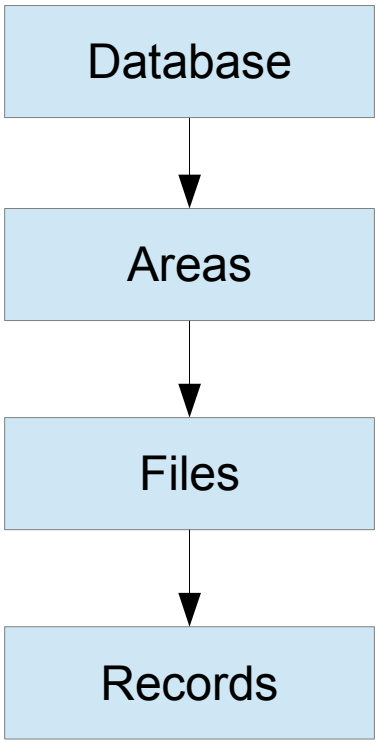
CS 640
Principles of Database Management and Use
Winter 2013

Today: Discussion about Concurrency Control

J.Gray, R.A.Lorie, G.R.Putzolu, and I.L.Traiger: Granularity of Locks and Degrees of Consistency in a Shared Data Base. *IFIP Conference on Modelling in DBMSs 1976*.

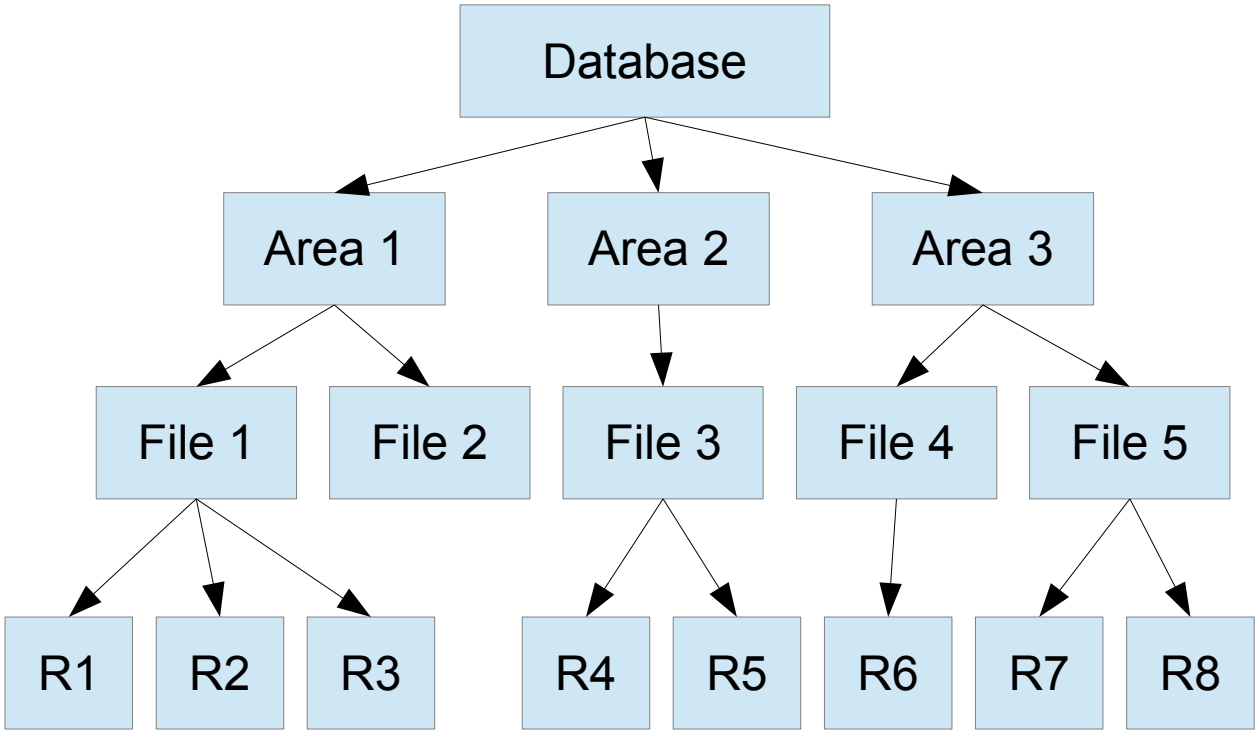
Keep in Mind:

A *lock hierarchy* such as this:

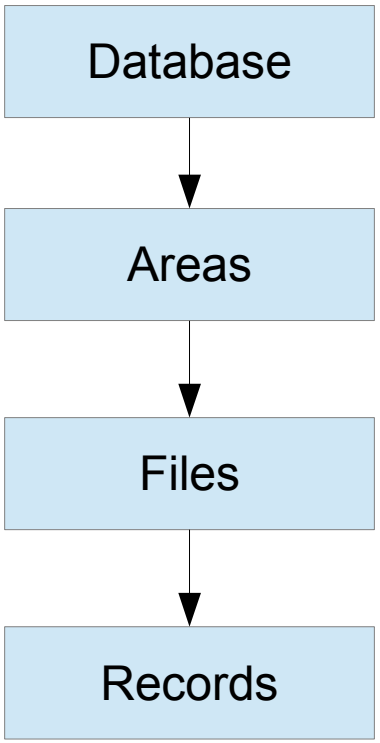


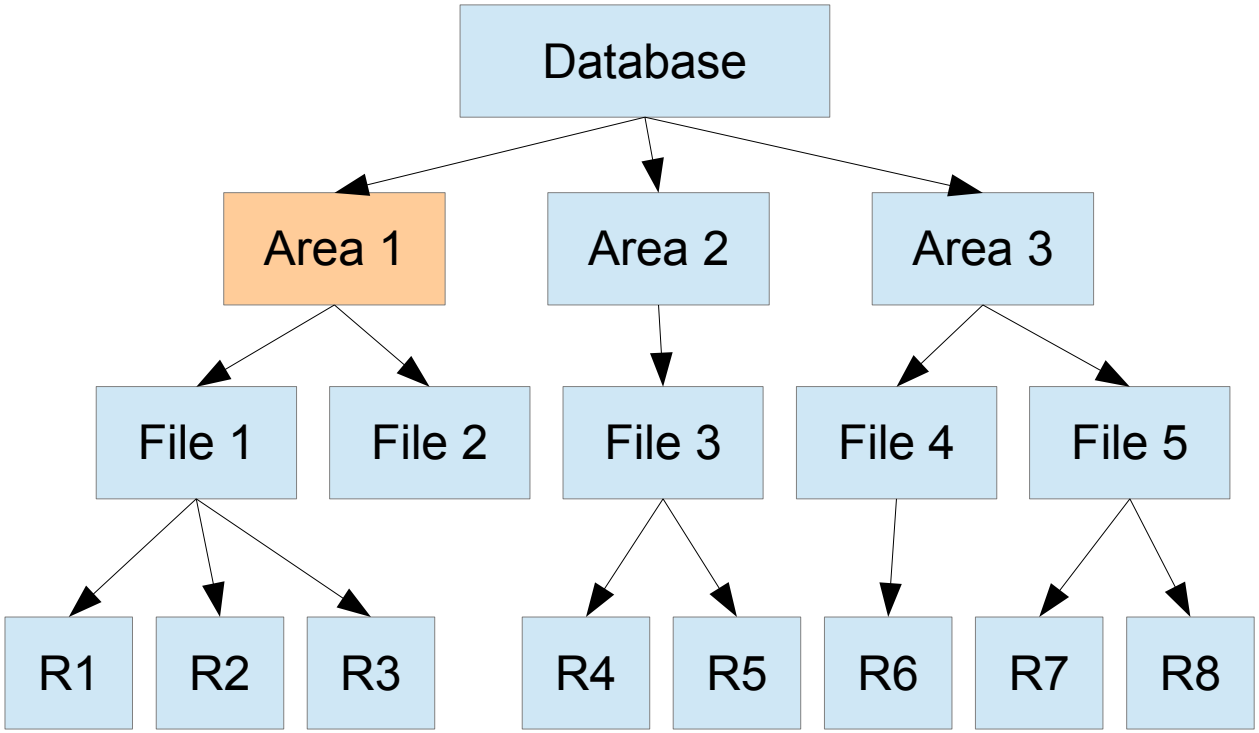
represents

… an actual organization of DB objects such as this:

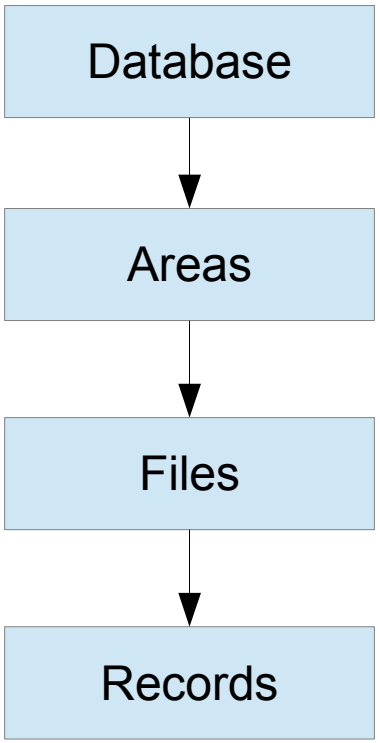


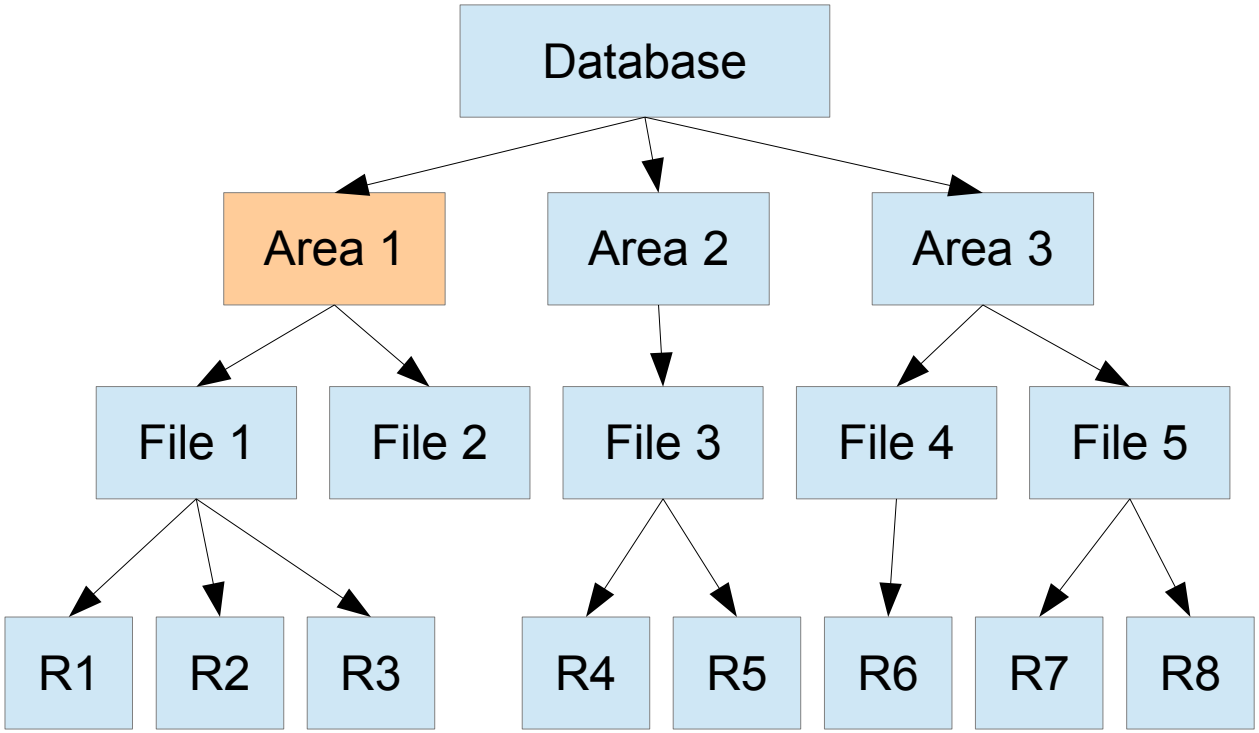
What does a *share lock* on Area 1 mean?



