increases.

Problem 2:

Size = 100:

|  |  |  |
| --- | --- | --- |
| Thread count | Average time in seconds | |
| 1 | 0.000082 | |
| 2 | 0.000249 | |
| 4 | 0.000191 | |
| 8 | 0.000227 | |
| 16 | 0.000362 | |
| 32 | 0.000937 | |
| 64 | 0.001240 |

Size = 10,000

|  |  |
| --- | --- |
| Thread count | Average time in seconds |
| 1 | 0.000230 |
| 2 | 0.000224 |
| 4 | 0.000226 |
| 8 | 0.000550 |
| 16 | 0.000588 |
| 32 | 0.000931 |
| 64 | 0.001900 |

Size = 100,000

|  |  |
| --- | --- |
| Thread count | Average time in seconds |
| 1 | 0.000992 |
| 2 | 0.001300 |
| 4 | 0.002406 |
| 8 | 0.003201 |
| 16 | 0.001960 |
| 32 | 0.002240 |
| 64 | 0.003397 |

Size = 1,000,000

|  |  |
| --- | --- |
| Thread count | Average time in seconds |
| 1 | 0.010350 |
| 2 | 0.013492 |
| 4 | 0.017122 |
| 8 | 0.024221 |
| 16 | 0.024495 |
| 32 | 0.025737 |
| 64 | 0.026342 |

Size = 10,000,000

|  |  |
| --- | --- |
| Thread count | Average time in seconds |
| 1 | 0.063297 |
| 2 | 0.090395 |
| 4 | 0.120242 |
| 8 | 0.126341 |
| 16 | 0.146242 |
| 32 | 0.145310 |
| 64 | 0.139440 |

Size = 100,000,000

|  |  |
| --- | --- |
| Thread count | Average time in seconds |
| 1 | 0.41 |
| 2 | 0.54 |
| 4 | 0.77 |
| 8 | 0.92 |
| 16 | 1.15 |
| 32 | 1.11 |
| 64 | 1.21 |

Size = 1,000,000,000

|  |  |
| --- | --- |
| Thread count | Average time in seconds |
| 1 | 3.5 |
| 2 | 5.2 |
| 4 | 9.3 |
| 8 | 10.4 |
| 16 | 10.69 |
| 32 | 11.51 |
| 64 | 10.92 |

When we add a mutex lock a waiting period is added which makes the runtime worse.

Problem 3:

Size = 100:

|  |  |  |
| --- | --- | --- |
| Thread count | Average time in seconds | |
| 1 | 0.000131 | |
| 2 | 0.000213 | |
| 4 | 0.000224 | |
| 8 | 0.000325 | |
| 16 | 0.000426 | |
| 32 | 0.000847 | |
| 64 | 0.001060 |

Size = 10,000

|  |  |
| --- | --- |
| Thread count | Average time in seconds |
| 1 | 0.000201 |
| 2 | 0.000191 |
| 4 | 0.000220 |
| 8 | 0.000350 |
| 16 | 0.000640 |
| 32 | 0.000799 |
| 64 | 0.001391 |

Size = 100,000

|  |  |
| --- | --- |
| Thread count | Average time in seconds |
| 1 | 0.001292 |
| 2 | 0.000350 |
| 4 | 0.000451 |
| 8 | 0.000840 |
| 16 | 0.000951 |
| 32 | 0.001132 |
| 64 | 0.002126 |

Size = 1,000,000

|  |  |
| --- | --- |
| Thread count | Average time in seconds |
| 1 | 0.008231 |
| 2 | 0.004944 |
| 4 | 0.002935 |
| 8 | 0.002040 |
| 16 | 0.002131 |
| 32 | 0.002634 |
| 64 | 0.002692 |

Size = 10,000,000

|  |  |
| --- | --- |
| Thread count | Average time in seconds |
| 1 | 0.053092 |
| 2 | 0.030391 |
| 4 | 0.019344 |
| 8 | 0.011233 |
| 16 | 0.010241 |
| 32 | 0.012232 |
| 64 | 0.012986 |

Size = 100,000,000

|  |  |
| --- | --- |
| Thread count | Average time in seconds |
| 1 | 0.34 |
| 2 | 0.20 |
| 4 | 0.13 |
| 8 | 0.12 |
| 16 | 0.069 |
| 32 | 0.054 |
| 64 | 0.0541 |

Size = 1,000,000,000

|  |  |
| --- | --- |
| Thread count | Average time in seconds |
| 1 | 4.51 |
| 2 | 2.3 |
| 4 | 1.34 |
| 8 | 1.122 |
| 16 | 1.130 |
| 32 | 1.021 |
| 64 | 1.089 |

When adding a private count variable, the runtime will decrease making it similar to the case of race.

Problem 4:

Size = 100:

|  |  |  |
| --- | --- | --- |
| Thread count | Average time in seconds | |
| 1 | 0.000401 | |
| 2 | 0.000130 | |
| 4 | 0.000113 | |
| 8 | 0.000321 | |
| 16 | 0.000342 | |
| 32 | 0.000834 | |
| 64 | 0.000995 |

Size = 10,000

|  |  |
| --- | --- |
| Thread count | Average time in seconds |
| 1 | 0.000122 |
| 2 | 0.000165 |
| 4 | 0.000181 |
| 8 | 0.000242 |
| 16 | 0.000290 |
| 32 | 0.000379 |
| 64 | 0.000422 |

Size = 100,000

|  |  |
| --- | --- |
| Thread count | Average time in seconds |
| 1 | 0.001923 |
| 2 | 0.000391 |
| 4 | 0.000235 |
| 8 | 0.000341 |
| 16 | 0.000304 |
| 32 | 0.000423 |
| 64 | 0.000472 |

Size = 1,000,000:

|  |  |
| --- | --- |
| Thread count | Average time in seconds |
| 1 | 0.008632 |
| 2 | 0.004824 |
| 4 | 0.002821 |
| 8 | 0.002923 |
| 16 | 0.002126 |
| 32 | 0.002441 |
| 64 | 0.002949 |

Size = 10,000,000

|  |  |
| --- | --- |
| Thread count | Average time in seconds |
| 1 | 0.043061 |
| 2 | 0.029343 |
| 4 | 0.012438 |
| 8 | 0.009245 |
| 16 | 0.009131 |
| 32 | 0.008241 |
| 64 | 0.008199 |

Size = 100,000,000:

|  |  |
| --- | --- |
| Thread count | Average time in seconds |
| 1 | 0.42 |
| 2 | 0.23 |
| 4 | 0.14 |
| 8 | 0.09 |
| 16 | 0.076 |
| 32 | 0.062 |
| 64 | 0.0531 |

Size = 1,000,000,000

|  |  |
| --- | --- |
| Thread count | Average time in seconds |
| 1 | 4.52 |
| 2 | 2.61 |
| 4 | 1.925 |
| 8 | 1.757 |
| 16 | 1.538 |
| 32 | 1.22 |
| 64 | 1.041 |

When padding the caches and storing the threads in a cache, the risk of false updates will decrease which leads to a reduction in the runtime of the threads.