1. 比较公平性 20个线程各自运行时间
2. counter\_time
3. counter重复测试
4. **counter\_fair\_spinlock**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| spinlock | 15.461 | 15.926 | 16.074 | 16.187 | 16.244 | 16.334 | 16.339 | 17.202 | 17.368 | 17.681 | 17.81 | 17.997 | 18.041 | 18.063 | 18.095 | 18.178 | 18.176 | 18.2 | 18.215 | 18.214 |
| spinlock | 10.424 | 10.441 | 11.648 | 11.827 | 12.003 | 12.053 | 12.09 | 12.402 | 12.462 | 12.571 | 12.719 | 12.72 | 12.773 | 12.795 | 12.865 | 12.863 | 12.861 | 12.941 | 12.956 | 12.918 |
| spinlock | 12.296 | 12.862 | 13.241 | 13.244 | 13.464 | 13.715 | 13.73 | 13.981 | 14.063 | 14.206 | 14.435 | 14.638 | 14.772 | 14.79 | 14.889 | 14.891 | 14.896 | 14.884 | 14.883 | 14.903 |

1. **counter\_fair\_mutex**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| mutex | 6.751 | 6.812 | 6.923 | 6.993 | 7.062 | 7.146 | 7.21 | 7.186 | 7.244 | 7.257 | 7.255 | 7.275 | 7.297 | 7.268 | 7.283 | 7.319 | 7.291 | 7.33 | 7.334 | 7.323 |
| mutex | 3.334 | 3.815 | 3.847 | 3.873 | 3.919 | 3.952 | 3.98 | 4.062 | 4.074 | 4.106 | 4.116 | 4.12 | 4.097 | 4.131 | 4.139 | 4.139 | 4.141 | 4.141 | 4.145 | 4.152 |
| mutex | 6.896 | 6.931 | 6.983 | 7.005 | 7.008 | 7.067 | 7.104 | 7.113 | 7.143 | 7.152 | 7.166 | 7.162 | 7.171 | 7.172 | 7.196 | 7.189 | 7.205 | 7.205 | 7.208 | 7.227 |
| mutex | 3.462 | 3.624 | 3.654 | 3.681 | 3.68 | 3.678 | 3.727 | 3.714 | 3.734 | 3.773 | 3.888 | 3.92 | 3.959 | 3.993 | 3.97 | 3.967 | 3.97 | 3.985 | 4.004 | 3.985 |
| mutex | 7.531 | 7.597 | 7.607 | 7.613 | 7.64 | 7.624 | 7.634 | 7.654 | 7.645 | 7.666 | 7.65 | 7.671 | 7.675 | 7.684 | 7.668 | 7.682 | 7.691 | 7.681 | 7.69 | 7.688 |

1. **counter\_fair\_two\_phase**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| two\_phase | 5.86 | 6.983 | 7.019 | 7.152 | 7.133 | 7.192 | 7.199 | 7.216 | 7.243 | 7.263 | 7.256 | 7.324 | 7.337 | 7.345 | 7.328 | 7.323 | 7.333 | 7.339 | 7.336 | 7.339 |
| two\_phase | 7.127 | 7.228 | 7.274 | 7.334 | 7.326 | 7.351 | 7.376 | 7.42 | 7.405 | 7.442 | 7.419 | 7.451 | 7.49 | 7.478 | 7.471 | 7.476 | 7.501 | 7.519 | 7.535 | 7.518 |
| two\_phase | 7.086 | 7.421 | 7.544 | 7.603 | 7.602 | 7.675 | 7.642 | 7.689 | 7.716 | 7.748 | 7.798 | 7.794 | 7.823 | 7.839 | 7.837 | 7.844 | 7.882 | 7.886 | 7.909 | 7.908 |

1. **counter\_fair\_pthread**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| pthread | 0.522 | 0.552 | 0.58 | 0.63 | 0.649 | 0.654 | 0.669 | 0.67 | 0.679 | 0.748 | 0.752 | 0.779 | 0.807 | 0.827 | 0.878 | 0.878 | 0.88 | 0.88 | 0.906 | 0.905 |
| pthread | 0.359 | 0.523 | 0.59 | 0.689 | 0.712 | 0.767 | 0.802 | 0.82 | 0.824 | 0.828 | 0.853 | 0.858 | 0.904 | 0.916 | 0.924 | 0.969 | 0.965 | 0.974 | 0.975 | 0.988 |
| pthread | 0.321 | 0.421 | 0.423 | 0.43 | 0.513 | 0.576 | 0.593 | 0.594 | 0.61 | 0.619 | 0.666 | 0.723 | 0.725 | 0.725 | 0.761 | 0.837 | 0.842 | 0.862 | 0.856 | 0.866 |

1. **counter\_fair**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| spinlock | 12.296 | 12.862 | 13.241 | 13.244 | 13.464 | 13.715 | 13.73 | 13.981 | 14.063 | 14.206 | 14.435 | 14.638 | 14.772 | 14.79 | 14.889 | 14.891 | 14.896 | 14.884 | 14.883 | 14.903 |
| mutex | 6.896 | 6.931 | 6.983 | 7.005 | 7.008 | 7.067 | 7.104 | 7.113 | 7.143 | 7.152 | 7.166 | 7.162 | 7.171 | 7.172 | 7.196 | 7.189 | 7.205 | 7.205 | 7.208 | 7.227 |
| two\_phase | 7.127 | 7.228 | 7.274 | 7.334 | 7.326 | 7.351 | 7.376 | 7.42 | 7.405 | 7.442 | 7.419 | 7.451 | 7.49 | 7.478 | 7.471 | 7.476 | 7.501 | 7.519 | 7.535 | 7.518 |
| pthread | 0.522 | 0.552 | 0.58 | 0.63 | 0.649 | 0.654 | 0.669 | 0.67 | 0.679 | 0.748 | 0.752 | 0.779 | 0.807 | 0.827 | 0.878 | 0.878 | 0.88 | 0.88 | 0.906 | 0.905 |

1. list\_time
2. list重复测试
3. **list\_fair\_spinlock**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| spinlock | 15.474 | 16.577 | 16.811 | 17.582 | 18.237 | 18.582 | 18.96 | 19.169 | 19.404 | 19.437 | 19.559 | 19.645 | 19.701 | 19.741 | 19.876 | 19.827 | 19.914 | 19.926 | 19.945 | 19.979 |
| spinlock | 17.534 | 17.582 | 17.788 | 18.455 | 18.749 | 18.882 | 19.784 | 19.81 | 19.951 | 20.008 | 20.041 | 20.249 | 20.48 | 20.509 | 20.519 | 20.552 | 20.54 | 20.622 | 20.65 | 20.661 |
| spinlock | 14.167 | 14.413 | 16.455 | 17.711 | 18.286 | 18.364 | 18.433 | 19.11 | 19.155 | 19.621 | 19.661 | 19.814 | 19.81 | 19.815 | 19.895 | 19.868 | 19.947 | 19.946 | 19.965 | 19.987 |

1. **list\_fair\_mutex**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| mutex | 10.723 | 10.843 | 10.844 | 10.862 | 10.876 | 10.913 | 10.939 | 10.998 | 11.049 | 11.161 | 11.204 | 11.22 | 11.222 | 11.226 | 11.24 | 11.241 | 11.25 | 11.26 | 11.278 | 11.299 |
| mutex | 5.842 | 5.854 | 5.965 | 5.968 | 5.979 | 5.992 | 5.996 | 5.994 | 6.015 | 6.021 | 6.022 | 6.031 | 6.038 | 6.039 | 6.055 | 6.05 | 6.066 | 6.067 | 6.072 | 6.075 |
| mutex | 10.477 | 10.526 | 10.615 | 10.868 | 11.064 | 11.168 | 11.228 | 11.219 | 11.273 | 11.33 | 11.334 | 11.35 | 11.394 | 11.431 | 11.441 | 11.466 | 11.504 | 11.5 | 11.509 | 11.513 |
| mutex | 5.654 | 5.724 | 5.737 | 5.742 | 5.765 | 5.773 | 5.776 | 5.779 | 5.788 | 5.783 | 5.817 | 5.829 | 5.825 | 5.837 | 5.839 | 5.853 | 5.849 | 5.862 | 5.864 | 5.864 |
| mutex | 10.976 | 11.365 | 11.381 | 11.49 | 11.513 | 11.587 | 11.59 | 11.622 | 11.626 | 11.641 | 11.651 | 11.668 | 11.741 | 11.787 | 11.787 | 11.817 | 11.83 | 11.847 | 11.865 | 11.872 |

1. **list\_fair\_two\_phase**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| two\_phase | 4.916 | 4.935 | 4.939 | 4.965 | 4.982 | 5.014 | 5.017 | 5.063 | 5.073 | 5.1 | 5.107 | 5.121 | 5.125 | 5.144 | 5.144 | 5.144 | 5.148 | 5.152 | 5.162 | 5.167 |
| two\_phase | 8.604 | 8.801 | 8.805 | 8.864 | 8.997 | 9.104 | 9.119 | 9.162 | 9.174 | 9.208 | 9.214 | 9.257 | 9.272 | 9.309 | 9.313 | 9.343 | 9.346 | 9.36 | 9.377 | 9.379 |
| two\_phase | 9.228 | 9.329 | 9.462 | 9.582 | 9.595 | 9.606 | 9.621 | 9.624 | 9.648 | 9.652 | 9.669 | 9.68 | 9.714 | 9.725 | 9.784 | 9.789 | 9.796 | 9.812 | 9.82 | 9.83 |
| two\_phase | 4.988 | 5.018 | 5.138 | 5.158 | 5.172 | 5.21 | 5.22 | 5.224 | 5.239 | 5.284 | 5.284 | 5.284 | 5.292 | 5.294 | 5.305 | 5.32 | 5.324 | 5.327 | 5.33 | 5.337 |
| two\_phase | 4.963 | 5.052 | 5.091 | 5.174 | 5.178 | 5.186 | 5.204 | 5.218 | 5.238 | 5.24 | 5.26 | 5.266 | 5.267 | 5.27 | 5.273 | 5.275 | 5.298 | 5.299 | 5.307 | 5.308 |