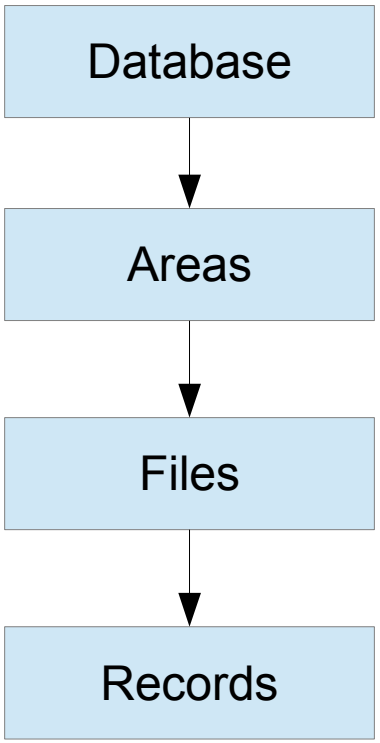


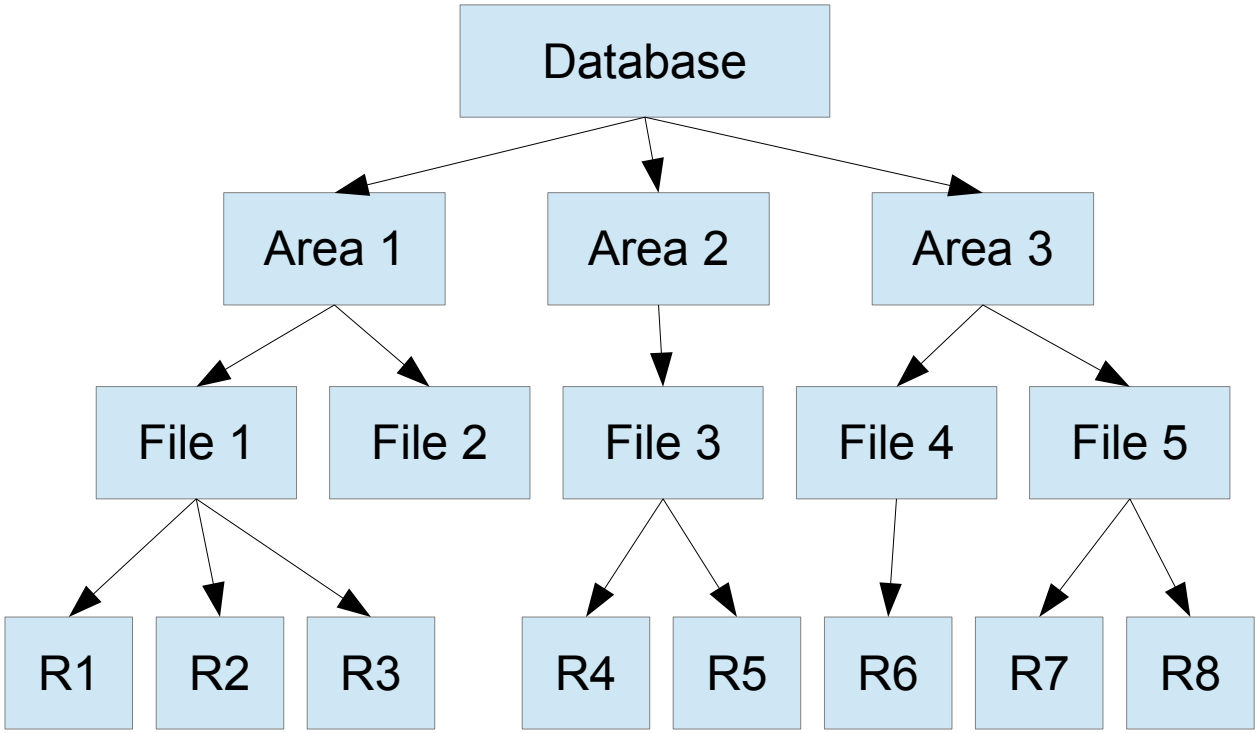
What does an *exclusive lock* on Area 1 mean?



