# GETTING STARTED WITH NoSQL

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- The problem with SQL
- History of NoSQL
- Database theories
- Modeling
- Patterns

## THE PROBLEM WITH SQL

- Designed to run on large servers
- Built for Vertical Scaling
- Separated Models i.e. Tables

## IN DEVELOPMENT

- We assemble objects as a whole
  - Cart
  - Order
  - Profile
  - Product
- Saving objects requires
  - Deconstructing
  - Multiple rows
  - Multiple tables

## IMPEDANCE MISTMATCH

*"The object-relational impedance mismatch is a set of conceptual and technical difficulties that are often encountered when a relational database management system (RDBMS) is being used by a program written in an object-oriented programming language or style, particularly when objects or class definitions are mapped in a straightforward way to database tables or relational schema." - Wikipedia*

YOU CAN IGNORE SQL
AND TRUST THE ORM MAGIC
memegenerator.net

## Google BigTable

## Amazon DynamoDB

## NoSQL

## No SQL

# N̲ot o̲nly SQL

# #nosql

## WHAT IS NOSQL?

- non-relational
- cluster friendly
- generally open-source
- 21st century
- schema-less

## TYPES OF NOSQL DATABASES

- Key-Value: Redis, Riak, Memcached
- Column-family: Cassandra, HBase, BigTable
- Document: CouchDB, Couchbase, MongoDB
- Graph: Neo4J, Giraph, OrientD

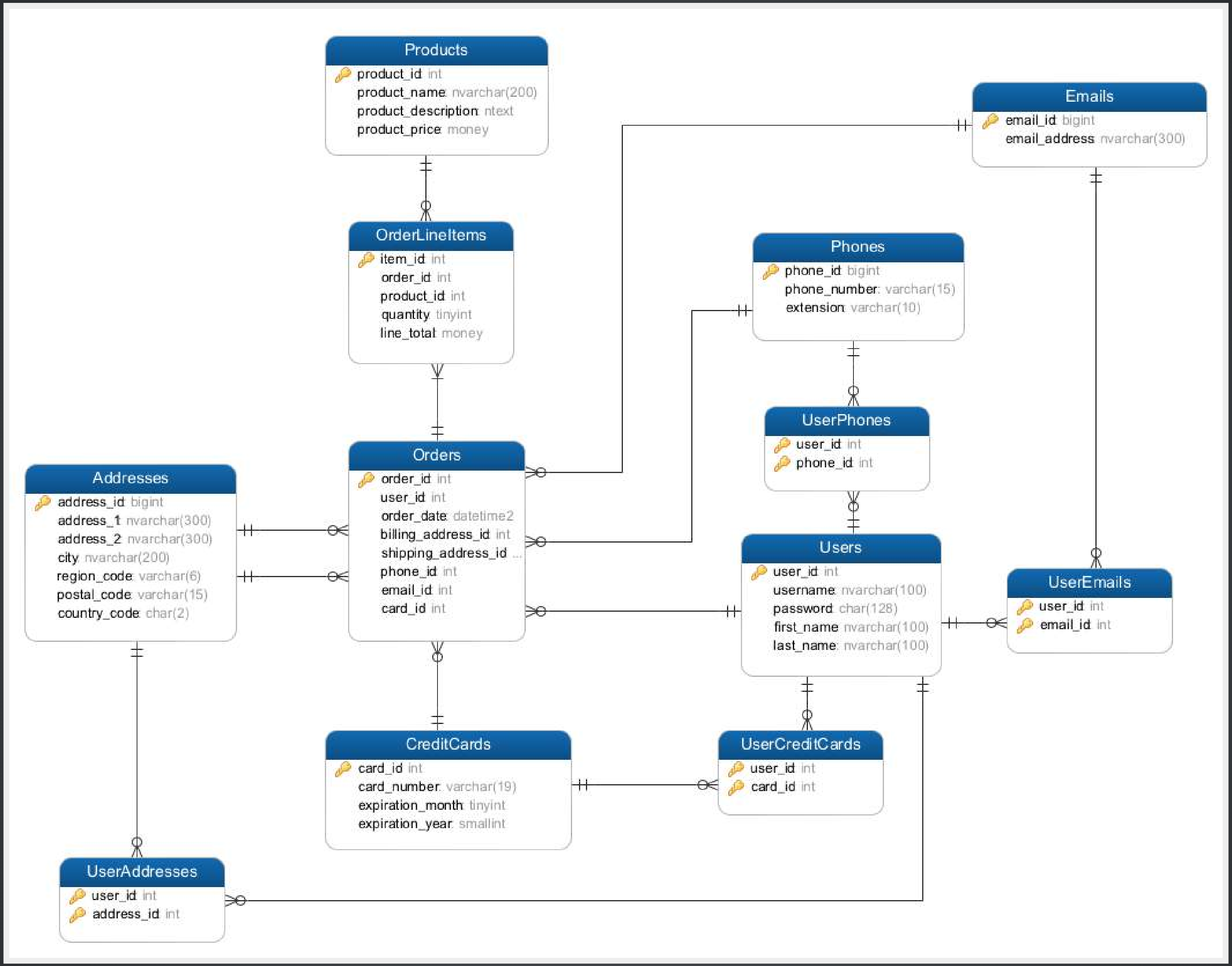
## AGGREGATES

```
// Order.cfc
component accessors="true"{
        property="order_id" type="numeric";
        property="order_date" type="date";
        property="products" type="array";
        property="user_id" type="numeric";
        property="billing_address_1" type="string";
        property="billing_address_2" type="string";
        property="billing_city" type="string";
        property="billing_region_code" type="string";
        property="billing_postal_code" type="string";
        property="billing_country_code" type="string";
        property="shipping_address_1" type="string";
        property="shipping_address_2" type="string";
        property="shipping_city" type="string";
        property="shipping_region_code" type="string";
        property="shipping_postal_code" type="string";
        property="shipping_country_code" type="string";
        property="card_number" type="string";
        property="expiration_month" type="numeric";
        property="expiration_year" type="numeric";
}
```

```
// Order.cfc
component accessors="true"{
         property="order_id" type="numeric";
         property="order_date" type="date";
         property="products" type="array";
         property="user" type="User";
         property="billing" type="Address";
         property="shipping" type="Address";
         property="cc_info" type="CreditCard";
}
```

