

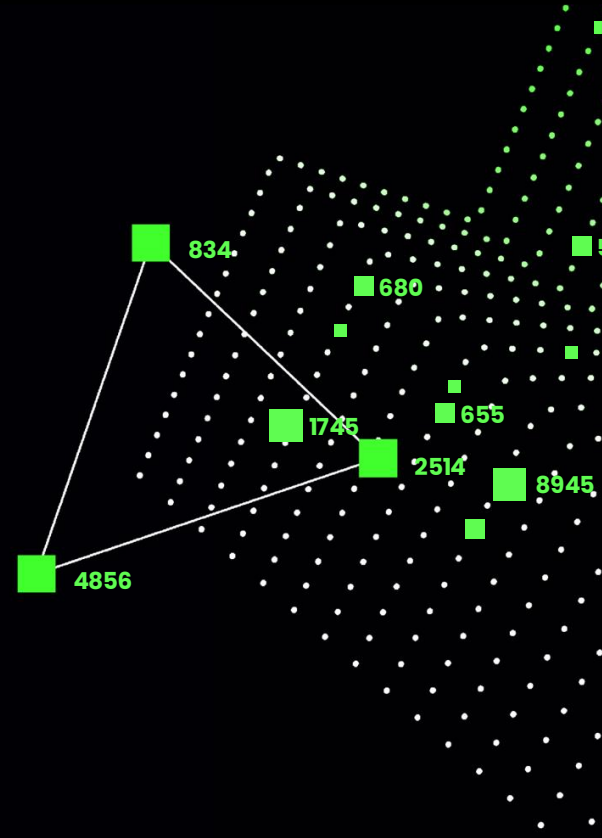
Getting the Data

Not so easy, but the key to success

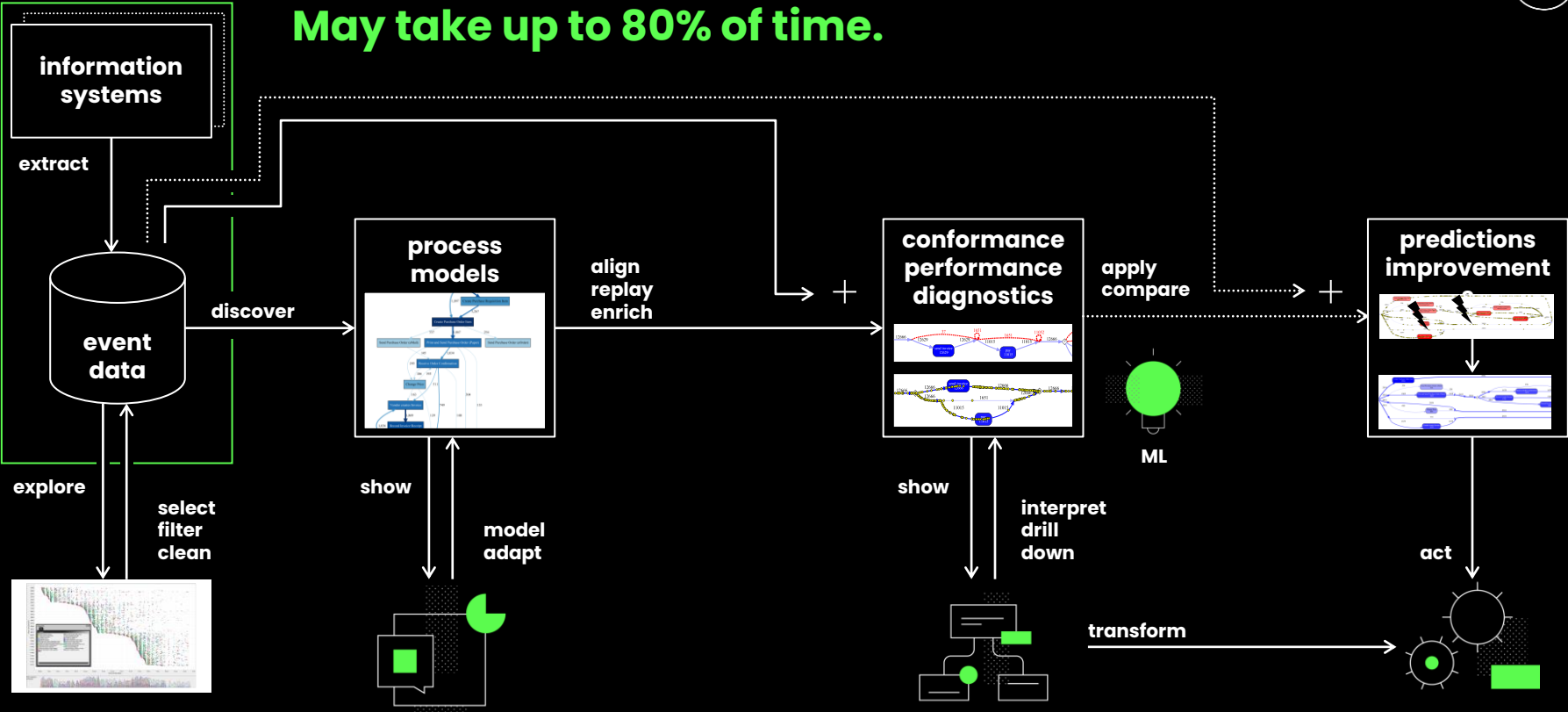
Process mining:
From Theory to Execution

prof.dr.ir. Wil van der Aalst

www.vdaalst.com @wvdaalst | www.pads.rwth-aachen.de



May take up to 80% of time.