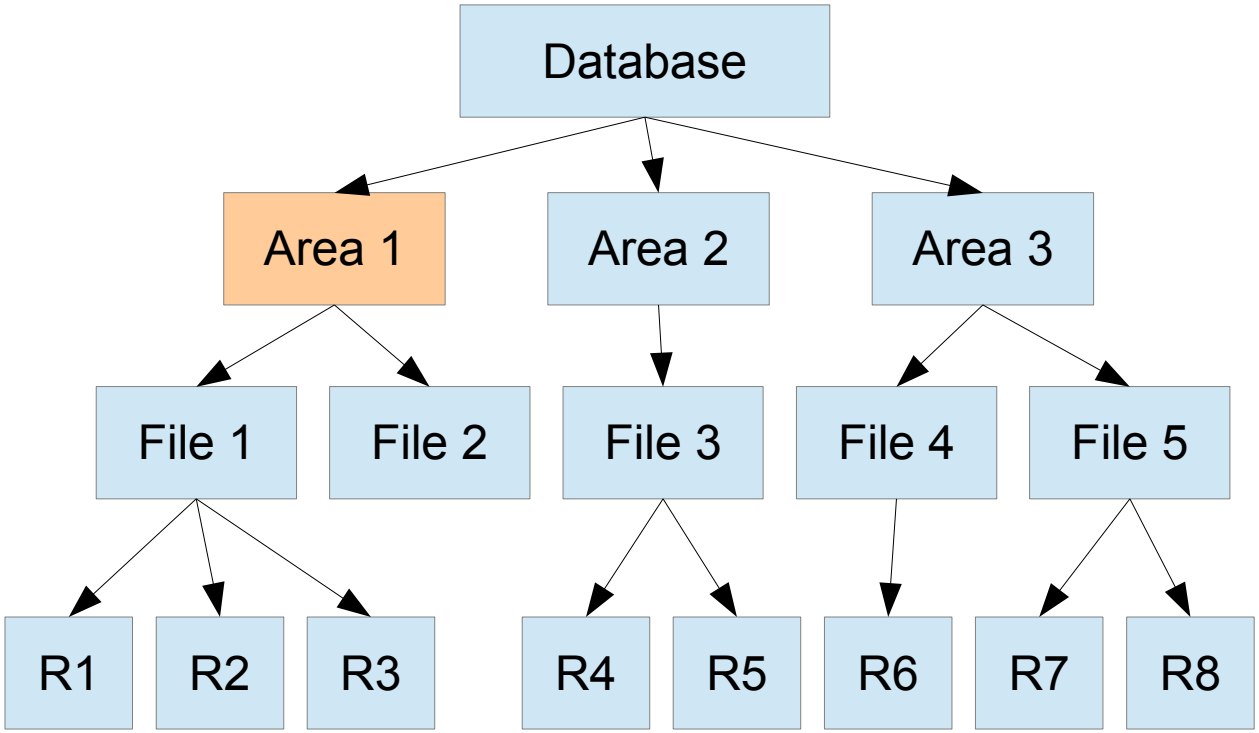


Why do Gray et al. (need to) introduce *intention locks*?

