GET OVER THE BOUNDARIES BETWEEN CLIENT AND SERVER IN WEB APP DEVELOPMENT

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EuroPython 2017 in Rimini

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WHAT I MEAN WITH **WEB APP**

- an interface to **relational** data
- replacement for **desktop database applications**
- data intensive with features like
  - filtering
  - reordering
- optimized to show many records
- complex forms
- master-detail

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- often heavily customized to meet customer's needs
- narrower user base than public web publishing
- often installed on premise or cloud distributed for intranet use
- usually they are called **SPA**, or Single Page Applications

HOW A WEB APP IS TODAY BUILT USING PYTHON TOOLS?

- develop a database structure that best helps persisting domain data
- pick your server framework
- *optionally* develop an ORM to access the data
- expose the data using REST or some other solution

BUT THEN...

- pick a JavaScript application framework
- develop the application logic and user interaction

DEALING WITH JAVASCRIPT IS INEVITABLE

- even if it has many inconsistencies
- every now and then a new trendy framework appears and reinvents the wheel, in a *cooler* way
- it has a broader developer base than Python
- often the libraries and packages have poor quality

BUT ES6 IS BETTER!

- it is way better than previous iterations
  - Classes
  - Promises
  - iterators
  - generators
  - **Map** and **Set** implemented natively

MY REACTION TO *WEAKMAP* AND *WEAKSET*

- finally! Fantastic!
- What I was waiting for!

BUT THEN I DISCOVERED THAT

- it isn't possible to known which elements or keys (or values) the object contains
- it is equally impossible to iterate over any of them
- it is only possible to check if a given element or key is contained

WHAT?

JS DEVELOPERS SEEMS HAPPY WITH IT

Some have even found an use for them:

From Exploring ES6:

It is impossible to inspect the innards of a WeakMap, to get an overview of them.

[...]

These restrictions enable a security property. Quoting Mark Miller: “The mapping from weakmap/key pair value can only be observed or affected by someone who has both the weakmap and the key. [...]”

They call it **a security property**...

TYPESCRIPT TO THE RESCUE!

Ride the TypeScript hype!

This seems fun to me:

```
class Animal {}
class Bird extends Animal {}

const foo: Array<Bird> = [];

foo.push(new Animal()); // ok in typescript
```

from reddit's blog entry: Why We Chose Typescript of just few days ago

WHAT?

BACK TO PYTHON

THE ROLE OF PYTHON IN MODERN WEB APPS

- the role of the Python server has become that of a *data hub*
- no application-level development, it moved to the JS app… sad
- usually the fun ends with the completion of the **database structure** - **ORM** part

HOW WEB FRAMEWORKS DO THEIR JOB?

Most major Python web frameworks (used to build the server part of our applications) are modeled around HTTP with its **request-response** model

- handlers attach to (choose your level of complexity) resource paths
- a client makes a **request**
- the **request** is the main **context object** often with the help of **session** data.
- objects are created, data is retrieved, a **response** object with numeric result codes and your content is created
- the **response** is serialized, some state is saved to the session
- the objects are destroyed

When do we really need REST APIs we think they are really needed when your application has to interface with other services and your service provides an API to its users.

IS IT POSSIBLE TO IMMAGINE A DIFFERENT MODEL?

Desktop applications using **PyQt** or **PyGTK** are driven completely by Python objects, interfacing with the toolkit's **ui** elements

WELCOME RACCOON

In late 2016 we decided to replace an old application named **Safety** with a new application and develop a new framework along with it to try bring back the fun when developing a web app with Python

Safety is an application to asses and report working environment health risks.

Goodbye **Safety**

Welcome **Raccoon** and **Ytefas** (or ʎʇǝɟɐs made right)

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THE IDEA

- use an **asynchronous system** to ease maintaining the state in the server
- do the same on the client for the state that drives the UI
- connect these two elements with a modern **RPC** and **event system**
- bring some application-level logic back to Python

ASYNC FROM THE GROUND UP

- **PostgreSQL** and PatchDB to define and maintain the database
- **AsyncPG** and **SQLAlchemy** for data access
- Crossbar's **WAMP** router for RPC and events
- aiohttp for **HTTP**

DATA ACCESS LAYER

- SQLAlchemy's ORM cannot be used in an async environment
- ORM is used anyway in tests and to carry field-level metadata
- AsyncPG is fast but has no symbolic query api
- we plugged SQLAlchemy's symbolic query rendering with AsyncPG

RPC

- **Crossbar** has a lot of **features** and supports clients written in any of the major languages used today
- built with **Twisted**, its Python client library supports both Twisted and **asyncio** applications
- it's the primary implementation of a WAMP protocol router
- most of the configuration setup is asynchronous
- uses a dotted string as endpoint/topic address
- error handling
- simple registration/subscription system out of the box

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It's based on a **Node** mixin class

