CEP am Beispiel von Esper

Seminar - Event Driven Architectures

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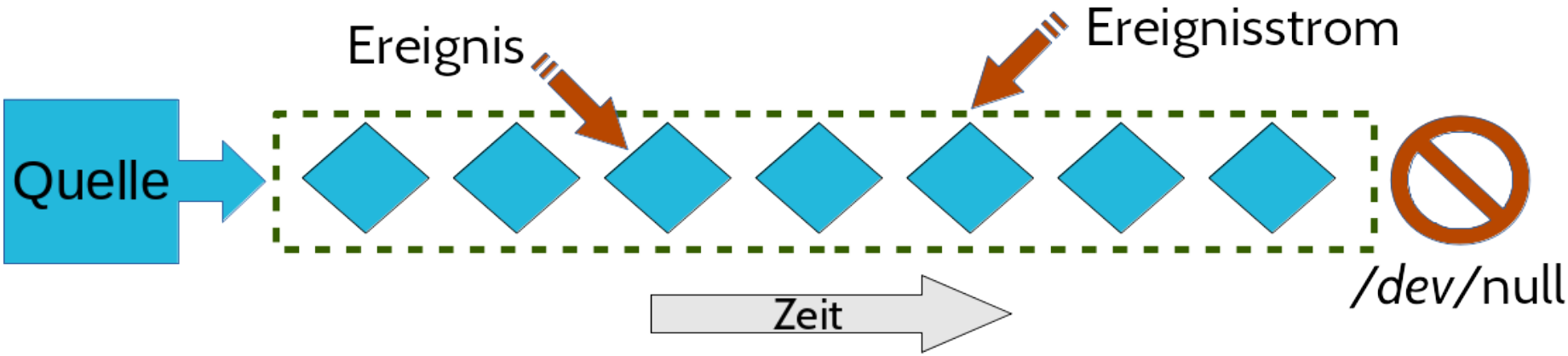
Januar 2019

