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**Task1**

A: 47 B : 11 C : 8 D : 15

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Given History | | |  | Solution Task1 | | | | | |
|  | T1 | T2 | T3 |  | LSN | TA | Page | Redo | U/PL | PL/UN |
| 1 |  | BOT |  |  | [#1 | T2 | BOT |  |  | #0] |
| 2 |  | r2(A, a2) |  | a2 = 47 |  |  |  |  |  |  |
| 3 |  | r2(B, b2) |  | b2 = 11 |  |  |  |  |  |  |
| 4 | BOT |  |  |  | [#2 | T1 | BOT |  |  | #0] |
| 5 | r1(C, c1) |  |  | c1 = 8 |  |  |  |  |  |  |
| 6 |  | w2(D, 2 · a2 + b2) |  | d1 = 105 | [#3 | T2 | PD | D += 90 | D -= 90 | #1] |
| 7 |  | abort |  |  | [#4 | T2 | abort |  |  | #3] |
|  |  |  |  |  | <#5 | T2 | PD | D -= 90 | #3 | #1> |
| 8 | r1(D, d1) |  |  | d1 = 15 |  |  |  |  |  |  |
| 9 |  |  | BOT |  | [#6 | T3 | BOT |  |  | #0] |
|  |  | | | | | | | | | |
| 10 |  |  | r3(A, a3) | a3 = 47 |  | | | | | |
| 11 | w1(A, c1 + 2 · d) |  |  | A = 38 | [#7 | T3 | PA | A -= 9 | A += 9 | #2] |
| 12 |  |  | w3(A, a3 + 4) | A=51 | [#8 | T3 | PA | A+=13 | A-=13 | #6] |
| 13 | r1(B, b1) |  |  | B1=11 |  | | | | | |
| 14 |  |  | w3(C, a3 − 7) | C=40 | [#9 | T3 | PC | C+=32 | C-=32 | #8] |
| 15 | w1(D, c1 − 40) |  |  | D=-32 | [#10 | T1 | PD | D-=47 | D+=47 | #7] |
| 16 |  |  | r3(B, b3) | b3=11 |  | | | | | |
| 17 |  |  | w3(D, 27) | D=27 | [#11 | T3 | PD | D+=59 | D-=59 | #9] |
| 18 |  |  | w3(C, b3 + a3) | C=58 | [#12 | T3 | PC | C+=18 | C-=18 | #11] |
| 19 |  |  | commit |  | [#13 | T3 | commit |  |  | #12] |
| 20 | commit |  |  |  | [#14 | T1 | commit |  |  | #10] |

**Task 2:**

A) State the values of A, B, C, and D after the redo-step

For A last transaction was #3. After that we have #9 -> -5 (A=22) then we have #11 -> +5 which undo to A=27

For B last transaction was #2. After that we have #7 -,> +7 (B=11), then #10 -> -14 (B=-3), then #14 -> -8 (B=-11)

For C last was #5. After that we have #13 -> -9 (C=20)

For D last was #0. We have #12 -> -2 (D=16),then we have #15 -> +6 (D=22)

B)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| LSN | TA | PageID | Redo | PrevLSN | UndoNextLSN |
| <#16 | T1 | PD | D-=6 | #15 | #14> |
| <#17 | T1 | PB | B+=8 | #16 | #12> |
| <#18 | T1 | PD | D+=2 | #17 | #10> |
| <#19 | T1 | PB | B+=14 | #18 | #6> |
| <#20 | T3 | PA | A+=5 | #9 | #5> |
| <#21 | T1 | BOT |  | #0> |  |
| <#22 | T3 | PC | C-=9 | #20 | #4> |
| <#23 | T3 | BOT |  | #0> |  |

C) A: 32, B: 11, C: 11, D: 18

**Task 3**

T1 -> T2:

* w1(D) -> w2(D)
* r1(D) -> w2(D)
* r1(A) -> w2(A)
* r1(C) -> r2(C)

T2 -> T4:

