

### 1) Non Persistent Stores

Program: np\_stores.c

Commands:

```
gcc -o np_stores np_stores.c -lpmemobj -lpmem -pthread  
valgrind --tool=pmemcheck ./np_stores
```

Result:

```
==146321== Number of stores not made persistent: 1  
==146321== Stores not made persistent properly:  
==146321== [0] at 0x4B93722: __memcpy_avx_unaligned_erms  
(memmove-vec-unaligned-erms.S:329)  
==146321== by 0x109554: main (in /home/pramod/Desktop/839/Code/hw3/np_stores)  
==146321== Address: 0x5000000 size: 3 state: DIRTY  
==146321== Total memory not made persistent: 3  
==146321== ERROR SUMMARY: 1 errors
```

### 2) Stores not added in transactions

Program: stores\_not\_in\_tx.c

Commands:

```
gcc -o stores_not_in_tx stores_not_in_tx.c -lpmemobj -lpmem -pthread  
valgrind --tool=pmemcheck ./stores_not_in_tx
```

Result:

```
==146408== Number of stores not made persistent: 0  
==146408==  
==146408== Number of stores made without adding to transaction: 1  
==146408== Stores made without adding to transactions:  
==146408== [0] at 0x109504: main (in  
/home/pramod/Desktop/839/Code/hw3/stores_not_in_tx)  
==146408== Address: 0x53c0550 size: 4  
==146408== ERROR SUMMARY: 1 errors
```

Program: stores\_not\_in\_tx1.c

Commands:

```
gcc -o stores_not_in_tx1 stores_not_in_tx1.c -lpmemobj -lpmem -pthread  
valgrind --tool=pmemcheck ./stores_not_in_tx1
```

Result:

```
==146484== Number of stores not made persistent: 2  
==146484== Stores not made persistent properly:  
==146484== [0] at 0x1094BA: main (in  
/home/pramod/Desktop/839/Code/hw3/stores_not_in_tx1)  
==146484== Address: 0x53c0550 size: 4 state: DIRTY
```

```
==146484== [1] at 0x109521: main (in
/home/pramod/Desktop/839/Code/hw3/stores_not_in_tx1)
==146484== Address: 0x53c0554 size: 4 state: DIRTY
==146484== Total memory not made persistent: 8
==146484==
==146484== Number of stores made without adding to transaction: 2
==146484== Stores made without adding to transactions:
==146484== [0] at 0x1094BA: main (in
/home/pramod/Desktop/839/Code/hw3/stores_not_in_tx1)
==146484== Address: 0x53c0550 size: 4
==146484== [1] at 0x109521: main (in
/home/pramod/Desktop/839/Code/hw3/stores_not_in_tx1)
==146484== Address: 0x53c0554 size: 4
==146484== ERROR SUMMARY: 4 errors
```

Program: stores\_not\_in\_tx2.c

Commands:

```
gcc -o stores_not_in_tx2 stores_not_in_tx2.c -lpmemobj -lpmem -pthread
valgrind --tool=pmemcheck ./stores_not_in_tx2
```

Result:

```
==146515== Number of stores not made persistent: 2
==146515== Stores not made persistent properly:
==146515== [0] at 0x1097A8: main (in
/home/pramod/Desktop/839/Code/hw3/stores_not_in_tx2)
==146515== Address: 0x53c0550 size: 4 state: DIRTY
==146515== [1] at 0x10980F: main (in
/home/pramod/Desktop/839/Code/hw3/stores_not_in_tx2)
==146515== Address: 0x53c0554 size: 4 state: DIRTY
==146515== Total memory not made persistent: 8
==146515==
==146515== Number of stores made without adding to transaction: 2
==146515== Stores made without adding to transactions:
==146515== [0] at 0x1097A8: main (in
/home/pramod/Desktop/839/Code/hw3/stores_not_in_tx2)
==146515== Address: 0x53c0550 size: 4
==146515== [1] at 0x10980F: main (in
/home/pramod/Desktop/839/Code/hw3/stores_not_in_tx2)
==146515== Address: 0x53c0554 size: 4
==146515== ERROR SUMMARY: 4 errors
```