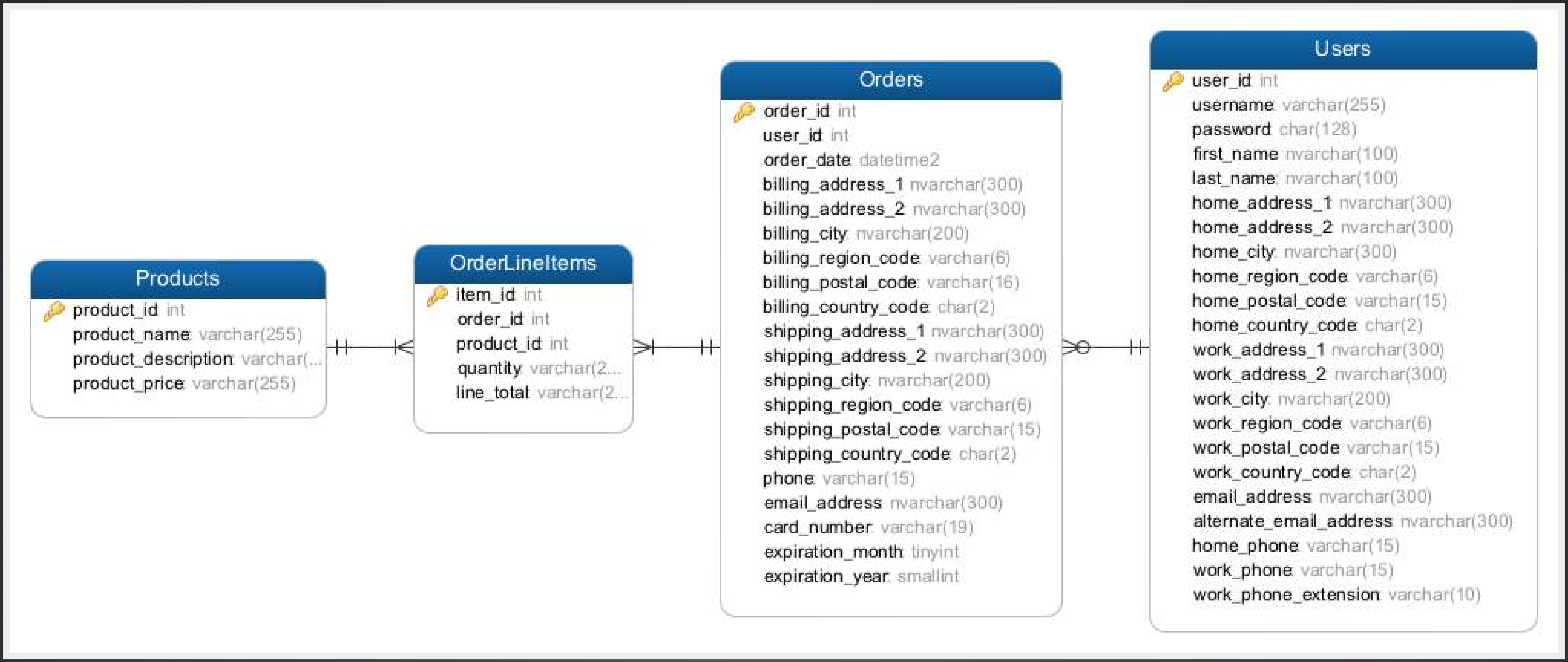
## NORMALIZATION

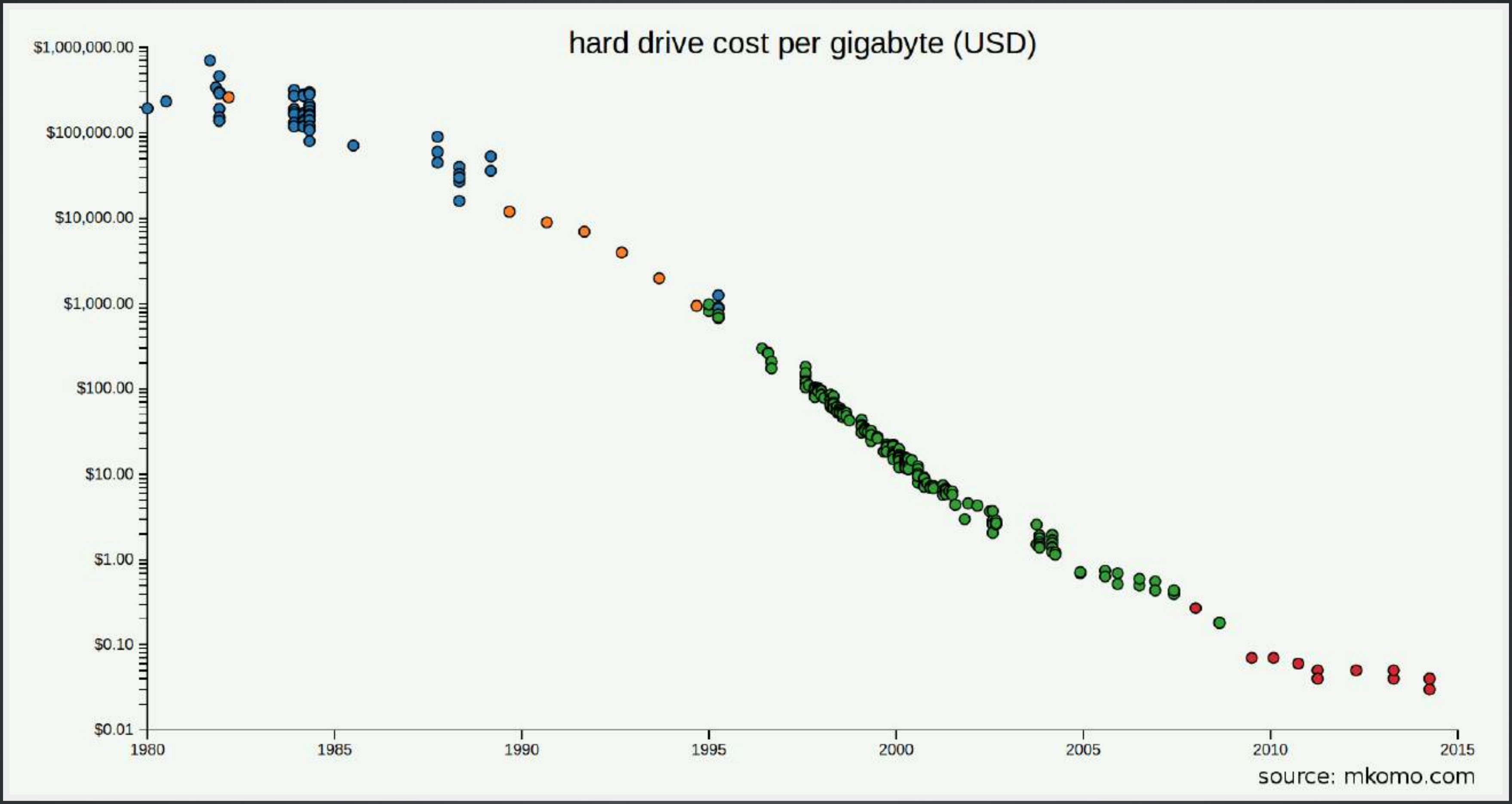
- Minimize data redundancy
- Structured models
- Logical queries
- Fast inserts / updates
- Less storage requirements


