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Project Management and Scrum Software

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PGCon 2010

PostgreSQL as a secret weapon for high-performance Ruby on Rails applications

www.acunote.com

About

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Acunote www.acunote.com

Online project management and Scrum software

~7000 customers

Hosted on Own Servers

Hosted on Customer's Servers

nginx + mongrel

PostgreSQL 8.4

Web Development Pains

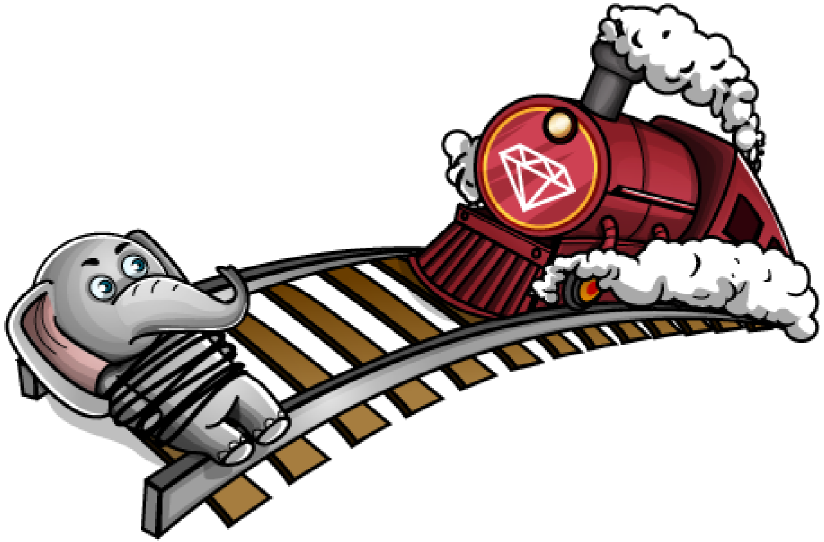
- Performance
- Data integrity
- Developer productivity

Types of Web Apps

- Web apps range from Digg to a custom accounting system
- Your app is somewhere in between

Outline

- **Rails as ORM**
- Optimizing Rails With PostgreSQL
- PostgreSQL Limitations
- PostgreSQL Approaches
- Optimizing Database



Rails as ORM > Myths and Realities

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Myth: not close to SQL

Rails as ORM > Myths and Realities

Close to SQL:

```
author = Author.find(:first)
     select * from authors limit 1;
articles = author.articles
     select * from articles where author_id = 1


author_name = “Orwell”
author = Author.find(:all, :conditions => [“name = ?”,
  author_name])
     select * from authors where name = “Orwell”
```

Drop down to SQL easily:

```
author = Author.find_by_sql(“select * from authors
  where authors.birthday > now()”)
```

Rails as ORM > Attribute Preloading

The conventional Rails way is not so bad:

```
Tasks                   Tags                 Tasks_Tags
id     serial           id serial            tag_id integer
name   varchar          name varchar         task_id integer


tasks = Task.find(:all, :include => :tags)

      select * from tasks
      select * from tags inner join tasks_tags
         on tags.id = tasks_tags.tag_id
         where tasks_tags.task_id in (1,2,3,..)
```

Rails as ORM > Multiplying Queries

But classical ORM problem exists:

```
create table Task (          class Task < ActiveRecord::Base
  id serial not null,          acts_as_tree
  parent_id integer          end
)
```

Uses N+1 database queries to load N nodes from the tree:

```
(root)              select * from tasks where parent_id = nil
- 1                 select * from tasks where parent_id = 1
    - 11            select * from tasks where parent_id = 11
        - 111       select * from tasks where parent_id = 111
        - 112       select * from tasks where parent_id = 112
    - 12            select * from tasks where parent_id = 12
- 2                 select * from tasks where parent_id = 2
    - 21            select * from tasks where parent_id = 21
```

Rails as ORM > Multiplying Queries

```
create table Task (
  id serial not null,
  parent_id integer
)
```

```
class Task < ActiveRecord::Base
   acts_as_tree
end
```

Should rather be:

```
select * from tasks
    left outer join
        (select id as parents_id, parent_id as parents_parent_id from tasks)
        as parents on (tasks.parent_id = parents_id)
    left outer join
        (select id as parents_parents_id from tasks)
        as parents_parents on (parents_parent_id = parents_parents_id)
```

