Test Design Strategy

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The basic format of our output:

----------Action type (pin, unpin, pinNew, etc.)----------
<BEFORE>
freelist:
hashtable:
buffers:

<AFTER>
freelist:
hashtable:
buffers:

We also added print functions in the LRU and Clock Policy to make it easy to track when replacement happens, because there are a lot of outputs, but the replacement event does not happen that much. In the test output, you can search "LRU" or "Clock" to find the replacement part.

Basic Tests using StudentClient

We tested all the original simpleDB client programs to make sure our new functionality did not break the original one. For example, we ran "Create BrokerDB" to test our new functionality. It creates new tables and writes to them, therefore can be used to test our freelist when the server tries to get an available buffer, our hash table when the server tries to find an existing block in the buffer, our LRU and clock replacement policies when the buffer is full, and pin and dirty write back as well when the block is written back to the disk file. The results also helps confirm the buffer printing (toString) works correctly.

To run this test, we first launch the Startup.class server with two arguments. The first one is the database folder name "cs4432DB", and the second argument is either "LRU" or "Clock", so that the buffer manager will know which policy to use.

The output of this test is included in:
"ServeStart_Clock.txt"
"CreateStudentDB_Clock.txt"
"ServerStart_LRU.txt"
"CreateStudentDB_LRU.txt".

1. **Test free list and hash table functionalities.**

The following test result confirms our free list and hash table both function well. When the server pins a new file to a buffer, the first buffer frame is filled, and the free list pops number 0. The hash table also added an entry that maps the block hashCode to the ID of the buffer frame.

```
--------------------Pin new file: tblcat.tbl--------------------
                <BEFORE>
Free list:7,6,5,4,3,2,1,0,

Hash table:

Buffers:
(0),lastAccessTime: 1443291103839,[],NotPinned
(1),lastAccessTime: 1443291103839,[],NotPinned
(2),lastAccessTime: 1443291103839,[],NotPinned
(3),lastAccessTime: 1443291103839,[],NotPinned
(4),lastAccessTime: 1443291103839,[],NotPinned
(5),lastAccessTime: 1443291103839,[],NotPinned
(6),lastAccessTime: 1443291103839,[],NotPinned
(7),lastAccessTime: 1443291103839,[],NotPinned


                <AFTER>
Free list:7,6,5,4,3,2,1,

Hash table:
Block: 1806850661 Buffer id is 0

Buffers:
(0),lastAccessTime: 1443291103839,[file tblcat.tbl, block 0],Pinned
(1),lastAccessTime: 1443291103839,[],NotPinned
(2),lastAccessTime: 1443291103839,[],NotPinned
(3),lastAccessTime: 1443291103839,[],NotPinned
(4),lastAccessTime: 1443291103839,[],NotPinned
(5),lastAccessTime: 1443291103839,[],NotPinned
(6),lastAccessTime: 1443291103839,[],NotPinned
(7),lastAccessTime: 1443291103839,[],NotPinned
```

The above test result confirms our free list and hash table both function well. When the server pins a new file to a buffer, the first buffer frame is filled, and the free list pops number 0. The hash table also added an entry that maps the block hashCode to the ID of the buffer frame.

2. Test pin and unpin.

The following test result confirms pin and unpin works. The first action tries to pin an existing block in the buffer to its buffer frame, and succeeded. This test also confirms again our hash table is working, because the server is able to find the block from the buffer and pin it, instead of using a new buffer frame. The second action unpins the block and also succeeded.

```
--------------------Unpin buffer: (0),lastAccessTime: 1443291103839,[file tblcat.tbl, block 0],Pinned----------
--
                <BEFORE>
Free list:7,6,5,4,3,2,1,

Hash table:
Block: 1806850661 Buffer id is 0

Buffers:
(0),lastAccessTime: 1443291103839,[file tblcat.tbl, block 0],Pinned
(1),lastAccessTime: 1443291103839,[],NotPinned
```

