

EVENT SOURCING WITH JVM LANGUAGES

Rahul Somasunderam

ABOUT ME

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- Wanted Event Sourcing in 2016

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- Built my own thing - Grooves

ABOUT ME

- Wanted Event Sourcing in 2016
- Didn't like anything I saw
- Built my own thing - Grooves
- I solve problems in Health Care

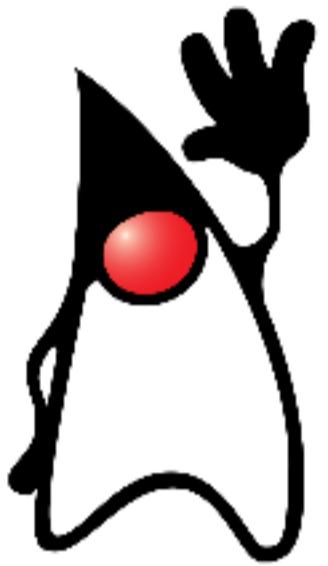
WHERE I WORK



Transcend Insights® empowers population health management with The Platform Above—technology that rises above the data silos and connects care teams with the insights they need to succeed in a value-based care world.

ABOUT YOU

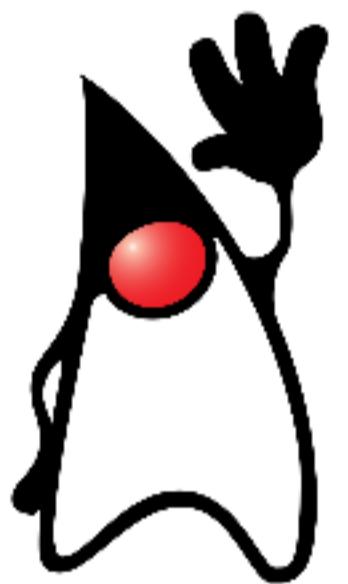
ABOUT YOU



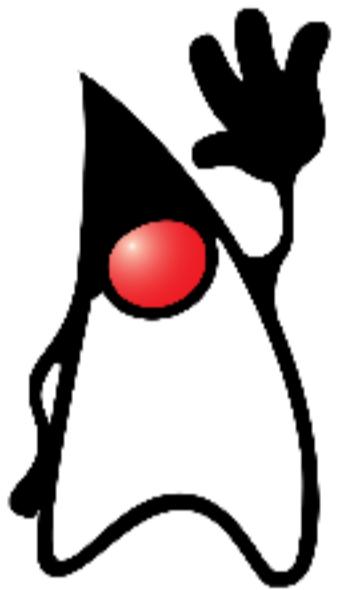
ABOUT YOU



ABOUT YOU



ABOUT YOU



ooo

WHAT IS EVENT SOURCING

Treat your database like you treat your application logs

WHAT DOES THAT MEAN

Create

Read

~~Update~~

~~Delete~~

BAD EXAMPLE 1

Mark and Jane share a bank account. The account has a balance of \$75. Mark goes to an ATM and withdraws \$50. At the same time Jane attempts to withdraw \$50.

This is what our code looks like

```
1 @Transactional  
boolean withdraw(String accountNumber, double amount) {  
    double balance = accountService.getBalance(accountNumber);  
    if (balance > amount) {  
        balance -= amount;  
        accountService.setBalance(accountNumber, balance);  
        return true;  
    } else {  
        return false;  
    }  
}
```

WHAT BANKS TYPICALLY DO

Tag, Monat und Jahr der Eintragung 1	DM-Betrag der Einlage oder Rückzahlung in Buchstaben 2	Betrag der Einlage 3 DM Pf		Betrag der Rückzahlung 4 DM Pf	
05.05.	hiebe - d 86 adikAdi)	87			
07.05.	86 Jh	10			
26.05.	25-	50			
12.06.	9-32	15			
28.06.	86 Technikunivis	26			
09.06.	Ü20	40			

1. Blatt

Guthaben 5 DM Pf	Unterschrift des Beamten und Tagesstempel	
87		
97		
47		
32		
16		
46		

1. Blatt

Nr. 72.259.103

By Deutsche Bundespost (Scan by User:Mattes) - Scan (700dpi, Millionen Farben), Public Domain [Wikimedia](#)

BUT THAT WAS BANKING

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If you can look at your logs and debug your application, you
are already doing that.

