Problems that Occur when Multiple Things Use a Database at the Same Time

… and some suggested solutions and workarounds.

A Quick Caveat.

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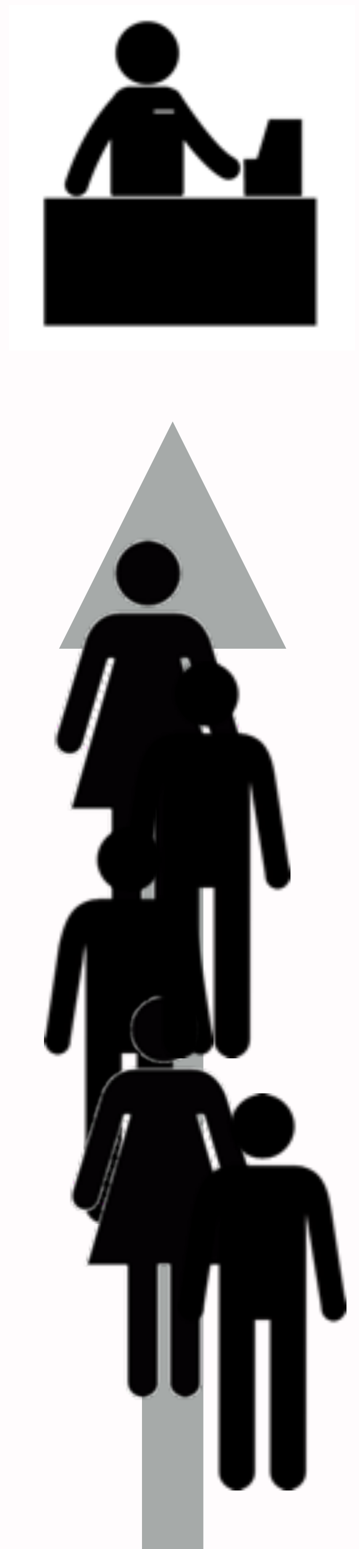
The Problem

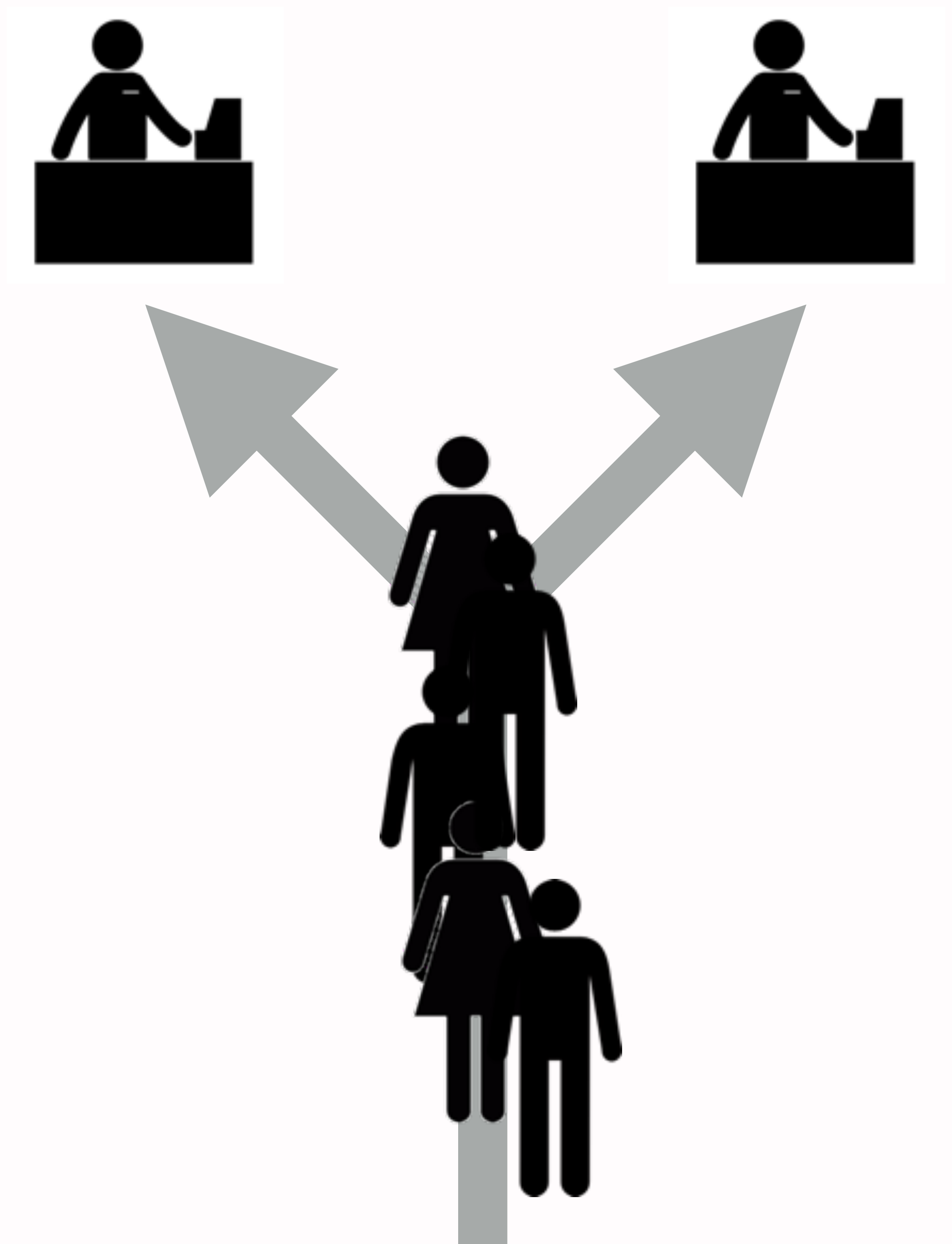
An example.

