



AGH UNIVERSITY OF SCIENCE
AND TECHNOLOGY

Databases II: Not Only SQL

Apache CouchDB has started. Time to relax.
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- www.couchdb.org
- Apache Foundation
- Erlang

Django may be built for the Web, but CouchDB is built of the Web. I've never seen software that so completely embraces the philosophies behind HTTP. CouchDB makes Django look old-school in the same way that Django makes ASP look outdated.

— Kaplan-Moss, Django developer

- HTTP
- Document
- No schema
- JSON
- Replication
- Multi-Version Concurrency Control (MVCC)
- Stateless connection



AGH How to talk to the database?

API: <https://docs.couchdb.org/en/stable/api>
An example using curl:

```
$ curl -X GET http://awing.kis.agh.edu.pl:5984/
```

```
{"couchdb":"Welcome","version":"1.0.1"}
```

```
$ curl -X GET http://awing.kis.agh.edu.pl:5984/_all_dbs
```

```
["_users"]
```



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How to create a new database?

```
$ curl -X PUT http://awing.kis.agh.edu.pl:5984/announcements  
  
{ "ok": true }  
  
$ curl -X GET http://awing.kis.agh.edu.pl:5984/_all_dbs  
  
[ "announcements", "_users" ]  
  
$ curl -X PUT http://awing.kis.agh.edu.pl:5984/announcements  
  
{ "error": "file_exists",  
  "reason": "The database could not be created,  
            the file already exists." }
```



```
$ curl -X PUT http://awing.kis.agh.edu.pl:5984/  
to_delete
```

```
{"ok":true}
```

```
$ curl -X DELETE http://awing.kis.agh.edu.pl:5984/  
to_delete
```

```
{"ok":true}
```

```
$ curl -X GET http://awing.kis.agh.edu.pl:5984/  
_all_dbs
```

```
["announcements", "_users"]
```

```
$ curl -X GET http://awing.kis.agh.edu.pl:5984/  
announcements/_all_docs
```

```
{"total_rows":0,"offset":0,"rows":[]}
```




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Inserting data, a new document

```
$ curl -X POST http://awing.kis.agh.edu.pl:5984/  
announcements  
-H "Content-Type: application/json"  
-d  
'{"course":"ADS" , "subject":"class cancelled"}'  
  
{"ok":true,  
 "id":"5474fe40a47e9e554f03bb2def74f425",  
 "rev":"1-952bd6fd9cf92592c0370f2c30713dd2"}
```

Revision: subsequent_number-MD5 (document)



AGH Inserting data

```
$ curl -X GET http://awing.kis.agh.edu.pl:5984/  
announcements/_all_docs
```

```
{"total_rows":1,"offset":0,"rows":  
[{"id":"5474fe40a47e9e554f03bb2def74f425",  
  "key":"5474fe40a47e9e554f03bb2def74f425",  
  "value":{"rev":"1-952bd6fd9cf92592c0370f2c30713dd2"}}]  
]}
```

```
$ curl -X GET http://awing.kis.agh.edu.pl:5984/  
announcements/  
5474fe40a47e9e554f03bb2def74f425
```

```
{"_id":"5474fe40a47e9e554f03bb2def74f425",  
  "_rev":"1-952bd6fd9cf92592c0370f2c30713dd2",  
  "course":"ADS","subject":"class cancelled"}
```



It means replacing!

```
$ curl -X PUT http://awing.kis.agh.edu.pl:5984/
  announcements/5474fe40a47e9e554f03bb2def74f425
  -H "Content-Type: application/json"
  -d '{"_id":"5474fe40a47e9e554f03bb2def74f425",
      "_rev":"2-acc9738539da4e04b0af5366131ba0b2",
      "course":"ADS",
      "subject":"class cancelled",
      "date":"2012-03-01"}'

{"ok":true,"id":"5474fe40a47e9e554f03bb2def74f425",
 "rev":"3-a5d979e8767925bcf7de6c27b767ffd7"}
```

```
$ curl -X DELETE http://awing.kis.agh.edu.pl:5984/  
announcements/5474fe40a47e9e554f03bb2def74f425?  
rev=3-a5d979e8767925bcf7de6c27b767ffd7
```

```
{"ok":true,  
"id":"5474fe40a47e9e554f03bb2def74f425",  
"rev":"4-a903837c8891e7d400a91e44d4291e2e"}
```



