

PBMS has

- data, and
- algorithms

for bringing the 2ndary-storage
data back to consistency

= without any knowledge of
the constraints involved

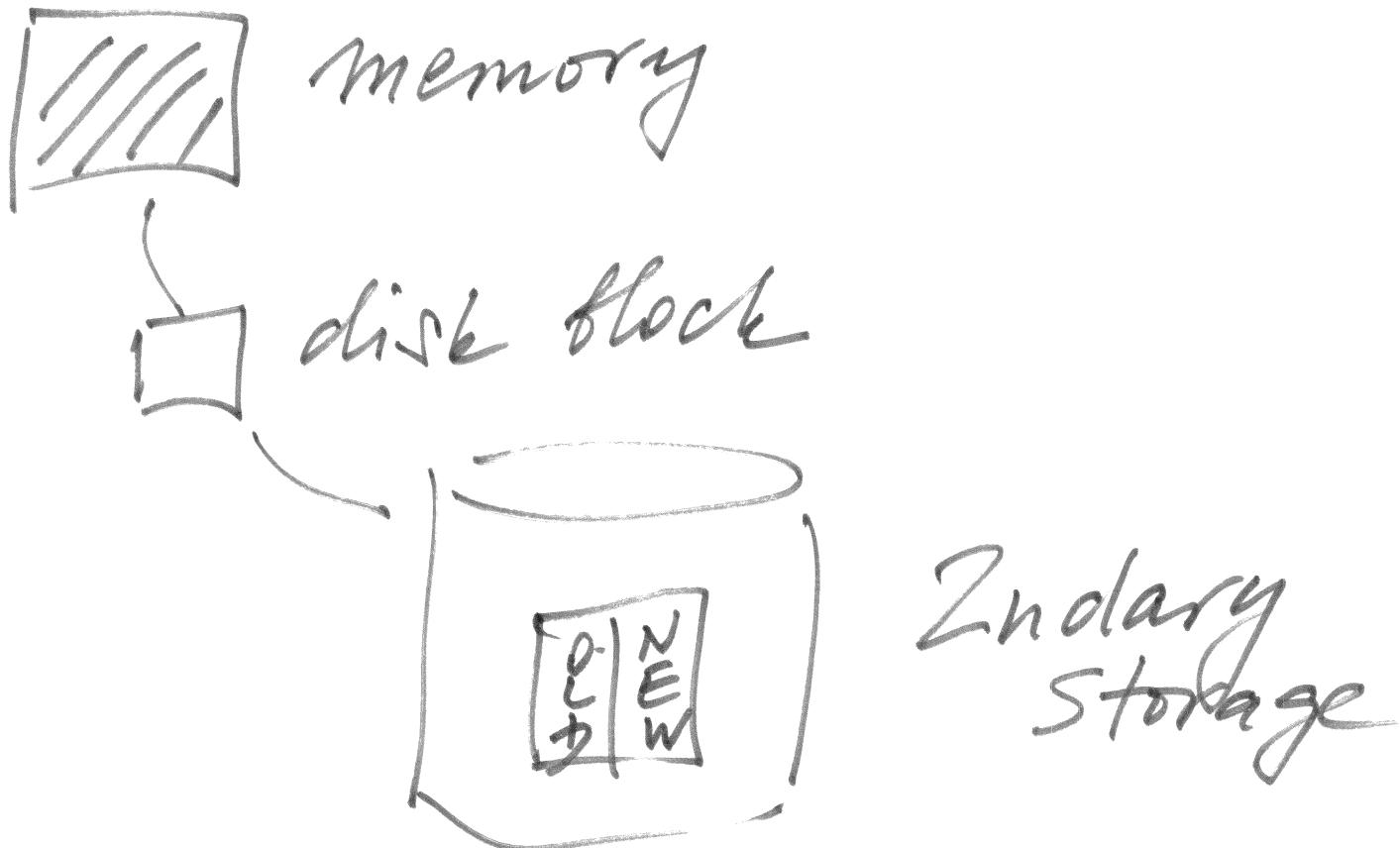
= and (for coping with system
failures) by