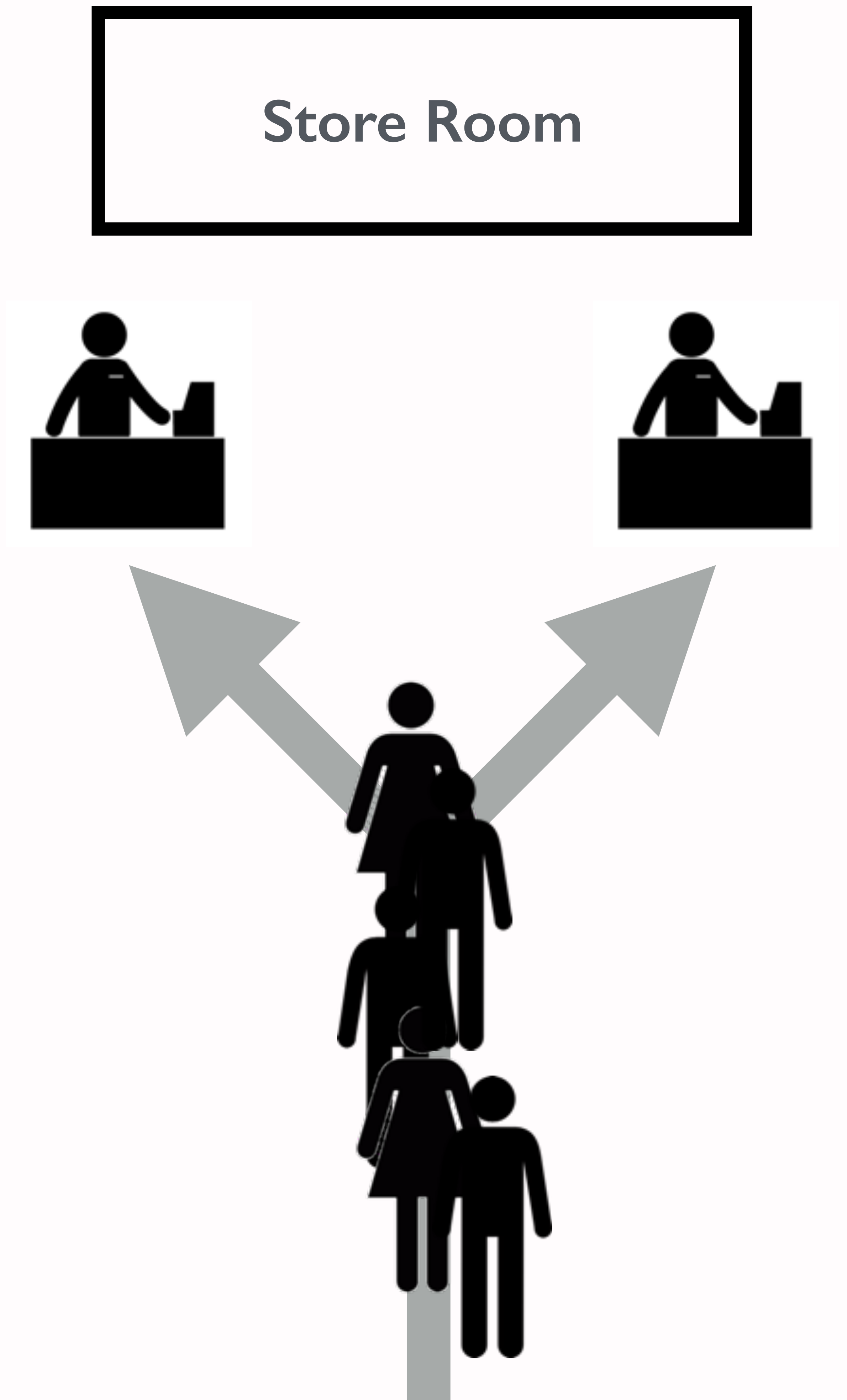
An example.