Program: stores\_not\_in\_tx2.c

Commands:

```
gcc -o stores_not_in_tx2 stores_not_in_tx2.c -lpmemobj -lpmem -pthread
```

```
valgrind --tool=memcheck ./stores_not_in_tx2
```

Result:

```
==146515== Number of stores not made persistent: 2
==146515== Stores not made persistent properly:
==146515== [0] at 0x1097A8: main (in
/home/pramod/Desktop/839/Code/hw3/stores_not_in_tx2)
==146515== Address: 0x53c0550 size: 4 state: DIRTY
==146515== [1] at 0x10980F: main (in
/home/pramod/Desktop/839/Code/hw3/stores_not_in_tx2)
==146515== Address: 0x53c0554 size: 4 state: DIRTY
==146515== Total memory not made persistent: 8
==146515==
==146515== Number of stores made without adding to transaction: 2
==146515== Stores made without adding to transactions:
==146515== [0] at 0x1097A8: main (in
/home/pramod/Desktop/839/Code/hw3/stores_not_in_tx2)
==146515== Address: 0x53c0550 size: 4
==146515== [1] at 0x10980F: main (in
/home/pramod/Desktop/839/Code/hw3/stores_not_in_tx2)
==146515== Address: 0x53c0554 size: 4
==146515== ERROR SUMMARY: 4 errors
```

### 3) Memory added to different transactions

Program: mmy\_in\_diff\_txs.c

Commands:

```
gcc -o mmy_in_diff_txs mmy_in_diff_txs.c -lpmemobj -lpmem -pthread
valgrind --tool=memcheck ./mmy_in_diff_txs
```

Result:

```
==146627== Number of stores not made persistent: 0
==146627==
==146627== Number of overlapping regions registered in different transactions: 1
==146627== Overlapping regions:
==146627== [0] at 0x487A53C: pmemobj_tx_add_snapshot.constprop.0 (in
/usr/local/lib/libpmemobj.so.1.0.0)
==146627== by 0x487A9C7: pmemobj_tx_add_common.constprop.0 (in
/usr/local/lib/libpmemobj.so.1.0.0)
==146627== by 0x487BE5F: pmemobj_tx_add_range (in /usr/local/lib/libpmemobj.so.1.0.0)
==146627== by 0x10955B: thread_func (in
/home/pramod/Desktop/839/Code/hw3/mmy_in_diff_txs)
==146627== by 0x48A1608: start_thread (pthread_create.c:477)
==146627== by 0x49DD292: clone (clone.S:95)
==146627== Address: 0x53c0550 size: 8 tx_id: 2
```

```

==146627== First registered here:
==146627== [0]' at 0x487A53C: pmemobj_tx_add_snapshot.constprop.0 (in
/usr/local/lib/libpmemobj.so.1.0.0)
==146627== by 0x487A9C7: pmemobj_tx_add_common.constprop.0 (in
/usr/local/lib/libpmemobj.so.1.0.0)
==146627== by 0x487BE5F: pmemobj_tx_add_range (in /usr/local/lib/libpmemobj.so.1.0.0)
==146627== by 0x1097C5: main (in /home/pramod/Desktop/839/Code/hw3/mmy_in_diff_txs)
==146627== Address: 0x53c0550 size: 8 tx_id: 1
==146627== ERROR SUMMARY: 1 errors

```

#### 4) Memory overwrites

Program: mmy\_overwrite.c

Commands:

```

gcc -o mmy_overwrite mmy_overwrite.c -lpmemobj -lpmem -pthread
valgrind --tool=pmemcheck --mult-stores=yes ./mmy_overwrite