You can use your own identifiers:

```
$ curl -X PUT http://awing.kis.agh.edu.pl:5984/  
      announcements/my1  
      -H "Content-Type: application/json"  
      -d '{"course":"ADS",  
          "subject":"finals are coming",  
          "date":"2012-04-01"}'  
  
{ "ok":true,  
  "id":"my1",  
  "rev":"1-b1805cae2fbae27e6bc929a5b16672b1" }
```

```
$ curl -X GET http://awing.kis.agh.edu.pl:5984/  
announcements/_all_docs
```

```
{ "total_rows": 3, "offset": 0, "rows": [  
  { "id": "5474fe40a47e9e554f03bb2def74f42d",  
    "key": "5474fe40a47e9e554f03bb2def74f42d",  
    "value": { "rev": "2-8fafd9f0ee6bbcdf1753d5e310f02c75" } },  
  { "id": "5474fe40a47e9e554f03bb2def750eaa",  
    "key": "5474fe40a47e9e554f03bb2def750eaa",  
    "value": { "rev": "1-02adafaeb85d80139c3dde97e47b367" } },  
  { "id": "my1",  
    "key": "my1",  
    "value": { "rev": "1-b1805cae2fbae27e6bc929a5b16672b1" } }  
]
```

Universally Unique Identifier

```
$ curl -X GET http://awing.kis.agh.edu.pl:5984/_uuids  
  
{"uuids":["5474fe40a47e9e554f03bb2def75401d"]}
```

```
$ curl -X PUT http://awing.kis.agh.edu.pl:5984/  
    announcements/my1/  
photo.jpg?rev=1-b1805cae2fbae27e6bc929a5b16672b1  
    --date-binary @photo.jpg  
    -H "Content-Type: image/jpeg"  
  
{ "ok": true,  
  "id": "my1",  
  "rev": "2-29b17212e3635e445f1a009c4d04e384" }
```




AGH Attachments, is it there?

```
$ curl -X GET http://awing.kis.agh.edu.pl:5984/  
announcements/my1
```

```
{ "_id": "my1",  
  "_rev": "2-29b17212e3635e445f1a009c4d04e384",  
  "course": "ADS",  
  "subject": "koniec semestru",  
  "date": "2012-04-01",  
  "_attachments": {  
    "photo.jpg": { "content_type": "image/jpg",  
                  "revpos": 2,  
                  "length": 5240,  
                  "stub": true } } }
```

Attachment access: <http://awing.kis.agh.edu.pl:5984/announcements/my1/photo.jpg>

```
$ curl -X DELETE
http://awing.kis.agh.edu.pl:5984/
    announcements/my1/
    cos.odt?rev=2-29b17212e3635e445f1a009c4d04e384

{"ok":true,"id":"moja1",
 "rev":"3-a158c2c2a0ae7f31effb0402844515d1"}
```

- `map`: executed for every document in the database → key, value
- `reduce`: key, a list of values → value

- Materialized in the database.
- Language: JavaScript.
- Results materialized in the database.
- Data always ordered according to the key (ascending)
- If descending order is needed add to URI:
`descending="true"`
- Limiting output, add to URI: `limit=5`
- Skip output, add to URI: `skip=30`



Argument: document. Output by calling: emit ()

```
function(doc) {  
  if (doc.course=='ADS') {  
    emit(doc.date, { subject: doc.subject,  
                    course: doc.course });  
  }  
}
```



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View, an example JSON object

Lets put the following data in a file: paw.json

```
{ "map" : "  
function(doc) {  
  if (doc.course=='ADS') {  
    emit(doc.date, { subject: doc.subject,  
                    course: doc.course });  
  }  
}  
"}
```



AGH Reduce, an example

```
map:  
function(doc) {  
  if (doc.course=='ADS') {  
    emit(doc.date, 1);  
  }  
}
```

```
reduce:  
function(key,value) {  
  return value;  
}
```



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Reduce, an example, output

```
"2012-04-01" [1]
"2012-03-22" [1, 1]
"2012-03-20" [1]
"2011-11-01" [1]
"2011-10-01" [1]
```




```
function(key,value) {  
    return sum(value);  
}
```

Output:

```
"2012-04-01" 1  
"2012-03-22" 2  
"2012-03-20" 1  
"2011-11-01" 1  
"2011-10-01" 1
```

Alternative code:

```
function(key,value) {  
    n=0;  
    for (var i=0; i<value.length; i++) {  
        n+=value[i];  
    }  
    return n;  
}
```

- <https://docs.couchdb.org/en/stable/ddocs>
- *Design Documents*
- `.../database/_design/name`



```
{
  "_id": "_design/paw",
  "language": "javascript",
  "views":
  {
    "all": {
      "map": "function(doc) {
                if (doc.course == 'ADS')
                  emit(null, doc) }"
    },
    "date": {
      "map": "function(doc) {
                if (doc.course == 'ADS')
                  emit(doc.date, doc.subject) }"
    },
    "howmany": {
```

```
"map": "function(doc) {  
    if (doc.course == 'ADS')  
        emit(doc.date,1) }",  
"reduce": "function(keys, values) {  
    return sum(values) }"  
}  
}
```

```
curl -X PUT http://awing.kis.agh.edu.pl:5984/  
        announcements/_design/paw  
-H "Content-Type: application/json"  
-d @views.json
```