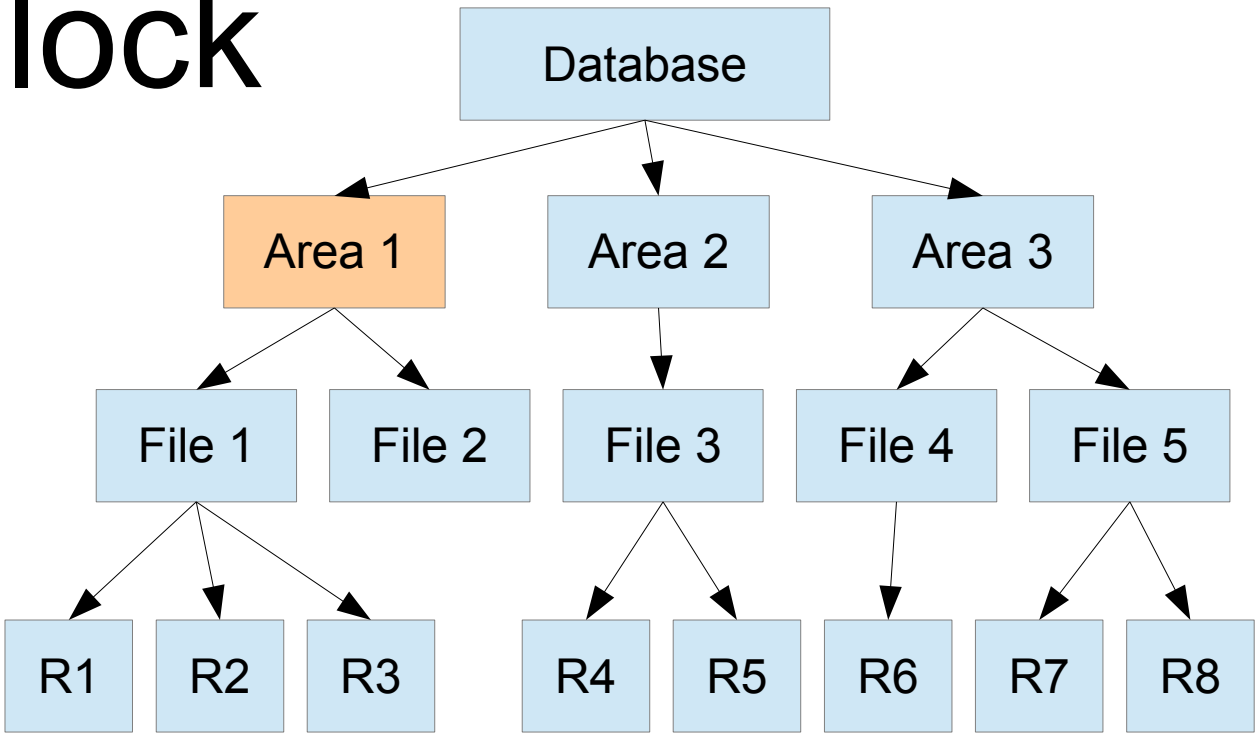




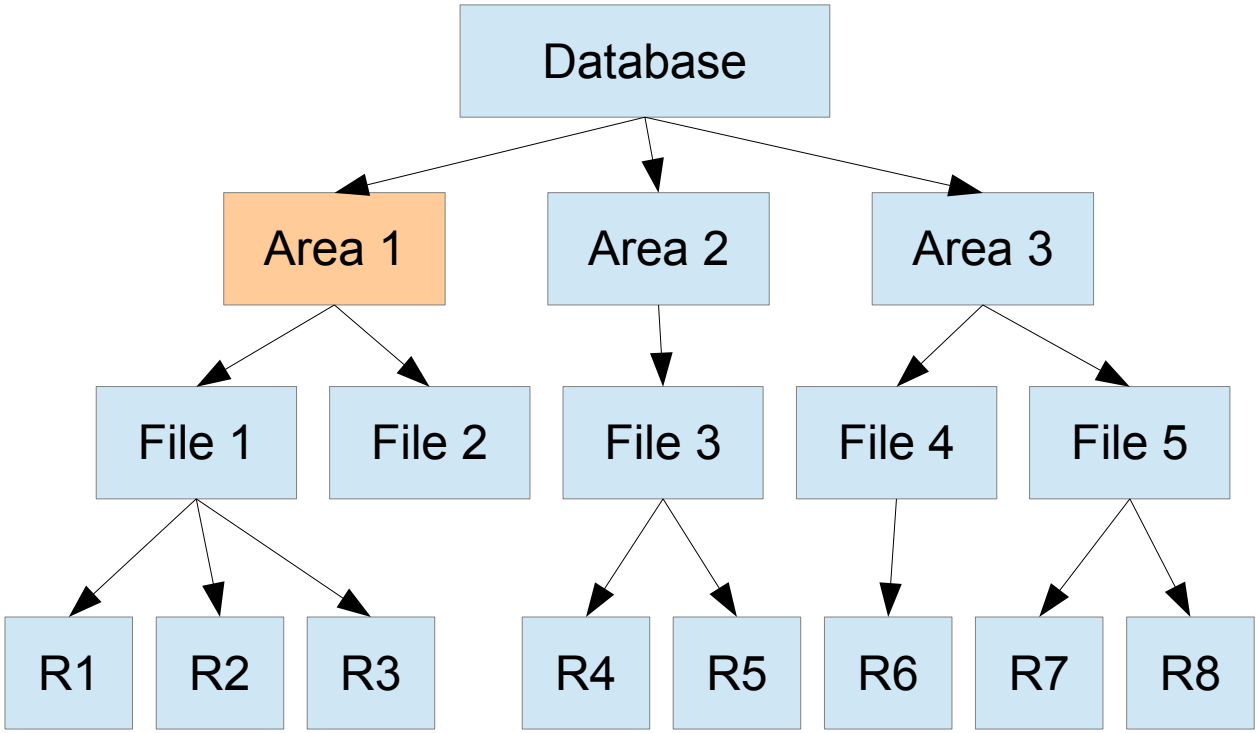
What does an IX lock on Area 1 mean?



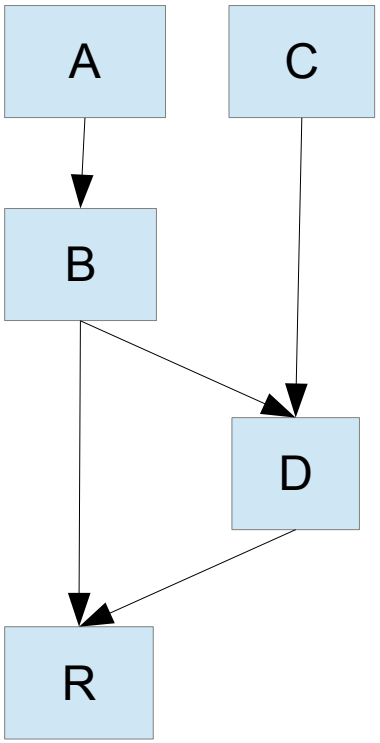
What conditions need to be satisfied to grant such an IX lock on Area 1?



What does a SIX lock on Area 1 mean?

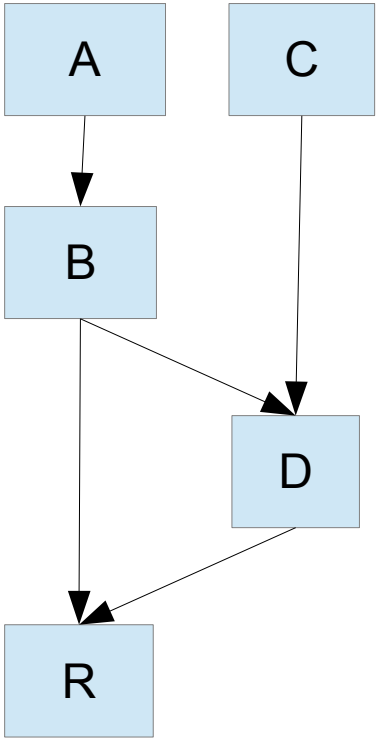


Assume a *lock hierarchy* such as this:



Which locks do you need to obtain if you want to *read* a particular R?