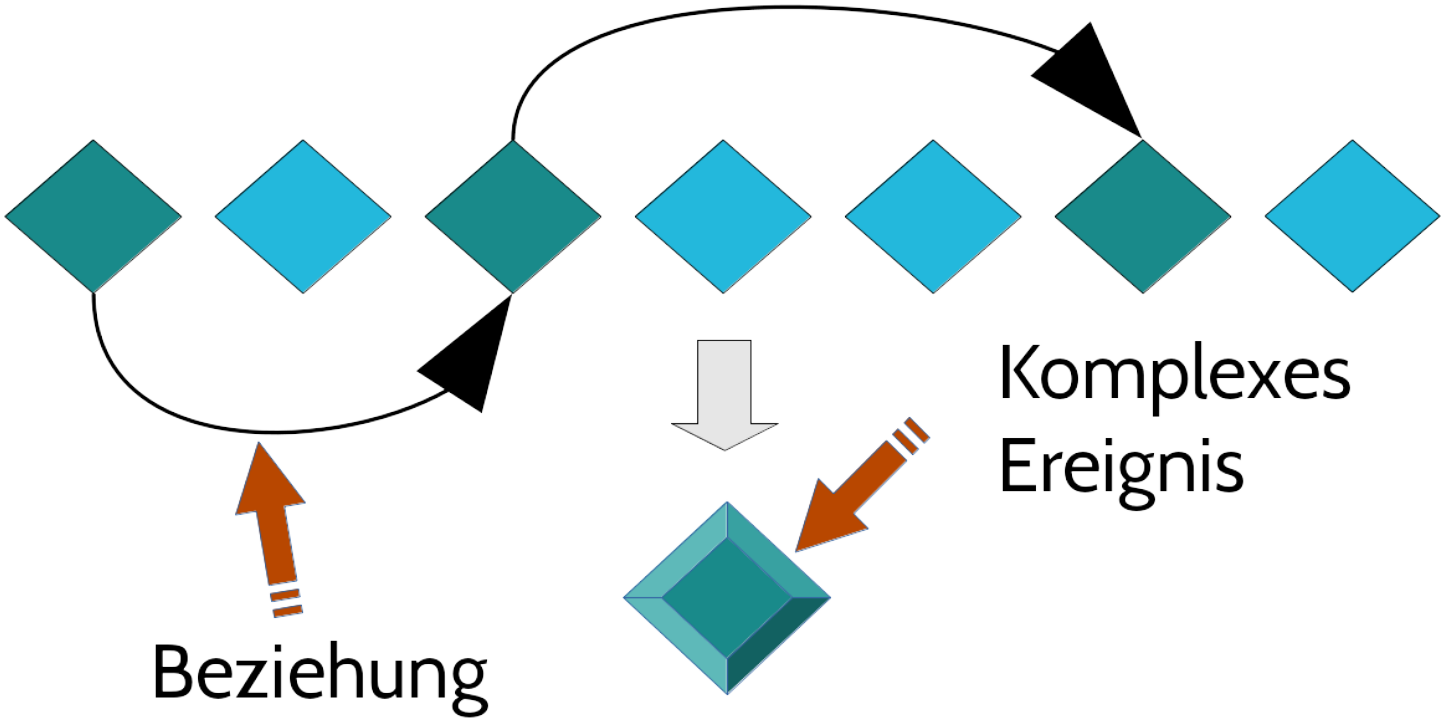
Complex Event Processing

- Analyse von unendlichen Ereignisströmen



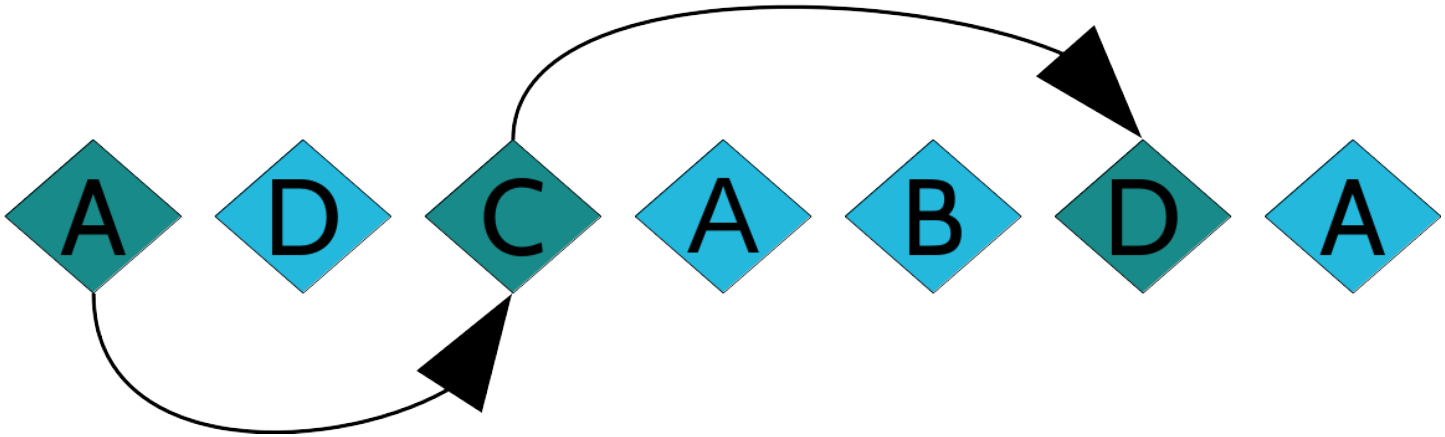
Komplexe Ereignisse

- Ereignismuster beschreiben Beziehungen zwischen Ereignissen
- Komplexe Ereignisse sind Abstraktionen von Ereignismengen



Ereignismuster

A vor **C** vor **D**



Ereignistypen

Ereignis in CEP

Metadaten	
Ereignistyp	`Kursänderung`
Ereignisquelle	`Frankfurt`
Zeitstempel	`21:19:55`
ID	`98127634`
Kontextinformation	
`Name: GCME AG` `Aktueller Kurs: 42.1`	

- Aufbereitete Rohdaten
- Strukturiert
- Maschinenlesbar
- Atomar

ESPER I

Free Software (GPLv2)