1. **list\_fair\_pthread**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| pthread | 0.832 | 0.859 | 0.86 | 0.896 | 0.986 | 1.021 | 1.044 | 1.049 | 1.056 | 1.073 | 1.074 | 1.084 | 1.089 | 1.092 | 1.106 | 1.114 | 1.14 | 1.167 | 1.175 | 1.175 |
| pthread | 0.716 | 0.77 | 0.875 | 0.918 | 0.948 | 0.949 | 1.004 | 1.038 | 1.077 | 1.079 | 1.101 | 1.11 | 1.111 | 1.115 | 1.122 | 1.136 | 1.138 | 1.142 | 1.172 | 1.174 |
| pthread | 0.74 | 0.774 | 0.809 | 0.862 | 0.892 | 0.915 | 0.933 | 0.985 | 1.0 | 1.018 | 1.045 | 1.066 | 1.074 | 1.091 | 1.114 | 1.143 | 1.16 | 1.179 | 1.18 | 1.182 |
| pthread | 0.801 | 0.914 | 0.921 | 0.928 | 0.96 | 0.984 | 0.987 | 0.994 | 1.032 | 1.041 | 1.086 | 1.101 | 1.126 | 1.126 | 1.128 | 1.13 | 1.133 | 1.143 | 1.166 | 1.166 |
| pthread | 0.752 | 0.85 | 0.884 | 0.939 | 0.942 | 0.944 | 0.946 | 0.96 | 0.996 | 1.004 | 1.029 | 1.047 | 1.065 | 1.102 | 1.112 | 1.127 | 1.14 | 1.155 | 1.156 | 1.165 |

1. **list\_fair**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| spinlock | 15.474 | 16.577 | 16.811 | 17.582 | 18.237 | 18.582 | 18.96 | 19.169 | 19.404 | 19.437 | 19.559 | 19.645 | 19.701 | 19.741 | 19.876 | 19.827 | 19.914 | 19.926 | 19.945 | 19.979 |
| mutex | 10.723 | 10.843 | 10.844 | 10.862 | 10.876 | 10.913 | 10.939 | 10.998 | 11.049 | 11.161 | 11.204 | 11.22 | 11.222 | 11.226 | 11.24 | 11.241 | 11.25 | 11.26 | 11.278 | 11.299 |
| two\_phase | 4.988 | 5.018 | 5.138 | 5.158 | 5.172 | 5.21 | 5.22 | 5.224 | 5.239 | 5.284 | 5.284 | 5.284 | 5.292 | 5.294 | 5.305 | 5.32 | 5.324 | 5.327 | 5.33 | 5.337 |
| pthread | 0.716 | 0.77 | 0.875 | 0.918 | 0.948 | 0.949 | 1.004 | 1.038 | 1.077 | 1.079 | 1.101 | 1.11 | 1.111 | 1.115 | 1.122 | 1.136 | 1.138 | 1.142 | 1.172 | 1.174 |

1. hash\_time
2. hash重复测试
3. **hash\_fair\_spinlock**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| spinlock | 8.555 | 9.333 | 10.209 | 10.643 | 10.819 | 10.864 | 10.976 | 11.093 | 11.214 | 11.262 | 11.292 | 11.322 | 11.339 | 11.364 | 11.386 | 11.369 | 11.876 | 11.908 | 11.878 | 11.926 |
| spinlock | 8.525 | 8.758 | 9.401 | 9.502 | 9.817 | 10.242 | 10.394 | 10.791 | 10.85 | 10.984 | 10.992 | 11.009 | 11.052 | 11.177 | 11.196 | 11.238 | 11.292 | 11.298 | 11.318 | 11.317 |
| spinlock | 9.832 | 9.951 | 10.071 | 10.125 | 10.315 | 10.455 | 10.502 | 10.852 | 10.973 | 10.999 | 11.076 | 11.177 | 11.19 | 11.159 | 11.23 | 11.339 | 11.323 | 11.361 | 11.367 | 11.362 |
| spinlock | 7.516 | 7.685 | 8.647 | 8.777 | 8.831 | 9.33 | 9.498 | 9.833 | 9.926 | 9.966 | 10.068 | 10.098 | 10.244 | 10.321 | 10.34 | 12.048 | 22.887 | 25.504 | 25.502 | 25.504 |
| spinlock | 8.583 | 8.863 | 9.058 | 9.445 | 9.96 | 10.054 | 10.265 | 10.304 | 10.389 | 10.462 | 10.516 | 10.665 | 10.732 | 10.86 | 10.899 | 10.949 | 10.949 | 10.977 | 11.0 | 10.986 |

1. **hash\_fair\_mutex**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| mutex | 7.845 | 8.207 | 8.243 | 8.257 | 8.301 | 8.315 | 8.318 | 8.323 | 8.325 | 8.346 | 8.356 | 8.372 | 8.399 | 8.395 | 8.397 | 8.406 | 8.418 | 8.424 | 8.431 | 8.421 |
| mutex | 4.445 | 4.591 | 4.74 | 4.745 | 4.753 | 4.759 | 4.763 | 4.767 | 4.778 | 4.779 | 4.81 | 4.832 | 4.836 | 4.856 | 4.856 | 4.87 | 4.876 | 4.878 | 4.879 | 4.89 |
| mutex | 4.157 | 4.842 | 4.849 | 4.846 | 4.856 | 4.874 | 4.891 | 4.883 | 4.902 | 4.905 | 4.909 | 4.916 | 4.926 | 4.929 | 4.95 | 4.963 | 4.969 | 4.971 | 4.973 | 4.964 |
| mutex | 4.463 | 4.445 | 4.533 | 4.576 | 4.61 | 4.622 | 4.624 | 4.644 | 4.61 | 4.669 | 4.616 | 4.679 | 4.69 | 4.69 | 4.695 | 4.662 | 4.719 | 4.735 | 4.735 | 4.69 |
| mutex | 4.307 | 4.554 | 4.62 | 4.769 | 4.903 | 4.932 | 4.949 | 4.967 | 4.965 | 4.986 | 4.975 | 4.99 | 4.995 | 5.021 | 5.019 | 5.024 | 5.024 | 5.038 | 5.036 | 5.037 |

1. **hash\_fair\_two\_phase**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| two\_phase | 7.449 | 8.199 | 8.226 | 8.247 | 8.25 | 8.276 | 8.276 | 8.286 | 8.294 | 8.295 | 8.3 | 8.302 | 8.302 | 8.31 | 8.311 | 8.319 | 8.322 | 8.323 | 8.326 | 8.329 |
| two\_phase | 7.822 | 7.915 | 7.917 | 7.94 | 7.943 | 7.951 | 7.956 | 7.98 | 8.001 | 7.991 | 8.011 | 8.026 | 8.028 | 8.027 | 8.033 | 8.045 | 8.048 | 8.054 | 8.065 | 8.068 |
| two\_phase | 4.033 | 4.545 | 4.571 | 4.588 | 4.612 | 4.623 | 4.665 | 4.675 | 4.677 | 4.68 | 4.684 | 4.687 | 4.701 | 4.702 | 4.71 | 4.717 | 4.724 | 4.725 | 4.726 | 4.734 |
| two\_phase | 7.822 | 7.966 | 7.994 | 8.008 | 7.999 | 8.021 | 8.032 | 8.026 | 8.064 | 8.081 | 8.097 | 8.121 | 8.218 | 8.229 | 8.252 | 8.23 | 8.248 | 8.254 | 8.278 | 8.26 |
| two\_phase | 7.683 | 8.409 | 8.504 | 8.555 | 8.563 | 8.599 | 8.6 | 8.603 | 8.604 | 8.62 | 8.666 | 8.661 | 8.691 | 8.672 | 8.711 | 8.712 | 8.714 | 8.717 | 8.721 | 8.724 |

1. **hash\_fair\_pthread**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| pthread | 0.883 | 1.016 | 1.033 | 1.052 | 1.122 | 1.135 | 1.148 | 1.171 | 1.173 | 1.199 | 1.211 | 1.241 | 1.257 | 1.267 | 1.267 | 1.27 | 1.273 | 1.282 | 1.284 | 1.285 |
| pthread | 0.84 | 0.958 | 1.048 | 1.117 | 1.131 | 1.162 | 1.188 | 1.226 | 1.229 | 1.242 | 1.248 | 1.25 | 1.265 | 1.273 | 1.27 | 1.285 | 1.286 | 1.293 | 1.301 | 1.301 |
| pthread | 0.919 | 0.958 | 0.964 | 1.159 | 1.16 | 1.164 | 1.19 | 1.211 | 1.231 | 1.234 | 1.266 | 1.282 | 1.29 | 1.308 | 1.31 | 1.325 | 1.332 | 1.335 | 1.347 | 1.356 |
| pthread | 0.701 | 0.907 | 0.961 | 0.963 | 1.086 | 1.094 | 1.124 | 1.136 | 1.147 | 1.152 | 1.164 | 1.169 | 1.171 | 1.195 | 1.213 | 1.214 | 1.226 | 1.238 | 1.245 | 1.256 |
| pthread | 0.859 | 0.977 | 0.987 | 1.017 | 1.106 | 1.11 | 1.112 | 1.114 | 1.159 | 1.161 | 1.174 | 1.184 | 1.234 | 1.237 | 1.25 | 1.253 | 1.261 | 1.262 | 1.264 | 1.276 |

1. **hash\_fair**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| spinlock | 8.525 | 8.758 | 9.401 | 9.502 | 9.817 | 10.242 | 10.394 | 10.791 | 10.85 | 10.984 | 10.992 | 11.009 | 11.052 | 11.177 | 11.196 | 11.238 | 11.292 | 11.298 | 11.318 | 11.317 |
| mutex | 4.445 | 4.591 | 4.74 | 4.745 | 4.753 | 4.759 | 4.763 | 4.767 | 4.778 | 4.779 | 4.81 | 4.832 | 4.836 | 4.856 | 4.856 | 4.87 | 4.876 | 4.878 | 4.879 | 4.89 |
| two\_phase | 7.822 | 7.966 | 7.994 | 8.008 | 7.999 | 8.021 | 8.032 | 8.026 | 8.064 | 8.081 | 8.097 | 8.121 | 8.218 | 8.229 | 8.252 | 8.23 | 8.248 | 8.254 | 8.278 | 8.26 |
| pthread | 0.883 | 1.016 | 1.033 | 1.052 | 1.122 | 1.135 | 1.148 | 1.171 | 1.173 | 1.199 | 1.211 | 1.241 | 1.257 | 1.267 | 1.267 | 1.27 | 1.273 | 1.282 | 1.284 | 1.285 |