Products
product_id int
product_name nvarchar(200)
product_description ntext
product_price money
Emails
email_id bigint
email_address nvarchar(300)
OrderLineItems
item_id int
order_id int
product_id int
quantity tinyint
line_total money
Phones
phone_id bigint
phone_number varchar(15)
extension varchar(10)
UserPhones
user_id int
phone_id int
Addresses
address_id bigint
address_1 nvarchar(300)
address_2 nvarchar(300)
city nvarchar(200)
region_code varchar(6)
postal_code varchar(15)
country_code char(2)
Orders
order_id int
user_id int
order_date datetime2
billing_address_id int
shipping_address_id ...
phone_id int
email_id int
card_id int
Users
user_id int
username nvarchar(100)
password char(128)
first_name nvarchar(100)
last_name nvarchar(100)
UserEmails
user_id int
email_id int
CreditCards
card_id int
card_number varchar(19)
expiration_month tinyint
expiration_year smallint
UserCreditCards
user_id int
card_id int
UserAddresses
user_id int
address_id int

## DENORMALIZATION

- Minimize JOINs
- Fast reads
- Repeated data
- More storage


Products
product_id int
product_name varchar(255)
product_description varchar(...
product_price varchar(255)
OrderLineItems
item_id int
order_id int
product_id int
quantity varchar(2...
line_total varchar(2...
Orders
order_id int
user_id int
order_date datetime2
billing_address_1 nvarchar(300)
billing_address_2 nvarchar(300)
billing_city nvarchar(200)
billing_region_code varchar(6)
billing_postal_code varchar(16)
billing_country_code char(2)
shipping_address_1 nvarchar(300)
shipping_address_2 nvarchar(300)
shipping_city nvarchar(200)
shipping_region_code varchar(6)
shipping_postal_code varchar(15)
shipping_country_code char(2)
phone varchar(15)
email_address nvarchar(300)
card_number varchar(19)
expiration_month tinyint
expiration_year smallint
Users
user_id int
username varchar(255)
password char(128)
first_name nvarchar(100)
last_name nvarchar(100)
home_address_1 nvarchar(300)
home_address_2 nvarchar(300)
home_city nvarchar(300)
home_region_code varchar(6)
home_postal_code varchar(15)
home_country_code char(2)
work_address_1 nvarchar(300)
work_address_2 nvarchar(300)
work_city nvarchar(200)
work_region_code varchar(6)
work_postal_code varchar(15)
work_country_code char(2)
email_address nvarchar(300)
alternate_email_address nvarchar(300)
home_phone varchar(15)
work_phone varchar(15)
work_phone_extension varchar(10)


hard drive cost per gigabyte (USD)
$1,000,000.00
$100,000.00
$10,000.00
$1,000.00
$100.00
$10.00
$1.00
$0.10
$0.01
1980
1985
1990
1995
2000
2005
2010
2015
source: mkomo.com

## TRANSACTION PROCESSING

## ACID

- <u>A</u>tomicity
- <u>C</u>onsistency
- <u>I</u>solation
- <u>D</u>urability

## BASE

- <u>B</u>asically <u>A</u>vailable
- <u>S</u>oft State
- <u>E</u>ventual Consistency

## ATOMIC TRANSACTIONS

## Aggregate Orientated == NoSQL - Graph

## CONFLICT RESOLUTION

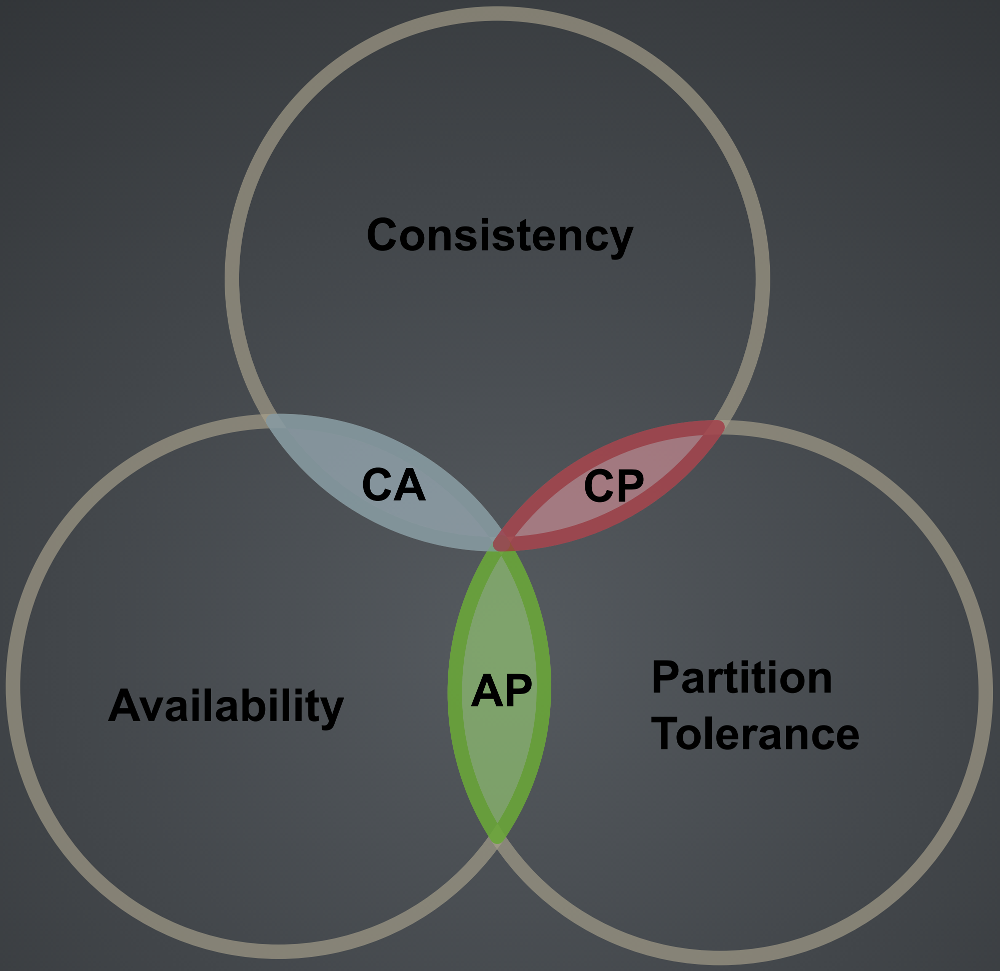
## CONSISTENCY

### SHARDING VS. REPLICATION

## CAP THEOREM

- Consistency
- Availability
- Partition Tolerance

You can only provide 2 of the 3


Consistency
CA
CP
Availability
AP
Partition Tolerance

## RDBMS SCHEMAS

- Known Models
- Fixed Fields
- Data types
- Database managed
- Change can be difficult