- class level definition of **signals** (events), event handlers, and rpc endpoints
- **Node**'s basic API is composed of just four coroutines:
    - node.node_bind(path, node_context=None, parent=None)
    - node.node_add(name, node)
    - node.node_remove(name)
    - node.node_unbind()

  and the corresponding signals:
    - on_node_bind
    - on_node_add
    - on_node_unbind

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node.node_bind(path, node_context=None, parent=None)
"path" is a dotted string compatible with Crossbar's addresses or a special **Path** instance.
"node_context" is a instance of **NodeContext** which is basically a prototype-like namespace which inherits its members from its parent. Its role is to:

- carry connectivity information and security wrappers
- supplement the role of the **request** object in other frameworks

Path instances with the help of the node_context are pluggable resolvers

EXAMPLE OF THREE NODES INTERACTION IN PYTHON

```python
@pytest.mark.asyncio
async def test_node_communication(connection1, connection2):

    import asyncio
    from metapensiero.signal import Signal, handler
    from raccoon.rocky.node import WAMPNode as Node, Path, call

    await when_connected(connection1)
    await when_connected(connection2)

    ev = asyncio.Event()
    first = Node()

    class Second(Node):
        on_foo = Signal()

        async def call_third(self):
            await self.remote('@third').rpc('hello')

    class Third(Node):
        def __init__(self):
            self.handler_args = None
            self.somenthing = None

        @handler('@first.second')
        def do_on_second_foo(self, *args):
            self.handler_args = args
            ev.set()

        @call
        async def rpc(self, something):
            self.something = something
```

```python
base = Path('test')
second = Second()
third = Third()

await first.node_bind(base + 'first', connection1.new_context())
await third.node_bind(base + 'third', connection2.new_context())
await first.node_add('second', second)

await second.call_third()
await second.on_foo.notify('hello handler')
await ev.wait()

assert third.something == 'hello' and third.handler_args == ('hello handler',)
await first.node_unbind()
await third.node_unbind()
```

.. AND IN JAVASCRIPT

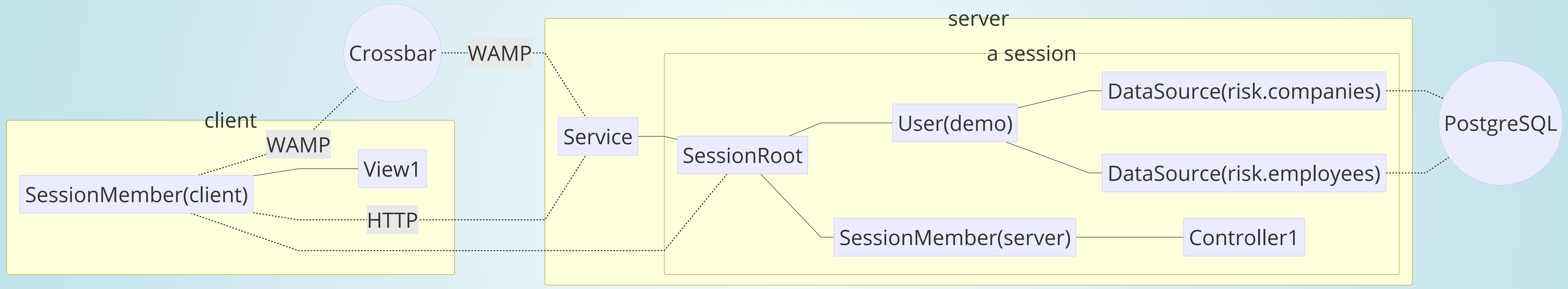
```python
from __globals__ import expect, it, jest

from raccoon__rocky import (WAMPNode as Node, Path, call,
                            Signal, handler, reversed_promise,
                            register_signals)

from raccoon__rocky.testing import gen_ctx

async def test_node_communication():
    ctx1, ctx2 = gen_ctx(), gen_ctx()
    ev = reversed_promise()
    first = Node()

    @register_signals
    class Second(Node):
        on_foo = Signal()

        async def call_third(self):
            await self.remote('@third').rpc('hello')

    @register_signals
```

```python
class Third(Node):
    def __init__(self):
        self.handler_args = None
        self.something = None

    @handler('@first.second')
    def do_on_second_foo(self, *args):
        self.handler_args = args
        ev.resolve()

    @call
    async def rpc(self, something):
        self.something = something
    base = Path('test')
    second = Second()
    third = Third()

    await first.node_bind(base + 'first', ctx1)
    await third.node_bind(base + 'third', ctx2)
    await first.node_add('second', second)

    await second.call_third()
    await second.on_foo.notify('hello handler')
    await ev

    expect(third.something).toEqual('hello')
    expect(third.handler_args).toEqual(('hello handler',))

    await first.node_unbind()
    await third.node_unbind()

it('Basic com works', test_node_communication)
```

REDUCE MIND CONTEXT-SWITCHING BURDEN WHILE CODING BOTH PYTHON AND JS CODE

Raccoon is equally available in both Python and JavaScript thanks to JavaScripthon that we use together with BabelJS and Webpack.
We use the same abstractions like generators, async/await, decorators using the same syntax and producing code that can be run down to Firefox 49 (no, we do not test on IE).

