

# EVENT SOURCING WITH JVM LANGUAGES

Rahul Somasunderam

JavaOne 2017

# ABOUT ME

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- Wanted Event Sourcing in 2016

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- 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

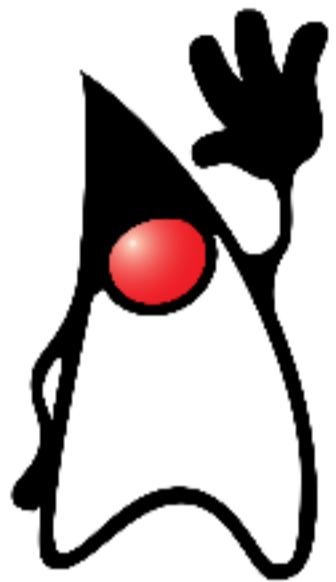
# ABOUT YOU



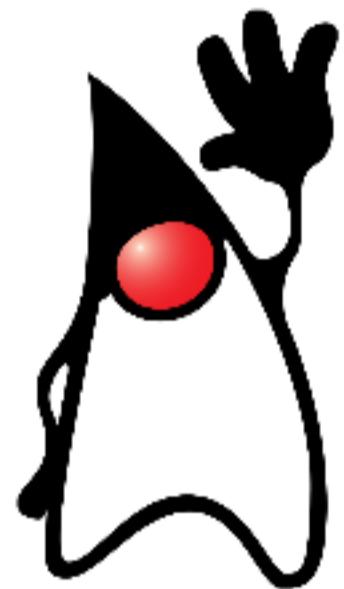
# ABOUT YOU



# ABOUT YOU



# ABOUT YOU



# 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 -= account;  
        accountService.setBalance(accountNumber, balance);  
        return true;  
    } else {  
        return false;  
    }  
}
```

# WHAT BANKS TYPICALLY DO

1. Blatt				1. Blatt				Nr. 72.259.103	
Tag, Monat und Jahr der Eintragung 1	DM-Betrag der Einlage oder Rückzahlung in Buchstaben 2	Betrag der Einlage DM   Pf 3		Betrag der Rückzahlung DM   Pf 4		Guthaben 5	Unterschrift des Beamten und Tagesstempel		
