Homework 2

Deadlock

For this homework you will start with an existing Java program (in Homework2.java). Currently the program deadlocks. Modify the program to get rid of the deadlock and serialize the activities of the Writer threads.

The table below shows examples of the output under different concurrency constraints. Thread1 runs the Writer that uppercases the names, and thead2 runs the Writer that replaces ‘o’ with ‘0’ and replaces ‘I’ with ‘1’.

The first two rows show the results when the threads are serialized: one thread completes its activities before the other thread starts its activities. For these two cases the output will always look like the samples given in the table. Review the program to see why the output looks like this.

For the third case, the thread activities are interleaved (thread1 || thread2). In this case the output could look different each time, depending on timing. (It’s non-deterministic.)

Your task is to serialize access to the shared resources, so your output should match the first or second row in the table. Here is a summary of your task:

* Fix the deadlock.
* Serialize the Writers, so that your output looks like the first or second row in the table.
* You may modify only class Writer. You may not create an additional Writer class (to have the writers do different things).

Note that your corrected program will probably always look like the first row, since the main starts thread1 before thread2. You can temporarily change the startup order to check your program, but make sure you change it back before turning in your program.

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| **Thread Activity** | **Description of Output** | **Sample Run** |
| thread1; thread2 | First list:   * all uppercase * all I and i replaced   Second list:   * all uppercase * no replacements | First list:  Client AL1CE has id 1000  Client BOB has id 1010  Client CHARL1E has id 1020  Client DOUGLAS has id 1030  Client EDW1N has id 1040  Client FA1TH has id 1050  Client GAV1N has id 1060  Client HARR1ET has id 1070  Client 1NEZ has id 1080  Client JOHN has id 1090  Client KARLA has id 1100  Second list:  Client ALICE has id 1000  Client BOB has id 1010  Client CHARLIE has id 1020  Client DOUGLAS has id 1030  Client EDWIN has id 1040  Client FAITH has id 1050  Client GAVIN has id 1060  Client HARRIET has id 1070  Client INEZ has id 1080  Client JOHN has id 1090  Client KARLA has id 1100 |
| thread2; thread1 | First list:   * original case * all o’s replaced * capital I (in Inez) replaced   Second list:   * all uppercase * same replacements as first list | First list:  Client Alice has id 1000  Client B0b has id 1010  Client Charlie has id 1020  Client D0uglas has id 1030  Client Edwin has id 1040  Client Faith has id 1050  Client Gavin has id 1060  Client Harriet has id 1070  Client 1nez has id 1080  Client J0hn has id 1090  Client Karla has id 1100  Second list:  Client ALICE has id 1000  Client B0B has id 1010  Client CHARLIE has id 1020  Client D0UGLAS has id 1030  Client EDWIN has id 1040  Client FAITH has id 1050  Client GAVIN has id 1060  Client HARRIET has id 1070  Client 1NEZ has id 1080  Client J0HN has id 1090  Client KARLA has id 1100 |
| thread1 || thread2 | Results will vary.  First list:   * If word is mixed case, small ‘o’ and capital ‘I’ are replaced. * If word is uppercase, only ‘i’ and ‘I’ are replaced.   Second list:   * All uppercase * If word in first list is mixed case, then see the same replacements as in first list. (e.g., in the second sample output, ALICE through D0UGLAS) * If word in first list is uppercase, then see no replacements. (e.g., in the second sample output, EDWIN to end) | First list:  Client AL1CE has id 1000  Client BOB has id 1010  Client CHARL1E has id 1020  Client DOUGLAS has id 1030  Client EDW1N has id 1040  Client FA1TH has id 1050  Client Gavin has id 1060  Client Harriet has id 1070  Client 1nez has id 1080  Client J0hn has id 1090  Client Karla has id 1100  Second list:  Client ALICE has id 1000  Client BOB has id 1010  Client CHARLIE has id 1020  Client DOUGLAS has id 1030  Client EDWIN has id 1040  Client FAITH has id 1050  Client GAVIN has id 1060  Client HARRIET has id 1070  Client 1NEZ has id 1080  Client J0HN has id 1090  Client KARLA has id 1100 |
| First list:  Client Alice has id 1000  Client B0b has id 1010  Client Charlie has id 1020  Client D0uglas has id 1030  Client EDW1N has id 1040  Client FA1TH has id 1050  Client GAV1N has id 1060  Client HARR1ET has id 1070  Client 1NEZ has id 1080  Client JOHN has id 1090  Client KARLA has id 1100  Second list:  Client ALICE has id 1000  Client B0B has id 1010  Client CHARLIE has id 1020  Client D0UGLAS has id 1030  Client EDWIN has id 1040  Client FAITH has id 1050  Client GAVIN has id 1060  Client HARRIET has id 1070  Client INEZ has id 1080  Client JOHN has id 1090  Client KARLA has id 1100 |