1. **fairmutex\_fair**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_rank | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| counter\_fairmutex | 192.036 | 192.302 | 192.311 | 192.312 | 192.312 | 192.326 | 192.326 | 192.326 | 192.326 | 192.326 | 192.326 | 192.326 | 192.326 | 192.342 | 192.399 | 192.399 | 192.399 | 192.403 | 192.403 | 192.403 |
| list\_fairmutex | 193.741 | 193.74 | 193.741 | 193.741 | 193.741 | 193.741 | 193.741 | 193.733 | 193.742 | 193.742 | 193.742 | 193.742 | 193.743 | 193.743 | 193.742 | 193.742 | 193.742 | 193.743 | 193.743 | 193.743 |

1. 比较四种锁 针对三种数据结构
2. Counter
3. **Counter**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| spinlock | 0.029 | 0.150 | 0.399 | 0.743 | 1.041 | 1.521 | 2.117 | 2.917 | 3.499 | 4.521 | 4.683 | 5.088 | 5.478 | 6.178 | 9.352 | 9.201 | 11.311 | 12.545 | 12.381 | 15.296 |
| mutex | 0.602 | 0.731 | 1.129 | 1.574 | 1.939 | 2.219 | 2.653 | 2.998 | 3.366 | 3.718 | 4.075 | 4.583 | 4.892 | 5.215 | 5.614 | 5.897 | 6.368 | 6.736 | 7.163 | 7.491 |
| two\_phase | 0.216 | 0.407 | 0.613 | 0.811 | 1.018 | 1.229 | 1.425 | 1.611 | 1.847 | 2.036 | 2.226 | 2.469 | 2.647 | 2.844 | 3.024 | 3.226 | 3.417 | 3.633 | 3.854 | 4.056 |
| pthread | 0.040 | 0.209 | 0.297 | 0.336 | 0.446 | 0.592 | 0.701 | 0.771 | 0.884 | 0.904 | 1.028 | 1.050 | 1.364 | 1.269 | 1.459 | 1.598 | 1.480 | 1.906 | 1.680 | 1.952 |

1. list仅插入
2. list重复测试
3. **list\_insert\_spinlock**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| spinlock | 0.065 | 0.222 | 0.488 | 0.791 | 1.524 | 2.192 | 2.776 | 3.607 | 4.480 | 5.709 | 6.973 | 8.358 | 9.716 | 11.037 | 12.456 | 14.436 | 15.046 | 16.725 | 19.738 | 21.524 |
| spinlock | 0.065 | 0.242 | 0.486 | 0.928 | 1.335 | 1.943 | 2.852 | 3.683 | 4.887 | 5.622 | 6.404 | 7.946 | 9.361 | 11.196 | 12.238 | 13.695 | 15.696 | 16.841 | 20.409 | 21.222 |
| spinlock | 0.067 | 0.236 | 0.478 | 1.023 | 1.358 | 2.041 | 2.822 | 3.600 | 4.815 | 6.225 | 6.691 | 7.307 | 9.478 | 10.481 | 11.597 | 14.347 | 16.259 | 16.729 | 19.213 | 21.855 |

1. **list\_insert\_mutex**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| mutex | 0.691 | 0.944 | 1.501 | 2.105 | 2.443 | 2.840 | 3.257 | 4.057 | 4.289 | 4.927 | 5.139 | 5.778 | 6.052 | 6.581 | 6.905 | 7.670 | 8.252 | 8.546 | 8.670 | 9.577 |
| mutex | 0.686 | 1.188 | 1.356 | 2.098 | 2.932 | 2.941 | 3.613 | 4.047 | 4.838 | 5.306 | 6.060 | 6.853 | 7.616 | 8.121 | 8.882 | 9.881 | 9.876 | 10.866 | 11.149 | 12.069 |
| mutex | 0.683 | 0.908 | 1.684 | 1.924 | 2.957 | 3.363 | 3.983 | 4.620 | 4.995 | 5.839 | 5.889 | 6.722 | 7.195 | 7.393 | 8.051 | 8.631 | 9.294 | 10.144 | 10.488 | 11.020 |
| mutex | 0.691 | 0.882 | 1.667 | 1.924 | 2.735 | 2.997 | 3.812 | 4.368 | 5.144 | 5.368 | 5.209 | 6.027 | 6.711 | 7.219 | 7.366 | 8.226 | 8.427 | 8.856 | 9.616 | 9.892 |

1. **list\_insert\_two\_phase**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| two\_phase | 0.068 | 0.417 | 0.654 | 0.843 | 1.139 | 2.372 | 1.445 | 1.746 | 1.990 | 2.166 | 2.337 | 2.650 | 2.870 | 3.058 | 3.207 | 6.912 | 7.206 | 3.943 | 7.754 | 8.267 |
| two\_phase | 0.069 | 0.622 | 0.829 | 1.646 | 2.122 | 2.552 | 2.818 | 3.439 | 3.771 | 4.252 | 4.563 | 5.134 | 5.595 | 5.857 | 6.329 | 6.907 | 3.985 | 7.673 | 4.269 | 4.604 |
| two\_phase | 0.068 | 0.442 | 1.162 | 1.570 | 2.070 | 2.629 | 2.895 | 3.455 | 3.873 | 4.317 | 4.703 | 5.150 | 5.706 | 6.134 | 6.512 | 7.032 | 3.842 | 7.990 | 4.338 | 4.401 |
| two\_phase | 0.067 | 0.589 | 0.875 | 1.630 | 2.250 | 2.365 | 2.994 | 3.237 | 3.911 | 4.293 | 4.788 | 5.224 | 5.715 | 6.248 | 6.551 | 6.978 | 3.828 | 8.040 | 4.145 | 4.325 |
| two\_phase | 0.067 | 0.663 | 1.142 | 1.597 | 2.231 | 2.472 | 2.798 | 3.251 | 3.708 | 4.313 | 4.401 | 4.857 | 5.367 | 5.746 | 6.088 | 6.731 | 3.911 | 7.344 | 4.247 | 4.523 |

1. **list\_insert\_pthread**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| pthread | 0.071 | 0.174 | 0.202 | 0.286 | 0.425 | 0.495 | 0.438 | 0.473 | 0.471 | 0.509 | 0.592 | 0.677 | 0.694 | 0.729 | 0.762 | 0.840 | 0.882 | 0.932 | 1.017 | 1.016 |
| pthread | 0.069 | 0.197 | 0.185 | 0.319 | 0.429 | 0.450 | 0.455 | 0.460 | 0.526 | 0.582 | 0.620 | 0.622 | 0.705 | 0.755 | 0.839 | 0.857 | 0.887 | 0.961 | 1.025 | 1.049 |
| pthread | 0.070 | 0.209 | 0.267 | 0.292 | 0.370 | 0.632 | 0.478 | 0.425 | 0.464 | 0.553 | 0.565 | 0.627 | 0.676 | 0.733 | 0.794 | 0.808 | 0.890 | 0.904 | 0.984 | 1.006 |

1. **list\_insert**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| spinlock | 0.065 | 0.222 | 0.488 | 0.791 | 1.524 | 2.192 | 2.776 | 3.607 | 4.480 | 5.709 | 6.973 | 8.358 | 9.716 | 11.037 | 12.456 | 14.436 | 15.046 | 16.725 | 19.738 | 21.524 |
| mutex | 0.683 | 0.908 | 1.684 | 1.924 | 2.957 | 3.363 | 3.983 | 4.620 | 4.995 | 5.839 | 5.889 | 6.722 | 7.195 | 7.393 | 8.051 | 8.631 | 9.294 | 10.144 | 10.488 | 11.020 |
| two\_phase | 0.067 | 0.589 | 0.875 | 1.630 | 2.250 | 2.365 | 2.994 | 3.237 | 3.911 | 4.293 | 4.788 | 5.224 | 5.715 | 6.248 | 6.551 | 6.978 | 3.828 | 8.040 | 4.145 | 4.325 |
| pthread | 0.069 | 0.197 | 0.185 | 0.319 | 0.429 | 0.450 | 0.455 | 0.460 | 0.526 | 0.582 | 0.620 | 0.622 | 0.705 | 0.755 | 0.839 | 0.857 | 0.887 | 0.961 | 1.025 | 1.049 |

1. list插入删除
2. list重复测试
3. **list\_insert\_delete\_spinlock**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| spinlock | 0.083 | 0.267 | 0.572 | 0.878 | 1.607 | 2.303 | 2.755 | 3.724 | 4.703 | 5.945 | 6.697 | 8.070 | 9.784 | 10.857 | 11.655 | 13.291 | 15.739 | 16.834 | 19.440 | 22.142 |
| spinlock | 0.085 | 0.257 | 0.540 | 0.934 | 1.503 | 2.307 | 2.850 | 3.846 | 4.668 | 6.118 | 6.147 | 7.962 | 9.221 | 11.209 | 11.879 | 14.099 | 14.577 | 14.934 | 20.877 | 22.042 |
| spinlock | 0.083 | 0.272 | 0.599 | 0.997 | 1.444 | 2.183 | 2.721 | 3.572 | 4.831 | 5.843 | 6.666 | 8.552 | 9.734 | 11.279 | 12.917 | 13.617 | 15.457 | 18.221 | 19.409 | 22.719 |