```

Result:

```

==146792== Number of stores not made persistent: 0
==146792==
==146792== Number of overwritten stores: 5
==146792== Overwritten stores before they were made persistent:
==146792== [0] at 0x4B9371D: __memcpy_avx_unaligned_erms
(memmove-vec-unaligned-erms.S:328)
==146792== by 0x1095B0: main (in /home/pramod/Desktop/839/Code/hw3/mmy_overwrite)
==146792== Address: 0x5000001 size: 1 state: DIRTY
==146792== [1] at 0x4B9371D: __memcpy_avx_unaligned_erms
(memmove-vec-unaligned-erms.S:328)
==146792== by 0x1095B0: main (in /home/pramod/Desktop/839/Code/hw3/mmy_overwrite)
==146792== Address: 0x5000002 size: 1 state: DIRTY
==146792== [2] at 0x4B93722: __memcpy_avx_unaligned_erms
(memmove-vec-unaligned-erms.S:329)
==146792== by 0x1095B0: main (in /home/pramod/Desktop/839/Code/hw3/mmy_overwrite)
==146792== Address: 0x5000001 size: 1 state: DIRTY
==146792== [3] at 0x4B93722: __memcpy_avx_unaligned_erms
(memmove-vec-unaligned-erms.S:329)
==146792== by 0x1095B0: main (in /home/pramod/Desktop/839/Code/hw3/mmy_overwrite)
==146792== Address: 0x5000000 size: 1 state: DIRTY
==146792== [4] at 0x4B9371D: __memcpy_avx_unaligned_erms
(memmove-vec-unaligned-erms.S:328)
==146792== by 0x1095C8: main (in /home/pramod/Desktop/839/Code/hw3/mmy_overwrite)
==146792== Address: 0x5000001 size: 1 state: DIRTY
==146792== ERROR SUMMARY: 5 errors

```

#### 5) Unnecessary flushes

Program: unnecessary\_flush.c

Commands:

```
gcc -o unnecessary_flush unnecessary_flush.c -lpmemobj -lpmem -pthread  
valgrind --tool=pmemcheck --flush-check=yes ./unnecessary_flush
```

Result:

```
==146959== Number of stores not made persistent: 0  
==146959==  
==146959== Number of unnecessary flushes: 1  
==146959== [0] at 0x10949A: flush (in  
/home/pramod/Desktop/839/Code/hw3/unnecessary_flush)  
==146959== by 0x1095D2: main (in  
/home/pramod/Desktop/839/Code/hw3/unnecessary_flush)  
==146959== Address: 0x5000000 size: 64  
==146959== ERROR SUMMARY: 1 errors
```

#### Testing with HashTable code:

*(The HashTable implementation has been made modular as per the suggestions given in HW2)*

6) Check all the functions with initialization/writes/appends for correctness

Program: ht00.cpp

Commands:

```
g++ -o ht00 ht00.cpp -lpmemobj -lpmem -pthread  
valgrind --tool=pmemcheck ./ht00
```

Result:

```
==156557== Number of stores not made persistent: 0  
==156557== ERROR SUMMARY: 0 errors
```

7) Check if newly initialized hash entry before being pushed into persistent hash entry vector in hash table is detected as non persistent

Program: ht01.cpp

Commands:

```
g++ -o ht01 ht01.cpp -lpmemobj -lpmem -pthread  
valgrind --tool=pmemcheck ./ht01
```

Result:

```
==157026== by 0x10F71A: std::_Function_handler<void (),  
createhtables(pmem::obj::pool<root>, int)::lambda(#2)>::_M_invoke(std::_Any_data const&)  
(in /home/pramod/Desktop/839/Code/hw3/hw2_cases/ht01)  
==157026== by 0x112E4F: std::function<void ()>::operator()() const (in  
/home/pramod/Desktop/839/Code/hw3/hw2_cases/ht01)  
==157026== by 0x11346F: void pmem::obj::transaction::run<>(pmem::obj::pool_base&,  
std::function<void ()>) (in /home/pramod/Desktop/839/Code/hw3/hw2_cases/ht01)
```

```
==157026== by 0x10C2D1: createhtables(pmem::obj::pool<root>, int) (in
/home/pramod/Desktop/839/Code/hw3/hw2_cases/ht01)
==157026== by 0x10EBDE: main (in /home/pramod/Desktop/839/Code/hw3/hw2_cases/ht01)
==157026== Address: 0x1ffeffd58 size: 4
==157026== ERROR SUMMARY: 258 errors
```

8) Check if persistent string object created in hashtable persisted successfully

Program: ht02.cpp

Commands:

```
g++ -o ht02 ht02.cpp -lpmemobj -lpmem -pthread
```

```
valgrind --tool=pmemcheck ./ht02
```

Test: Calls made to each function- get, put, move, resize, print, debug-print; verified correctness.

