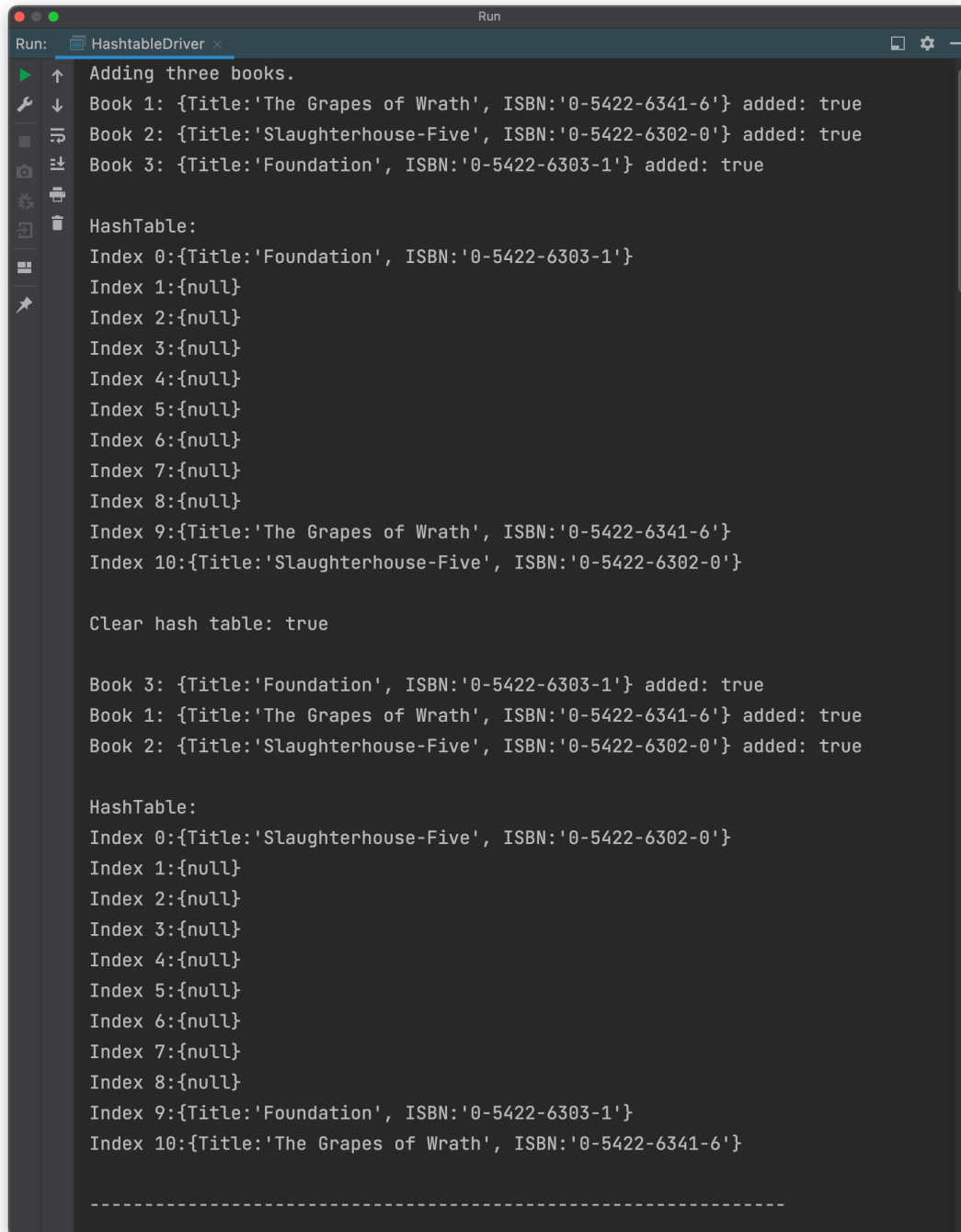


# Question 3: Hashing — Test Exhibits

The following demonstrates how adding in a different order causes an alternate hashing  
Tests methods: `.add(book)` `.getHashKey()` `.toString()` `.clear()`



```
Run: HashTableDriver x
Adding three books.
