Life Beyond Relational Database

Capital Match Team

2016-03-10

Agenda

- Introduction

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- Event-Sourcing Model

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- Implementation & Usage

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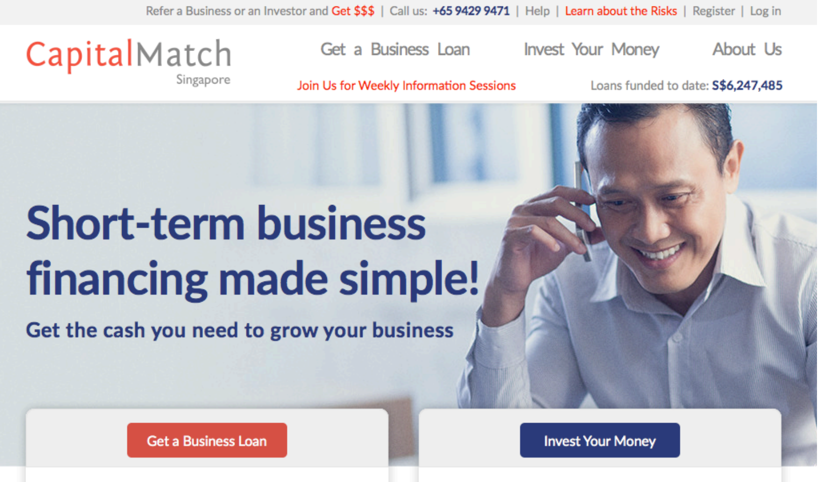
- Future works

Introduction

Who are we?



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Invest Your Money

Short-term business financing made simple!

Get the cash you need to grow your business

Figure 1:

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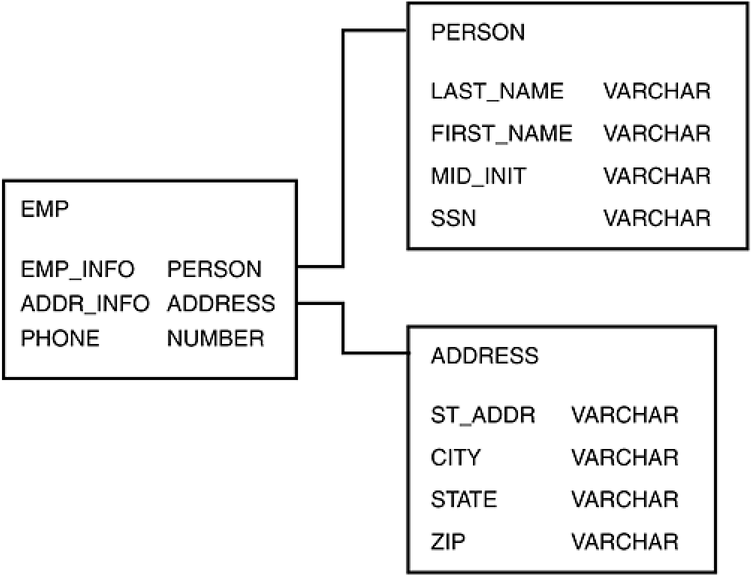
- Core Development team of $3 + 1$: Amar, Arnaud, Guo Liang, Zhou Yu

Relational Model



EMP

EMP_INFO	PERSON
ADDR_INFO	ADDRESS
PHONE	NUMBER

PERSON

LAST_NAME	VARCHAR
FIRST_NAME	VARCHAR
MID_INIT	VARCHAR
SSN	VARCHAR

ADDRESS

ST_ADDR	VARCHAR
CITY	VARCHAR
STATE	VARCHAR
ZIP	VARCHAR

Figure 2:

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- Ubiquitous

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- **Mutable State**

Figure 3:

Event Sourcing

State vs. Transitions

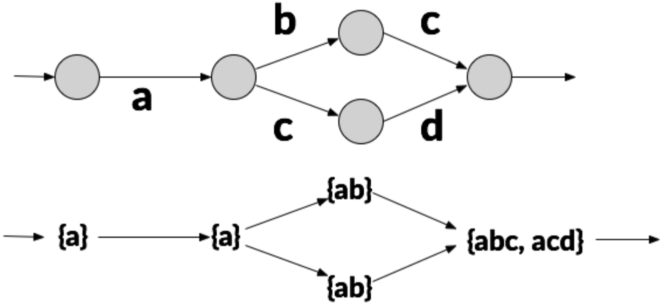

Figure 4:

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- ... But we are also interested in the **transitions** ...
- ... And state[1] can always be reconstructed from a *sequence of transitions*.

[1] Assuming state is deterministic of course

The Event Sourcing Model

> *Event Sourcing ensures that all changes to application state are stored as a sequence of events. Not just can we query these events, we can also use the event log to reconstruct past states, and as a foundation to automatically adjust the state to cope with retroactive changes.*
>
> *Martin Fowler*

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- Audit current state and what lead to it
- Implement generic undo/redo mechanism[2]
- Run simulations with different hypothesis over live data
- Cope with data format migrations
- Handle potentially conflicting changes[3]

[2] May require invertible events

[3] That's the way RDBMS handle transactional isolation: Record a *log* of all operations on data then reconcile when transactions are committed

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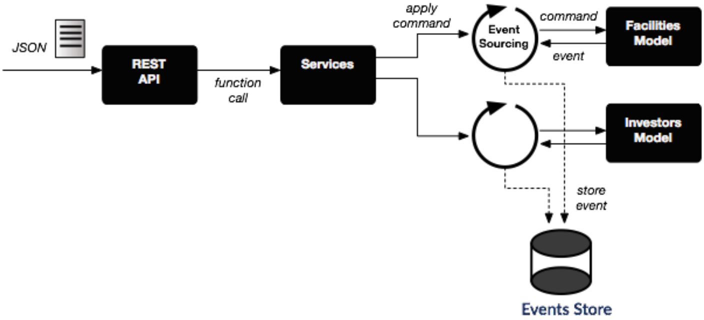
- Provide foundation for Domain Driven Design techniques ⟶ Better business models, Ubiquitous language
- Lead to Event Storming technique for “requirements” elicitation and business domain modelling[4]

[4] I never know how many `l`s modelling takes...

In Practice

Overview



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Pure Business Models

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- Distinguish *Commands* from *Events*

Pure Business Models (2)

- Commands compute Event from State

```
act :: Command -> Model -> Event
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- Events modify model

  ```
  apply :: Event -> Model -> Model
  ```

Effectful Services

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- Services are functions operating *across several contexts*
- They can be synchronous or asynchronous (we use mostly synchronous)[5]
- There are no *distributed transactions*: Service has to cope with failures from each context

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Effectful Services (2)

- We have a monad to express effects and sequencing on each context: `WebStateM`

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newtype WebStateM g l m a = WebStateM { runWebM :: TVar g -
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- `l` is local data, contextual to a single service execution
- `m` is underlying monad, usually `IO`

Events Storage

