

IBM

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Workshop on Event-based Media Integration and Processing
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Modeling and semantics of events and contexts

Opher Etzion

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Example to kickoff the discussion:
context driven scenario- detecting car theft

A specific car is moving

detect ->

All authorized drivers for this car are not in the car: theft is concluded

derive ->

Either notify police or chase the car by private agency

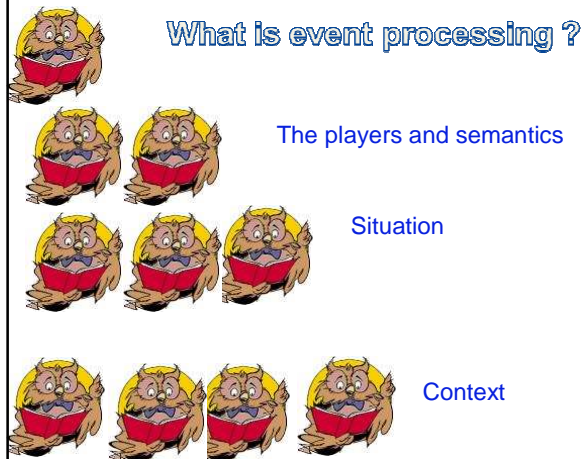
decide ->

Stop the car by police or by car built-in stopper

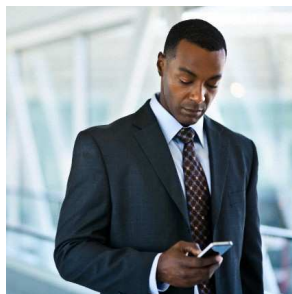
do

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Outline of this talk



In daily life we often react to events..



17 DEC 06

FROM LUANGPRABANG TO

DAILY FLIGHT

	FLT. NR.	CHK-IN	DEP.	DELAY K
CHANGMAI	Q-635	09:10	11:10	4 HR
BANGKOK	Q-633	09:30	11:30	2-30
BANGKOK	R-942	10:30	12:30	
HANOI	Q-313	11:40	13:40	5 HR
VIENTIANE	Q-645	12:20	14:20	4 HR
BANGKOK	R-946	13:20	15:20	
VIENTIANE	Q-110	14:35	16:35	2-30
VIENTIANE	Q-112	14:50	16:50	5 HR
VIENTIANE	Q-104	17:10	19:10	1-40

Many times we react to situations that are combination of events within a context

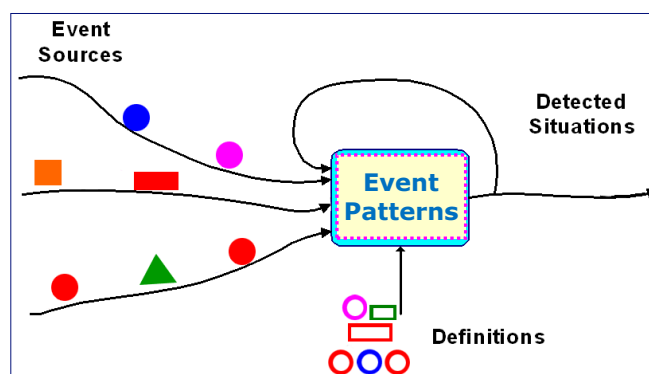


The house sensor detects that the child did not arrive home within 2 hours from the scheduled end of classes for the day



I want to be notified when my own investment portfolio is down 5% since the start of the trading Day; have an agent call me when I am available, send SMS when I am in a meeting, and Email when I am out of office.

Event pattern



The house sensor detects that the child did not arrive home within 2 hours from the scheduled end of classes for the day

Event Driven Applications follow the 4D paradigm

I want to know about it immediately and react in the best possible way



Awareness → Situation → Reaction



Did Something Happen?

Yes!

What should we do about it?

Detect

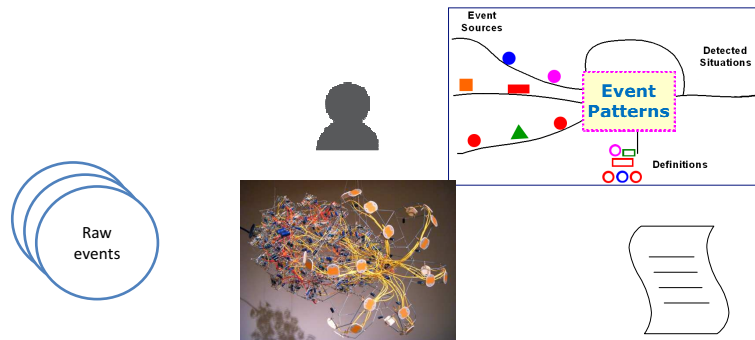
The act of bringing into a system's sphere of understanding knowledge about an event.