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are already doing that.

Banks defined their business model this way hundreds of
years ago.

WHAT ABOUT MY DOMAIN?

```
/* Aggregate */  
class Account {  
    String accountNumber;  
}
```

```
/* Events */  
abstract class Transaction {  
    Account account;  
}  
class AtmWithdrawal  
    extends Transaction {  
    String location;  
    double amount;  
}  
class AtmDeposit  
    extends Transaction {  
    String location;  
    double amount;  
}
```

```
/* Snapshot */  
class AccountSummary {  
    double balance;  
}
```

WHAT ABOUT MY DOMAIN?

```
/* Aggregate */  
class Patient {  
    String identifier;  
    String system;  
}
```

```
/* Events */  
abstract class PatientEvent {  
    Patient patient;  
}  
class MedicationPrescribed  
    extends PatientEvent {  
    String code;  
    int quantity;  
}  
class ProcedurePerformed  
    extends PatientEvent {  
    String code;  
}
```

```
/* Snapshot */  
class PatientSummary {  
    List<String> medications;  
    List<String> procedures;  
}
```

COMPUTING SNAPSHOTS

$$S_N = f(S_0, E_1 \dots E_N)$$

S_N Snapshot at Version N

S_0 empty snapshot

$E_1 \dots E_N$ events from position 1 through N

f query

BUT IT'S NOT THAT SIMPLE

INCREMENTAL COMPUTATION

This is what we would like to do

$$S_N = f(S_K, E_{K+1} \dots E_N)$$

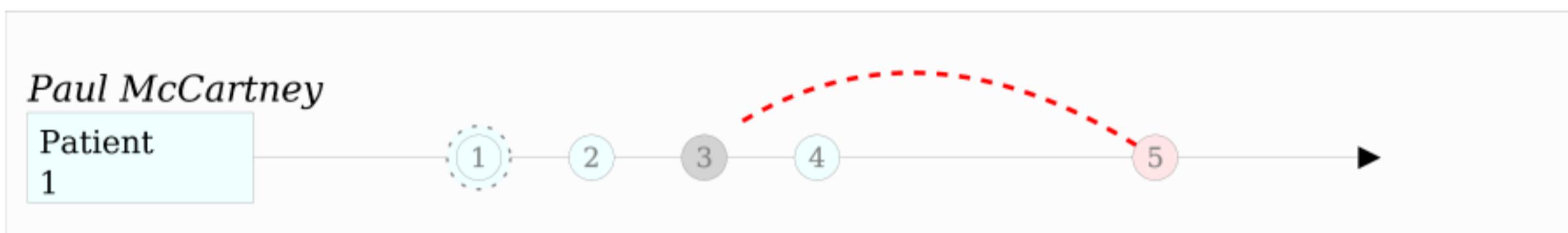
In Mathematics, it's called the distributive property

