Deadlock in Java

Deadlock in Java is a part of multithreading. Deadlock can occur in a situation when a thread is waiting for an object lock, that is acquired by another thread and second thread is waiting for an object lock that is acquired by first thread. Since, both threads are waiting for each other to release the lock, the condition is called deadlock.



Example of Deadlock in Java

**TestDeadlockExample1.java**

1. **public** **class** TestDeadlockExample1 {
2. **public** **static** **void** main(String[] args) {
3. **final** String resource1 = "ratan jaiswal";
4. **final** String resource2 = "vimal jaiswal";
5. // t1 tries to lock resource1 then resource2
6. Thread t1 = **new** Thread() {
7. **public** **void** run() {
8. **synchronized** (resource1) {
9. System.out.println("Thread 1: locked resource 1");
11. **try** { Thread.sleep(100);} **catch** (Exception e) {}
13. **synchronized** (resource2) {
14. System.out.println("Thread 1: locked resource 2");
15. }
16. }
17. }
18. };
20. // t2 tries to lock resource2 then resource1
21. Thread t2 = **new** Thread() {
22. **public** **void** run() {
23. **synchronized** (resource2) {
24. System.out.println("Thread 2: locked resource 2");
26. **try** { Thread.sleep(100);} **catch** (Exception e) {}
28. **synchronized** (resource1) {
29. System.out.println("Thread 2: locked resource 1");
30. }
31. }
32. }
33. };

36. t1.start();
37. t2.start();
38. }
39. }

**Output:**

Thread 1: locked resource 1

Thread 2: locked resource 2

More Complicated Deadlocks

A deadlock may also include more than two threads. The reason is that it can be difficult to detect a deadlock. Here is an example in which four threads have deadlocked:

Thread 1 locks A, waits for B

Thread 2 locks B, waits for C

Thread 3 locks C, waits for D

Thread 4 locks D, waits for A

Thread 1 waits for thread 2, thread 2 waits for thread 3, thread 3 waits for thread 4, and thread 4 waits for thread 1.

How to avoid deadlock?

A solution for a problem is found at its roots. In deadlock it is the pattern of accessing the resources A and B, is the main issue. To solve the issue we will have to simply re-order the statements where the code is accessing shared resources.

**DeadlockSolved.java**

1. **public** **class** DeadlockSolved {
3. **public** **static** **void** main(String ar[]) {
4. DeadlockSolved test = **new** DeadlockSolved();
6. **final** resource1 a = test.**new** resource1();
7. **final** resource2 b = test.**new** resource2();
9. // Thread-1
10. Runnable b1 = **new** Runnable() {
11. **public** **void** run() {
12. **synchronized** (b) {
13. **try** {
14. /\* Adding delay so that both threads can start trying to lock resources \*/
15. Thread.sleep(100);
16. } **catch** (InterruptedException e) {
17. e.printStackTrace();
18. }
19. // Thread-1 have resource1 but need resource2 also
20. **synchronized** (a) {
21. System.out.println("In block 1");
22. }
23. }
24. }
25. };
27. // Thread-2
28. Runnable b2 = **new** Runnable() {
29. **public** **void** run() {
30. **synchronized** (b) {
31. // Thread-2 have resource2 but need resource1 also
32. **synchronized** (a) {
33. System.out.println("In block 2");
34. }
35. }
36. }
37. };

40. **new** Thread(b1).start();
41. **new** Thread(b2).start();
42. }
44. // resource1
45. **private** **class** resource1 {
46. **private** **int** i = 10;
48. **public** **int** getI() {
49. **return** i;
50. }
52. **public** **void** setI(**int** i) {
53. **this**.i = i;
54. }
55. }
57. // resource2
58. **private** **class** resource2 {
59. **private** **int** i = 20;
61. **public** **int** getI() {
62. **return** i;
63. }
65. **public** **void** setI(**int** i) {
66. **this**.i = i;
67. }
68. }
69. }

**Output:**

In block 1

In block 2

In the above code, class DeadlockSolved solves the deadlock kind of situation. It will help in avoiding deadlocks, and if encountered, in resolving them.

How to Avoid Deadlock in Java?

Deadlocks cannot be completely resolved. But we can avoid them by following basic rules mentioned below:

1. **Avoid Nested Locks**: We must avoid giving locks to multiple threads, this is the main reason for a deadlock condition. It normally happens when you give locks to multiple threads.
2. **Avoid Unnecessary Locks**: The locks should be given to the important threads. Giving locks to the unnecessary threads that cause the deadlock condition.
3. **Using Thread Join**: A deadlock usually happens when one thread is waiting for the other to finish. In this case, we can use **join** with a maximum time that a thread will take.