Rails as ORM > Generating Queries

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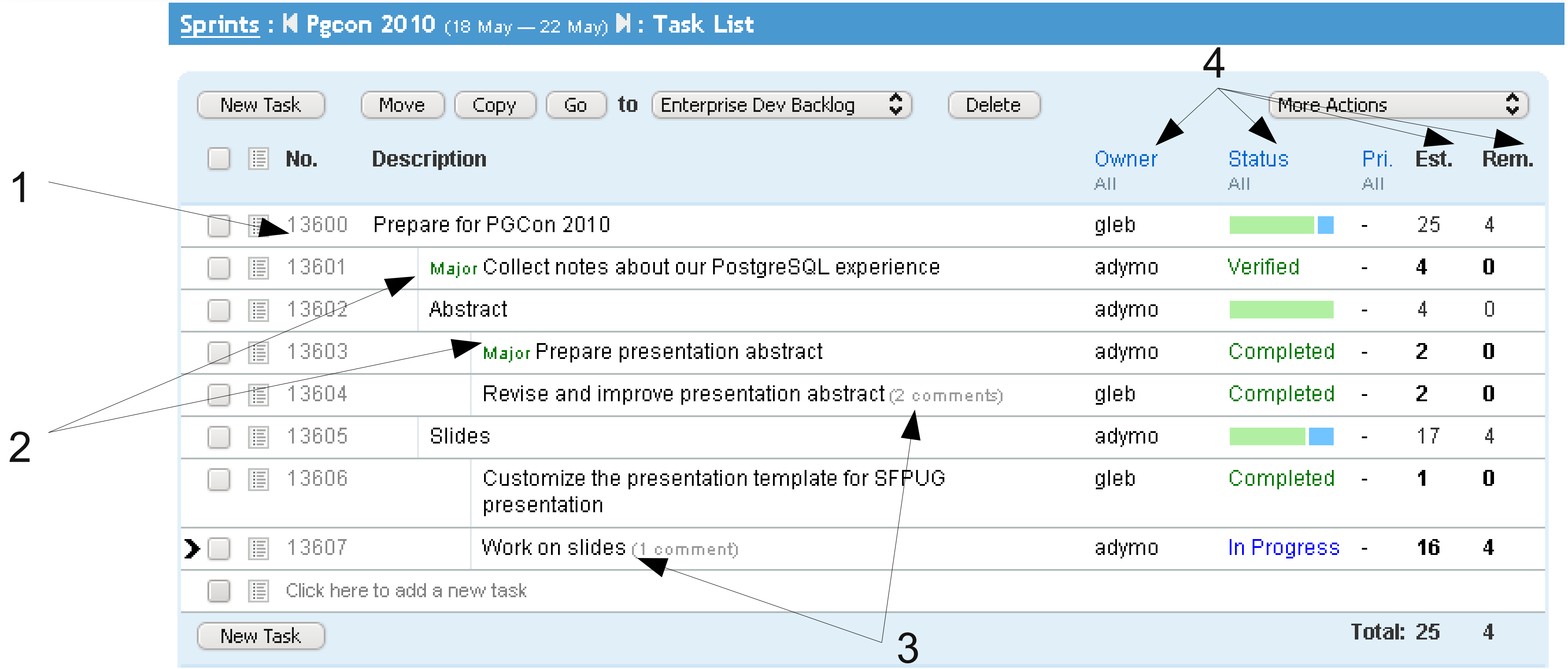


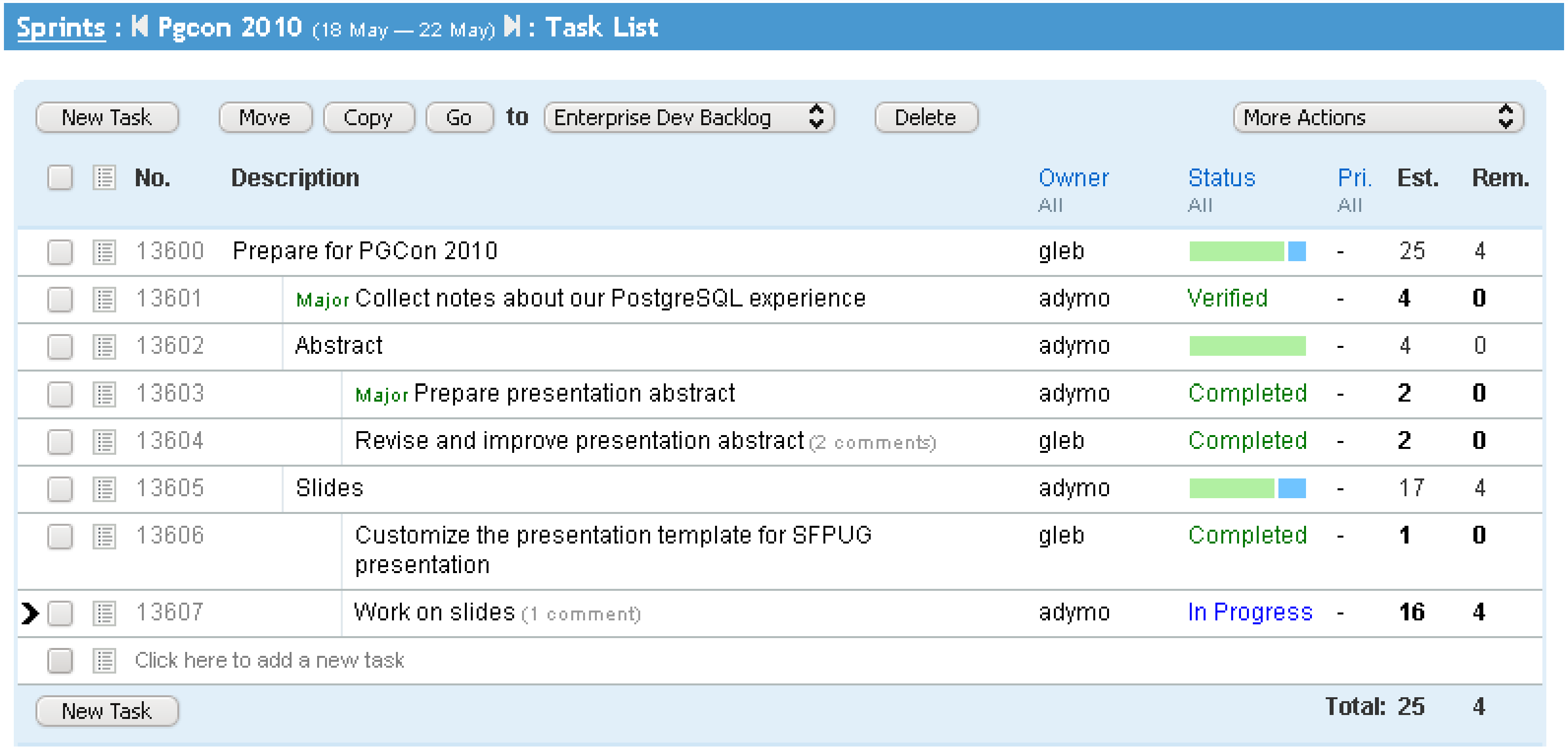
Sprints : ⏮ Pgcon 2010 (18 May — 22 May) ⏭ : Task List