Book 1: {Title:'The Grapes of Wrath', ISBN:'0-5422-6341-6'} added: true
Book 2: {Title:'Slaughterhouse-Five', ISBN:'0-5422-6302-0'} added: true
Book 3: {Title:'Foundation', ISBN:'0-5422-6303-1'} added: true

HashTable:
Index 0:{Title:'Foundation', ISBN:'0-5422-6303-1'}
Index 1:{null}
Index 2:{null}
Index 3:{null}
Index 4:{null}
Index 5:{null}
Index 6:{null}
Index 7:{null}
Index 8:{null}
Index 9:{Title:'The Grapes of Wrath', ISBN:'0-5422-6341-6'}
Index 10:{Title:'Slaughterhouse-Five', ISBN:'0-5422-6302-0'}

Clear hash table: true

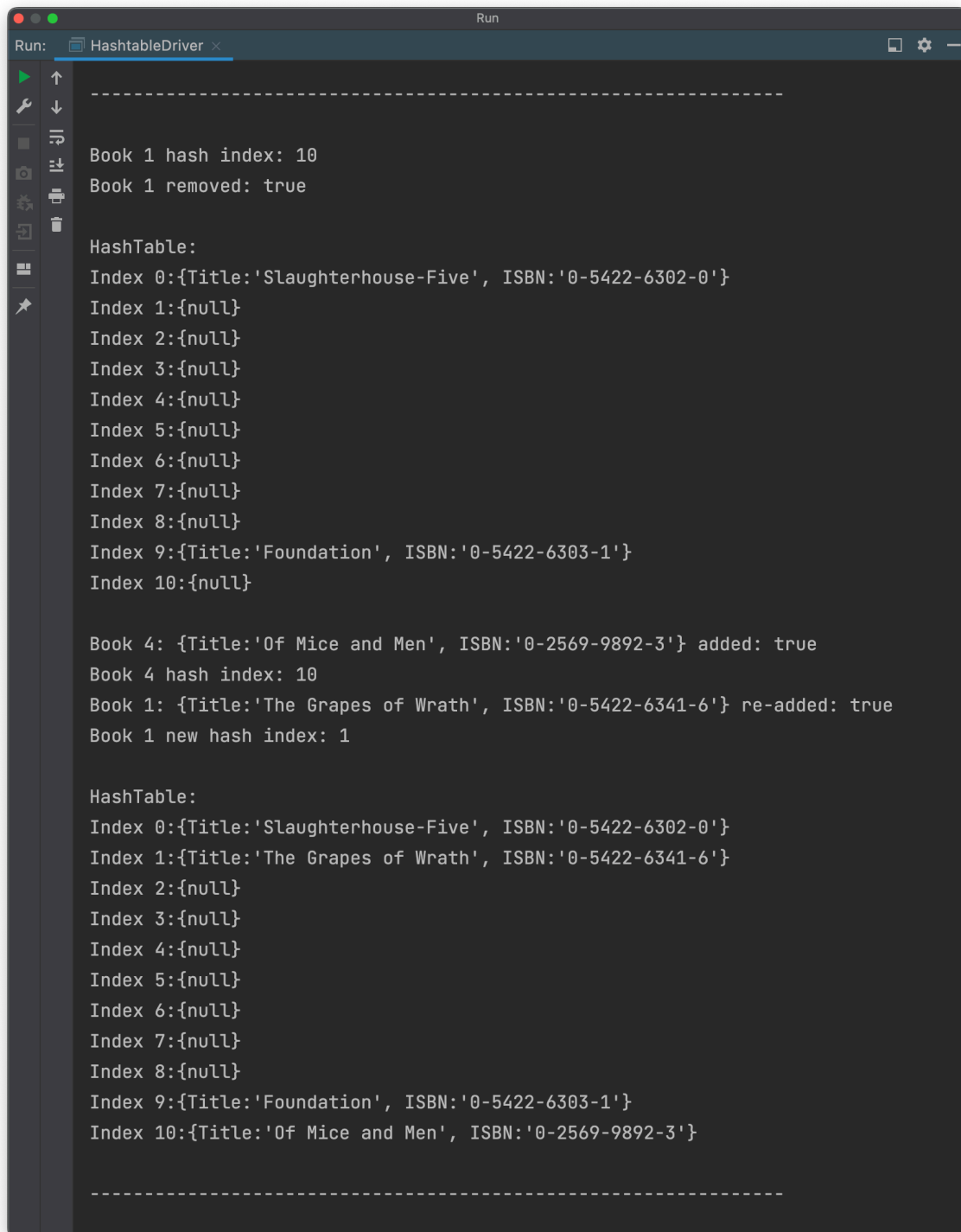
Book 3: {Title:'Foundation', ISBN:'0-5422-6303-1'} added: true
Book 1: {Title:'The Grapes of Wrath', ISBN:'0-5422-6341-6'} added: true
Book 2: {Title:'Slaughterhouse-Five', ISBN:'0-5422-6302-0'} added: true

HashTable:
Index 0:{Title:'Slaughterhouse-Five', ISBN:'0-5422-6302-0'}
Index 1:{null}
Index 2:{null}
Index 3:{null}
Index 4:{null}
Index 5:{null}
Index 6:{null}
Index 7:{null}
Index 8:{null}
Index 9:{Title:'Foundation', ISBN:'0-5422-6303-1'}
Index 10:{Title:'The Grapes of Wrath', ISBN:'0-5422-6341-6'}

-----
```

