```
rails db:migrate:safely
```

HI, I'M MATT.

MATT DUSZYNSKI

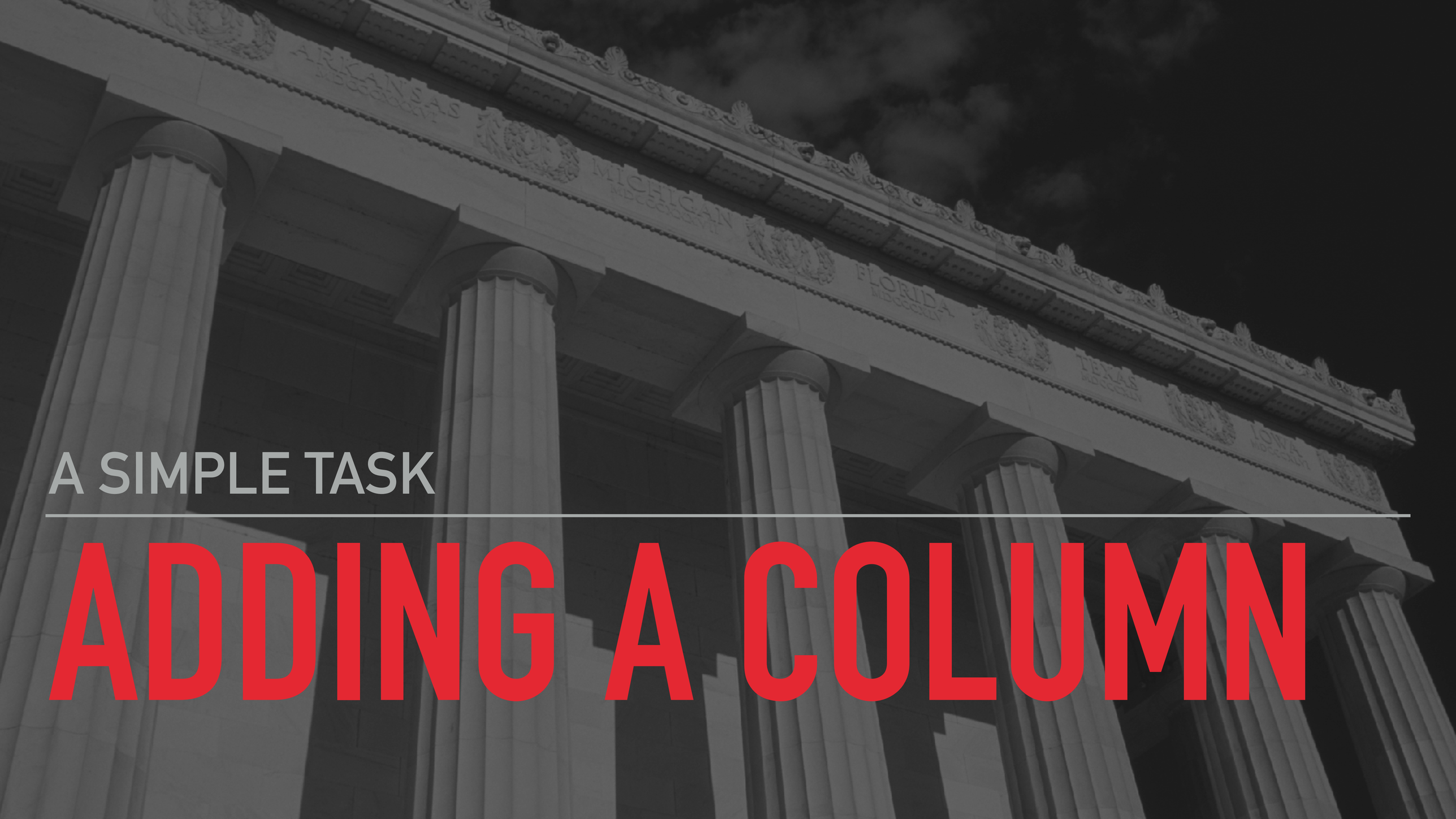
@BSDZUNK

GITHUB.COM/DZUNK


wm®

50 Million Records

50 Records



A SIMPLE TASK

ADDING A COLUMN

ADDING A COLUMN

```
class AddActiveToUsers < ActiveRecord::Migration[5.2]
  def change
    add_column :users, :active, :boolean, default: true
  end
end
```