ANATOMY OF A RACCOON USER SESSION



Service is an **aiohttp** application It publishes an entrypoint in **WAMP**
Usually a **Controller** (sever side) and a **View** (client side) are paired together in what's called "a context" and can use relative paths (beginning with '#') to refer to each other resources.

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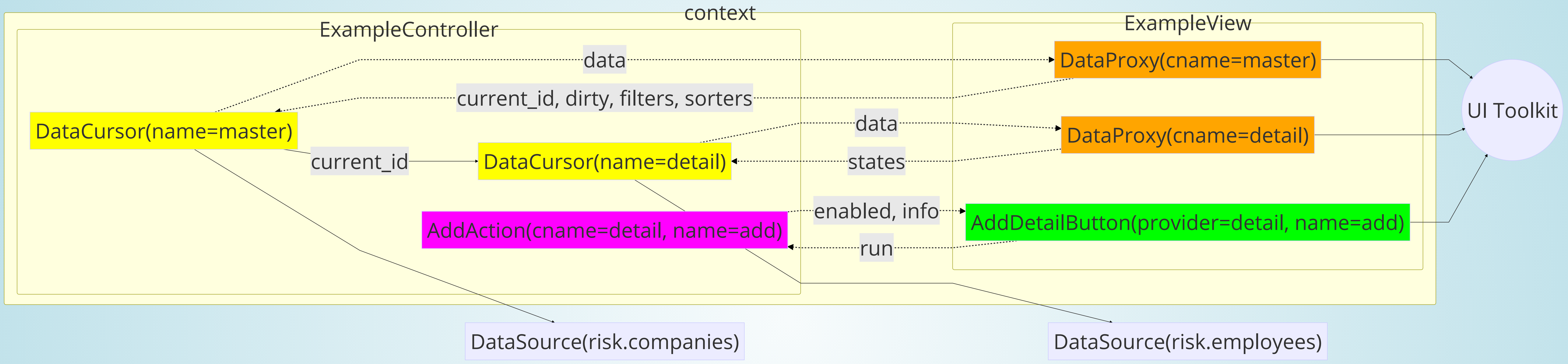
AN EXAMPLE OF A RACCOON APPLICATION **CONTEXT**



- the **controller** has relative address **#controller**
- the **view** has relative address **#view**
- a **cursor** handles data and has notion of a "currentid"
- a **proxy** drives the ui and sends back information about the currentid and if some change is pending (dirty state)
- an action affect the current **context** or can start a new one
- they are all subclasses of **Node**

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DATA SYNCHRONIZATION ORIGINATES ON THE SERVER

- the client sends back to the server status information that allow the server side to re-synchronize its "data sources" and send updates to the client.
- every **Node** is also a "reactive dictionary" (using the metapensiero.reactive package) capable of storing immutable data and automatically notifies interested parties of data changes.
- a change of **currentid** in the "master" cursor triggers a reload (async) of the "detail" cursors that's **tracking** master['current_id'] value.
- this way there is now need to setup "data relations" on the toolkit.

THERE'S **NO ROUTING**

- **Raccoon** borrows the **Intent** concept from Android
- any data that can be expressed using a DataSource (SQL for now) is serializable to a **Content** instance
- a **Controller** declares conditions that must be fullfilled for it to be elected as a candidate
- the most important is the kind of **Operation** it can "realize" (view, create, edit, pick...)

AN EXAMPLE

Some textual examples:

- the **Desktop** context/view gets executed because is the only one that can do the operation "view" on an "auth.user" content, the user that just logged in

```
class Desktop(Controller):
    OPERATION = OPERATIONS.VIEW
    CONTENT = {(Content.source == 'auth.users') & (Content.len == 1)}
    CURSORS = {
        'user': 'auth.users',
    }
    VIEW = {
        'type': 'Desktop',
    }

    class Logout(Action):

        ID = 'logout'
        CATEGORIES = ('session',)
        LABEL = _('Logout')
        HINT = _('Leave this session.')
        ICON = 'sign-out'
```

```
@call
async def run(self):
    await self.remote('#view').logout()
```

SCALING

- our server probably consumes more memory that other frameworks
- deploied using docker containers in a Rancher environment
- can be scaled *HAProxy* and Rancher's service *sidekiks*

FINALLY

- **Raccoon** isn't public yet but it will be when it's in good shape (documentation, pluggability, more tests) and we decided on the license.
- if you are interested in a demo account to try **Ytefas** and play with it or simply want to know more just **ask me** or **drop me a line**.
  Thank you
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