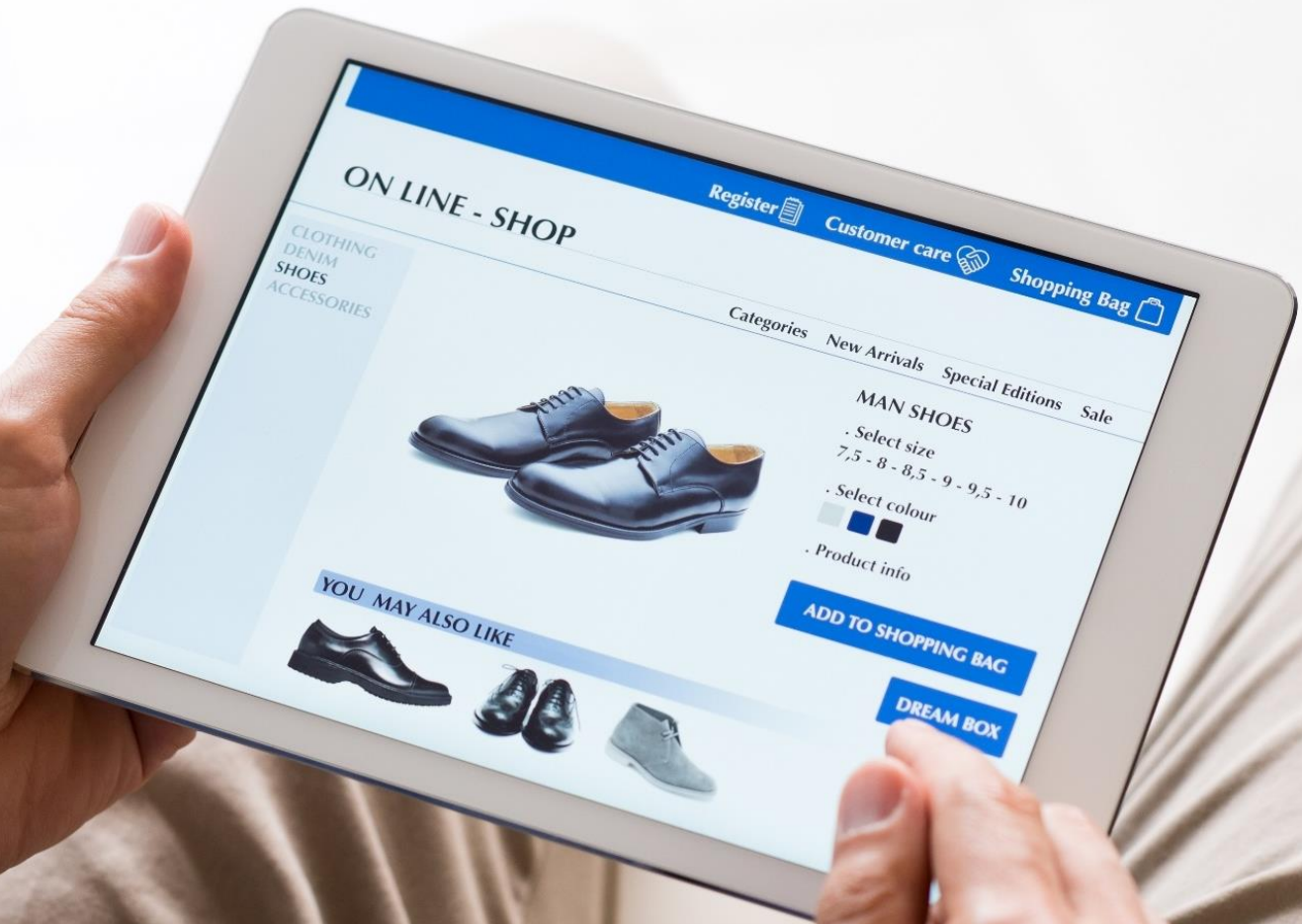


Remember: Event data



Case ID	Activity	Resource	Timestamp	Product	Prod-price	Quantity	Address
6350	place order	Aiden	2018/02/13 14:29:45.000	APPLE iPhone 6 16 GB	639,00 €	5	NL-7751DG-21
6283	pay	Lily	2018/02/13 14:39:25.000	SAMSUNG Galaxy S6 32 GB	543,99 €	3	NL-7828AM-11a
6253	prepare delivery	Sophia	2018/02/13 15:01:33.000	APPLE iPhone 6s 16 GB	449,00 €	3	NL-7887AC-13
6257	prepare delivery	Aiden	2018/02/13 15:03:43.000	SAMSUNG Galaxy S6 32 GB	543,99 €	1	NL-9521KJ-34
6185	confirm payment	Emily	2018/02/13 15:05:36.000	SAMSUNG Galaxy S4	329,00 €	1	NL-9521GC-32
6218	confirm payment	Emily	2018/02/13 15:08:11.000	APPLE iPhone 6s 16 GB	969,00 €	2	NL-7948BX-10
6245	make delivery	Michael	2018/02/13 15:14:04.000	APPLE iPhone 6 16 GB	639,00 €	3	NL-7905AX-38
6272	pay	Emily	2018/02/13 15:20:36.000	APPLE iPhone 6 16 GB	639,00 €	1	NL-7821AC-3
6269	pay	Charlotte	2018/02/13 15:25:21.000	SAMSUNG Galaxy S4	329,00 €	1	NL-7907EJ-42
6212	prepare delivery	Sophia	2018/02/13 15:43:39.000	HUAWEI P8lite	135,00 €	1	NL-7905AX-38
6323	send invoice	Alexander	2018/02/13 15:46:08.000	APPLE iPhone 6 16 GB	639,00 €	1	NL-7833HT-15
6246	confirm payment	Jack	2018/02/13 15:56:03.000	SAMSUNG Galaxy S4	329,00 €	3	NL-7833HT-15
6347	send invoice	Jack	2018/02/13 15:57:42.000	SAMSUNG Galaxy S4	329,00 €	3	NL-7905AX-38
6351	place order	Zoe	2018/02/13 16:17:37.000	APPLE iPhone 6s 16 GB	449,00 €	3	NL-9521GC-32
6204	prepare delivery	Sophia	2018/02/13 16:31:28.000	SAMSUNG Core Prime G361	135,00 €	1	NL-7828AM-11a
6204	make delivery	Kaylee	2018/02/13 16:51:54.000	SAMSUNG Core Prime G361	135,00 €	1	NL-7828AM-11a
6265	confirm payment	Lily	2018/02/13 16:55:55.000	SAMSUNG Galaxy S4	329,00 €	4	NL-9521GC-32
6250	confirm payment	Jack	2018/02/13 17:03:26.000	MOTOROLA Moto G	199,00 €	4	NL-7942GT-2
6328	send invoice	Lily	2018/02/13 17:30:16.000	APPLE iPhone 6s 64 GB	858,00 €	4	NL-9514BV-16
6352	place order	Aiden	2018/02/13 17:53:22.000	APPLE iPhone 6 16 GB	639,00 €	2	NL-9514BV-16
6317	send invoice	Jack	2018/02/13 18:45:30.000	APPLE iPhone 6s 64 GB	858,00 €	5	NL-7907EJ-42
6353	place order	Sophia	2018/02/13 20:16:20.000	APPLE iPhone 5s 16 GB	449,00 €	4	NL-7751AR-19