The following demonstrates a collision causing a change of hash

Tests methods: `.getIndex(book)` `.remove(book)` `.keyIsValid(int)`



```
Run: HashtableDriver x
-----
Book 1 hash index: 10
Book 1 removed: true

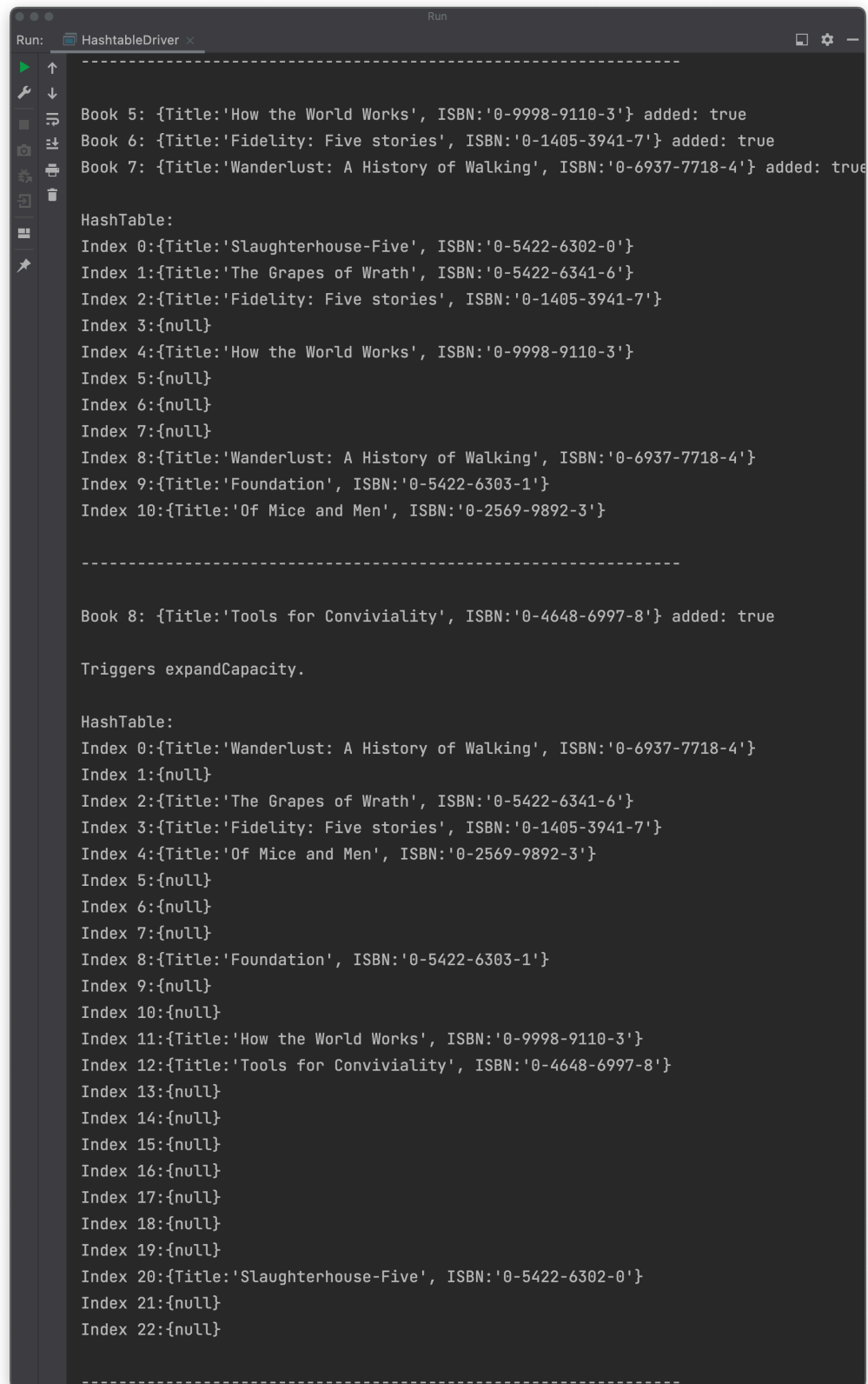
HashTable:
Index 0:{Title:'Slaughterhouse-Five', ISBN:'0-5422-6302-0'}
Index 1:{null}
Index 2:{null}
Index 3:{null}
Index 4:{null}
Index 5:{null}
Index 6:{null}
Index 7:{null}
Index 8:{null}
Index 9:{Title:'Foundation', ISBN:'0-5422-6303-1'}
Index 10:{null}

Book 4: {Title:'Of Mice and Men', ISBN:'0-2569-9892-3'} added: true
Book 4 hash index: 10
Book 1: {Title:'The Grapes of Wrath', ISBN:'0-5422-6341-6'} re-added: true
Book 1 new hash index: 1

HashTable:
Index 0:{Title:'Slaughterhouse-Five', ISBN:'0-5422-6302-0'}
Index 1:{Title:'The Grapes of Wrath', ISBN:'0-5422-6341-6'}
Index 2:{null}
Index 3:{null}
Index 4:{null}
Index 5:{null}
Index 6:{null}
Index 7:{null}
Index 8:{null}
Index 9:{Title:'Foundation', ISBN:'0-5422-6303-1'}
Index 10:{Title:'Of Mice and Men', ISBN:'0-2569-9892-3'}
-----
```

The following demonstrates the expansion of capacity when the load > .70