Detection can be by : human report, sensor, instrumentation, publisher...

Derive

The act of becoming aware of events that are not directly detectable by bringing together events with other events, data, patterns and publishing the observation as a derived event.

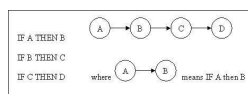


Decide

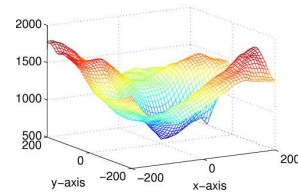
The act of determining the course of action to do in response to the situation. This includes the background information needed to be collected to make the decision.



Decision by human



Decision by rule
based systems



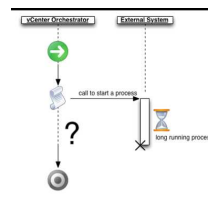
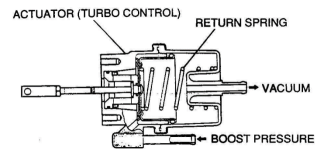
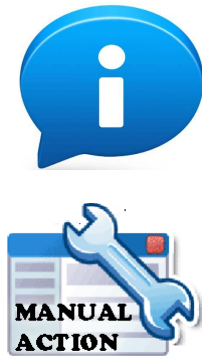
Decision by optimization

No Decision

Pass through:
Sometimes there no
decision is required;
only
course of action.

Do

The act of performing the course of action that was decided upon.



Notification: Sending a signal of sort to either a person or system. This would include calling a web-service or subscription to alerts.

The evolution of analytics

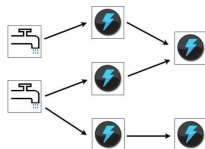


Analytics 1.0 – business intelligence / reporting over data warehouse



Analytics 2.0 --- statistical reasoning based on big data .
Volume is the key driver

Event processing is key technology



Analytics 3.0 – real-time operational on streaming data. Velocity is the key driver.

Event Processing is being used for various reasons

EP Solution Segments – Business Value

BUSINESS

IT

CONSUMERS

Information Dissemination

Getting the right information in the right granularity to the right person at the right time

Observation

Quick observation into exceptional business behavior and notification to the appropriate people

Active Diagnostics

Diagnose problems based on symptoms and resolve them

Predictive Processing

Integrate or eliminate predictive events

Detect
Decide
Respond

Real-Time Operational

Reactions to events are done as part of business transactions- achieving low latency decisions and quick reaction to threats and opportunities

The Event Processing Value

In a moderate-sized financial institution, over a billion transactions occur each and every working day; there are multiple events associated with each transaction



We don't know if any specific event will happen



We don't know when any specific event will happen



Within all these events, hidden situations can be deduced. These situations indicate business opportunities or threats; for some of them, there is a short time to exploit or contain.



Event Processing gives organizations the awareness into these situations to build competitive edge

Outline of this talk



What is event processing ?



The players and semantics



Situation



Context

Getting back to the car theft example:



A specific car is moving

detect ->



All authorized drivers for this car are not in the car: theft is concluded

derive ->



Either notify police or chase the car by private agency

decide ->



Stop the car by police

do

Players in the story

Sensors:

Car GPS sensor
Car camera
Person's location sensor

Events:

Car moving
Person changed location
Person enters car



Situation:

Person enters car and then
Car moving
Person location for all eligible
drivers is not near car
location
Entering person does not look
like any eligible driver

Actuators:

Car stopper
Security enforcers

Concepts

Player

Processing
Element

Fact

Context

Domain

Situation

Event

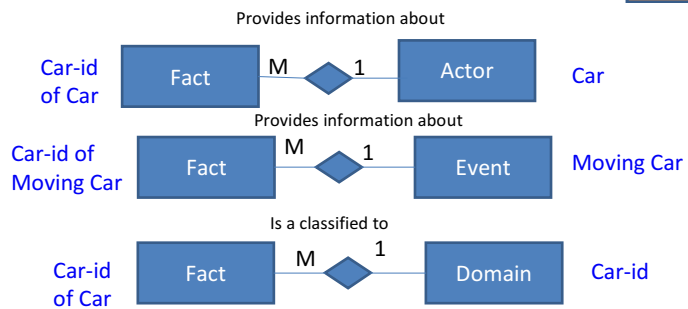
Actor

Fact

What?	Piece of information about actor or event
How?	A function of the actor/event to a domain

Examples:

Car-id of Car
Car-id of Moving Car
Authorized-driver of Car



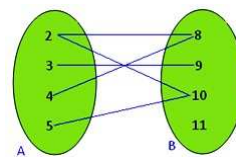
Domain

What?	Describes an entity type in the real world
How?	An abstract term, associated with data type and

Examples:

Car
Driver


Name: Car	Synonyms: Vehicle	Data type: 2 char + 8 digits		
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Event

What?	Something that happens
How?	Represented as a aggregation of characteristics and associated facts

Examples:
 Moving Car
 Person enters car
 Person changes location

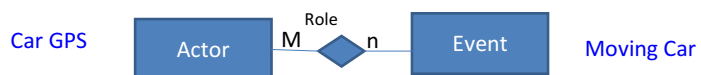
Name: Person enters car	Characteristics: Time: 22/10/2013 22:24 Location: Barcelona, Balmes 132 Certainty: 1 Source : car camera 453430	Car id: 14321313	Picture: 
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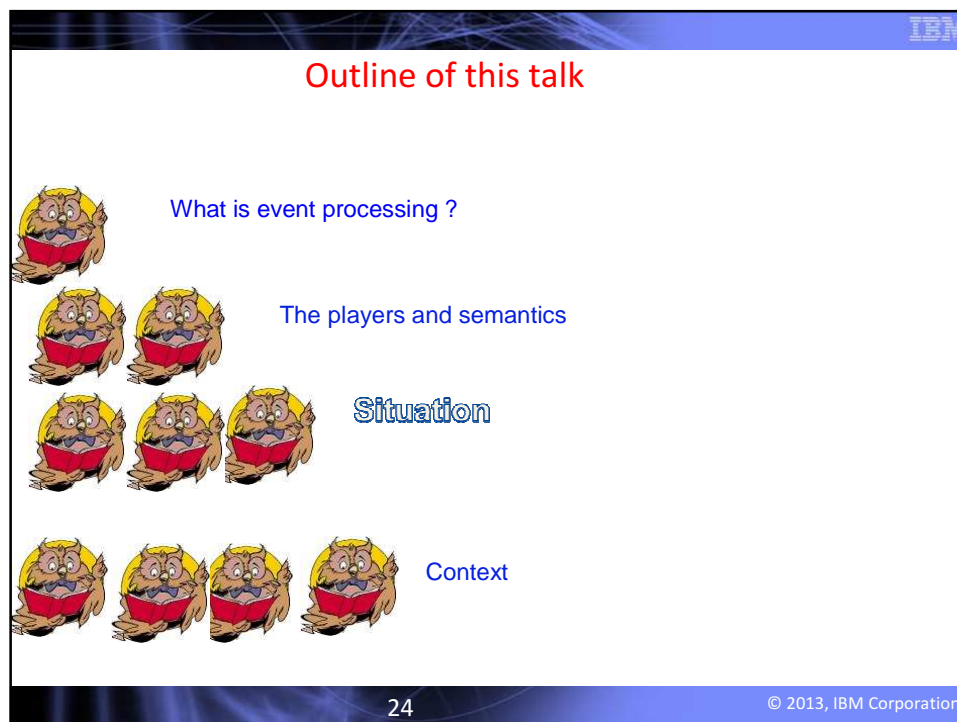


