

EVENT SOURCING WITH JVM LANGUAGES

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ABOUT ME

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- Wanted Event Sourcing in 2016

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- Didn't like anything I saw

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ABOUT ME

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

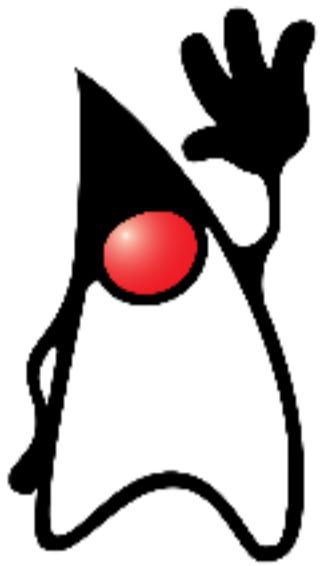
WHERE I WORK



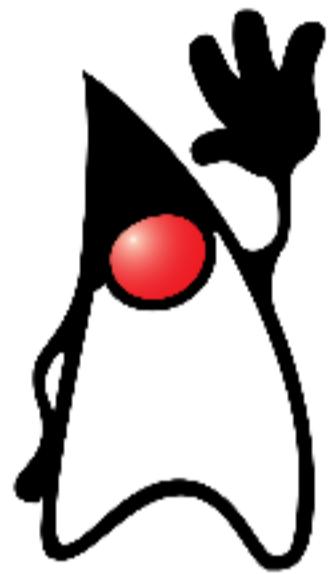
- Used by 130 Health Systems, 600 Hospitals, 20K physicians
- 10M patients

ABOUT YOU

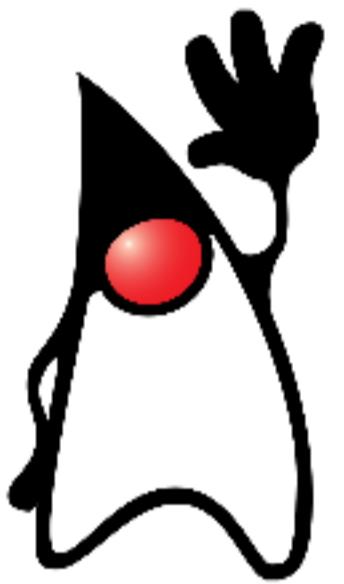
ABOUT YOU



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

DATE	DESCRIPTION	WITHDRAWALS	DEPOSITS	BALANCE
03-10-16	ATMW	***21.25		***474.11
03-10-16	ATMF	***1.50		***472.61
03-10-20	DEBP	***2.99		***469.62
03-10-21	WEBP	***300.00		***169.62
03-10-22	ATMW	***100.00		***69.62
03-10-23	DEBP	***29.08		***40.54
03-10-24	DEBR		***2.99	***43.53
03-10-27	TELP	***6.77		***36.76
03-10-28	PYRL		***694.81	***731.57
03-10-30	WEBT		***50.00	***781.57

Please refer to the back cover for the list of common transaction codes.

Please verify your account activity regularly. If there is an error, notify the bank within 45 days.

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

In Mathematics, it's called the distributive property

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

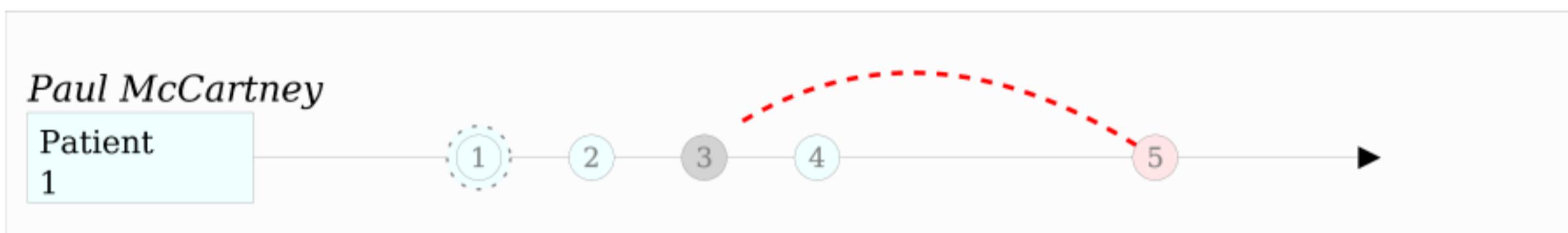
In our case, this is what we would like to do