```
data StoredEvent s = StoredEvent { eventVersion :: EventVersi
                           , eventType   :: EventType s
                                 , eventDate    :: Date
                               , eventUser    :: UserId
                          , eventRequest :: Encoded Hex
                           , eventSHA1   :: Encoded Hex
                            , event       :: ByteString
                                  }
```

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- Each event has a (monotonically increasing) version which is used for proper deserialization
- Events carry useful information for troubleshooting and auditing: User who initiated the request, request id itself, SHA1 representing version of appplication
- Events Store serializes concurrent writes

Software

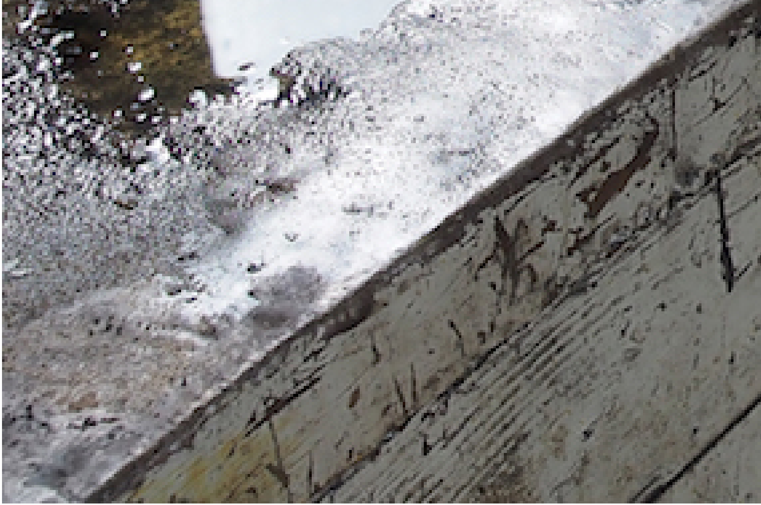

Figure 6: In Practice

Demo

- Anatomy of a complete business model

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    - Web layer w/ servant

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    - Migration code
    - Standalone service
- Using Haskell scripts for operational queries and updates

Future Works

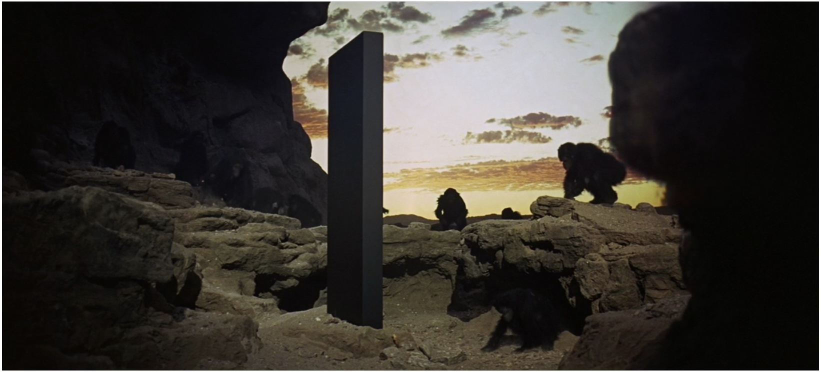

Figure 7:

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- Separate *Read Model* from *Write Model*
- *Write Model*: Append-only linear data store per context, very fast, minimize locking/write time
- *Read model*: Optimized for specific querying, may be relational if needed in order to make it more user-friendly

Make models resilient

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- Use Raft to maintain strong consistency of models: several implementations in Haskell
- Started implementation of practical cluster based on Raft, called raptr

Make models secure

- Turn event stream into a *source of truth* ⟶ Blockchain[6] and beyond...

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Make models secure

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- Juno: Smart contracts over Raft cluster
- Uses cryptographically signed events to ensure history cannot be tampered with
- Turns journal into a “legally binding ledger”?

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Questions?

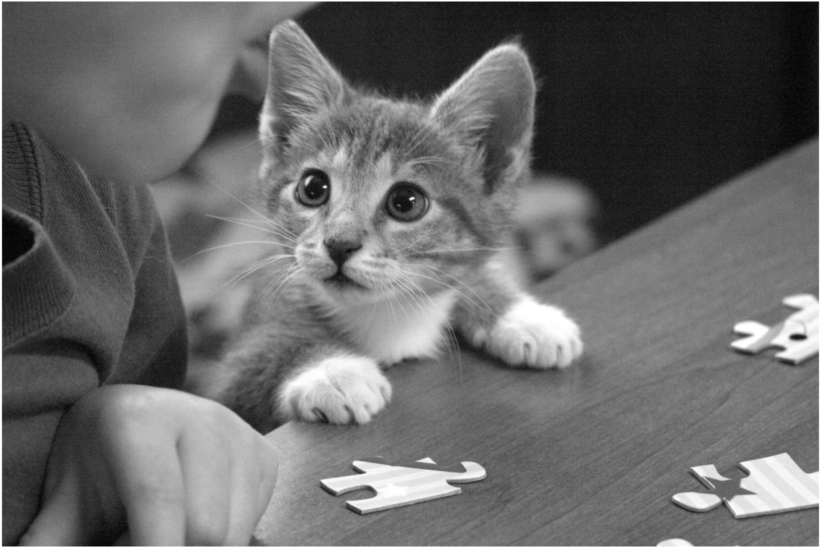

Figure 8:

Credits