Tests methods: `.HashTable(int)` `.isPrime(int)` `.findNextPrime(int)`



```
Run: HashTableDriver x
-----
Book 5: {Title:'How the World Works', ISBN:'0-9998-9110-3'} added: true
Book 6: {Title:'Fidelity: Five stories', ISBN:'0-1405-3941-7'} added: true
Book 7: {Title:'Wanderlust: A History of Walking', ISBN:'0-6937-7718-4'} added: true

HashTable:
Index 0:{Title:'Slaughterhouse-Five', ISBN:'0-5422-6302-0'}
Index 1:{Title:'The Grapes of Wrath', ISBN:'0-5422-6341-6'}
Index 2:{Title:'Fidelity: Five stories', ISBN:'0-1405-3941-7'}
Index 3:{null}
Index 4:{Title:'How the World Works', ISBN:'0-9998-9110-3'}
Index 5:{null}
Index 6:{null}
Index 7:{null}
Index 8:{Title:'Wanderlust: A History of Walking', ISBN:'0-6937-7718-4'}
Index 9:{Title:'Foundation', ISBN:'0-5422-6303-1'}
Index 10:{Title:'Of Mice and Men', ISBN:'0-2569-9892-3'}

-----

Book 8: {Title:'Tools for Conviviality', ISBN:'0-4648-6997-8'} added: true

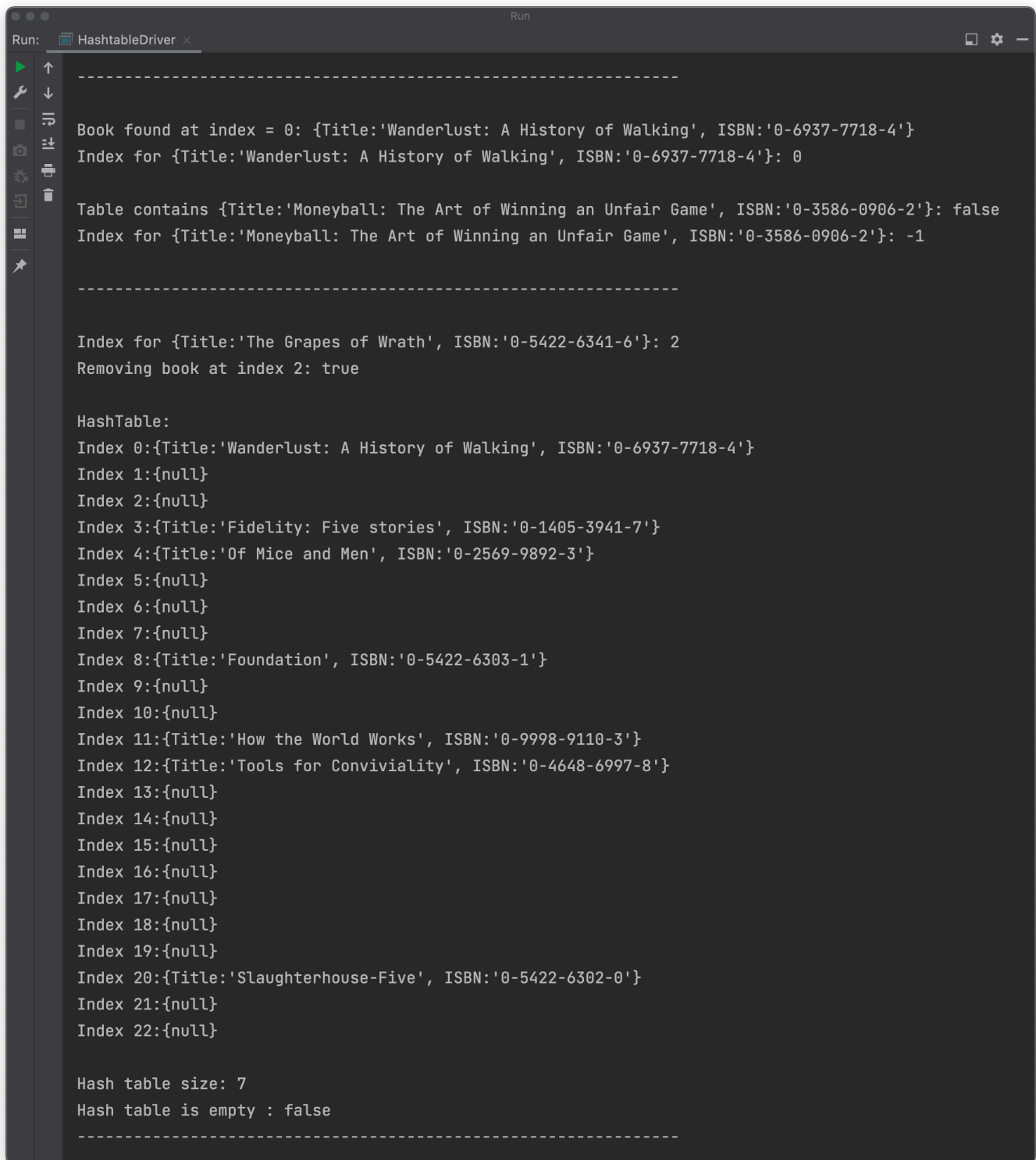
Triggers expandCapacity.

HashTable:
Index 0:{Title:'Wanderlust: A History of Walking', ISBN:'0-6937-7718-4'}
Index 1:{null}
Index 2:{Title:'The Grapes of Wrath', ISBN:'0-5422-6341-6'}