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

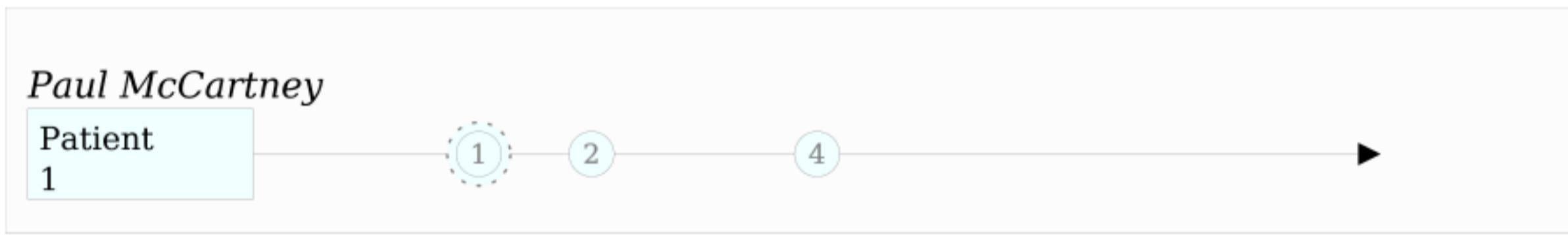
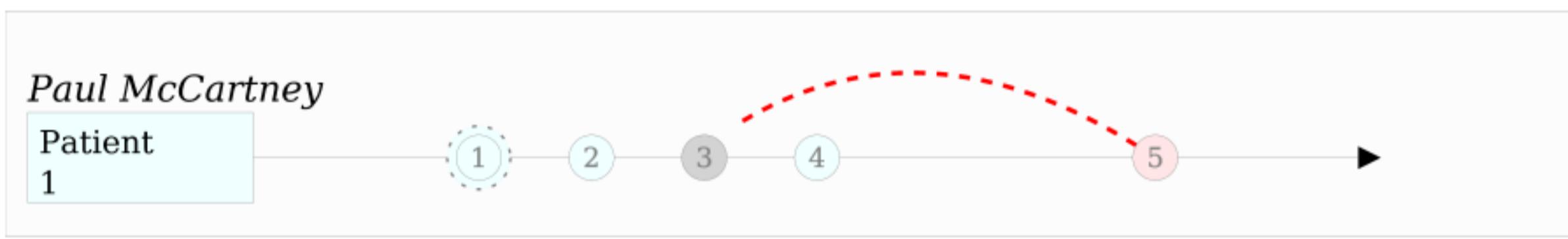
WE'RE NOT DONE YET

There are special events

REVERT



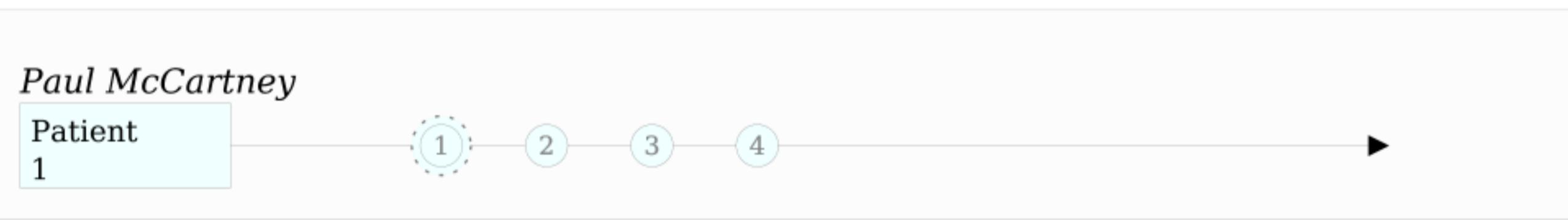
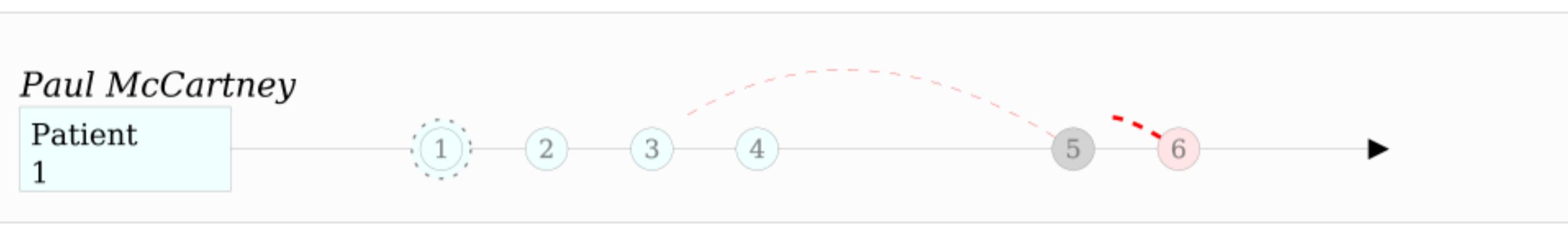
REVERT