□		No.	Description	Owner All	Status All	Pri. All	Est.	Rem.
□		13600	Prepare for PGCon 2010	gleb	🟩🟦	-	25	4
□		13601	Major Collect notes about our PostgreSQL experience	adymo	Verified	-	**4**	**0**
□		13602	Abstract	adymo	🟩	-	4	0
□		13603	Major Prepare presentation abstract	adymo	Completed	-	**2**	**0**
□		13604	Revise and improve presentation abstract (2 comments)	gleb	Completed	-	**2**	**0**
□		13605	Slides	adymo	🟩🟦	-	17	4
□		13606	Customize the presentation template for SFPUG presentation	gleb	Completed	-	**1**	**0**
❯ □		13607	Work on slides (1 comment)	adymo	In Progress	-	**16**	**4**
□			Click here to add a new task					
						Total:	25	4

1. Task tree (3 levels) (+2 joins & 1 subselect)
2. Task tags (+2 subselects)
3. Task property counters (+4 subselects)
4. Last "timecell" values (+4 joins to get group-wise maximum)

etc... - **12 joins and subselects**

Rails as ORM > Generating Queries



Sprints : Pgcon 2010 (18 May — 22 May) : Task List

New Task | Move | Copy | Go | to Enterprise Dev Backlog | Delete | More Actions

	No.	Description	Owner All	Status All	Pri. All	Est.	Rem.
□	13600	Prepare for PGCon 2010	gleb	🟩🟦	-	25	4
□	13601	Major Collect notes about our PostgreSQL experience	adymo	Verified	-	**4**	**0**
□	13602	Abstract	adymo	🟩	-	4	0
□	13603	Major Prepare presentation abstract	adymo	Completed	-	**2**	**0**
□	13604	Revise and improve presentation abstract (2 comments)	gleb	Completed	-	**2**	**0**
□	13605	Slides	adymo	🟩🟦	-	17	4
□	13606	Customize the presentation template for SFPUG presentation	gleb	Completed	-	**1**	**0**
› □	13607	Work on slides (1 comment)	adymo	In Progress	-	**16**	**4**
□		Click here to add a new task					
New Task					Total:	25	4

All this done in **1 query** in **under 60ms** even on EeePC!

Equivalent Ruby code took up to **8 sec!**

133x!

Rails as ORM > Query Tests

```
rev 834: Show past and future sprints in the list

--- application_helper.rb
+++ application_helper.rb
@@ -456,8 +456,8 @@
sprints = []
sprints.concat current_project.sprints(:present)
+sprints.concat current_project.sprints(:past)
+sprints.concat current_project.sprints(:future)
```

Rails as ORM > Query Tests

```
rev 834: Show past and future sprints in the list

--- application_helper.rb
+++ application_helper.rb
@@ -456,8 +456,8 @@
sprints = []
sprints.concat current_project.sprints(:present)
+sprints.concat current_project.sprints(:past)
+sprints.concat current_project.sprints(:future)
```

	Before	**After**
Sprint 20 x (1+5) (C)	0.87 ± 0.01	0.88 ± 0.01

Rails as ORM > Query Tests

```
rev 834: Show past and future sprints in the list

--- application_helper.rb
+++ application_helper.rb
@@ -456,8 +456,8 @@
sprints = []
sprints.concat current_project.sprints(:present)
+sprints.concat current_project.sprints(:past)
+sprints.concat current_project.sprints(:future)

--- empty_controller_test.rb
+++ empty_controller_test.rb
@@ -79,11 +79,12 @@
            "Sprint Load",
+            "Sprint Load",
+            "Sprint Load",
            "common/_nav_dialog",
            "Project Load",
```

Rails as ORM > Query Tests

Query tests to make sure we don't fall into the multiplying queries trap

```
def test_queries
  queries = track_queries do
    get :index
  end
  assert_equal queries, [
    "Task Load",
    "Tag Load",
    "Event Create",
    "SQL"
  ]
end
```