Index 3:{Title:'Fidelity: Five stories', ISBN:'0-1405-3941-7'}
Index 4:{Title:'Of Mice and Men', ISBN:'0-2569-9892-3'}
Index 5:{null}
Index 6:{null}
Index 7:{null}
Index 8:{Title:'Foundation', ISBN:'0-5422-6303-1'}
Index 9:{null}
Index 10:{null}
Index 11:{Title:'How the World Works', ISBN:'0-9998-9110-3'}
Index 12:{Title:'Tools for Conviviality', ISBN:'0-4648-6997-8'}
Index 13:{null}
Index 14:{null}
Index 15:{null}
Index 16:{null}
Index 17:{null}
Index 18:{null}
Index 19:{null}
Index 20:{Title:'Slaughterhouse-Five', ISBN:'0-5422-6302-0'}
Index 21:{null}
Index 22:{null}

-----
```

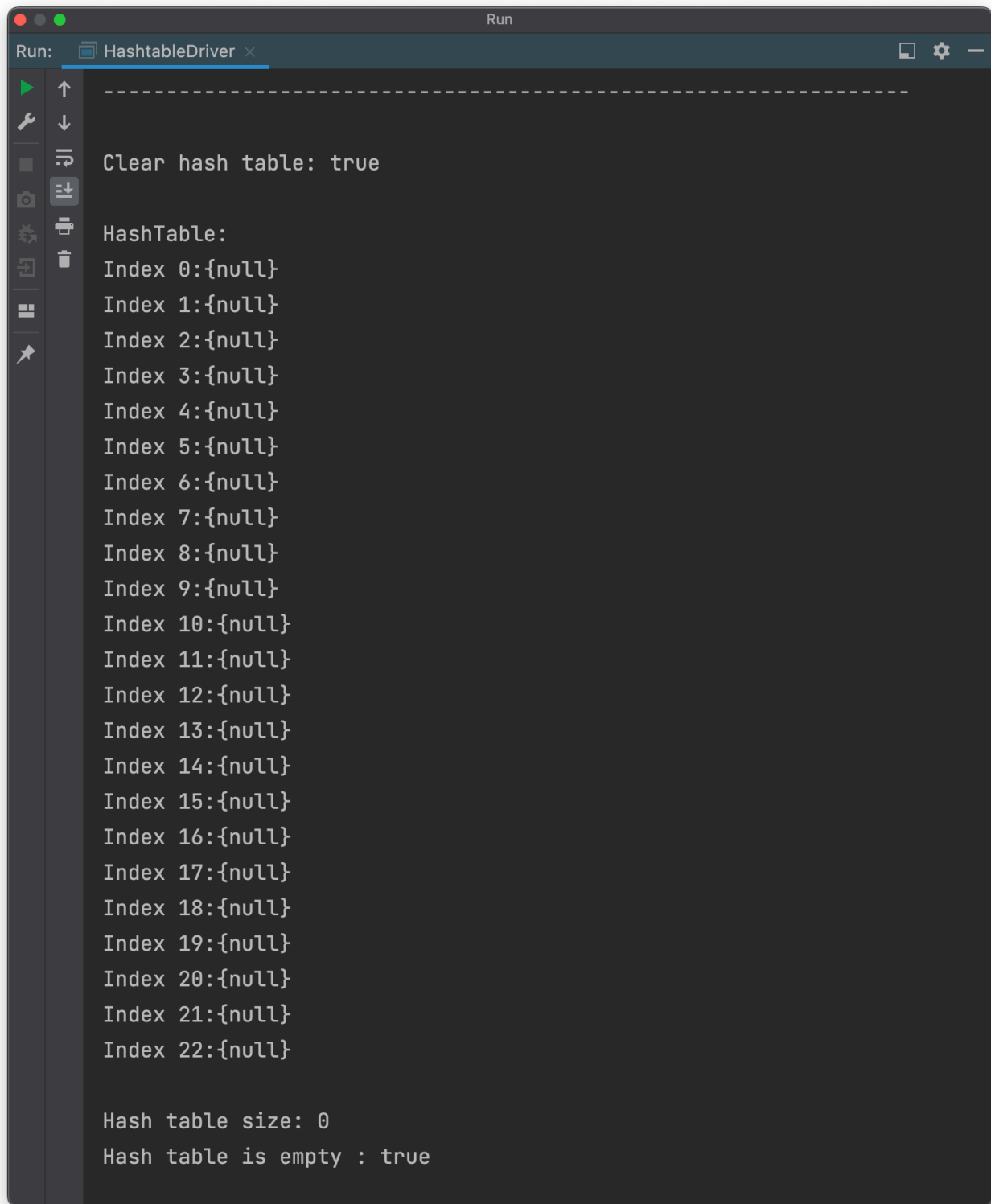
The following explicitly demonstrates finding items in the hash table, and various remaining methods. Tests the following:

```
.getBook(int) .getIndex(book) .contains(book) .remove(int) .size()  
.isEmpty()
```



```
Run: HashTableDriver x  
-----  
Book found at index = 0: {Title:'Wanderlust: A History of Walking', ISBN:'0-6937-7718-4'}  
Index for {Title:'Wanderlust: A History of Walking', ISBN:'0-6937-7718-4'}: 0  
  
Table contains {Title:'Moneyball: The Art of Winning an Unfair Game', ISBN:'0-3586-0906-2'}: false  