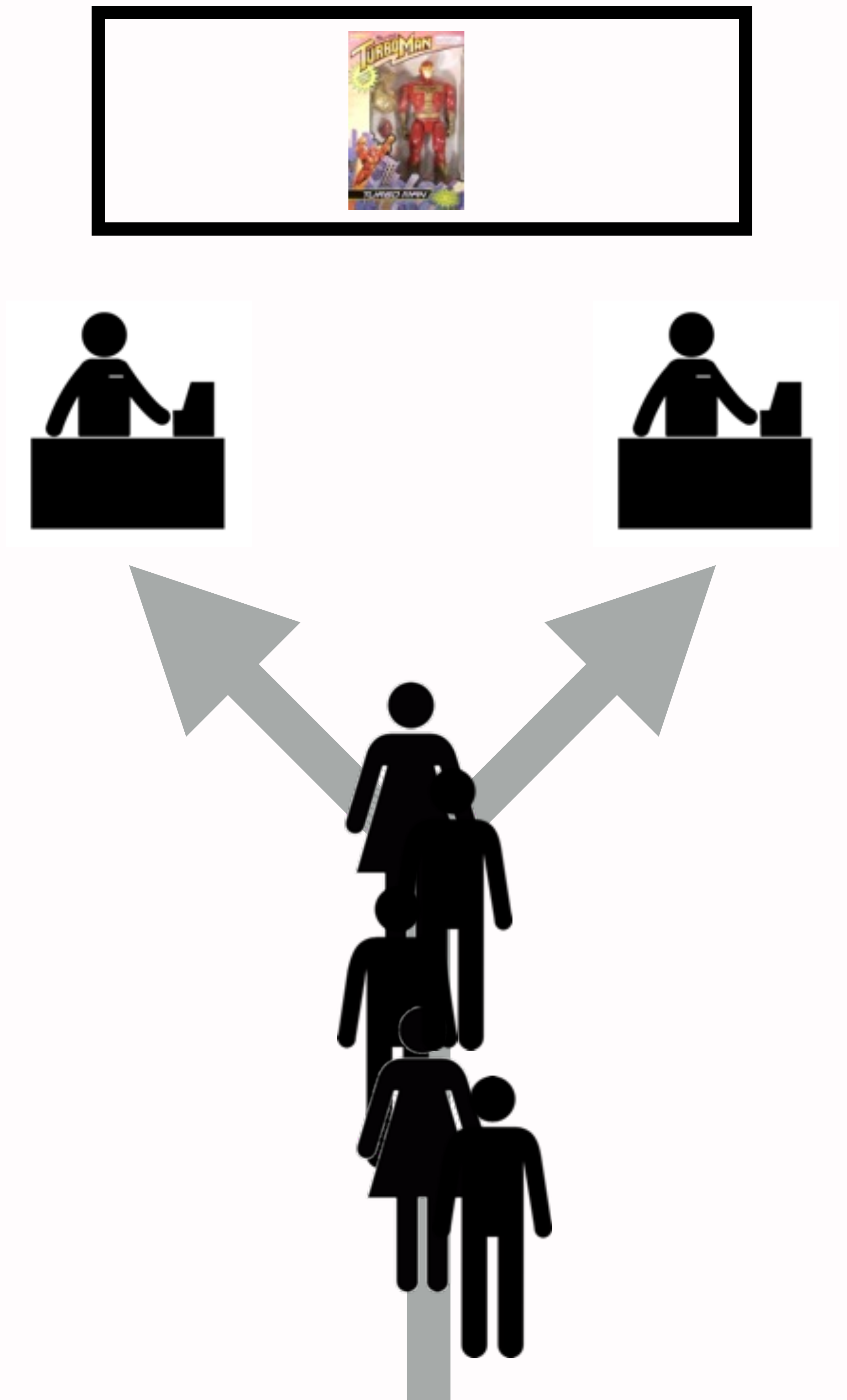
An example.