event =
case +
activity +
timestamp +



ON LINE - SHOP

Register  Customer care  Shopping Bag 

CLOTHING
DENIM
SHOES
ACCESSORIES

Categories New Arrivals Special Editions Sale



MAN SHOES

. Select size
7,5 - 8 - 8,5 - 9 - 9,5 - 10

. Select colour

. Product info

ADD TO SHOPPING BAG

DREAM BOX

YOU MAY ALSO LIKE





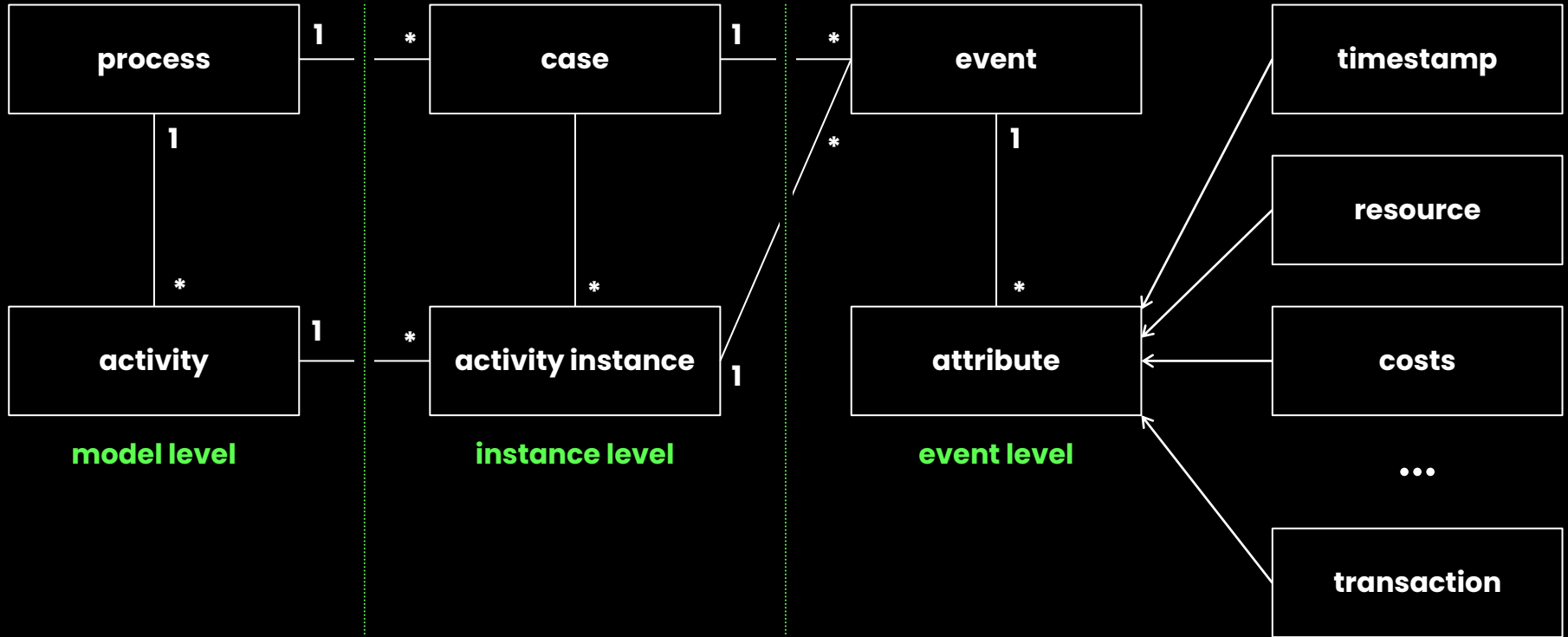


C

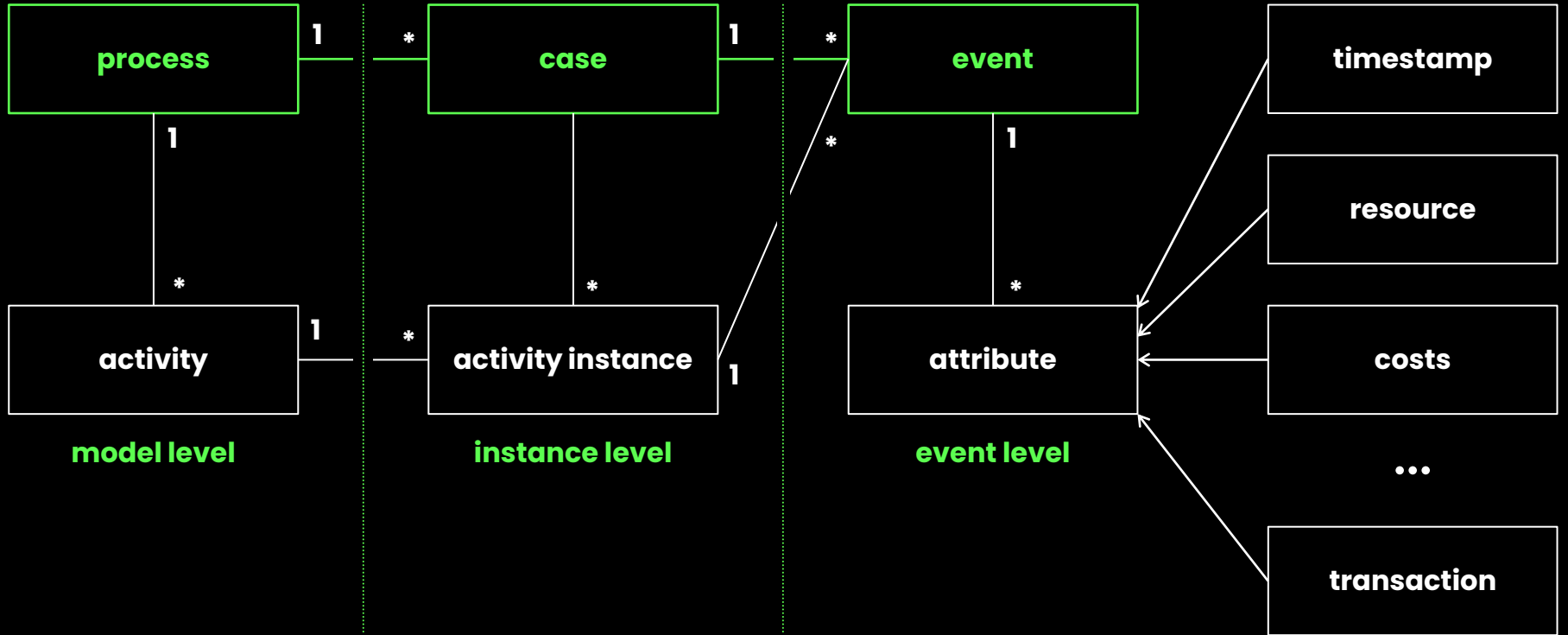


C

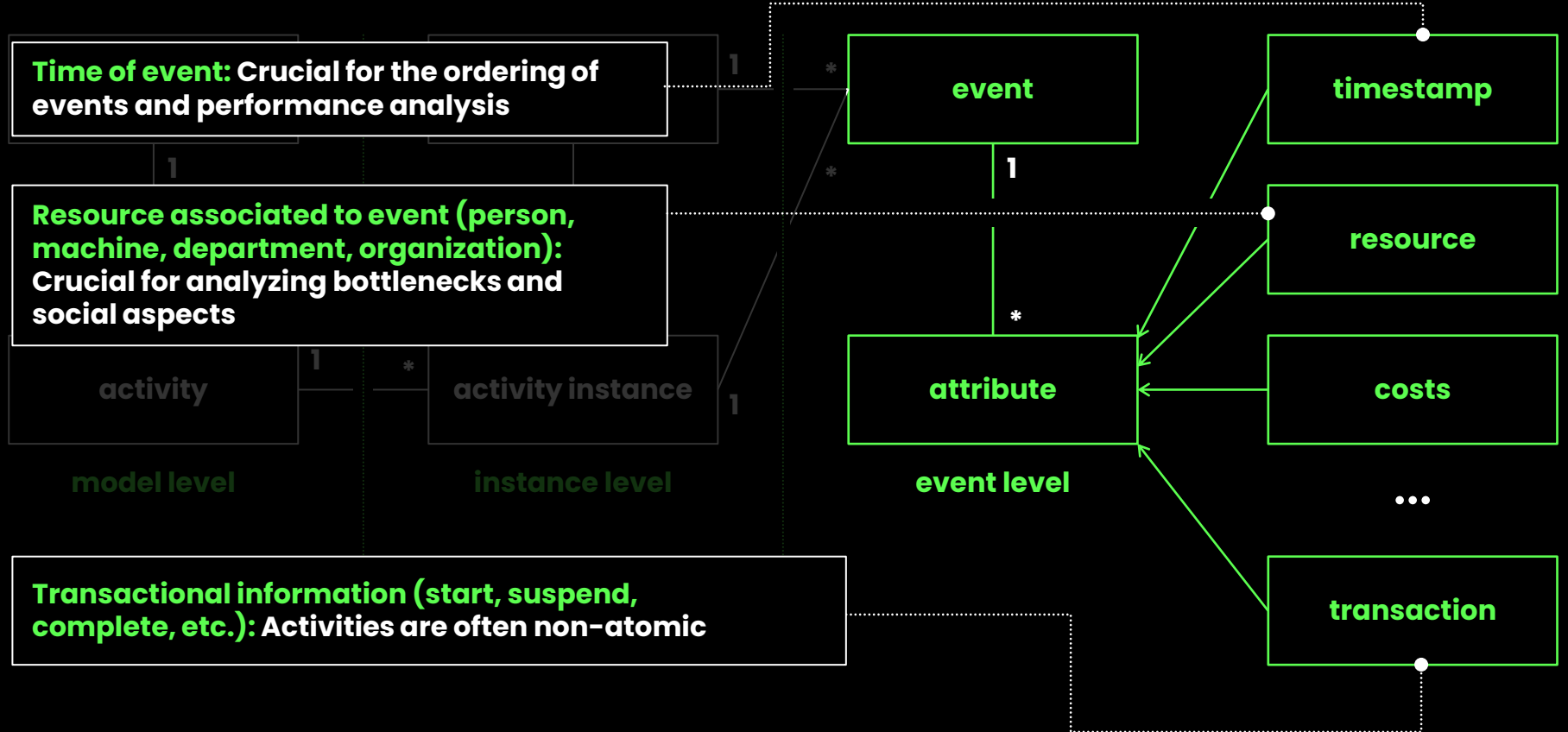
A more refined view



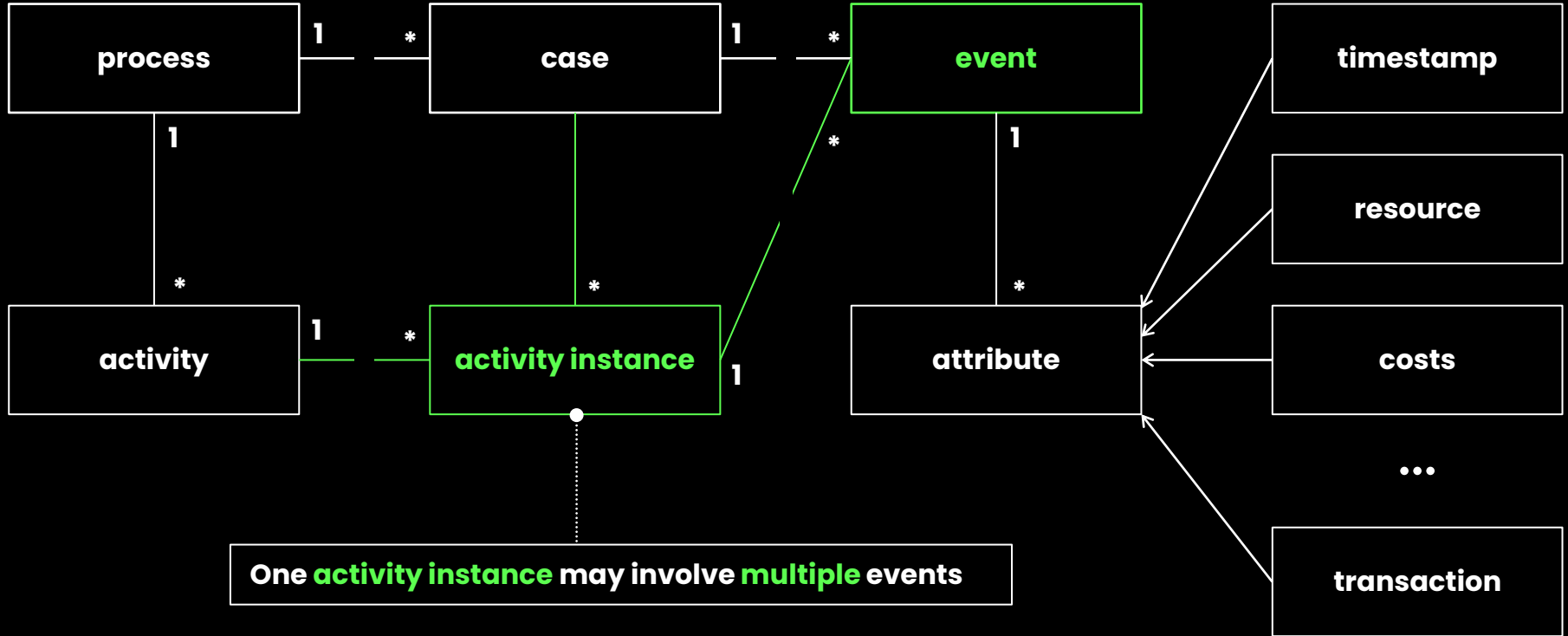
Process – case – event



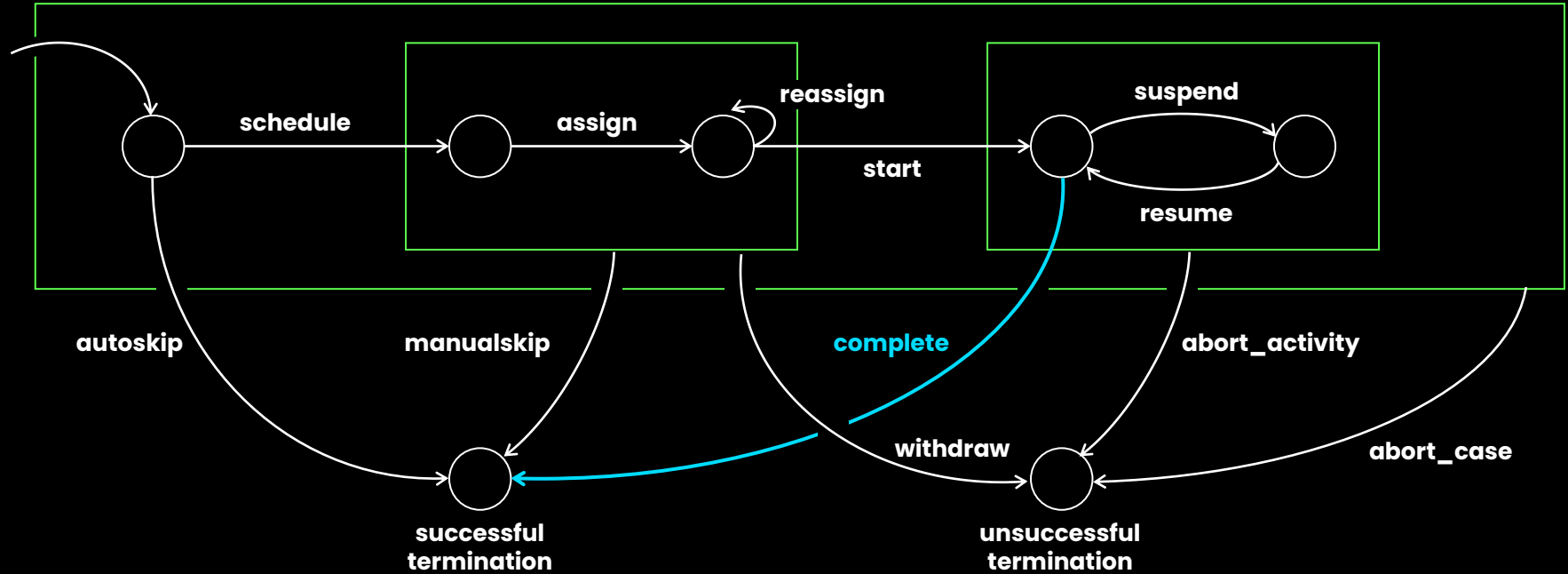
Events have attributes



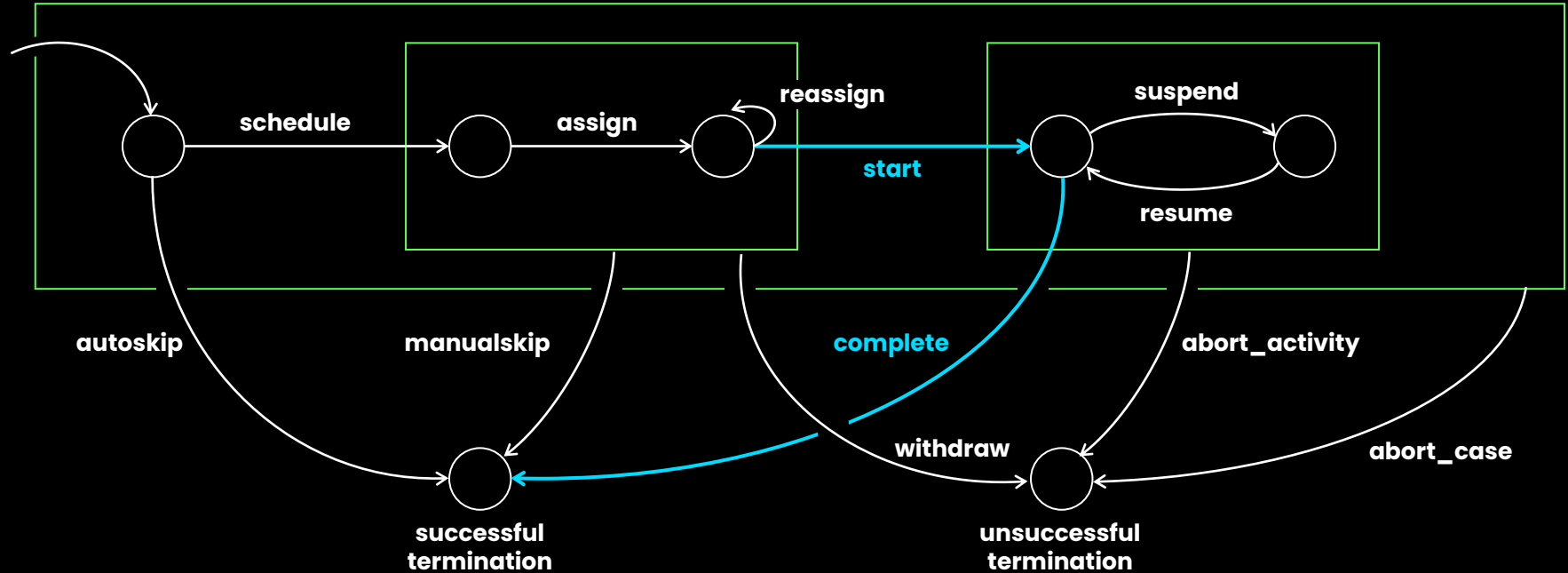
Activity instances



Atomic activities



Activities that have a duration



XES

XES

Extensible Event Stream

xes-standard.org

The screenshot shows the IEEE Xplore Digital Library interface. At the top, there are logos for IEEE Xplore Digital Library, RWTH Aachen University, and IEEE. A navigation bar includes 'Browse', 'My Settings', and 'Get Help'. A search bar contains the text 'All' and a search icon. Below the search bar, the main content area displays the search results for '1849-2016 - IEEE Standard for eXtensible Event Stream (XES) for Achieving Interoperability in Event Logs and Event Streams'. The status is 'Active - Approved'. There are two buttons: 'View Document' and '316 Full Text Views'. To the right, there is a 'Related Articles' section with two entries. At the bottom, there is a navigation bar with tabs for 'Abstract', 'Figures', 'References', 'Citations', 'Keywords', 'Definitions', 'Metrics', 'Versions', and 'Media'. The 'Abstract' tab is selected, showing the abstract text. The year '2016' is displayed in the bottom right corner.

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Advanced Search | Other Search Options ▾

Browse Standards ?

1849-2016 - IEEE Standard for eXtensible Event Stream (XES) for Achieving Interoperability in Event Logs and Event Streams

Status: **Active - Approved**

[View Document](#) **316** Full Text Views

Related Articles

- C95.6-2002 - IEEE Standard for Safety Levels With Respect to Human Exposure to E...
- 1553-2002 - IEEE Trial-Use Standard for Voltage-Endurance Testing of Form-Wound ...

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Abstract | Figures | References | Citations | Keywords | Definitions | Metrics | Versions | Media

Abstract:
A grammar for a tag-based language whose aim is to provide designers of information systems with a unified and extensible methodology for capturing systems behaviors by means of event logs and event streams is defined in the XES standard. An XML Schema describing the structure of an XES event log/stream and a XML Schema describing the structure of an extension of such a log/stream are included in this standard. Moreover, a basic collection of so-called XES extension prototypes that provide semantics to certain attributes as recorded in the event log/stream is included in this standard.