0:00 / 0:09

## NOSQL SCHEMAS

- Any type of data
- Flexible
- Application managed
- Change is easy

0:00 / 0:14

## IMPLICIT SCHEMA

~~SCHEMA-LESS~~

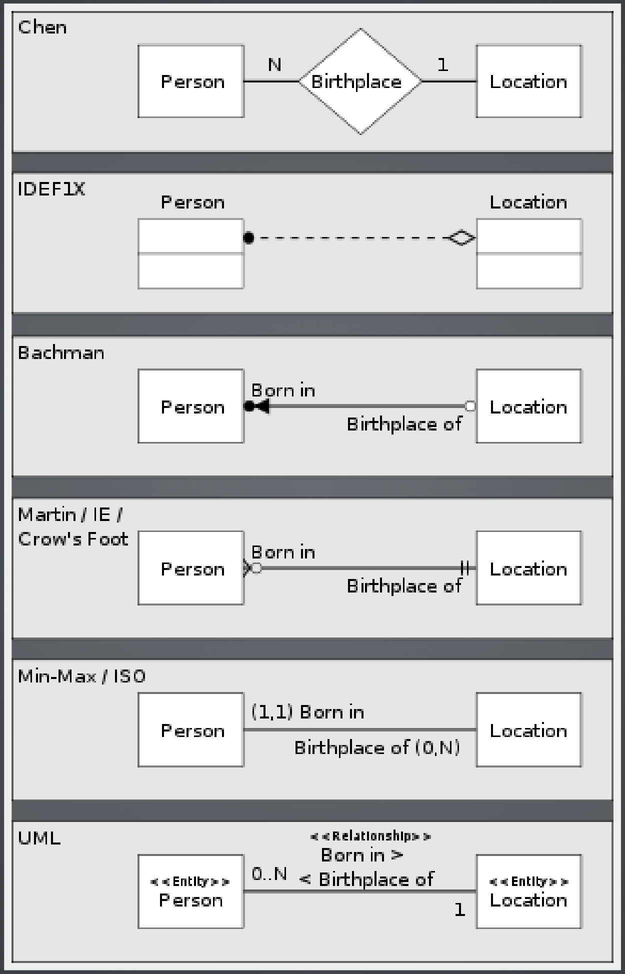
## DATA / ENTITY RELATIONSHIP MODELING

- Conceptual Data Model
- Logical Data Model
- Physical Data Model

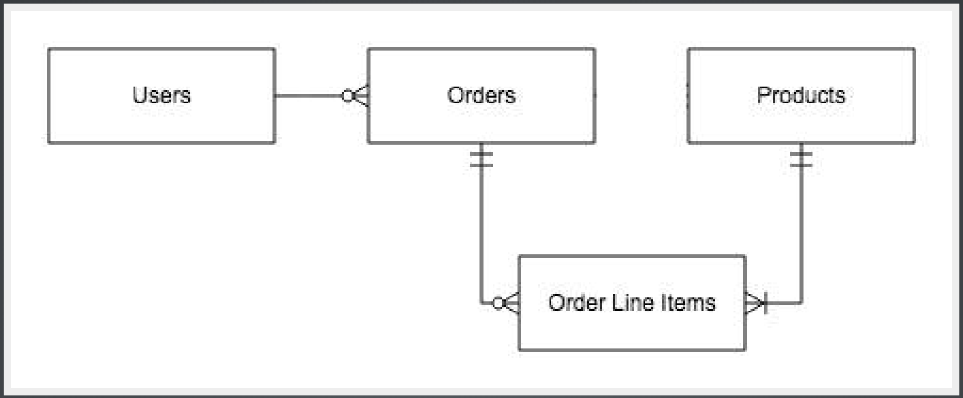
## CONCEPTUAL DATA MODEL

- Entity Names
- Entity Relationships

# MODELING NOTATIONS



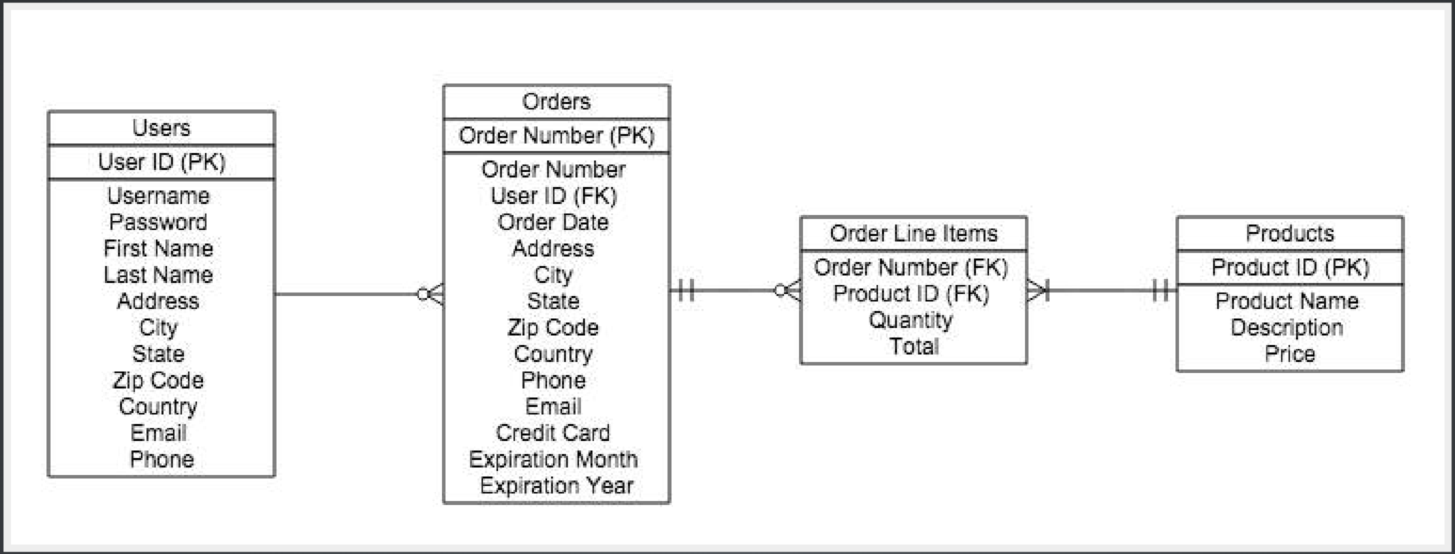
## CONCEPTUAL DATA MODEL



## LOGICAL DATA MODEL

- Entity Names
- Entity Relationships
- Attributes
- Primary / Foreign Keys

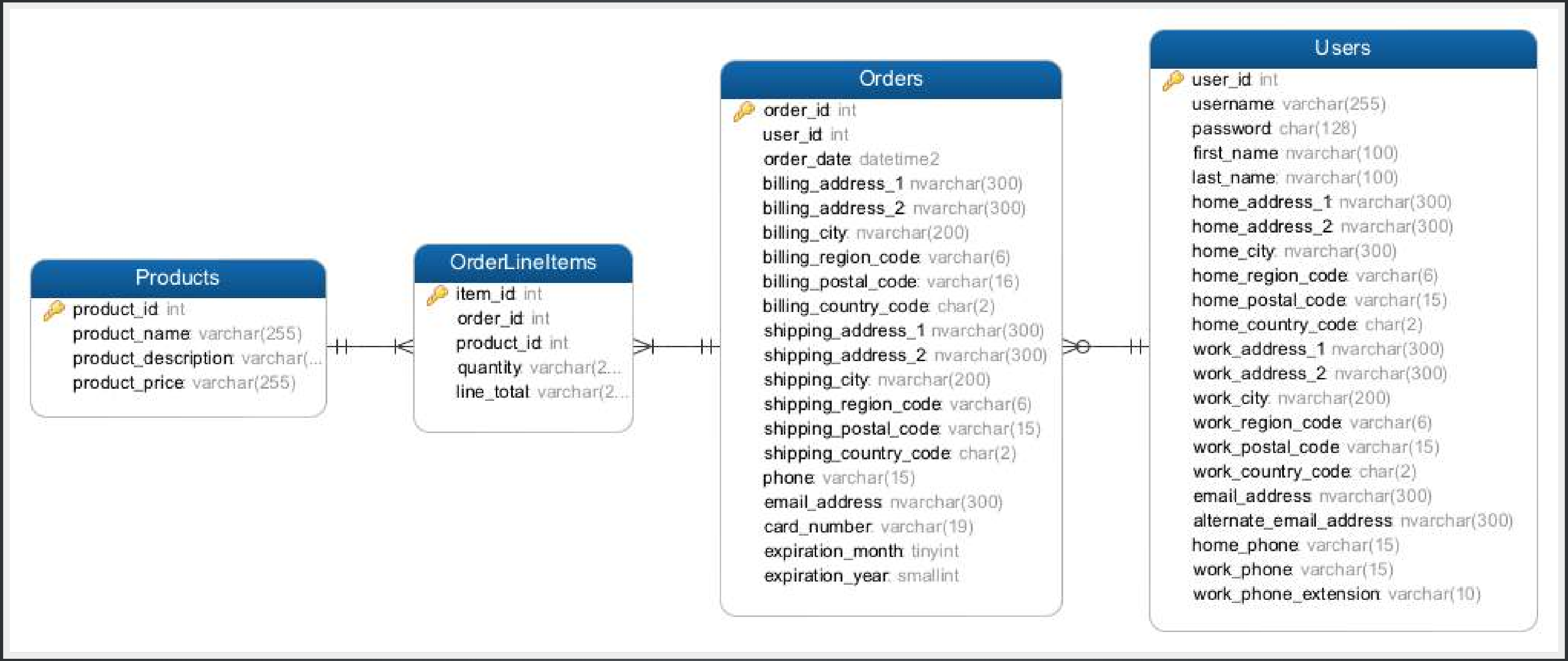
# LOGICAL DATA MODEL



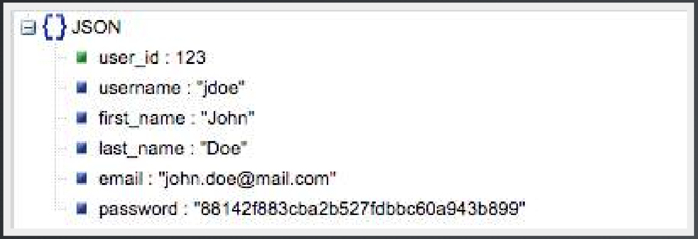
## PHYSICAL DATA MODEL

- Entity -> Table Names
- Attributes -> Field Names
- Keys -> Primary / Foreign Keys
- Data Types

# PHYSICAL DATA MODEL


Products
product_id: int
product_name: varchar(255)
product_description: varchar(...
product_price: varchar(255)
OrderLineItems
item_id: int
order_id: int
product_id: int
quantity: varchar(2...
line_total: varchar(2...
Orders
order_id: int
user_id: int
order_date: datetime2
billing_address_1: nvarchar(300)
billing_address_2: nvarchar(300)
billing_city: nvarchar(200)
billing_region_code: varchar(6)
billing_postal_code: varchar(16)
billing_country_code: char(2)
shipping_address_1: nvarchar(300)
shipping_address_2: nvarchar(300)
shipping_city: nvarchar(200)
shipping_region_code: varchar(6)
shipping_postal_code: varchar(15)
shipping_country_code: char(2)
phone: varchar(15)
email_address: nvarchar(300)
card_number: varchar(19)
expiration_month: tinyint
expiration_year: smallint
Users
user_id: int
username: varchar(255)
password: char(128)
first_name: nvarchar(100)
last_name: nvarchar(100)
home_address_1: nvarchar(300)
home_address_2: nvarchar(300)
home_city: nvarchar(300)
home_region_code: varchar(6)
home_postal_code: varchar(15)