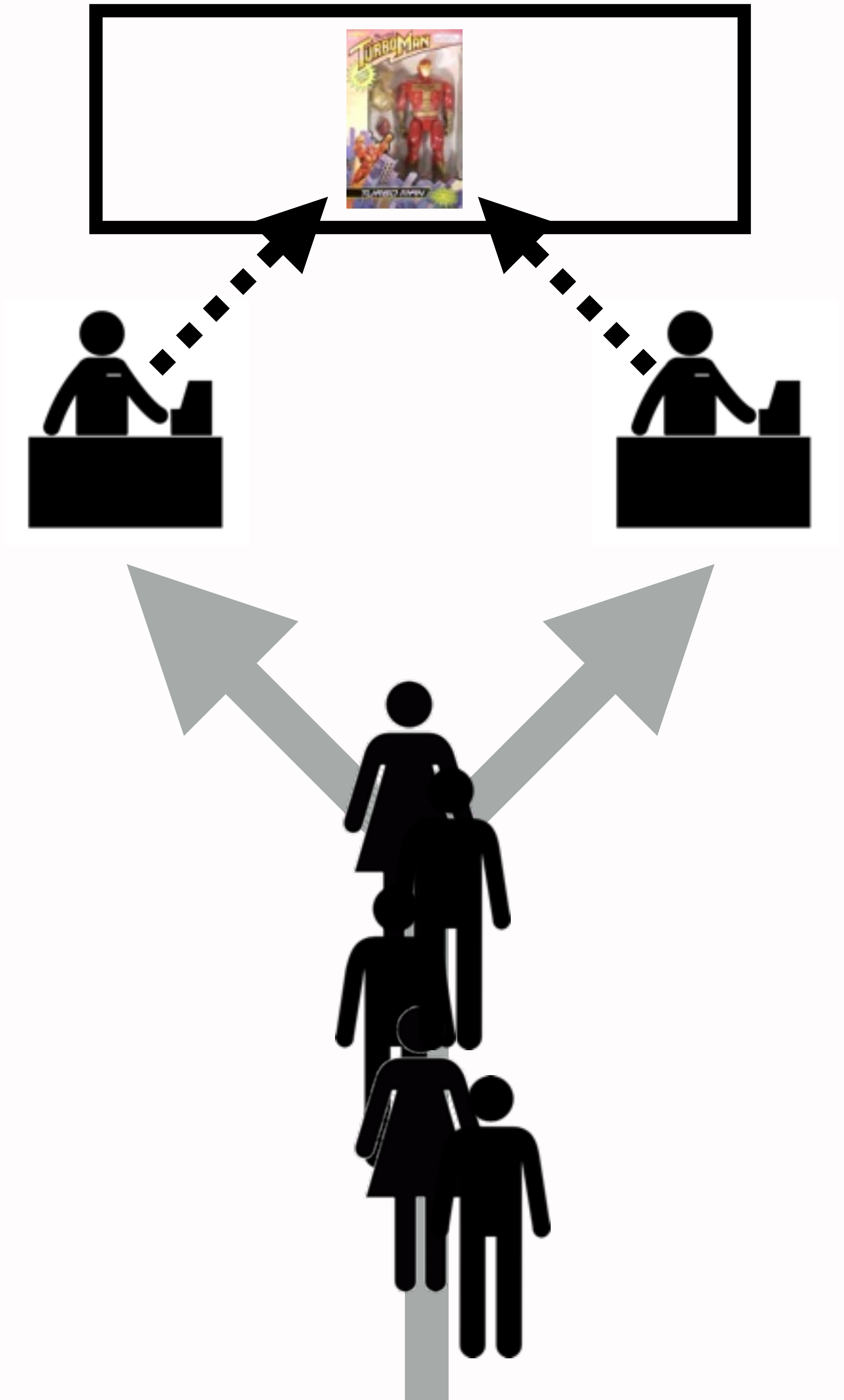


An example.




Store Room


TURBO MAN


TURBO MAN

An example.

An example.

```
p = Post.find(123)
```

```
SELECT *
FROM posts
WHERE id = 123;
```

An example.

```
p = Post.find(123)   SELECT *
                     FROM posts
                     WHERE id = 123;


p.name = "Wow"
p.save               UPDATE posts
                     SET name = "Wow"
                     WHERE id = 123;
```

An example.

Something can happen in here →

```
SELECT *
FROM posts
WHERE id = 123;


UPDATE posts
SET name = "Wow"
WHERE id = 123;
```

Two examples at once.

A

B

```
SELECT *
FROM posts
WHERE id = 123;
```

A

```
SELECT *
FROM posts
WHERE id = 123;
```

B

```
SELECT *
FROM posts
WHERE id = 123;
```

A

```
SELECT *
FROM posts
WHERE id = 123;


UPDATE posts
SET name = "Wow"
WHERE id = 123;
```

B

```
SELECT *
FROM posts
WHERE id = 123;
```

A

```
SELECT *
FROM posts
WHERE id = 123;

UPDATE posts
SET name = "Wow"
WHERE id = 123;
```

B

```
SELECT *
FROM posts
WHERE id = 123;

UPDATE posts
SET name = "Nope"
WHERE id = 123;
```

A

```
SELECT *
FROM posts
WHERE id = 123;


UPDATE posts
SET name = "Wow"
WHERE id = 123;
```

B

```
SELECT *
FROM posts
WHERE id = 123;


UPDATE posts
SET name = "Nope"
WHERE id = 123;
```

Winner: B

```
{
  id: 123,
  name: "nope",
  body: "........"
}
```

ATOMICITY

Atoms

```
p = Post.find(123)    SELECT *
                      FROM posts
                      WHERE id = 123;

p.name = "Wow"
p.save                UPDATE posts
                      SET name = "Wow"
                      WHERE id = 123;
```

Atoms

```
p = Post.find(123)
```

```
SELECT *
FROM posts
WHERE id = 123;
```

```
p.name = "Wow"
p.save
```

```
UPDATE posts
SET name = "Wow"
WHERE id = 123;
```