Scope:

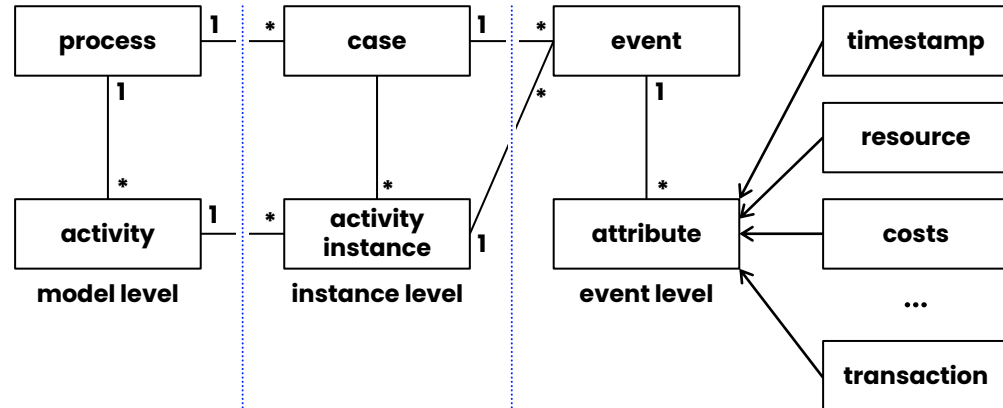
2016

Challenges

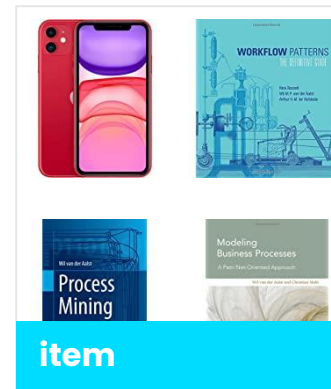
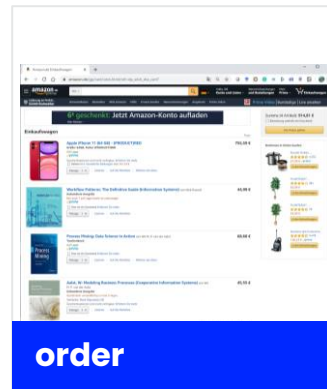
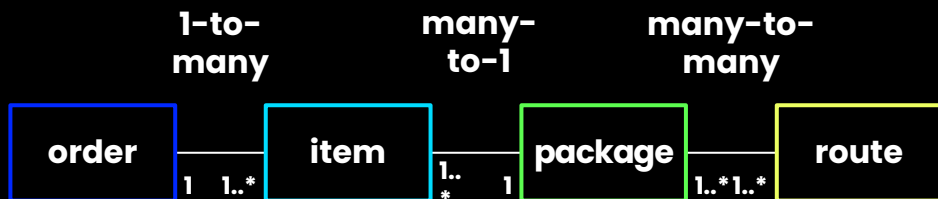
- Finding the data
- Extracting the data
- Understand the meaning
- Dealing with quality problems
- Scalability
- **Picking a case identifier**



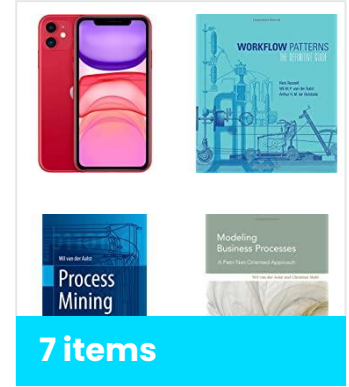
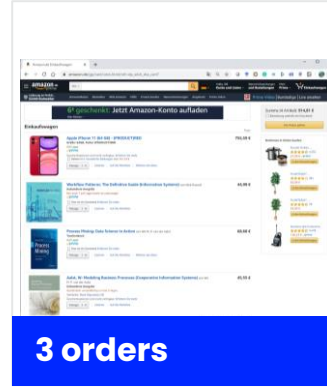
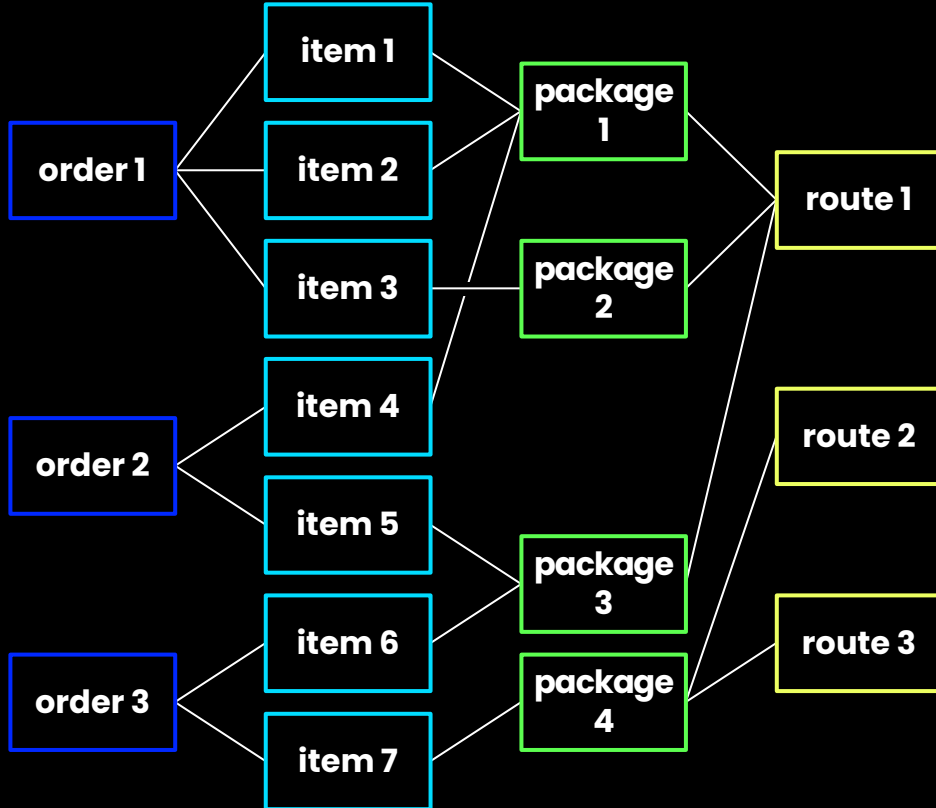
Hundreds
of systems
Thousands
of tables



Example: Amazon

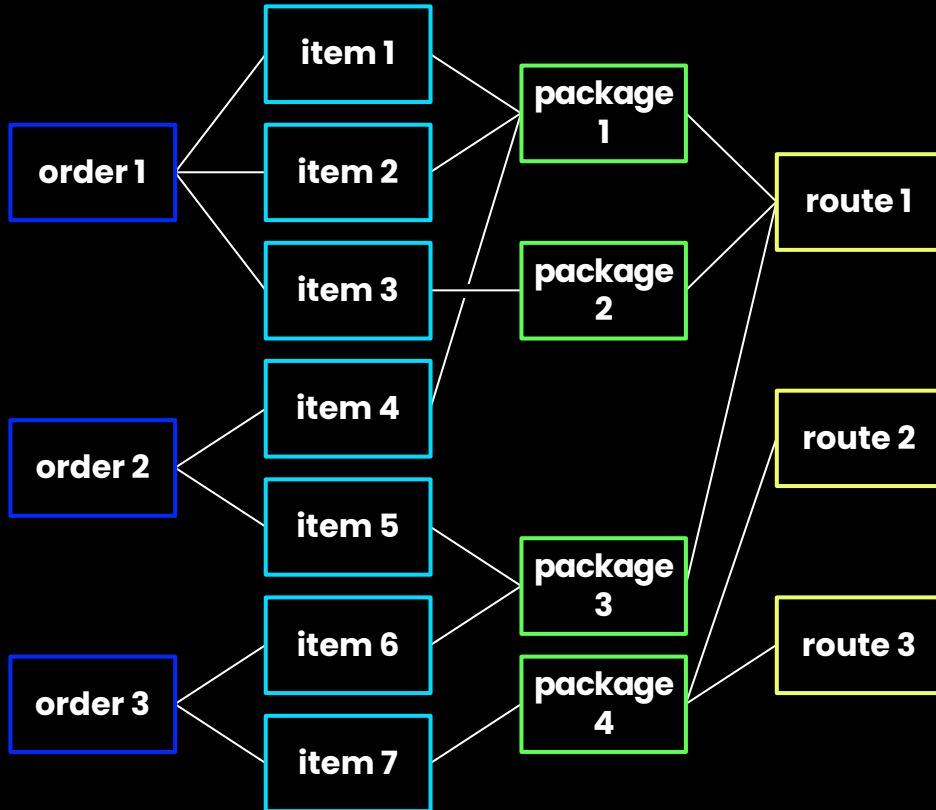


Example objects



Example objects

C



Items of order 1 end up in packages 1 and 2

Package 1 contains items of orders 1 and 2

Etc.

What is a suitable case notion?