home_country_code: char(2)
work_address_1: nvarchar(300)
work_address_2: nvarchar(300)
work_city: nvarchar(200)
work_region_code: varchar(6)
work_postal_code: varchar(15)
work_country_code: char(2)
email_address: nvarchar(300)
alternate_email_address: nvarchar(300)
home_phone: varchar(15)
work_phone: varchar(15)
work_phone_extension: varchar(10)

## PHYSICAL DATA MODEL IN NOSQL



```
{} JSON
   user_id : 123
   username : "jdoe"
   first_name : "John"
   last_name : "Doe"
   email : "john.doe@mail.com"
   password : "88142f883cba2b527fdbbc60a943b899"
```

```
{
 "user_id": 123,
 "username": "jdoe",
 "first_name": "John",
 "last_name": "Doe",
 "email": "john.doe@mail.com",
 "password": "88142f883cba2b527fdbbc60a943
}
```

```yaml
type: object
properties:
  _id:
    type: string
    description: The ID of the document
  user_id:
    type: integer
    description: > An auto-incremented number from `users_counter`
    that is the ID of the user
  first_name:
    type: string
    description: The users first name
  last_name:
    type: string
    description: The users last name
  username:
    type: string
    description: A unique username chosen by the user
  friends:
    type: array
    description: An array of user_id who the user is friends with
  created_on:
    type: integer
    description: An epoch time in seconds when the user was created
```

## KEY DESIGN

- Prefixing
- Predictable
- Counter ID
- Unpredictable
- Combinations

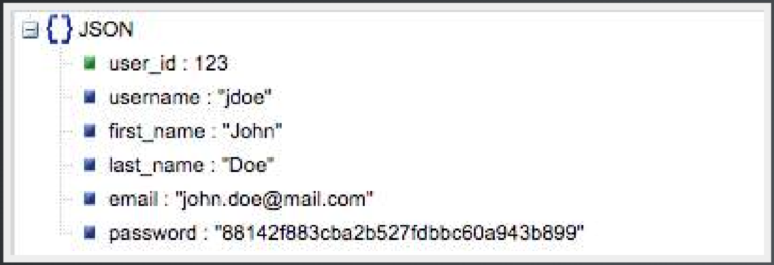
## PREFIXING

- user_123
- u::john.doe@mail.com
- user-123
- user_123_orders

- order_123
- o::john.doe@mail.com
- product-123
- user_123_orders

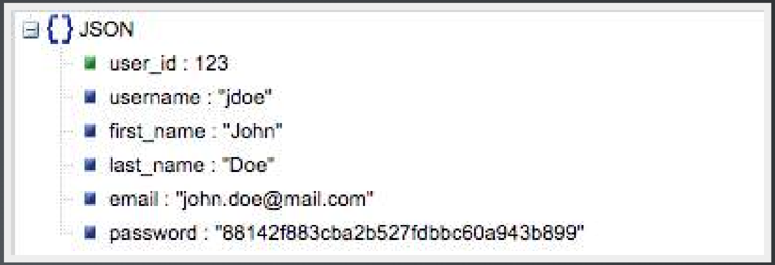
## PREDICTABLE

Key: user_john.doe@mail.com



```
{} JSON
  user_id : 123
  username : "jdoe"
  first_name : "John"
  last_name : "Doe"
  email : "john.doe@mail.com"
  password : "88142f883cba2b527fdbbc60a943b899"
```

