Multi-Thread Lab Report

运行配置

```
CPU Model:
13th Gen Intel(R) Core(TM) i7-13620H

CPU Base Frequency:
2.9 GHz

Cores and Threads:
8 cores, 16 threads

RAM:
15Gi

Cache:
L1d: 384
L1i: 256
L2: 10
L3: 24

Operating System:
Ubuntu 24.04.3 LTS
```

测试说明

本测试采用对300px-Unequalized_Hawkes_Bay_NZ.ppm,earth.ppm,flood.ppm,moon-small.ppm,moon-large.ppm,phobos.ppm,university.ppm的顺序执行，且均重复测试 100 次,取平均值和标准差（括号内），单位均为 ns。

使用方法

解压src.zip,然后执行以下操作:

```
make
chmod +x system.sh
chmod +x test.sh
./system.sh
./test.sh
```

表格

Verification Test

```
=== Verifying correctness with diff ===
histo_private:  PASS
histo_lockfree: PASS
histo_lock1: PASS
histo_lock2: PASS
```

Valgrind Test

```
=== Running Valgrind Memory Leak Detection ===
Testing with moon-small.ppm and 4 threads

--- histo_private ---
==398779== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)

--- histo_lockfree ---
==398785== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)

--- histo_lock1 (Test-and-Set) ---
==398797== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)

--- histo_lock2 (Ticket Lock) ---
==398815== ERROR SUMMARY: 0 errors from 0 contexts (suppressed: 0 from 0)
```

histo_baseline

Image Index	1 (Baseline)
Unequalized_HawkesBay.ppm	44838(7116)
earth.ppm	4020929(196198)
flood.ppm	159250(35533)
moon-small.ppm	262757(35867)
moon-large.ppm	19583792(738037)
phobos.ppm	904386(82520)
university.ppm	121321(19016)

histo_private

```
| Image Index | 1             | 2             | 4             | 8             |
|-------------|---------------|---------------|---------------|---------------|
| 1           | 168610(29885) | 166524(35676) | 212614(30841) | 332008(63941) |
| 2           | 3899873(132594)| 2106341(156107)| 1303041(170857)| 1241643(163759)|
| 3           | 269899(29828) | 230412(39707) | 247685(41504) | 346143(74838) |
| 4           | 393372(60318) | 284063(41184) | 301030(62406) | 385148(87012) |
| 5           |18261865(371666)|9521500(546749)|5298238(577444)|3974701(462108) |
| 6           | 1128528(73544)| 729028(73603) | 538287(75005) | 588256(94322) |
| 7           | 233694(38454) | 213028(52804) | 251339(52998) | 347190(59544) |
```

histo_lockfree

```
|In| 1                 | 2                 | 4                 | 8
|--|-------------------|-------------------|-------------------|----------------
| 1| 878495(70918)     | 1226632(69751)    | 1224315(70073)    | 1353055(74430)
| 2| 47335108(42954117)| 97296040(96406381)|101287776(105259961)|94785165(96058866
| 3| 2593691(126587)   | 3553825(119633)   | 3401159(193179)   | 3196850(143349)
| 4| 3335290(156154)   | 7171775(288167)   | 6771852(167080)   | 6659661(153958)
| 5| 239910081(239145689)| 470532212(193010798)|464616123(177233190)|441198802(1053474
| 6| 8302002(199382)   | 19157453(994301)  | 17214357(655633)  | 16359319(313899)
| 7| 1588661(85118)    | 2610349(124009)   | 2905169(131532)   | 2840201(95602)
```

histo_lock1(spinlock)

```
| Image Index | 1             | 2             | 4             | 8             |
|-------------|---------------|---------------|---------------|---------------|
| 1           | 197098(50295) | 167465(39964) | 223410(42674) | 324071(68281) |
| 2           | 4104838(144512)| 2202052(136329)| 1400157(183938)| 1210245(169459)|
| 3           | 313424(42787) | 253650(72517) | 276457(72838) | 352809(69324) |
| 4           | 484101(71879) | 349878(72554) | 329396(67539) | 394963(72842) |
| 5           | 19515904(705651)| 10028263(365342)| 5616079(628396)| 3998560(431183)|
| 6           | 1154789(101704)| 708147(102658)| 559215(99103) | 590395(91917) |
| 7           | 248689(48455) | 222622(42357) | 247814(47609) | 350413(85735) |
```

histo_lock2(sequencelock)

Image Index	1	2	4	8
1	175535(40821)	177514(39995)	212631(50537)	316858(71600)
2	4075246(156387)	2217394(125587)	1376515(204657)	1200749(151498
3	286804(45828)	247717(59541)	265269(56987)	347930(53930)
4	446905(55861)	303863(41783)	282759(52658)	367753(76008)
5	19347524(546132)	10000228(366413)	5569728(608452)	4023107(417761
6	1121244(90048)	699200(77570)	536469(90155)	622101(104326)
7	237585(34882)	200581(40666)	250358(52341)	343729(64393)

参考文献

1.Claude-Sonnet 4.5
2.https://www.zhihu.com/question/66733477
3.https://zhuanlan.zhihu.com/p/1982046758805709899
4.https://zhuanlan.zhihu.com/p/676901806
5.https://zhuanlan.zhihu.com/p/364044850
6.https://zhuanlan.zhihu.com/p/654435377