Let's make the following assumption



Activity	Time	Orders	Items	Packages	Customers	Products	Price	Weight
pick item	2019/12/26 12:04:46	{991224}	{884803}	{}	Wil van der Aalst	iPhone 8	529.0	0.21
reorder item	2019/12/26 12:27:26	{991271}	{885002}	{}	Mohammadreza Fani Sani	Kindle Paperwhite	129.0	0.495
place order	2019/12/26 12:44:23	{991283}	{885038, 885039}	{}	Luis Santos	MacBook Air, iPad	2700.0	1.733
pick item	2019/12/26 14:01:16	{991266}	{884983}	{}	Marco Pegoraro	Macbook Air	2200.0	1.25
create package	2019/12/26 14:01:16	{991264}	{884975, 884974, 884978, 884971, 884970, 884973}	{660798}	Seran Uysal	Fire Stick 4K, iPad Pro, iPad Pro, iPad Pro, Fire Stick, Kindle	3506.97	2.412
send package	2019/12/26 14:16:11	{991264}	{884975, 884974, 884978, 884971, 884970, 884973}	{660798}	Seran Uysal	Fire Stick 4K, iPad Pro, iPad Pro, iPad Pro, Fire Stick, Kindle	3506.97	2.412
pick item	2019/12/26 14:16:48	{991279}	{885027}	{}	Claudia Graf	iPhone 11	799.0	0.166
confirm order	2019/12/26 14:26:01	{991283}	{885038, 885039}	{}	Luis Santos	MacBook Air, iPad	2700.0	1.733
reorder item	2019/12/26 14:32:43	{991251}	{884912}	{}		Stick	39.99	0.2
confirm order	2019/12/26 14:32:44	{991272}	{885036, 885037}	{}		Book Pro	134.98	1.16
pick item	2019/12/26 14:33:28	{885024}	{885024}	{}		Book Pro	2500.0	1.37
place order	2019/12/26 14:48:33	{991284}	{885040, 885041, 885042}	{}		Book Pro, Fire Stick, MacBook Air, Echo Show 8, iPhone 11 Pro	4222.98	2.79
failed delivery	2019/12/26 15:04:53	{991240, 991168}	{884878, 884561, 884878}	{}		Book Pro, Fire Stick, MacBook Air, Echo Show 8, iPhone 11 Pro	5982.95	7.642
pick item	2019/12/26 15:20:05	{991278}	{885025}	{}		iPhone 8	699.0	0.172
confirm order	2019/12/26 15:25:00	{991248}	{884938, 884939, 884944}	{}		Kindle Paperwhite	3247.98	2.666
send package	2019/12/26 15:26:49	{991247, 881253}	{884902, 884922, 884923}	{}		MacBook Air, iPad	8496.0	4.054
failed delivery	2019/12/26 15:36:16	{991264}	{884975, 884974, 884978}	{}		MacBook Air	3506.97	2.412
confirm order	2019/12/26 15:40:51	{991274}	{885008, 885009, 885010}	{}		Kindle, iPhone X, Fire Stick, iPhone 8	1352.98	1.065
failed delivery	2019/12/26 15:46:21	{991128, 991255}	{884426, 884932, 884998}	{}		Kindle, iPhone X, iPhone 8, Echo Show 8, Echo Plus, iPad Air, iPad mini	2145.97	3.6
payment reminder	2019/12/26 15:54:44	{991169}	{884565, 884566, 884567, 884568}	{}	Gyunam Park	Kindle, iPhone X, iPhone 8, Echo Show 8, Echo Plus, iPad Air, iPad mini	1608.99	2.21
pick item	2019/12/26 15:55:38	{991201}	{884717}	{}	Seran Uysal	Echo Show 8	129.99	0.98
pick item	2019/12/26 16:00:38	{991251}	{884912}	{}	Tobias Brockhoff	Fire Stick	39.99	0.2
reorder item	2019/12/26 16:04:42	{991265}	{884977}	{}	Seran Uysal	Fire Stick 4K	89.99	0.28
payment reminder	2019/12/26 16:11:39	{991164}	{884542, 884543, 884544, 884545, 884546, 884547}	{}	Junxiong Gao	Kindle Paperwhite, iPad Air, iPhone 11, MacBook Air, iPad mini, Echo Dot	4087.99	3.011
pick item	2019/12/26 16:22:04	{991241}	{884882}	{}	Lisa Mannel	iPhone 8	529.0	0.21
create package	2019/12/26 16:22:04	{991263, 991162}	{884967, 884964, 884966}	{660799}	Luis Santos	iPad Air, iPhone 8, iPad	1500.0	1.133

- products
- customers
- parts
- locations
- packages
- patients
- orders

event = activity + timestamp + objects + attributes

Let's make the following assumption



Activity	Time	Orders	Items	Packages	Customers	Products	Price	Weight
pick item	2019/12/26 12:04:46	{991224}	{884803}	{}	Wil van der Aalst	iPhone 8	529.0	0.21
reorder item	2019/12/26 12:27:26	{991271}	{885002}	{}			129.0	0.495
place order	2019/12/26 12:44:23	{991283}	{885038, 885039}	{}			2700.0	1.733
pick item	2019/12/26 14:01:16	{991266}	{884983}	{}			2200.0	1.25
create package	2019/12/26 14:01:16	{991264}	{884975, 884974, 884978, 884971, 884970, 884973}	{660798}			3506.97	2.412
send package	2019/12/26 14:16:11	{991264}	{884975, 884974, 884978, 884971, 884970, 884973}	{660798}			3506.97	2.412
pick item	2019/12/26 14:16:48	{991279}	{885027}	{}	Claudia Graf	iPhone 11	799.0	0.166
confirm order	2019/12/26 14:26:01	{991283}	{885038, 885039}	{}	Luis Santos	MacBook Air, iPad	2700.0	1.733
reorder item	2019/12/26 14:32:43	{991251}	{884912}	{}	Tobias Brockhoff	Fire Stick	39.99	0.2
confirm order	2019/12/26 14:32:44	{991272}	{885036, 885037}	{}	Lise Mannel	Echo, Echo Dot	134.98	1.16
pick item	2019/12/26 14:33:28	{885024}	{885024}	{}	Junxiong Gao	MacBook Pro	2500.0	1.37
pick item	2019/12/26 14:33:28	{885041, 885042, 885043, 885044}	{885041, 885042, 885043, 885044}	{}	Christine Dobbert	iPhone, Fire Stick, MacBook Air, Echo Show 8, iPhone 11 Pro	4222.98	2.79
failed delivery	2019/12/26 14:33:28	{884973, 884913, 884976, 884958, 884914, 884941, 884973, 884974, 884978, 884971, 884970, 884973}	{884973, 884913, 884976, 884958, 884914, 884941, 884973, 884974, 884978, 884971, 884970, 884973}	{660790}	Tobias Brockhoff	iPad Air, Echo Studio, Echo Studio, Kindle, Kindle Echo, iPad mini, iPad Pro, iPad Pro	5982.95	7.642
pick item	2019/12/26 14:33:28	{884940, 884941, 884942, 884943}	{884940, 884941, 884942, 884943}	{}	Junxiong Gao	iPhone 8	699.0	0.172
confirm order	2019/12/26 15:40:51	{991274}	{885008, 885009, 885010, 885011}	{}	Tobias Brockhoff		2.666	
failed delivery	2019/12/26 15:46:21	{991128, 991255}	{884923, 885004, 885005, 884901, 884974, 884978, 884971, 884970, 884973}	{660796}	Mohammadreza Fani Sani		1.054	
confirm order	2019/12/26 15:40:51	{991274}	{885008, 885009, 885010, 885011}	{}	Seran Uysal		2.412	
failed delivery	2019/12/26 15:46:21	{991128, 991255}	{884426, 884932, 884999, 885008, 885009, 885011, 884903}	{660797}	Junxiong Gao		1.065	
payment reminder	2019/12/26 15:54:44	{991169}	{884565, 884566, 884567, 884568}	{}	Gyunam Park		2.21	
pick item	2019/12/26 15:55:38	{991201}	{884717}	{}	Seran Uysal		0.98	
pick item	2019/12/26 16:00:38	{991251}	{884912}	{}	Tobias Brockhoff		0.2	
reorder item	2019/12/26 15:04:42	{991285}	{884977}	{}	Seran Uysal		0.28	
payment reminder	2019/12/26 16:11:39	{991164}	{884542, 884543, 884544, 884545, 884546, 884547}	{}	Junxiong Gao		3.011	
pick item	2019/12/26 16:22:04	{991241}	{884882}	{}	Lisa Mannel	iPhone 8	529.0	0.21
create package	2019/12/26 16:22:04	{991263, 99162}	{884967, 884964, 884966}	{660799}	Luis Santos	iPad Air, iPhone 8, iPad	1500.0	1.133

this "place order" event refers to two items

every "pick item" event refers to one item

this "failed delivery" event refers to one package, seven items, two orders, etc.