1. **list\_insert\_delete\_mutex**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| mutex | 0.694 | 0.997 | 1.707 | 2.102 | 3.047 | 3.348 | 4.012 | 4.378 | 5.176 | 6.051 | 6.224 | 6.409 | 7.402 | 7.399 | 7.777 | 9.062 | 9.551 | 10.158 | 10.204 | 11.114 |
| mutex | 0.275 | 0.503 | 0.759 | 1.037 | 1.367 | 1.568 | 1.736 | 2.061 | 2.404 | 2.546 | 2.835 | 3.081 | 3.417 | 3.617 | 3.839 | 4.139 | 4.541 | 5.051 | 4.913 | 5.144 |
| mutex | 0.702 | 1.020 | 1.456 | 1.876 | 2.634 | 3.095 | 3.539 | 4.348 | 4.432 | 5.359 | 5.495 | 5.913 | 7.000 | 7.289 | 7.465 | 8.090 | 9.118 | 9.418 | 9.563 | 10.122 |
| mutex | 0.283 | 0.530 | 0.773 | 1.062 | 1.417 | 1.721 | 1.881 | 2.276 | 2.618 | 2.705 | 3.093 | 3.362 | 3.749 | 3.937 | 4.327 | 4.626 | 4.885 | 5.276 | 5.324 | 5.599 |

1. **list\_insert\_delete\_two\_phase**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| two\_phase | 0.085 | 0.460 | 0.686 | 0.995 | 1.254 | 2.715 | 1.644 | 1.924 | 2.274 | 2.413 | 2.615 | 2.937 | 3.263 | 3.401 | 3.554 | 7.171 | 8.047 | 4.367 | 8.714 | 9.157 |
| two\_phase | 0.086 | 0.692 | 1.209 | 1.716 | 2.282 | 2.646 | 3.117 | 3.752 | 3.933 | 4.483 | 4.780 | 5.442 | 5.851 | 6.329 | 6.438 | 7.421 | 7.644 | 7.947 | 8.576 | 8.991 |
| two\_phase | 0.085 | 0.458 | 0.714 | 0.965 | 1.256 | 1.491 | 1.709 | 2.029 | 2.282 | 2.488 | 2.633 | 2.898 | 3.258 | 3.448 | 3.767 | 3.885 | 7.681 | 4.508 | 8.331 | 8.707 |

1. **list\_insert\_delete\_pthread**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| pthread | 0.092 | 0.214 | 0.301 | 0.341 | 0.486 | 0.553 | 0.583 | 0.581 | 0.641 | 0.688 | 0.857 | 0.837 | 0.903 | 0.995 | 1.051 | 1.098 | 1.178 | 1.251 | 1.314 | 1.374 |
| pthread | 0.089 | 0.243 | 0.263 | 0.337 | 0.516 | 0.597 | 0.546 | 0.599 | 0.668 | 0.753 | 0.819 | 0.917 | 0.935 | 1.010 | 1.067 | 1.161 | 1.195 | 1.285 | 1.351 | 1.476 |
| pthread | 0.088 | 0.242 | 0.255 | 0.416 | 0.470 | 0.574 | 0.513 | 0.622 | 0.665 | 0.716 | 0.807 | 0.870 | 0.918 | 0.995 | 1.055 | 1.149 | 1.215 | 1.311 | 1.435 | 1.450 |

1. **list\_insert\_delete**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| spinlock | 0.083 | 0.272 | 0.599 | 0.997 | 1.444 | 2.183 | 2.721 | 3.572 | 4.831 | 5.843 | 6.666 | 8.552 | 9.734 | 11.279 | 12.917 | 13.617 | 15.457 | 18.221 | 19.409 | 22.719 |
| mutex | 0.702 | 1.020 | 1.456 | 1.876 | 2.634 | 3.095 | 3.539 | 4.348 | 4.432 | 5.359 | 5.495 | 5.913 | 7.000 | 7.289 | 7.465 | 8.090 | 9.118 | 9.418 | 9.563 | 10.122 |
| two\_phase | 0.085 | 0.458 | 0.714 | 0.965 | 1.256 | 1.491 | 1.709 | 2.029 | 2.282 | 2.488 | 2.633 | 2.898 | 3.258 | 3.448 | 3.767 | 3.885 | 7.681 | 4.508 | 8.331 | 8.707 |
| pthread | 0.089 | 0.243 | 0.263 | 0.337 | 0.516 | 0.597 | 0.546 | 0.599 | 0.668 | 0.753 | 0.819 | 0.917 | 0.935 | 1.010 | 1.067 | 1.161 | 1.195 | 1.285 | 1.351 | 1.476 |

1. hash仅插入
2. hash重复测试
3. **hash\_insert\_spinlock**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| spinlock | 0.075 | 0.130 | 0.186 | 0.458 | 1.146 | 1.132 | 1.792 | 2.788 | 3.449 | 3.923 | 4.616 | 9.794 | 7.526 | 7.891 | 11.948 | 16.969 | 14.214 | 14.697 | 16.162 | 21.457 |
| spinlock | 0.068 | 0.154 | 0.293 | 0.607 | 0.868 | 1.531 | 2.445 | 5.054 | 3.321 | 4.266 | 5.041 | 5.485 | 7.186 | 8.316 | 9.844 | 12.763 | 14.378 | 16.412 | 14.905 | 18.318 |

1. **hash\_insert\_mutex**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| mutex | 0.691 | 0.843 | 1.470 | 1.716 | 2.150 | 2.689 | 3.107 | 3.676 | 4.044 | 4.624 | 2.846 | 3.139 | 6.493 | 3.938 | 7.558 | 4.620 | 8.221 | 8.577 | 8.879 | 9.227 |
| mutex | 0.683 | 0.871 | 1.251 | 1.644 | 2.085 | 2.540 | 3.121 | 3.618 | 4.094 | 4.506 | 5.034 | 3.528 | 6.897 | 7.005 | 7.436 | 7.633 | 8.245 | 8.838 | 9.463 | 10.062 |

1. **hash\_insert\_two\_phase**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| two\_phase | 0.069 | 0.120 | 0.197 | 0.264 | 0.477 | 0.642 | 0.915 | 1.124 | 1.315 | 1.360 | 1.673 | 1.775 | 1.977 | 2.233 | 2.153 | 2.220 | 2.734 | 2.962 | 3.156 | 3.560 |
| two\_phase | 0.070 | 0.148 | 0.237 | 0.341 | 0.488 | 0.580 | 0.829 | 1.052 | 1.130 | 1.771 | 1.680 | 2.018 | 2.003 | 2.192 | 2.675 | 3.072 | 3.324 | 3.929 | 3.406 | 3.435 |
| two\_phase | 0.067 | 0.124 | 0.214 | 0.277 | 0.528 | 0.665 | 0.913 | 1.118 | 1.333 | 1.514 | 1.866 | 2.094 | 2.253 | 2.733 | 2.172 | 2.284 | 2.455 | 2.698 | 3.084 | 2.907 |

1. **hash\_insert\_pthread**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| pthread | 0.069 | 0.159 | 0.244 | 0.310 | 0.402 | 0.459 | 0.751 | 1.009 | 1.142 | 1.473 | 1.550 | 1.856 | 2.148 | 2.132 | 2.812 | 2.411 | 2.522 | 3.259 | 3.549 | 3.520 |
| pthread | 0.071 | 0.106 | 0.233 | 0.292 | 0.372 | 0.474 | 0.822 | 1.030 | 1.351 | 1.466 | 2.027 | 1.736 | 1.761 | 1.932 | 2.436 | 2.753 | 2.859 | 3.017 | 3.497 | 3.427 |
| pthread | 0.069 | 0.123 | 0.233 | 0.277 | 0.391 | 0.513 | 1.037 | 1.178 | 1.228 | 1.241 | 1.724 | 1.893 | 2.283 | 2.387 | 2.183 | 2.249 | 2.800 | 3.221 | 3.541 | 3.568 |

1. **hash\_insert**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| spinlock | 0.068 | 0.154 | 0.293 | 0.607 | 0.868 | 1.531 | 2.445 | 5.054 | 3.321 | 4.266 | 5.041 | 5.485 | 7.186 | 8.316 | 9.844 | 12.763 | 14.378 | 16.412 | 14.905 | 18.318 |
| mutex | 0.683 | 0.871 | 1.251 | 1.644 | 2.085 | 2.540 | 3.121 | 3.618 | 4.094 | 4.506 | 5.034 | 3.528 | 6.897 | 7.005 | 7.436 | 7.633 | 8.245 | 8.838 | 9.463 | 10.062 |
| two\_phase | 0.069 | 0.120 | 0.197 | 0.264 | 0.477 | 0.642 | 0.915 | 1.124 | 1.315 | 1.360 | 1.673 | 1.775 | 1.977 | 2.233 | 2.153 | 2.220 | 2.734 | 2.962 | 3.156 | 3.560 |
| pthread | 0.069 | 0.159 | 0.244 | 0.310 | 0.402 | 0.459 | 0.751 | 1.009 | 1.142 | 1.473 | 1.550 | 1.856 | 2.148 | 2.132 | 2.812 | 2.411 | 2.522 | 3.259 | 3.549 | 3.520 |

1. hash插入删除
2. hash重复测试
3. **hash\_insert\_delete\_spinlock**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| spinlock | 0.101 | 0.275 | 0.438 | 0.726 | 1.225 | 2.195 | 2.498 | 3.862 | 4.653 | 5.657 | 7.604 | 11.012 | 10.015 | 12.247 | 12.876 | 14.748 | 16.808 | 19.376 | 20.268 | 23.387 |
| spinlock | 0.107 | 0.249 | 0.403 | 0.779 | 1.118 | 2.201 | 5.504 | 3.653 | 5.479 | 5.079 | 6.370 | 8.200 | 10.367 | 9.310 | 14.394 | 14.354 | 16.256 | 19.083 | 18.883 | 19.368 |
| spinlock | 0.104 | 0.245 | 0.380 | 0.767 | 1.811 | 1.895 | 2.727 | 3.055 | 4.592 | 5.881 | 6.707 | 8.102 | 9.909 | 10.962 | 13.244 | 15.098 | 17.999 | 18.045 | 21.569 | 23.631 |