CEP-Engine

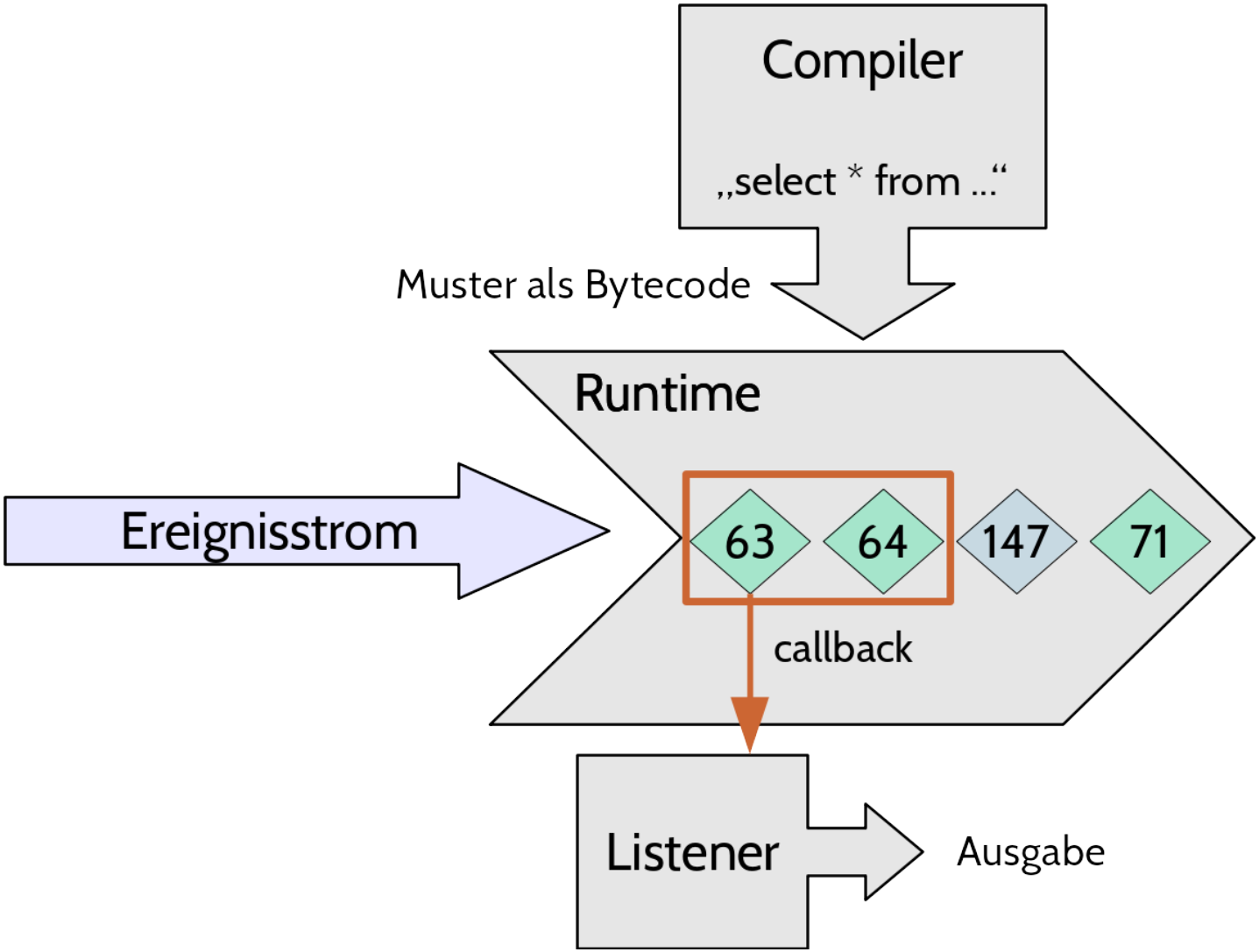
Event **P**rocessing **L**anguage

`Java` und `C#`

EPL $\rightarrow$ Bytecode

SQL - `MATCH_RECOGNIZE`

ESPER II


Compiler
„select * from ...“
Muster als Bytecode
Runtime
Ereignisstrom
63
64
147
71
callback
Listener
Ausgabe

Musterdefinition - EPL/SQL

Event **P**rocessing **L**anguage

- Syntax ähnlich SQL
- Beschreibung durch Aussagenlogik + spezielle Operatoren
- Operiert auf unterschiedlichen Ereignistypen

SQL-Erweiterung: `MATCH_RECOGNIZE`

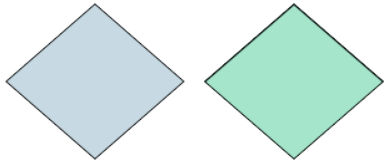
- Einbettung in EPL-Anfrage
- Standardisiert in SQL:2016 (ISO/IEC 9075:2016)
- Beschreibung durch reguläre Ausdrücke
- Operiert auf einem Ereignistyp

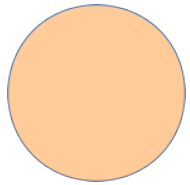
EPL-Operatoren

wichtige Operatoren von EPL

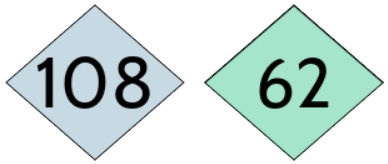
`A and B:`	A $\wedge$ B, Reihenfolge egal
`A or B:`	A $\vee$ B, Reihenfolge egal
`A -> B:`	Sequenz, B tritt zeitlich nach A ein
`(A -> B) and not C:`	kein C vor A oder B
`every A:`	detektiert alle A im Strom
`[5] A:`	Repeat, Detektion nach 5 A

Esper - Ereignistypen

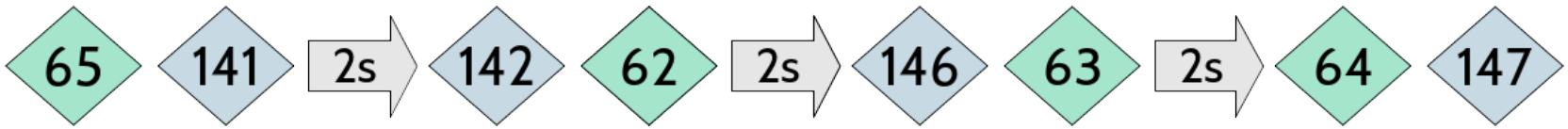




Ereignistyp:	StockTick	NewsTick
symbol:	'IBM'/'SAP'	'IBM'
price:	Integer	-
message:	-	'good'/'bad'



EPL - einfache Anfragen



EPL - einfache Anfragen

```
select PARAMETER from SOURCE where CONDITION;
```

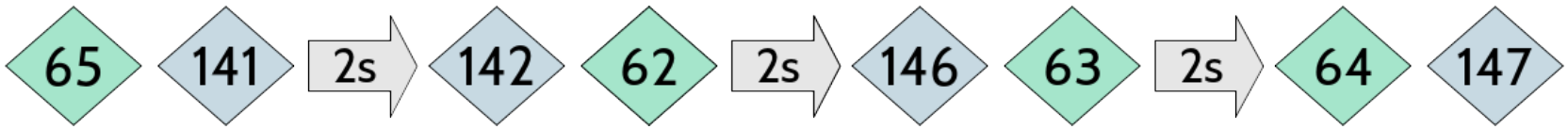
Eine einfache Anfrage

```
select * from StockTick where price > 100;
```