Atoms

```
p = Post.find(123)
```

```
SELECT *
FROM posts
WHERE id = 123;
```

```
p.name = "Wow"
p.save
```

```
UPDATE posts
SET name = "Wow"
WHERE id = 123;
```

Atoms

```
p = Post.find(123)
```

```
SELECT *
FROM posts
WHERE id = 123;
```

```
p.name = "Wow"
p.save
```

```
UPDATE posts
SET name = "Wow"
WHERE id = 123;
```

Making Database Interactions Atomic

Three Ways

Three Ways

1. UPDATE a column's value based on its *current* value.
    - Get the database to figure out the new value. Don't assume we know what the value is in advance.

1) Push it to the DB.

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```
p = Post.find(123)
```

```
SELECT *
FROM posts
WHERE id = 123;
```

1) Push it to the DB.

```
p = Post.find(123)
```

```
SELECT *
FROM posts
WHERE id = 123;
```

```
p.increment(
  :views, 1
)
```

```
UPDATE posts
SET views =
 COALESCE(views, 0)
 + 1
WHERE id = 123;
```

1) Push it to the DB.

```
Post.increment_counter(
  :views, 1
)
```

```
UPDATE posts
SET views =
 COALESCE(views, 0)
 + 1
WHERE id = 123;
```

1) Push it to the DB.

```
p = Post.find(123)

p.tags << "a new tag"

# Rails 4 w/ Postgres
# and a DB migration,
# eg.
# t.string(
#   :tags,
#   array: true
# )
```

```
-- SELECT ...

UPDATE posts
SET tags =
 array_append(
   tags,
   "a new tag"
  )

WHERE id = 123;
```

Three Ways

1. UPDATE a column's value based on its *current* value.
   - Get the database to figure out the new value. Don't assume we know what the value is in advance.

2. Add conditions to the UPDATE.
   - Only update if our assumptions are true.

2) Add Conditions to UPDATE.

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```ruby
p = Post.find(123)

Post.where(
 id: 123,
 name: p.name,
).update_all(
 name: "Wow",
)

# => 1 means it worked
# => 0 means it didn't
```

```sql
-- SELECT ...

UPDATE posts
SET
 name = "Wow"
WHERE
 id = 123 AND
 name = "Old Name";
```

2) Add Conditions to UPDATE.

```
# Database Migration
add_column :posts,
  :lock_version,
  :integer
```

2) Add Conditions to UPDATE.

```
# Database Migration
add_column :posts,
  :lock_version,
  :integer

# Form View
<%= form.hidden_field
    :lock_version %>
```

2) Add Conditions to UPDATE.

```
add_column :posts,
  :lock_version,
  :integer
```

```
<%= form.hidden_field :lock_version %>
```

2) Add Conditions to UPDATE.

```
add_column :posts,
  :lock_version,
  :integer
```

```
<%= form.hidden_field :lock_version %>
```

```
# Controller
pp = post_params
p = Post.find(pp[:id])
p.lock_version =
   pp[:lock_version]
p.name = pp[:name]
p.save
```

2) Add Conditions to UPDATE.

```
add_column :posts,
  :lock_version,
  :integer
```

```
<%= form.hidden_field :lock_version %>
```

```
# Controller
pp = post_params
p = Post.find(pp[:id])       -- SELECT ...
p.lock_version =
   pp[:lock_version]
p.name = pp[:name]
p.save
```

2) Add Conditions to UPDATE.

```
add_column :posts,
  :lock_version,
  :integer
```

```
<%= form.hidden_field :lock_version %>
```

```
# Controller
pp = post_params
p = Post.find(pp[:id])   -- SELECT ...
p.lock_version =
    pp[:lock_version]
p.name = pp[:name]
p.save
```

2) Add Conditions to UPDATE.

```
add_column :posts,
  :lock_version,
  :integer
```

```
<%= form.hidden_field :lock_version %>
```

```
# Controller
pp = post_params
p = Post.find(pp[:id])
p.lock_version =
   pp[:lock_version]
p.name = pp[:name]
p.save
```

```
-- SELECT ...
UPDATE posts
SET
 name = "Wow",
 lock_version = 2
WHERE
 id = 123 AND
 lock_version = 1;
```

2) Add Conditions to UPDATE.

