122022010 Shrayank Jai Mistry
Aries Algorithm Output:

System Before 1st Crash:

```
############################## SYSTEM STATE BEFORE CRASH ##############################
  Log Records[On MEMORY]
LSN    prevLSN    TxnId    type    data    before    after    undoNext
-----  ---------  -------  ------  ------  --------  -------  ----------

  Log Records[On DISK]
  LSN  prevLSN    TxnId    type        data    before    after    undoNext
-----  ---------  -------  ----------  ------  --------  -------  ----------
    0  None       T1       BEGIN       -       -         -        -
    1  0          T1       UPDATE      A       5         15       -
    2  1          T1       UPDATE      C       10        15       -
    3  2          T1       UPDATE      B       15        30       -
    4  None       T2       BEGIN       -       -         -        -
    5  4          T2       UPDATE      F       6         13       -
    6  5          T2       COMMIT      -       -         -        -
    7  None       None     CHECKPOINT  -       -         -        -
    8  None       T3       BEGIN       -       -         -        -
    9  8          T3       UPDATE      F       13        29       -
   10  9          T3       UPDATE      E       20        70       -
   11  10         T3       ABORT       -       -         -        -
   12  11         T3       CLR         E       70        20       9
   13  12         T3       CLR         F       29        13       8

  MEMORY [Volatile]
  pageId    pageLSN    recLSN  data
--------  ---------  --------  ------------------
       1          3         1  {'A': 15, 'B': 30}
       2          2         2  {'C': 15, 'D': 6}
       3         13         5  {'E': 20, 'F': 13}

  DISK MEMORY [NON-Volatile]
  pageId    pageLSN    recLSN  data
--------  ---------  --------  ------------------
       1          3         1  {'A': 15, 'B': 30}
       2          2         2  {'C': 15, 'D': 6}
       3          5         5  {'E': 20, 'F': 13}

  Dirty Page Table(DPT)
  PageId    recLSN
--------  --------
       1         1
       2         2
       3         5

Active Transaction Table(ATT)
TransactionId    status      lastLSN
---------------  --------  ---------
T1               UNDO              3
T2               COMMIT            6
T3               ABORT            13
#######################################################################################
```

System After 1st Crash:

```
############################## SYSTEM STATE AFTER RECOVERY ##############################
  Log Records[On MEMORY]
  LSN    prevLSN  TxnId    type    data    before    after    undoNext
-----  ---------  -------  ------  ------  --------  -------  ----------
   21         20  T1       END     -       -         -        -

  Log Records[On DISK]
  LSN  prevLSN    TxnId    type        data    before    after    undoNext
-----  ---------  -------  ----------  ------  --------  -------  ----------
    0  None       T1       BEGIN       -       -         -        -
    1  0          T1       UPDATE      A       5         15       -
    2  1          T1       UPDATE      C       10        15       -
    3  2          T1       UPDATE      B       15        30       -
    4  None       T2       BEGIN       -       -         -        -
    5  4          T2       UPDATE      F       6         13       -
    6  5          T2       COMMIT      -       -         -        -
    7  None       None     CHECKPOINT  -       -         -        -
    8  None       T3       BEGIN       -       -         -        -
    9  8          T3       UPDATE      F       13        29       -
   10  9          T3       UPDATE      E       20        70       -
   11  10         T3       ABORT       -       -         -        -
   12  11         T3       CLR         E       70        20       9
   13  12         T3       CLR         F       29        13       8
   15  6          T2       END         -       -         -        -
   16  11         T3       END         -       -         -        -
   17  3          T1       CLR         B       30        15       2
   18  17         T1       CLR         C       15        10       1
   19  18         T1       CLR         A       15        5        0
   20  19         T1       ABORT       -       -         -        -

  MEMORY [Volatile]
  pageId    pageLSN    recLSN  data
--------  ---------  --------  ------------------
       1         19         1  {'A': 5, 'B': 15}
       2         18         2  {'C': 10, 'D': 6}
       3         13         5  {'E': 20, 'F': 13}

  DISK MEMORY [NON-Volatile]
  pageId    pageLSN    recLSN  data
--------  ---------  --------  ------------------
       1         19         1  {'A': 5, 'B': 15}
       2         18         2  {'C': 10, 'D': 6}
       3         13         5  {'E': 20, 'F': 13}

  Dirty Page Table(DPT)
PageId    recLSN
--------  --------

Active Transaction Table(ATT)
TransactionId    status    lastLSN
---------------  --------  ---------
#########################################################################################
```

