



# **CS 1632 Software Quality Assurance**

## **Deliverable 4**

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Team Name: THE Legion

### **Introduction**

Write your retrospective here. Please describe the division of work between group members. Also, please describe any difficulties that you faced while using VisualVM.

1.

Both of us worked on a single computer together, as we are roommates so we could afford to do this. We both went through the code and did exploratory testing to figure out what was slowing down the program. We saw right away from using VisualVM that two methods were very slow: `iterateCell` and `calculateNextIteration`. It did not take long to determine what was wrong with the code. Then, we had to go into more detail to find that `Cell.toString()` was slowing down other methods. So, we debugged, found and fixed the error, and finished refactoring the methods. After fixing that, we found that `toString` executed roughly 250x faster. For the pinning tests, we also both just talked about what to write while one of us wrote the tests. In total, we didn't have any trouble with VisualVM, and most of the debugging went smooth.

2.

### Optimized Feature 1

- Write the name of the feature optimized (the label on the button)  
Run continuous
- Write the name(s) of the method(s) you refactored to optimize this feature  
MainPanel.iterateCell  
MainPanel.calculateNextIteration
- Insert hotspots-feature1-before.png

Name	Self Time (CPU)	Total Time (CPU)	Invocations
edu.pitt.cs.MainPanel.calculateNextIteration ()	28,900 ms (53.2%)	54,091 ms (31%)	448
edu.pitt.cs.MainPanel.iterateCell (int, int)	25,095 ms (46.2%)	25,156 ms (14.4%)	11,200
edu.pitt.cs.MainPanel.backup ()	109 ms (0.2%)	122 ms (0.1%)	448
edu.pitt.cs.Cell.toString ()	69.7 ms (0.1%)	69.7 ms (0%)	25
edu.pitt.cs.Cell.getAlive ()	41.4 ms (0.1%)	41.4 ms (0%)	112,050
edu.pitt.cs.Cell.setAlive (boolean)	37.3 ms (0.1%)	37.3 ms (0%)	22,503
edu.pitt.cs.MainPanel.getNumNeighbors (int, int)	25.2 ms (0%)	51.8 ms (0%)	11,200
edu.pitt.cs.MainPanel.runContinuous ()	7.22 ms (0%)	47,335 ms (27.1%)	1
edu.pitt.cs.MainPanel.displayIteration (boolean[])	6.2 ms (0%)	36.1 ms (0%)	450
edu.pitt.cs.FileAccess.loadFile (String)	1.69 ms (0%)	1.69 ms (0%)	1
edu.pitt.cs.MainPanel.toString ()	1.35 ms (0%)	71.1 ms (0%)	1
edu.pitt.cs.FileAccess.saveFile (String, String)	0.594 ms (0%)	0.594 ms (0%)	1
edu.pitt.cs.MainPanel.load (java.util.ArrayList)	0.165 ms (0%)	0.566 ms (0%)	1
edu.pitt.cs.Cell.reset ()	0.153 ms (0%)	0.354 ms (0%)	25
edu.pitt.cs.LoadButton\$LoadButtonListener.actionPerformed (java.awt.event.ActionEvent)	0.140 ms (0%)	2.40 ms (0%)	1
edu.pitt.cs.RunContinuousButton\$RunContinuousButtonListener.actionPerformed (java.awt.event.ActionEvent)	0.123 ms (0%)	0.123 ms (0%)	1

- Insert hotspots-feature1-after.png

edu.pitt.cs.MainPanel.backup ()	914 ms (31.8%)	1,152 ms (9.7%)	1,268
edu.pitt.cs.Cell.getAlive ()	649 ms (22.6%)	649 ms (5.4%)	316,809
edu.pitt.cs.MainPanel.getNumNeighbors (int, int)	518 ms (18%)	974 ms (8.2%)	31,675
edu.pitt.cs.Cell.setAlive (boolean)	290 ms (10.1%)	290 ms (2.4%)	63,465
edu.pitt.cs.MainPanel.iterateCell (int, int)	185 ms (6.4%)	1,215 ms (10.2%)	31,675
edu.pitt.cs.Cell.toString ()	101 ms (3.5%)	101 ms (0.9%)	25
edu.pitt.cs.MainPanel.calculateNextIteration ()	72.2 ms (2.5%)	1,545 ms (12.9%)	1,267
edu.pitt.cs.MainPanel.displayIteration (boolean[])	69.5 ms (2.4%)	258 ms (2.2%)	1,269
edu.pitt.cs.MainPanel.runContinuous ()	45.2 ms (1.6%)	2,743 ms (23%)	2
edu.pitt.cs.FileAccess.loadFile (String)	24.1 ms (0.8%)	24.1 ms (0.2%)	1
edu.pitt.cs.MainPanel.toString ()	2.8 ms (0.1%)	104 ms (0.9%)	1
edu.pitt.cs.RunContinuousButton\$RunContinuousButtonListener.actionPerformed (java.awt.event.ActionEvent)	1.90 ms (0.1%)	1.90 ms (0%)	2
edu.pitt.cs.WriteButton\$WriteButtonListener.actionPerformed (java.awt.event.ActionEvent)	0.999 ms (0%)	105 ms (0.9%)	1

3.

### Optimized Feature 2

- Write the name of the feature optimized (the label on the button)  
Write
- Write the name(s) of the method(s) you refactored to optimize this feature  
Cell.toString()
- Insert hotspots-feature2-before.png

Name	Self Time (CPU)	Total Time (CPU)	Invocations
edu.pitt.cs.Cell.toString ()	1,482 ms (98.8%)	1,482 ms (33.1%)	500
edu.pitt.cs.MainPanel.toString ()	9.58 ms (0.6%)	1,493 ms (33.3%)	20
edu.pitt.cs.FileAccess.saveFile (String, String)	6.84 ms (0.5%)	6.84 ms (0.2%)	20
edu.pitt.cs.Cell.getAlive ()	0.877 ms (0.1%)	0.877 ms (0%)	500
edu.pitt.cs.WriteButton\$WriteButtonListener.actionPerformed ()	0.462 ms (0%)	1,500 ms (33.5%)	20
edu.pitt.cs.Cell.setAlive (boolean)	0.396 ms (0%)	0.396 ms (0%)	3
edu.pitt.cs.Cell\$CellButtonListener.actionPerformed (java.awt.event.ActionEvent)	0.104 ms (0%)	0.509 ms (0%)	3
edu.pitt.cs.Cell.resetBeenAlive ()	0.009 ms (0%)	0.009 ms (0%)	3

- Insert hotspots-feature2-after.png

Name	Self Time (CPU)	Total Time (CPU)	Invocations
edu.pitt.cs.FileAccess.saveFile (String, String)	17.3 ms (53.6%)	17.3 ms (25.2%)	20
edu.pitt.cs.MainPanel.toString ()	6.37 ms (19.7%)	12.7 ms (18.5%)	20
edu.pitt.cs.Cell.toString ()	4.56 ms (14.1%)	4.56 ms (6.6%)	500
edu.pitt.cs.WriteButton\$WriteButtonListener.actionPerformed ()	2.26 ms (7%)	32.3 ms (47%)	20
edu.pitt.cs.Cell.getAlive ()	1.77 ms (5.5%)	1.77 ms (2.6%)	500