=

```
select * from StockTick(price > 100);
```

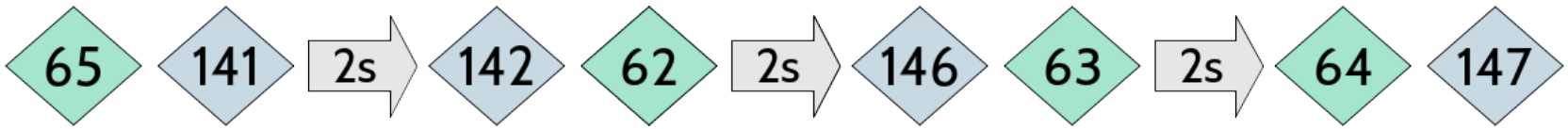
EPL - einfache Anfragen



Aggregation

```
select avg(price) from StockTick(symbol='IBM')
```

EPL - einfache Anfragen



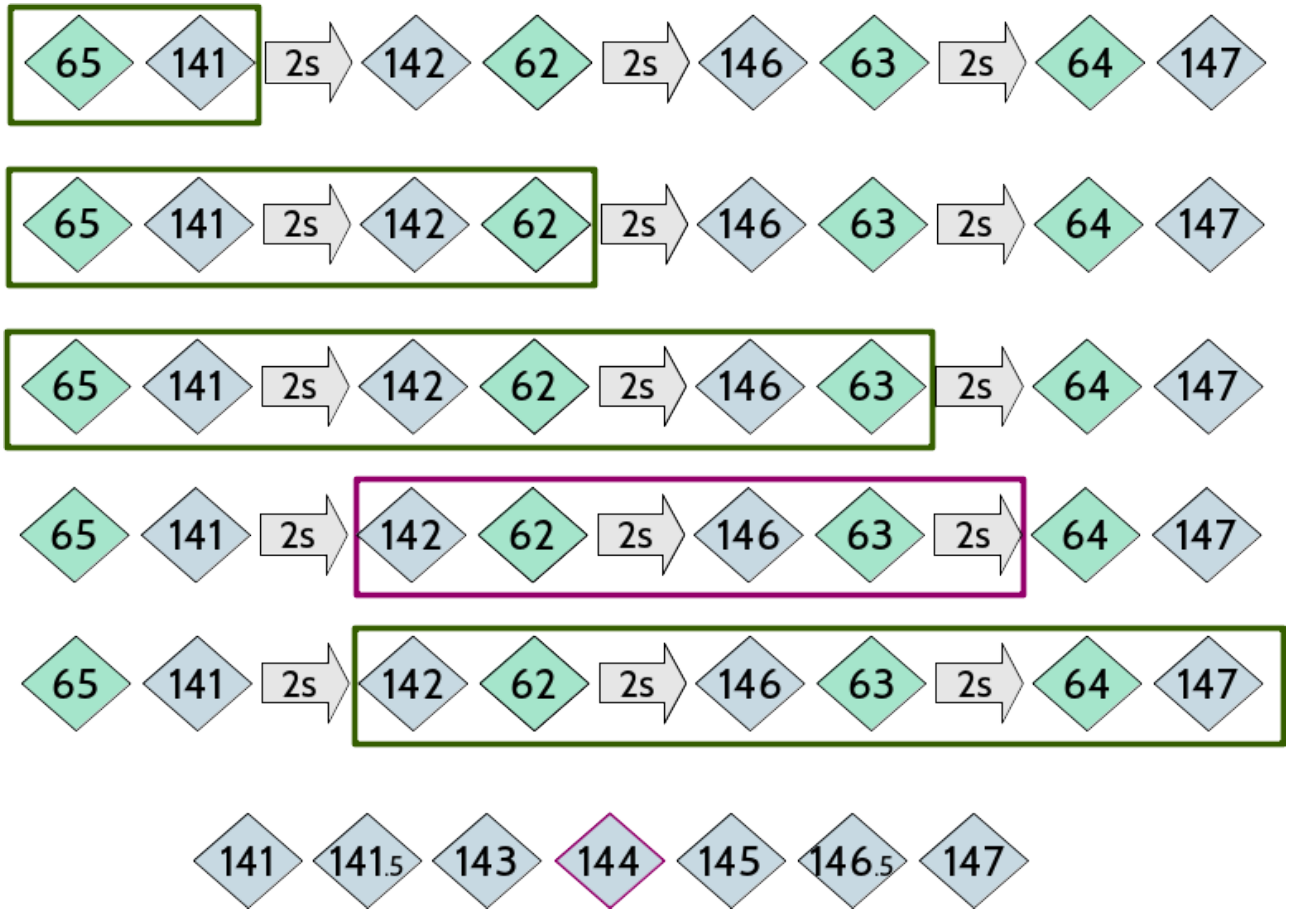
Aggregation

```
select avg(price) from StockTick(symbol='IBM')
```