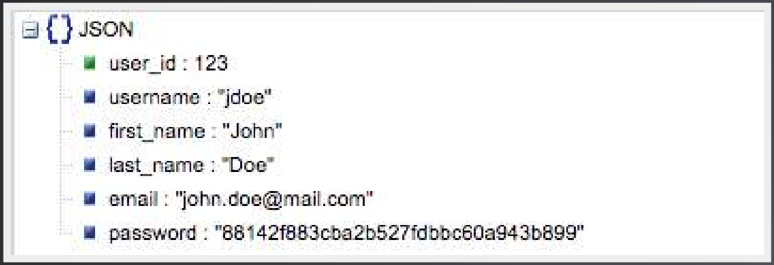
Key: user_jdoe



```
{} JSON
  user_id : 123
  username : "jdoe"
  first_name : "John"
  last_name : "Doe"
  email : "john.doe@mail.com"
  password : "88142f883cba2b527fdbbc60a943b899"
```

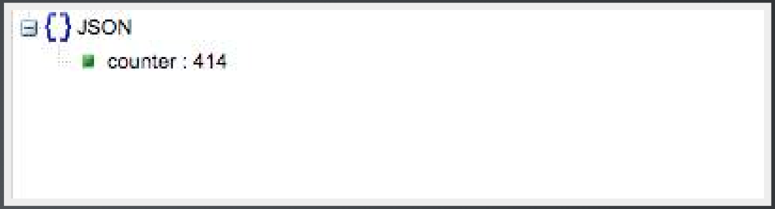
## COUNTER ID

Key: user_123



```
JSON
  user_id : 123
  username : "jdoe"
  first_name : "John"
  last_name : "Doe"
  email : "john.doe@mail.com"
  password : "88142f883cba2b527fdbbc60a943b899"
```

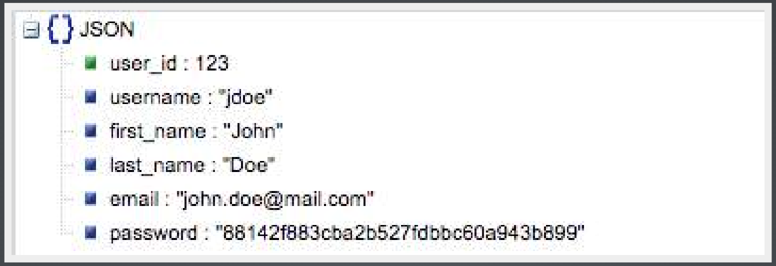
Key: user_counter



```
JSON
  counter : 414
```

## UNPREDICTABLE

Key: 23ad6bac-7599-4874-af98-7af734027834



```
{} JSON
   user_id : 123
   username : "jdoe"
   first_name : "John"
   last_name : "Doe"
   email : "john.doe@mail.com"
   password : "88142f883cba2b527fdbbc60a943b899"
```

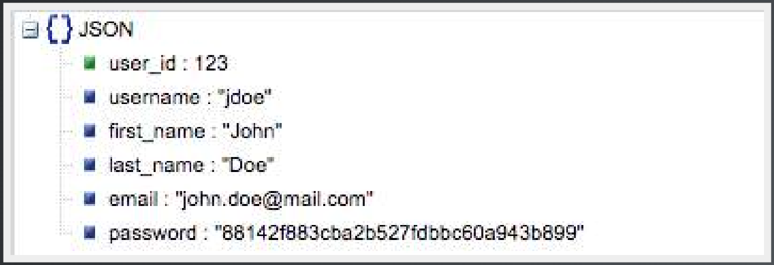
## COMBINATIONS

- user_123_preferences
- user_jdoe_order_23ad6bac-7599-4874-af98-7af734027834
- user_john.doe@mail.com_comment_5664

## DOCUMENT PATTERNS

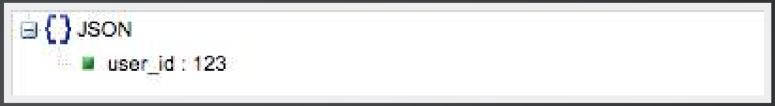
## LOOKUP PATTERN

Key: user_123



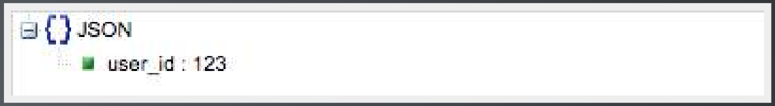
```
JSON
  user_id : 123
  username : "jdoe"
  first_name : "John"
  last_name : "Doe"
  email : "john.doe@mail.com"
  password : "88142f883cba2b527fdbbc60a943b899"
```

Key: user_john.doe@mail.com



```
JSON
  user_id : 123
```

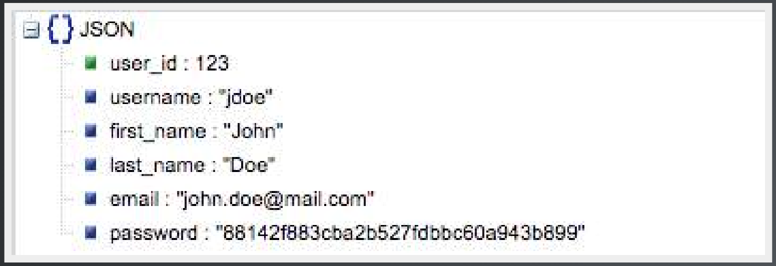
Key: user_jdoe



```
JSON
  user_id : 123
```

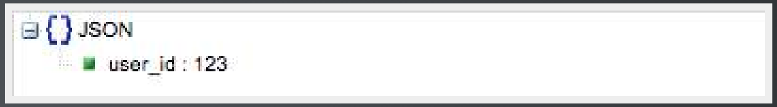
# LOOKUP PATTERN FOR AUTH

Key: user_123



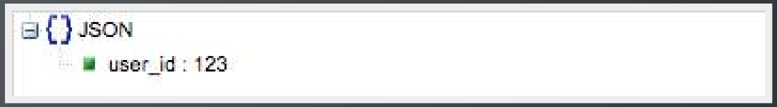
```
JSON
  user_id : 123
  username : "jdoe"
  first_name : "John"
  last_name : "Doe"
  email : "john.doe@mail.com"
  password : "88142f883cba2b527fdbbc60a943b899"
```