AGH How to use a view? I

```
$ curl -X GET http://awing.kis.agh.edu.pl:5984/  
announcements/_design/paw/_view/date
```

```
{ "total_rows": 5, "offset": 0, "rows": [  
  { "id": "5474fe40a47e9e554f03bb2def75508f",  
    "key": "2011-11-01",  
    "value": "course starts" },  
  { "id": "5474fe40a47e9e554f03bb2def74f42d",  
    "key": "2012-03-20",  
    "value": "class cancelled" },  
  { "id": "5474fe40a47e9e554f03bb2def750ea",  
    "key": "2012-03-22",  
    "value": "test time" },  
  { "id": "5474fe40a47e9e554f03bb2def7545cc",  
    "key": "2012-03-22",  
    "value": "final grades" },
```



```
{ "id":  
  "my1", "key": "2012-04-01",  
  "value": "semester ends"  
}]}
```



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How to use a view, cont.

```
$ curl -X GET http://awing.kis.agh.edu.pl:5984/  
announcements/_design/paw/_view/howmany
```

```
{"rows": [  
  {"key": null, "value": 5}  
]}
```

Ooops, all data thrown at reduce



```
$ curl -X GET http://awing.kis.agh.edu.pl:5984/  
announcements/_design/paw/_view/howmany?group="true"
```

```
{ "rows": [  
  { "key": "2011-11-01", "value": 1 },  
  { "key": "2012-03-20", "value": 1 },  
  { "key": "2012-03-22", "value": 2 },  
  { "key": "2012-04-01", "value": 1 }  
] }
```



```
$ curl -X GET http://awing.kis.agh.edu.pl:5984/  
announcements/_design/paw/_view/all
```

```
{ "total_rows":5, "offset":0, "rows": [  
  { "id": "5474fe40a47e9e554f03bb2def74f42d",  
    "key": null,  
    "value": { "_id": "5474fe40a47e9e554f03bb2def74f42d",  
              "_rev": "2-8fafd9f0ee6bbcdf1753d5e310f02c75",  
              "course": "ADS",  
              "subject": "class cancelled",  
              "date": "2012-03-20" } },  
  { "id": "5474fe40a47e9e554f03bb2def750eaa",  
    "key": null,  
    "value": { "_id": "5474fe40a47e9e554f03bb2def750eaa",  
              ...  
  ]
```



Providing key ranges:

- key, startkey, endkey, keys, skip, limit.
- <https://docs.couchdb.org/en/stable/ddocs>

```
curl -X GET 'http://awing.kis.agh.edu.pl:5984/  
announcements/_design/ogolny/_view/course?key=null'
```

```
curl -X GET 'http://awing.kis.agh.edu.pl:5984/  
announcements/_all_docs?  
key="5474fe40a47e9e554f03bb2def75508f"'
```

```
curl -X GET 'http://awing.kis.agh.edu.pl:5984/  
announcements/_all_docs?  
startkey="5474fe40a47e9e554f03bb2def75508f"'
```



```
curl -X GET 'http://awing.kis.agh.edu.pl:5984/  
announcements/_all_docs?  
startkey="5474fe40a47e9e554f03bb2def75508f"&  
endkey="5474fe40a47e9e554f03bb2def755ef5"'
```

```
curl -X GET 'http://awing.kis.agh.edu.pl:5984/  
announcements/_all_docs?limit=2'
```

```
curl -X GET 'http://awing.kis.agh.edu.pl:5984/  
announcements/_all_docs?key="_design/paw"'
```



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Bulk document API

`https://docs.couchdb.org/en/stable/api`



Let's have a *reduce* function:

```
function (key, values, rereduce) {  
    return sum(values);  
}
```

rereduce can be one of:

- false, key-values from *map*

```
reduce([ ... ],  
       [value1,value2,value3],  
       false)
```

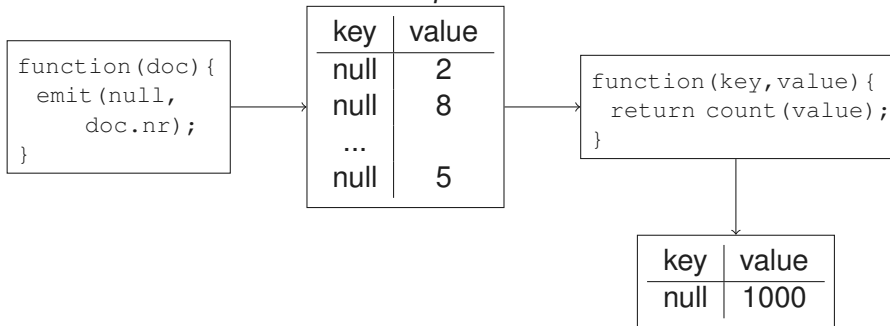
- true, key-values from *reduce*

```
reduce(null,  
       [value1,value2,value3],  
       true)
```



AGH Reduce, Houston we have a PROBLEM!