(2),lastAccessTime: 1443291103839,[],NotPinned
(3),lastAccessTime: 1443291103839,[],NotPinned
(4),lastAccessTime: 1443291103839,[],NotPinned
(5),lastAccessTime: 1443291103839,[],NotPinned
(6),lastAccessTime: 1443291103839,[],NotPinned
(7),lastAccessTime: 1443291103839,[],NotPinned

<AFTER>
Free list:7,6,5,4,3,2,1,

Hash table:
Block: 1806850661 Buffer id is 0

Buffers:
(0),lastAccessTime: 1443291103839,[file tblcat.tbl, block 0],NotPinned
(1),lastAccessTime: 1443291103839,[],NotPinned
(2),lastAccessTime: 1443291103839,[],NotPinned
(3),lastAccessTime: 1443291103839,[],NotPinned
(4),lastAccessTime: 1443291103839,[],NotPinned
(5),lastAccessTime: 1443291103839,[],NotPinned
(6),lastAccessTime: 1443291103839,[],NotPinned
(7),lastAccessTime: 1443291103839,[],NotPinned

----------Pin block: [file tblcat.tbl, block 0]----------
<BEFORE>
Free list:7,6,5,4,3,2,1,

Hash table:
Block: 1806850661 Buffer id is 0

Buffers:
(0),lastAccessTime: 1443291103839,[file tblcat.tbl, block 0],NotPinned
(1),lastAccessTime: 1443291103839,[],NotPinned
(2),lastAccessTime: 1443291103839,[],NotPinned
(3),lastAccessTime: 1443291103839,[],NotPinned
(4),lastAccessTime: 1443291103839,[],NotPinned
(5),lastAccessTime: 1443291103839,[],NotPinned
(6),lastAccessTime: 1443291103839,[],NotPinned
(7),lastAccessTime: 1443291103839,[],NotPinned

<AFTER>
Free list:7,6,5,4,3,2,1,

Hash table:
Block: 1806850661 Buffer id is 0

Buffers:
(0),lastAccessTime: 1443291103839,[file tblcat.tbl, block 0],Pinned
(1),lastAccessTime: 1443291103839,[],NotPinned
(2),lastAccessTime: 1443291103839,[],NotPinned
(3),lastAccessTime: 1443291103839,[],NotPinned
(4),lastAccessTime: 1443291103839,[],NotPinned
(5),lastAccessTime: 1443291103839,[],NotPinned
(6),lastAccessTime: 1443291103839,[],NotPinned
(7),lastAccessTime: 1443291103839,[],NotPinned

3. Test LRU and Clock replacement policy.

The following results shows our LRU and Clock replacement policy are fully functional. The first action is to pin the 0 block of enroll.tbl to the buffer. The result shows the buffer is full, and frame (2) was selected for replacement. We can see it is selected because it has the earliest access time 1443248961636. After the action, the 2nd frame is now pinned to that block, and the hash table's also gets updated to map the new block to the 2nd frame.

----------Pin new file: enroll.tbl----------
<BEFORE>
Free list:

Hash table:
Block: -1223333400 Buffer id is 5
Block: -1527684667 Buffer id is 1
Block: -1422963712 Buffer id is 6
Block: -1527684636 Buffer id is 4
Block: -2040828718 Buffer id is 3
Block: -1527684605 Buffer id is 7
Block: 1634910422 Buffer id is 2
Block: 1806850661 Buffer id is 0

Buffers:
(0),lastAccessTime: 1443291127117,[file tblcat.tbl, block 0],NotPinned
(1),lastAccessTime: 1443291127117,[file fldcat.tbl, block 0],NotPinned
(2),lastAccessTime: **1443291127039**,[file student.tbl, block 0],NotPinned
(3),lastAccessTime: 1443291127055,[file dept.tbl, block 0],NotPinned
(4),lastAccessTime: 1443291127117,[file fldcat.tbl, block 1],NotPinned
(5),lastAccessTime: 1443291127070,[file course.tbl, block 0],NotPinned
(6),lastAccessTime: 1443291127117,[file section.tbl, block 0],NotPinned
(7),lastAccessTime: 1443291127117,[file fldcat.tbl, block 2],NotPinned

!!!!!! I am LRU policy !!!!!!