ACTOR

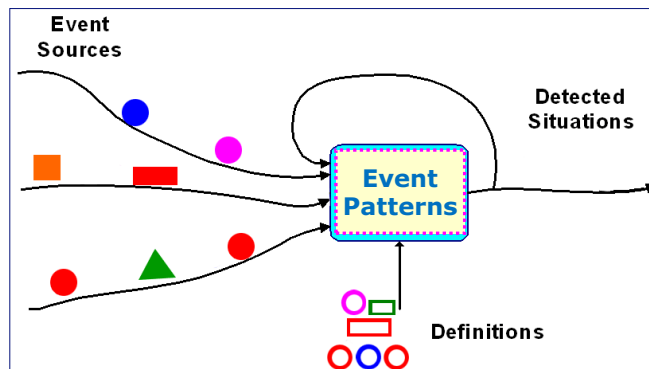
What?	Any entity, person, or organization that has a relevant role
How?	Represented through associated Fact-types and event related roles

Examples:
 Car
 Driver
 Car GPS
 Mobile phone





The notion of pattern

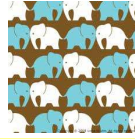


Partitioned by	Car		
Filter	Picture <Person enters car>	Is not similar to	Any picture <driver>
Pattern	Person enters car	Occurs before	Moving Car
Pattern	Location <Car>	Is not near	Any Last location <driver>

Pattern example

Partitioned by	Car		
Filter	Picture <Person enters car>	Is not similar to	Any picture <driver>
Pattern	Person enters car	Occurs before	Moving Car
Pattern	Location <Car>	Is not near	Any Last location <driver>

Sample of pattern types



▪ **all** pattern is satisfied when the relevant event set contains at least one instance of each event type in the participant set

▪ **any** pattern is satisfied if the relevant event set contains an instance of any of the event types in the participant set

▪ **absence** pattern is satisfied when there are no relevant events

▪ **Top/bottom K values** pattern is satisfied by the events which have the N highest value of a specific attribute over all the relevant events, where N is an argument

▪ **value average** pattern is satisfied when the value of a specific attribute, averaged over all the relevant events, satisfies the value average threshold assertion.

▪ **always** pattern is satisfied when all the relevant events satisfy the always pattern assertion

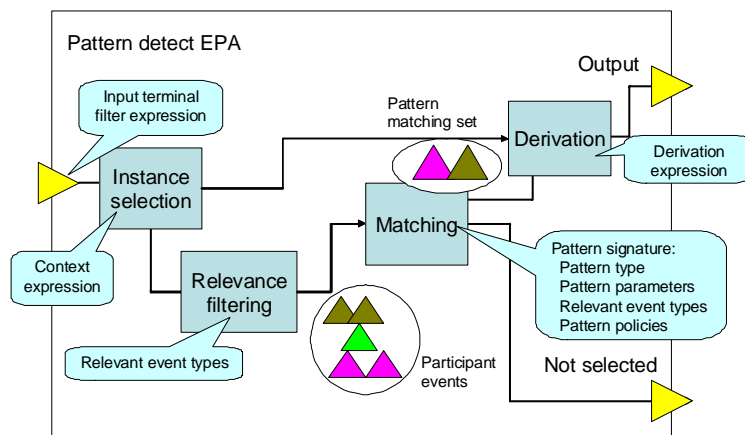
▪ **sequence** pattern is satisfied when the relevant event set contains at least one event instance for each event type in the participant set, and the order of the event instances is identical to the order of the event types in the participant set.

▪ **increasing** pattern is satisfied by an attribute A if for all the relevant events, $e1 \ll e2 \Rightarrow e1.A < e2.A$

▪ **relative max distance** pattern is satisfied when the maximal distance between any two relevant events satisfies the max threshold assertion

▪ **moving toward** pattern is satisfied when for any pair of relevant events $e1, e2$ we have $e1 \ll e2 \Rightarrow$ the location of $e2$ is closer to a certain object than the location of $e1$.

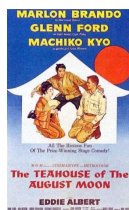
Pattern detection



Outline of this talk



Our entire culture is context sensitive



In the play “The Tea house of the August Moon” one of the characters says: **Pornography question of geography**

- This says that in different geographical contexts people view things differently
- Furthermore, the syntax of the language (no verbs) is typical to the way that the people of Okinawa are talking



When hearing concert people are not talking, eating, and keep their mobile phone on “silent”.