Assume a *lock hierarchy* such as this:



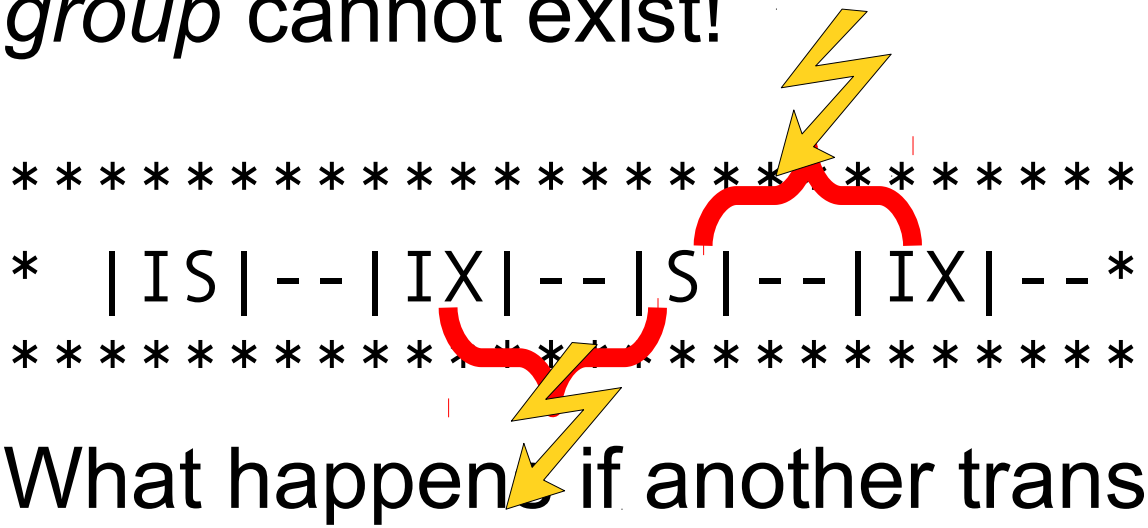
Which locks do you need to obtain if you want to *write* a particular R?

Assume a *granted group* such as this:

```
**************************
* |IS|--|IX|--|S|--|IX|--*
**************************
```

What happens if another transaction, e.g., T1, requests an IS lock; may this be immediately granted (and, thus, added to the group)?

Okay, you hopefully figured that such a *granted group* cannot exist!



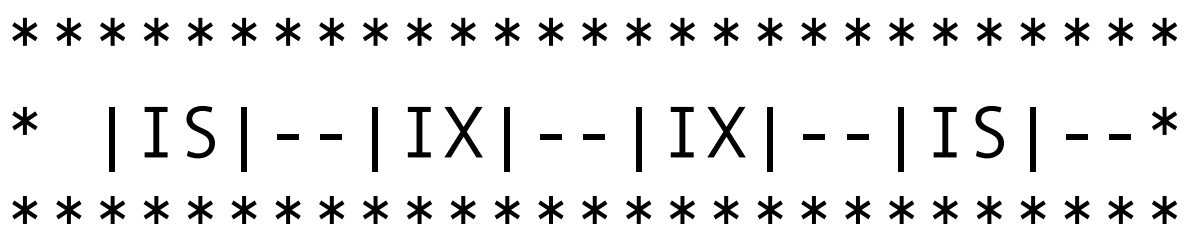
What happens if another transaction, e.g., T1, requests an IS lock; may this be immediately granted (and, thus, added to the group)?

Assume a *granted group* such as this:

```
**********************
* |IS|--|IX|--|IX|--*
**********************
```

What happens if another transaction, e.g., T1, requests an IS lock; may this be immediately granted (and, thus, added to the group)?

Assume a *granted group* such as this:

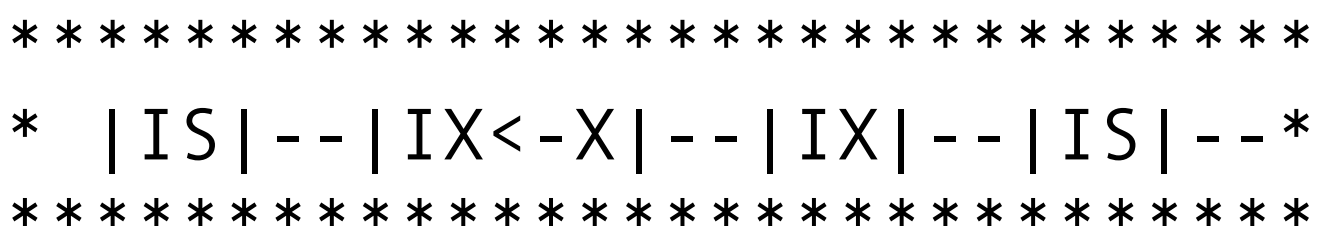


Assume a *granted group* such as this:

```
**************************
* |IS|--|IX|--|IX|--|IS|--*
**************************
```

Now assume the transaction who holds the first IX lock in the group wants to upgrade its lock to an X lock (i.e., a *conversion*). What happens?