1. **hash\_insert\_delete\_mutex**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| mutex | 0.764 | 0.944 | 1.410 | 1.863 | 1.426 | 2.055 | 2.542 | 3.208 | 5.450 | 4.118 | 7.064 | 7.656 | 5.634 | 9.111 | 9.719 | 10.108 | 11.034 | 11.136 | 12.775 | 13.322 |
| mutex | 0.725 | 0.930 | 1.368 | 1.883 | 1.478 | 2.157 | 3.054 | 3.203 | 3.560 | 4.111 | 6.436 | 7.308 | 5.876 | 9.645 | 10.309 | 10.772 | 11.316 | 12.124 | 12.779 | 13.507 |
| mutex | 0.747 | 0.990 | 1.514 | 2.066 | 2.513 | 3.306 | 4.120 | 4.665 | 5.181 | 5.688 | 6.324 | 7.505 | 9.082 | 8.539 | 9.157 | 10.005 | 11.092 | 10.807 | 7.546 | 12.139 |

1. **hash\_insert\_delete\_two\_phase**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| two\_phase | 0.100 | 0.221 | 0.346 | 0.435 | 0.794 | 1.104 | 1.612 | 1.920 | 2.426 | 2.823 | 3.295 | 3.267 | 4.162 | 4.617 | 5.085 | 5.088 | 5.954 | 6.364 | 6.880 | 7.388 |
| two\_phase | 0.105 | 0.240 | 0.370 | 0.558 | 0.982 | 1.529 | 1.709 | 2.099 | 2.232 | 2.662 | 3.417 | 4.134 | 3.425 | 3.778 | 3.993 | 4.119 | 4.542 | 4.937 | 6.210 | 7.085 |
| two\_phase | 0.102 | 0.251 | 0.353 | 0.457 | 0.767 | 1.031 | 1.463 | 1.846 | 2.259 | 2.572 | 3.003 | 3.779 | 3.767 | 4.813 | 6.322 | 5.169 | 6.122 | 6.568 | 5.810 | 6.425 |

1. **hash\_insert\_delete\_pthread**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| pthread | 0.106 | 0.243 | 0.350 | 0.512 | 0.588 | 0.873 | 1.252 | 1.410 | 1.917 | 2.456 | 2.435 | 2.763 | 3.618 | 3.680 | 3.985 | 4.823 | 4.917 | 4.946 | 5.596 | 6.101 |
| pthread | 0.101 | 0.200 | 0.348 | 0.474 | 0.606 | 1.038 | 1.581 | 1.922 | 2.386 | 2.518 | 3.168 | 3.127 | 3.604 | 3.896 | 4.602 | 4.705 | 4.554 | 5.385 | 5.530 | 5.708 |
| pthread | 0.106 | 0.226 | 0.410 | 0.446 | 0.597 | 0.858 | 1.263 | 1.651 | 2.120 | 2.223 | 2.715 | 2.691 | 3.431 | 3.546 | 4.186 | 4.624 | 4.643 | 4.785 | 4.742 | 5.050 |

1. **hash\_insert\_delete**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| thread\_number | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| spinlock | 0.104 | 0.245 | 0.380 | 0.767 | 1.811 | 1.895 | 2.727 | 3.055 | 4.592 | 5.881 | 6.707 | 8.102 | 9.909 | 10.962 | 13.244 | 15.098 | 17.999 | 18.045 | 21.569 | 23.631 |
| mutex | 0.725 | 0.930 | 1.368 | 1.883 | 1.478 | 2.157 | 3.054 | 3.203 | 3.560 | 4.111 | 6.436 | 7.308 | 5.876 | 9.645 | 10.309 | 10.772 | 11.316 | 12.124 | 12.779 | 13.507 |
| two\_phase | 0.100 | 0.221 | 0.346 | 0.435 | 0.794 | 1.104 | 1.612 | 1.920 | 2.426 | 2.823 | 3.295 | 3.267 | 4.162 | 4.617 | 5.085 | 5.088 | 5.954 | 6.364 | 6.880 | 7.388 |

1. 哈希表缩放测试 固定20个线程测桶数的影响
2. hash\_10-10^7共7个桶
3. hash重复测试
4. **hash\_bucket\_7\_spinlock\_average**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| bucket\_number | 10 | 100 | 1000 | 10000 | 10^5 | 10^6 | 10^7 |
| spinlock\_average | 13.718 | 8.882 | 14.264 | 6.949 | 3.117 | 2.719 | 2.202 |
| spinlock\_average | 14.673 | 9.669 | 16.951 | 6.988 | 3.076 | 2.257 | 2.485 |
| spinlock\_average | 12.930 | 9.268 | 12.272 | 6.964 | 3.592 | 3.053 | 2.488 |

1. **hash\_bucket\_7\_spinlock\_single**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| bucket\_number | 10 | 100 | 1000 | 10000 | 10^5 | 10^6 | 10^7 |
| spinlock\_single | 16.251 | 8.616 | 24.404 | 6.890 | 3.727 | 2.349 | 3.327 |
| spinlock\_single | 20.888 | 19.831 | 18.909 | 20.616 | 19.383 | 20.693 | 18.945 |
| spinlock\_single | 16.722 | 18.564 | 19.737 | 19.073 | 20.113 | 19.611 | 20.204 |
| spinlock\_single | 18.912 | 23.332 | 19.421 | 19.070 | 20.439 | 21.171 | 20.756 |

1. **hash\_bucket\_7\_mutex\_average**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| bucket\_number | 10 | 100 | 1000 | 10000 | 10^5 | 10^6 | 10^7 |
| mutex\_average | 8.917 | 8.527 | 9.197 | 8.561 | 9.123 | 6.131 | 5.667 |
| mutex\_average | 5.528 | 4.677 | 4.968 | 4.431 | 5.001 | 7.132 | 7.371 |
| mutex\_average | 8.693 | 8.544 | 9.396 | 9.776 | 9.017 | 6.533 | 5.518 |

1. **hash\_bucket\_7\_mutex\_single**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| bucket\_number | 10 | 100 | 1000 | 10000 | 10^5 | 10^6 | 10^7 |
| mutex\_single | 10.002 | 9.772 | 9.565 | 9.754 | 9.605 | 4.216 | 9.539 |
| mutex\_single | 9.955 | 9.745 | 9.050 | 9.376 | 9.501 | 9.040 | 11.478 |
| mutex\_single | 5.139 | 4.513 | 4.823 | 4.841 | 4.517 | 4.453 | 9.517 |

1. **hash\_bucket\_7\_two\_phase\_average**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| bucket\_number | 10 | 100 | 1000 | 10000 | 10^5 | 10^6 | 10^7 |
| two\_phase\_average | 6.097 | 1.146 | 2.089 | 1.809 | 1.341 | 1.773 | 1.665 |
| two\_phase\_average | 6.120 | 1.136 | 2.183 | 1.879 | 1.524 | 1.622 | 1.372 |

1. **hash\_bucket\_7\_two\_phase\_single**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| bucket\_number | 10 | 100 | 1000 | 10000 | 10^5 | 10^6 | 10^7 |
| two\_phase\_single | 5.265 | 4.827 | 4.767 | 4.771 | 4.941 | 8.468 | 8.871 |
| two\_phase\_single | 9.606 | 9.004 | 8.640 | 8.353 | 8.870 | 4.455 | 8.660 |
| two\_phase\_single | 5.214 | 4.678 | 4.941 | 4.574 | 4.449 | 8.308 | 4.849 |

1. **hash\_bucket\_7\_pthread\_average**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| bucket\_number | 10 | 100 | 1000 | 10000 | 10^5 | 10^6 | 10^7 |
| pthread\_average | 1.314 | 1.223 | 2.135 | 1.949 | 1.592 | 1.858 | 2.504 |
| pthread\_average | 1.327 | 1.145 | 2.395 | 2.196 | 1.871 | 2.121 | 2.058 |
| pthread\_average | 1.299 | 1.024 | 2.321 | 2.529 | 1.916 | 2.222 | 1.905 |

1. **hash\_bucket\_7\_pthread\_single**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| bucket\_number | 10 | 100 | 1000 | 10000 | 10^5 | 10^6 | 10^7 |
| pthread\_single | 1.217 | 1.147 | 1.123 | 1.090 | 1.143 | 1.121 | 2.176 |
| pthread\_single | 1.219 | 1.118 | 1.103 | 1.166 | 1.111 | 1.236 | 1.281 |
| pthread\_single | 1.232 | 1.094 | 1.099 | 1.121 | 1.128 | 1.127 | 1.332 |

1. **hash\_bucket\_7\_spinlock**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| bucket\_number | 10 | 100 | 1000 | 10000 | 10^5 | 10^6 | 10^7 |
| spinlock\_average | 13.718 | 8.882 | 14.264 | 6.949 | 3.117 | 2.719 | 2.202 |
| spinlock\_single | 16.722 | 18.564 | 19.737 | 19.073 | 20.113 | 19.611 | 20.204 |

1. **hash\_bucket\_7\_mutex**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| bucket\_number | 10 | 100 | 1000 | 10000 | 10^5 | 10^6 | 10^7 |
| mutex\_average | 8.917 | 8.527 | 9.197 | 8.561 | 9.123 | 6.131 | 5.667 |
| mutex\_single | 10.002 | 9.772 | 9.565 | 9.754 | 9.605 | 4.216 | 9.539 |

1. **hash\_bucket\_7\_two\_phase**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| bucket\_number | 10 | 100 | 1000 | 10000 | 10^5 | 10^6 | 10^7 |
| two\_phase\_average | 6.097 | 1.146 | 2.089 | 1.809 | 1.341 | 1.773 | 1.665 |
| two\_phase\_single | 5.214 | 4.678 | 4.941 | 4.574 | 4.449 | 8.308 | 4.849 |

1. **hash\_bucket\_7\_pthread**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| bucket\_number | 10 | 100 | 1000 | 10000 | 10^5 | 10^6 | 10^7 |
| pthread\_average | 1.327 | 1.145 | 2.395 | 2.196 | 1.871 | 2.121 | 2.058 |
| pthread\_single | 1.232 | 1.094 | 1.099 | 1.121 | 1.128 | 1.127 | 1.332 |

