Merging merges, more or less

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Tables on disk

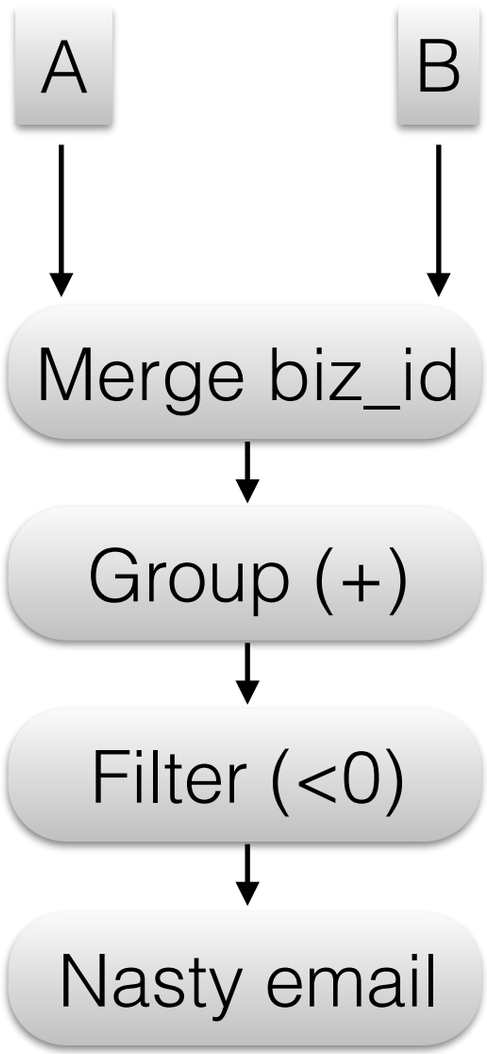
- A(ccount): { biz_id ASC, acct_id, amount }
- B(usiness): { biz_id ASC, name }
- C(ar): { biz_id ASC }

Arrears

```
SELECT B.* FROM business B

    INNER JOIN account  A
        ON B.biz_id = A.biz_id

  HAVING SUM(A.amount) < 0

GROUP BY B.biz_id, B.name
```