Rails as ORM > Query Tests

```
module ActiveSupport
class BufferedLogger

    attr_reader :tracked_queries

    def tracking=(val)
        @tracked_queries = []
        @tracking = val
    end

    def add_with_tracking(severity, message = nil, progname = nil, &block)
        @tracked_queries << $1 if @tracking && message =~ /3[56]\;1m(.* (Load|Create|
Update|Destroy)) \(/
        @tracked_queries << $1 if @tracking && message =~ /3[56]\;1m(SQL) \(/
        add_without_tracking(severity, message, progname, &block)
    end
    alias_method_chain :add, :tracking

end
end

class ActiveSupport::TestCase
    def track_queries(&block)
        RAILS_DEFAULT_LOGGER.tracking = true
        yield
        result = RAILS_DEFAULT_LOGGER.tracked_queries
        RAILS_DEFAULT_LOGGER.tracking = false
        result
    end
end
```

Rails as ORM > Migrations

Use SQL DDL not Rails DSL

(unless targeting multiple RDBMS)

Schema in SQL vs Rails parlance

Migration in SQL

```
execute "
    create table Foo (
        id serial not null,
        name varchar(20),
        bar_id integer,

        primary key (id),
        foreign key (bar_id)
            references Bar (id)
    );
"
```

Migration in Rails parlance

```
create_table :foo do |t|
    t.string :name, :limit => 20
    t.references :bar
end

execute "alter table foo add
    foreign key (bar_id)
    references Bar (id)"
```

Rails as ORM > Data Integrity

- Myth - rails does not support constraints
- Actually not possible to assure data integrity in Rails
- Use constraints, rules, triggers and other database magic to protect data integrity, not to implement business logic
- FK constraints -- everything should be RESTRICT ON X SET NULL and CASCADE is a problem

Outline

- Rails as ORM
- **Optimizing Rails with PostgreSQL**
- PostgreSQL Limitations
- PostgreSQL Approaches
- Optimizing Database

Rails Performance > Ruby

- Good language, bad implementation
- Slow
- Unreliable
- Deal with it!

Rails Performance > Ruby

Compare to the database:

PostgreSQL:

```
explain analyze select sin(2+2) as hard_stuff;
                            QUERY PLAN
-------------------------------------------------------------------
 Result  (cost=0.00..0.01 rows=1 width=0)
       (actual time=0.001..0.002 rows=1 loops=1)
 Total runtime: 0.012 ms
```

Ruby:

```
Benchmark.realtime{ sin(2+2) }*1000
   > 0.027 ms
```

13x!

Rails Performance > Rails

- Has a reputation of being slow
- Actually even slower

- Most of the time spent in GC
- CPU bound
- Doesn't parallelize

Rails Performance > Performance Tests

Keep a set of benchmarks for most frequent user requests.
For example:

```
Benchmark Burndown 120                 0.70 ± 0.00
Benchmark Inc. Burndown 120            0.92 ± 0.01
Benchmark Sprint 20 x (1+5) (C)        0.45 ± 0.00
Benchmark Issues 100 (C)               0.34 ± 0.00
Benchmark Prediction 120               0.56 ± 0.00
Benchmark Progress 120                 0.23 ± 0.00
Benchmark Sprint 20 x (1+5)            0.93 ± 0.00
Benchmark Timeline 5x100               0.11 ± 0.00
Benchmark Signup                       0.77 ± 0.00
Benchmark Export                       0.20 ± 0.00
Benchmark Move Here 20/120             0.89 ± 0.00
Benchmark Order By User                0.98 ± 0.00
Benchmark Set Field (EP)               0.21 ± 0.00
Benchmark Task Create + Tag            0.23 ± 0.00
... 30 more ...
```

Rails Performance > Performance Tests

Benchmarks as a special kind of tests:

```
class RenderingTest < ActionController::IntegrationTest

   def test_sprint_rendering
      login_with users(:user), "user"

      benchmark :title => "Sprint 20 x (1+5) (C)",
         :route => "projects/1/sprints/3/show",
         :assert_template => "tasks/index"
   end

end
```

```
Benchmark Sprint 20 x (1+5) (C)        0.45 ± 0.00
```

Rails Performance > Performance Tests

Benchmarks as a special kind of tests:

```
def benchmark(options = {})
    (0..100).each do |i|
        GC.start
        pid = fork do
            begin
                out = File.open("values", "a")
                ActiveRecord::Base.transaction do
                    elapsed_time = Benchmark::realtime do
                        request_method = options[:post] ? :post : :get
                        send(request_method, options[:route])
                    end
                    out.puts elapsed_time if i > 0
                    out.close
                    raise CustomTransactionError
                end
            rescue CustomTransactionError
                exit
            end
        end
        Process::waitpid pid
        ActiveRecord::Base.connection.reconnect!
    end
    values = File.read("values")
    print "#{mean(values).to_02f} ± #{sigma(values).to_02f}\n"
end
```

Rails Performance > Solution

Scalability is not a substitute for performance

Rails Performance > Solution

Delegate as much work as possible to...

Rails Performance > Solution

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Delegate as much work as possible to the database!