- Operationen auf ∞-Datenstrom
- Anfragen würde ewig Ereignisse erstellen

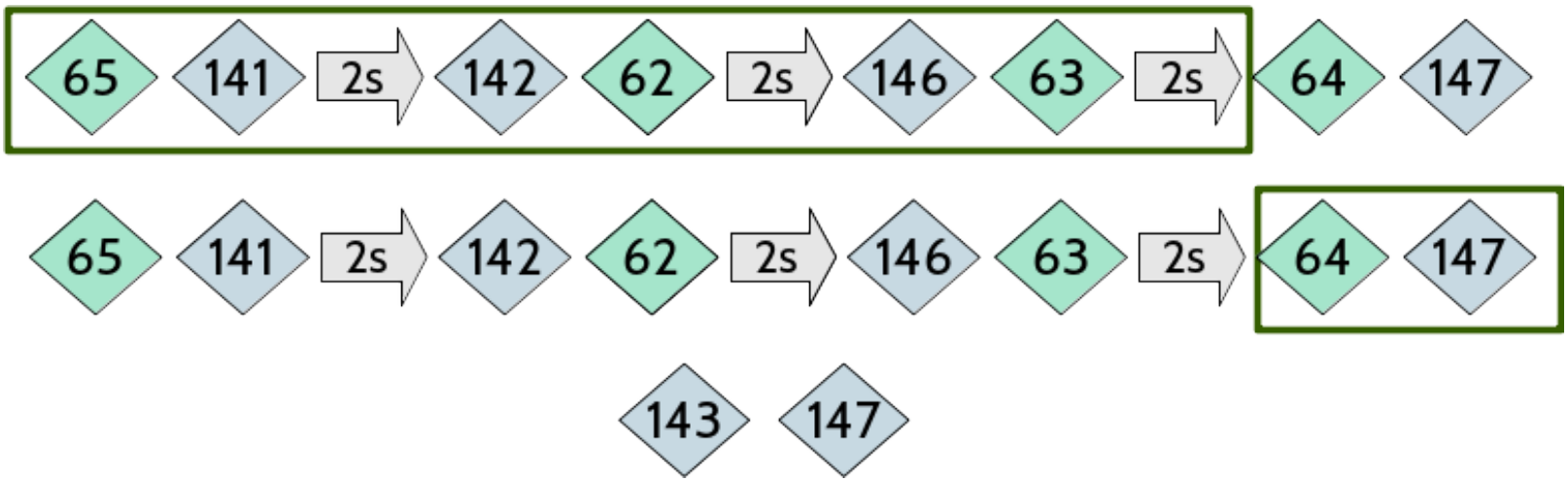
Fenster - einfache Zeitfenster

```
select avg(price) from StockTick.win:time(6 sec) where
                                    symbol='IBM'
```



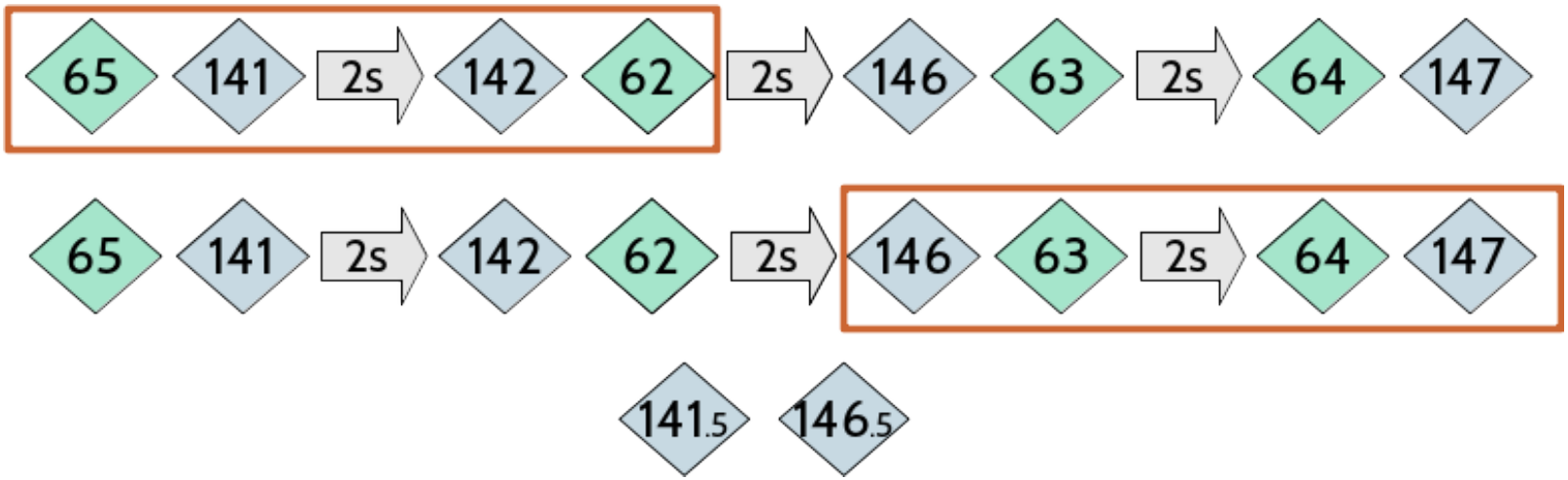
Fenster - batch-Zeitfenster

```
select avg(price) from StockTick.win:time_batch(6 sec)
                  where symbol='IBM'
```



Fenster - batch-Längenfenster

```
select avg(price) from StockTick.win:length_batch(4) where
                                    symbol='IBM'
```