UNDER THE HOOD

LOCKS

LOCKS

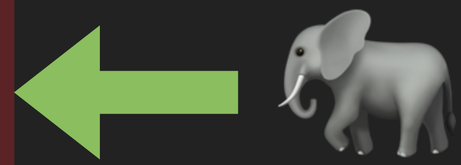
- Locks are a mechanism for ensuring multiple operations don't update the same row at the same time.
- There are 8 different lock modes, ranging from `ACCESS SHARE` (anyone can read and write data) to `ACCESS EXCLUSIVE` (no one else is permitted to read data).
- Certain database migrations will obtain an `ACCESS EXCLUSIVE` lock, and prevent the rest of your application from reading data until the migration completes.

id	username	email
1	alice	alice@example.com
2	bob	bob@example.com
3	charlie	charlie@foo.org
4	doug	doug@bar.net

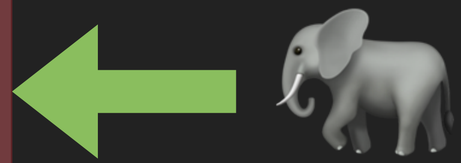
id	username	email
1	alice	alice@example.com
2	bob	bob@example.com
3	charlie	charlie@foo.org
4	doug	doug@bar.net

id	username	email	active
1	alice	alice@example.com	
2	bob	bob@example.com	
3	charlie	charlie@foo.org	
4	doug	doug@bar.net	

id	username	email	active
1	alice	alice@example.com	true
2	bob	bob@example.com	
3	charlie	charlie@foo.org	
4	doug	doug@bar.net	



id	username	email	active
1	alice	alice@example.com	true
2	bob	bob@example.com	true
3	charlie	charlie@foo.org	
4	doug	doug@bar.net	



id	username	email	active
1	alice	alice@example.com	true
2	bob	bob@example.com	true
3	charlie	charlie@foo.org	
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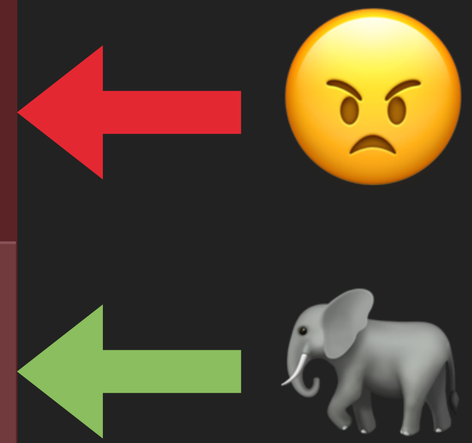
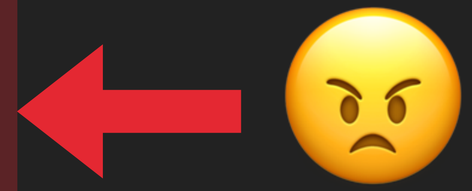
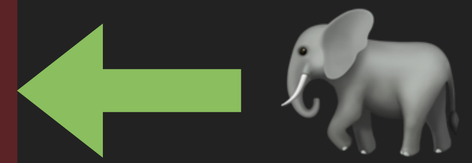


id	username	email	active
1	alice	alice@example.com	true
2	bob	bob@example.com	true
3	charlie	charlie@foo.org	true
4	doug	doug@bar.net	





id	username	email	active
1	alice	alice@example.com	true
2	bob	bob@example.com	true
3	charlie	charlie@foo.org	true
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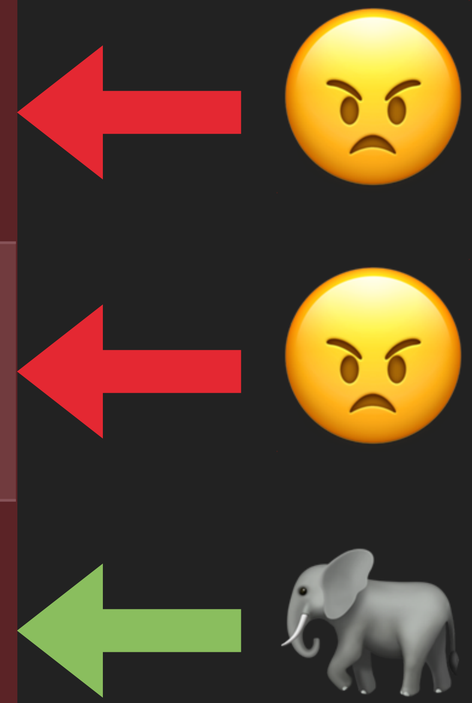
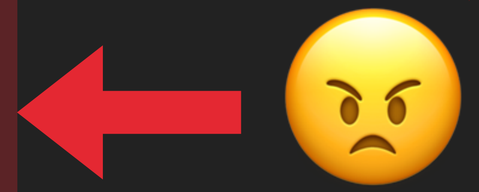
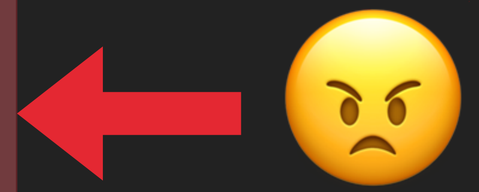
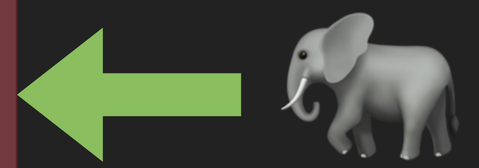