Assume a *granted group* such as this:

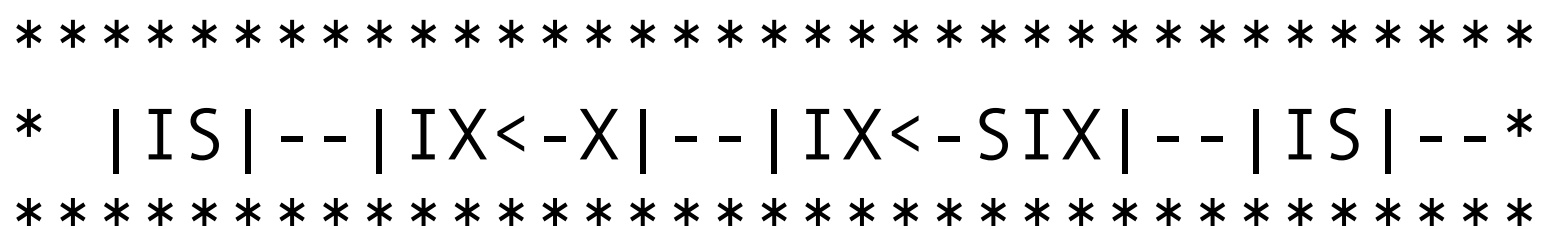


Assume a *granted group* such as this:

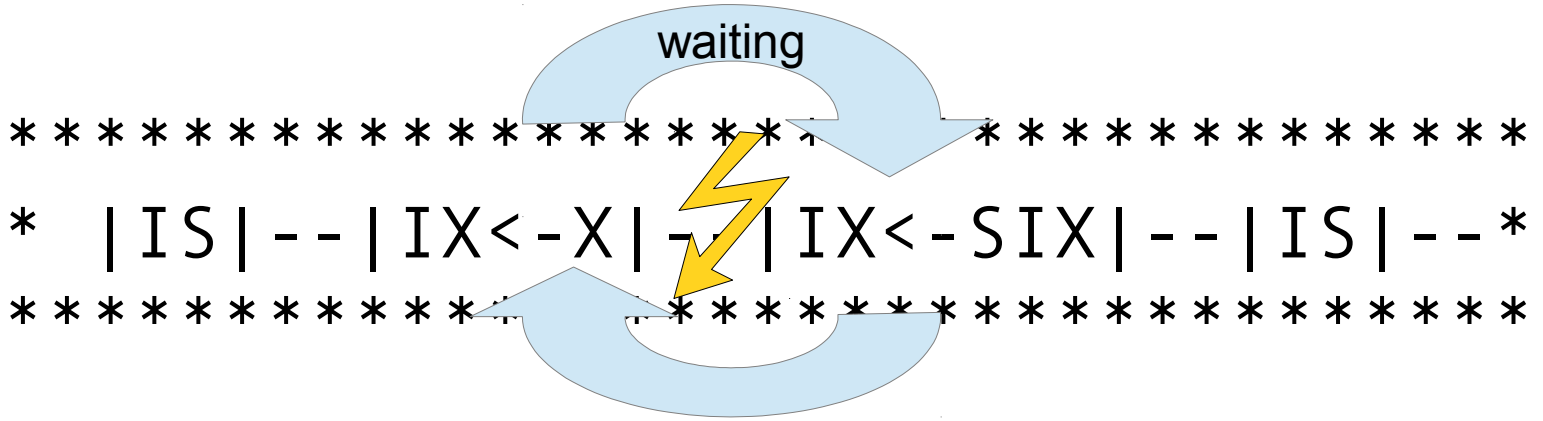
```
**************************************
* |IS|--|IX<-X|--|IX|--|IS|--*
**************************************
```

Ouch! The transaction who holds the second IX lock additionally requests an S lock. What happens?

Assume a *granted group* such as this:



Assume a *granted group* such as this:



… a deadlock!

Assume a schedule such as this:

Is it possible (w.r.t. locking)?

Which degree of consistency is it?

```
T1  WLOCK  A
T1  READ  A
T2  RLOCK  B
T1  WRITE  A
T3  WLOCK  C
T1  RLOCK  B
T1  UNLOCK  A
T3  WRITE  C
T3  UNLOCK  C
T1  WLOCK  C
T1  READ C
T1  UNLOCK  B
T1  WRITE  C
T2  READ  B
T2  WLOCK  A
T2  WRITE  A
T2  UNLOCK  B
T2  UNLOCK  A
T1  UNLOCK  C
```