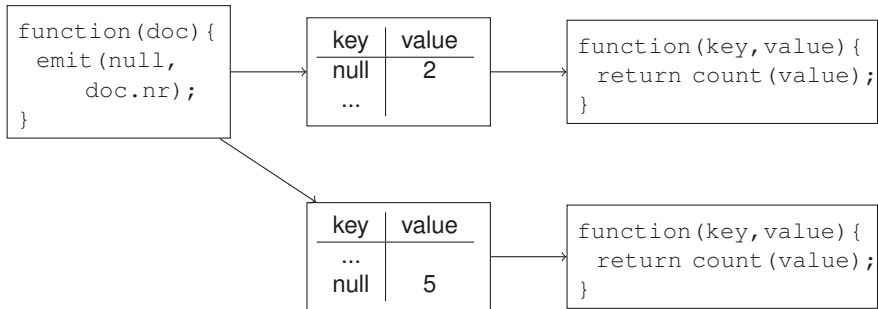
Let's assume 1000 docs from *map*:

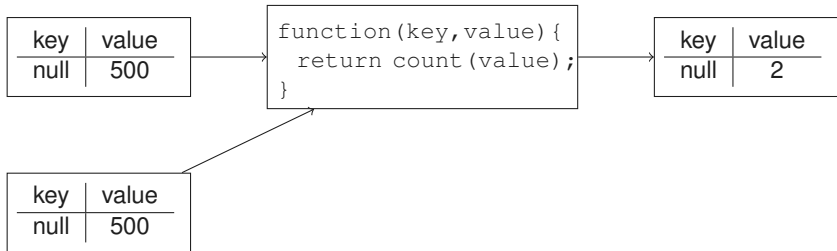


It might NOT WORK!



AGH How does reduce work? I







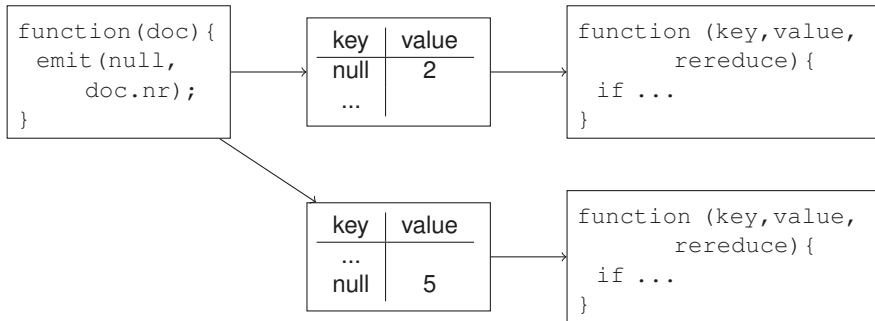
AGH Rereducer, an example

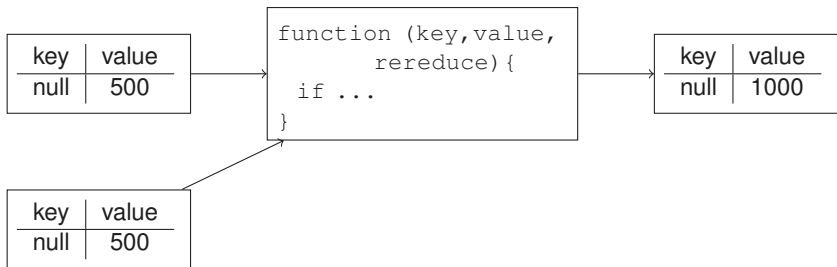
Bad:

```
function (keys, values) {  
  return count(values);  
}
```

Good:

```
function (keys, values, rereduce) {  
  if (rereduce===false) {  
    return count(values);  
  } else {  
    return sum(values);  
  }  
}
```







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Reduce built-in functions

- `_sum`
- `_count`
- `_stats`

- WWW interface (?!)
- `http://server.somewhere:5984/_utils`
- Quirk: to make reduce work reload the page.