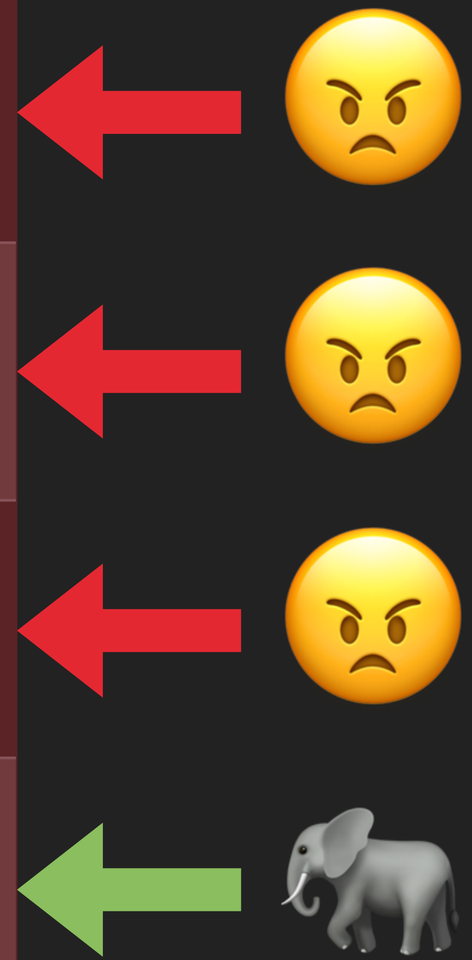
id	username	email	active
1	alice	alice@example.com	true
2	bob	bob@example.com	true
3	charlie	charlie@foo.org	true
4	doug	doug@bar.net	true