~ logging

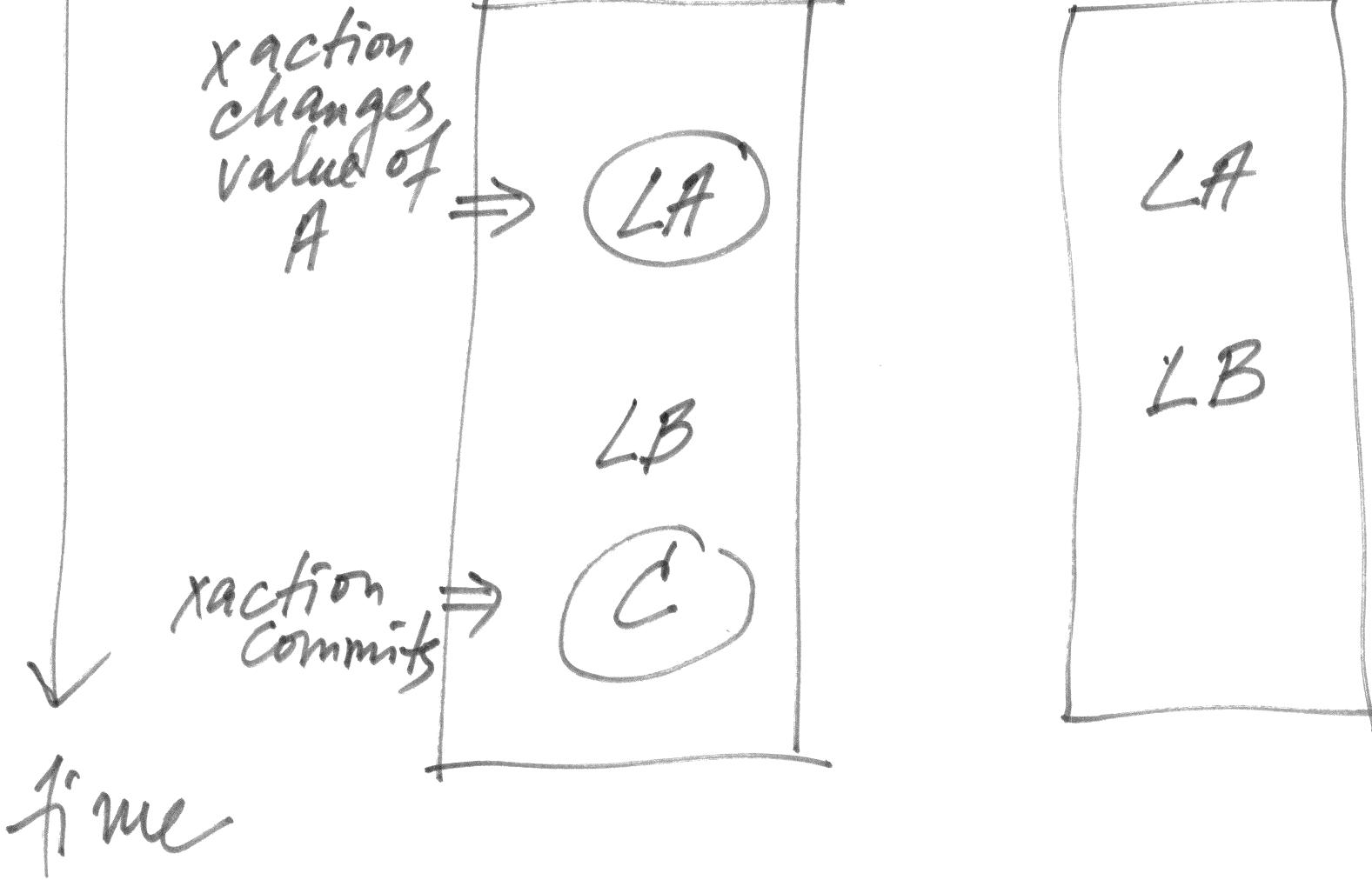
~ recovery after the
failures



Partial exec of reaction



log space on disk



Checkpointing:
goal - to reduce work
done
in recovery



Uncommitted actions:
S

Committed actions:

$U, T =$



$\langle \text{START } S \rangle$
 $\langle S, A, 1, 2 \rangle$ 3. output(A, 1)
 $\langle S, B, 2, 3 \rangle$ 2. output(B, 2)
 $\langle \text{START } T \rangle$
 $\langle T, C, 4, 5 \rangle$ 4. output(C, 5)
 $\langle \text{COMMIT } T \rangle$
 $\langle \text{START } U \rangle$
 $\langle U, G, 11, 14 \rangle$ 5. output(G, 14)
 $\langle U, D, 6, 7 \rangle$ 6. output(D, 7)
 $\langle S, F, 8, 9 \rangle$ 1. output(F, 8)
 $\langle \text{COMMIT } U \rangle$

(1) What are the ^{disk} values of A B C D F G after sys crash before recovery?

(2) What are the disk values of A B C D F G after undo/redo recovery?

(1) A = 1 or 2
 B = 2 or 3
 C = 4 or 5
 D = 6 or 7
 F = 8 or 9
 G = 11 or 14

(2) To BE
 CONTINUED
 - See previous note



Nonquiescent checkpoint rules (undo/redo)

1. Write to log

<START CKPT (^{active}
_{xactions})>
— then flush log

2. Write to disk **all** dirty buffers
= do all the outstanding
output operations

3. Flush <end ckpt> record



1. <START ~~A~~ T1>
2. <T1, A, 4, 5>
3. <START T2>
4. <COMMIT T1>
5. <T2, B, 9, 10>
6. <START CKPT (T2)> []
7. <T2, C, 14, 15> []
8. <START T3>
9. <T3, D, 19, 20>
10. <END CKPT> []
11. <COMMIT T3>
12. <COMMIT T2>]



Values before recovery

1. $\rightarrow A = 4, B = 9, C = 14, D = 19$
2. $\rightarrow A = 4 \text{ or } 5, \text{others same}$
- 3.
- 4.
5. $\rightarrow A = 4 \text{ or } 5, B = 9 \text{ or } 10, \text{others same}$
6. The dirty buffers are for A and B only
7. $\rightarrow A = 4 \text{ or } 5, B = 9 \text{ or } 10, C = 14 \text{ or } 15, D = 19$
- 8.
9. $\rightarrow A = 4 \text{ or } 5, B = 9 \text{ or } 10, C = 14 \text{ or } 15, D = 19 \text{ or } 20$
10. $\rightarrow \text{Output}(A, 5)$ and $\text{Output}(B, 10)$ must have happened by now
11. $\rightarrow A = 5, B = 10, C = 14 \text{ or } 15, D = 19 \text{ or } 20$
12. **answer**



Recovery : Line 12 not present in log

Uncommitted
xactions:

T2

T3

[3.] ⁽³⁾ (found "start T2" \Rightarrow done with backlog pass)

[5.] (2) Output(B, 9)

[6.] (4) Start redo pass

[7.] (1) Output(C, 14)

Committed
xactions:

[9]. (5) Output(D, 20)



Assuming that

12. <COMMIT T2>

- (15) in the log
 - submit the recovery process with nonquiescentckpt

By email by the end of day
Sunday April 12



Concurrency
control:
assume that all
individual actions
are correct