event = activity + timestamp + objects + attributes

No case notion



Activity	Time	Orders	Items	Packages	Customers	Products	Price	Weight
pick item	2019/12/26 12:04:46	{991224}	{884803}	{}	Wil van der Aalst	iPhone 8	529.0	0.21
reorder item	2019/12/26 12:27:26	{991271}	{885002}	{}	Mohammadreza Fani Sani	Kindle Paperwhite	129.0	0.495
place order	2019/12/26 12:44:23	{991283}	{885038, 885039}	{}	Luis Santos	MacBook Air, iPad	2700.0	1.733
pick item	2019/12/26 14:01:16	{991266}	{884983}	{}	Marco Pegoraro	MacBook Air	2200.0	1.25
create package	2019/12/26 14:01:16	{991264}	{884975, 884974, 884978, 884971, 884970, 884973}	{660798}	Seran Uysal			412
send package	2019/12/26 14:16:11	{991264}	{884975, 884974, 884978, 884971, 884970, 884973}	{660798}	Seran Uysal			412
pick item	2019/12/26 14:16:48	{991279}	{885027}	{}	Claudia Graf			166
confirm order	2019/12/26 14:26:01	{991283}	{885038, 885039}	{}	Luis Santos			733
reorder item	2019/12/26 14:32:43	{991251}	{884912}	{}	Tobias Brockhoff			0.2
confirm order	2019/12/26 14:32:44	{991272}	{885036, 885037}	{}	Lise Mannel			1.16
pick item	2019/12/26 14:33:28	{885024}	{885024}	{}	Junxiong Gao			1.37
place order	2019/12/26 14:48:33	{991284}	{885040, 885041, 885042, 885043, 885044}	{}	Christine Dobbert			1.79
failed delivery	2019/12/26 15:04:53	{991240, 991168}	{884878, 884561, 884873, 884913, 884876, 884938, 884914, 884941, 884932, 884923, 885004, 885005, 884901}	{660790}	Tobias Brockhoff			342
pick item	2019/12/26 15:20:05	{991278}	{885025}	{}	Junxiong Gao			172
confirm order	2019/12/26 15:25:00	{991248}	{884938, 884939, 884940, 884941, 884942, 884943}	{}	Tobias Brockhoff			366
send package	2019/12/26 15:26:49	{991247, 891253}	{884902, 884922, 884923, 885004, 885005, 884901}	{660796}	Mohammadreza Fani Sani			954
failed delivery	2019/12/26 15:36:16	{991264}	{884975, 884974, 884978, 884971, 884970, 884973}	{660798}	Seran Uysal			412
confirm order	2019/12/26 15:40:51	{991274}	{885008, 885009, 885010, 885011}	{}	Junxiong Gao			0.65
failed delivery	2019/12/26 15:46:21	{991128, 991255}	{884426, 884932, 884999, 885008, 885009, 885011, 884903}	{660797}	Junxiong Gao			3.6
payment reminder	2019/12/26 15:54:44	{991169}	{884565, 884566, 884567, 884568}	{}	Gyungam Park			2.21
pick item	2019/12/26 15:55:38	{991201}	{884717}	{}	Seran Uysal			1.98
pick item	2019/12/26 16:00:38	{991251}	{884912}	{}	Tobias Brockhoff			0.2
reorder item	2019/12/26 16:04:42	{991265}	{884977}	{}	Seran Uysal			1.28
payment reminder	2019/12/26 16:11:39	{991164}	{884542, 884543, 884544, 884545, 884546, 884547}	{}	Junxiong Gao			0.011
pick item	2019/12/26 16:22:04	{991241}	{884882}	{}	Lisa Mannel	MacBook Air, iPad mini, Echo Dot		
create package	2019/12/26 16:22:04	{991263, 991162}	{884967, 884964, 884966}	{660799}	Luis Santos	iPhone 8, iPad Air, iPhone 8, iPad	529.0	0.21
							1500.0	1.133

Five object types:
Orders,
Items,
Packages,
Customers, and
Products.

event = activity + timestamp + objects + attributes

Creating a conventional event log



Activity	Time	Orders	Items	Packages	Customers	Products	Price	Weight
pick item	2019/12/26 12:04:46	{991224}	{884803}	{}	Wil van der Aalst	iPhone 8	529.0	0.21
reorder item	2019/12/26 12:27:26	{991271}	{885002}	{}	Mohammadreza Fani Sani	Kindle Paperwhite	129.0	0.495
place order	2019/12/26 12:44:23	{991283}	{885038, 885039}	{}	Luis Santos	MacBook Air, iPad	2700.0	1.733
pick item	2019/12/26 14:01:16	{991266}	{884983}	{}	Marco Pegoraro	Macbook Air	2200.0	1.25
create package	2019/12/26 14:01:16	{991264}	{884975, 884974, 884978, 884971, 884970, 884973}	{660798}	Seran Uysal	Fire Stick 4K, iPad Pro, iPad Pro, iPad Pro, Fire Stick, Kindle	3506.97	2.412
send package	2019/12/26 14:16:11	{991264}	{884975, 884974, 884978, 884971, 884970, 884973}	{660798}	Seran Uysal	Fire Stick 4K, iPad Pro, iPad Pro, iPad Pro, Fire Stick, Kindle	3506.97	2.412
pick item	2019/12/26 14:16:48	{991279}	{885027}	{}	Claudia Graf	iPhone 11	799.0	0.166
confirm order	2019/12/26 14:26:01	{991283}	{885038, 885039}	{}	Luis Santos	MacBook Air, iPad	2700.0	1.733
reorder item	2019/12/26 14:32:43	{991251}					39.99	0.2
confirm order	2019/12/26 14:32:44	{991272}					134.98	1.16
pick item	2019/12/26 14:33:28	{885024}					2500.0	1.37
place order	2019/12/26 14:48:33	{991284}				Echo Show 8,	4222.98	2.79
failed delivery	2019/12/26 15:04:53	{991240, 991168}				io, Kindle, o, iPad Pro	5982.95	7.642
pick item	2019/12/26 15:20:05	{991278}					699.0	0.172
confirm order	2019/12/26 15:25:00	{991248}					3247.98	2.666
send package	2019/12/26 15:26:49	{991247, 881253}					8496.0	4.054
failed delivery	2019/12/26 15:36:16	{991264}					3506.97	2.412
confirm order	2019/12/26 15:40:51	{991274}	{885008, 885009, 885010, 885011}	{}	Junxiong Gao	Kindle, iPhone X, Fire Stick, iPhone 8	1352.98	1.065
failed delivery	2019/12/26 15:46:21	{991128, 991255}	{884426, 884932, 884999, 885008, 885009, 885011, 884903}	{660797}	Junxiong Gao	Echo Show 8, Kindle Paperwhite, iPad mini, Kindle, iPhone X, iPhone 8, Echo Show	2145.97	3.6
payment reminder	2019/12/26 15:54:44	{991169}	{884565, 884566, 884567, 884568}	{}	Gyunam Park	iPhone 8, Echo Plus, iPad Air, iPad mini	1608.99	2.21
pick item	2019/12/26 15:55:38	{991201}	{884717}	{}	Seran Uysal	Echo Show 8	129.99	0.98
pick item	2019/12/26 16:00:38	{991251}	{884912}	{}	Tobias Brockhoff	Fire Stick	39.99	0.2
reorder item	2019/12/26 16:04:42	{991265}	{884977}	{}	Seran Uysal	Fire Stick 4K	89.99	0.28
payment reminder	2019/12/26 16:11:39	{991164}	{884542, 884543, 884544, 884545, 884546, 884547}	{}	Junxiong Gao	Kindle Paperwhite, iPad Air, iPhone 11, MacBook Air, iPad mini, Echo Dot	4087.99	3.011
pick item	2019/12/26 16:22:04	{991241}	{884882}	{}	Lisa Mannel	iPhone 8	529.0	0.21
create package	2019/12/26 16:22:04	{991263, 99162}	{884967, 884964, 884966}	{660799}	Luis Santos	iPad Air, iPhone 8, iPad	1500.0	1.133

Need to pick a case identifier!

How?

event = activity + timestamp + objects + attributes

Need to flatten the event data when using a conventional process mining technique



Pick an object type as the **case** notion.

Replicate each event for each object of the corresponding type.

activity	time	orders	items	packages
...
Place Order	2020-6-20	99001 1	{88001, 88002} 2	{ } 0
...

- 1** one event if order is used as a case notion
- 2** two events if item is used as a case notion
- 0** no event if package is used as a case notion

Order as a case notion



activity	time	orders	items	packages
...
place order	2020-6-20	{99001}	{88001, 88002}	{}
pick items	2020-6-22	{99001}	{88001}	{}
pick item	2022-6-23	{99001}	{88002}	{}
...
send package	2020-6-25	{99001, 99002}	{88002, 88003, 88004}	{66001}
...

Events may be duplicated

case

activity	time	orders	items	packages
...
place order	2020-6-20	99001	{88001, 88002}	{}
pick item	2022-6-22	99001	{88001}	{}
pick item	2022-6-23	99001	{88002}	{}
...
send package	2020-6-25	99001	{88002, 88003, 88004}	{66001}
send package	2020-6-25	99002	{88002, 88003, 88004}	{66001}
...

Item as a case notion



activity	time	orders	items	packages
...
place order	2020-6-20	{99001}	{88001, 88002}	{}
pick items	2020-6-22	{99001}	{88001}	{}
pick item	2022-6-23	{99001}	{88002}	{}
...
send package	2020-6-25	{99001, 99002}	{88002, 88003, 88004}	{66001}
...

Events may be duplicated

case

activity	time	orders	items	packages
...
place order	2020-6-20	{99001}	88001	{}
place order	2020-6-20	{99001}	88002	{}
pick item	2022-6-22	{99001}	88001	{}
pick item	2022-6-23	{99001}	88002	{}
...
send package	2020-6-25	{99001, 99002}	88002	{66001}
send package	2020-6-25	{99001, 99002}	88003	{66001}
send package	2020-6-25	{99001, 99002}	88004	{66001}
...