1. **hash\_bucket\_7\_average**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| bucket\_number | 10 | 100 | 1000 | 10000 | 10^5 | 10^6 | 10^7 |
| spinlock\_average | 13.718 | 8.882 | 14.264 | 6.949 | 3.117 | 2.719 | 2.202 |
| mutex\_average | 8.917 | 8.527 | 9.197 | 8.561 | 9.123 | 6.131 | 5.667 |
| two\_phase\_average | 6.097 | 1.146 | 2.089 | 1.809 | 1.341 | 1.773 | 1.665 |
| pthread\_average | 1.327 | 1.145 | 2.395 | 2.196 | 1.871 | 2.121 | 2.058 |

1. **hash\_bucket\_7\_single**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| bucket\_number | 10 | 100 | 1000 | 10000 | 10^5 | 10^6 | 10^7 |
| spinlock\_single | 16.722 | 18.564 | 19.737 | 19.073 | 20.113 | 19.611 | 20.204 |
| mutex\_single | 10.002 | 9.772 | 9.565 | 9.754 | 9.605 | 4.216 | 9.539 |
| two\_phase\_single | 5.214 | 4.678 | 4.941 | 4.574 | 4.449 | 8.308 | 4.849 |
| pthread\_single | 1.232 | 1.094 | 1.099 | 1.121 | 1.128 | 1.127 | 1.332 |

1. **hash\_bucket\_7**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| bucket\_number | 10 | 100 | 1000 | 10000 | 10^5 | 10^6 | 10^7 |
| spinlock\_average | 13.718 | 8.882 | 14.264 | 6.949 | 3.117 | 2.719 | 2.202 |
| mutex\_average | 8.917 | 8.527 | 9.197 | 8.561 | 9.123 | 6.131 | 5.667 |
| two\_phase\_average | 6.097 | 1.146 | 2.089 | 1.809 | 1.341 | 1.773 | 1.665 |
| pthread\_average | 1.327 | 1.145 | 2.395 | 2.196 | 1.871 | 2.121 | 2.058 |
| spinlock\_single | 16.722 | 18.564 | 19.737 | 19.073 | 20.113 | 19.611 | 20.204 |
| mutex\_single | 10.002 | 9.772 | 9.565 | 9.754 | 9.605 | 4.216 | 9.539 |
| two\_phase\_single | 5.214 | 4.678 | 4.941 | 4.574 | 4.449 | 8.308 | 4.849 |
| pthread\_single | 1.232 | 1.094 | 1.099 | 1.121 | 1.128 | 1.127 | 1.332 |

1. hash\_10-100共10个桶
2. hash重复测试
3. **hash\_bucket\_10\_spinlock\_average**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| bucket\_number | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| spinlock\_average | 18.845 | 10.240 | 17.150 | 29.848 | 21.076 | 21.545 | 19.263 | 22.101 | 25.618 | 23.500 |
| spinlock\_average | 10.847 | 8.264 | 13.183 | 17.433 | 16.801 | 21.669 | 18.111 | 16.389 | 16.770 | 18.545 |
| spinlock\_average | 15.384 | 11.244 | 16.897 | 29.125 | 22.936 | 20.712 | 20.109 | 23.213 | 24.387 | 23.360 |

1. **hash\_bucket\_10\_spinlock\_single**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| bucket\_number | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| spinlock\_single | 19.122 | 19.984 | 20.197 | 20.513 | 22.063 | 19.395 | 21.076 | 19.241 | 18.852 | 20.379 |
| spinlock\_single | 20.148 | 14.582 | 18.233 | 25.091 | 21.102 | 18.235 | 16.629 | 19.751 | 20.309 | 20.946 |

1. **hash\_bucket\_10\_mutex\_average**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| bucket\_number | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| mutex\_average | 5.450 | 4.507 | 5.686 | 5.797 | 5.923 | 5.934 | 6.980 | 6.016 | 6.109 | 5.685 |
| mutex\_average | 5.637 | 4.686 | 5.626 | 5.950 | 6.000 | 5.961 | 7.570 | 5.860 | 5.629 | 6.455 |

1. **hash\_bucket\_10\_mutex\_single**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| bucket\_number | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| mutex\_single | 5.310 | 4.697 | 5.033 | 9.473 | 4.895 | 9.794 | 9.129 | 4.942 | 4.838 | 4.814 |
| mutex\_single | 10.002 | 10.326 | 10.315 | 10.574 | 10.014 | 10.054 | 10.654 | 9.763 | 10.004 | 9.899 |
| mutex\_single | 5.631 | 4.555 | 10.234 | 4.638 | 9.611 | 9.822 | 4.718 | 4.345 | 4.350 | 4.432 |

1. **hash\_bucket\_10\_two\_phase\_average**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| bucket\_number | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| two\_phase\_average | 3.718 | 1.930 | 2.250 | 2.741 | 2.896 | 2.585 | 3.301 | 3.023 | 2.560 | 2.977 |
| two\_phase\_average | 3.889 | 1.975 | 2.799 | 3.368 | 3.023 | 2.792 | 2.469 | 2.945 | 2.872 | 3.102 |

1. **hash\_bucket\_10\_two\_phase\_single**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| bucket\_number | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| two\_phase\_single | 5.308 | 4.967 | 4.878 | 5.052 | 4.714 | 4.862 | 4.799 | 4.763 | 4.603 | 4.480 |
| two\_phase\_single | 5.304 | 4.673 | 4.729 | 4.878 | 4.694 | 4.741 | 4.617 | 4.682 | 4.944 | 4.772 |

1. **hash\_bucket\_10\_pthread\_average**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| bucket\_number | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| pthread\_average | 1.273 | 1.271 | 2.819 | 2.847 | 2.709 | 2.826 | 2.809 | 3.230 | 3.133 | 3.431 |
| pthread\_average | 1.317 | 1.347 | 2.899 | 3.204 | 3.920 | 3.013 | 3.279 | 3.119 | 2.818 | 2.850 |
| pthread\_average | 1.288 | 1.295 | 2.962 | 2.929 | 2.796 | 2.708 | 2.718 | 2.697 | 2.648 | 2.984 |

1. **hash\_bucket\_10\_pthread\_single**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| bucket\_number | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| pthread\_single | 1.224 | 1.129 | 1.140 | 1.118 | 1.168 | 1.196 | 1.125 | 1.157 | 1.163 | 1.192 |
| pthread\_single | 1.266 | 1.170 | 1.156 | 1.132 | 1.147 | 1.169 | 1.185 | 1.134 | 1.175 | 1.152 |

1. **hash\_bucket\_10\_spinlock**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| bucket\_number | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| spinlock\_average | 18.845 | 10.240 | 17.150 | 29.848 | 21.076 | 21.545 | 19.263 | 22.101 | 25.618 | 23.500 |
| spinlock\_single | 19.122 | 19.984 | 20.197 | 20.513 | 22.063 | 19.395 | 21.076 | 19.241 | 18.852 | 20.379 |

1. **hash\_bucket\_10\_mutex**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| bucket\_number | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| mutex\_average | 5.450 | 4.507 | 5.686 | 5.797 | 5.923 | 5.934 | 6.980 | 6.016 | 6.109 | 5.685 |
| mutex\_single | 5.310 | 4.697 | 5.033 | 9.473 | 4.895 | 9.794 | 9.129 | 4.942 | 4.838 | 4.814 |

1. **hash\_bucket\_10\_two\_phase**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| bucket\_number | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| two\_phase\_average | 3.718 | 1.930 | 2.250 | 2.741 | 2.896 | 2.585 | 3.301 | 3.023 | 2.560 | 2.977 |
| two\_phase\_single | 5.304 | 4.673 | 4.729 | 4.878 | 4.694 | 4.741 | 4.617 | 4.682 | 4.944 | 4.772 |

1. **hash\_bucket\_10\_pthread**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| bucket\_number | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| pthread\_average | 1.273 | 1.271 | 2.819 | 2.847 | 2.709 | 2.826 | 2.809 | 3.230 | 3.133 | 3.431 |
| pthread\_single | 1.224 | 1.129 | 1.140 | 1.118 | 1.168 | 1.196 | 1.125 | 1.157 | 1.163 | 1.192 |

1. **hash\_bucket\_10\_average**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| bucket\_number | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| spinlock\_average | 18.845 | 10.240 | 17.150 | 29.848 | 21.076 | 21.545 | 19.263 | 22.101 | 25.618 | 23.500 |
| mutex\_average | 5.450 | 4.507 | 5.686 | 5.797 | 5.923 | 5.934 | 6.980 | 6.016 | 6.109 | 5.685 |
| two\_phase\_average | 3.718 | 1.930 | 2.250 | 2.741 | 2.896 | 2.585 | 3.301 | 3.023 | 2.560 | 2.977 |
| pthread\_average | 1.273 | 1.271 | 2.819 | 2.847 | 2.709 | 2.826 | 2.809 | 3.230 | 3.133 | 3.431 |

1. **hash\_bucket\_10\_single**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| bucket\_number | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| spinlock\_single | 19.122 | 19.984 | 20.197 | 20.513 | 22.063 | 19.395 | 21.076 | 19.241 | 18.852 | 20.379 |
| mutex\_single | 5.310 | 4.697 | 5.033 | 9.473 | 4.895 | 9.794 | 9.129 | 4.942 | 4.838 | 4.814 |
| two\_phase\_single | 5.304 | 4.673 | 4.729 | 4.878 | 4.694 | 4.741 | 4.617 | 4.682 | 4.944 | 4.772 |
| pthread\_single | 1.224 | 1.129 | 1.140 | 1.118 | 1.168 | 1.196 | 1.125 | 1.157 | 1.163 | 1.192 |

1. **hash\_bucket\_10**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| bucket\_number | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 |
| spinlock\_average | 18.845 | 10.240 | 17.150 | 29.848 | 21.076 | 21.545 | 19.263 | 22.101 | 25.618 | 23.500 |
| mutex\_average | 5.450 | 4.507 | 5.686 | 5.797 | 5.923 | 5.934 | 6.980 | 6.016 | 6.109 | 5.685 |
| two\_phase\_average | 3.718 | 1.930 | 2.250 | 2.741 | 2.896 | 2.585 | 3.301 | 3.023 | 2.560 | 2.977 |
| pthread\_average | 1.273 | 1.271 | 2.819 | 2.847 | 2.709 | 2.826 | 2.809 | 3.230 | 3.133 | 3.431 |
| spinlock\_single | 19.122 | 19.984 | 20.197 | 20.513 | 22.063 | 19.395 | 21.076 | 19.241 | 18.852 | 20.379 |
| mutex\_single | 5.310 | 4.697 | 5.033 | 9.473 | 4.895 | 9.794 | 9.129 | 4.942 | 4.838 | 4.814 |
| two\_phase\_single | 5.304 | 4.673 | 4.729 | 4.878 | 4.694 | 4.741 | 4.617 | 4.682 | 4.944 | 4.772 |
| pthread\_single | 1.224 | 1.129 | 1.140 | 1.118 | 1.168 | 1.196 | 1.125 | 1.157 | 1.163 | 1.192 |