* w2(D) -> w4(D)

T1 -> T3:

* r1(C) -> w3(C)
* w1(B) -> r3(B)
* w1(B) -> w3(B)

T3 -> T4:

* w3(B) -> w4(B)
* r3(B) -> w4(B)

T3 -> T2:

* w3(C) -> r2(C)

T1 -> T4:

* w1(B) -> w4(B)
* r1(D) -> w4(D)
* w1(D) -> w4(D)

**Task 4**

A)

|  |  |  |  |
| --- | --- | --- | --- |
| 1 | lockX3(A) | 10 | wait(4) |
| 2 | grantX3(A) | 11 | lockX1(C) |
| 3 | lockS1(C) | 12 | wait(1) |
| 4 | grantS1(C) | 13 | rel4(A) |
| 5 | lockX2(B) | 14 | relX4(A) |
| 6 | grantX2(B) | 15 | lockS3(B) |
| 7 | lockX2(C) | 16 | wait(3) |
| 8 | wait(2) | 17 | lockS1(D) |
| 9 | lockS4(A) | 18 | grantsS1(D) |

B)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | A | B | C | D |
| T1 |  |  | S/WX |  |
| T2 |  | X | WX |  |
| T3 | X | WS |  |  |
| T4 | WS |  |  |  |

C)

T3 -> T2:

* w3(A) -> w2(A)
* r3(A) -> w2(A)

T4 -> T1:

* w4(D) -> w1(D)
* r4(D) -> w1(D)
* w4(D) -> r4(D)

T1 -> T2:

* w1(D) -> w2(D)
* r1(D) -> w2(D)
* w1(D) -> r2(D)

T4 -> T2:

* w4(D) -> w2(D)
* r4(D) -> w2(D)
* w4(D) -> r2(D)

T2 -> T1:

* r2(B) -> w1(B)

T1 -> T4:

* r1(C) -> w4(C)

T4 -> T3:

* w4(C) -> r3(C)

**Task 5**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | T1 | T2 | T3 | info |
| 1 | lockS1(D) |  |  |  |
| 2 | r1(D) |  |  |  |
| 3 |  | lockS2(A) |  |  |
| 4 |  | r2(A) |  |  |
| 5 |  |  | lockS3(D) |  |
| 6 |  |  | r3(D) |  |
| 7 | lockS1(A) |  |  |  |
| 8 | r1(A) |  |  |  |
| 9 |  | lockS2(C) |  |  |
| 10 |  | r2(C) |  |  |
| 11 |  |  | lockX3(D) | Waiting for 1 |
| 12 | lockS1(B) |  |  |  |
| 13 | R1(B) |  |  |  |
| 14 |  | lockX2(A) |  | Waiting for 1 |
| 15 | lockS1(A) |  |  |  |
| 16 | R1(A) |  |  |  |
| 17 | lockS1(C) |  |  |  |
| 18 | R1(C) |  |  |  |
| 19 | Rel1(D) |  |  |  |
| 20 | Rel1(A) |  |  |  |
| 21 | Rel1(B) |  |  |  |
| 22 | Rel1(C) |  |  |  |
| 23 |  | W2(A) |  |  |
| 24 |  |  | W3(D) |  |
| 25 | c1 |  |  |  |
| 26 |  | lockS2(D) |  | waiting for 3 |
| 27 |  |  | lockS3(B) |  |
| 28 |  |  | r3(B) |  |
| 29 |  |  | lockS3(C) |  |
| 30 |  |  | r3(C) |  |
| 31 |  |  | lockX3(B) |  |
| 32 |  |  | W3(B) |  |
| 33 |  |  | Rel3(D) |  |
| 34 |  |  | Rel3(B) |  |
| 35 |  |  | Rel3(C) |  |
| 36 |  | R2(D) |  |  |
| 37 |  |  | c3 |  |
| 38 |  | lockX2(B) |  |  |
| 39 |  | W2(B) |  |  |
| 40 |  | c2 |  |  |