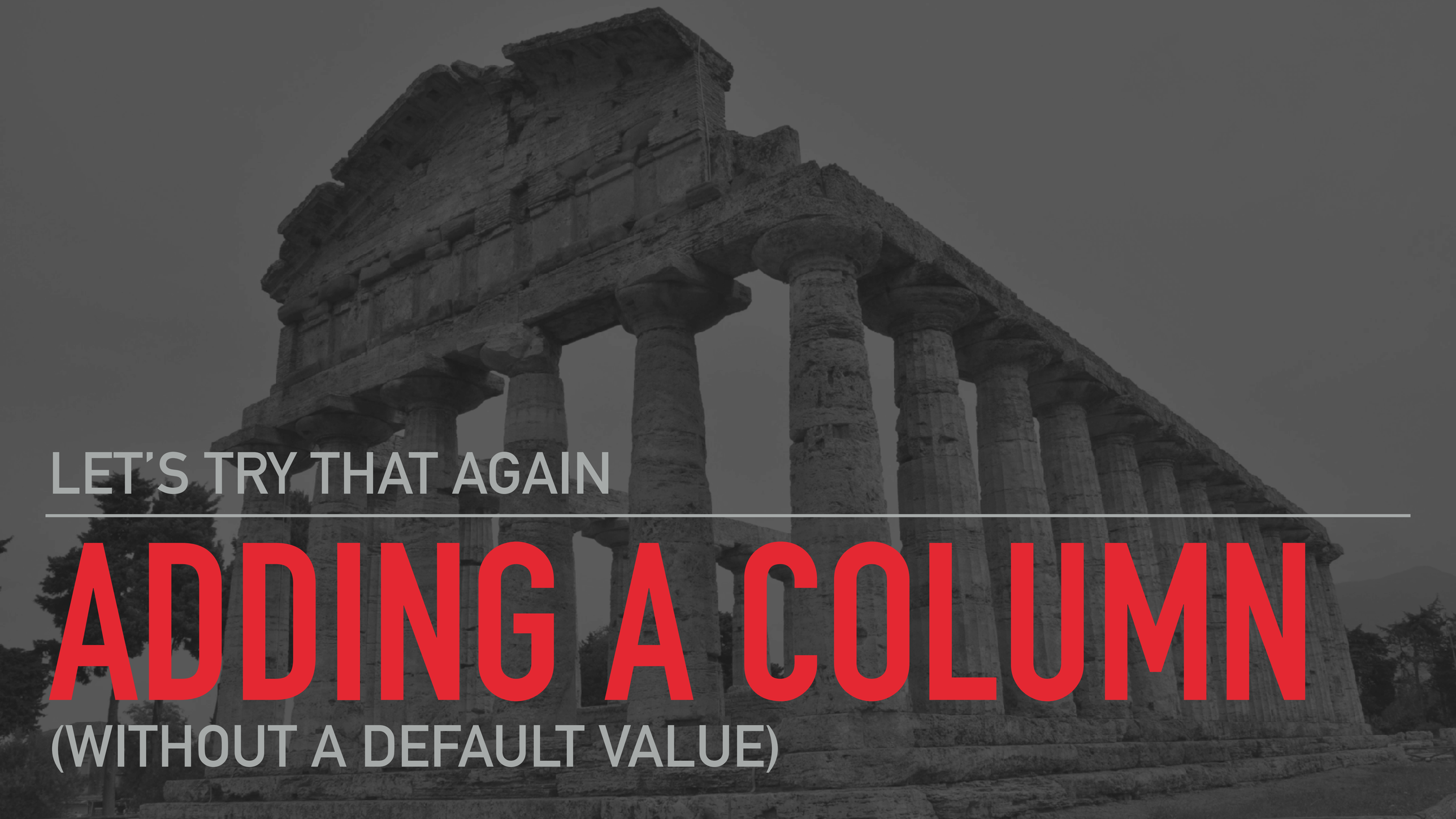


id	username	email	active
1	alice	alice@example.com	true
2	bob	bob@example.com	true
3	charlie	charlie@foo.org	true
4	doug	doug@bar.net	true



id	username	email	active
1	alice	alice@example.com	true
2	bob	bob@example.com	true
3	charlie	charlie@foo.org	true
4	doug	doug@bar.net	true

DON'T ADD COLUMNS WITH A DEFAULT VALUE.



LET'S TRY THAT AGAIN

ADDING A COLUMN

(WITHOUT A DEFAULT VALUE)

ADDING A COLUMN (WITHOUT A DEFAULT VALUE)

```
class AddActiveToUsers < ActiveRecord::Migration[5.2]
  def change
    add_column :users, :active, :boolean, default: true
  end
end
```

ADDING A COLUMN (WITHOUT A DEFAULT VALUE)

```
class AddActiveToUsers < ActiveRecord::Migration[5.2]
  def up
    add_column :users, :active, :boolean
    change_column_default :users, :active, true
    User.update_all(active: true)
  end

  def down
    remove_column :users, :active
  end
end
```

UNDER THE HOOD

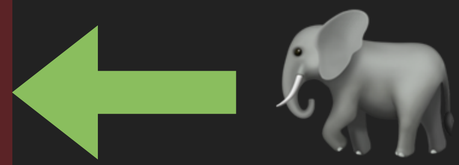
TRANSACTIONS

TRANSACTIONS

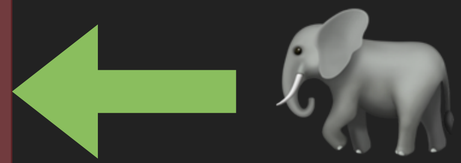
- Transactions combine multiple database operations into a single, “all-or-nothing” operation.
- They provide four guarantees: atomicity, consistency, isolation, and durability (“ACID”). Consistency and isolation are guaranteed by locks.
- When a a row is being updated, an exclusive lock is issued, and no one else can update that same row until the first update is complete.
- Locks are issued on a first-come, first-served basis, and live for the duration of a transaction, *even if the statement that requested the lock has already executed*.
- Migrations are automatically wrapped in a transaction.

