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Carnegie Mellon Univ.
Dept. of Computer Science
15-415 - Database Applications

Lecture #22PLUS: Concurrency Control
Part 2 (R&G ch. 17)

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Outline

- Q1: Which order to release locks in multiple-granularity locking?
  - A1: bottom up
- Q2: Which order to release locks in tree-locking?
  - A2: top down (to max concurrency)
- Details on tree locking, for hw10

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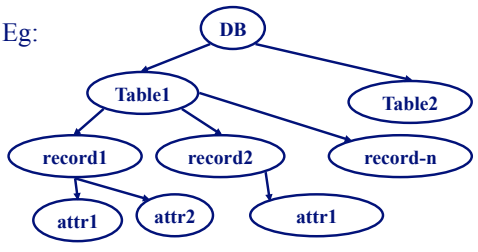
Multiple granularity

- Eg:



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Multiple Granularity Lock Protocol

- Each Xact: lock root.
- To get S or IS lock on a node, must hold **at least** IS on parent node.
  - What if Xact holds SIX on parent? S on parent?
- To get X or IX or SIX on a node, must hold **at least** IX on parent node.
- Must release locks in bottom-up order.

Faloutsos SCS 15-415 **Originally, page 18**

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Outline

- Q1: Which order to release locks in multiple-granularity locking?
  - A1: bottom up
- Q2: Which order to release locks in tree-locking?
  - A2: as early as possible (to max concurrency)
- Details on tree locking

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A Simple Tree Locking Algorithm: "crabbing"

- Search: Start at root and go down; repeatedly,
  - S lock child
  - then unlock parent
- Insert/Delete: Start at root and go down, obtaining X locks as needed. Once child is locked, check if it is safe:
  - If child is safe, release all locks on ancestors.

Faloutsos SCS 15-415 **Original page 36**

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Use for hw10

- The algo before (original page #36)
  - No 'gambling' of [Bayer, Schkolnick]
  - No lock upgrades and no deadlocks
  - Ignore the update of sibling pointers
- Next examples: repeats of examples in original lecture, with more details

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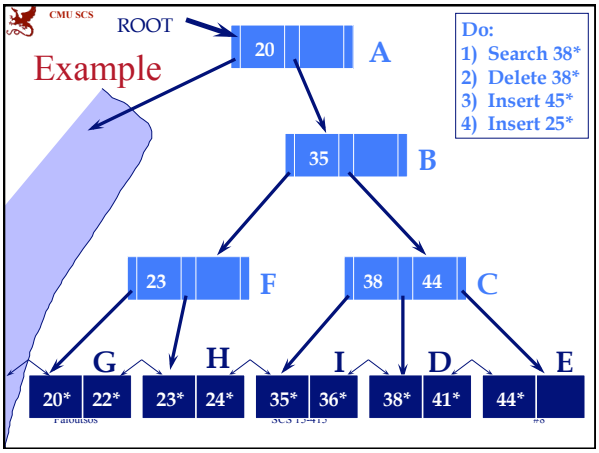
Example



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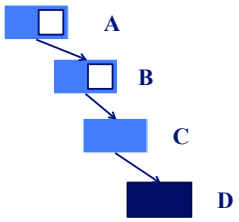
Answer: search 38*



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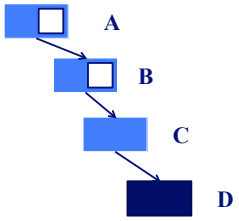
Answer: search 38*

S A
S B
U A
S C
U B
S D
U C
<read 38*>
U D



Faloutsos SCS 15-415 #10

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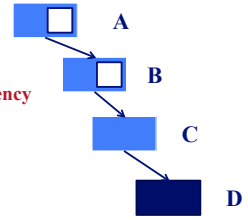
Answer: delete 38*

← max concurrency



Faloutsos SCS 15-415 #11

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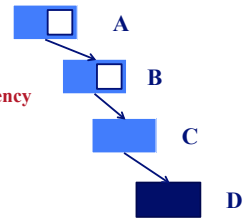
Answer: delete 38*

X A
X B
X C
U A ← max concurrency
U B
X D
U C
<delete 38*>
U D



Faloutsos SCS 15-415 #12

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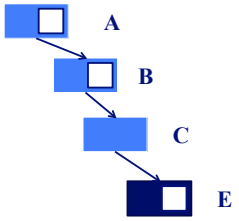
Answer: insert 45*



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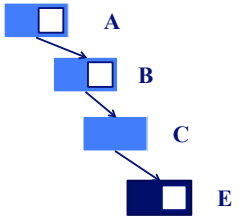
Answer: insert 45*

X A
X B
U A
X C
X E
U B
U C
<insert 45* >
U E



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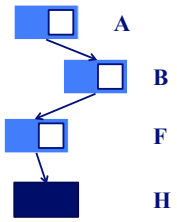
Answer: insert 25*



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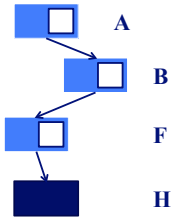
Answer: insert 25*

X A
X B
U A
X F
U B
X H
<insert 25*>
<split H>
<update F>
U F
U H



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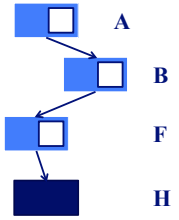
Answer: insert 25*

X A
X B
U A
X F
U B
X H
<insert 25*>
<split H>
<update F>
U H
U F



Q: Why not swap?

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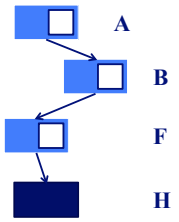
Answer: insert 25*

X A
X B
U A
X F
U B
X H
<insert 25*>
<split H>
<update F>
U H
U F



Q: Why not swap?

A: swapping does not help concurrency!