Context has three distinct roles (which may be combined)

Partition the incoming events



The events that relate to each customer are processed separately

Grouping events together

Time	Contextual Information	Transactional Information	Operational Information
T
T+1
T+2

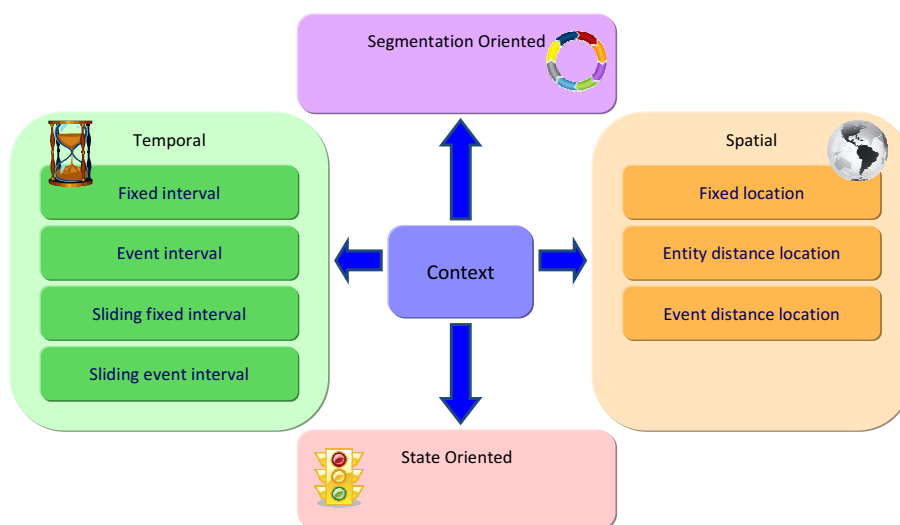
Grouping together events that happened in the same hour at the same location