$$a + b + c = (a + b) + c$$

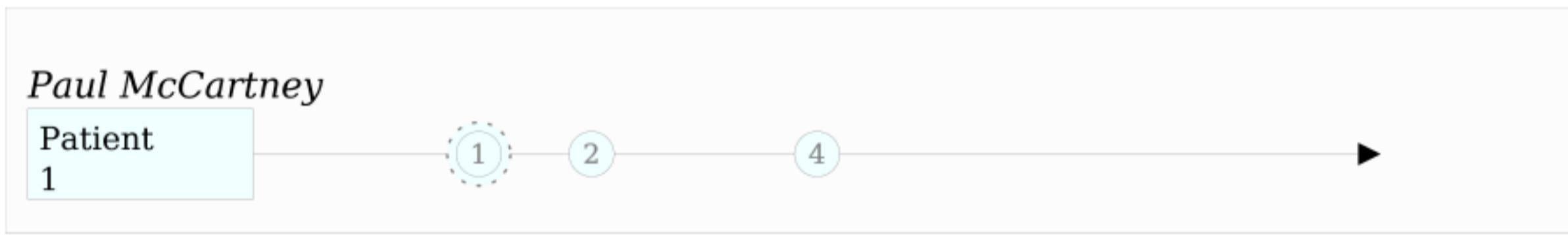
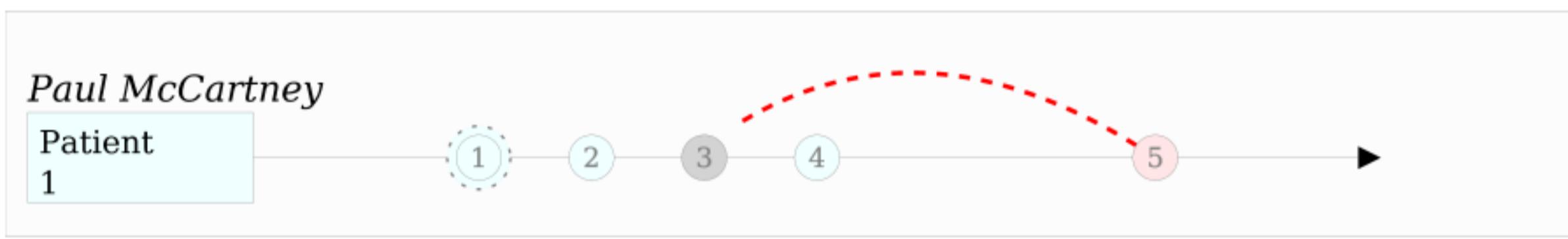
WE'RE NOT DONE YET

There are special events

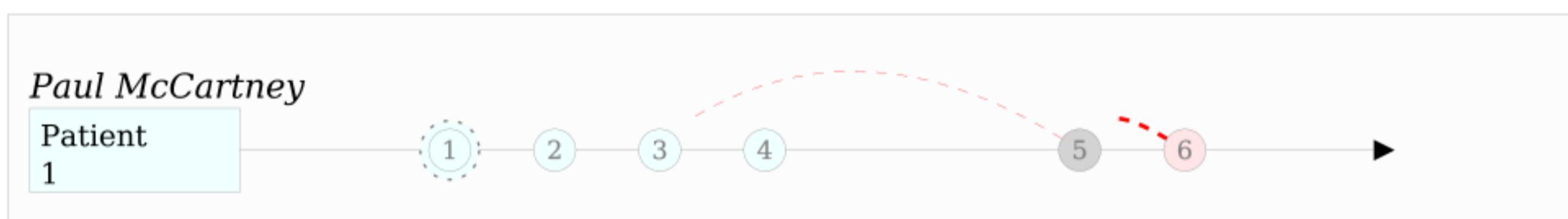
REVERT



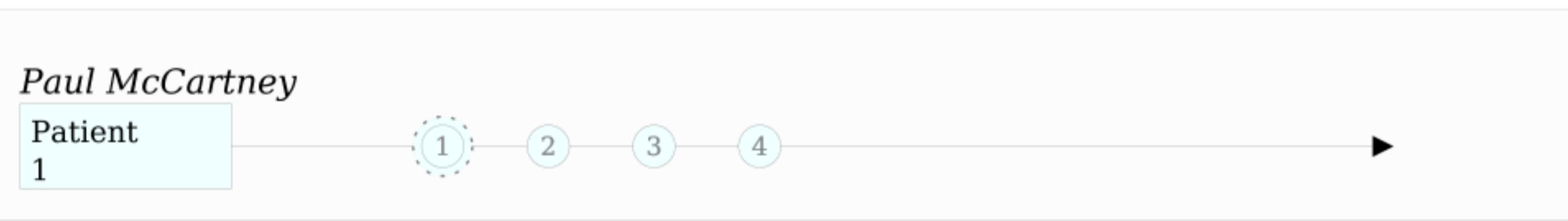
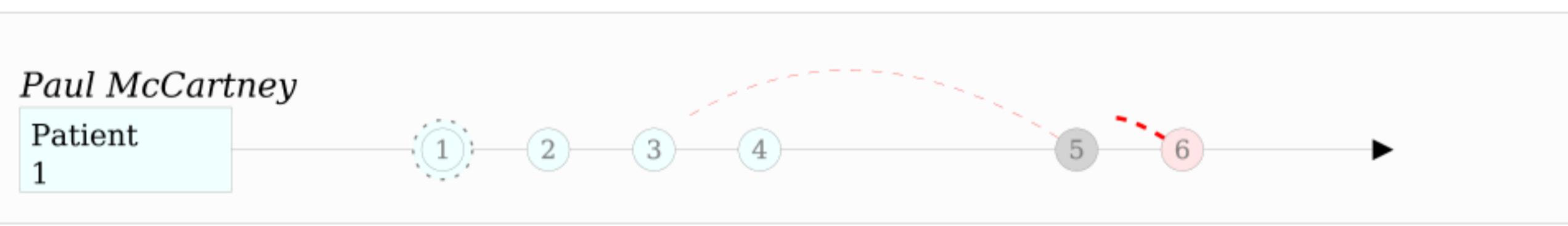
REVERT