1. 缩放单个线程项目数 固定20个线程 list
2. list仅插入
3. list重复测试
4. **list\_scale\_insert\_spinlock**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| item\_number | 10 | 100 | 1000 | 10000 | 100000 | 1000000 |
| spinlock | 0.000 | 0.000 | 0.002 | 0.063 | 1.653 | 21.490 |
| spinlock | 0.031 | 0.011 | 0.002 | 0.099 | 1.648 | 20.936 |
| spinlock | 0.033 | 0.006 | 0.011 | 0.079 | 1.640 | 20.205 |
| spinlock | 0.008 | 0.004 | 0.033 | 0.160 | 1.796 | 19.318 |
| spinlock | 0.001 | 0.009 | 0.036 | 0.116 | 1.710 | 20.495 |
| spinlock | 0.018 | 0.002 | 0.004 | 0.055 | 1.582 | 21.181 |
| spinlock | 0.020 | 0.012 | 0.002 | 0.053 | 1.839 | 21.459 |
| spinlock | 0.007 | 0.016 | 0.025 | 0.075 | 1.507 | 18.535 |
| spinlock | 0.028 | 0.006 | 0.002 | 0.078 | 2.109 | 20.777 |
| spinlock | 0.018 | 0.002 | 0.021 | 0.101 | 1.927 | 21.074 |

1. **list\_scale\_insert\_mutex**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| item\_number | 10 | 100 | 1000 | 10000 | 100000 | 1000000 |
| mutex | 0.001 | 0.003 | 0.017 | 0.129 | 1.256 | 12.590 |
| mutex | 0.001 | 0.002 | 0.008 | 0.063 | 0.536 | 5.515 |
| mutex | 0.001 | 0.002 | 0.009 | 0.060 | 0.564 | 5.772 |
| mutex | 0.001 | 0.001 | 0.007 | 0.066 | 0.575 | 5.679 |
| mutex | 0.001 | 0.002 | 0.015 | 0.107 | 1.021 | 9.804 |
| mutex | 0.002 | 0.002 | 0.008 | 0.065 | 0.621 | 5.959 |
| mutex | 0.004 | 0.004 | 0.024 | 0.115 | 1.039 | 10.074 |
| mutex | 0.001 | 0.001 | 0.015 | 0.102 | 1.038 | 10.970 |
| mutex | 0.003 | 0.002 | 0.009 | 0.060 | 0.555 | 5.702 |
| mutex | 0.001 | 0.002 | 0.015 | 0.113 | 1.056 | 10.499 |

1. **list\_scale\_insert\_two\_phase**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| item\_number | 10 | 100 | 1000 | 10000 | 100000 | 1000000 |
| two\_phase | 0.000 | 0.002 | 0.006 | 0.058 | 0.540 | 5.370 |
| two\_phase | 0.000 | 0.000 | 0.002 | 0.066 | 0.511 | 5.054 |
| two\_phase | 0.001 | 0.000 | 0.007 | 0.058 | 0.482 | 5.120 |
| two\_phase | 0.002 | 0.003 | 0.007 | 0.056 | 0.513 | 5.140 |
| two\_phase | 0.002 | 0.004 | 0.011 | 0.099 | 0.901 | 9.532 |
| two\_phase | 0.002 | 0.003 | 0.007 | 0.047 | 0.506 | 5.040 |
| two\_phase | 0.003 | 0.004 | 0.012 | 0.094 | 0.910 | 9.372 |
| two\_phase | 0.002 | 0.002 | 0.006 | 0.054 | 0.488 | 5.001 |
| two\_phase | 0.000 | 0.002 | 0.007 | 0.056 | 0.485 | 5.108 |
| two\_phase | 0.002 | 0.002 | 0.007 | 0.054 | 0.518 | 5.208 |
| two\_phase | 0.001 | 0.002 | 0.007 | 0.057 | 0.492 | 4.968 |
| two\_phase | 0.002 | 0.002 | 0.005 | 0.029 | 0.505 | 5.136 |
| two\_phase | 0.001 | 0.002 | 0.005 | 0.053 | 0.532 | 5.468 |

1. **list\_scale\_insert\_two\_phase\_1times**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| item\_number | 10 | 100 | 1000 | 10000 | 100000 | 1000000 |
| two\_phase\_1times | 0.002 | 0.002 | 0.014 | 0.102 | 0.944 | 9.651 |
| two\_phase\_1times | 0.002 | 0.003 | 0.004 | 0.053 | 0.482 | 5.022 |
| two\_phase\_1times | 0.001 | 0.002 | 0.006 | 0.057 | 0.512 | 5.477 |
| two\_phase\_1times | 0.002 | 0.003 | 0.014 | 0.101 | 0.924 | 9.211 |
| two\_phase\_1times | 0.002 | 0.003 | 0.014 | 0.098 | 0.919 | 9.535 |

1. **list\_scale\_insert\_two\_phase\_2times**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| item\_number | 10 | 100 | 1000 | 10000 | 100000 | 1000000 |
| two\_phase\_2times | 0.001 | 0.002 | 0.006 | 0.061 | 0.527 | 5.434 |
| two\_phase\_2times | 0.001 | 0.002 | 0.007 | 0.055 | 0.498 | 5.191 |
| two\_phase\_2times | 0.000 | 0.002 | 0.007 | 0.059 | 0.537 | 5.434 |
| two\_phase\_2times | 0.002 | 0.002 | 0.003 | 0.088 | 0.895 | 9.549 |
| two\_phase\_2times | 0.001 | 0.001 | 0.002 | 0.054 | 0.517 | 5.022 |
| two\_phase\_2times | 0.002 | 0.003 | 0.015 | 0.096 | 0.919 | 9.817 |
| two\_phase\_2times | 0.003 | 0.004 | 0.012 | 0.100 | 0.902 | 9.815 |
| two\_phase\_2times | 0.000 | 0.001 | 0.010 | 0.095 | 0.917 | 9.294 |
| two\_phase\_2times | 0.002 | 0.002 | 0.012 | 0.092 | 0.861 | 9.070 |
| two\_phase\_2times | 0.003 | 0.002 | 0.012 | 0.116 | 0.933 | 9.527 |

1. **list\_scale\_insert\_two\_phase\_3times**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| item\_number | 10 | 100 | 1000 | 10000 | 100000 | 1000000 |
| two\_phase\_3times | 0.001 | 0.003 | 0.007 | 0.055 | 0.515 | 5.249 |
| two\_phase\_3times | 0.003 | 0.002 | 0.012 | 0.100 | 0.893 | 9.463 |
| two\_phase\_3times | 0.000 | 0.000 | 0.002 | 0.056 | 0.491 | 5.039 |
| two\_phase\_3times | 0.003 | 0.003 | 0.012 | 0.095 | 0.900 | 8.662 |
| two\_phase\_3times | 0.002 | 0.003 | 0.014 | 0.094 | 0.892 | 9.204 |
| two\_phase\_3times | 0.000 | 0.003 | 0.006 | 0.046 | 0.504 | 5.147 |
| two\_phase\_3times | 0.002 | 0.004 | 0.013 | 0.094 | 0.877 | 9.515 |

1. **list\_scale\_insert\_pthread**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| item\_number | 10 | 100 | 1000 | 10000 | 100000 | 1000000 |
| pthread | 0.002 | 0.002 | 0.003 | 0.016 | 0.121 | 1.130 |
| pthread | 0.002 | 0.002 | 0.003 | 0.021 | 0.120 | 1.110 |
| pthread | 0.002 | 0.002 | 0.002 | 0.014 | 0.119 | 1.172 |
| pthread | 0.000 | 0.000 | 0.002 | 0.019 | 0.120 | 1.144 |
| pthread | 0.001 | 0.002 | 0.005 | 0.019 | 0.119 | 1.117 |
| pthread | 0.002 | 0.001 | 0.003 | 0.019 | 0.118 | 1.146 |
| pthread | 0.001 | 0.001 | 0.002 | 0.019 | 0.118 | 1.133 |
| pthread | 0.002 | 0.002 | 0.003 | 0.020 | 0.119 | 1.136 |
| pthread | 0.004 | 0.002 | 0.003 | 0.019 | 0.116 | 1.114 |
| pthread | 0.002 | 0.002 | 0.004 | 0.022 | 0.118 | 1.133 |

1. **list\_scale\_insert**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| item\_number | 10 | 100 | 1000 | 10000 | 100000 | 1000000 |
| spinlock | 0.028 | 0.006 | 0.002 | 0.078 | 2.109 | 20.777 |
| mutex | 0.004 | 0.004 | 0.024 | 0.115 | 1.039 | 10.074 |
| two\_phase | 0.002 | 0.002 | 0.007 | 0.054 | 0.518 | 5.208 |
| pthread | 0.002 | 0.002 | 0.004 | 0.022 | 0.118 | 1.133 |

1. **list\_scale\_insert\_two\_phase\_times\_cmp**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| item\_number | 10 | 100 | 1000 | 10000 | 100000 | 1000000 |
| two\_phase | 0.002 | 0.002 | 0.007 | 0.054 | 0.518 | 5.208 |
| two\_phase\_1times | 0.002 | 0.003 | 0.014 | 0.101 | 0.924 | 9.211 |
| two\_phase\_2times | 0.002 | 0.003 | 0.015 | 0.096 | 0.919 | 9.817 |
| two\_phase\_3times | 0.003 | 0.003 | 0.012 | 0.095 | 0.900 | 8.662 |

