Subject: Impressive improvement in stl::vector when dealing with raw memory. Posted by Lance on Mon, 14 Nov 2022 00:48:14 GMT

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Roughly 2 years ago, Mirek wrote this article. Some of the facts, like the speed of NTL containers versus standard library counterparts, which are well know to us, obviously surprised other readers. In the comment section of the article, Mirek and Espen Harlinn had an in depth discussion:

Here is a quote that kind of initiated the interesting discussion:

Quote:

OK ...

U++ appears to be an impressive piece of work, but:

You are making some remarkable claims with regard to the performance of your library, and how you have achieved this alleged performance boost.

You claim that memcpy/memmove is faster than std::copy, while in my experience the performance of memcpy/memmove is the same as for std::copy/std::copy\_backward.

Your string class is supposed to be faster than std::string. While this may be true for some operations, it is probably not true for the most important ones, and for situations where your implementation is faster, you will probably get similar performance using std::string\_view.

## Statements like:

Quote:

it is still very useful and using memmove for this task easily results in 5 times speedup of the operation.

implies that the standard library is really bad. If it were true, than that would be rather embarrassing ...

I've made similar, if not so bold, claims in the past, but C++ and the standard library has evolved to a point where I would be hesitant to do so again.

I am also not plagued by memory leaks since I am mostly using std::unique\_ptr and std::shared\_ptr to manage memory resource ownership.

Best regards Espen Harlinn

I reread the article a few weeks ago, and decided to do a short test. Guess what, I am surprised by the test result. I want to share my findings with the community and please do similar test on your own machine --- either to confirm or disprove my test.

I basically used the benchmarks/Vector package but tailored it to builtin types.

```
#include <Core/Core.h>
#include <vector>
using namespace Upp;
const int N = 400000;
const int M = 30;
const size t buffsize = 128;
struct Buff{
  Buff()=default;
  Buff(const Buff&)=default;
  Buff(Buff&&)=default;
  char buff[buffsize];
};
namespace Upp{
NTL_MOVEABLE(Buff);
void TestInt();
void TestIntInsert();
void TestCharBuffer();
CONSOLE_APP_MAIN
  TestCharBuffer();
  TestInt();
   TestIntInsert();
void TestCharBuffer()
  for(int i=0; i < M; ++i)
 {
       RTIMING("std::vector<Buff>::push_back");
   std::vector<Buff> v;
   for(int i = 0; i < N; i++){
     Buff b;
 v.push_back(b);
```

```
RTIMING("Upp::Vector<Buff>::push_back");
   Upp::Vector<Buff> v;
   for(int i = 0; i < N; i++){
 Buff b;
 v.Add(b);
}
void TestInt()
  for(int i=0; i < M; ++i)
{
   RTIMING("std::vector<int>::push_back");
   std::vector<int> v;
   for(int i = 0; i < N; i++)
 v.push_back(i);
   RTIMING("Upp::Vector<int>::push_back");
   Upp::Vector<int> v;
   for(int i = 0; i < N; i++)
 v.push_back(i);
void TestIntInsert()
  for(int i=0; i < M; ++i)
  {
   RTIMING("std::vector<int>::insert");
   std::vector<int> v;
   for(int i = 0; i < N; i++)
 v.insert(v.begin(), i);
}
   RTIMING("Upp::Vector<int>::insert");
   Upp::Vector<int> v;
   for(int i = 0; i < N; i++)
 v.Insert(0, i);
}
  }
```

}

## Some of the test results:

TIMING Upp::Vector<Buff>::push\_back: 1.99 s - 66.33 ms ( 1.99 s / 30 ), min: 63.00 ms, max: 73.00 ms, nesting: 0 - 30 TIMING std::vector<Buff>::push\_back: 1.23 s - 41.07 ms ( 1.23 s / 30 ), min: 39.00 ms, max: 47.00 ms, nesting: 0 - 30

The number fluctuate quite a lot, but mostly the result is in favour of std::vector (when handling raw bytes).

BTW, testing insertion is very time consuming, considering start from small number for N and M, then gradually increase. It appears std::vector excels when N are big.

## My CPU:

Architecture: x86 64

CPU op-mode(s): 32-bit, 64-bit

Address sizes: 39 bits physical, 48 bits virtual

Byte Order: Little Endian

CPU(s): 8

On-line CPU(s) list: 0-7

Vendor ID: GenuineIntel

Model name: Intel(R) Core(TM) i7-8650U CPU @ 1.90GHz

CPU family: 6
Model: 142
Thread(s) per core: 2
Core(s) per socket: 4
Socket(s): 1
Stepping: 10

CPU max MHz: 4200.0000 CPU min MHz: 400.0000 BogoMIPS: 4199.88

Flags: fpu vme de pse tsc msr pae mce cx8 apic sep mtrr pge mca cmov pat pse36 clflush dts acpi mmx fxsr sse sse2 ss ht tm pbe syscall

nx pdpe1gb rdtscp lm constant\_tsc art arch\_perfmon pebs bts rep\_good nopl xtopology nonstop\_tsc cpuid aperfmperf pni pclmulqdq

dtes64 monitor ds\_cpl vmx smx est tm2 ssse3 sdbg fma cx16 xtpr pdcm pcid sse4\_1 sse4\_2 x2apic movbe popcnt tsc\_deadline\_timer

aes xsave avx f16c rdrand lahf\_lm abm 3dnowprefetch cpuid\_fault epb

invpcid\_single pti ssbd ibrs ibpb stibp tpr\_shadow vnmi fle

xpriority ept vpid ept\_ad fsgsbase tsc\_adjust bmi1 avx2 smep bmi2 erms invpcid mpx rdseed adx smap clflushopt intel\_pt xsaveopt

xsavec xgetbv1 xsaves dtherm ida arat pln pts hwp hwp\_notify hwp\_act\_window hwp\_epp md\_clear flush\_l1d arch\_capabilities

Virtualization features: Virtualization: VT-x

Caches (sum of all):

L1d: 128 KiB (4 instances)
L1i: 128 KiB (4 instances)
L2: 1 MiB (4 instances)
L3: 8 MiB (1 instance)

NUMA:

NUMA node(s): 1

NUMA node0 CPU(s): 0-7

Vulnerabilities:

Itlb multihit: KVM: Mitigation: VMX disabled

L1tf: Mitigation; PTE Inversion; VMX conditional cache flushes, SMT vulnerable

Mds: Mitigation; Clear CPU buffers; SMT vulnerable

Meltdown: Mitigation; PTI

Mmio stale data: Mitigation; Clear CPU buffers; SMT vulnerable

Retbleed: Mitigation; IBRS

Spec store bypass: Mitigation; Speculative Store Bypass disabled via prctl and seccomp Spectre v1: Mitigation; usercopy/swapgs barriers and \_\_user pointer sanitization

Spectre v2: Mitigation; IBRS, IBPB conditional, RSB filling, PBRSB-eIBRS Not affected

Srbds: Mitigation; Microcode

Tsx async abort: Mitigation; TSX disabled

I would appreciate if you can do the test and share your results.

BR, Lance