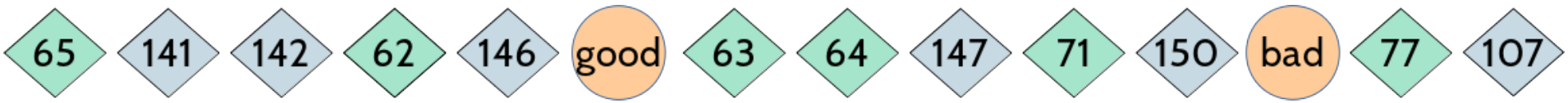


Ereignistypbasierte Regeln

`pattern[]`

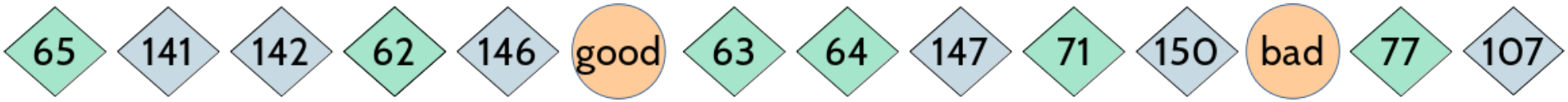
- Betrachtung unabhängig von Zeit und Länge
- boolesche Ausdrücke + Sequenzoperator: $\rightarrow$
- `pattern[A` $\rightarrow$ `B]`
  - `A, B` sind Ereignistypen
  - `a,b` deren Instanzen
  - A tritt zeitlich nach B ein
  - A ist Initiator, B ist Detektor
- `every`-Operator (*Event Consumption Modes*)

Ereignistypbasierte Regeln




```
select b from pattern[a=StockTick(symbol='IBM') →
                      b=StockTick(symbol='SAP')];
```

Ereignistypbasierte Regeln - Consumption Modes I

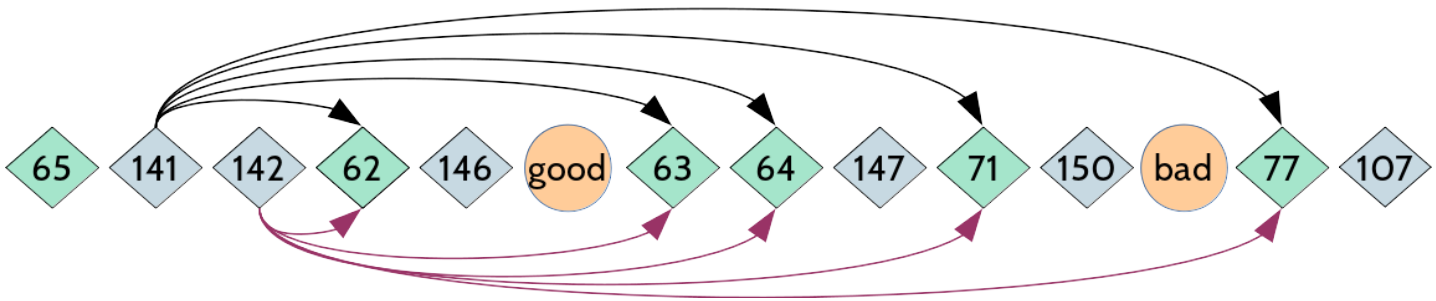


Unrestricted Consumption Mode:

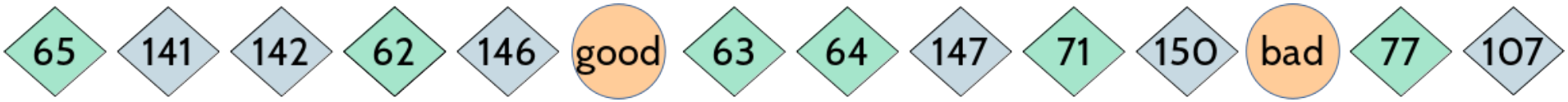
```
pattern[ every A → every B]
```

```
select a,b from pattern[every a=StockTick(symbol='IBM') →
                        every b=StockTick(symbol='SAP')];
```

- Jeder Initiator konsumiert alle Detektoren
- sehr große Ergebnismenge



Ereignistypbasierte Regeln - Consumption Modes II

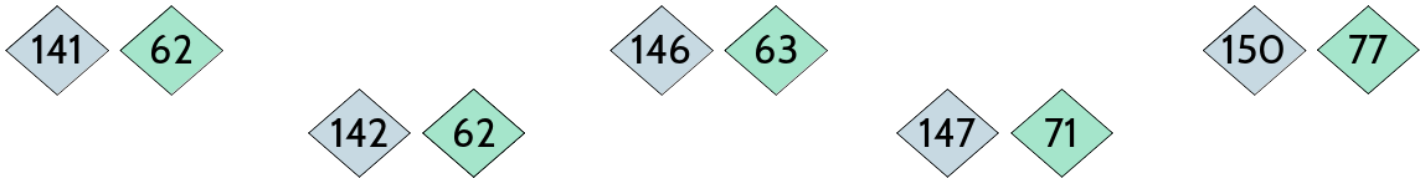


Continous Consumption Mode:

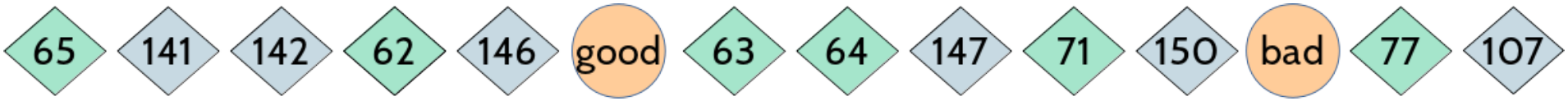
```
pattern[ every A → B]
```

```
select a,b from pattern[every a=StockTick(symbol='IBM') →
                        b=StockTick(symbol='SAP')];
```