Rails Performance > Attribute Preloading

The conventional Rails way:

```
Tasks                      Tags                 Tasks_Tags
id    serial               id serial            tag_id integer
name  varchar              name varchar         task_id integer
```

```
tasks = Task.find(:all, :include => :tags)
   > 0.058 sec
```

2 SQL queries

```
      select * from tasks
      select * from tags inner join tasks_tags
         on tags.id = tasks_tags.tag_id
         where tasks_tags.task_id in (1,2,3,..)
```

Rals creates an object for each tag,
   that's not fast and takes memory

Rails Performance > Attribute Preloading

Faster with Postgres arrays:

```
Tasks                   Tags                 Tasks_Tags
id     serial           id serial            tag_id integer
name   varchar          name varchar         task_id integer
```

```
tasks = Task.find(:all, :select => "*,
      array(select tags.name from tags inner join tasks_tags
            on (tags.id = tasks_tags.tag_id)
            where tasks_tasks.task_id=tasks.id) as tag_names
   ")
> 0.018 sec
```

1 SQL query
Rails doesn't have to create objects
>3x faster:

`(was 0.058 sec, now 0.018 sec)`

3x!

Rails Performance > Preloading Attributes

Faster with Postgres arrays:

```
Tasks                   Tags                 Tasks_Tags
id    serial            id serial            tag_id integer
name  varchar           name varchar         task_id integer
```

```
tasks = Task.find(:all, :select => "*,
      array(select tags.name from tags inner join tasks_tags
            on (tags.id = tasks_tags.tag_id)
            where tasks_tasks.task_id=tasks.id) as tag_names
   ")
```

```
puts tasks.first.tag_names
   > "{Foo,Bar,Zee}"
```

Rails Performance > Access Control

Simplified model for user privilege management:

```
Users                   Role                   Roles_Users
id     serial           id serial              user_id integer
name   varchar          name varchar           role_id integer
                        privilege1 boolean
                        privilege2 boolean
                        ...
```

```
user = User.find(:first, :include => :roles)

can_do_1 = user.roles.any { |role| role.privilege1? }
```

Rails Performance > Access Control

Simplified model for user privilege management:

```
Users                   Role                    Roles_Users
id     serial           id serial               user_id integer
name   varchar          name varchar            role_id integer
                        privilege1 boolean
                        privilege2 boolean
                        ...
```

```
user = User.find(:first, :include => :roles)

can_do_1 = user.roles.any { |role| role.privilege1? }
```

Where is the problem?

- 2 SQL queries
- Rails has to create objects for each role
- Ruby iterates over the roles array

Rails Performance > Access Control

Same in SQL:

```
Users                   Role                Roles_Users
id    serial            id serial           user_id integer
name  varchar           name varchar        role_id integer
                        privilege1 boolean
                        privilege2 boolean
```

```
user = User.find(:first, :select => "*",
   :joins => "
    inner join
        (select user_id, bool_or(privilege1) as privilege1
            from roles_users
            inner join roles
            on (roles.id = roles_users.role_id)
            group by user_id)
        as roles_users
    on (users.id = roles_users.user_id)
   "
)

can_do_1 = ActiveRecord::ConnectionAdapters::Column.
   value_to_boolean(user.privilege1)
```

Rails Performance > Access Control

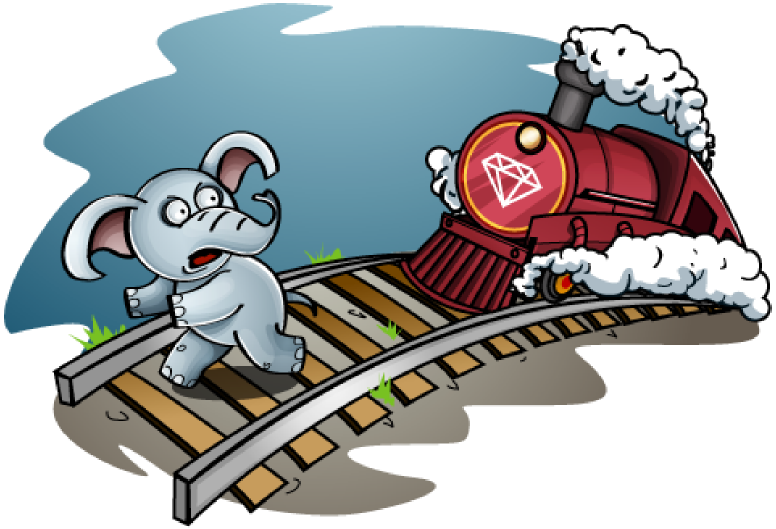
Optimization Effect:

```
can_do_1 = user.roles.any { |role| role.privilege1? }

   > 2.1 sec


can_do_1 = ActiveRecord::ConnectionAdapters::Column.
   value_to_boolean(user.privilege1)

   > 64 msec !!!
```



Rails Performance > Aggregations

Perform calculations and aggregations

on large datasets in SQL:

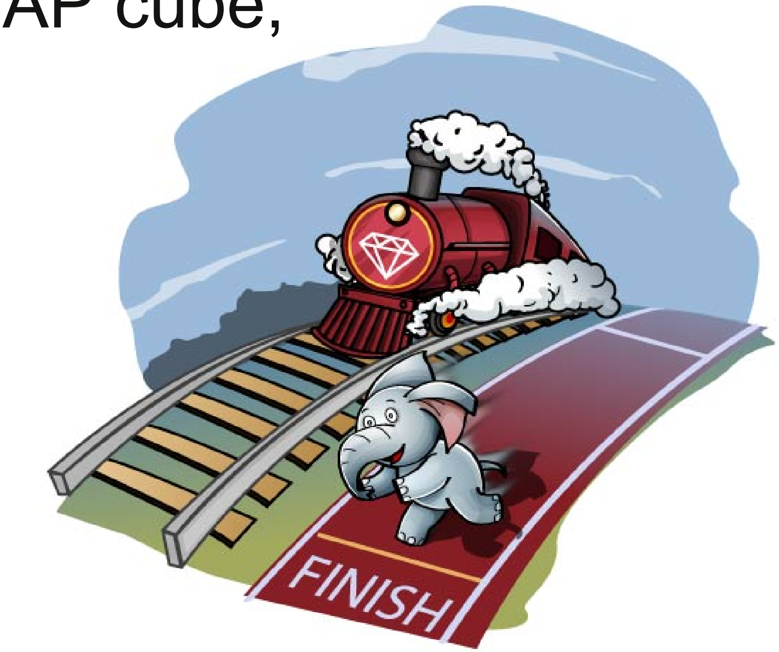
real life example:

600 000 data rows, 3-dimensional OLAP cube,

slicing and aggregation:

Ruby: ~1 Gb RAM, ~90 sec

SQL: up to 5 sec



Outline

- Rails as ORM
- Rails Performance and PostgreSQL
- **PostgreSQL Experience**
- PostgreSQL Approaches
- Optimizing Database

Postgres Experience > Good Things

Good things about Postgres:

- SQL standard compliance (and useful non-standard addons)
- good documentation
- sustainable development
- good optimizer and EXPLAIN ANALYZE
- a lot of things can be expressed in pure SQLConstraints
- referential integrity
- deadlock detection

Postgres Experience > Good Things

Good things that were introduced recently:

- replication (warm and hot standby, streaming replication)
- windowing functions
- recursive queries
- ordering for aggregates

Postgres Experience > Limitations

And now... limitations

Postgres Experience > Limit/Offset

Pagination VS Subselects:

```
select *,
   (select count(*) from attachments
      where issue_id = issues.id) as num_attachments
from issues
limit 100 offset 0;
```

```
Limit  (cost=0.00..831.22 rows=100 width=143) (actual time=0.050..1.242 rows=100 loops=1)
   ->  Seq Scan on issues  (cost=0.00..2509172.92 rows=301866 width=143)
             (actual time=0.049..1.119 rows=100 loops=1)
         SubPlan
           ->  Aggregate  (cost=8.27..8.28 rows=1 width=0)
                     (actual time=0.006..0.006 rows=1 loops=100)
                 ->  Index Scan using attachments_issue_id_idx on attachments
(cost=0.00..8.27 rows=1 width=0) (actual time=0.004..0.004 rows=0 loops=100)
                       Index Cond: (issue_id = $0)
Total runtime: 1.383 ms
```

Postgres Experience > Limit/Offset

Pagination VS Subselects:

```
select *,
   (select count(*) from attachments
      where issue_id = issues.id) as num_attachments
from issues
limit 100 offset 100;
```

```
Limit  (cost=831.22..1662.44 rows=100 width=143) (actual time=1.070..7.927 rows=100 loops=1)
   ->  Seq Scan on issues  (cost=0.00..2509172.92 rows=301866 width=143)
             (actual time=0.039..7.763 rows=200 loops=1)
         SubPlan
           ->  Aggregate  (cost=8.27..8.28 rows=1 width=0)
                     (actual time=0.034..0.034 rows=1 loops=200)
                 ->  Index Scan using attachments_issue_id_idx on attachments
(cost=0.00..8.27 rows=1 width=0) (actual time=0.032..0.032 rows=0 loops=200)
                       Index Cond: (issue_id = $0)
 Total runtime: 8.065 ms
```

Postgres Experience > Limit/Offset

Be careful with subselects:

they are executed **limit + offset** times!

Use joins to overcome the limitation

Postgres Experience > in() and Joins

Use *any(array ())* instead of *in()*

to force subselect and avoid join

explain analyze select * from issues where id in (select issue_id from tags_issues);

```
                                        QUERY PLAN
-------------------------------------------------------------------------------------------------------------------------------
 Merge IN Join  (actual time=0.096..576.704 rows=55363 loops=1)
   Merge Cond: (issues.id = tags_issues.issue_id)
   ->  Index Scan using issues_pkey on issues  (actual time=0.027..270.557 rows=229991 loops=1)
   ->  Index Scan using tags_issues_issue_id_key on tags_issues  (actual time=0.051..73.903 rows=70052loops=1)
 Total runtime: 605.274 ms
```

explain analyze select * from issues where id = any(array((select issue_id from tags_issues)));

```
                                  QUERY PLAN
---------------------------------------------------------------------------------------------------------
 Bitmap Heap Scan on issues  (actual time=247.358..297.932 rows=55363 loops=1)
   Recheck Cond: (id = ANY ($0))
   InitPlan
     ->  Seq Scan on tags_issues  (actual time=0.017..51.291 rows=70052 loops=1)
   ->  Bitmap Index Scan on issues_pkey  (actual time=246.589..246.589 rows=70052 loops=1)
         Index Cond: (id = ANY ($0))
 Total runtime: 325.205 ms
```

2x!