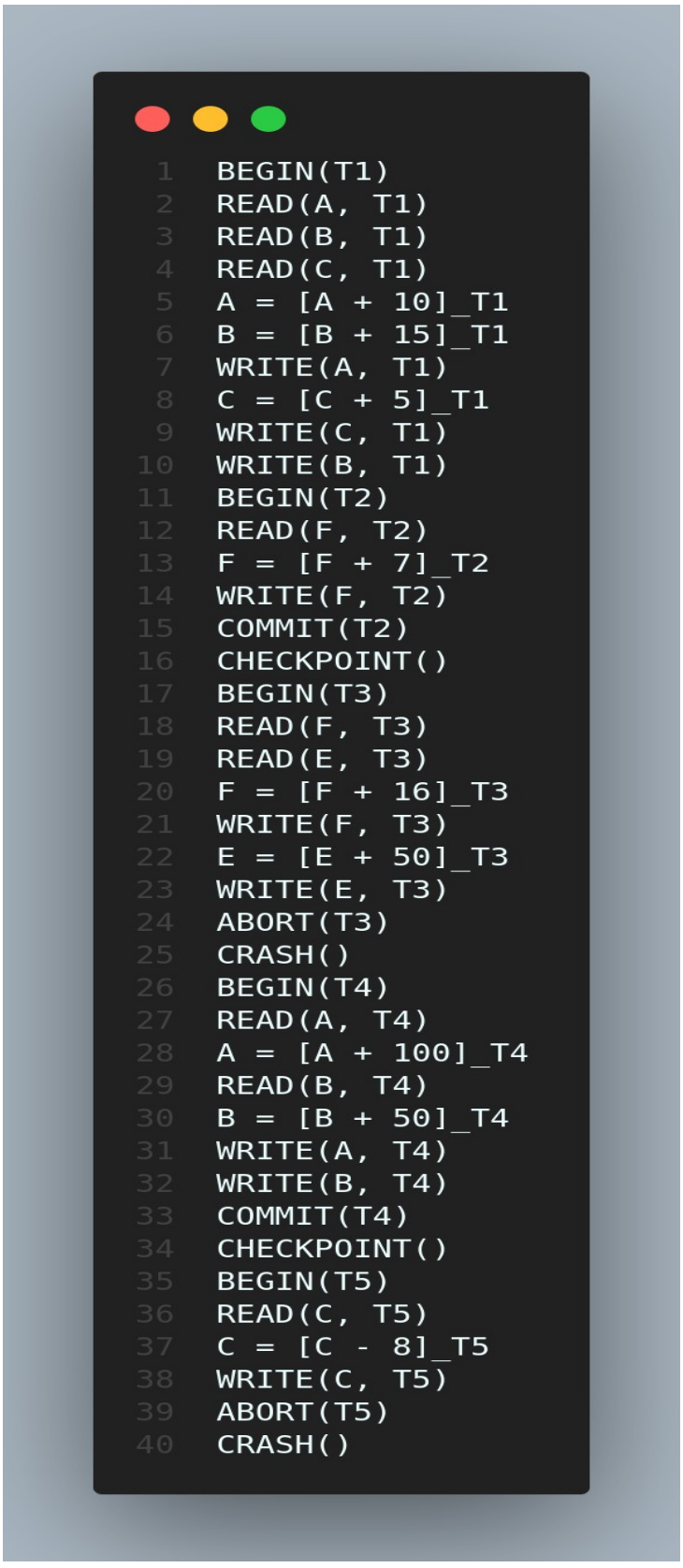
System Before 2nd Crash:

```
############################ SYSTEM STATE BEFORE CRASH ##############################
  Log Records[On MEMORY]
LSN    prevLSN    TxnId    type    data    before    after    undoNext
-----  ---------  -------  ------  ------  --------  -------  ----------

  Log Records[On DISK]
  LSN  prevLSN    TxnId    type        data    before    after    undoNext
-----  ---------  -------  ----------  ------  --------  -------  ----------
    0  None       T1       BEGIN       -       -         -        -
    1  0          T1       UPDATE      A       5         15       -
    2  1          T1       UPDATE      C       10        15       -
    3  2          T1       UPDATE      B       15        30       -
    4  None       T2       BEGIN       -       -         -        -
    5  4          T2       UPDATE      F       6         13       -
    6  5          T2       COMMIT      -       -         -        -
    7  None       None     CHECKPOINT  -       -         -        -
    8  None       T3       BEGIN       -       -         -        -
    9  8          T3       UPDATE      F       13        29       -
   10  9          T3       UPDATE      E       20        70       -
   11  10         T3       ABORT       -       -         -        -
   12  11         T3       CLR         E       70        20       9
   13  12         T3       CLR         F       29        13       8
   15  6          T2       END         -       -         -        -
   16  11         T3       END         -       -         -        -
   17  3          T1       CLR         B       30        15       2
   18  17         T1       CLR         C       15        10       1
   19  18         T1       CLR         A       15        5        0
   20  19         T1       ABORT       -       -         -        -
   21  20         T1       END         -       -         -        -
   22  None       T4       BEGIN       -       -         -        -
   23  22         T4       UPDATE      A       5         105      -
   24  23         T4       UPDATE      B       15        65       -
   25  24         T4       COMMIT      -       -         -        -
   26  None       None     CHECKPOINT  -       -         -        -
   27  None       T5       BEGIN       -       -         -        -
   28  27         T5       UPDATE      C       10        2        -
   29  28         T5       ABORT       -       -         -        -
   30  29         T5       CLR         C       2         10       27

  MEMORY [Volatile]
  pageId    pageLSN    recLSN  data
--------  ---------  --------  --------------------
       1         24         1  {'A': 105, 'B': 65}
       2         30         2  {'C': 10, 'D': 6}
       3         13         5  {'E': 20, 'F': 13}

  DISK MEMORY [NON-Volatile]
  pageId    pageLSN    recLSN  data
--------  ---------  --------  --------------------
       1         24         1  {'A': 105, 'B': 65}
       2         18         2  {'C': 10, 'D': 6}
       3         13         5  {'E': 20, 'F': 13}

  Dirty Page Table(DPT)
  PageId    recLSN
--------  --------
       1        23
       2        28

Active Transaction Table(ATT)
TransactionId    status      lastLSN
---------------  --------  ---------
T4               COMMIT           25
T5               ABORT            30
#####################################################################################
```