1. list插入删除
2. list重复测试
3. **list\_scale\_insert\_delete\_spinlock**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| item\_number | 10 | 100 | 1000 | 10000 | 100000 | 1000000 |
| spinlock | 0.001 | 0.001 | 0.021 | 0.116 | 1.786 | 21.300 |
| spinlock | 0.029 | 0.008 | 0.003 | 0.122 | 1.875 | 21.067 |
| spinlock | 0.013 | 0.009 | 0.039 | 0.146 | 1.528 | 21.252 |
| spinlock | 0.003 | 0.001 | 0.020 | 0.100 | 2.170 | 20.742 |
| spinlock | 0.000 | 0.025 | 0.022 | 0.119 | 1.767 | 22.943 |

1. **list\_scale\_insert\_delete\_mutex**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| item\_number | 10 | 100 | 1000 | 10000 | 100000 | 1000000 |
| mutex | 0.003 | 0.003 | 0.017 | 0.116 | 1.116 | 11.059 |
| mutex | 0.000 | 0.001 | 0.006 | 0.061 | 0.591 | 5.891 |
| mutex | 0.002 | 0.003 | 0.018 | 0.111 | 1.085 | 10.641 |
| mutex | 0.002 | 0.004 | 0.017 | 0.114 | 1.156 | 12.296 |
| mutex | 0.002 | 0.003 | 0.016 | 0.111 | 1.161 | 11.922 |
| mutex | 0.001 | 0.002 | 0.010 | 0.064 | 0.585 | 6.325 |

1. **list\_scale\_insert\_delete\_two\_phase**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| item\_number | 10 | 100 | 1000 | 10000 | 100000 | 1000000 |
| two\_phase | 0.001 | 0.001 | 0.007 | 0.061 | 0.554 | 5.397 |
| two\_phase | 0.002 | 0.002 | 0.012 | 0.095 | 0.921 | 9.660 |
| two\_phase | 0.000 | 0.003 | 0.011 | 0.109 | 0.967 | 9.839 |
| two\_phase | 0.003 | 0.003 | 0.013 | 0.095 | 0.928 | 9.276 |
| two\_phase | 0.001 | 0.002 | 0.017 | 0.102 | 1.010 | 10.818 |
| two\_phase | 0.001 | 0.004 | 0.013 | 0.108 | 0.916 | 9.513 |

1. **list\_scale\_insert\_delete\_pthread**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| item\_number | 10 | 100 | 1000 | 10000 | 100000 | 1000000 |
| pthread | 0.002 | 0.002 | 0.004 | 0.026 | 0.158 | 1.483 |
| pthread | 0.000 | 0.001 | 0.002 | 0.024 | 0.154 | 1.570 |
| pthread | 0.001 | 0.002 | 0.002 | 0.024 | 0.155 | 1.489 |
| pthread | 0.003 | 0.002 | 0.004 | 0.022 | 0.161 | 1.522 |
| pthread | 0.003 | 0.003 | 0.004 | 0.024 | 0.159 | 1.486 |

1. **list\_scale\_insert\_delete**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| item\_number | 10 | 100 | 1000 | 10000 | 100000 | 1000000 |
| spinlock | 0.013 | 0.009 | 0.039 | 0.146 | 1.528 | 21.252 |
| mutex | 0.003 | 0.003 | 0.017 | 0.116 | 1.116 | 11.059 |
| two\_phase | 0.002 | 0.002 | 0.012 | 0.095 | 0.921 | 9.660 |
| pthread | 0.001 | 0.002 | 0.002 | 0.024 | 0.155 | 1.489 |

1. 缩放单个线程项目数 固定20个线程 固定桶数 hash
2. hash仅插入
3. hash重复测试
4. **hash\_scale\_insert\_spinlock**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| item\_number | 10 | 100 | 1000 | 10000 | 100000 | 1000000 |
| spinlock | 0.000 | 0.013 | 0.024 | 0.102 | 1.032 | 14.979 |
| spinlock | 0.013 | 0.008 | 0.025 | 0.067 | 1.174 | 10.750 |
| spinlock | 0.013 | 0.002 | 0.098 | 0.132 | 0.833 | 10.955 |
| spinlock | 0.001 | 0.020 | 0.010 | 0.111 | 0.899 | 11.212 |
| spinlock | 0.025 | 0.004 | 0.055 | 0.113 | 1.078 | 10.950 |

1. **hash\_scale\_insert\_mutex**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| item\_number | 10 | 100 | 1000 | 10000 | 100000 | 1000000 |
| mutex | 0.002 | 0.003 | 0.014 | 0.093 | 0.831 | 8.442 |
| mutex | 0.005 | 0.003 | 0.015 | 0.092 | 0.836 | 9.096 |
| mutex | 0.002 | 0.003 | 0.016 | 0.091 | 0.861 | 8.843 |
| mutex | 0.003 | 0.003 | 0.014 | 0.096 | 0.833 | 8.659 |
| mutex | 0.000 | 0.001 | 0.007 | 0.054 | 0.478 | 4.965 |

1. **hash\_scale\_insert\_two\_phase**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| item\_number | 10 | 100 | 1000 | 10000 | 100000 | 1000000 |
| two\_phase | 0.000 | 0.003 | 0.004 | 0.039 | 0.355 | 3.946 |
| two\_phase | 0.003 | 0.001 | 0.004 | 0.025 | 0.306 | 2.802 |
| two\_phase | 0.002 | 0.002 | 0.003 | 0.035 | 0.362 | 4.163 |
| two\_phase | 0.001 | 0.002 | 0.004 | 0.032 | 0.256 | 2.785 |
| two\_phase | 0.003 | 0.001 | 0.002 | 0.028 | 0.267 | 3.050 |

1. **hash\_scale\_insert\_pthread**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| item\_number | 10 | 100 | 1000 | 10000 | 100000 | 1000000 |
| pthread | 0.002 | 0.003 | 0.002 | 0.018 | 0.135 | 1.342 |
| pthread | 0.003 | 0.002 | 0.003 | 0.021 | 0.133 | 1.403 |
| pthread | 0.002 | 0.001 | 0.002 | 0.018 | 0.135 | 1.321 |
| pthread | 0.000 | 0.002 | 0.003 | 0.030 | 0.132 | 1.331 |
| pthread | 0.003 | 0.001 | 0.003 | 0.017 | 0.133 | 1.262 |

1. **hash\_scale\_insert**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| item\_number | 10 | 100 | 1000 | 10000 | 100000 | 1000000 |
| spinlock | 0.013 | 0.002 | 0.098 | 0.132 | 0.833 | 10.955 |
| mutex | 0.003 | 0.003 | 0.014 | 0.096 | 0.833 | 8.659 |
| two\_phase | 0.003 | 0.001 | 0.002 | 0.028 | 0.267 | 3.050 |
| pthread | 0.002 | 0.003 | 0.002 | 0.018 | 0.135 | 1.342 |

1. hash插入删除
2. hash重复测试
3. **hash\_scale\_insert\_delete\_spinlock**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| item\_number | 10 | 100 | 1000 | 10000 | 100000 | 1000000 |
| spinlock | 0.022 | 0.012 | 0.005 | 0.140 | 1.270 | 13.638 |
| spinlock | 0.020 | 0.013 | 0.002 | 0.121 | 1.126 | 12.894 |
| spinlock | 0.013 | 0.001 | 0.016 | 0.074 | 0.905 | 13.408 |
| spinlock | 0.024 | 0.012 | 0.040 | 0.120 | 1.118 | 13.118 |
| spinlock | 0.011 | 0.004 | 0.026 | 0.102 | 0.959 | 11.438 |

1. **hash\_scale\_insert\_delete\_mutex**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| item\_number | 10 | 100 | 1000 | 10000 | 100000 | 1000000 |
| mutex | 0.003 | 0.003 | 0.017 | 0.097 | 0.985 | 10.452 |
| mutex | 0.003 | 0.003 | 0.014 | 0.095 | 1.004 | 10.743 |
| mutex | 0.003 | 0.003 | 0.014 | 0.095 | 0.964 | 10.144 |
| mutex | 0.003 | 0.003 | 0.014 | 0.097 | 0.964 | 10.410 |
| mutex | 0.002 | 0.002 | 0.014 | 0.096 | 0.964 | 10.519 |

1. **hash\_scale\_insert\_delete\_two\_phase**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| item\_number | 10 | 100 | 1000 | 10000 | 100000 | 1000000 |
| two\_phase | 0.002 | 0.004 | 0.005 | 0.033 | 0.380 | 4.432 |
| two\_phase | 0.000 | 0.002 | 0.004 | 0.039 | 0.398 | 4.245 |
| two\_phase | 0.005 | 0.002 | 0.006 | 0.046 | 0.476 | 5.269 |
| two\_phase | 0.003 | 0.002 | 0.008 | 0.043 | 0.473 | 5.311 |
| two\_phase | 0.001 | 0.002 | 0.005 | 0.040 | 0.509 | 5.602 |

1. **hash\_scale\_insert\_delete\_pthread**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| item\_number | 10 | 100 | 1000 | 10000 | 100000 | 1000000 |
| pthread | 0.003 | 0.002 | 0.003 | 0.028 | 0.204 | 2.341 |
| pthread | 0.000 | 0.001 | 0.003 | 0.027 | 0.209 | 2.326 |
| pthread | 0.011 | 0.001 | 0.003 | 0.022 | 0.205 | 2.313 |
| pthread | 0.002 | 0.002 | 0.003 | 0.029 | 0.219 | 2.259 |
| pthread | 0.003 | 0.002 | 0.006 | 0.027 | 0.211 | 2.132 |

1. **hash\_scale\_insert\_delete**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| item\_number | 10 | 100 | 1000 | 10000 | 100000 | 1000000 |
| spinlock | 0.024 | 0.012 | 0.040 | 0.120 | 1.118 | 13.118 |
| mutex | 0.003 | 0.003 | 0.017 | 0.097 | 0.985 | 10.452 |
| two\_phase | 0.005 | 0.002 | 0.006 | 0.046 | 0.476 | 5.269 |
| pthread | 0.011 | 0.001 | 0.003 | 0.022 | 0.205 | 2.313 |