Postgres Experience > generate_series()

```
select * from
    (select *, (select min(split_date) from tasks
                where tasks.issue_id = issues.id) as split_date
       from issues where org_id = 2) as issues,
    (select generate_series(0,10) + date '2010-01-01' as date) as dates
```

```
QUERY PLAN
----------------------------------------------------------------------------------------
 Nested Loop  (actual time=2.581..2525.798 rows=149666 loops=1)
   ->  Result  (actual time=0.007..0.063 rows=11 loops=1)
   ->  Bitmap Heap Scan on issues  (actual time=2.697..47.756 rows=13606 loops=11)
         Recheck Cond: (public.issues.org_id = 2)
         ->  Bitmap Index Scan on issues_org_id_idx (actual time=1.859..1.859 rows=13607
loops=11)
               Index Cond: (public.issues.org_id = 2)
   SubPlan 1
     ->  Aggregate  (actual time=0.010..0.010 rows=1 loops=149666)
           ->  Index Scan using tasks_issue_id_key on tasks (actual time=0.006..0.008
rows=1 loops=149666)
                 Index Cond: (issue_id = $0)

 Total runtime: 2608.891 ms
```

Postgres Experience > generate_series()

```
select * from
    (select * from issues
        left outer join (
            select issue_id, min(split_date) as split_date from tasks
            where org_id = 2 group by issue_id
        ) tasks
        on (tasks.issue_id = issues.id) where org_id = 2) as issues,
    (select generate_series(0,10) + date '2010-01-01' as date) as dates
```

```
QUERY PLAN
----------------------------------------------------------------------------------------
 Nested Loop  (actual time=174.706..831.263 rows=149666 loops=1)
   ->  Result  (actual time=0.006..0.055 rows=11 loops=1)
   ->  Merge Left Join  (actual time=15.885..60.496 rows=13606 loops=11)
         Merge Cond: (public.issues.id = public.tasks.issue_id)
         ->  Sort  (actual time=8.048..18.068 rows=13606 loops=11)
               ->  Bitmap Heap Scan on issues  (actual time=2.7..55 rows=13606 loops=1)
                     Recheck Cond: (org_id = 2)
                     ->  Bitmap Index Scan on issues_org_id_idx (actual time=1.912..1.>>
                           Index Cond: (org_id = 2)
         ->  Sort  (actual time=7.834..15.519 rows=13202 loops=11)
               ->  HashAggregate  (actual time=62.150..71.767 rows=13202 loops=1)
                     ->  Bitmap Heap Scan on tasks  (actual time=3.177..41.700 rows=18>>
                           Recheck Cond: (org_id = 2)
                           ->  Bitmap Index Scan on tasks_org_id_idx (actual time=2.50>>
                                 Index Cond: (org_id = 2)
 Total runtime: 906.146 ms
```

Outline

- Rails as ORM
- Rails Performance and PostgreSQL
- PostgreSQL Limitations
- **PostgreSQL Approaches**
- Optimizing Database

Postgres Approaches

- Benchmarking/performance
- Distrust vendors
- Sane appreciation of commodity hardware
- Culture of operations
- Release management

Outline

- Rails as ORM
- Rails Performance and PostgreSQL
- PostgreSQL Experience
- PostgreSQL Approaches
- **Optimizing Database**

Optimize Database > Basics

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How to optimize PostgreSQL:

explain analyze

explain analyze

explain analyze

...

Optimize Database > Cold DB Tip

EXPLAIN ANALYZE explains everything, but...

... run it also for the "cold" database state!

Example: complex query which works on 230 000 rows and does 9 subselects / joins:

cold state: **28** sec, hot state: **2.42** sec

Database server restart doesn't help

Need to clear disk cache:

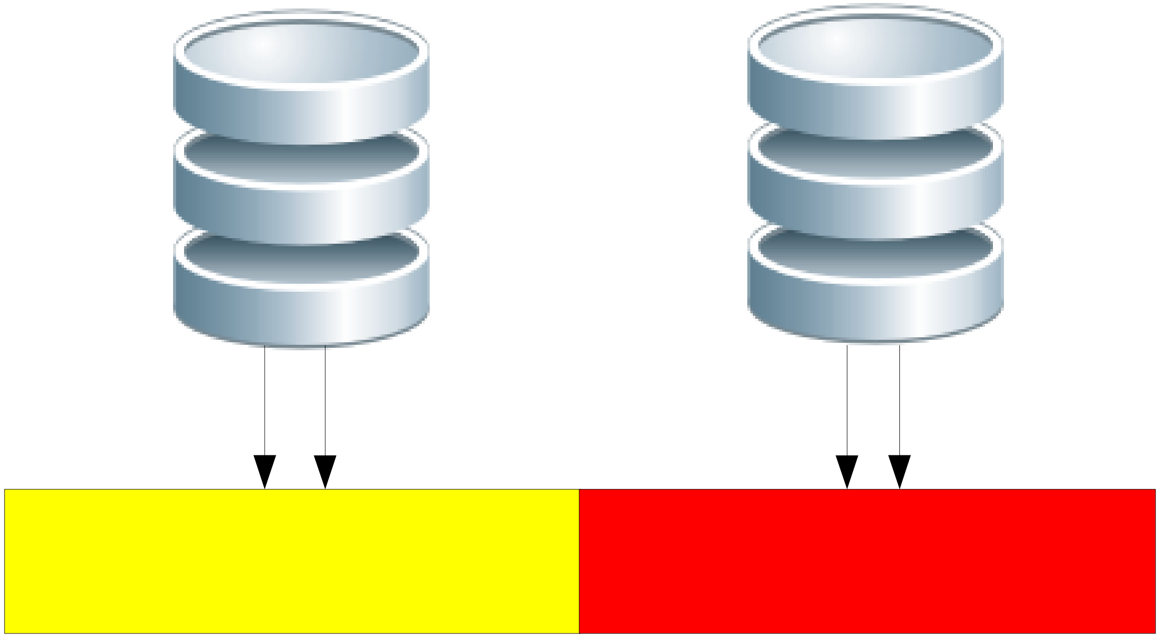
sudo echo 3 | sudo tee /proc/sys/vm/drop_caches