Index for {Title:'Moneyball: The Art of Winning an Unfair Game', ISBN:'0-3586-0906-2'}: -1  
  
-----  
  
Index for {Title:'The Grapes of Wrath', ISBN:'0-5422-6341-6'}: 2  
Removing book at index 2: true  
  
HashTable:  
Index 0:{Title:'Wanderlust: A History of Walking', ISBN:'0-6937-7718-4'}  
Index 1:{null}  
Index 2:{null}  
Index 3:{Title:'Fidelity: Five stories', ISBN:'0-1405-3941-7'}  
Index 4:{Title:'Of Mice and Men', ISBN:'0-2569-9892-3'}  
Index 5:{null}  
Index 6:{null}  
Index 7:{null}  
Index 8:{Title:'Foundation', ISBN:'0-5422-6303-1'}  
Index 9:{null}  
Index 10:{null}  
Index 11:{Title:'How the World Works', ISBN:'0-9998-9110-3'}  
Index 12:{Title:'Tools for Conviviality', ISBN:'0-4648-6997-8'}  
Index 13:{null}  
Index 14:{null}  
Index 15:{null}  
Index 16:{null}  
Index 17:{null}  
Index 18:{null}  
Index 19:{null}  
Index 20:{Title:'Slaughterhouse-Five', ISBN:'0-5422-6302-0'}  
Index 21:{null}  
Index 22:{null}  
  
Hash table size: 7  
Hash table is empty : false  
-----
```

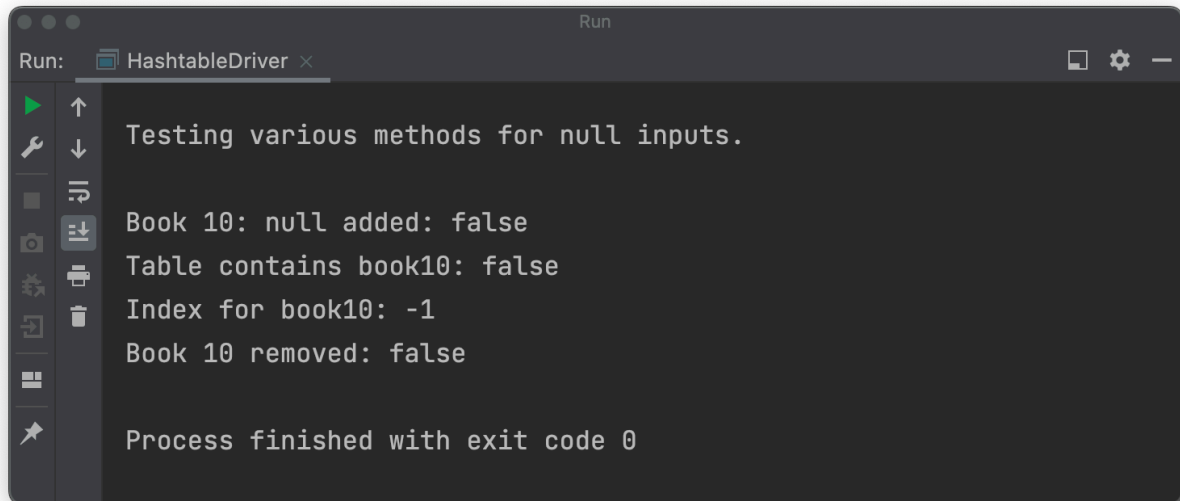
Testing `clear()` `size()` and `isEmpty()` in additional situations



The screenshot shows a Java IDE's Run console window. The title bar says "Run". Below the title bar, there is a tab labeled "Run: HashtableDriver x". The console output is as follows:

```
-----  
Clear hash table: true  
  
HashTable:  
Index 0:{null}  
Index 1:{null}  
Index 2:{null}  
Index 3:{null}  
Index 4:{null}  
Index 5:{null}  
Index 6:{null}  
Index 7:{null}  
Index 8:{null}  
Index 9:{null}  
Index 10:{null}  
Index 11:{null}  
Index 12:{null}  
Index 13:{null}  
Index 14:{null}  
Index 15:{null}  
Index 16:{null}  
Index 17:{null}  
Index 18:{null}  
Index 19:{null}  
Index 20:{null}  
Index 21:{null}  
Index 22:{null}  
  
Hash table size: 0  
Hash table is empty : true
```

Testing various methods for null inputs:



The screenshot shows a 'Run' window in a Java IDE. The title bar says 'Run' and the tab is labeled 'HashtableDriver'. The console output is as follows:

```
Testing various methods for null inputs.  
  
Book 10: null added: false  
Table contains book10: false  
Index for book10: -1  
Book 10 removed: false  
  
Process finished with exit code 0
```