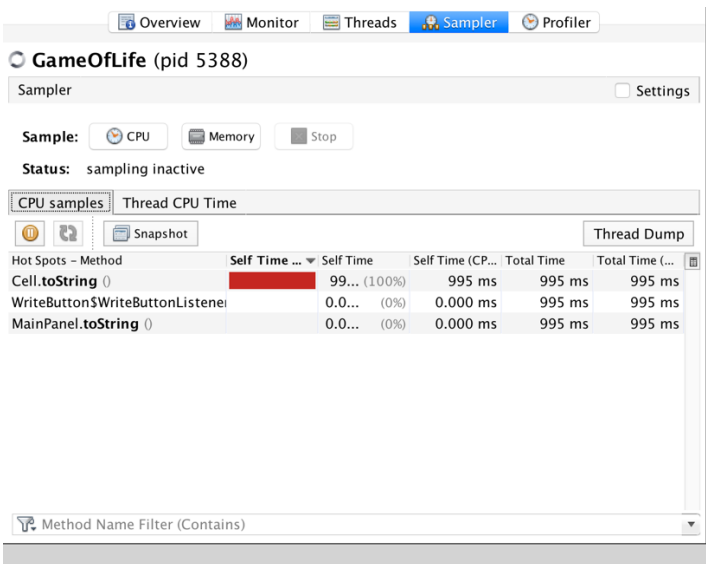


In Deliverable Four, I made modification of three methods which are `Cell.toString()`, `MainPanel.runContinuous()` and `MainPanel.convertToInt()` to improve the performance. These three methods are easily identified as "hot spots" of the application when using VisualVM as profiler to determine methods that consume most resources. To test the function of method doesn't change after modification. I used unit tests for `Cell.toString()` and `MainPanel.convertToInt()`, but manual testing for `MainPanel.runContinuous()` as this method has no return value.

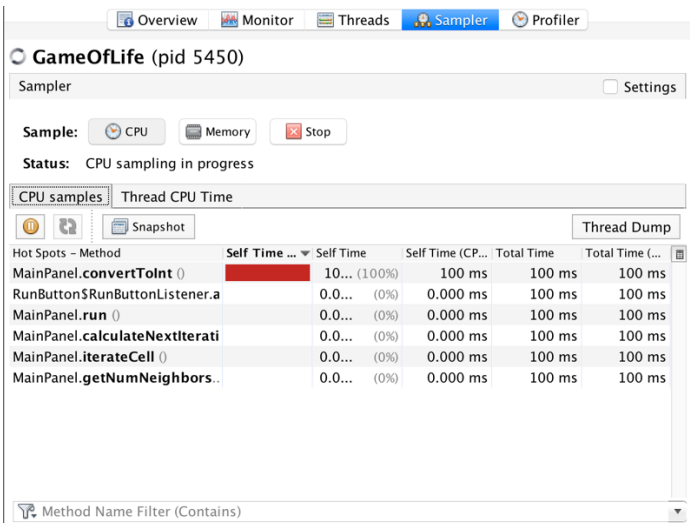
Method One: `Cell.toString()`

After clicking the cells to change their state, I click "Run" button and then click "Write" button. According to the screenshot, it is obvious that `Cell.toString()` is a hot spot method, so I choose to modify this method. There is an unnecessary for loop in the method, as it only extract the first character of the string. I removed the for loop and keep the local fields in case they will be used in future. After modification, `Cell.toString()` is no longer in the Hot Spots-Method list.

Before:



After:

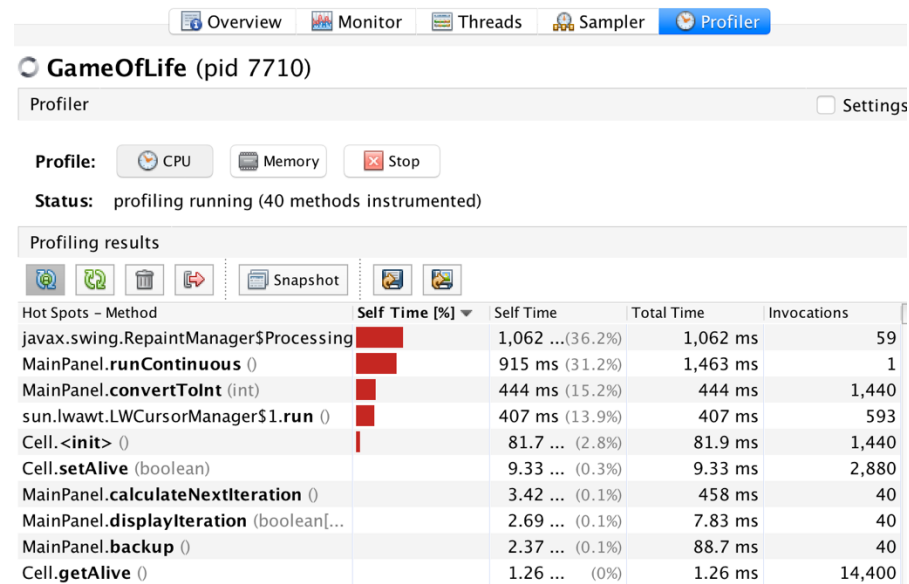


After clicking the cells to change their state, I click “Run Continuous” button, I found that `MainPanel.runContinuous()` and `MainPanel.convertToInt()` are two hot spot methods, and both of them have unnecessary loops which occupy the CPU. I first modified `MainPanel.convertToInt()` method. After testing the modification and comparing the performance of this method before and after modification, I ensured that the modification works. Then, I began to change `MainPanel.runContinuous()`.