REVERT AGAIN



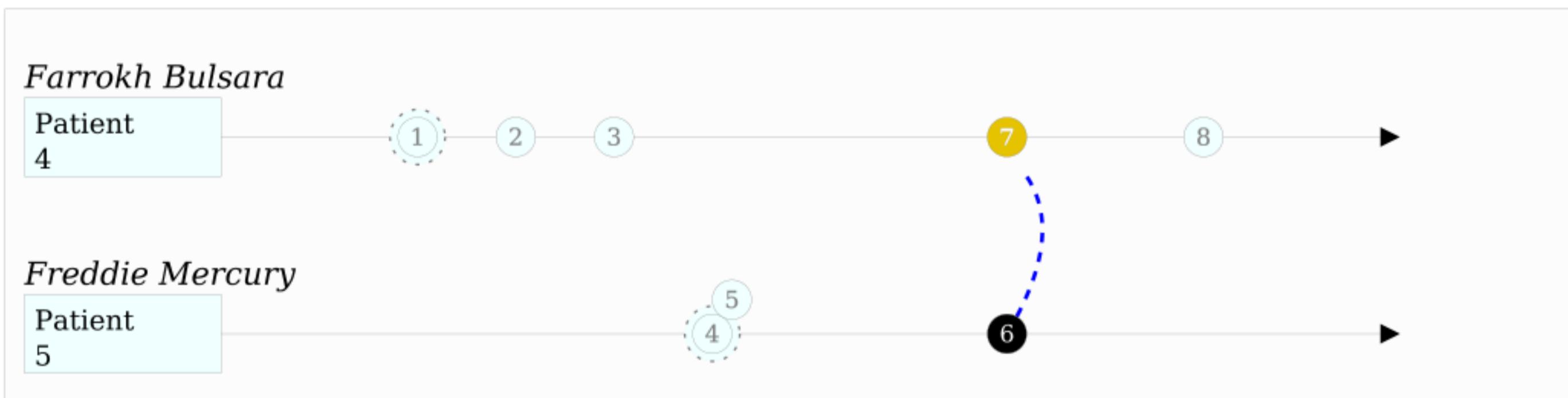
REVERT AGAIN



MERGE/DEPRECATE



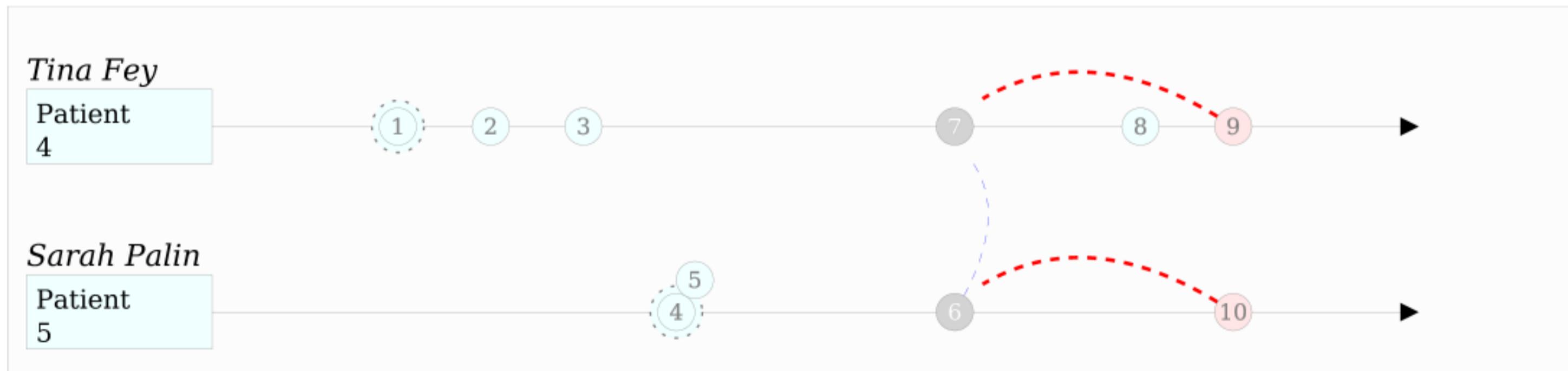
MERGE/DEPRECATE



REVERTING A MERGE



REVERTING A MERGE



BAD EXAMPLE 2

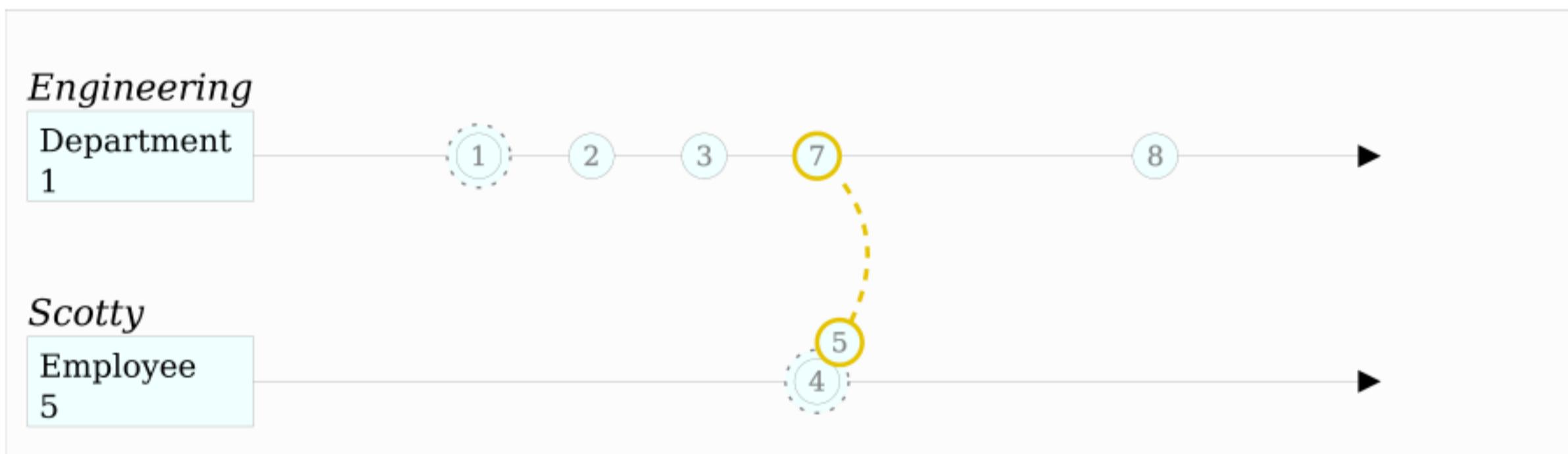
Employee

ID	EMP_NAME	DEPT_ID
1	Mr Spock	1
2	Scotty	2
3	Kirk	3
4	Janeway	3
5	La Forge	2

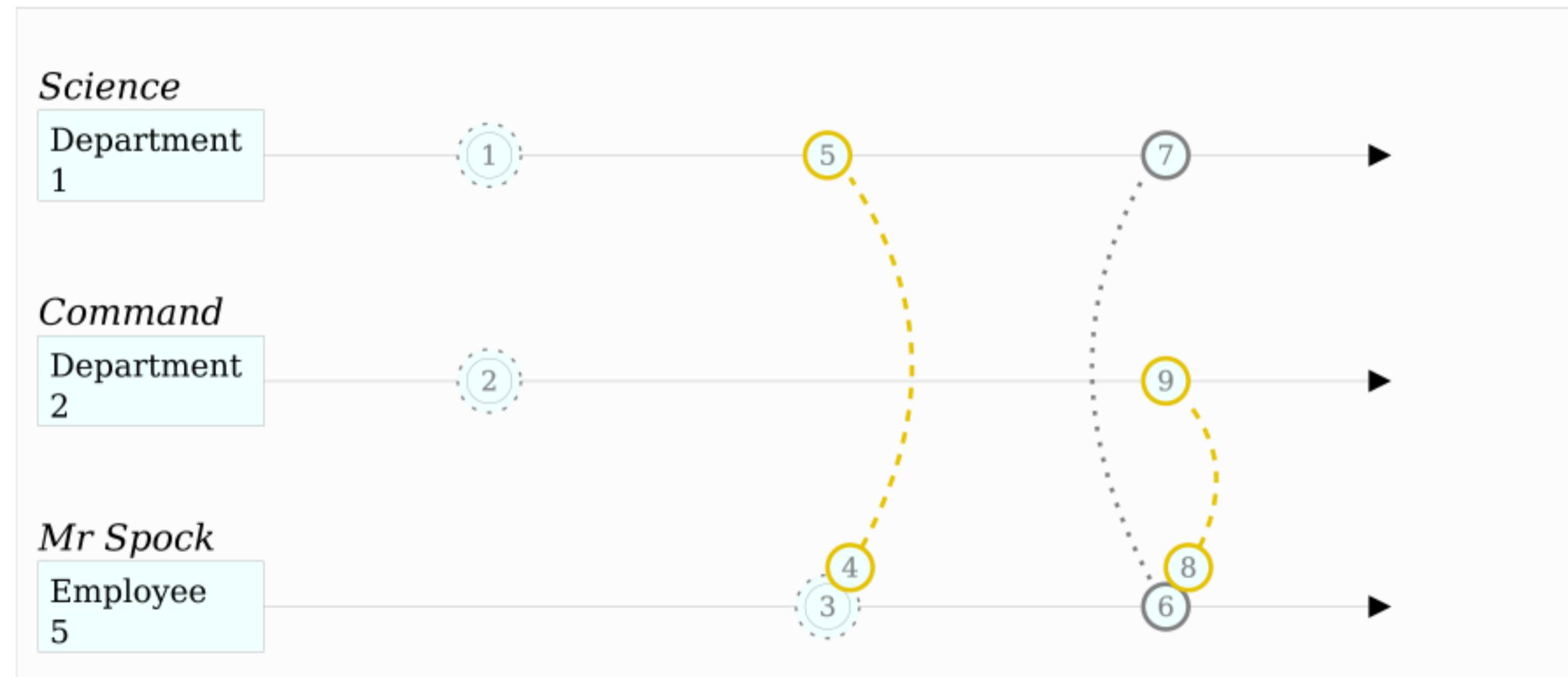
Department

ID	DEPT_NAME
1	Science
2	Engineering
3	Command

JOINS IN EVENT SOURCING



DISJOINS TOO



GROOVES DOMAIN OBJECTS

AGGREGATES

```
public class Patient implements AggregateType<Long> {  
    private Long id;  
    private String uniqueId;  
}
```