Determining the processing

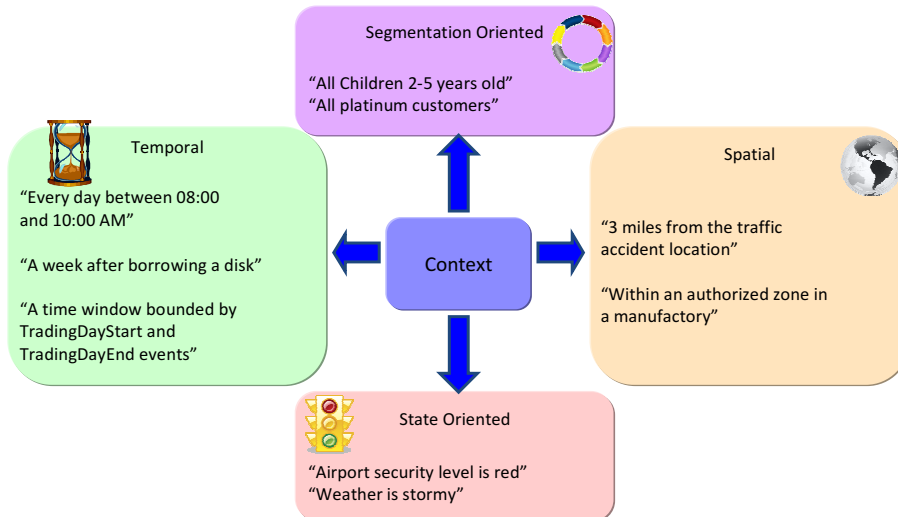


Different processing for Different context partitions

Context types

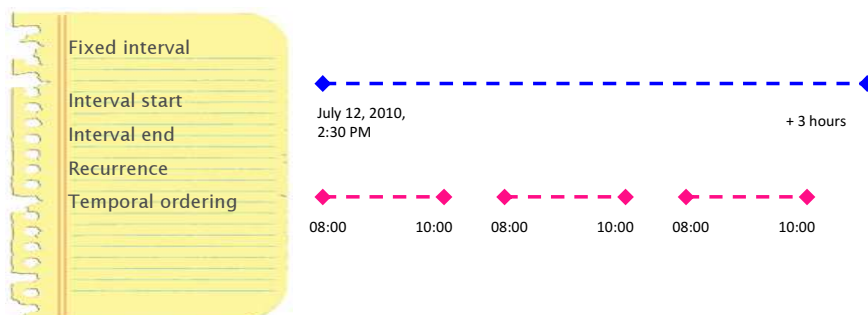


Context type examples



Fixed Interval

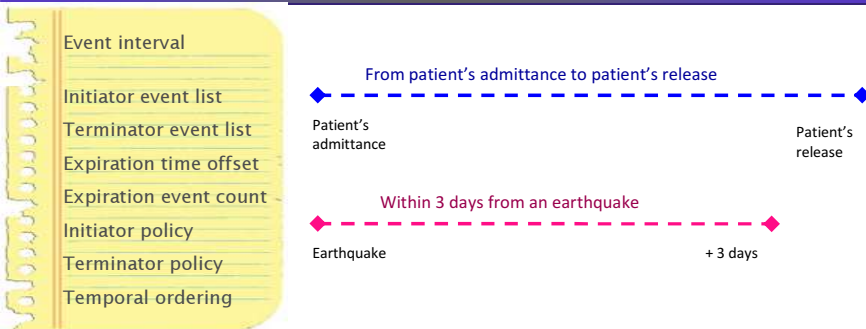
In a **fixed interval** context each window is an interval that has a fixed time length; there may be just one single window or a periodically repeating sequence of windows.



Event Interval

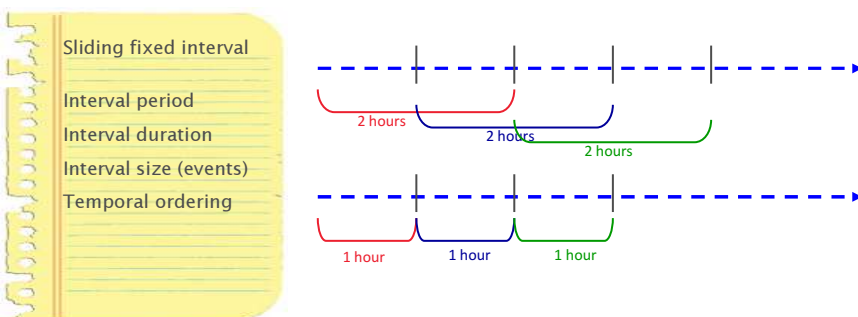
In an event interval context each window is an interval that starts when the associated EPA receives an event that satisfies a specified predicate.

It ends when it receives an event that satisfies a second predicate, or when a given period has elapsed.



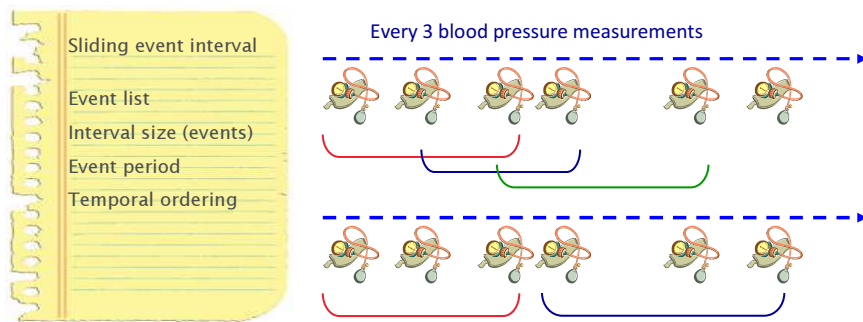
Sliding fixed interval

In a sliding fixed interval context each window is an interval with fixed temporal size. New windows are opened at regular intervals relative to one another.



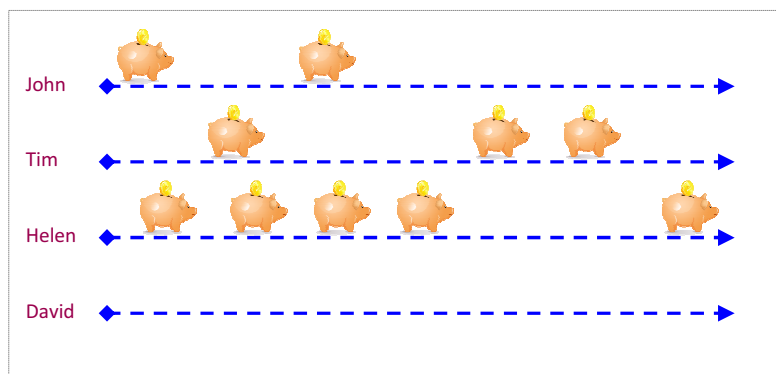
Sliding event interval

A **sliding event interval** is an interval of fixed size (events number) that continuously slides on the time axis.