- Problematic...?
  - The "did it update or not?" counter is too coarse.
  - You get another race condition: does the record still exist? Can't differentiate between Stale and Gone.
- But you can (in most cases) just ask the DB again to check.

Three Ways

1. UPDATE a column's value based on its *current* value.
   - Get the database to figure out the new value. Don't assume we know what the value is in advance.
2. Add conditions to the UPDATE.
   - Only update if our assumptions are true.
3. Put everything inside a container.
   - Suddenly the *container* is the atom.

3) Put actions inside a container.

Atoms

```
p = Post.find(123)
```

```
SELECT *
FROM posts
WHERE id = 123;
```

```
p.name = "Wow"
p.save
```

```
UPDATE posts
SET name = "Wow"
WHERE id = 123;
```

Atoms

```
p = Post.find(123)
```

```
SELECT *
FROM posts
WHERE id = 123;
```

```
p.name = "Wow"
p.save
```

```
UPDATE posts
SET name = "Wow"
WHERE id = 123;
```

"Just Add a Transaction"

```
ActiveRecord::Base.transaction do |t|

  p = Post.find(123) # SELECT ...

  p.name = "Wow"
  p.save             # UPDATE ...

end
```

220g NET
Cottee's
SETS HARD IN SECONDS
BEGIN TRANSACTION
chocolate
FLAVOURED ICE CREAM COATING
PX17341F/A
Serving Suggestion

A

```
SELECT *
FROM posts
WHERE id = 123;

UPDATE posts
SET name = "Wow"
WHERE id = 123;
```

B

```
SELECT *
FROM posts
WHERE id = 123;

UPDATE posts
SET name = "Nope"
WHERE id = 123;
```

A

```
SELECT *
FROM posts
WHERE id = 123;


UPDATE posts
SET name = "Wow"
WHERE id = 123;
```

B

```
SELECT *
FROM posts
WHERE id = 123;


UPDATE posts
SET name = "Nope"
    E id = 123;
```

3) Put actions inside a container.

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- Locking (rows, tables, advisory)

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- Locking (rows, tables, advisory)
- Transaction Isolation Levels

Locks

- Locking a particular row.
- Locking an entire table.
- Arbitrary application-level locks.

Locks: SELECT FOR UPDATE

```
p = Post.lock(true).find(123)
# SELECT ... FOR UPDATE

p.name = "Foo"
p.save
# UPDATEs, COMMITs
```

Locks: Table Lock

- The nuclear options; blocks access entirely.

```
Post.connection.execute(
  'LOCK TABLE posts IN ... MODE'
);
```

Locks: Application Lock

https://github.com/heroku/pg_lock

```
post = Post.new(...)
key = "#{Post}-#{post.author}"
PgLock.new(name: key).lock do
  # Stuff, eg. call post.save
  # to insert the new Post.
end
```

Isolation Levels

- Read Uncommitted
- Read Committed **(the default)**
- Repeatable Read
- Serializable

(Good reference: http://www.postgresql.org/docs/9.1/static/transaction-iso.html)

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- Read Uncommitted
- Read Committed **(the default)**
- Repeatable Read
- Serializable

(Good reference: http://www.postgresql.org/docs/9.1/static/transaction-iso.html)

