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Aries Algorithm Output:

System Before 1st Crash:

```
1 ##### SYSTEM STATE BEFORE CRASH #####
2 Log Records[On MEMORY]
3 LSN      prevLSN    TxnId    type    data    before    after    undoNext
4 -----
5
6 Log Records[On DISK]
7 LSN      prevLSN    TxnId    type    data    before    after    undoNext
8 -----
9 0      None      T1      BEGIN    -      -      -      -
10 1      0      T1      UPDATE    A      5      15      -
11 2      1      T1      UPDATE    C      10     15      -
12 3      2      T1      UPDATE    B      15     30      -
13 4      None    T2      BEGIN    -      -      -      -
14 5      4      T2      UPDATE    F      6      13      -
15 6      5      T2      COMMIT    -      -      -      -
16 7      None    None    CHECKPOINT -      -      -      -
17 8      None    T3      BEGIN    -      -      -      -
18 9      8      T3      UPDATE    F      13     29      -
19 10     9      T3      UPDATE    E      20     70      -
20 11     10     T3      ABORT    -      -      -      -
21 12     11     T3      CLR      E      70     20      9
22 13     12     T3      CLR      F      29     13      8
23
24 MEMORY [Volatile]
25 pageId    pageLSN    recLSN    data
26 -----
27 1          3          1    {'A': 15, 'B': 30}
28 2          2          2    {'C': 15, 'D': 6}
29 3         13          5    {'E': 20, 'F': 13}
30
31 DISK MEMORY [NON-Volatile]
32 pageId    pageLSN    recLSN    data
33 -----
34 1          3          1    {'A': 15, 'B': 30}
35 2          2          2    {'C': 15, 'D': 6}
36 3          5          5    {'E': 20, 'F': 13}
37
38 Dirty Page Table(DPT)
39 PageId    recLSN
40 -----
41 1          1
42 2          2
43 3          5
44
45 Active Transaction Table(ATT)
46 TransactionId    status    lastLSN
47 -----
48 T1                UNDO      3
49 T2                COMMIT    6
50 T3                ABORT     13
51 #####
```

System After 1st Crash:

```
1 ##### SYSTEM STATE AFTER RECOVERY #####
2 Log Records[On MEMORY]
3 LSN      prevLSN  TxnId  type  data  before  after  undoNext
4 -----
5      21         20   T1     END   -      -      -      -
6
7 Log Records[On DISK]
8 LSN      prevLSN  TxnId  type  data  before  after  undoNext
9 -----
10      0   None     T1     BEGIN  -      -      -      -
11      1      0     T1     UPDATE  A      5      15     -
12      2      1     T1     UPDATE  C     10      15     -
13      3      2     T1     UPDATE  B     15      30     -
14      4   None     T2     BEGIN  -      -      -      -
15      5      4     T2     UPDATE  F      6      13     -
16      6      5     T2     COMMIT  -      -      -      -
17      7   None     None    CHECKPOINT  -      -      -      -
18      8   None     T3     BEGIN  -      -      -      -
19      9      8     T3     UPDATE  F     13      29     -
20     10      9     T3     UPDATE  E     20      70     -
21     11     10     T3     ABORT   -      -      -      -
22     12     11     T3     CLR     E     70      20      9
23     13     12     T3     CLR     F     29      13      8
24     15      6     T2     END     -      -      -      -
25     16     11     T3     END     -      -      -      -
26     17      3     T1     CLR     B     30      15      2
27     18     17     T1     CLR     C     15      10      1
28     19     18     T1     CLR     A     15       5      0
29     20     19     T1     ABORT   -      -      -      -
30
31 MEMORY [Volatile]
32 pageId   pageLSN   recLSN  data
33 -----
34      1      19      1  {'A': 5, 'B': 15}
35      2      18      2  {'C': 10, 'D': 6}
36      3      13      5  {'E': 20, 'F': 13}
37
38 DISK MEMORY [NON-Volatile]
39 pageId   pageLSN   recLSN  data
40 -----
41      1      19      1  {'A': 5, 'B': 15}
42      2      18      2  {'C': 10, 'D': 6}
43      3      13      5  {'E': 20, 'F': 13}
44
45 Dirty Page Table(DPT)
46 PageId   recLSN
47 -----
48
49 Active Transaction Table(ATT)
50 TransactionId  status  lastLSN
51 -----
52 #####
```