EVENTS

```
public abstract class PatientEvent implements
    BaseEvent<Long, Patient, Long, PatientEvent> {
    private Patient aggregate;
    private Long id;
    private String createdBy;
    private RevertEvent<Long, Patient, Long, PatientEvent> revertedBy;
    private Date timestamp;
    private Long position;

    @Override
    @NotNull
    public Observable<Patient> getAggregateObservable() {
        return aggregate != null ? just(aggregate) : empty();
    }
}
```

REAL EVENTS

```
public class PatientCreated extends PatientEvent {  
    private String name;  
}
```

SPECIAL EVENTS

```
public class PatientEventReverted
    extends PatientEvent
    implements RevertEvent<Long, Patient, Long, PatientEvent> {
    private Long revertedEventId;
}
```

SNAPSHOTS

```
public class PatientAccount
    implements JavaSnapshot<Long, Patient, Long, Long, PatientEvent>, Serializable {
    private Long id;
    private Patient aggregate;
    private Patient deprecatedBy;
    private List<Patient> deprecates = new ArrayList<>();
    private Long lastEventPosition;
    private Date lastEventTimestamp;

    11   private String name;
    12   private BigDecimal balance = new BigDecimal(0);
    13   private BigDecimal moneyMade = new BigDecimal(0);

    public Observable<Patient> getAggregateObservable() {
        return just(aggregate);
```

GROOVES QUERIES

SATISFYING GROOVES

```
public class PatientAccountQuery<...> extends QuerySupport<...> {  
    ...  
}
```

Could also be `VersionedQuerySupport` or
`TemporalQuerySupport`

FETCHING SNAPSHOTS

```
@Override  
public PatientAccount createEmptySnapshot() {  
    return new PatientAccount();  
}  
  
@Override  
public Observable<PatientAccount> getSnapshot(  
    long maxPosition, Patient aggregate) {  
    ...  
}  
  
@Override  
public Observable<PatientAccount> getSnapshot(  
    Date maxTimestamp, Patient aggregate) {  
    ...  
}
```

FETCHING EVENTS

```
@Override  
public Observable<PatientEvent> getUncomputedEvents(  
    Patient aggregate, PatientAccount lastSnapshot, long version) {  
  
}  
  
@Override  
public Observable<PatientEvent> getUncomputedEvents(  
    Patient aggregate, PatientAccount lastSnapshot, Date snapshotTim  
  
}
```

HANDLING ERRORS

```
@Override  
default Observable<EventApplyOutcome> onException(  
    Exception e, PatientAccount snapshot, PatientEvent event) {  
    getLog().error("Error computing snapshot", e);  
    return just(CONTINUE);  
}
```

PROCESSING EVENTS

For languages like Java, Groovy

```
public Observable<EventApplyOutcome> applyPatientCreated(  
    PatientCreated event, PatientAccount snapshot) {  
    if (snapshot.getAggregate() == event.getAggregate()) {  
        snapshot.setName(event.getName());  
    }  
    return just(CONTINUE);  
}
```

...