Isolation Level: Default

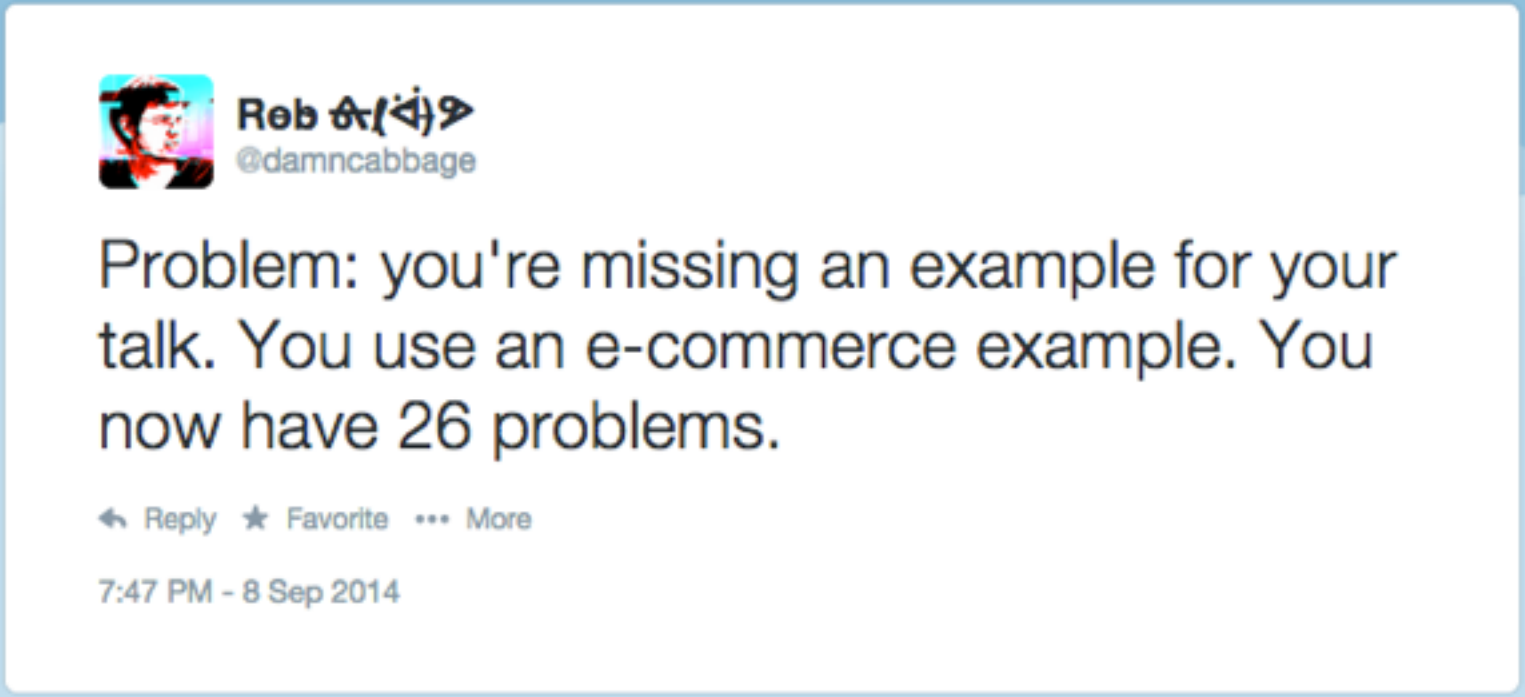
```
ActiveRecord::Base.transaction do |t|

  p = Post.find(123) # SELECT ...

  p.name = "Wow"
  p.save             # UPDATE ...

end
```

Isolation Level: Maximum

```
Post.transaction(
  isolation: :serializable
) do |t|

  p = Post.find(123) # SELECT ...

  p.name = "Wow"
  p.save             # UPDATE ...

end
```

Summin' up.

- In-database modifications where possible.
- Isolation or Locks where not.
- The more restrictions, the slower it's gonna go.
- More work, but makes the problem **visible**.



Rɵb ᕦ(ᐛ)ᕤ
@damncabbage

Problem: you're missing an example for your talk. You use an e-commerce example. You now have 26 problems.

7:47 PM - 8 Sep 2014

Fin.

Rob Howard
@damncabbage