System After 2nd Recovery

```
############################ SYSTEM STATE AFTER RECOVERY ############################
  Log Records[On MEMORY]
  LSN    prevLSN  TxnId    type    data    before    after    undoNext
-----  ---------  -------  ------  ------  --------  -------  ----------
   32         25  T4       END     -       -         -        -
   33         29  T5       END     -       -         -        -

  Log Records[On DISK]
  LSN  prevLSN    TxnId    type        data    before    after    undoNext
-----  ---------  -------  ----------  ------  --------  -------  ----------
    0  None       T1       BEGIN       -       -         -        -
    1  0          T1       UPDATE      A       5         15       -
    2  1          T1       UPDATE      C       10        15       -
    3  2          T1       UPDATE      B       15        30       -
    4  None       T2       BEGIN       -       -         -        -
    5  4          T2       UPDATE      F       6         13       -
    6  5          T2       COMMIT      -       -         -        -
    7  None       None     CHECKPOINT  -       -         -        -
    8  None       T3       BEGIN       -       -         -        -
    9  8          T3       UPDATE      F       13        29       -
   10  9          T3       UPDATE      E       20        70       -
   11  10         T3       ABORT       -       -         -        -
   12  11         T3       CLR         E       70        20       9
   13  12         T3       CLR         F       29        13       8
   15  6          T2       END         -       -         -        -
   16  11         T3       END         -       -         -        -
   17  3          T1       CLR         B       30        15       2
   18  17         T1       CLR         C       15        10       1
   19  18         T1       CLR         A       15        5        0
   20  19         T1       ABORT       -       -         -        -
   21  20         T1       END         -       -         -        -
   22  None       T4       BEGIN       -       -         -        -
   23  22         T4       UPDATE      A       5         105      -
   24  23         T4       UPDATE      B       15        65       -
   25  24         T4       COMMIT      -       -         -        -
   26  None       None     CHECKPOINT  -       -         -        -
   27  None       T5       BEGIN       -       -         -        -
   28  27         T5       UPDATE      C       10        2        -
   29  28         T5       ABORT       -       -         -        -
   30  29         T5       CLR         C       2         10       27

  MEMORY [Volatile]
  pageId    pageLSN    recLSN  data
--------  ---------  --------  --------------------
       1         24         1  {'A': 105, 'B': 65}
       2         30         2  {'C': 10, 'D': 6}

  DISK MEMORY [NON-Volatile]
  pageId    pageLSN    recLSN  data
--------  ---------  --------  --------------------
       1         24         1  {'A': 105, 'B': 65}
       2         18         2  {'C': 10, 'D': 6}
       3         13         5  {'E': 20, 'F': 13}

  Dirty Page Table(DPT)
  PageId    recLSN
--------  --------
       1        23
       2        28

Active Transaction Table(ATT)
TransactionId    status    lastLSN
---------------  --------  ---------
################################################################################
```

Input Schedule:



```
BEGIN(T1)
READ(A, T1)
READ(B, T1)
READ(C, T1)
A = [A + 10]_T1
B = [B + 15]_T1
WRITE(A, T1)
C = [C + 5]_T1
WRITE(C, T1)
WRITE(B, T1)
BEGIN(T2)
READ(F, T2)
F = [F + 7]_T2
WRITE(F, T2)
COMMIT(T2)
CHECKPOINT()
BEGIN(T3)
READ(F, T3)
READ(E, T3)
F = [F + 16]_T3
WRITE(F, T3)
E = [E + 50]_T3
WRITE(E, T3)
ABORT(T3)
CRASH()
BEGIN(T4)
READ(A, T4)
A = [A + 100]_T4
READ(B, T4)
B = [B + 50]_T4
WRITE(A, T4)
WRITE(B, T4)
COMMIT(T4)
CHECKPOINT()
BEGIN(T5)
READ(C, T5)
C = [C - 8]_T5
WRITE(C, T5)
ABORT(T5)
CRASH()
```