id	username	email	active
1	alice	alice@example.com	
2	bob	bob@example.com	
3	charlie	charlie@foo.org	
4	doug	doug@bar.net	

id	username	email	active
1	alice	alice@example.com	true
2	bob	bob@example.com	
3	charlie	charlie@foo.org	
4	doug	doug@bar.net	



id	username	email	active
1	alice	alice@example.com	true
2	bob	bob@example.com	true
3	charlie	charlie@foo.org	
4	doug	doug@bar.net	



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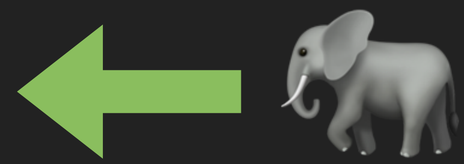

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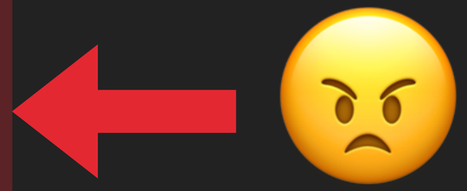

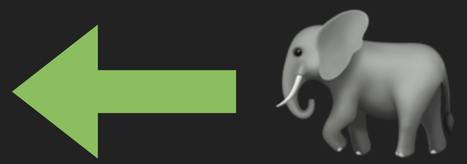

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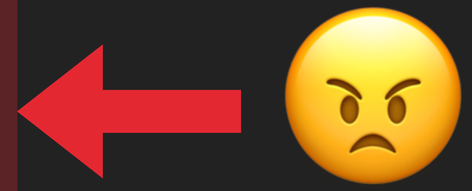

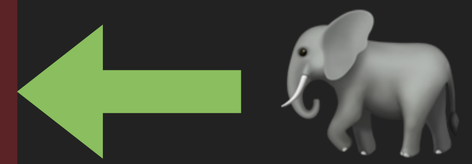

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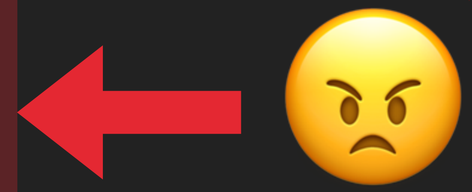

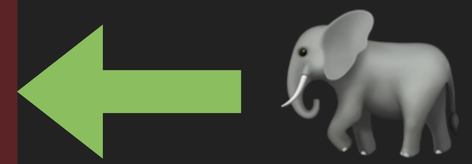

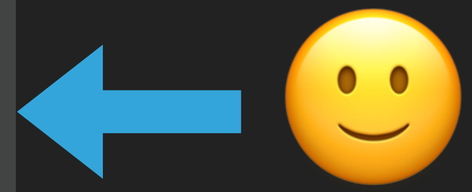

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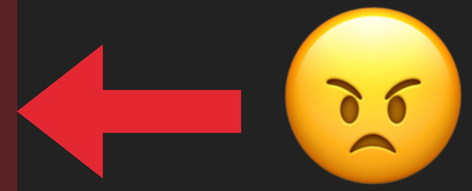

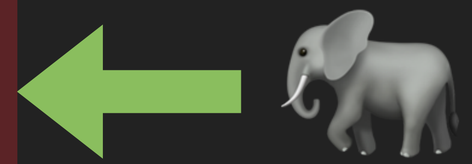

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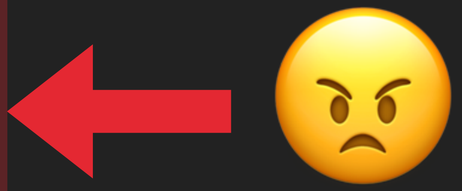

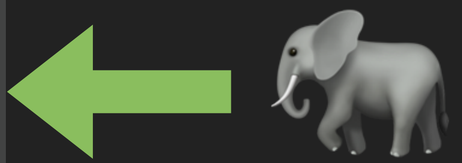

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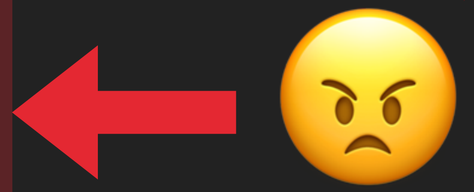