REVERT AGAIN



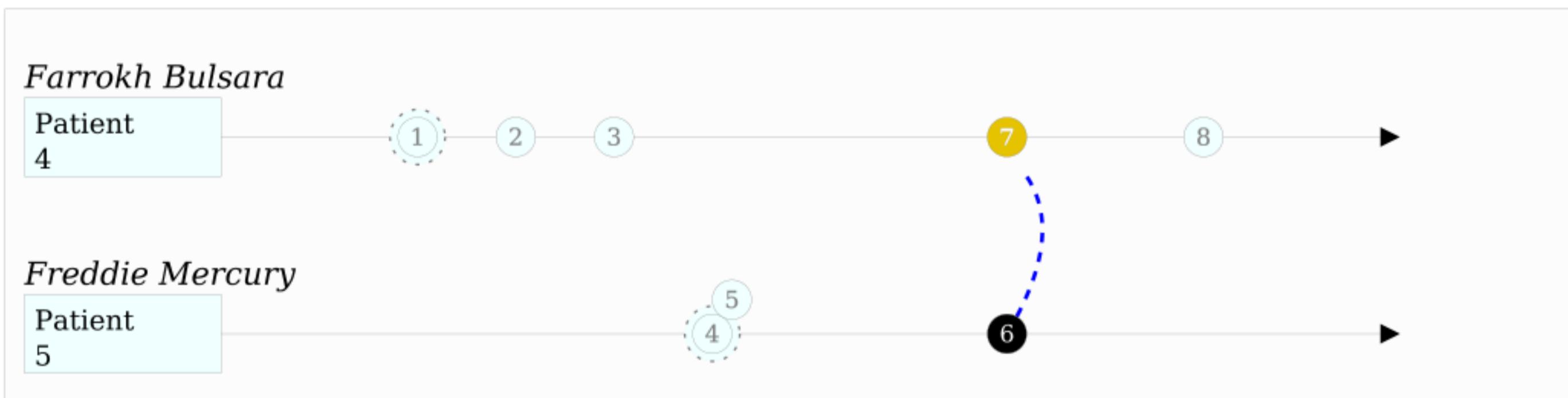
REVERT AGAIN



MERGE/DEPRECATE



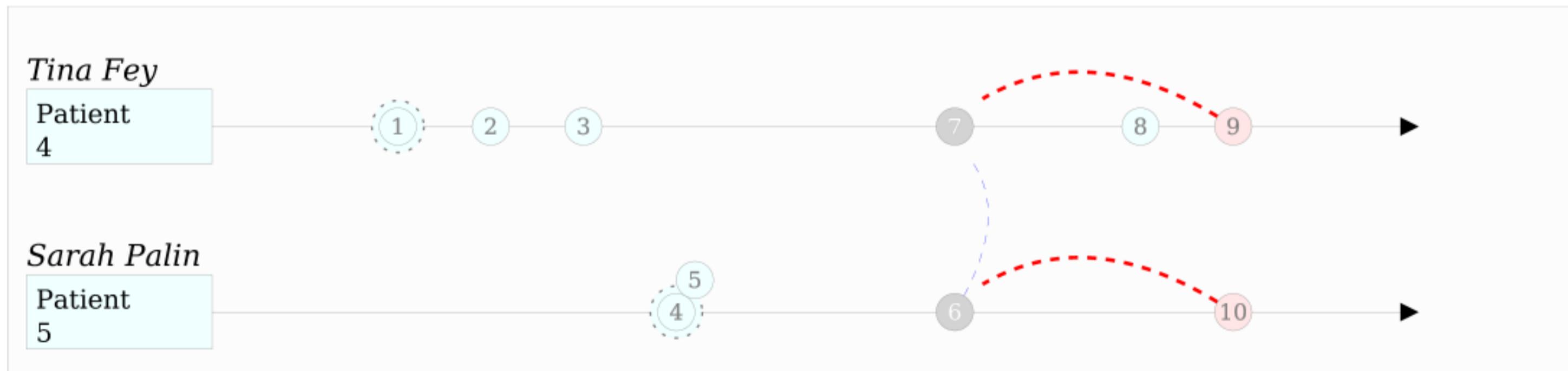
MERGE/DEPRECATE



REVERTING A MERGE



REVERTING A MERGE



BAD EXAMPLE 2

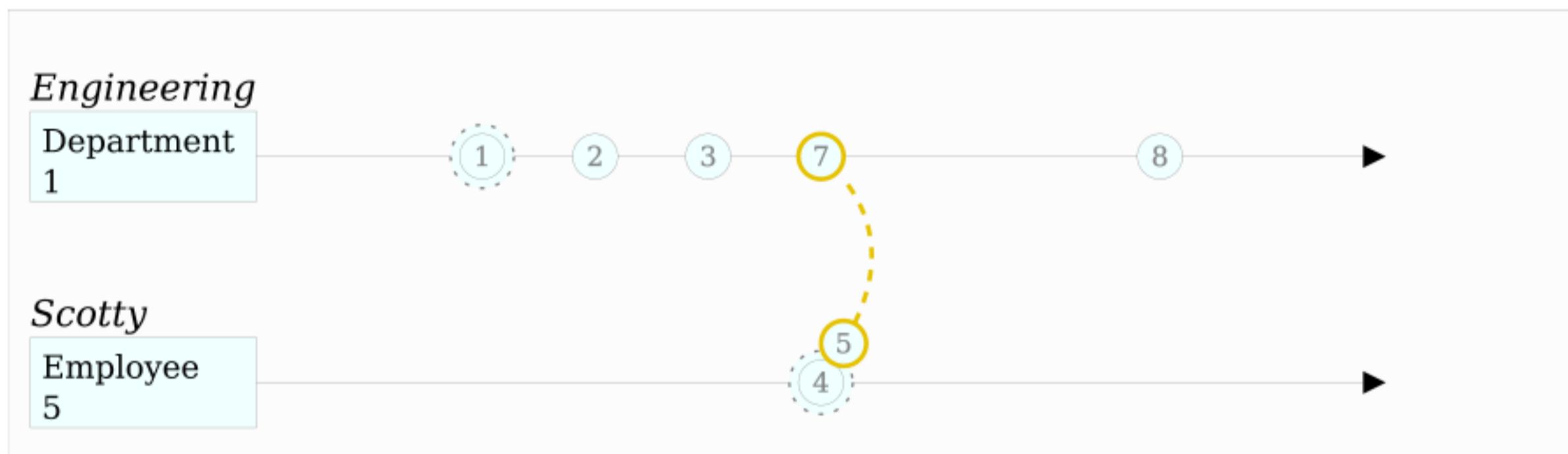
Employee

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

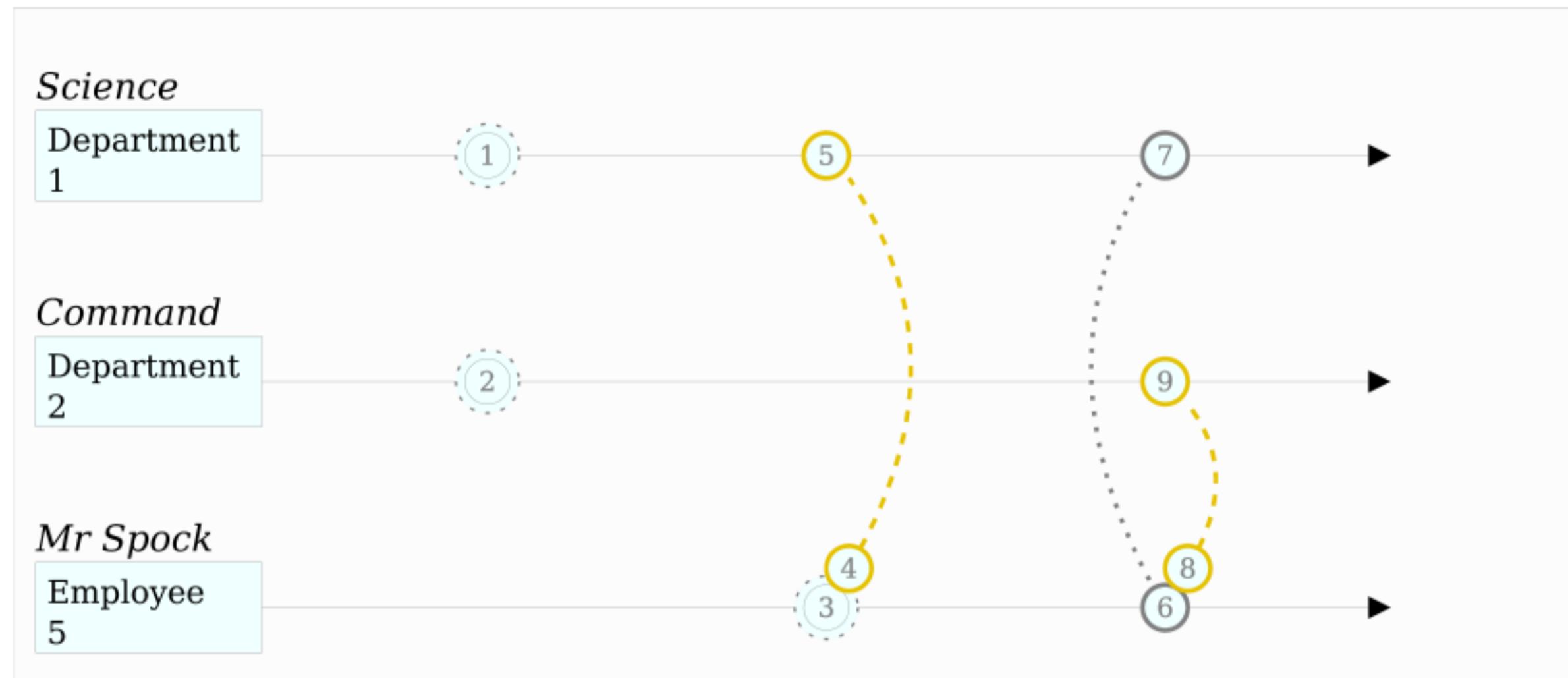
Department

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;  
  
    @Override  
    public String getAudit() {  
        return "name: " + name;  
    }  
  
    public PatientCreated(String name) {  
        this.name = name;  
    }  
}
```

SPECIAL EVENTS

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

    @Override
    public Long getRevertedEventId() {
        return revertedEventId;
    }

    @Override
    public String getAudit() {
        return "revertedEvent:" + 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  
  
}
```

STOPPING COMPUTATIONS EARLY

```
@Override  
default boolean shouldEventsBeApplied(PatientAccount snapshot) {  
    return true;  
}
```

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() {
            override fun getAudit(): String = "$id - Created '$name'"
        }
    }

    data class Reverted(override val revertedEventId: String) :
        PatientEvent(), RevertEvent<...> {
        override fun getAudit(): String = "$id - Revert $revertedEventId"
    }
}
```

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?

LANCE ARMSTRONG

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

A professional cyclist, wearing a bright yellow jersey with the 'United States Postal Service' logo, is captured in a moment of triumph. He is wearing a white and blue helmet and sunglasses, and has his arms raised high in the air. The background is blurred, showing other cyclists and spectators, suggesting a race finish line.

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 a yellow Tour de France leader's jersey, with his arms raised in triumph. He is wearing a white helmet and sunglasses. The background shows other cyclists and spectators.

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Asking the right question is key

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.



THANK YOU

Slidedeck [rahulsom/javaone-2017-eventsourcing](#)

Grooves [rahulsom/grooves](#)