Key: user_john.doe@mail.com_
88142f883cba2b527fdbbc60a943b8



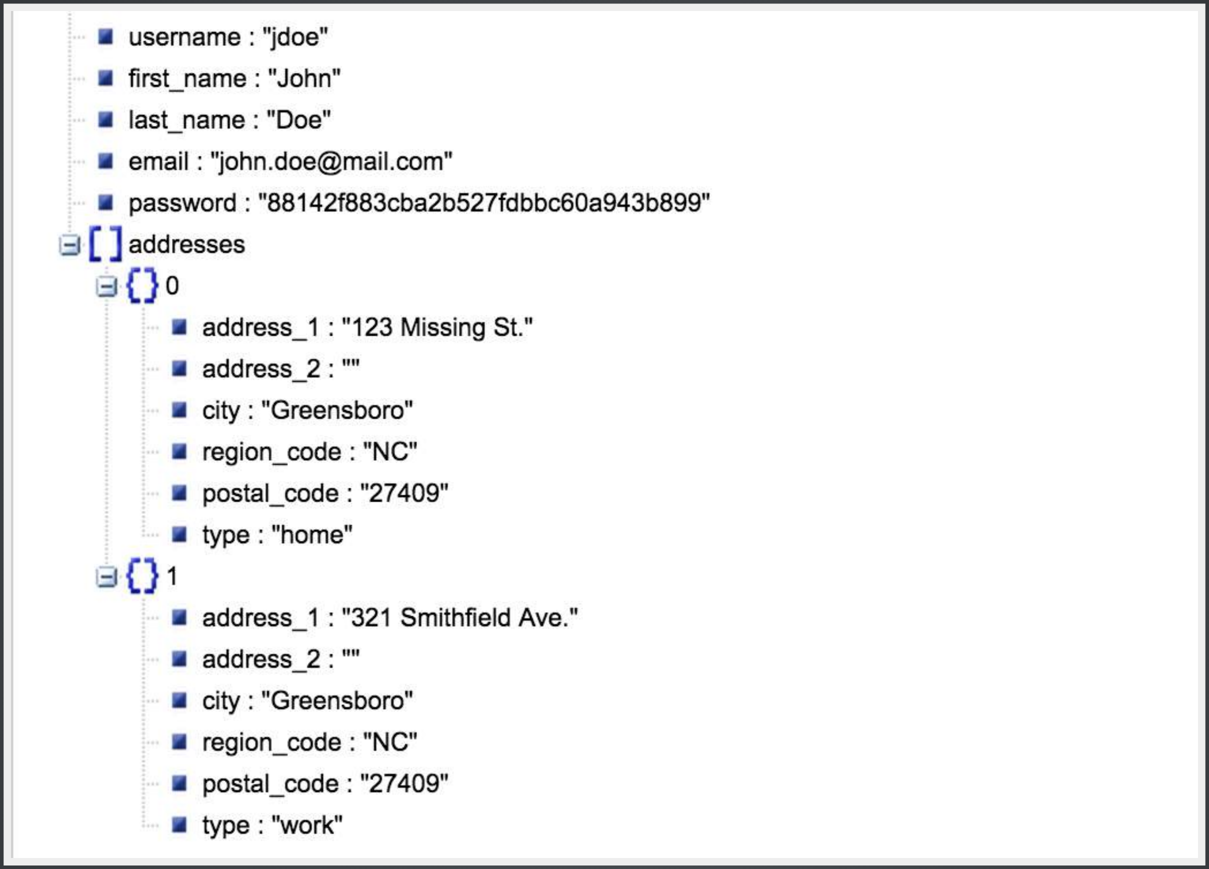
```
JSON
  user_id : 123
```

Key: user_jdoe_
88142f883cba2b527fdbbc60a943b8



```
JSON
  user_id : 123
```

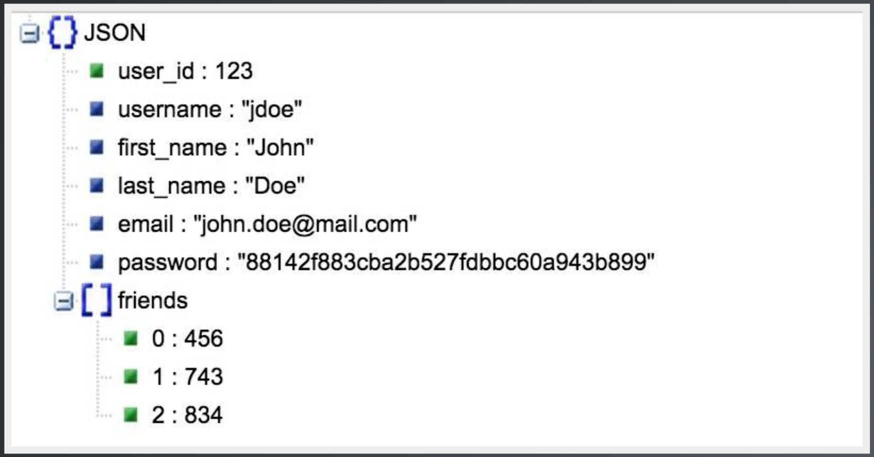
## EMBEDDING



```
username : "jdoe"
first_name : "John"
last_name : "Doe"
email : "john.doe@mail.com"
password : "88142f883cba2b527fdbbc60a943b899"
[ ] addresses
  { } 0
    address_1 : "123 Missing St."
    address_2 : ""
    city : "Greensboro"
    region_code : "NC"
    postal_code : "27409"
    type : "home"
  { } 1
    address_1 : "321 Smithfield Ave."
    address_2 : ""
    city : "Greensboro"
    region_code : "NC"
    postal_code : "27409"
    type : "work"
```

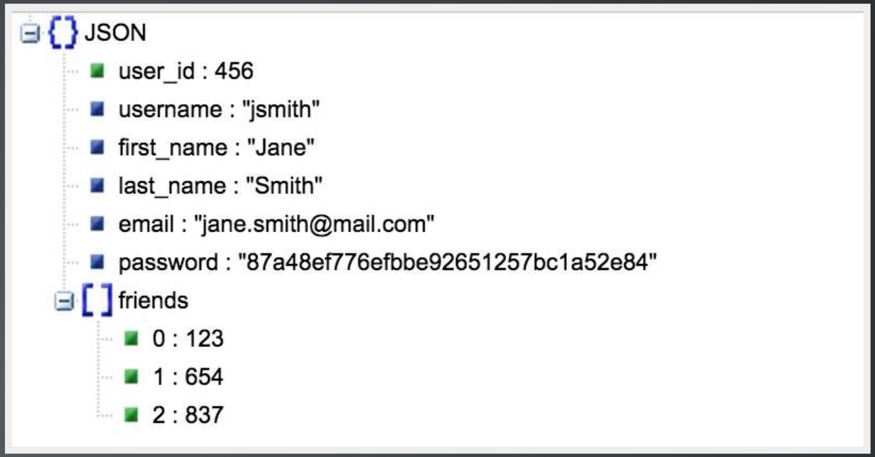
## REFERRING / LINKING

Key: user_123



```
{} JSON
   user_id : 123
   username : "jdoe"
   first_name : "John"
   last_name : "Doe"
   email : "john.doe@mail.com"
   password : "88142f883cba2b527fdbbc60a943b899"
  [] friends
     0 : 456
     1 : 743
     2 : 834
```