(Linux)

Optimize Database > Shared Database

You're competing for memory cache on a shared server:

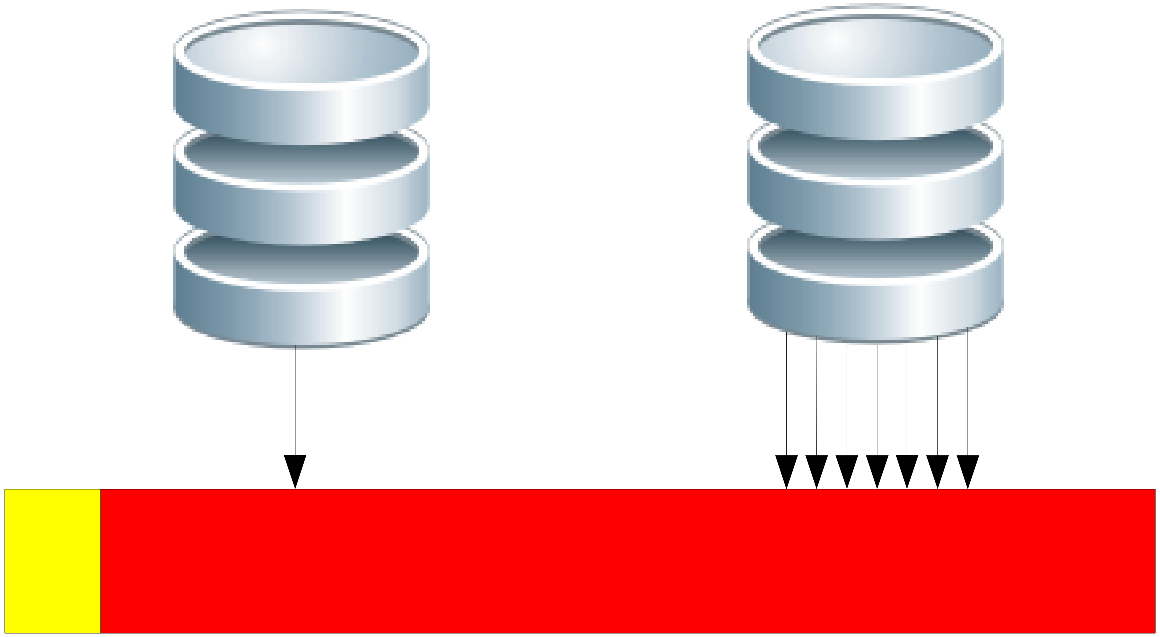
1. two databases with equal load share the cache



Optimize Database > Shared Database

You're competing for memory cache on a shared server:

2. one of the databases gets more load and wins the cache



Optimize Database > Shared Database

As a result, your database can always be in a "cold" state

and you **read data from disk, not from memory!**

complex query which works on 230 000 rows and

does 9 subselects / joins:

from disk: **28** sec, from memory: **2.42** sec

Solutions:

optimize for IO/cold state

```
sudo echo 3 | sudo tee /proc/sys/vm/drop_caches
```

push down SQL conditions

Optimize Database > Postgres Config

```
# How much memory we have to cache the database, RAM_FOR_DATABASE * 3/4
effective_cache_size = <%= ram_for_database.to_i * 3/4 %>MB

# Shared memory to hold data in RAM, RAM_FOR_DATABASE/4
shared_buffers = <%= ram_for_database.to_i / 3 %>MB

# Work memory for queries  (RAM_FOR_DATABASE/max_connections) ROUND DOWN 2^x
work_mem = <%= 2**(Math.log(ram_for_database.to_i / expected_max_active_connections.to_i)/Math.log(2)).floor %>MB

# Memory for vacuum, autovacuum, index creation, RAM/16 ROUND DOWN 2^x
maintenance_work_mem = <%= 2**(Math.log(ram_for_database.to_i / 16)/Math.log(2)).floor %>MB

# To ensure that we don't lose data, always fsync after commit
synchronous_commit = on

# Size of WAL on disk, recommended setting: 16
checkpoint_segments = 16

# WAL memory buffer
wal_buffers = 8MB

# Ensure autovacuum is always turned on
autovacuum = on

# Set the number of concurrent disk I/O operations that PostgreSQL expects can be executed simultaneously.
effective_io_concurrency = 4
```

Optimize Database > Postgres Config

Effect from better configuration:

Query	Default Settings	Custom Settings	Effect
Aggregation on a large dataset	8205 ms	7685 ms	6%
Query with complex joins and subselects	229 ms	143 ms	38%

Thanks!

Rails performance articles and more:
http://blog.pluron.com

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