Arrears

Query plan

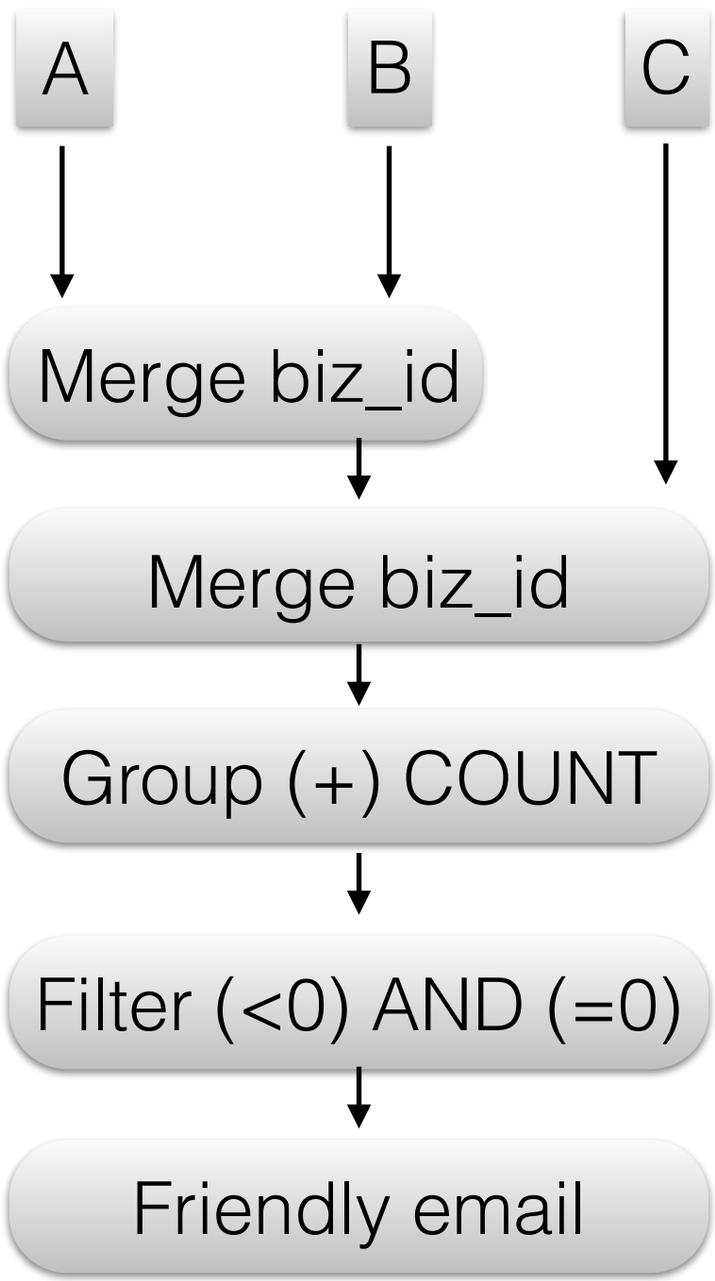


Offer loans

```
SELECT B.* FROM business B

    INNER JOIN account  A ON...
INNER JOIN car      C ON...

    HAVING SUM(A.amount) > 0

      AND COUNT(C) = 0
```

Offer loans

Query plan



Combinators

Merge

	Ak < Bk	Ak = Bk	Ak > Bk
Move	A /\ ¬B	A /\ B	¬A /\ B
Output	(Ak,Av,Bv)		

$A \rightarrow \Diamond B$ $B \rightarrow \Diamond A$

Plus-merge

	Ak < Bk	Ak = Bk	Ak > Bk
Move	A /\ ¬B	AB	¬A /\ B
Output	(Ak, Av)	(Ak, Av + Bv)	(Bk, Bv)

A → ◊B

B → ◊A

Zip

True	
Move	$A \wedge B$
Output	(A,B)

Append

	|A| > 0	|A| = 0 & |B| > 0
Move	A /\ ¬ B	¬A /\ B
Output	A	B

$$A \rightarrow \Diamond B$$

Fusion

What can we fuse?

Lemmas

A → ◊B

B → ◊A

B → ◊C

C → ◊B

What can we fuse?

	A < B	A = B	A > B
B < C			
B = C			
B > C			

merge A B

	A < B	A = B	A > B
	A ¬B	A B	¬A B

Lemmas

A → ◊B

B → ◊A

B → ◊C

C → ◊B

merge B C

B < C	B ¬C
B = C	B C
B > C	¬B C

What can we fuse?

	A < B	**A = B**	**A > B**
B < C	$A < B \land B < C \rightarrow (A \neg B) \land (B \neg C)$		
B = C			
B > C			

merge A B

	A < B	**A = B**	**A > B**
	A ¬B	A B	¬A B

Lemmas

$A \rightarrow \Diamond B$

$B \rightarrow \Diamond A$

$B \rightarrow \Diamond C$

$C \rightarrow \Diamond B$

merge B C

B < C	B ¬C
B = C	B C
B > C	¬B C

What can we fuse?

	A < B	A = B	A > B
B < C	A		
B = C			
B > C			

merge A B

	A < B	A = B	A > B
	A ¬B	A B	¬A B

Lemmas

$A \rightarrow \Diamond B$

$B \rightarrow \Diamond A$

$B \rightarrow \Diamond C$

$C \rightarrow \Diamond B$

merge B C

B < C	B ¬C
B = C	B C
B > C	¬B C

What can we fuse?

	A < B	A = B	A > B
B < C	A	A=B ∧ B<C → (AB) ∧ (B¬C)	
B = C			
B > C			

merge A B

	A < B	A = B	A > B
	A ¬B	A B	¬A B

Lemmas

A → ◊B

B → ◊A

B → ◊C

C → ◊B

merge B C

B < C	B ¬C
B = C	B C
B > C	¬B C

What can we fuse?