I choose buffer number 2 to replace

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

<AFTER>
Free list:

Hash table:
Block: -1023521997 Buffer id is 2
Block: -1223333400 Buffer id is 5
Block: -1527684667 Buffer id is 1
Block: -1422963712 Buffer id is 6
Block: -1527684636 Buffer id is 4
Block: -2040828718 Buffer id is 3
Block: -1527684605 Buffer id is 7
Block: 1806850661 Buffer id is 0

Buffers:
(0),lastAccessTime: 1443291127117,[file tblcat.tbl, block 0],NotPinned
(1),lastAccessTime: 1443291127117,[file fldcat.tbl, block 0],NotPinned
(2),lastAccessTime: 1443291127133,[file enroll.tbl, block 0],Pinned
(3),lastAccessTime: 1443291127055,[file dept.tbl, block 0],NotPinned
(4),lastAccessTime: 1443291127117,[file fldcat.tbl, block 1],NotPinned

(5),lastAccessTime: 1443291127070,[file course.tbl, block 0],NotPinned
(6),lastAccessTime: 1443291127117,[file section.tbl, block 0],NotPinned
(7),lastAccessTime: 1443291127117,[file fldcat.tbl, block 2],NotPinned

Similarly, the following result indicates our Clock replacement policy was also functional. The number 0 frame was selected according to the rule of clock replacement policy, using the clock pointer.

----------Pin new file: enroll.tbl----------
<BEFORE>
Free list:

Hash table:
Block: -1223333400 Buffer id is 5
Block: -1527684667 Buffer id is 1
Block: -1422963712 Buffer id is 6
Block: -1527684636 Buffer id is 4
Block: -2040828718 Buffer id is 3
Block: -1527684605 Buffer id is 7
Block: 1634910422 Buffer id is 2
Block: 1806850661 Buffer id is 0

Buffers:
(0),lastAccessTime: 1443291323142,[file tblcat.tbl, block 0],NotPinned
(1),lastAccessTime: 1443291323146,[file fldcat.tbl, block 0],NotPinned
(2),lastAccessTime: 1443291323016,[file student.tbl, block 0],NotPinned
(3),lastAccessTime: 1443291323031,[file dept.tbl, block 0],NotPinned
(4),lastAccessTime: 1443291323148,[file fldcat.tbl, block 1],NotPinned
(5),lastAccessTime: 1443291323062,[file course.tbl, block 0],NotPinned
(6),lastAccessTime: 1443291323136,[file section.tbl, block 0],NotPinned
(7),lastAccessTime: 1443291323148,[file fldcat.tbl, block 2],NotPinned

!!!!!! I am Clock policy !!!!!!

I choose buffer number 0 to replace

!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!

<AFTER>
Free list:

Hash table:
Block: -1023521997 Buffer id is 0
Block: -1223333400 Buffer id is 5
Block: -1527684667 Buffer id is 1
Block: -1422963712 Buffer id is 6
Block: -1527684636 Buffer id is 4
Block: -2040828718 Buffer id is 3
Block: -1527684605 Buffer id is 7
Block: 1634910422 Buffer id is 2

Buffers:
(0),lastAccessTime: 1443291323152,[file enroll.tbl, block 0],Pinned
(1),lastAccessTime: 1443291323146,[file fldcat.tbl, block 0],NotPinned
(2),lastAccessTime: 1443291323016,[file student.tbl, block 0],NotPinned
(3),lastAccessTime: 1443291323031,[file dept.tbl, block 0],NotPinned
(4),lastAccessTime: 1443291323148,[file fldcat.tbl, block 1],NotPinned
(5),lastAccessTime: 1443291323062,[file course.tbl, block 0],NotPinned
(6),lastAccessTime: 1443291323136,[file section.tbl, block 0],NotPinned

(7),lastAccessTime: 1443291323148,[file fldcat.tbl, block 2],NotPinned