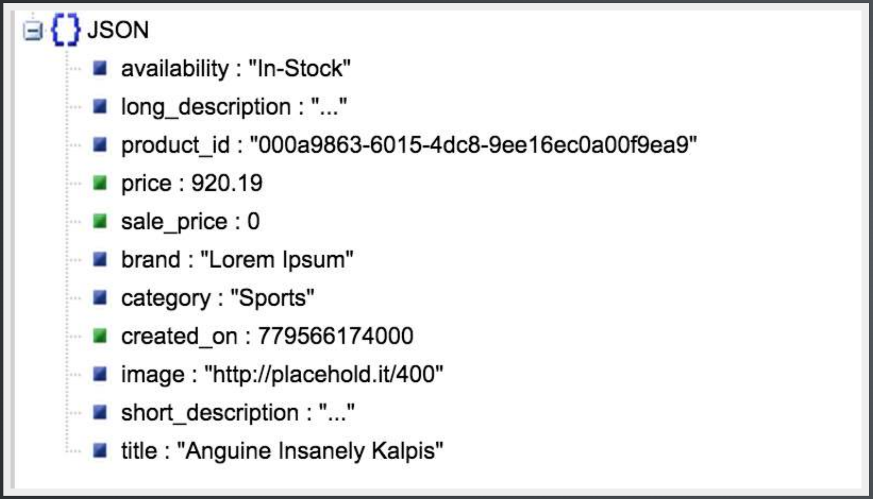
Key: user_456



```
{} JSON
   user_id : 456
   username : "jsmith"
   first_name : "Jane"
   last_name : "Smith"
   email : "jane.smith@mail.com"
   password : "87a48ef776efbbe92651257bc1a52e84"
  [] friends
     0 : 123
     1 : 654
     2 : 837
```

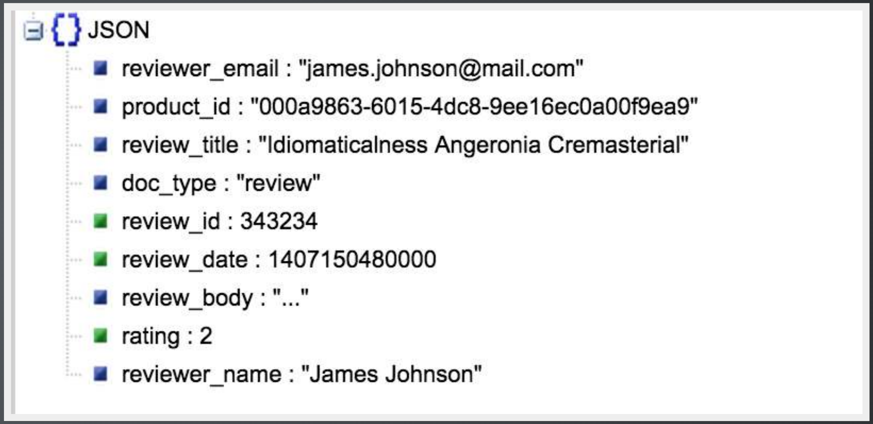
## PARENT-REFERENCING

Key: product_000a9863-6015-4dc8-9ee16ec0a00f9ea9



```
{} JSON
  availability : "In-Stock"
  long_description : "..."
  product_id : "000a9863-6015-4dc8-9ee16ec0a00f9ea9"
  price : 920.19
  sale_price : 0
  brand : "Lorem Ipsum"
  category : "Sports"
  created_on : 779566174000
  image : "http://placehold.it/400"
  short_description : "..."
  title : "Anguine Insanely Kalpis"
```

Key: product_000a9863-6015-4dc8-9ee16ec0a00f9ea9_review_343234



```
{} JSON
  reviewer_email : "james.johnson@mail.com"
  product_id : "000a9863-6015-4dc8-9ee16ec0a00f9ea9"
  review_title : "Idiomaticalness Angeronia Cremasterial"
  doc_type : "review"
  review_id : 343234
  review_date : 1407150480000
  review_body : "..."
  rating : 2
  reviewer_name : "James Johnson"
```

## FAKEIT

Inspired by Swagger, fakeit is a CLI data generator based on YAML models that outputs JSON, YAML, CSON, or CSV formats

```
npm install fakeit -g
```

- https://www.npmjs.com/package/fakeit
- https://github.com/bentonam/fakeit
- https://github.com/bentonam/fakeit-examples

## FAKEIT

- Generate fixed or random number of documents per model
- Event Transforms: Pre / Post Run, Pre / Post Build
- Data generation via FakerJS, ChanceJS, Custom or Static
- Data Typing
- Model Dependencies
- JSON, YAML, CSON, CSV output formats
- Output to File, Zip, Couchbase or Sync Gateway

```yaml
name: Users
type: object
key: _id
data:
  min: 200
  max: 500
  pre_run: >
    globals.user_counter = 0;
properties:
  id:
    type: string
    data:
      post_build: "return 'user_' + this.user_id;"
  type:
    type: string
    data:
      value: "user"
  user_id:
    type: integer
    data:
      build: "return ++globals.user_counter;"
  name:
    type: string
    data:
      fake: "{{name.firstName}} {{name.lastName}}"
  phone:
    type: string
    data:
      build: "return chance.phone();"
  created_on:
    type: string
    data:
      fake: "{{date.past}}"
      post_build: "return new Date(this.created_on).toISOString();"
```

## FAKEIT DEMO

## Is SQL Going Away?

**NO**

## CONSIDERATIONS

- How do you work with your data?
- Do you work with the same aggregates all the time?
- What are you trying to achieve?
- Where are you starting at?
- Do you need finite data and highly complex relationships?
- Is the tabular structure working for you?
- Do you want to scale vertically or horizontally?
- Does your data need to be data centralized or decentralized?

## QUESTIONS?

## SLIDES AVAILABLE AT:

bit.ly/gsw-nosql

## RESOURCES

- Introduction to NoSQL by Martin Fowler
- Relationships are Hard NoSQL Data Modeling by Curt Gratz
- Workshop: NoSQL Data Modelling by Jan Steemann
- CAP Twelve Years Later: How the "Rules" Have Changed by Eric Brewer
- NoSQL Databases: An Overview by Pramod Sadalage