	A < B	A = B	A > B
B < C	A	AB	B
B = C	A	ABC	BC
B > C	AC	C	C

merge A B

	A < B	A = B	A > B
	A ¬B	A B	¬A B

Lemmas

$A \rightarrow \Diamond B$

$B \rightarrow \Diamond A$

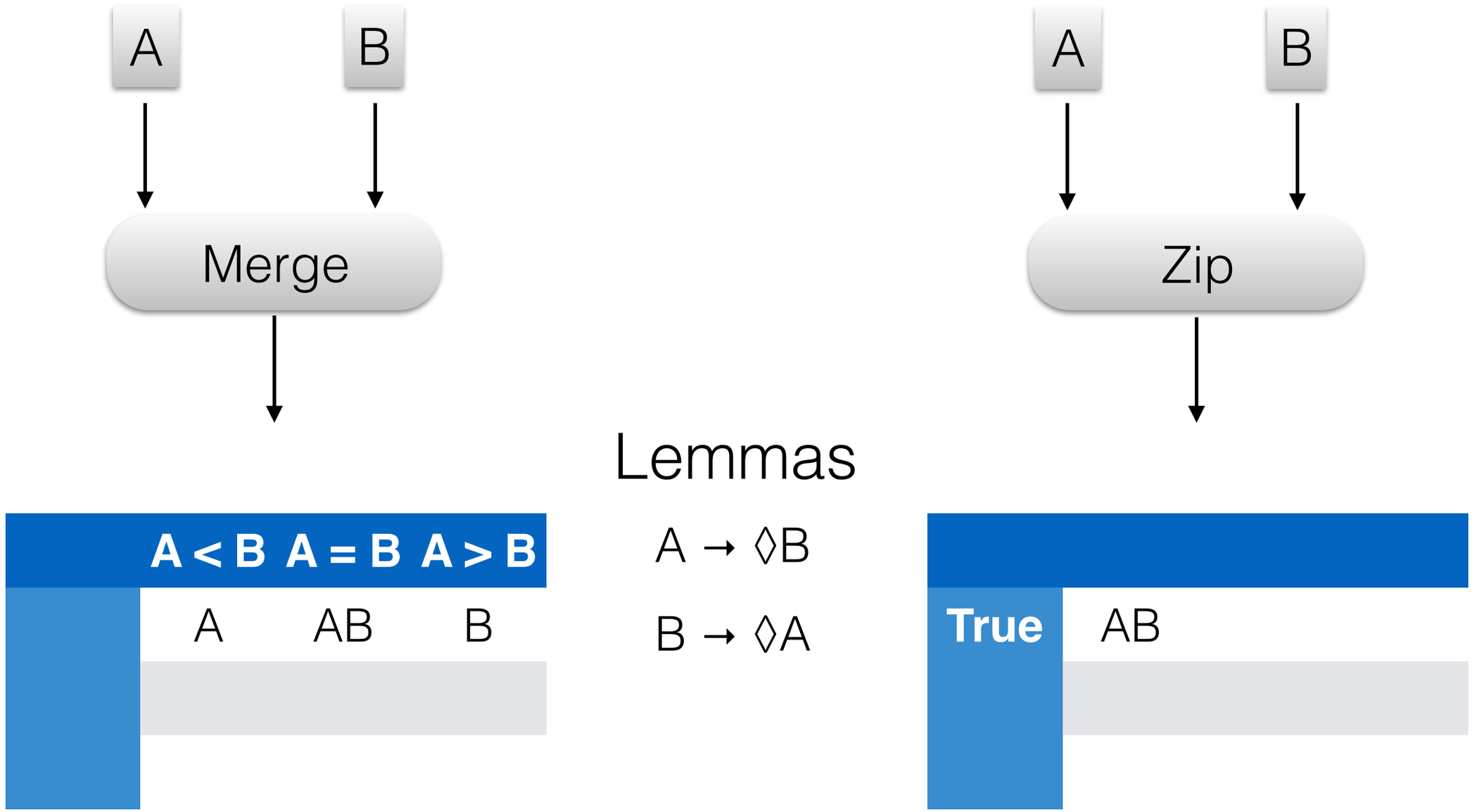
$B \rightarrow \Diamond C$

$C \rightarrow \Diamond B$

merge B C

B < C	B ¬C
B = C	B C
B > C	¬B C

What *can't* we fuse?



What *can't* we fuse?

	A < B	A = B	A > B
True	A < B => (A¬B) /\ (AB)		

merge A B

	A < B	A = B	A > B
	A	AB	B

Lemmas

A → ◊B

B → ◊A

zip A B

True	AB

What *can't* we fuse?

	A < B	A = B	A > B
True	B ∧ ¬B		

merge A B

	A < B	A = B	A > B
	A	AB	B

Lemmas

$A \rightarrow \Diamond B$

$B \rightarrow \Diamond A$

zip A B

True	AB

Thanks

I’d love to know about related work