Package as a case notion



activity	time	orders	items	packages
...
place order	2020-6-20	{99001}	{88001, 88002}	{}
pick items	2020-6-22	{99001}	{88001}	{}
pick item	2022-6-23	{99001}	{88002}	{}
...
send package	2020-6-25	{99001, 99002}	{88002, 88003, 88004}	{66001}
...

activity	time	orders	items	packages
...
send package	2020-6-25	99002	88002	66001
...

case

Events may disappear

Possible problems

Deficiency

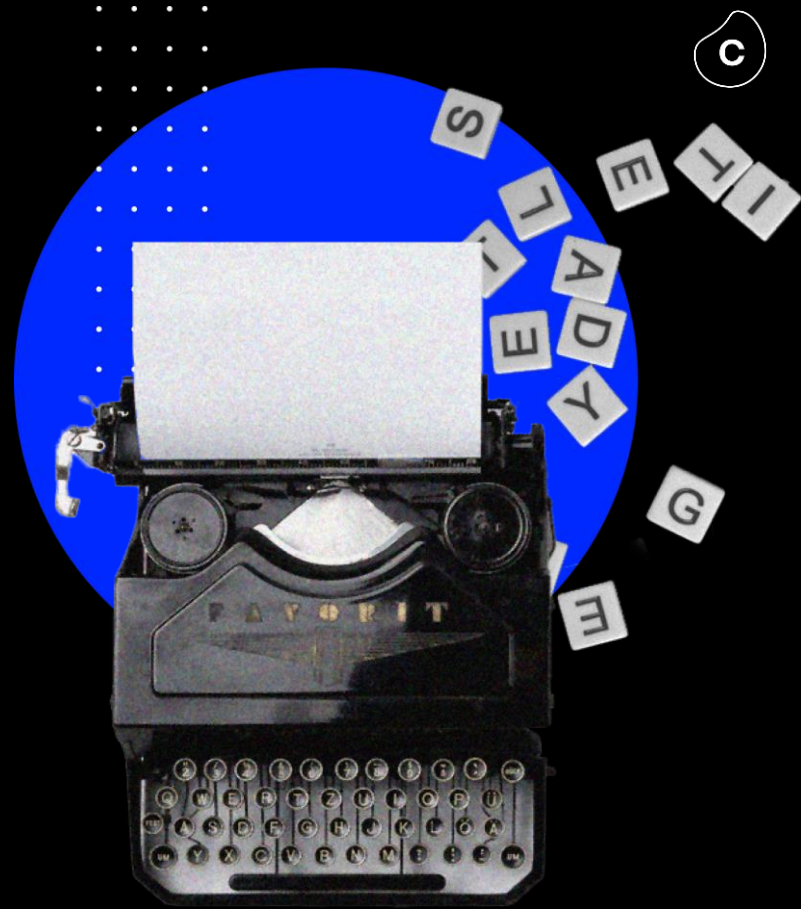
Events in the original event log that have no corresponding events in the flattened event log may **unintentionally disappear** from the data set.

Convergence

Events referring to multiple objects of the selected type are replicated, possibly leading to **unintentional duplication**.

Divergence

Two events referring to two **different objects** of a type not selected as the case notion may be considered to be **causally related** but are not.



Possible problems

Deficiency

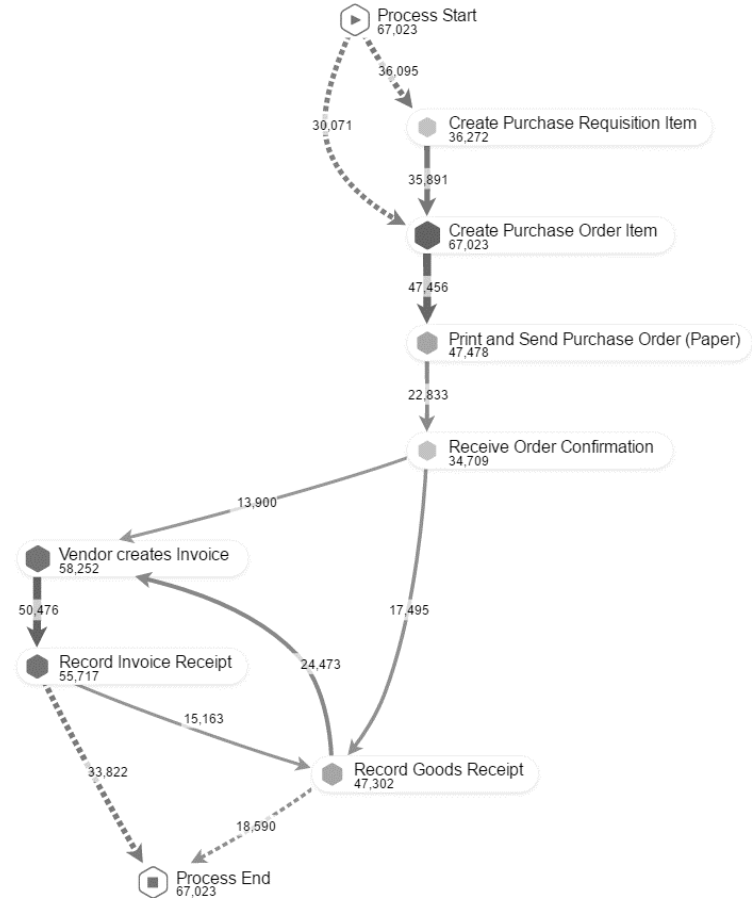
Events in the original event log that have no corresponding events in the flattened event log may **unintentionally disappear** from the data set.

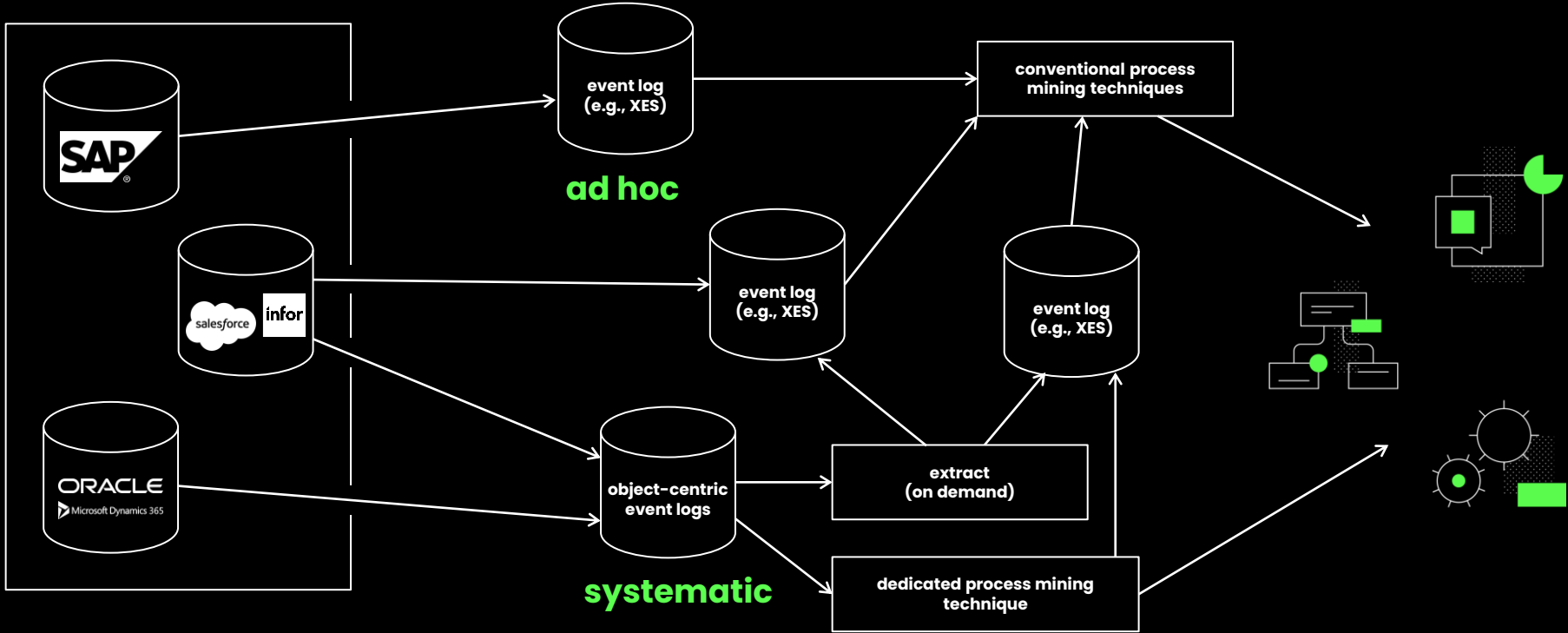
Convergence

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ingestion**

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aims to connect
different processes**

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