Result:

```
==157096== Number of stores not made persistent: 0
```

```
==157096== ERROR SUMMARY: 0 errors
```

9) Remove persistence of hash tables, continue to initialize hash table members and check if the error is detected

Program: ht03.cpp

Commands:

```
g++ -o ht03 ht03.cpp -lpmemobj -lpmem -pthread
```

```
valgrind --tool=pmemcheck ./ht03
```

Test: Calls made to each function- get, put, move, resize, print, debug-print; verified correctness.

Result:

```
==157184== Address: 0x57c05e8 size: 8 state: DIRTY
```

```
==157184== Total memory not made persistent: 32
```

```
==157184==
```

```
==157184== Number of active transactions: 1
```

```
==157184== [0] at 0x487B219: pmemobj_tx_begin (in /usr/local/lib/libpmemobj.so.1.0.0)
```

```
==157184== by 0x112FDE: void pmem::obj::transaction::run<>(pmem::obj::pool_base&,
std::function<void ()>) (in /home/pramod/Desktop/839/Code/hw3/hw2_cases/ht03)
```

```
==157184== by 0x10C1A8: createhtables(pmem::obj::pool<root>, int) (in
/home/pramod/Desktop/839/Code/hw3/hw2_cases/ht03)
```

```
==157184== by 0x10EA92: main (in /home/pramod/Desktop/839/Code/hw3/hw2_cases/ht03)
```

```
==157184== tx_id: 1 nesting: 1
```

```
==157184== ERROR SUMMARY: 5 errors
```

10) Remove persistence of hash table entries, continue to initialize hash table entries upto capacity and check if the error is detected

Program: ht04.cpp

Commands:

```
g++ -o ht04 ht04.cpp -lpmemobj -lpmem -pthread
```

```
valgrind --tool=memcheck ./ht04
```

Result:

```
==157281== Address: 0x57c0660 size: 8 state: DIRTY
==157281== Total memory not made persistent: 27
==157281==
==157281== Number of active transactions: 1
==157281== [0] at 0x487B219: pmemobj_tx_begin (in /usr/local/lib/libpmemobj.so.1.0.0)
==157281== by 0x1133BF: void pmem::obj::transaction::run<>(pmem::obj::pool_base&,
std::function<void ()>) (in /home/pramod/Desktop/839/Code/hw3/hw2_cases/ht04)
==157281== by 0x10C369: createhtables(pmem::obj::pool<root>, int) (in
/home/pramod/Desktop/839/Code/hw3/hw2_cases/ht04)
==157281== by 0x10EC0C: main (in /home/pramod/Desktop/839/Code/hw3/hw2_cases/ht04)
==157281== tx_id: 1 nesting: 1
==157281== ERROR SUMMARY: 6 errors
```

11) Check the impact of Valgrind TX\_START, TX\_END macros on result for write  
(make\_persistent) operation:

Program: ht05.cpp

Commands:

```
g++ -o ht05 ht05.cpp -lpmemobj -lpmem -pthread
valgrind --tool=memcheck ./ht05
```

Result: memcheck didn't raise an error here as it would have in C transactions for incorrect TX\_ADD, this seems to be because transactions in C++ do not rely on explicit TX\_ADD, TX\_ADD\_FIELD functions.

```
==157400== Number of stores not made persistent: 0
==157400== ERROR SUMMARY: 0 errors
```

12) Check the impact of Valgrind TX\_START, TX\_END macros on result for read operations from persistent memory

Program: ht06.cpp

Commands:

```
g++ -o ht06 ht06.cpp -lpmemobj -lpmem -pthread
valgrind --tool=memcheck ./ht06
```

Result:

```
==157702== Number of stores not made persistent: 0
==157702== ERROR SUMMARY: 0 errors
```

13) Check for persistence of hash entry after updating it in hash table

Program: ht07.cpp

Commands:

```
g++ -o ht07 ht07.cpp -lpmemobj -lpmem -pthread
```

```
valgrind --tool=memcheck ./ht07
```

Result:

```
==157806== Number of stores not made persistent: 0
```

```
==157806== ERROR SUMMARY: 0 errors
```