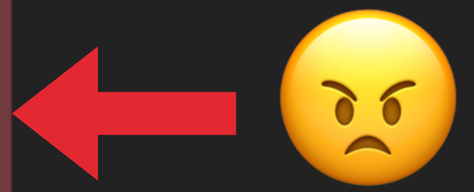

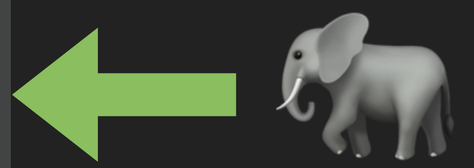

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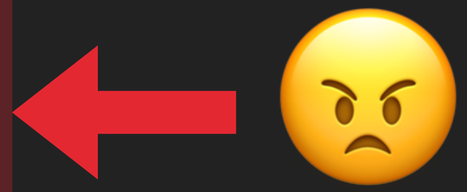
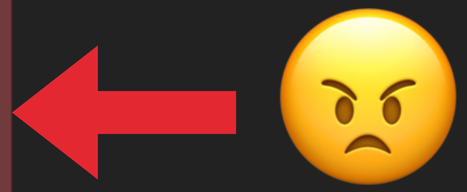
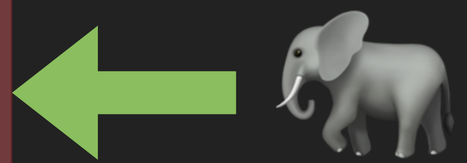






id	username	email	active
1	alice	alice@example.com	true
2	bob	bob@example.com	true
3	charlie	charlie@foo.org	true
4	doug	doug@bar.net	true

id	username	last_login_at	active
1	alice	1 day ago	true
2	bob	2 days ago	true
3	charlie	4 hours ago	true
4	doug	1 year ago	true

DON'T BACKFILL DATA INSIDE A TRANSACTION.

ADDING A COLUMN (THE CORRECT WAY)

```
class AddActiveToUsers < ActiveRecord::Migration[5.2]
  def up
    add_column :users, :active, :boolean
    change_column_default :users, :active, true
    User.update_all(active: true)
  end

  def down
    remove_column :users, :active
  end
end
```

ADDING A COLUMN (THE CORRECT WAY)

```
class MarkAllUsersActive < ActiveRecord::Migration[5.2]
  disable_ddl_transaction!

  def up
    User.in_batches do |batch|
      User.transaction { batch.update_all(active: true) }
    end
  end
end
```

DON'T MIX SCHEMA AND DATA CHANGES.

FOR POSTGRES ONLY

ADDING AN INDEX

ADDING AN INDEX

```
class AddIndexToActive < ActiveRecord::Migration[5.2]
  def change
    add_index :users, :active
  end
end
```

ADDING AN INDEX

```
class AddIndexToActive < ActiveRecord::Migration[5.2]
  disable_ddl_transaction!

  def change
    add_index :users, :active, algorithm: :concurrently
  end
end
```

DO ADD POSTGRES
INDICES CONCURRENTLY.

CASE STUDY

AUDITS

1. Write actual changes to model

2. Write audit record

AUDITING

OVERVIEW

AUDITS

- Needed to update a compound index on the audits table.
- Drop old index.
- Add new index concurrently.
- No locks, no transactions.
- What could go wrong?

EVERYTHING.

AUDITS

```
class UpdateAuditableIndex < ActiveRecord::Migration[5.2]
  disable_ddl_transaction!

  def change
    remove_index :audits, name: 'auditable_index'

    add_index :audits,
      ['auditable_type', 'auditable_id'],
      name: 'auditable_index',
      algorithm: :concurrently
  end
end
```

UNDER THE HOOD

CONCURRENCY

LITTLE'S LAW

$$L = \lambda W$$

Concurrency — Throughput — Response Time

$$4 = 100 * 40ms$$

Concurrent requests = Req's per second * Avg. response time

CONCURRENCY

- Every application has a theoretical maximum level of concurrency it can support at any given time.
- Your database obeys the same principles. How fast your queries are, and how large your connection pool is, determines how many queries you can concurrently handle.
- Requests start queueing when they arrive faster than your application, or its database, can respond to them.
- If a database operation blocks many requests for a long time, your entire application will grind to a halt.