		DM	Pf	DM	Pf				
05.05.	habe auf 86			87			87		
07.05.	86	10				97	87		
26.05.	25					47	87		
12.06.	95			15		32	87		
28.06.	86					16	87		
	Technik und Wiss.			26		46	87		
09.06.	Voraus			40					

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

**BUT THAT WAS BANKING**

## BUT THAT WAS BANKING

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

## BUT THAT WAS BANKING

If you can look at your logs and debug your application, you  
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

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

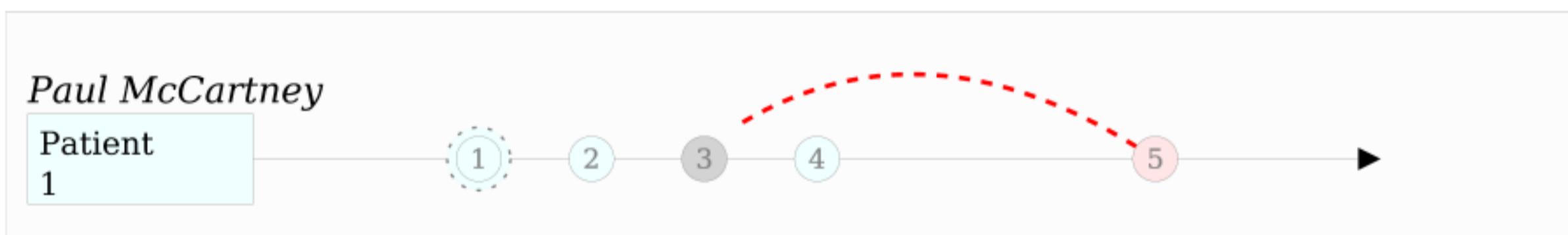
In Mathematics, it's called the distributive property

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

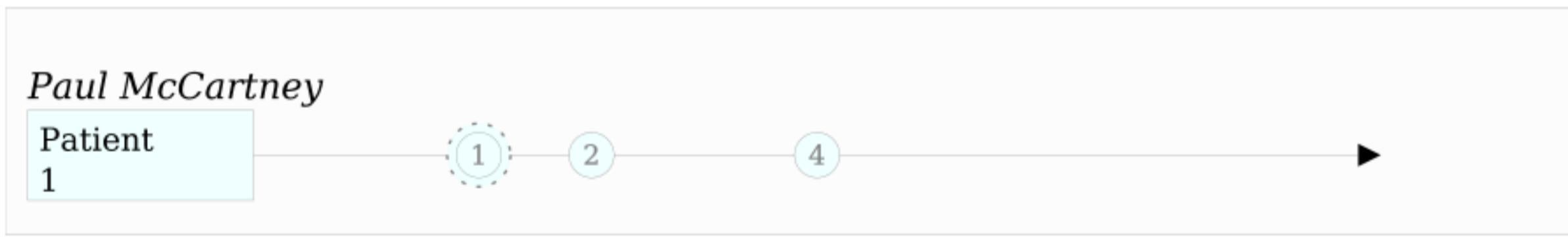
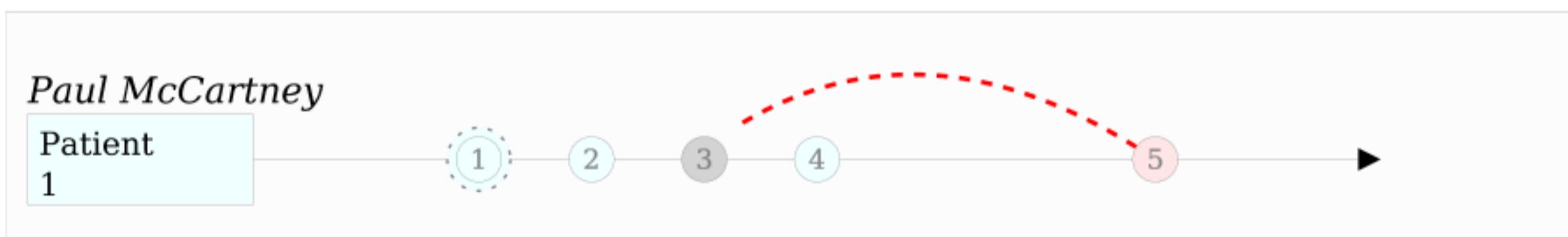