PROCESSING EVENTS

For languages with case classes

```
override fun applyEvent(  
    event: PatientEvent.Applicable, snapshot: PatientAccount) =  
    when (event) {  
        is PatientEvent.Applicable.Created -> {  
            // Your logic here  
            just(CONTINUE)  
        }  
        is PatientEvent.Applicable.ProcedurePerformed -> {  
            // Your logic here  
            just(CONTINUE)  
        }  
        is PatientEvent.Applicable.PaymentMade -> {  
            // Your logic here  
            just(CONTINUE)  
        }  
    }
```

EVENTS

For languages with case classes

```
sealed class PatientEvent : BaseEvent<..> {
    // Properties and methods from equivalent java class

    sealed class Applicable : PatientEvent() {
        data class Created(val name: String) : Applicable()
        data class ProcedurePerformed(
            val code: String, val cost: Double) : Applicable()
        ...
    }

    data class Reverted(override val revertedEventId: String) :
        PatientEvent(), RevertEvent<..>
}
```

COMPLETENESS FOR JAVA

...and Groovy.

```
@Aggregate public class Patient {...}  
public abstract class PatientEvent {}  
  
@Event(Patient.class)  
public class ProcedurePerformed extends PatientEvent {}  
@Event(Patient.class)  
public class PaymentMade extends PatientEvent {}  
  
@Query(aggregate=Patient.class, snapshot=PatientAccount.class)  
public class PatientAccountQuery {  
    ...  
    Observable<EventApply0utcome> applyProcedurePerformed() {...}  
    Observable<EventApply0utcome> applyPaymentMade() {...}  
}
```

GOTCHAS



How many Tour de France General Classification Tour victories did this guy have on 2007-10-01?

EPA/JASPER JUINEN, 22 July 2004. Sourced from *vosizneias*

LANCE ARMSTRONG

1992	Joins Motorola	2002	
1993	DNF	2003	
1994	DNF	2004	
1995	36	2005	
1996	DNF	2005	Jersey images from <i>Wikimedia commons</i>
1996-10-02	Diagnosed with Cancer	2009	Retires
1997-02	Declared cancer free	2009	Returns from retirement
1998	Joins US Postal	2010	3
1999		2010	23
2000		2012-10	Retires
2001			Stripped of all wins from 1998 through 2010

A photograph of Lance Armstrong, wearing the yellow overall leader's jersey, celebrating a victory by raising his arms in triumph. He is wearing a white and blue helmet and sunglasses. The background is blurred, showing other cyclists and spectators.

1. Based on what we knew in 2007, How many TdF GC Tour victories did he have on 2007-10-01?

2. Based on what we know in 2017, How many TdF GC Tour victories did he have on 2007-10-01?

A photograph of Lance Armstrong, wearing the yellow overall leader's jersey of the Tour de France, with his arms raised in triumph. He is wearing a white and blue helmet and sunglasses. The jersey features the 'CREDIT AGRICOLE' and 'L'ÉTOILE VERT' logos, along with the 'UNITED STATES POSTAL SERVICE' and 'BERRY FLOOR TREK AMD' sponsors. The background is blurred, showing other cyclists and spectators.

1. Based on what
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How many TdF GC
Tour victories did
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2. Based on what
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Tour victories did
he have on 2007-10-
01?

Ask the right question

ADVICE ON HANDLING DATA

- Be very careful about what your events look like.
- Don't worry much about what your snapshots look like.

COMMUNICATION IS KEY



Scott Bellware

@sbellware



Follow

95% of the cost of event sourcing projects is explaining event sourcing

2:06 AM - Jun 11, 2017

10

142

294



NON EVENT SOURCES OF DATA

When the intent of the user is not clear from the datasource.



The Story of Goldilocks and The Three Bears, Award Publications LTD

THANK YOU

Slidedeck [rahulsom/javaone-2017-eventsourcing](https://github.com/rahulsom/javaone-2017-eventsourcing)

Grooves [rahulsom/grooves](https://github.com/rahulsom/grooves)

Sun 15:00 **CON7610** Microservices Data Patterns: CQRS and ES

Mon 16:30 **CON2526** Reactive Stream Processing with Swarm and Kafka

Mon 17:30 **CON7474** ES, Distributed Systems, and CQRS with Java EE

Tue 13:15 **CON4083** Async by Default, Synchronous When Necessary

Wed 14:45 **CON4277** Three µS Patterns to Tear Down Your Monoliths