1. Write actual changes to model

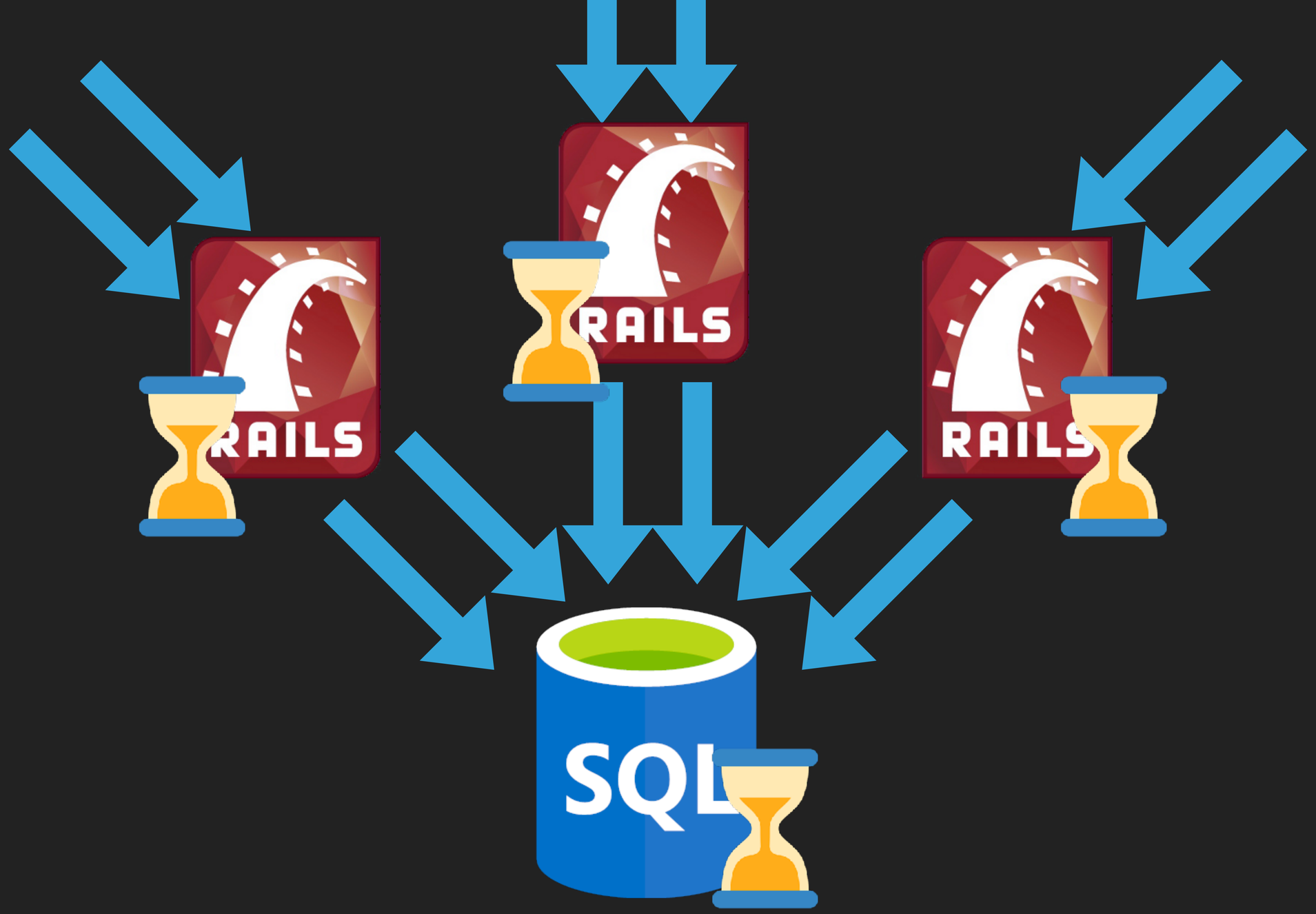
2. Get current version number

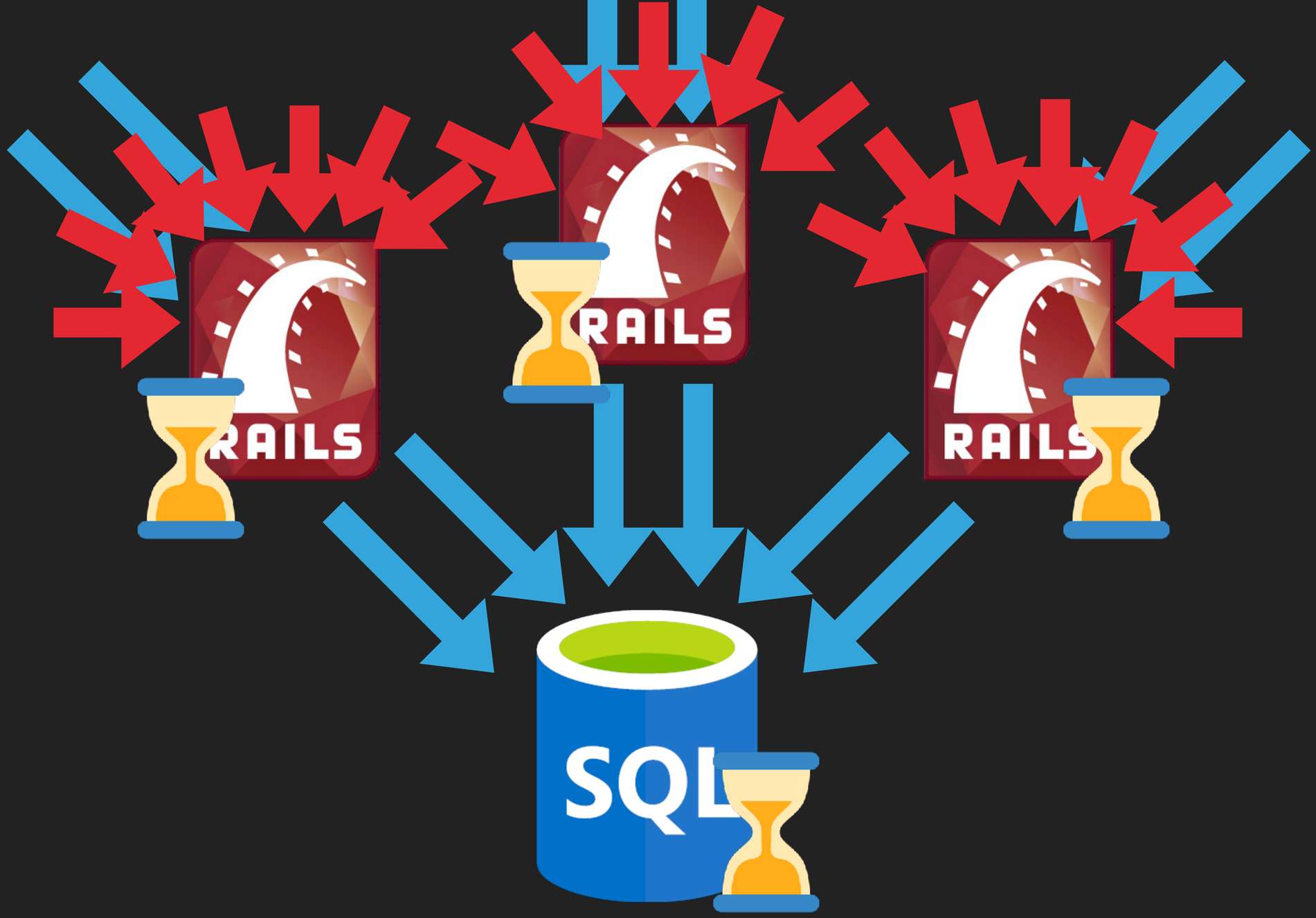
3. Write audit record with incremented version

AUDITING

OVERVIEW

BUT ACCURATE THIS TIME


RAILS
RAILS
RAILS
SQL


RAILS
RAILS
RAILS
SQL

RULE NO. 4

DO TEST DATABASE PERFORMANCE.

YES, THAT IS A FRYING PAN

TOOLS AND RESOURCES

GEMS

- Static analysis will warn in advance about certain unsafe migrations.
- Catch problems at dev time, not deploy time.
- ankane/strong_migrations
- LendingHome/zero_downtime_migrations
- Not technically a gem, but: Gitlab migration helpers

APPLICATION PERFORMANCE MONITORING

- Understanding your application's baseline performance is critical to understanding how migrations will change its performance characteristics.
- New Relic
- Skylight
- Scout
- AppSignal

YOU.

YOU

- You are your own best resource. Static analysis can only go so far. Know your application, and which migrations are potentially dangerous.
- Keep up with changes to your database engine. There are plenty of improvements being made in this area.
- Practice writing safe and reliable migrations when the stakes are lower, before you need to apply them to your production database.
- It’s better to listen to that nagging voice in the back of your head than feel the icy dread of taking down your production system.

TAKEAWAYS

- **DON'T** add columns with a default value.
- **DON'T** backfill data inside a transaction.
- **DON'T** mix schema and data changes in the same migration.
- **DO** add Postgres indexes concurrently.
- **DO** monitor and test database performance before, during, and after migrations.

UPTIME BEGINS AT $HOME

QUESTIONS?

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