# WE'RE NOT DONE YET

There are special events

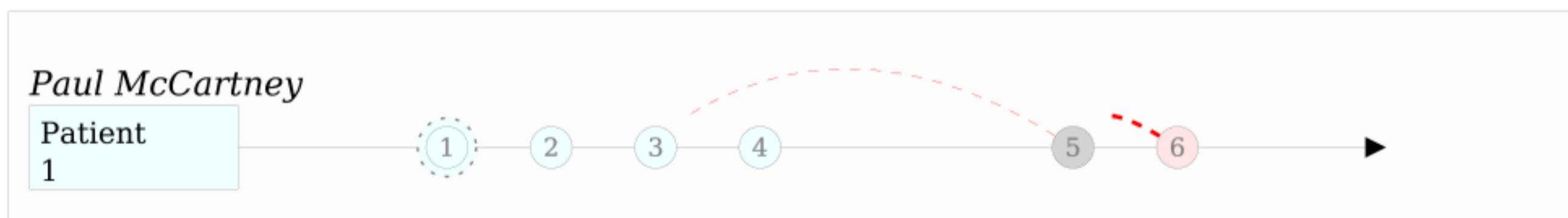
# REVERT



# REVERT



# REVERT AGAIN



# REVERT AGAIN



# MERGE/DEPRECATE



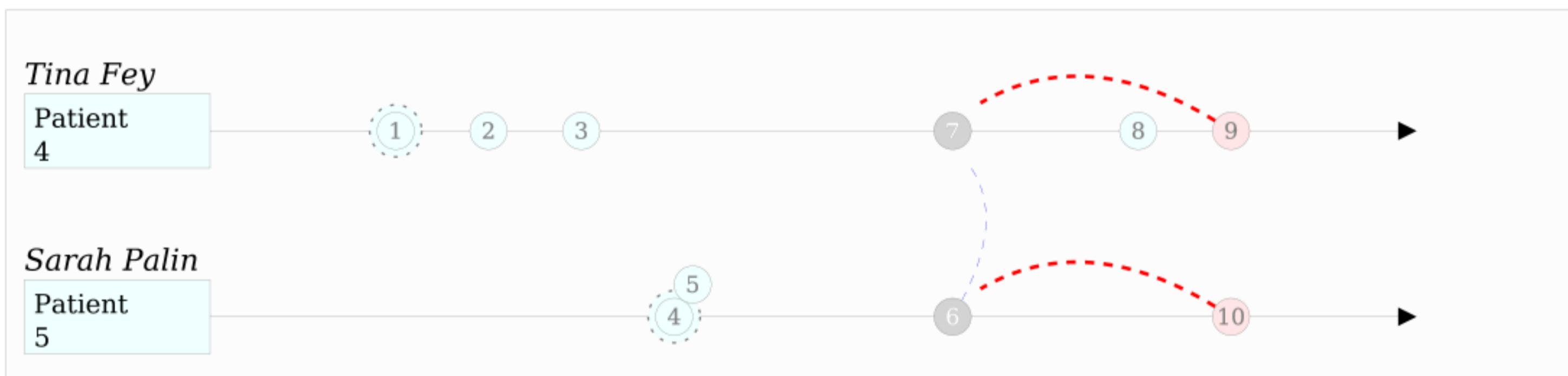
# MERGE/DEPRECATE



# REVERTING A MERGE



# REVERTING A MERGE



## BAD EXAMPLE 2

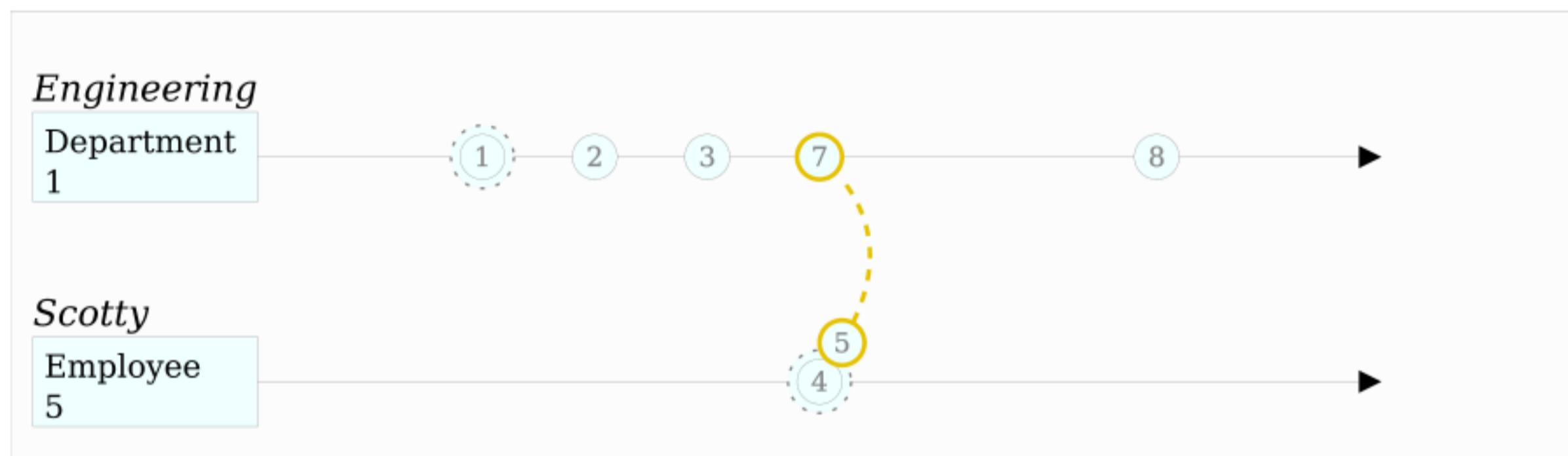
Employee

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

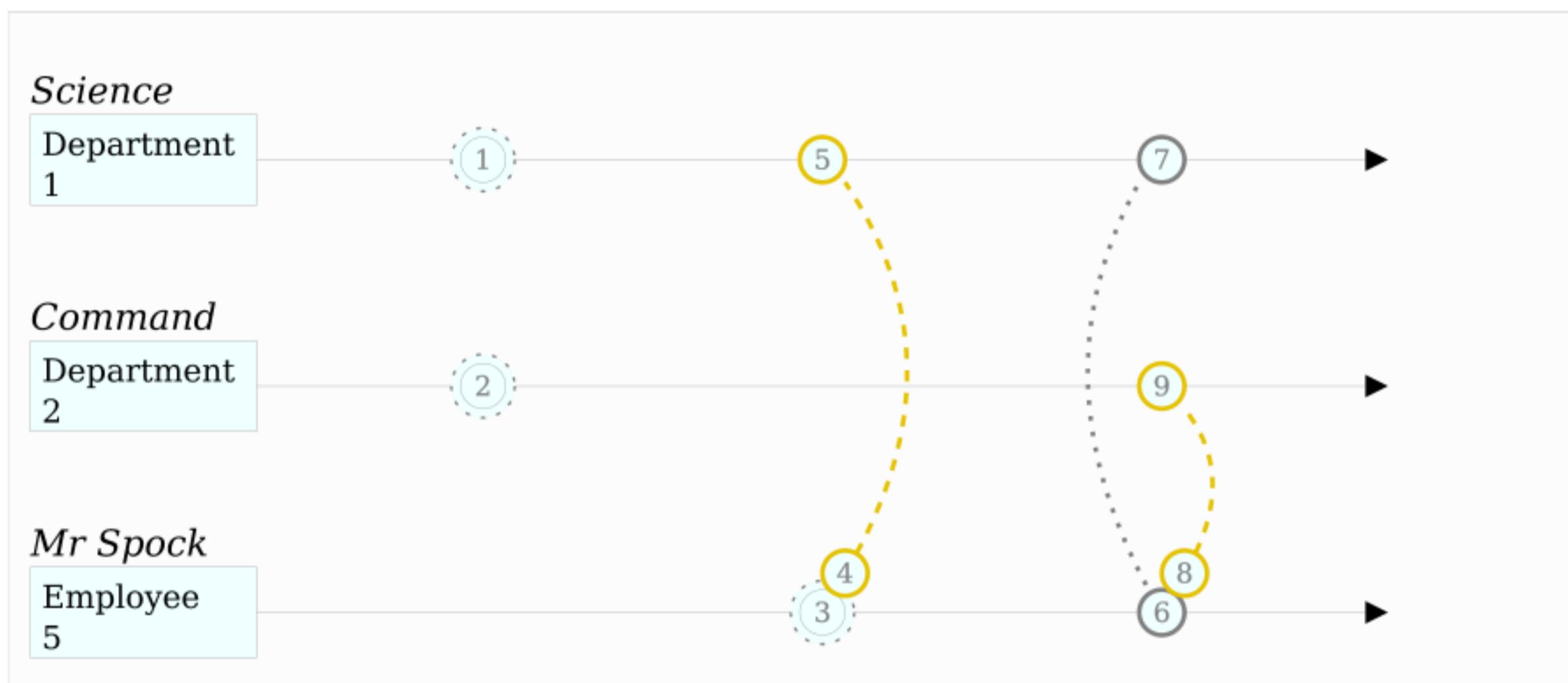
Department

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;

    private String name;
    private BigDecimal balance = new BigDecimal(0);
    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() {...}  
}
```

# USAGE

```
Patient patient = ...  
Observable<PatientAccount> account;  
  
// By Date  
account = patientAccountQuery.computeSnapshot(patient, new Date());  
  
// By version  
account = patientAccountQuery.computeSnapshot(patient, 7L);
```

# 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	Retires
1996-10	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 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 background is blurred 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?

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

i

## 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 [bit.ly/2017-es](http://bit.ly/2017-es)

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

Sun 15:00	<b>CON7610</b>	Microservices Data Patterns: CQRS and ES
Mon 16:30	<b>CON2526</b>	Reactive Stream Processing with Swarm and Kafka
Mon 17:30	<b>CON7474</b>	ES, Distributed Systems, and CQRS with Java EE
Tue 13:15	<b>CON4083</b>	Async by Default, Synchronous When Necessary
Wed 14:45	<b>CON4277</b>	Three µS Patterns to Tear Down Your Monoliths