- Jeder Initiator konsumiert nur nachfolgenden Detektor



Ereignistypbasierte Regeln - Consumption Modes III

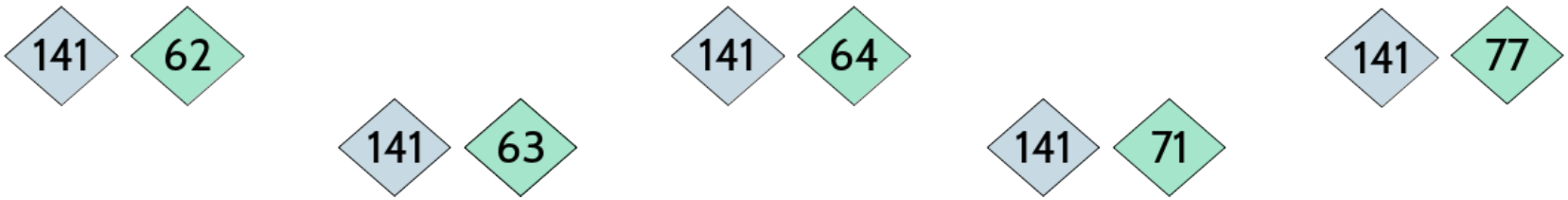


Continous Detection Mode:

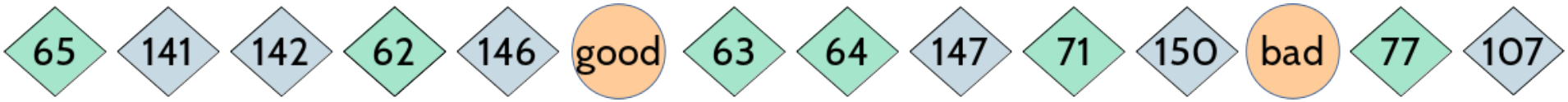
```
pattern[ A → every B]

select a,b from pattern[ a=StockTick(symbol='IBM') →
        every b=StockTick(symbol='SAP')];
```

- Ein Initiator konsumiert alle nachfolgenden Detektoren



Ereignistypbasierte Regeln - Consumption Modes IV

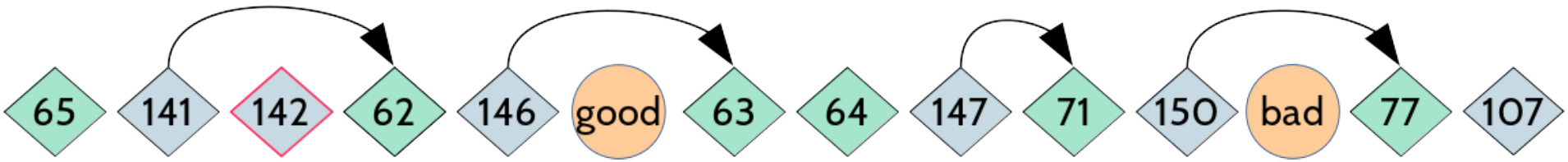


Regular Consumption Mode:

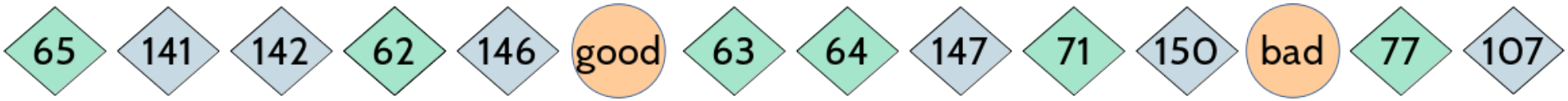
```
pattern[every (A → B)]
```

```
select a,b from pattern[every (a=StockTick(symbol='IBM')→
                b=StockTick(symbol='SAP'))];
```

- Initiator sucht nach Detektor
- Initiatoren auf dem Pfad werden nicht betrachtet