System Before 2nd Crash:

```

1 ##### SYSTEM STATE BEFORE CRASH #####
2   Log Records[On MEMORY]
3   LSN      prevLSN    TxnId    type    data    before  after  undoNext
4   ----
5
6   Log Records[On DISK]
7   LSN      prevLSN    TxnId    type    data    before  after  undoNext
8   ----
9   0      None      T1      BEGIN   -      -      -      -
10  1      0      T1      UPDATE  A      5      15     -
11  2      1      T1      UPDATE  C      10     15     -
12  3      2      T1      UPDATE  B      15     30     -
13  4      None     T2      BEGIN   -      -      -      -
14  5      4      T2      UPDATE  F      6      13     -
15  6      5      T2      COMMIT  -      -      -      -
16  7      None     None     CHECKPOINT -      -      -      -
17  8      None     T3      BEGIN   -      -      -      -
18  9      8      T3      UPDATE  F      13     29     -
19  10     9      T3      UPDATE  E      20     70     -
20  11     10     T3      ABORT   -      -      -      -
21  12     11     T3      CLR     E      70     20     9
22  13     12     T3      CLR     F      29     13     8
23  15     6      T2      END     -      -      -      -
24  16     11     T3      END     -      -      -      -
25  17     3      T1      CLR     B      30     15     2
26  18     17     T1      CLR     C      15     10     1
27  19     18     T1      CLR     A      15     5      0
28  20     19     T1      ABORT   -      -      -      -
29  21     20     T1      END     -      -      -      -
30  22     None    T4      BEGIN   -      -      -      -
31  23     22     T4      UPDATE  A      5      105    -
32  24     23     T4      UPDATE  B      15     65     -
33  25     24     T4      COMMIT  -      -      -      -
34  26     None     None     CHECKPOINT -      -      -      -
35  27     None    T5      BEGIN   -      -      -      -
36  28     27     T5      UPDATE  C      10     2      -
37  29     28     T5      ABORT   -      -      -      -
38  30     29     T5      CLR     C      2      10     27
39
40   MEMORY [Volatile]
41   pageId    pageLSN    recLSN    data
42   ----
43   1          24      1    {'A': 105, 'B': 65}
44   2          30      2    {'C': 10, 'D': 6}
45   3          13      5    {'E': 20, 'F': 13}
46
47   DISK MEMORY [NON-Volatile]
48   pageId    pageLSN    recLSN    data
49   ----
50   1          24      1    {'A': 105, 'B': 65}
51   2          18      2    {'C': 10, 'D': 6}
52   3          13      5    {'E': 20, 'F': 13}
53
54   Dirty Page Table(DPT)
55   PageId    recLSN
56   ----
57   1          23
58   2          28
59
60   Active Transaction Table(ATT)
61   TransactionId  status    lastLSN
62   ----
63   T4              COMMIT     25
64   T5              ABORT     30
65 #####

```

System After 2nd Recovery



```
1 ##### SYSTEM STATE AFTER RECOVERY #####
2   Log Records[On MEMORY]
3   LSN      prevLSN  TxnId    type    data    before  after  undoNext
4   ----      -
5   32        25    T4       END     -       -       -       -
6   33        29    T5       END     -       -       -       -
7
8   Log Records[On DISK]
9   LSN      prevLSN  TxnId    type    data    before  after  undoNext
10  ----      -
11  0         None    T1       BEGIN   -       -       -       -
12  1         0      T1       UPDATE  A       5       15      -
13  2         1      T1       UPDATE  C       10      15      -
14  3         2      T1       UPDATE  B       15      30      -
15  4         None    T2       BEGIN   -       -       -       -
16  5         4      T2       UPDATE  F       6       13      -
17  6         5      T2       COMMIT  -       -       -       -
18  7         None    None     CHECKPOINT -       -       -       -
19  8         None    T3       BEGIN   -       -       -       -
20  9         8      T3       UPDATE  F       13      29      -
21  10        9      T3       UPDATE  E       20      70      -
22  11        10     T3       ABORT   -       -       -       -
23  12        11     T3       CLR     E       70      20      9
24  13        12     T3       CLR     F       29      13      8
25  15        6      T2       END     -       -       -       -
26  16        11     T3       END     -       -       -       -
27  17        3      T1       CLR     B       30      15      2
28  18        17     T1       CLR     C       15      10      1
29  19        18     T1       CLR     A       15      5       0
30  20        19     T1       ABORT   -       -       -       -
31  21        20     T1       END     -       -       -       -
32  22        None    T4       BEGIN   -       -       -       -
33  23        22     T4       UPDATE  A       5       105     -
34  24        23     T4       UPDATE  B       15      65     -
35  25        24     T4       COMMIT  -       -       -       -
36  26        None    None     CHECKPOINT -       -       -       -
37  27        None    T5       BEGIN   -       -       -       -
38  28        27     T5       UPDATE  C       10      2       -
39  29        28     T5       ABORT   -       -       -       -
40  30        29     T5       CLR     C       2       10      27
41
42  MEMORY [Volatile]
43  pageId    pageLSN    recLSN    data
44  ----      -
45  1         24      1    {'A': 105, 'B': 65}
46  2         30      2    {'C': 10, 'D': 6}
47
48  DISK MEMORY [NON-Volatile]
49  pageId    pageLSN    recLSN    data
50  ----      -
51  1         24      1    {'A': 105, 'B': 65}
52  2         18      2    {'C': 10, 'D': 6}
53  3         13      5    {'E': 20, 'F': 13}
54
55  Dirty Page Table(DPT)
56  PageId    recLSN
57  ----      -
58  1         23
59  2         28
60
61  Active Transaction Table(ATT)
62  TransactionId  status  lastLSN
63  ----
64  #####
```

Input Schedule:



```
1  BEGIN(T1)
2  READ(A, T1)
3  READ(B, T1)
4  READ(C, T1)
5  A = [A + 10]_T1
6  B = [B + 15]_T1
7  WRITE(A, T1)
8  C = [C + 5]_T1
9  WRITE(C, T1)
10 WRITE(B, T1)
11 BEGIN(T2)
12 READ(F, T2)
13 F = [F + 7]_T2
14 WRITE(F, T2)
15 COMMIT(T2)
16 CHECKPOINT()
17 BEGIN(T3)
18 READ(F, T3)
19 READ(E, T3)
20 F = [F + 16]_T3
21 WRITE(F, T3)
22 E = [E + 50]_T3
23 WRITE(E, T3)
24 ABORT(T3)
25 CRASH()
26 BEGIN(T4)
27 READ(A, T4)
28 A = [A + 100]_T4
29 READ(B, T4)
30 B = [B + 50]_T4
31 WRITE(A, T4)
32 WRITE(B, T4)
33 COMMIT(T4)
34 CHECKPOINT()
35 BEGIN(T5)
36 READ(C, T5)
37 C = [C - 8]_T5
38 WRITE(C, T5)
39 ABORT(T5)
40 CRASH()
```