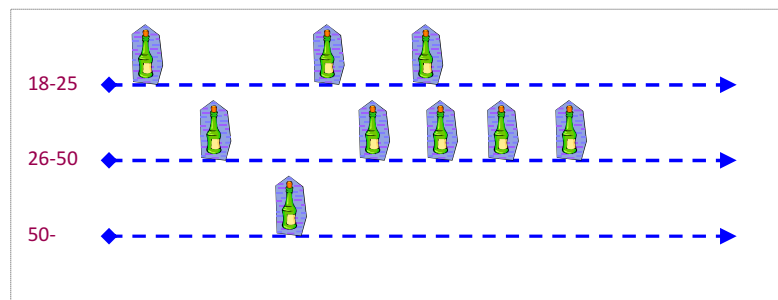
Segmentation oriented context

- ❖ Unrestricted number of partitions:
 - ❖ Average of customer's deposits over last month

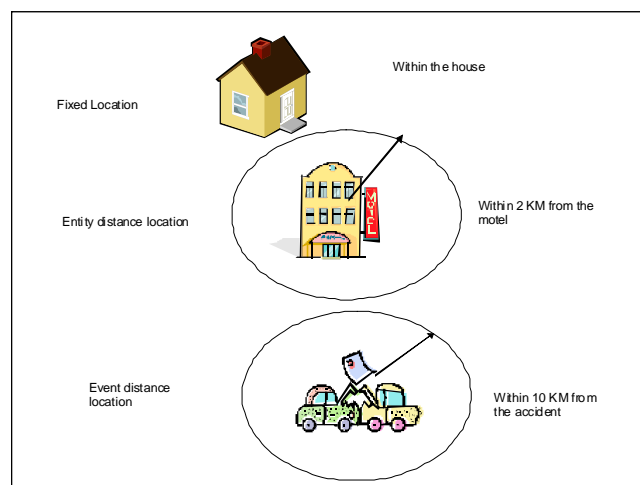


Segmentation context –(II)

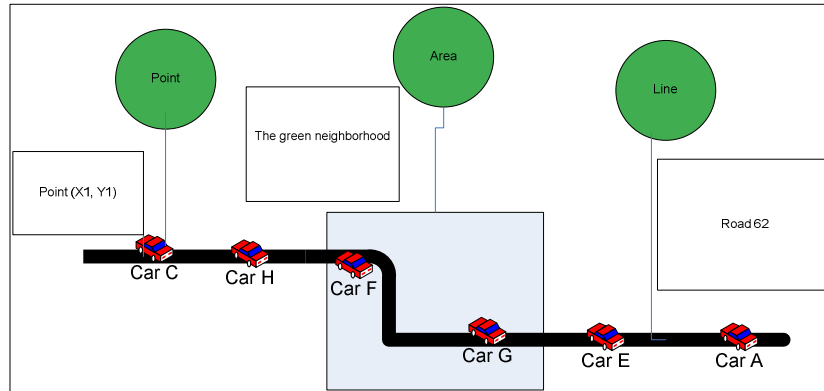
- ❖ Fixed number of partitions
 - ❖ Distribution of alcohol consumption by age



Spatial context



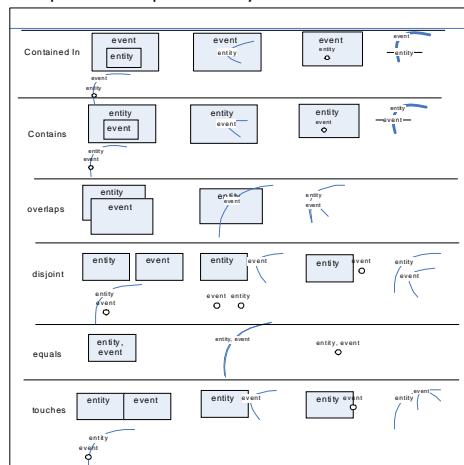
Spatial properties of events



Fixed location

A *fixed location* context has predefined context partitions based on specific spatial entities.

An event is included in a partition if its location attribute indicates that it is correlated with the partition's spatial entity.



Relations between
the event's location
and the context
entity's location

An event is classified
to a context partition
if satisfy a spatial
relationship
with fixed entity

One more thing

**OUR DRIVING FORCE IS TO HELP
EVERYBODY REALIZE THE POWER
OF EVENTS TO CREATE A BETTER
WORLD**