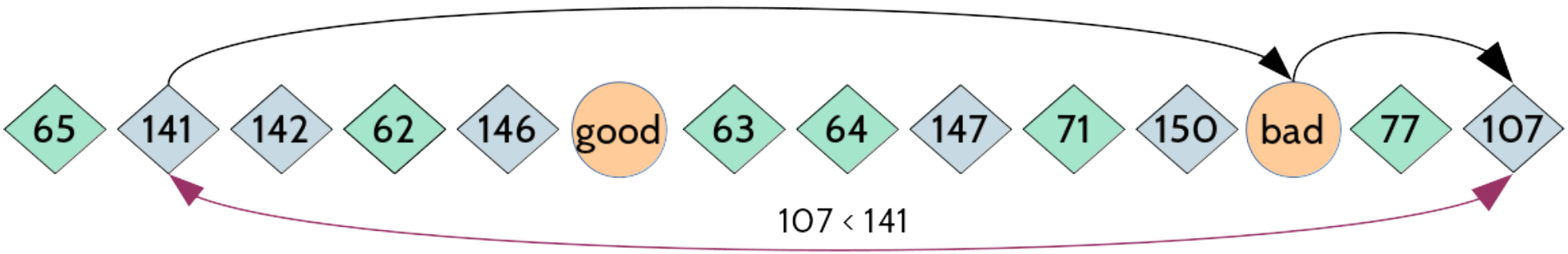


Ereignistypbasierte Regeln - Beispiel

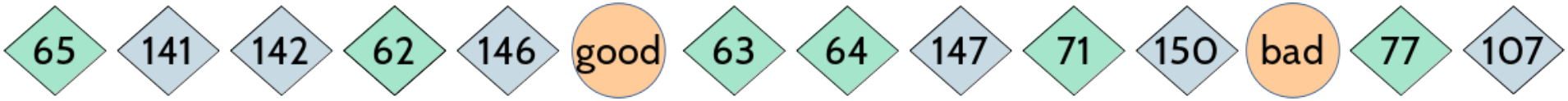


Wollen herausfinden, ob Nachrichtenmeldung Einfluss auf Aktienkurs hat

```
select c from pattern[a=StockTick(symbol='IBM') ->
  b=NewsTick(symbol='IBM' and message='bad') ->
  c=StockTick(symbol='IBM' and price < a.price)];
```



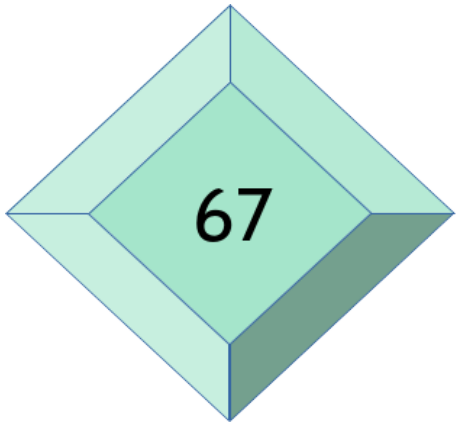
Komplexe Ereignisse

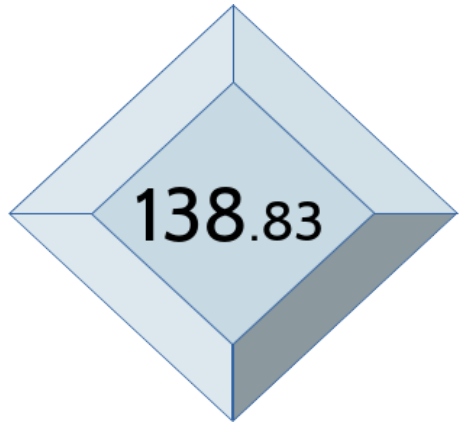


Wollen neues Ereignis: Mittelwert der letzten 6 Aktien einer Firma

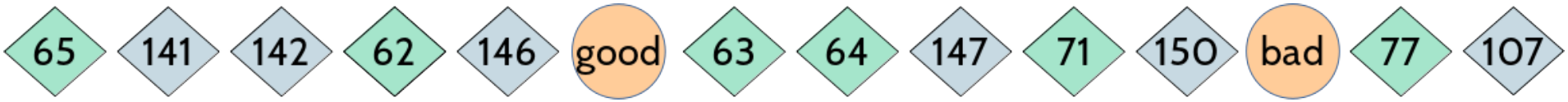
```
insert into TargetEvent(symbol, average)
select symbol, avg(price)
from StockTick#groupwin(symbol)#length_batch(6);

select * from TargetEvent;
```

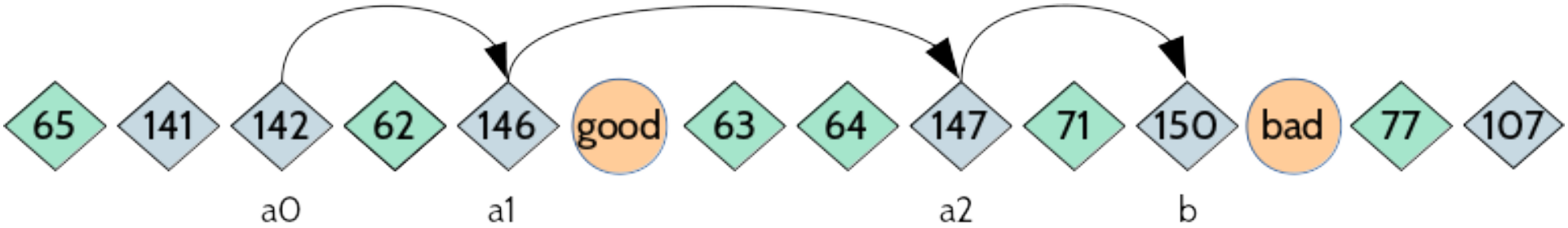




SQL: Match_Recognize




```
select * from StockTick match_recognize (
partition by symbol
measures A[0].price as a0,A[1].price as a1, A[2].price as
a2, B.price as b
pattern (A{2,3} B)
define
A as A.price < 150, B as B.price >= 150)
```



Fazit

- Hohe Einstiegshürde
  - EPL gut Dokumentiert
  - Software eher nicht
- Sehr großer Leistungsumfang
  - Doku $>$ 900 Seiten
  - TIMTOWDI
- EPL-Prüfung mittels EPL-Online[1]
- Sehr leistungsfähige Architektur

[1] `https://esper-epl-tryout.appspot.com/epltryout/mainform.html`

Danke für die Aufmerksamkeit.

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