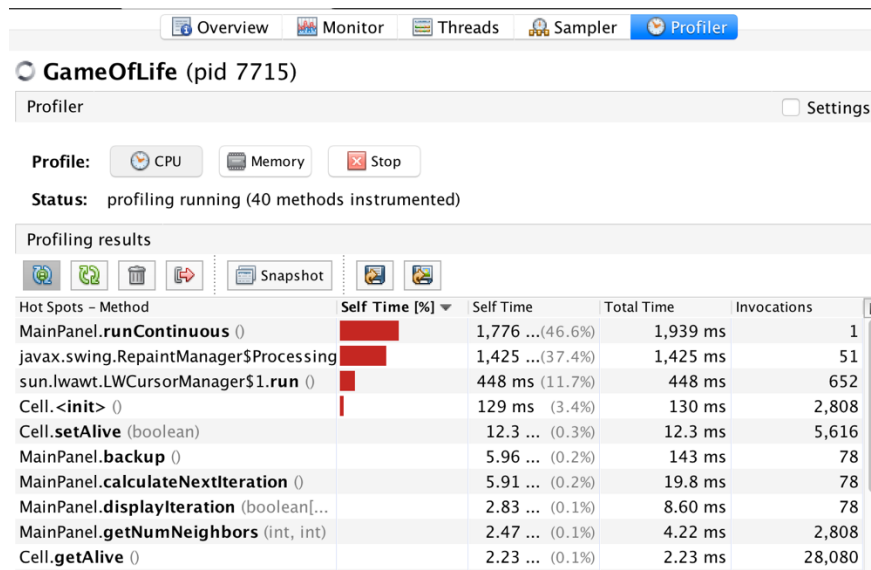
Mehthod Two: MainPanel.convertToInt()

The purpose of function `convertToInt()` is to covert the data type of input to int, however, the data type of input is restricted as int type. As this method is good for segmenting code and in case it will be useful in the future, so I just remove the unnecessary while loop instead of removing the whole method. After modification, `MainPanel.convertToInt()` is no longer in the Hot Spots-Method list.

Before:



After:

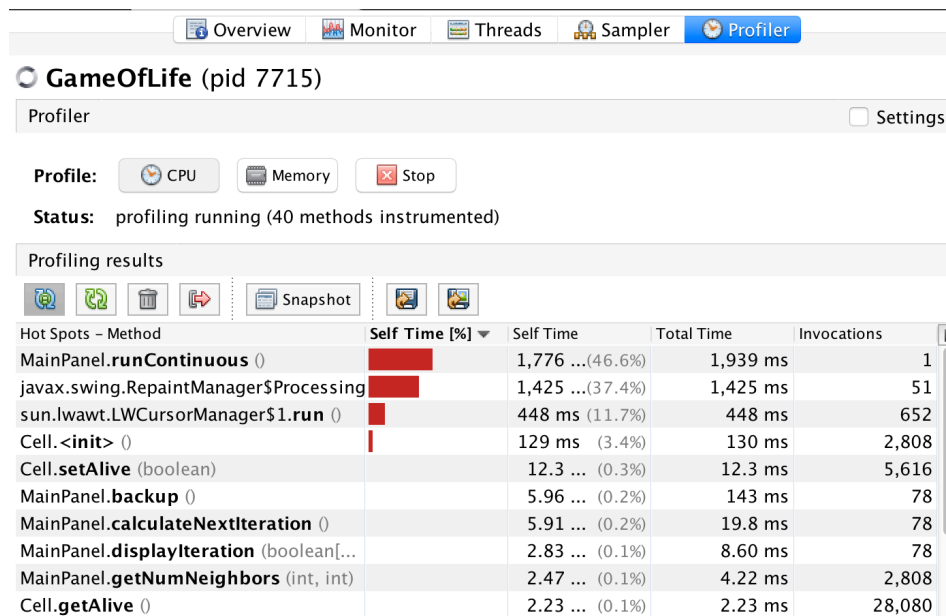


Method Three: MainPanel.runContinuous()

There is an unnecessary loop, as although the value of global parameter `_r` is changed during the loop, but it was changed back to its origin value after the loop, so I remove the for loop and try...catch which have `thread.sleep()` in it to improve the performance. After modification, `MainPanel.runContinuous()` is no longer in the Hot Spots-Method list.

As **MainPanel.runContinuous()** method **returns nothing**, I am unable to use Unit Test to test the outcome, so I use manual test to test the function is not changed.

Before:



After:

