
ONLINE PROCESS MINING: *GET REAL INSIGHTS IN YOUR PROCESSES!*

Dr.ir. Sebastiaan J. van Zelst

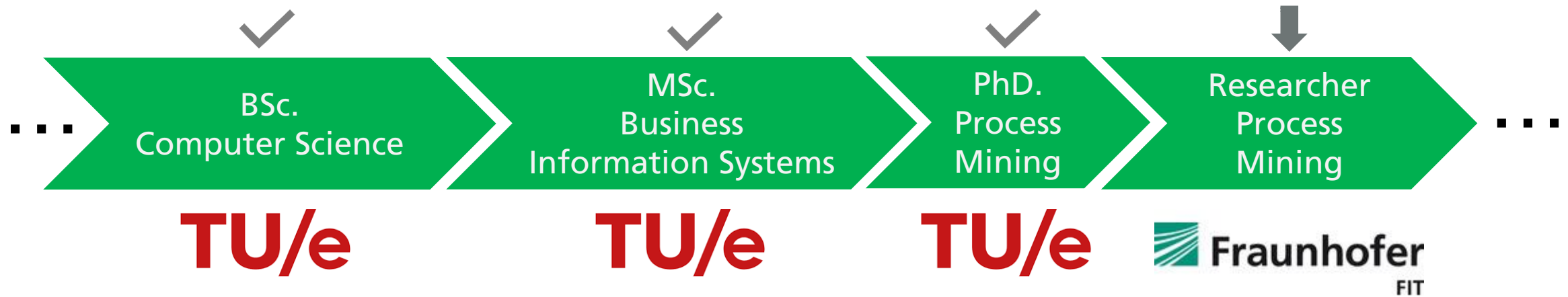
Process Mining Group of Fraunhofer Institute for Applied Information Technology – FIT
Masaryk University – Nov. 21st 2019



About Me



Name: Sebastiaan J. van Zelst



What is Process Mining?

Process Mining

What is Process Mining?

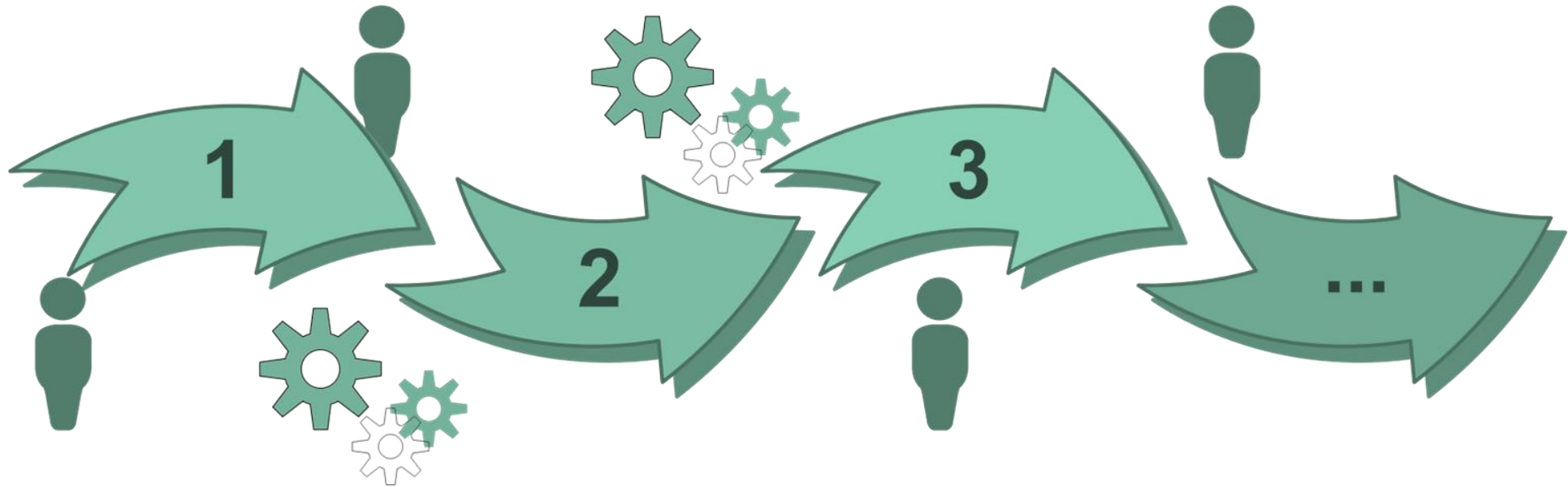


What is Process Mining?

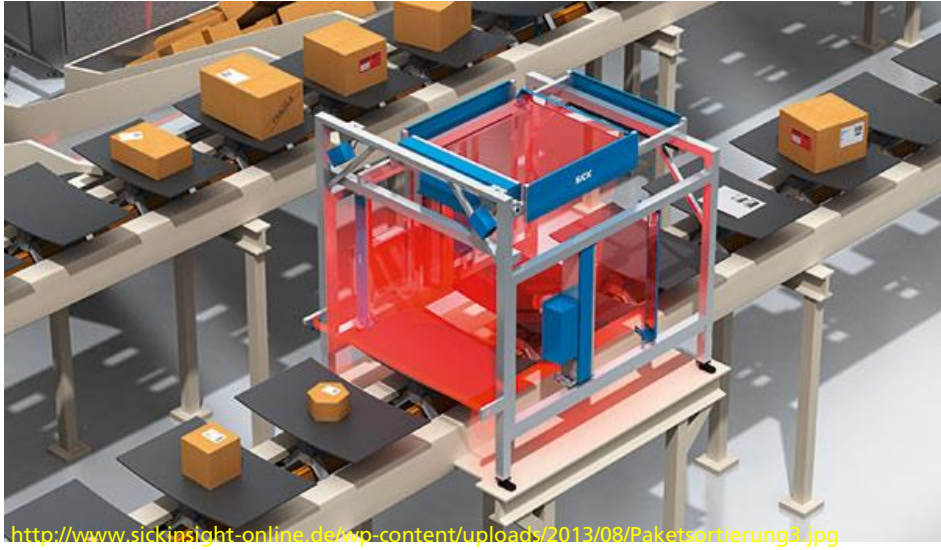


What is Process Mining?

Process Mining



What is Process Mining?– Examples of Processes



What is Process Mining?

Process Mining



What is Process Mining?

Process Mining

*Obtaining **knowledge** of, and **insights** in, **processes** by means of **analyzing** the **event data**, generated during the **execution** of the process.*



Introduction to Process Mining – Event Data/Event Log

Order-id	Activity	Timestamp
G468RGE6W	DISPATCH ORDER	2019-10-23 17:14
ZHT4574658	SEND REMINDER	2019-10-23 17:15
RTH468RTH4	SEND INVOICE	2019-10-23 17:43
RTH468RTH4	PACK ORDER	2019-10-23 17:45
ZHT4574658	CANCEL ORDER	2019-10-23 17:48
ZHT4574658	CLOSE ORDER	2019-10-23 17:51

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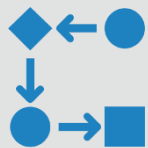
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Process Mining

Process
Discovery



Conformance
Checking

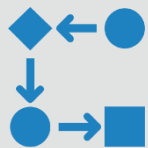


Process
Enhancement



Process Mining

Process
Discovery



Conformance
Checking



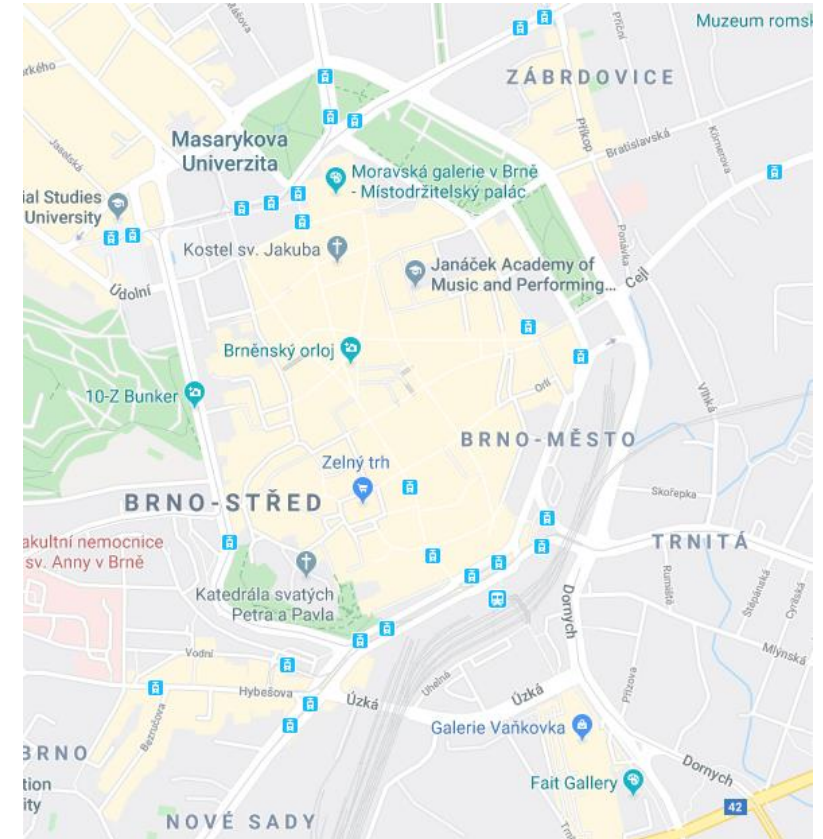
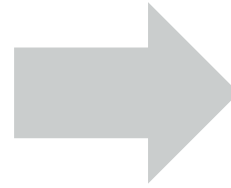
Process
Enhancement



Applying Process Mining – Process Discovery



≈ Event Log

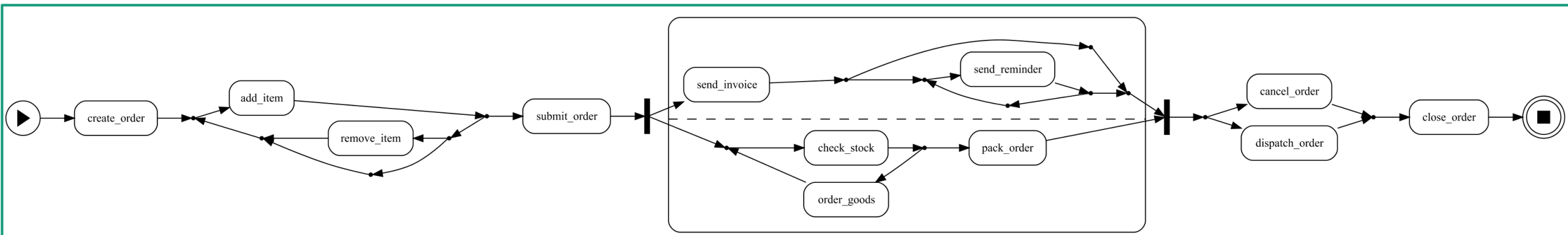


≈ Process Model

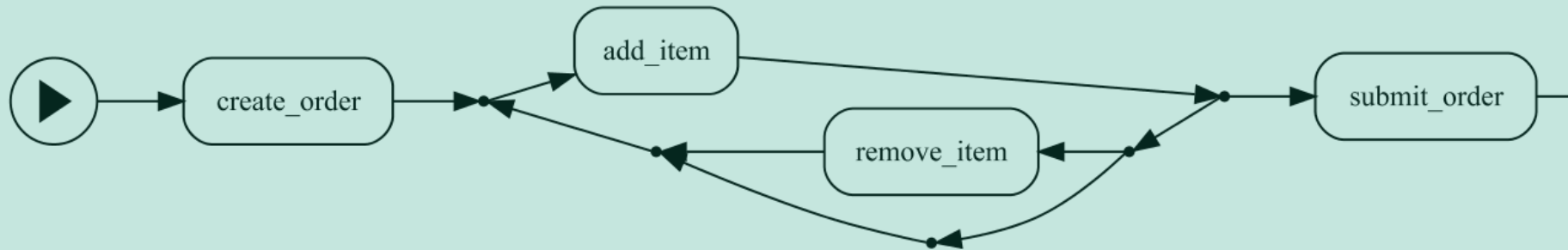
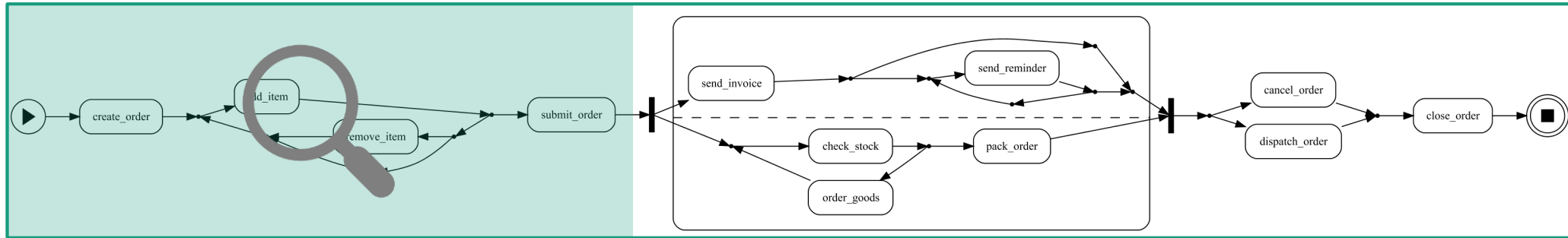
Applying Process Mining – Process Discovery

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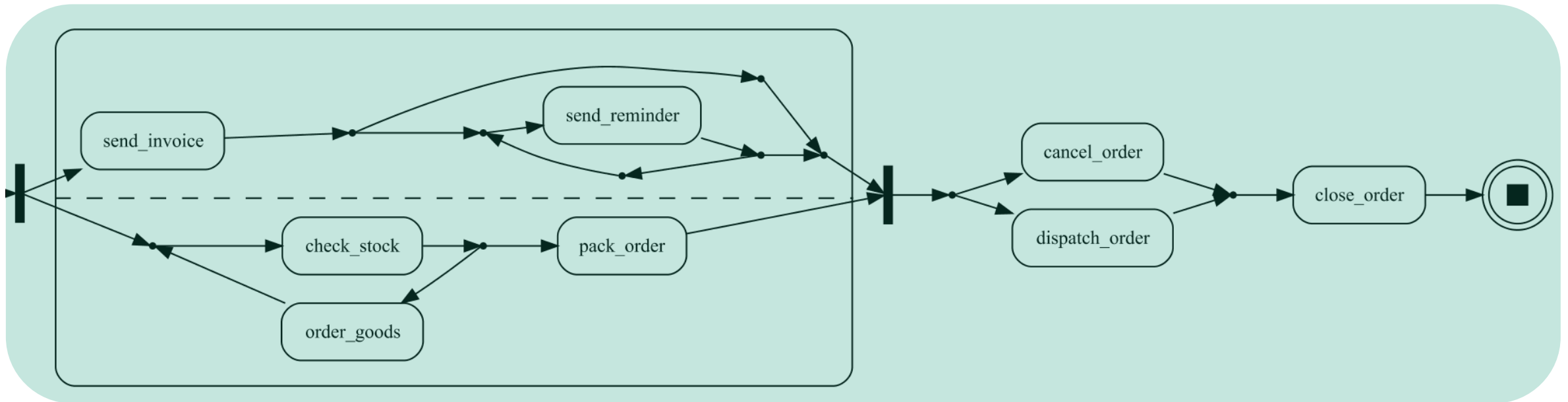
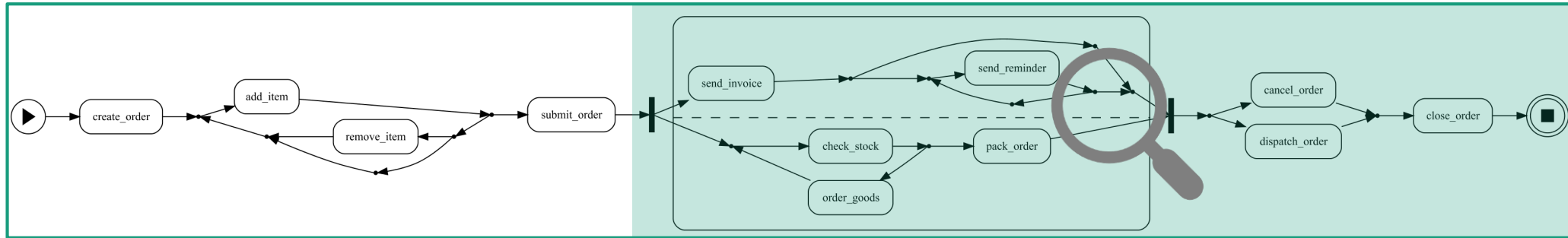
Process Discovery
Algorithm



Applying Process Mining – Process Discovery



Applying Process Mining – Process Discovery



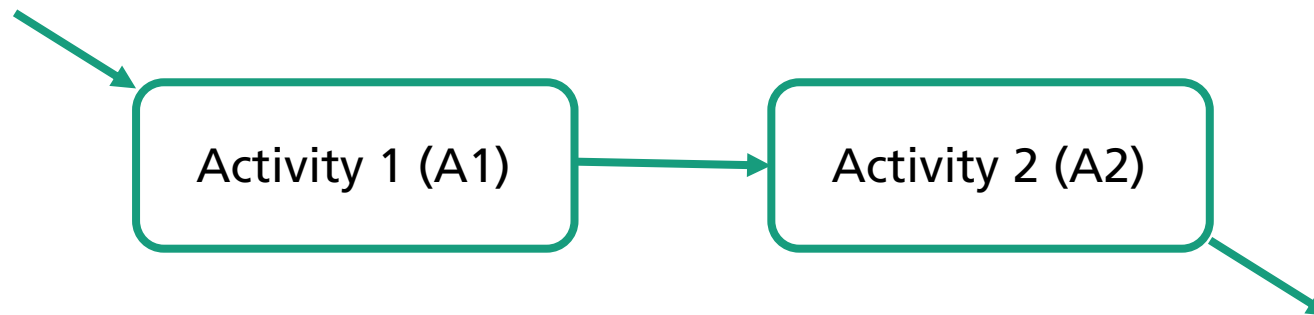
Applying Process Mining – Process Discovery: Inductive Mining in a Nutshell

- A different View on Event Logs
- ZHT4574658
 - <...,SEND REMINDER, CANCEL ORDER, CLOSE ORDER>
- RTH468RTH4
 - <...,SEND INVOICE, PACK ORDER,...>

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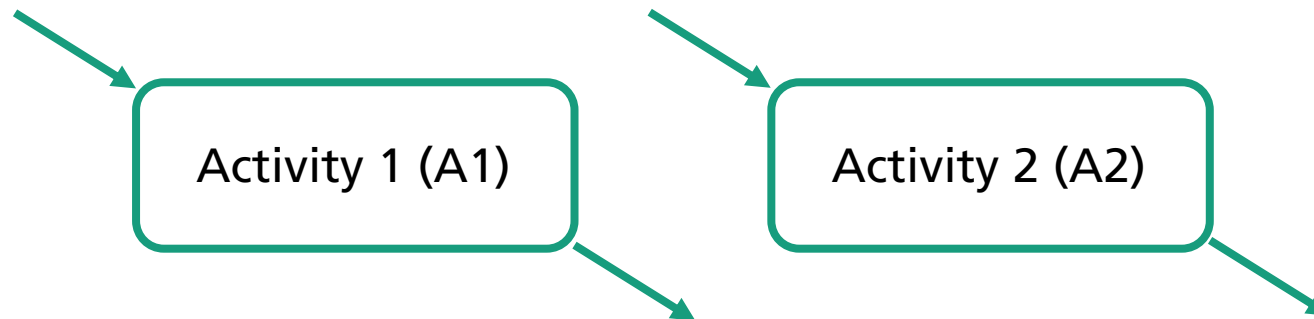
Applying Process Mining – Process Discovery: Inductive Mining in a Nutshell

- Given two activities: Activity 1
- What sequences can we generate?
 - if A1 always occurs directly before A2?
 - <A1,A2>



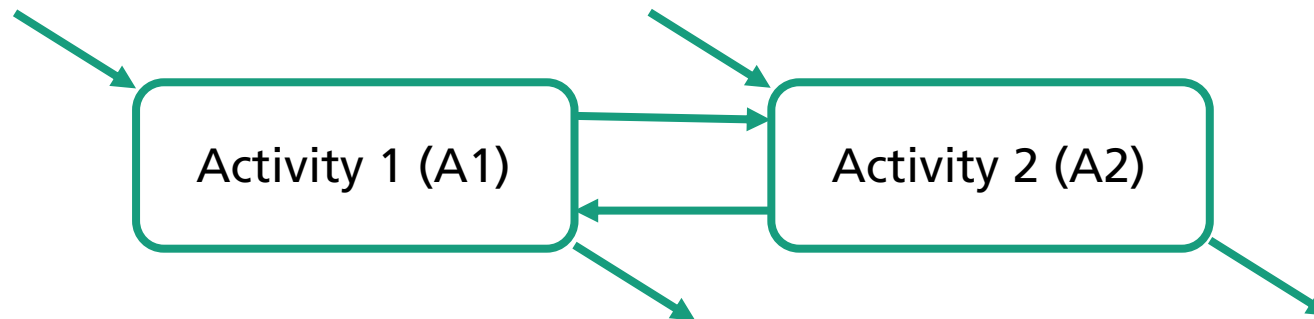
Applying Process Mining – Process Discovery: Inductive Mining in a Nutshell

- Given two activities: Activity 1
- What sequences can we generate?
 - if A1 and A2 never co-occur?
 - <A1>, <A2>



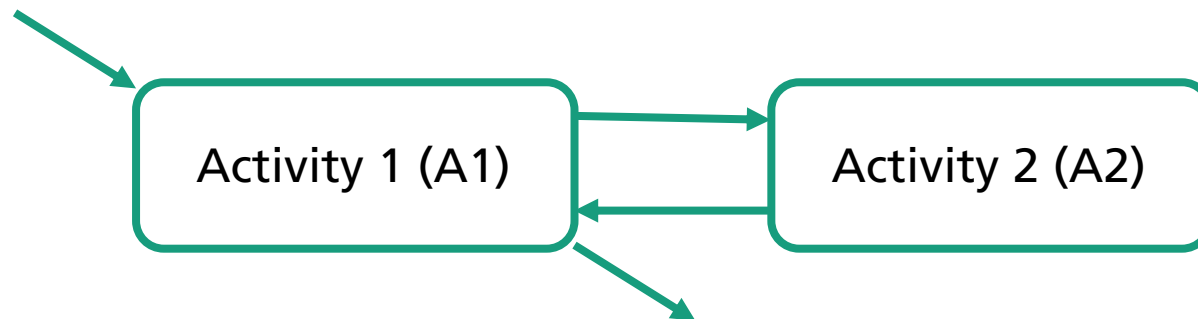
Applying Process Mining – Process Discovery: Inductive Mining in a Nutshell

- Given two activities: Activity 1
- What sequences can we generate?
 - if A1 and A2 are concurrent?
 - $\langle A1, A2 \rangle$, $\langle A2, A1 \rangle$



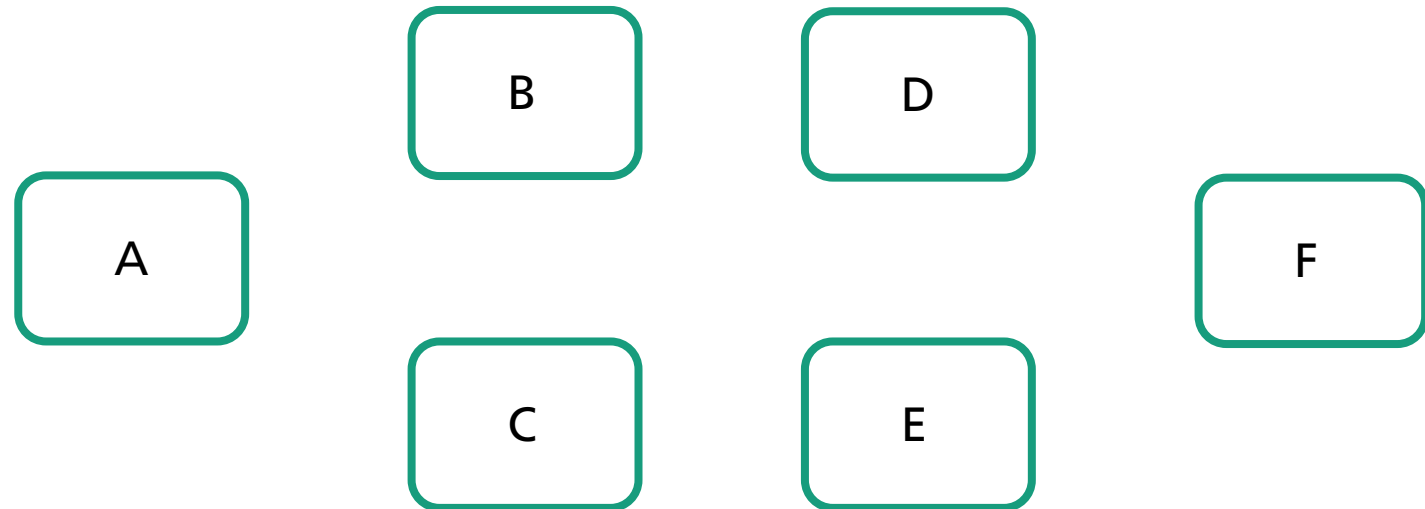
Applying Process Mining – Process Discovery: Inductive Mining in a Nutshell

- Given two activities: Activity 1
- What sequences can we generate?
 - if after executing A1, A2 requires us to “re-do” A1 (short-loop construct)
 - $\langle A1 \rangle$, $\langle A1, A2, A1 \rangle$, $\langle A1, A2, \dots, A1 \rangle$



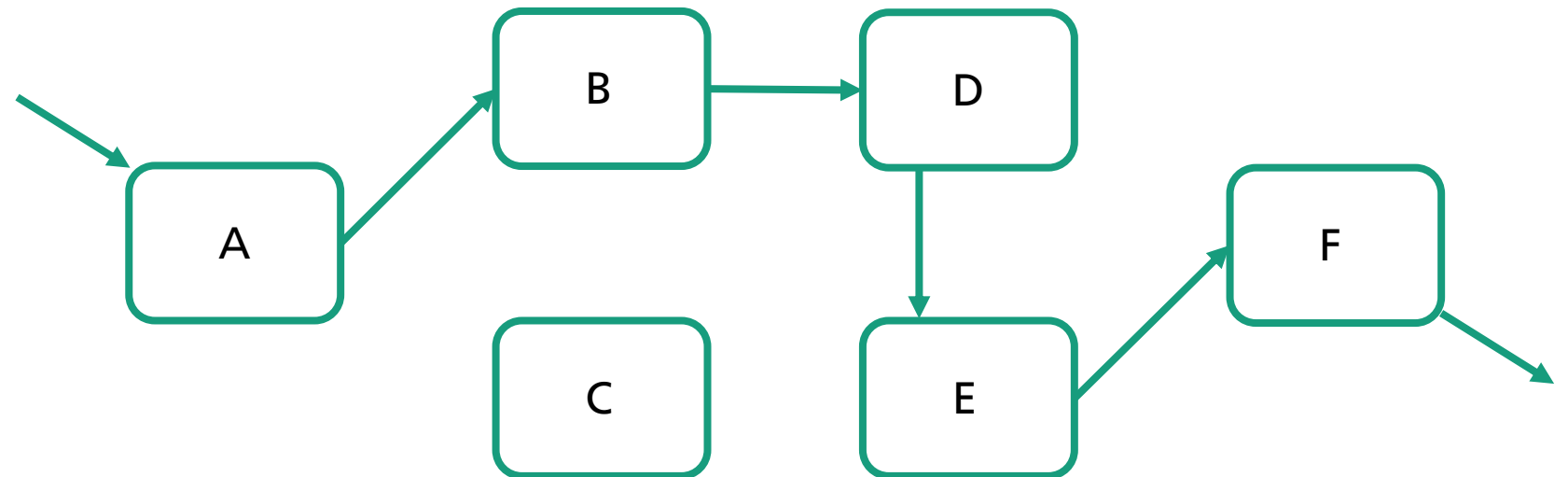
Applying Process Mining – Process Discovery: Inductive Mining in a Nutshell

- $\langle A, B, D, E, F \rangle$
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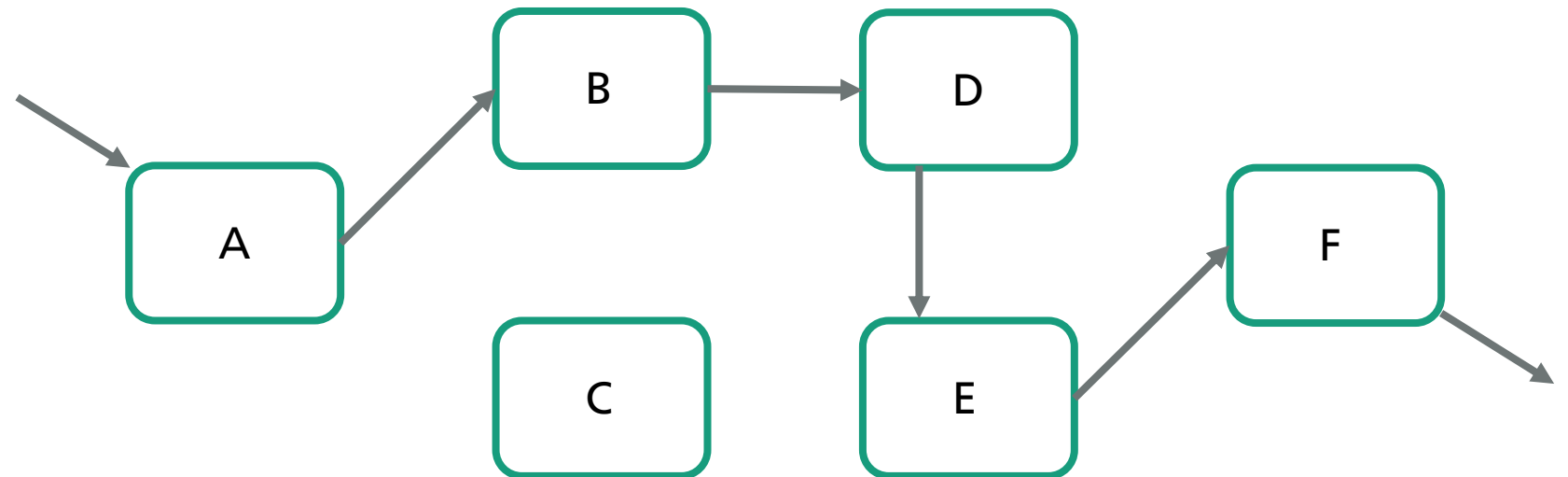
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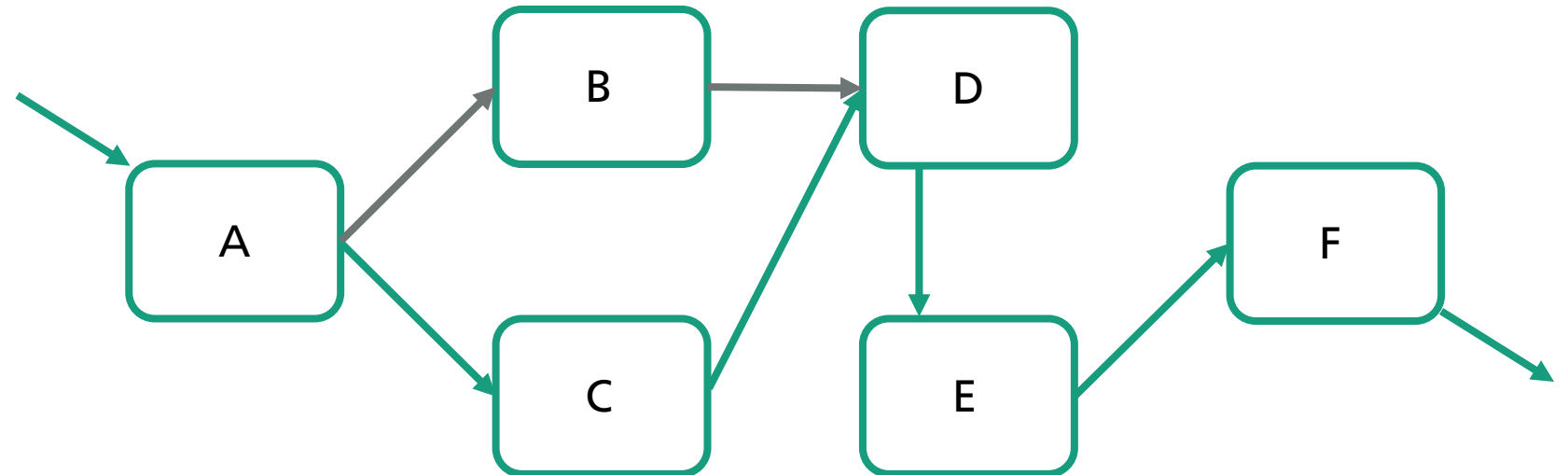
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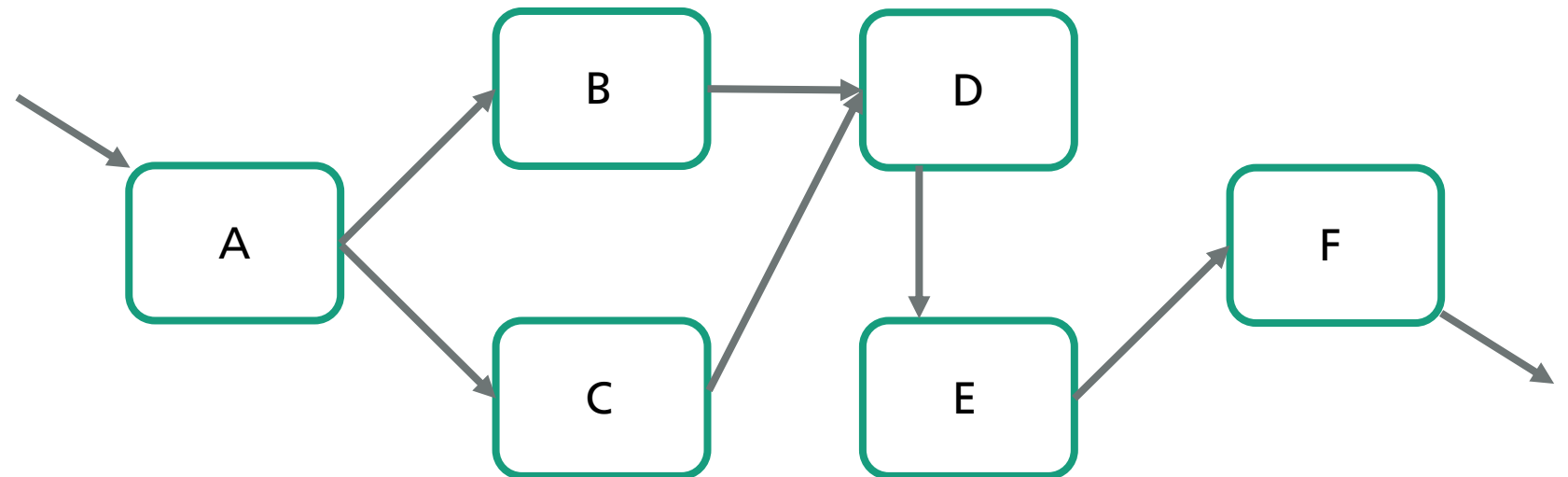
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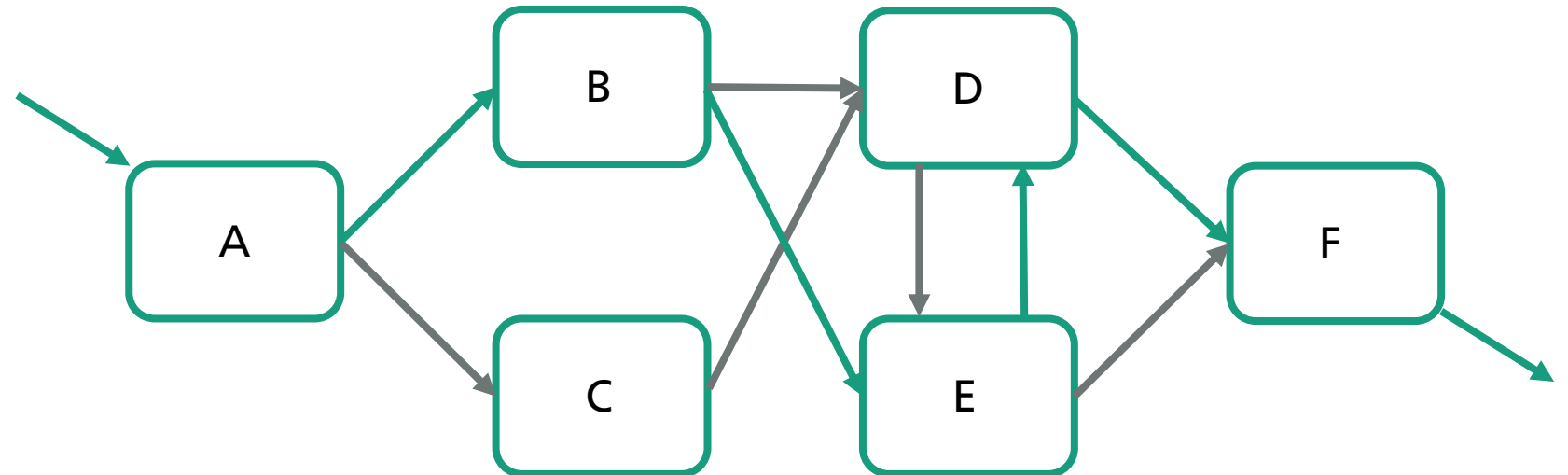
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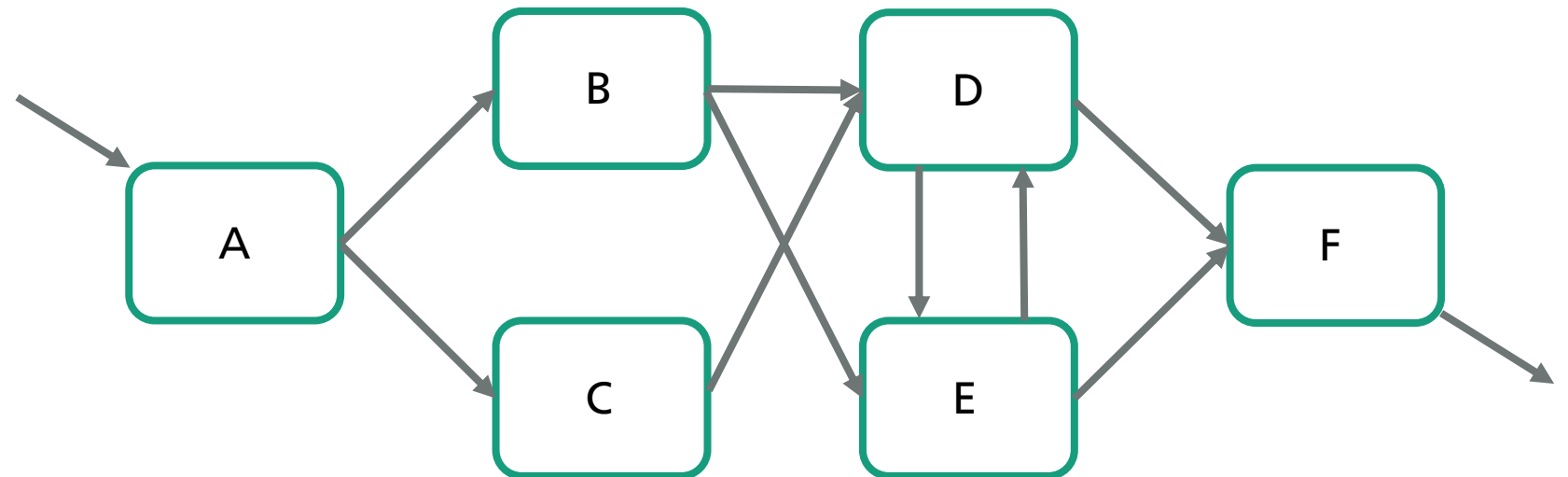
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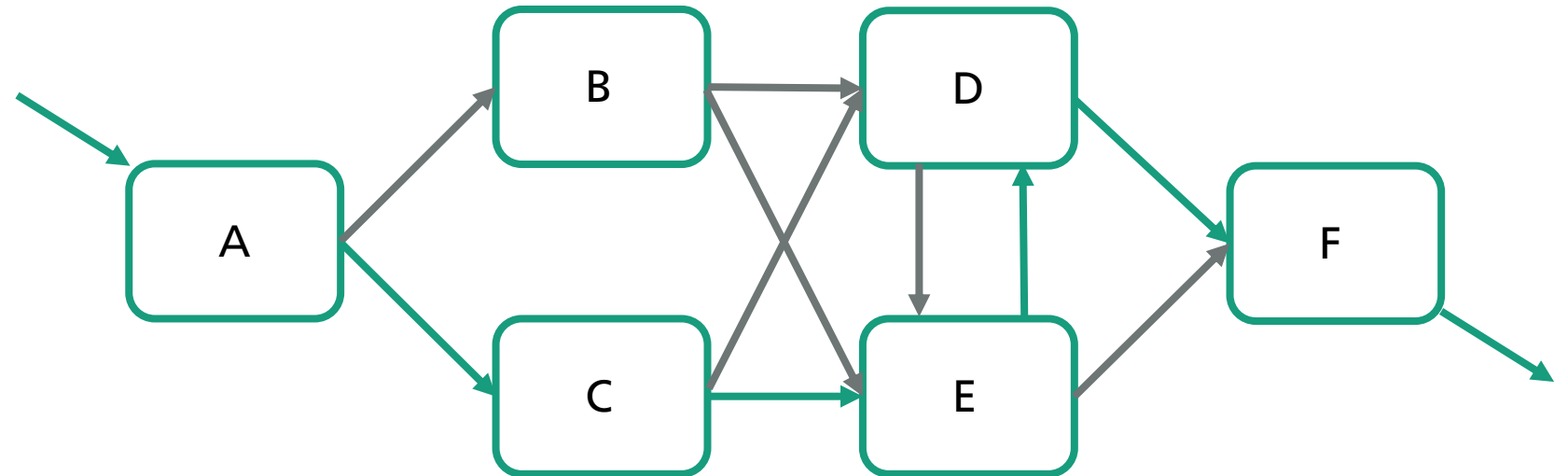
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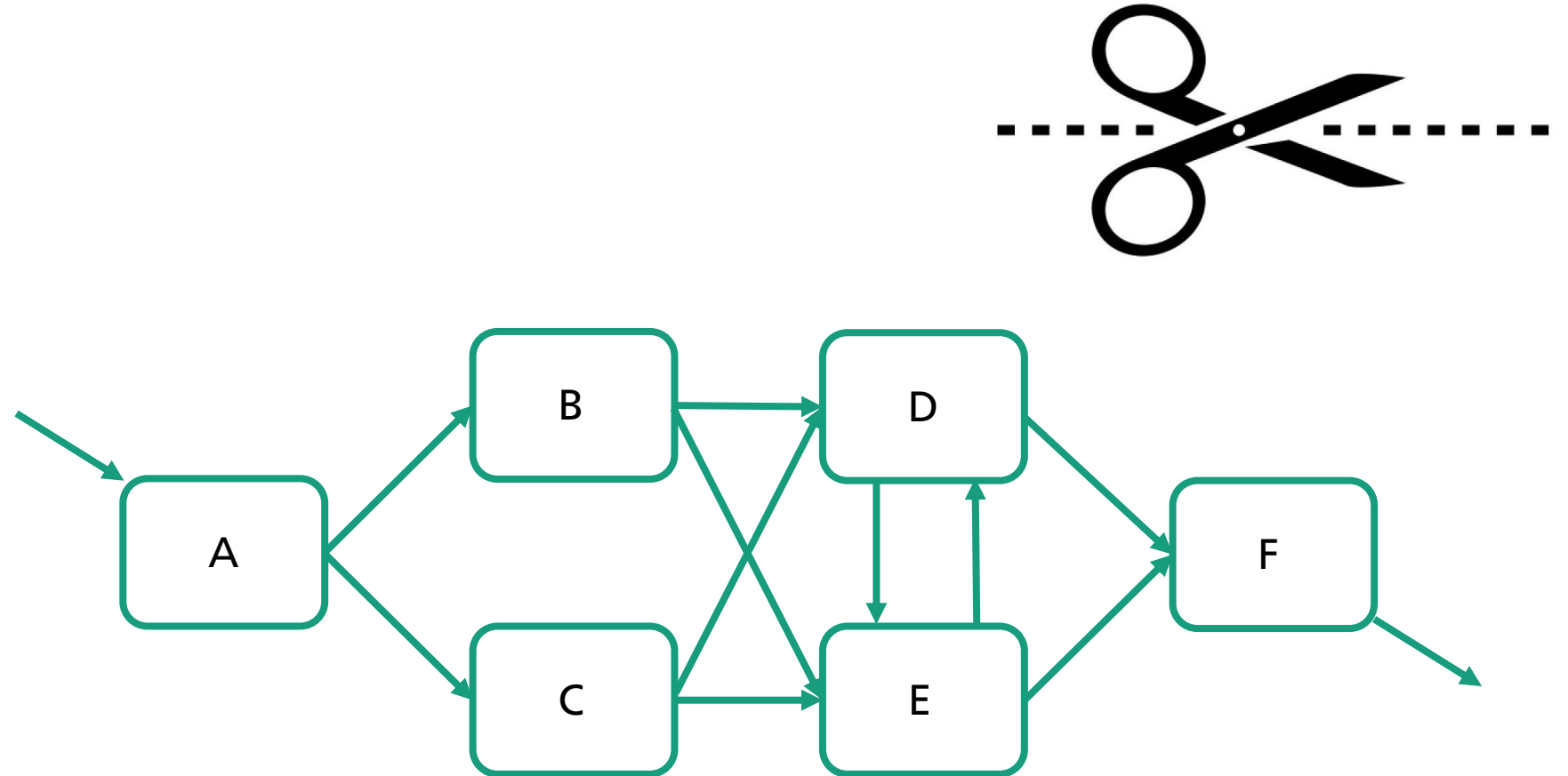
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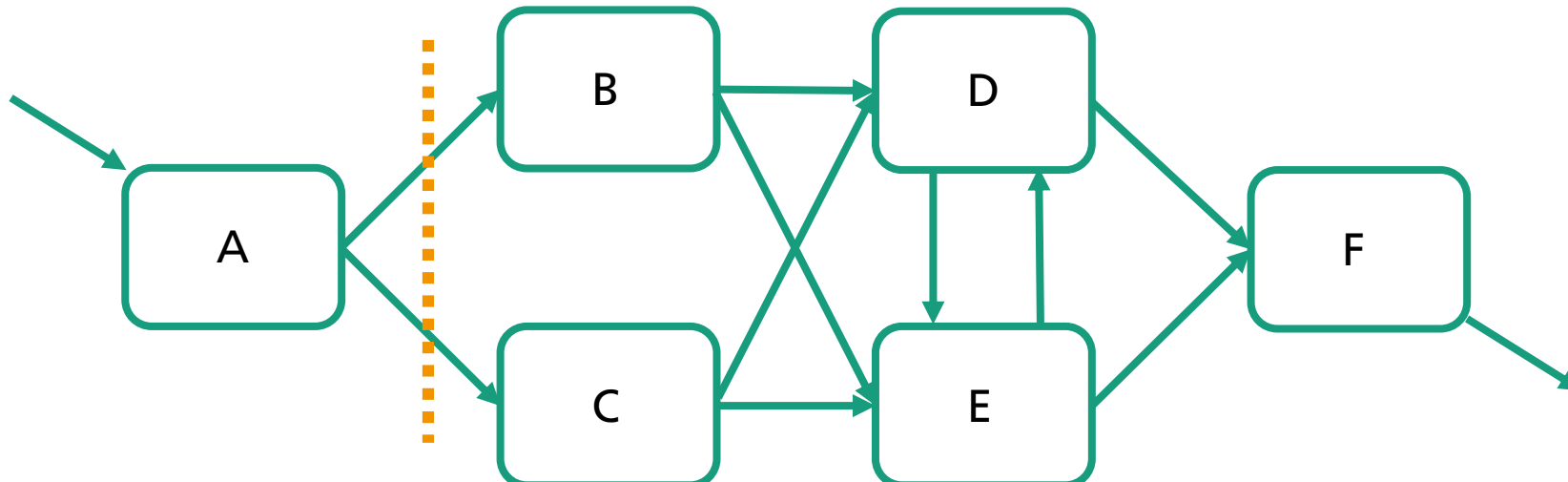
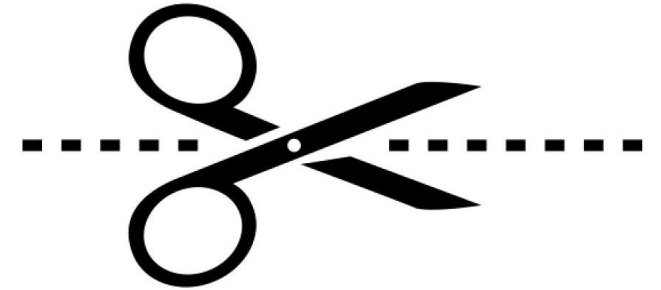
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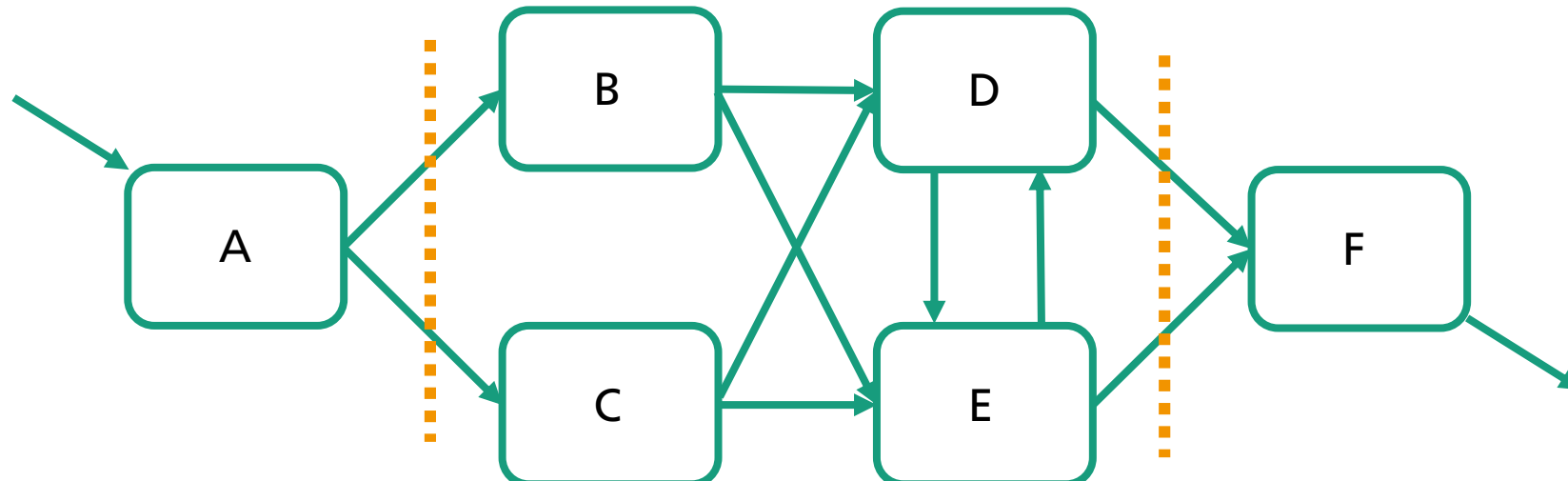
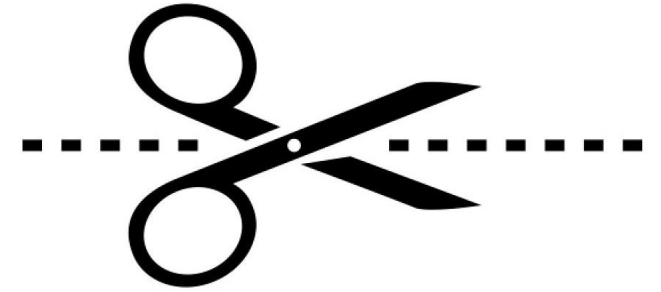
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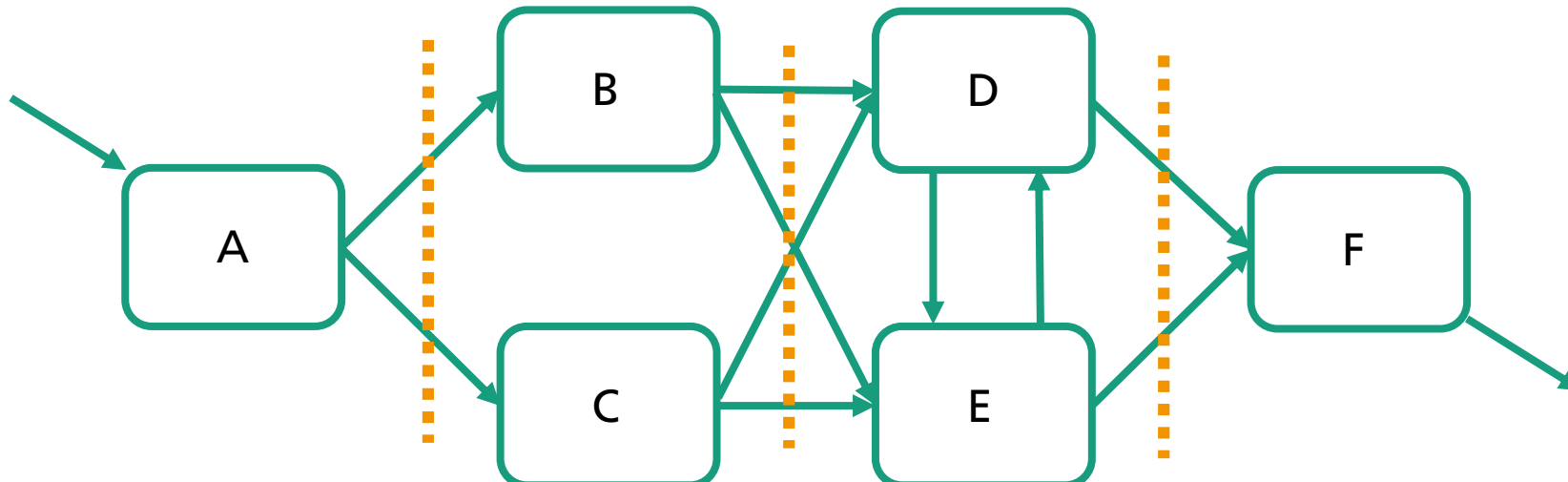
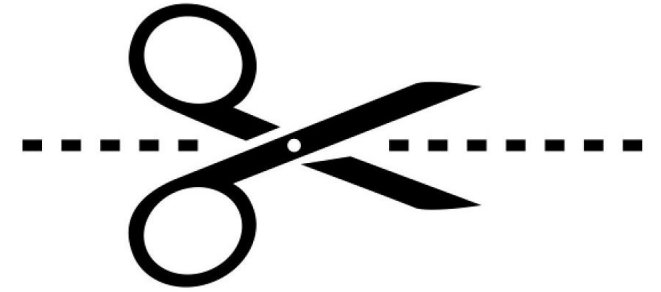
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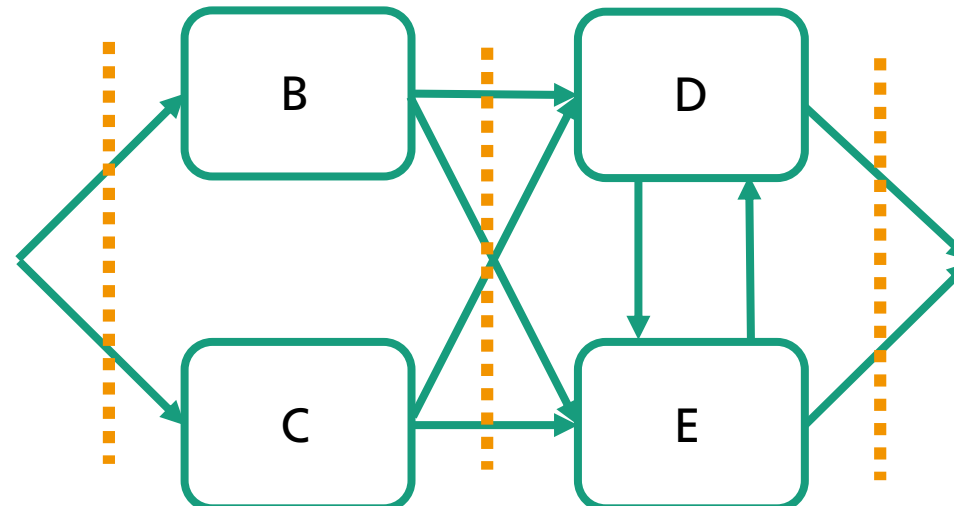
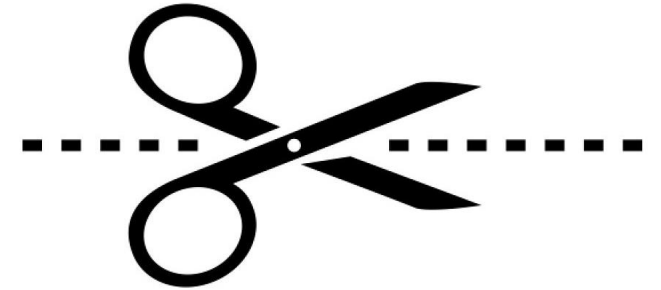
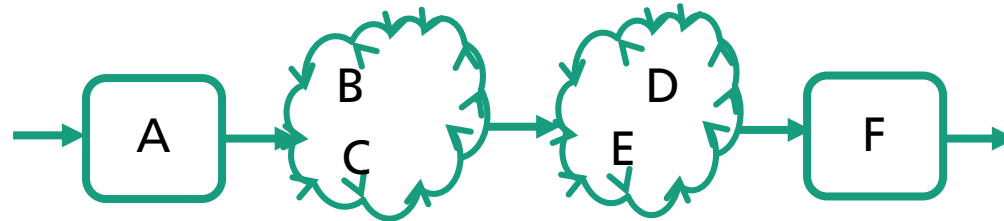
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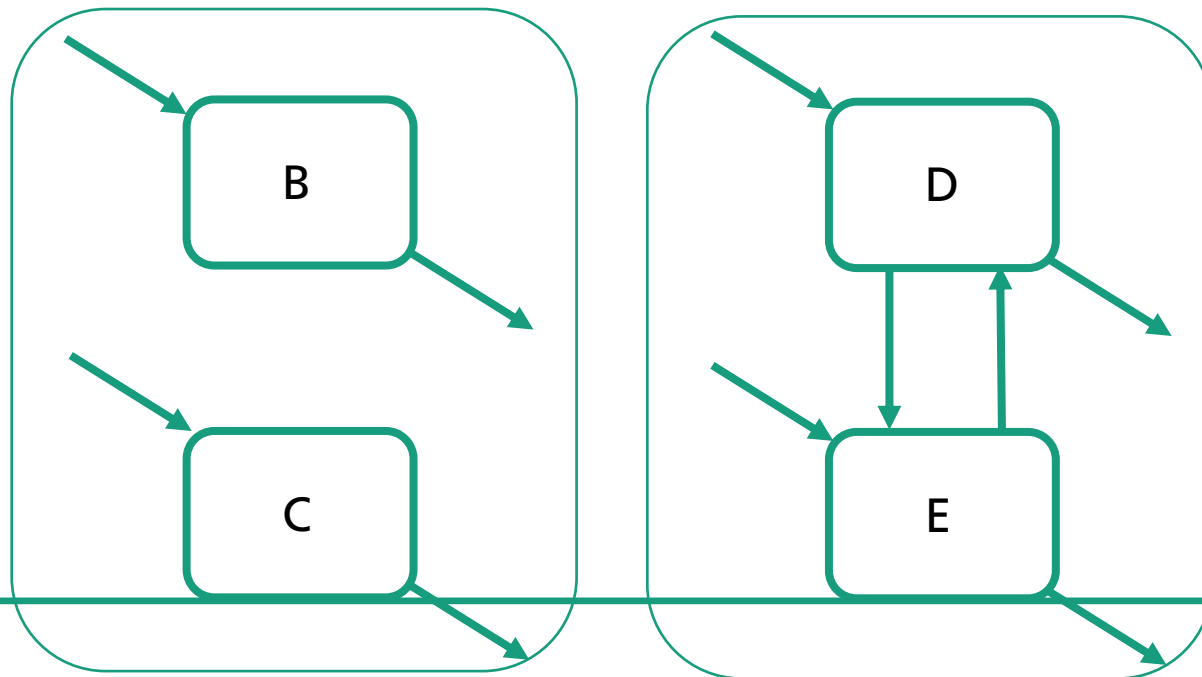
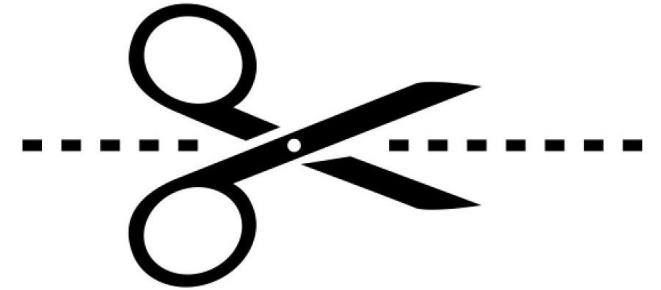
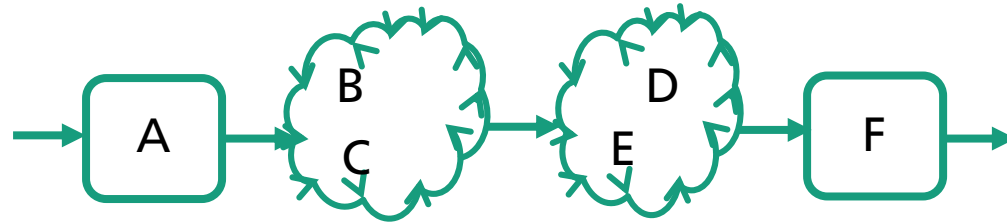
Applying Process Mining – Process Discovery: Inductive Mining in a Nutshell

- $\langle B \rangle \langle D, E \rangle$
- $\langle C \rangle \langle D, E \rangle$
- $\langle B \rangle \langle E, D \rangle$
- $\langle C \rangle \langle E, D \rangle$



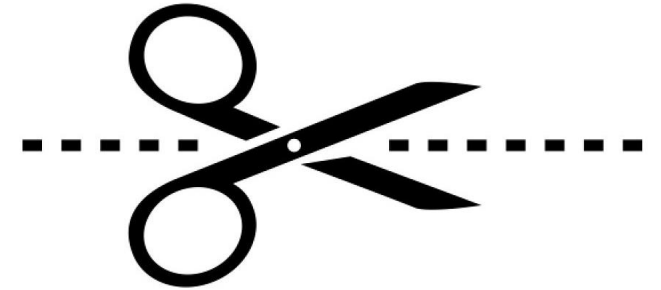
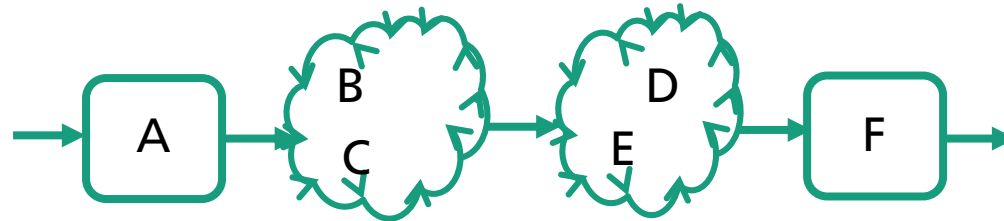
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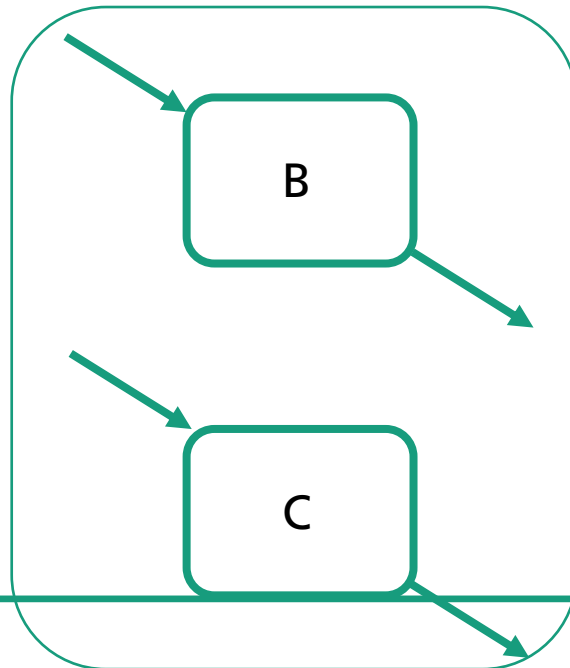


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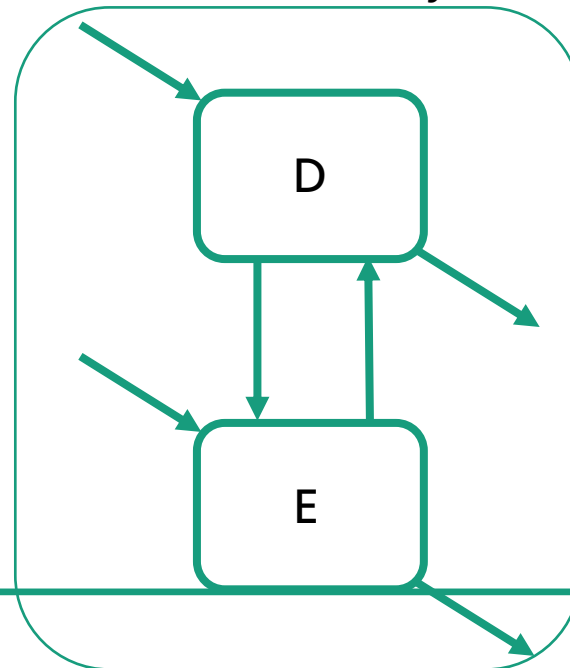
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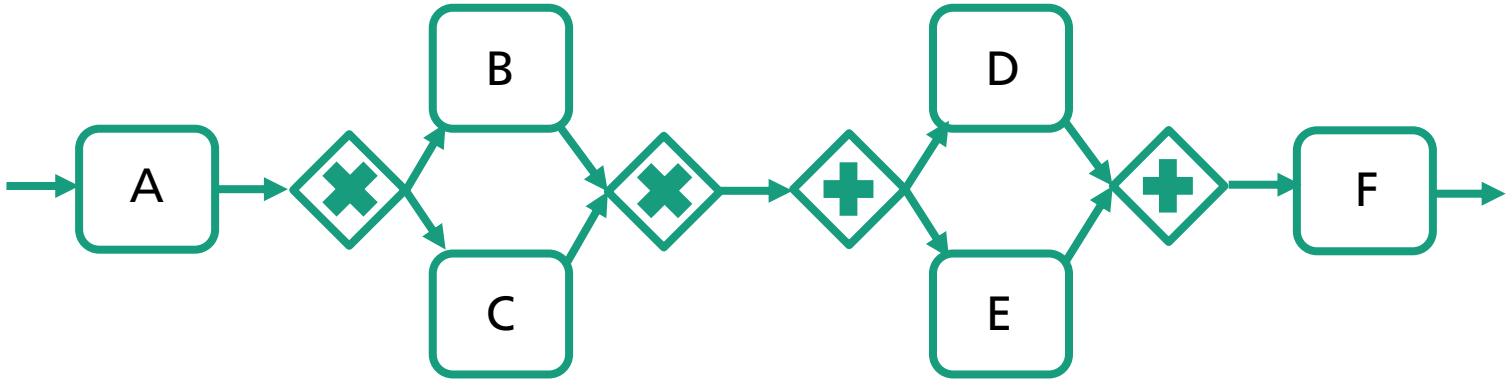
Choice



Concurrency

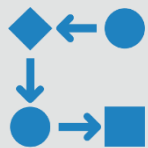


Applying Process Mining – Process Discovery: Inductive Mining in a Nutshell



Process Mining

Process
Discovery



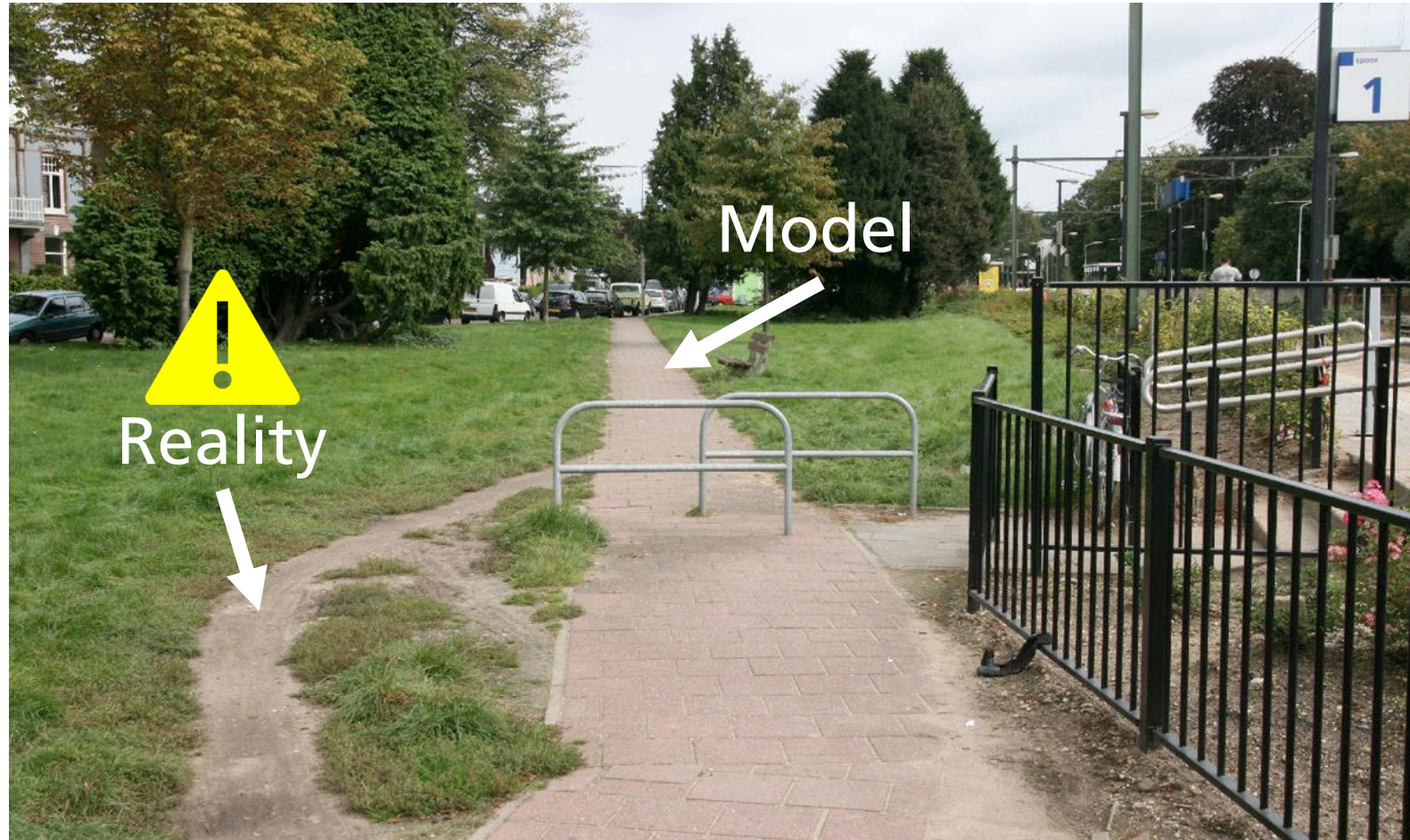
Conformance
Checking



Process
Enhancement



Applying Process Mining – Conformance Checking

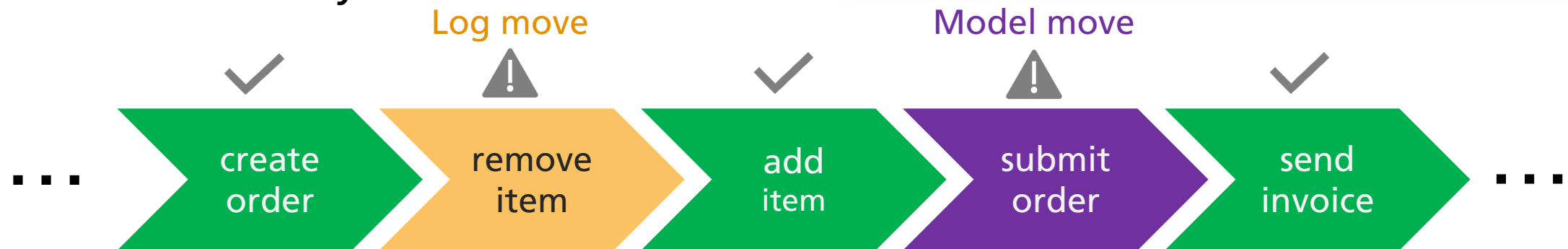


Applying Process Mining – Event Data/Event Log

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X268ZGE6W	send invoice	2019-10-23 17:45
...

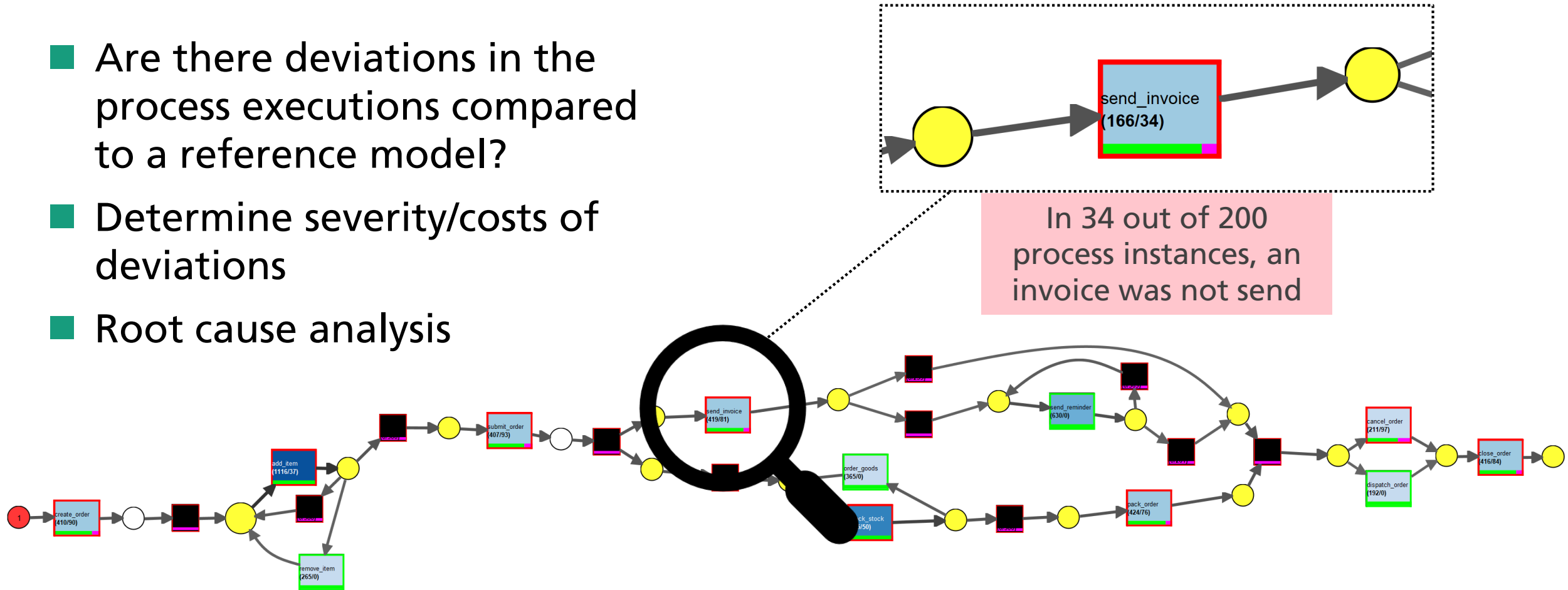
Applying Process Mining – Conformance Checking

- Are there deviations in the process executions compared to a reference model?
- Determine severity/costs of deviations
- Root cause analysis



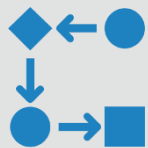
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Process Mining

Process
Discovery



Conformance
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Process
Enhancement



Applying Process Mining – Process Enhancement

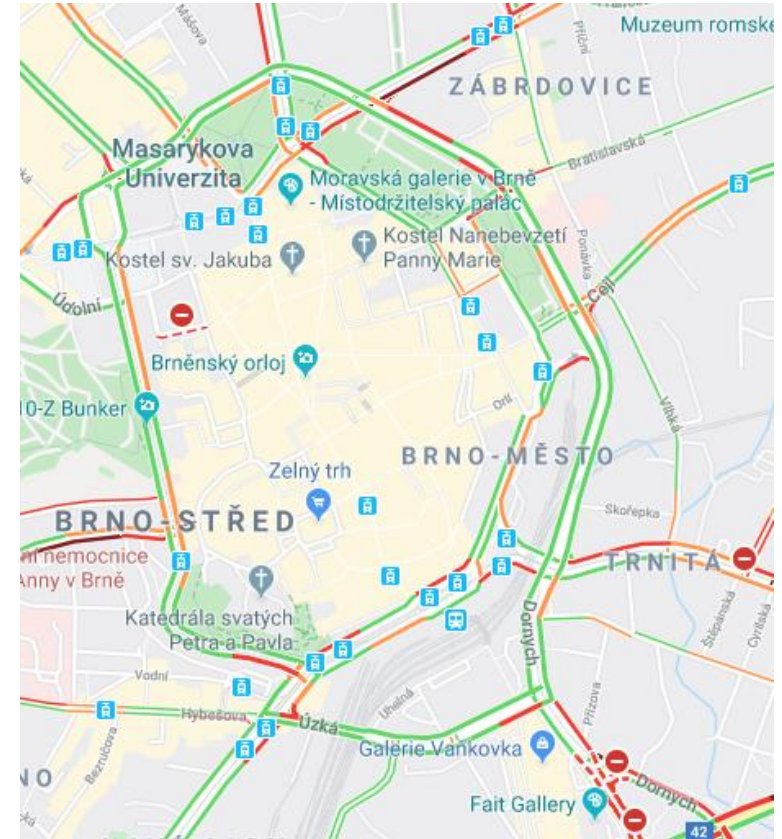
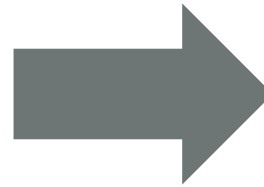
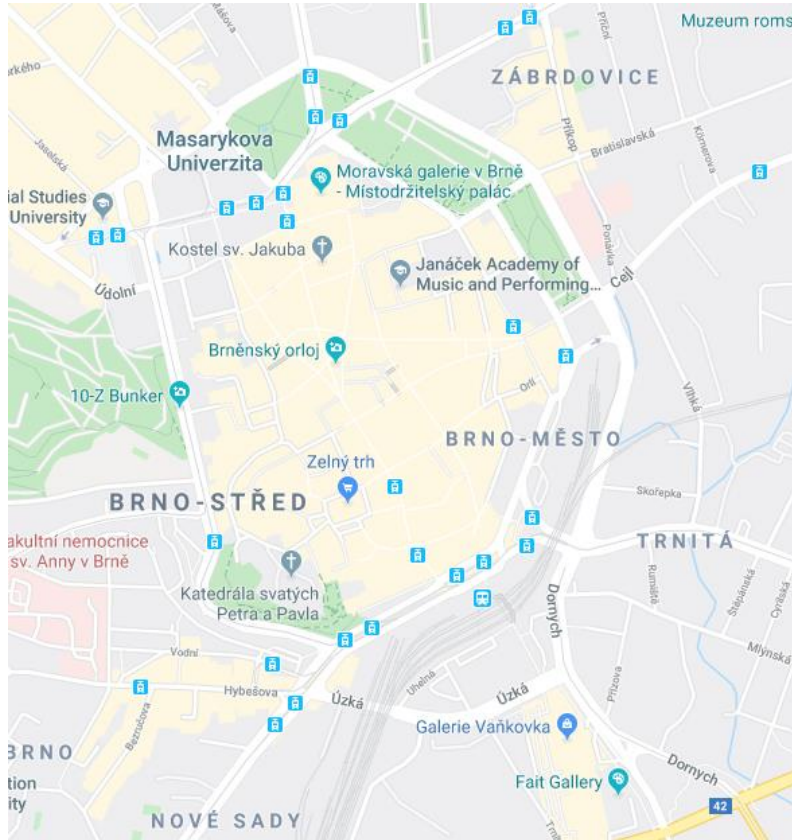
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Applying Process Mining – Process Enhancement

- Event data contains much more information
 - e.g. organizational extension (e.g. resource, role, group), domain specific knowledge

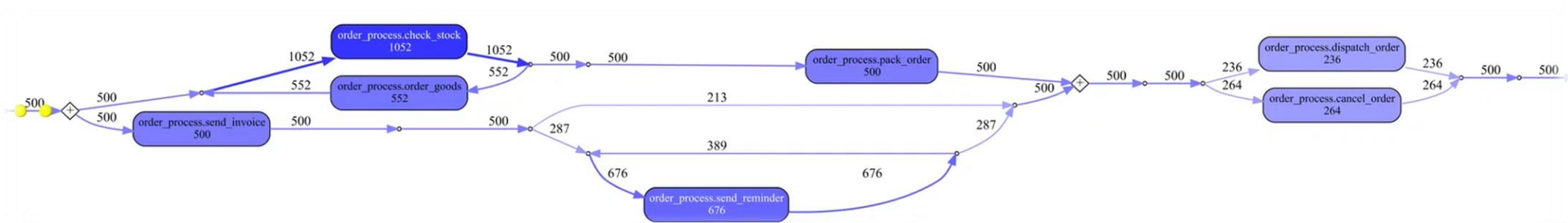
Order-id	Activity	Timestamp Start	Timestamp Complete	Resource	Costs	Products/ Items	...
G468RGE6W	DISPATCH ORDER	2019-10-23T17:14:10.000+02:00	2019-10-23T17:18:23.000+02:00	Worker_ID_XXXX	16.68	[product_id_x1, product_id_x_2]	...
ZHT4574658	SEND REMINDER	2019-10-23T17:15:10.000+02:00	2019-10-23T17:15:11.000+02:00	SYSTEM_ID_XXXX	--	[product_id_x]	...
RTH468RTH4	SEND INVOICE	2019-10-23T17:43:10.000+02:00	2019-10-23T17:53:10.000+02:00	Worker_ID_XXXX	6.31	[product_id_x1, product_id_x_2, product_id_x_3]	...
RTH468RTH4	PACK ORDER	2019-10-23T17:45:10.000+02:00	2019-10-23T18:35:10.000+02:00	Worker_ID_XXXX	23.65	[product_id_x1, product_id_x_2, product_id_x_3]	...
ZHT4574658	CANCEL ORDER	2019-10-23T17:48:10.000+02:00	2019-10-23T18:01:10.000+02:00	Worker_ID_XXXX	5.89	[product_id_x]	...
ZHT4574658	CLOSE ORDER	2019-10-23T17:51:10.000+02:00	2019-10-23T17:55:15.000+02:00	SYSTEM_ID_XXXX	--	[product_id_x]	...

Applying Process Mining – Process Enhancement



Applying Process Mining – Process Enhancement

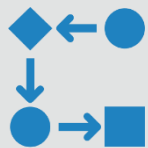
- Extend/improve existing process model using information about the actual process
 - Mining bottlenecks



- Decision mining
- Mining additional perspectives
 - Discovering organizational structures

Process Mining

Process
Discovery



Conformance
Checking

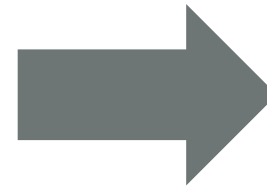


Process
Enhancement



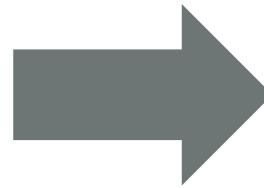
Online Process Mining – Overview

Order-id	Activity	Timestamp
G468RGE6W	DISPATCH ORDER	2019-10-23 17:14
ZHT4574658	SEND REMINDER	2019-10-23 17:15
RTH468RTH4	SEND INVOICE	2019-10-23 17:43
RTH468RTH4	PACK ORDER	2019-10-23 17:50
ZHT4574658	CANCEL ORDER	2019-10-23 17:55
ZHT4574658	CLOSE ORDER	2019-10-23 17:58



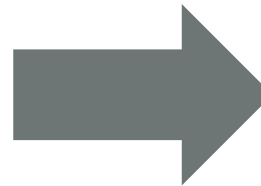
Online Process Mining – Overview

Order-id	Activity
----------	----------



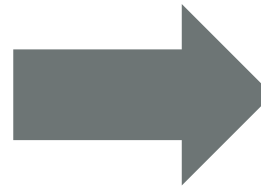
Online Process Mining – Overview

Order-id	Activity
G468RGE6W	DISPATCH ORDER



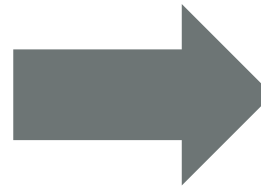
Online Process Mining – Overview

Order-id	Activity
G468RGE6W	DISPATCH ORDER
ZHT4574658	SEND REMINDER



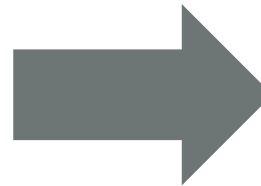
Online Process Mining – Overview

Order-id	Activity
G468RGE6W	DISPATCH ORDER
ZHT4574658	SEND REMINDER
RTH468RTH4	SEND INVOICE



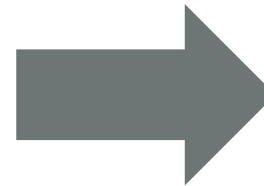
Online Process Mining – Overview

Order-id	Activity
G468RGE6W	DISPATCH ORDER
ZHT4574658	SEND REMINDER
RTH468RTH4	SEND INVOICE
RTH468RTH4	PACK ORDER



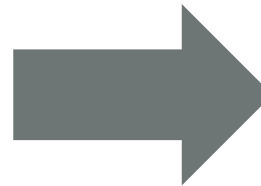
Online Process Mining – Overview

Order-id	Activity
G468RGE6W	DISPATCH ORDER
ZHT4574658	SEND REMINDER
RTH468RTH4	SEND INVOICE
RTH468RTH4	PACK ORDER
ZHT4574658	CANCEL ORDER



Online Process Mining – Overview

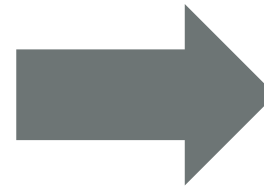
Order-id	Activity
G468RGE6W	DISPATCH ORDER
ZHT4574658	SEND REMINDER
RTH468RTH4	SEND INVOICE
RTH468RTH4	PACK ORDER
ZHT4574658	CANCEL ORDER
ZHT4574658	CLOSE ORDER



Online Process Mining – Overview



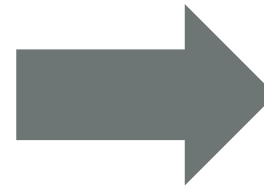
Order-id	Activity
G468RGE6W	DISPATCH ORDER
ZHT4574658	SEND REMINDER
RTH468RTH4	SEND INVOICE
RTH468RTH4	PACK ORDER
ZHT4574658	CANCEL ORDER
ZHT4574658	CLOSE ORDER
...	...



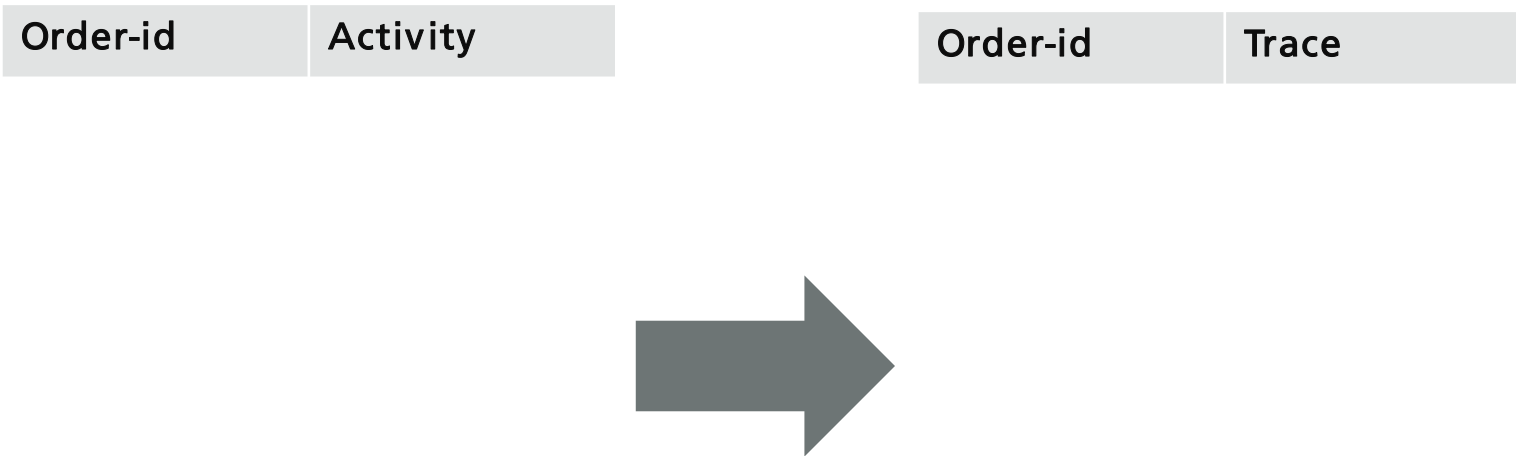
Online Process Mining – Overview



Order-id	Activity
G468RGE6W	DISPATCH ORDER
ZHT4574658	SEND REMINDER
RTH468RTH4	SEND INVOICE
RTH468RTH4	PACK ORDER
ZHT4574658	CANCEL ORDER
ZHT4574658	CLOSE ORDER
...	...



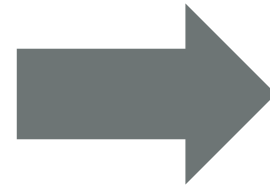
Online Process Discovery – Basic Approach (Sliding Window)



Online Process Discovery – Basic Approach (Sliding Window)

Window size: 1 (out of k)

Order-id	Activity
G468RGE6W	CREATE ORDER

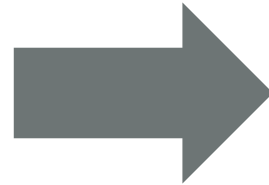


Order-id	Trace
G468RGE6W	<CO>

Online Process Discovery – Basic Approach (Sliding Window)

Window size: 2 (out of k)

Order-id	Activity
G468RGE6W	CREATE ORDER
ZHT4574658	CREATE ORDER

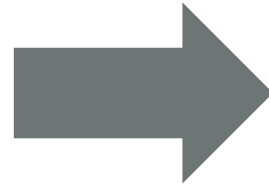


Order-id	Trace
G468RGE6W	<CO>
ZHT4574658	<CO>

Online Process Discovery – Basic Approach (Sliding Window)

Window size: 3 (out of k)

Order-id	Activity
G468RGE6W	CREATE ORDER
ZHT4574658	CREATE ORDER
RTH468RTH4	CREATE ORDER

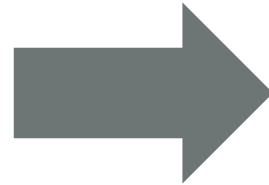


Order-id	Trace
G468RGE6W	<CO>
ZHT4574658	<CO>
RTH468RTH4	<CO>

Online Process Discovery – Basic Approach (Sliding Window)

Window size: 4 (out of k)

Order-id	Activity
G468RGE6W	CREATE ORDER
ZHT4574658	CREATE ORDER
RTH468RTH4	CREATE ORDER
G468RGE6W	ADD ITEM

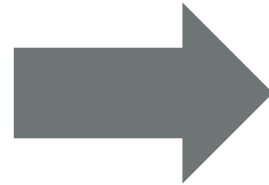


Order-id	Trace
G468RGE6W	<CO, AI>
ZHT4574658	<CO>
RTH468RTH4	<CO>

Online Process Discovery – Basic Approach (Sliding Window)

Window size: 5 (out of k)

Order-id	Activity
G468RGE6W	CREATE ORDER
ZHT4574658	CREATE ORDER
RTH468RTH4	CREATE ORDER
G468RGE6W	ADD ITEM
G468RGE6W	ADD ITEM

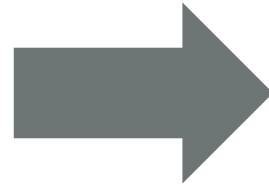


Order-id	Trace
G468RGE6W	<CO, AI, AI>
ZHT4574658	<CO>
RTH468RTH4	<CO>

Online Process Discovery – Basic Approach (Sliding Window)

Window size: 6 (out of k)

Order-id	Activity
G468RGE6W	CREATE ORDER
ZHT4574658	CREATE ORDER
RTH468RTH4	CREATE ORDER
G468RGE6W	ADD ITEM
G468RGE6W	ADD ITEM
RTH468RTH4	ADD ITEM

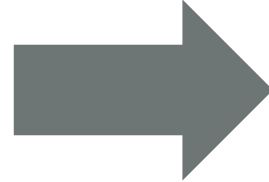


Order-id	Trace
G468RGE6W	<CO, AI, AI>
ZHT4574658	<CO>
RTH468RTH4	<CO, AI>

Online Process Discovery – Basic Approach (Sliding Window)

Window size: 7 (out of k)

Order-id	Activity
G468RGE6W	CREATE ORDER
ZHT4574658	CREATE ORDER
RTH468RTH4	CREATE ORDER
G468RGE6W	ADD ITEM
G468RGE6W	ADD ITEM
RTH468RTH4	ADD ITEM
G468RGE6W	SUBMIT ORDER

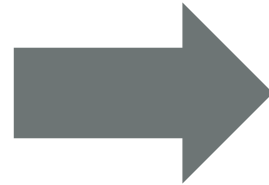


Order-id	Trace
G468RGE6W	<CO, AI, AI, SO>
ZHT4574658	<CO>
RTH468RTH4	<CO, AI>

Online Process Discovery – Basic Approach (Sliding Window)

Window size: k (out of k)

Order-id	Activity
G468RGE6W	CREATE ORDER
ZHT4574658	CREATE ORDER
RTH468RTH4	CREATE ORDER
G468RGE6W	ADD ITEM
G468RGE6W	ADD ITEM
RTH468RTH4	ADD ITEM
G468RGE6W	SUBMIT ORDER
...	...
XA997RRZ1	SUBMIT ORDER

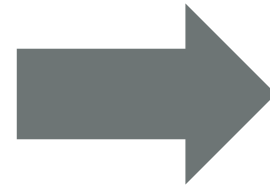


Order-id	Trace
G468RGE6W	<CO, AI, AI, SO, ...>
ZHT4574658	<CO, ...>
RTH468RTH4	<CO, AI, ...>
...	...
XA997RRZ1	<... ,SO>

Online Process Discovery – Basic Approach (Sliding Window)

Window size: k (out of k)

Order-id	Activity
G468RGE6W	CREATE ORDER
ZHT4574658	CREATE ORDER
RTH468RTH4	CREATE ORDER
G468RGE6W	ADD ITEM
G468RGE6W	ADD ITEM
RTH468RTH4	ADD ITEM
G468RGE6W	SUBMIT ORDER
...	...
XA997RRZ1	SUBMIT ORDER
XA997RRZ1	DISPATCH ORDER

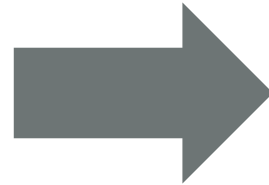


Order-id	Trace
G468RGE6W	<CO, AI, AI, SO, ...>
ZHT4574658	<CO, ...>
RTH468RTH4	<CO, AI, ...>
...	...
XA997RRZ1	<... ,SO, DO>

Online Process Discovery – Basic Approach (Sliding Window)

Window size: k (out of k)

Order-id	Activity
ZHT4574658	CREATE ORDER
RTH468RTH4	CREATE ORDER
G468RGE6W	ADD ITEM
G468RGE6W	ADD ITEM
RTH468RTH4	ADD ITEM
G468RGE6W	SUBMIT ORDER
...	...
XA997RRZ1	SUBMIT ORDER
XA997RRZ1	ADD ITEM

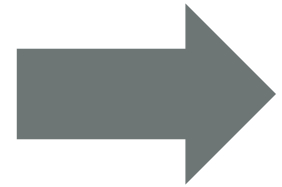


Order-id	Trace
G468RGE6W	<AI, AI, SO, ...>
ZHT4574658	<CO, ...>
RTH468RTH4	<CO, AI, ...>
...	...
XA997RRZ1	<... , SO, DO>

Online Process Discovery – Basic Approach (Sliding Window)

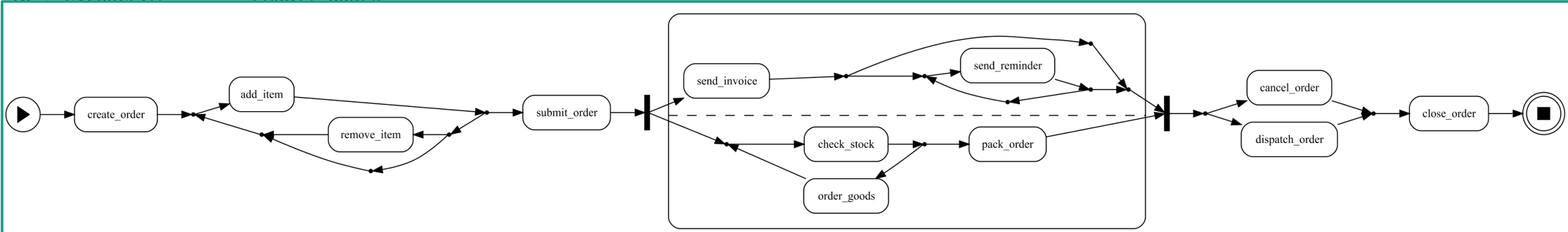
size: k (out of k)

Order-id	Activity
ZHT4574658	CREATE ORDER
RTH468RTH4	CREATE ORDER
G468RGE6W	ADD ITEM
G468RGE6W	ADD ITEM
RTH468RTH4	ADD ITEM
G468RGE6W	SUBMIT ORDER



Order-id	Trace
G468RGE6W	<AI,AI,S0, ...>
ZHT4574658	<CO, ...>
RTH468RTH4	<CO,AI, ...>
...	...
XA997RRZ1	<... ,S0,D0>

Any Discovery Algorithm!

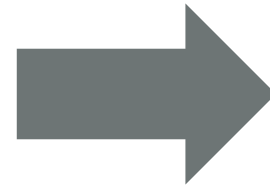


Online Process Discovery – Basic Approach

- Alternative Strategies Exist:
 - Time-Based Windows
 - Maximum Lifetime of cases/events
 - Decay Models
 - Reservoirs
 - (Biased) Random Sampling
 - Frequency Based Techniques
 - Lossy Counting Algorithm
 - Space Saving Algorithm
 - Frequency Algorithm

Online Process Discovery – Basic Approach (Sliding Window)

Order-id	Activity
ZHT4574658	CREATE ORDER
RTH468RTH4	CREATE ORDER
G468RGE6W	ADD ITEM
G468RGE6W	ADD ITEM
RTH468RTH4	ADD ITEM
G468RGE6W	SUBMIT ORDER



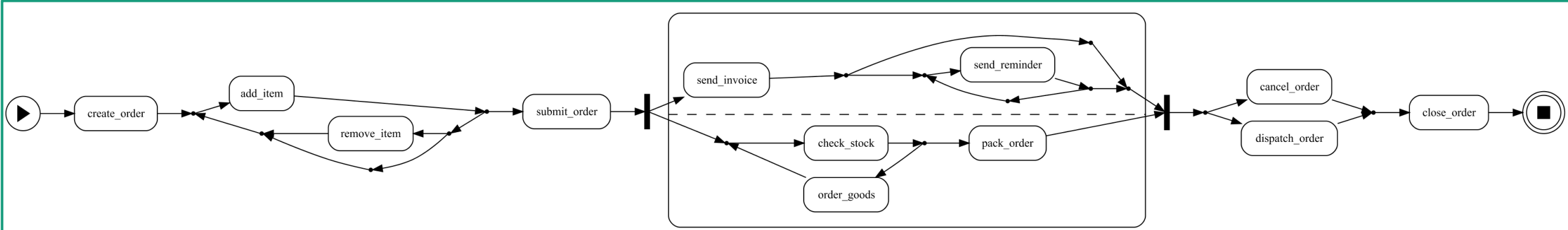
Order-id	Trace
G468RGE6W	<AI, AI, SO, ...>
ZHT4574658	<CO, ...>
RTH468RTH4	<CO, AI, ...>
...	...
XA997RRZ1	<... , SO, DO>



Any Discovery Algorithm!



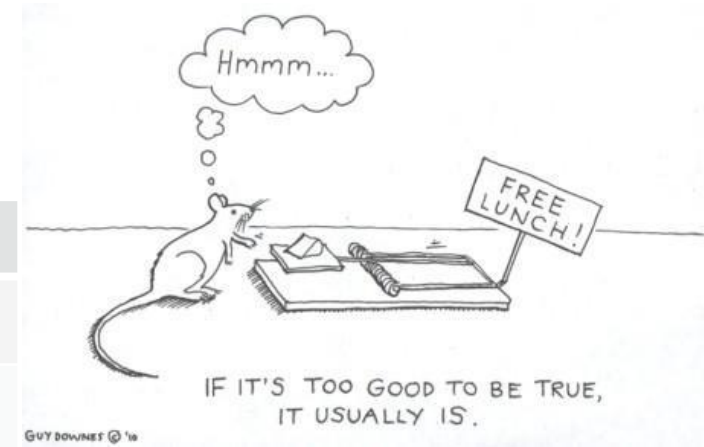
size: k (out of k)



Online Process Discovery – Basic Approach (Sliding Window)

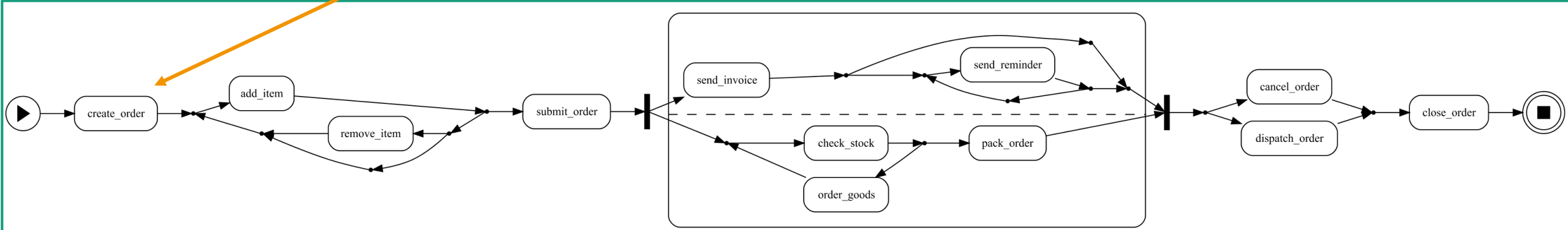
Order-id	Activity
ZHT4574658	CREATE ORDER
RTH468RTH4	CREATE ORDER
G468RGE6W	ADD ITEM
G468RGE6W	ADD ITEM
RTH468RTH4	ADD ITEM
G468RGE6W	SUBMIT ORDER

Order-id	Trace
G468RGE6W	<AI, AI, SO, ...>
ZHT4574658	<CO, ...>
RTH468RTH4	<CO, AI, ...>
...	...
XA997RRZ1	<... ,SO, DO>



Any Discovery Algorithm!

size: k (out of k)

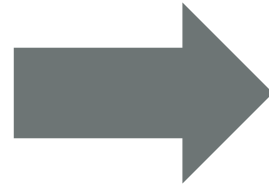


Online Process Discovery – Abstraction (DFG) Approach

New Event:

Order-id

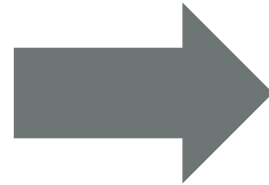
Activity



Online Process Discovery – Abstraction (DFG) Approach

New Event: ("G468RGE6W", "CREATE ORDER")

Order-id	Activity
----------	----------

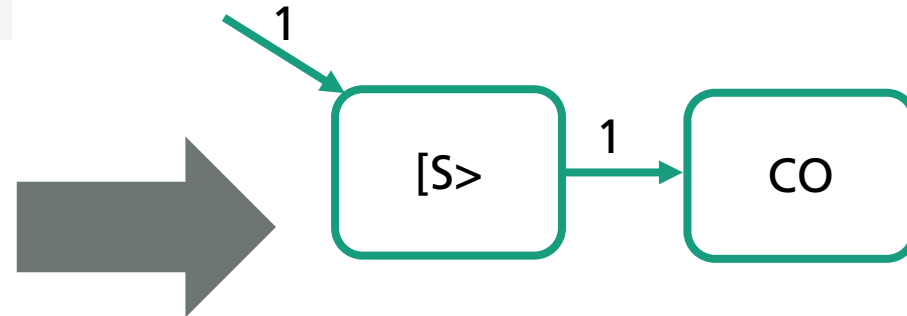


Online Process Discovery – Abstraction (DFG) Approach

Window size: 1 (out of k)

New Event: ("G468RGE6W", "CREATE ORDER")

Order-id	Activity
G468RGE6W	CREATE ORDER

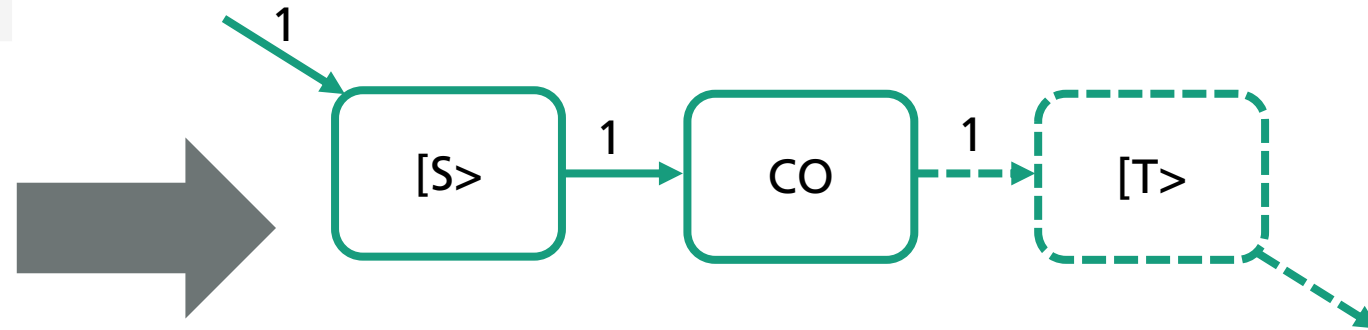


Online Process Discovery – Abstraction (DFG) Approach

Window size: 1 (out of k)

New Event: ("G468RGE6W", "CREATE ORDER")

Order-id	Activity
G468RGE6W	CREATE ORDER

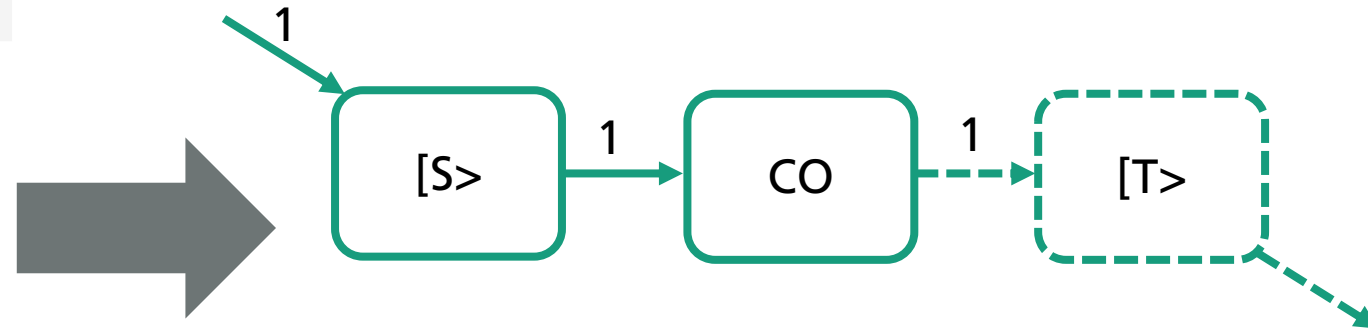


Online Process Discovery – Abstraction (DFG) Approach

Window size: 1 (out of k)

New Event:

Order-id	Activity
G468RGE6W	CREATE ORDER

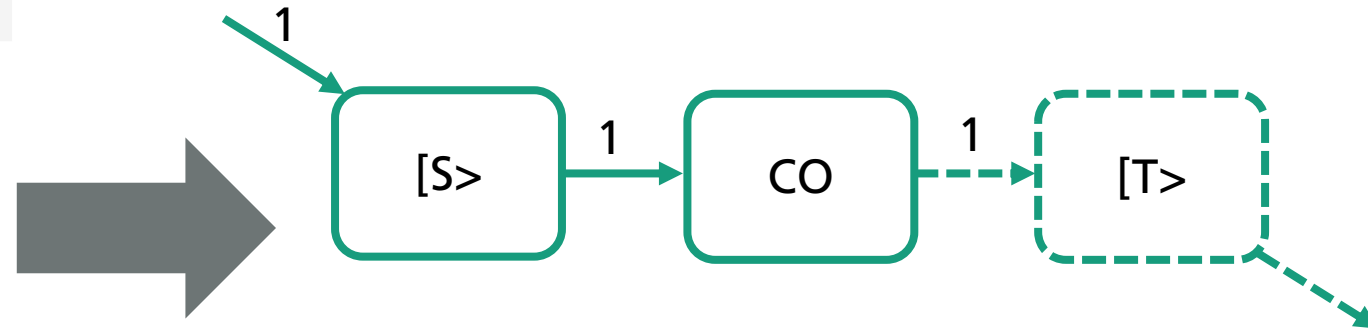


Online Process Discovery – Abstraction (DFG) Approach

Window size: 1 (out of k)

New Event: ("ZHT4574658", "CREATE ORDER")

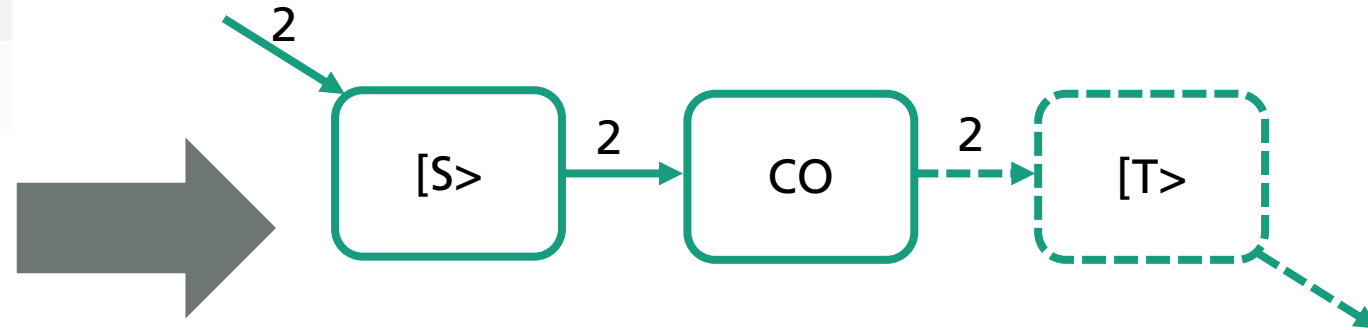
Order-id	Activity
G468RGE6W	CREATE ORDER



Online Process Discovery – Abstraction (DFG) Approach

New Event: ("ZHT4574658", "CREATE ORDER")

Order-id	Activity
G468RGE6W	CREATE ORDER
ZHT4574658	CREATE ORDER

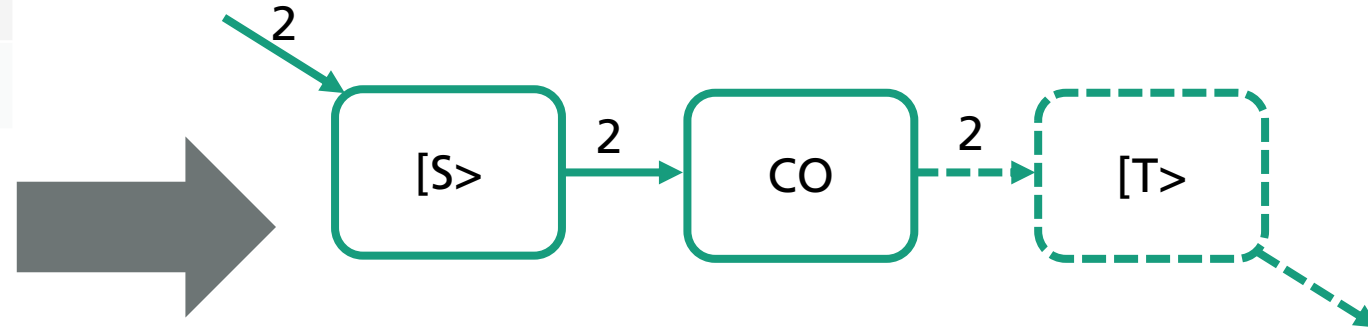


Online Process Discovery – Abstraction (DFG) Approach

Window size: 2 (out of k)



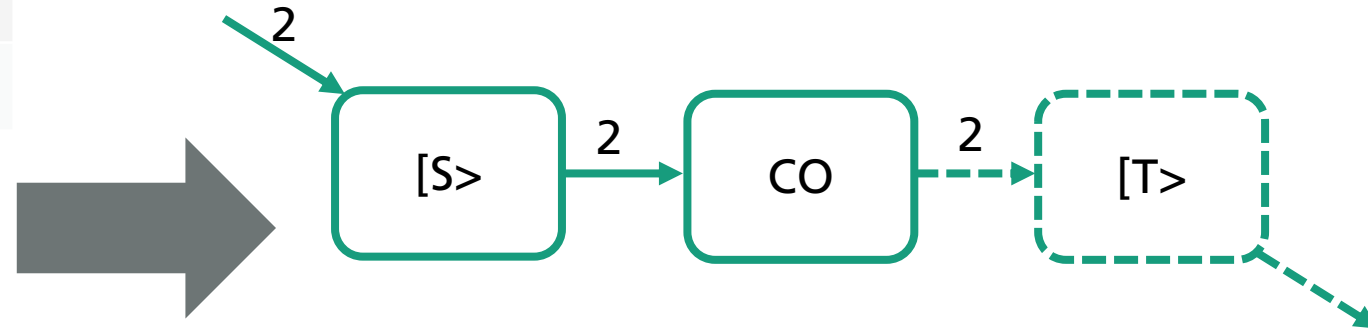
Order-id	Activity
G468RGE6W	CREATE ORDER
ZHT4574658	CREATE ORDER



Online Process Discovery – Basic Approach (Sliding Window)

New Event: ("RTH468RTH4", "CREATE ORDER")

Order-id	Activity
G468RGE6W	CREATE ORDER
ZHT4574658	CREATE ORDER

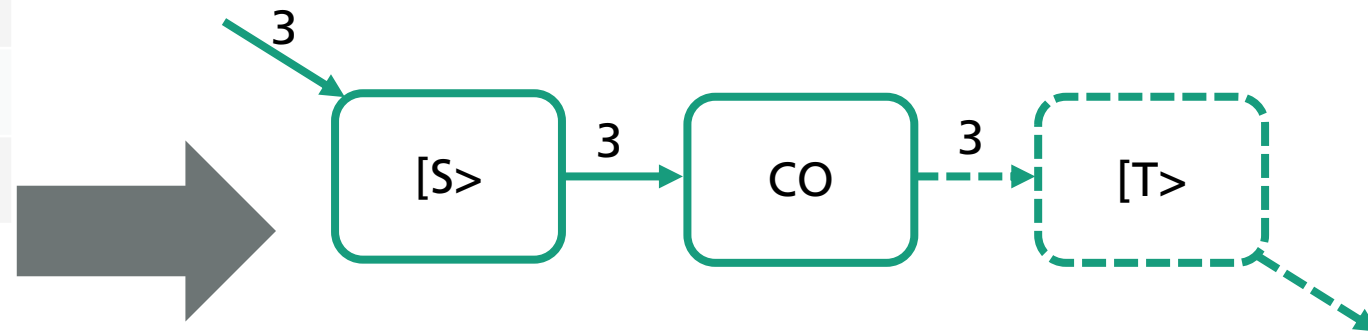


Online Process Discovery – Abstraction (DFG) Approach

New Event: ("RTH468RTH4", "CREATE ORDER")

Window size: 3 (out of k)

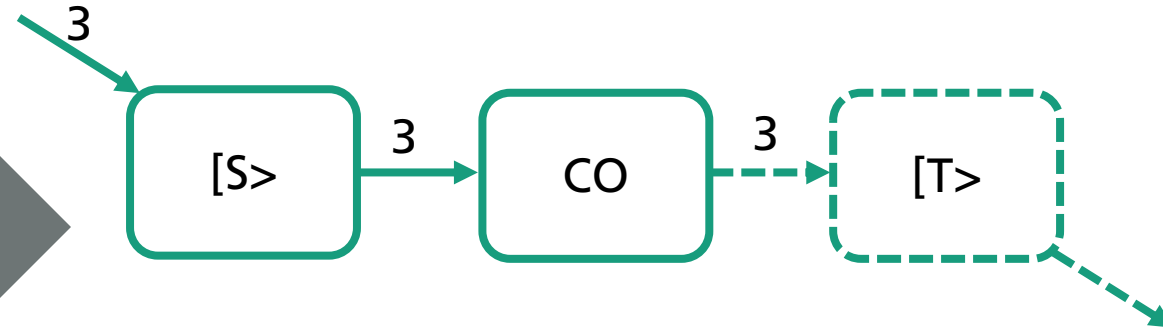
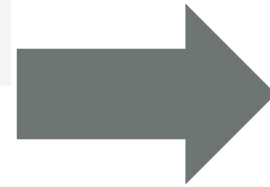
Order-id	Activity
G468RGE6W	CREATE ORDER
ZHT4574658	CREATE ORDER
RTH468RTH4	CREATE ORDER



Online Process Discovery – Abstraction (DFG) Approach

Window size: 3 (out of k)

Order-id	Activity
G468RGE6W	CREATE ORDER
ZHT4574658	CREATE ORDER
RTH468RTH4	CREATE ORDER

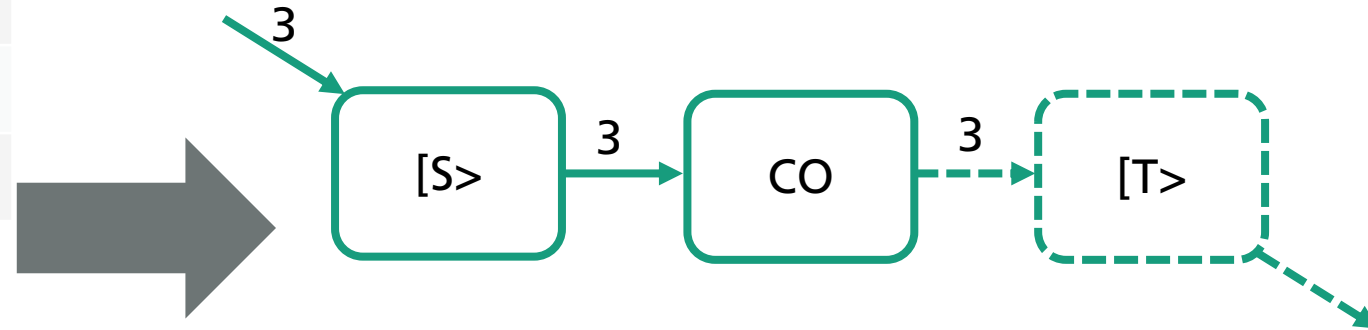


Online Process Discovery – Abstraction (DFG) Approach

New Event: ("G468RGE6W", "ADD ITEM")

Window size: 3 (out of k)

Order-id	Activity
G468RGE6W	CREATE ORDER
ZHT4574658	CREATE ORDER
RTH468RTH4	CREATE ORDER

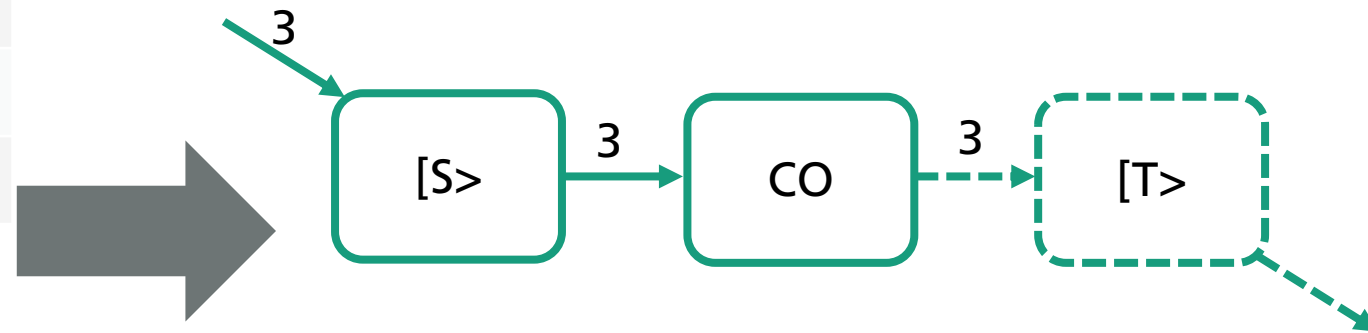


Online Process Discovery – Abstraction (DFG) Approach

New Event: ("G468RGE6W", "ADD ITEM")

Window size: 3 (out of k)

Order-id	Activity
G468RGE6W	CREATE ORDER
ZHT4574658	CREATE ORDER
RTH468RTH4	CREATE ORDER

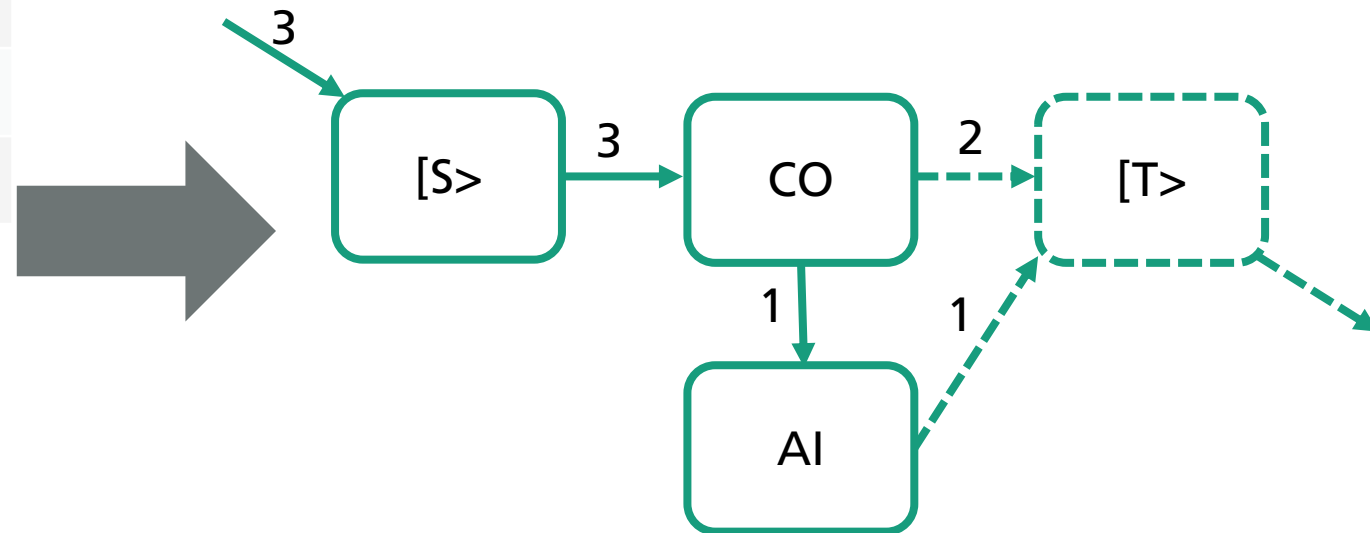


Online Process Discovery – Abstraction (DFG) Approach

New Event: ("G468RGE6W", "ADD ITEM")

Window size: 3 (out of k)

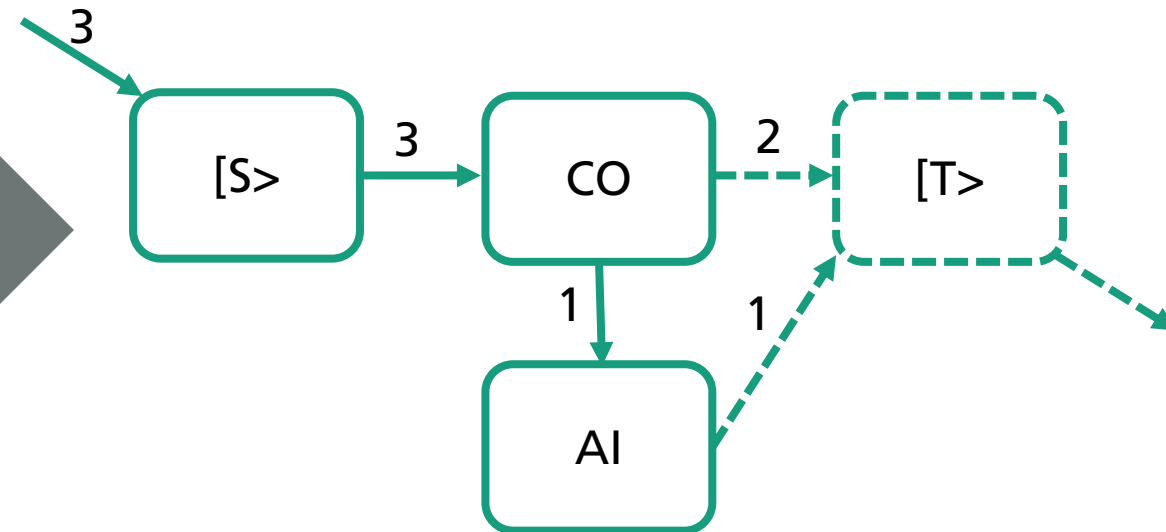
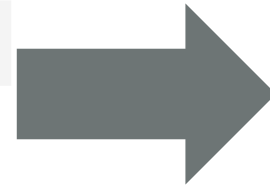
Order-id	Activity
G468RGE6W	ADD ITEM
ZHT4574658	CREATE ORDER
RTH468RTH4	CREATE ORDER



Online Process Discovery – Abstraction (DFG) Approach

Window size: 3 (out of k)

Order-id	Activity
G468RGE6W	ADD ITEM
ZHT4574658	CREATE ORDER
RTH468RTH4	CREATE ORDER

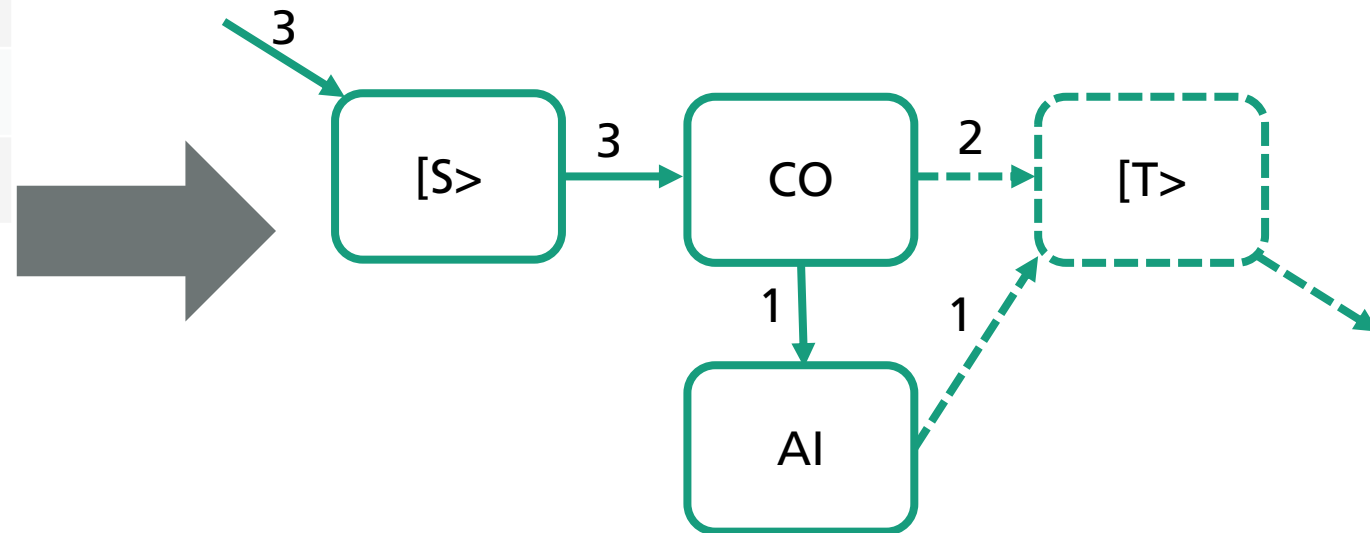


Online Process Discovery – Abstraction (DFG) Approach

New Event: ("G468RGE6W", "ADD ITEM")

Window size: 3 (out of k)

Order-id	Activity
G468RGE6W	ADD ITEM
ZHT4574658	CREATE ORDER
RTH468RTH4	CREATE ORDER

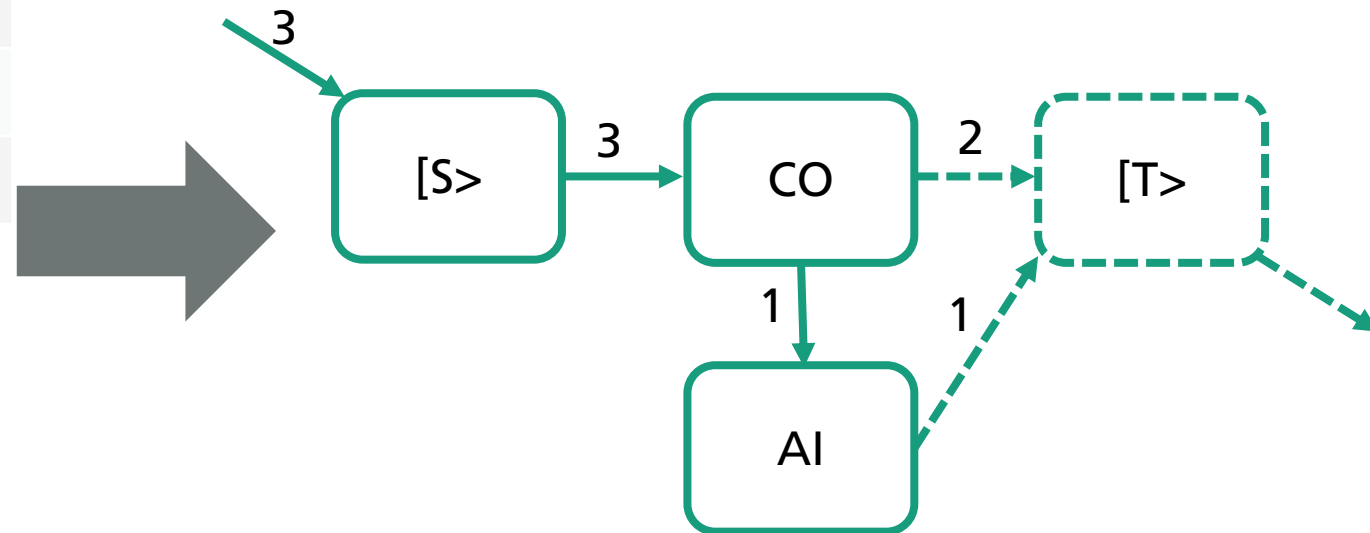


Online Process Discovery – Abstraction (DFG) Approach

New Event: ("G468RGE6W", "ADD ITEM")

Window size: 3 (out of k)

Order-id	Activity
G468RGE6W	ADD ITEM
ZHT4574658	CREATE ORDER
RTH468RTH4	CREATE ORDER

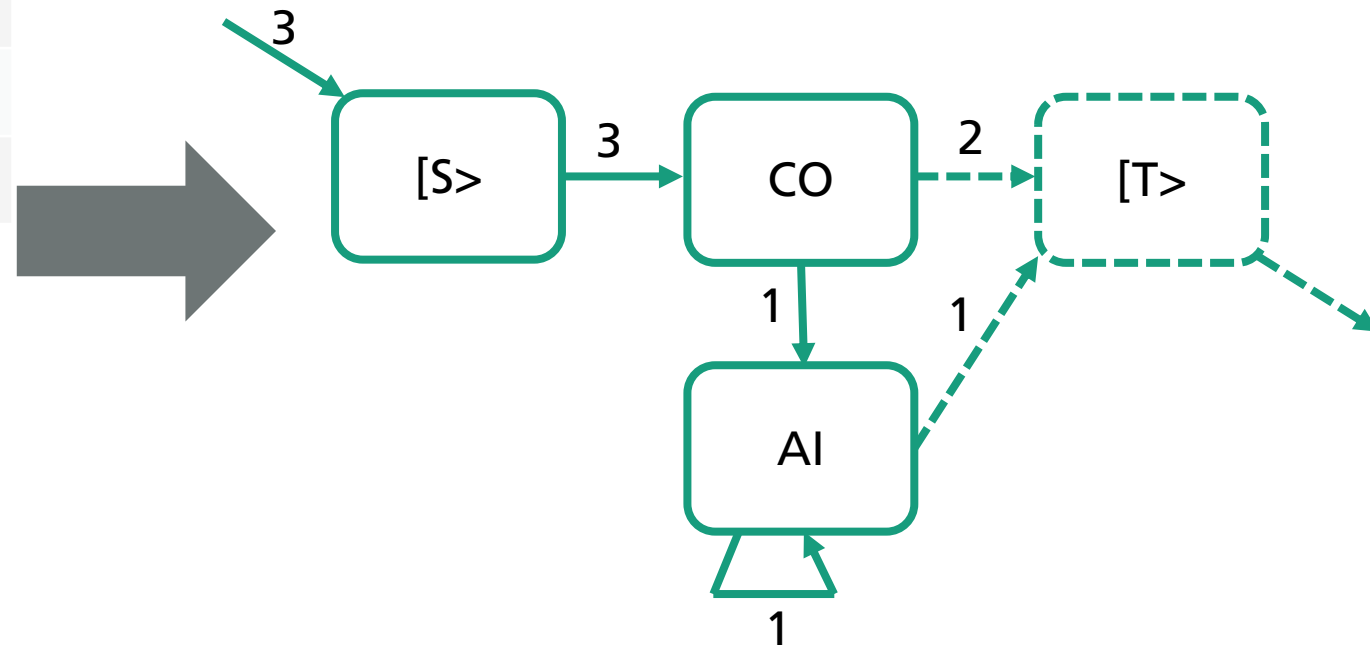


Online Process Discovery – Abstraction (DFG) Approach

New Event: ("G468RGE6W", "ADD ITEM")

Window size: 3 (out of k)

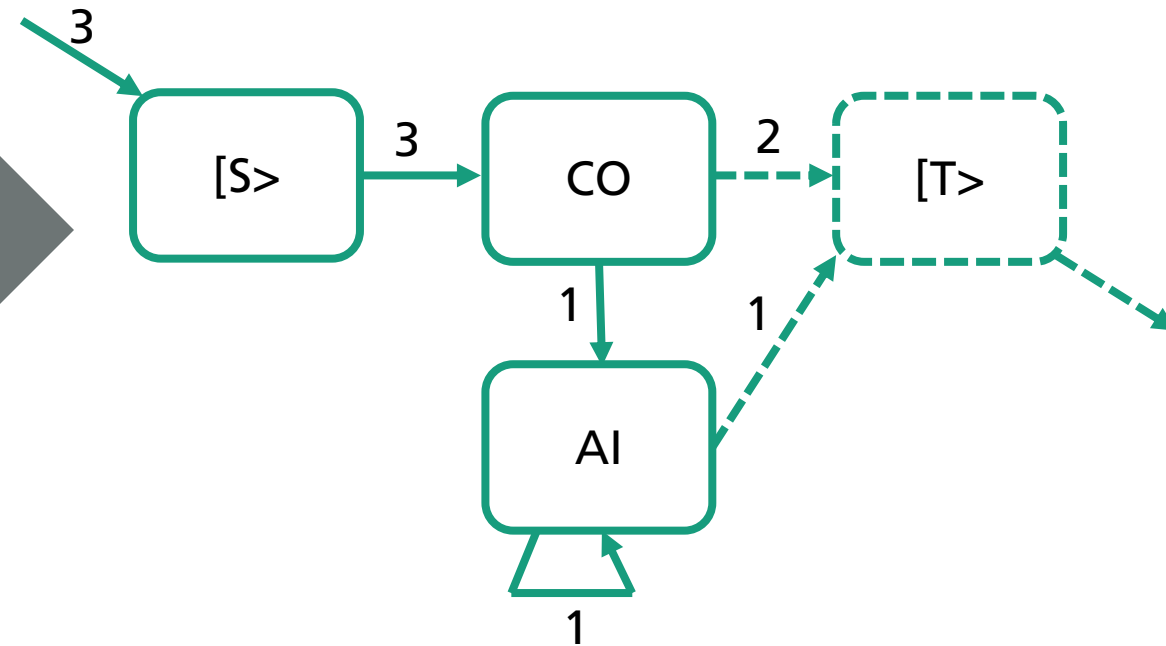
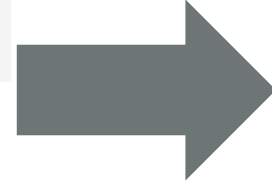
Order-id	Activity
G468RGE6W	ADD ITEM
ZHT4574658	CREATE ORDER
RTH468RTH4	CREATE ORDER



Online Process Discovery – Abstraction (DFG) Approach

Window size: 3 (out of k)

Order-id	Activity
G468RGE6W	ADD ITEM
ZHT4574658	CREATE ORDER
RTH468RTH4	CREATE ORDER

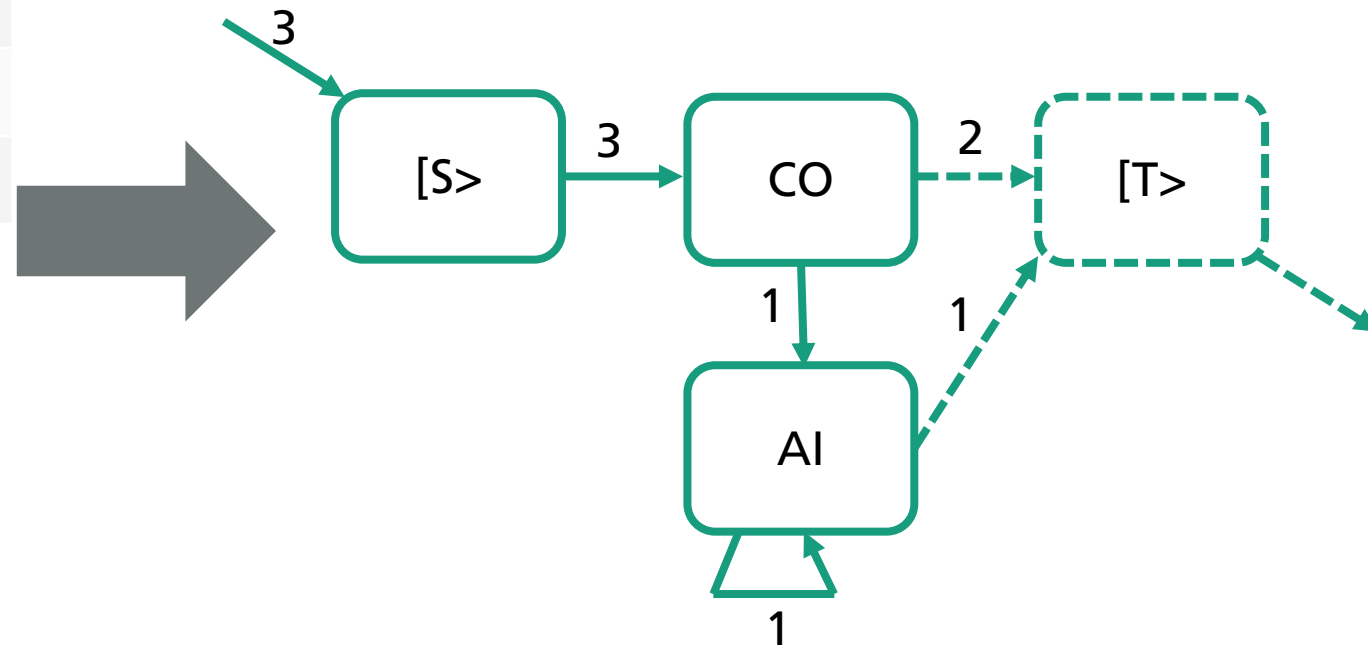


Online Process Discovery – Abstraction (DFG) Approach

New Event: ("RTH468RTH4", "ADD ITEM")

Window size: 3 (out of k)

Order-id	Activity
G468RGE6W	ADD ITEM
ZHT4574658	CREATE ORDER
RTH468RTH4	CREATE ORDER

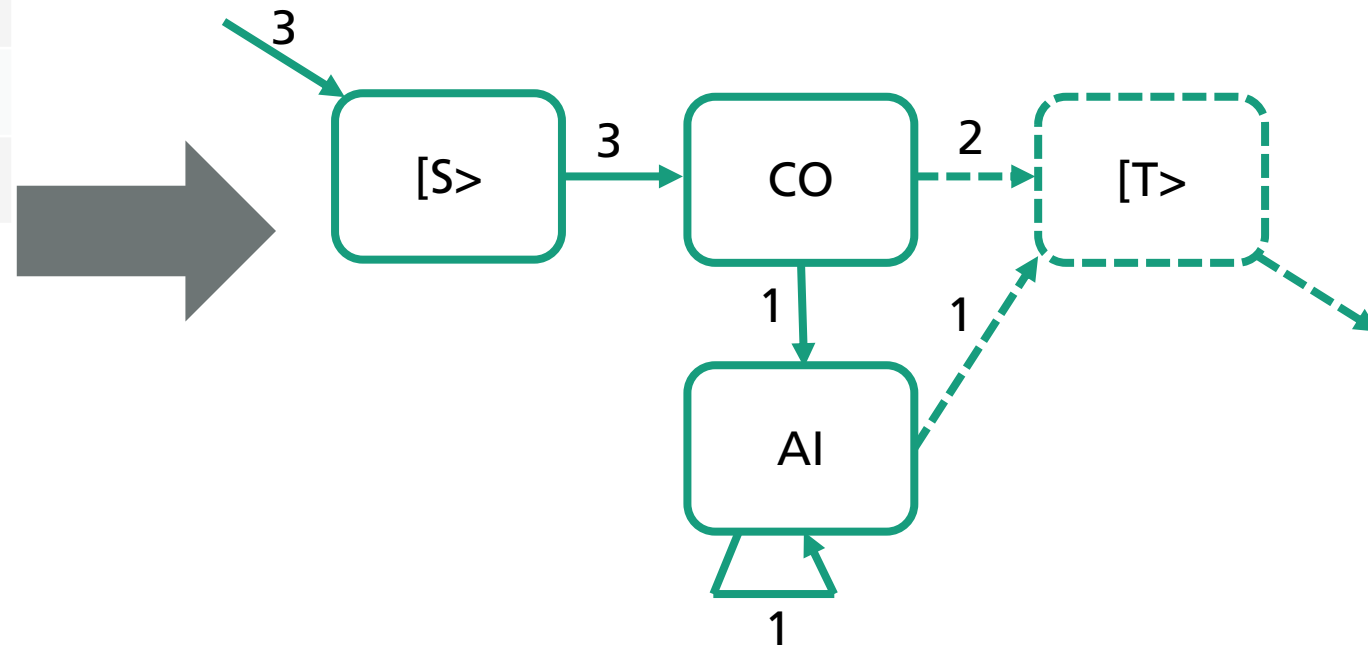


Online Process Discovery – Abstraction (DFG) Approach

New Event: ("RTH468RTH4", "ADD ITEM")

Window size: 3 (out of k)

Order-id	Activity
G468RGE6W	ADD ITEM
ZHT4574658	CREATE ORDER
RTH468RTH4	CREATE ORDER

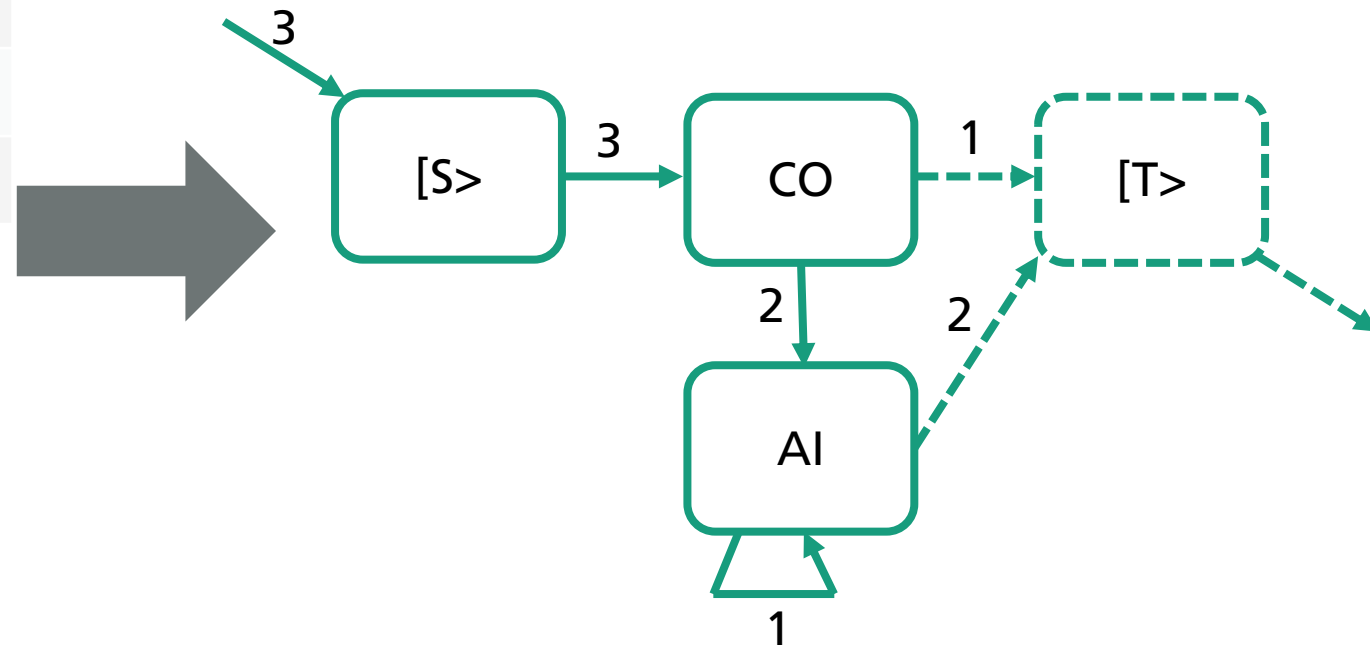


Online Process Discovery – Abstraction (DFG) Approach

New Event: ("RTH468RTH4", "ADD ITEM")

Window size: 3 (out of k)

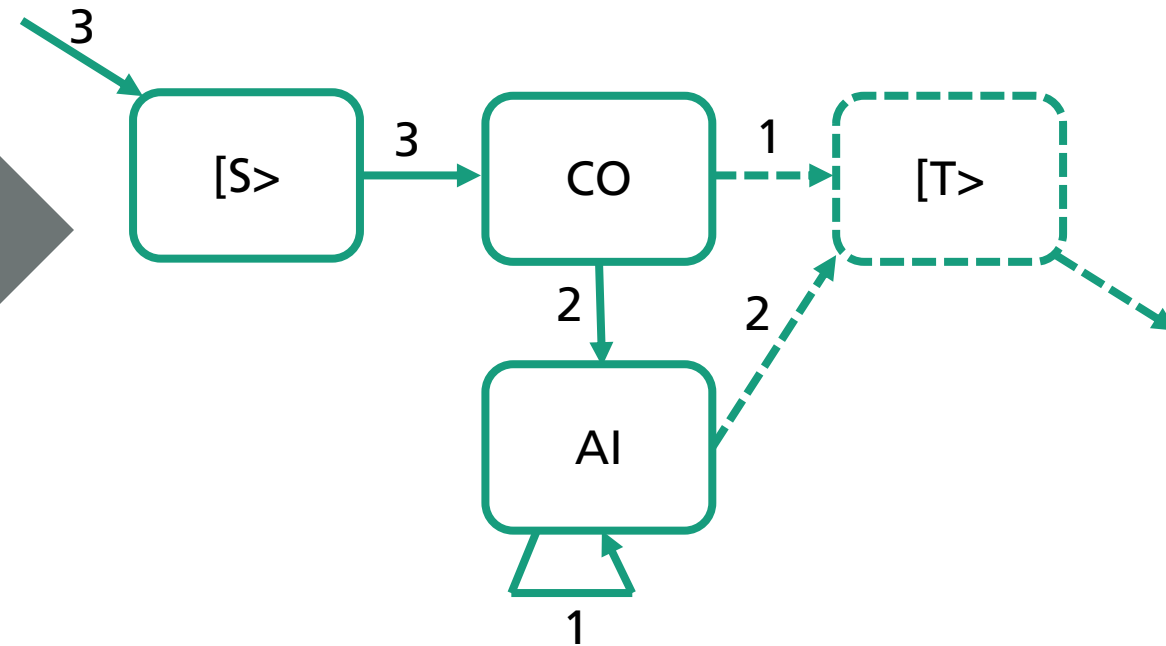
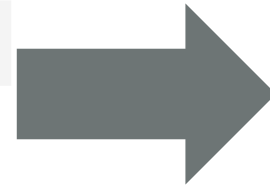
Order-id	Activity
G468RGE6W	ADD ITEM
ZHT4574658	CREATE ORDER
RTH468RTH4	ADD ITEM



Online Process Discovery – Abstraction (DFG) Approach

Window size: 3 (out of k)

Order-id	Activity
G468RGE6W	ADD ITEM
ZHT4574658	CREATE ORDER
RTH468RTH4	ADD ITEM

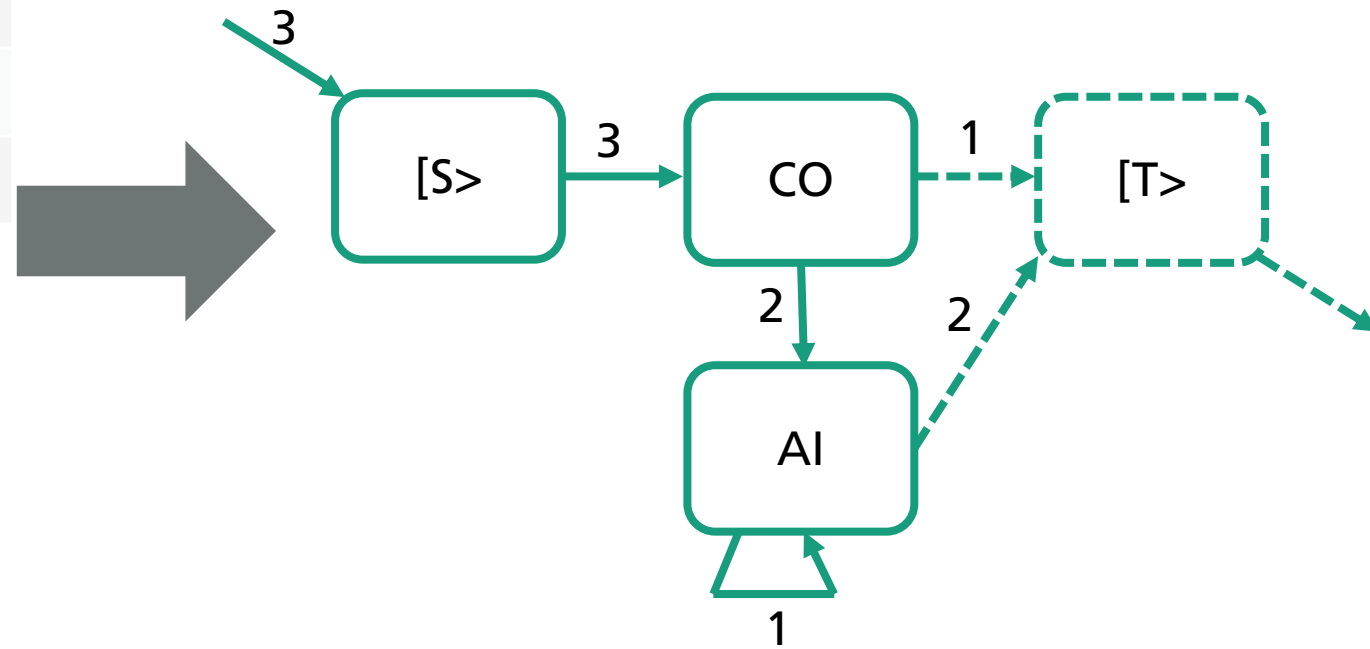


Online Process Discovery – Abstraction (DFG) Approach

New Event: ("G468RGE6W", "SUBMIT ORDER")

Window size: 3 (out of k)

Order-id	Activity
G468RGE6W	ADD ITEM
ZHT4574658	CREATE ORDER
RTH468RTH4	ADD ITEM

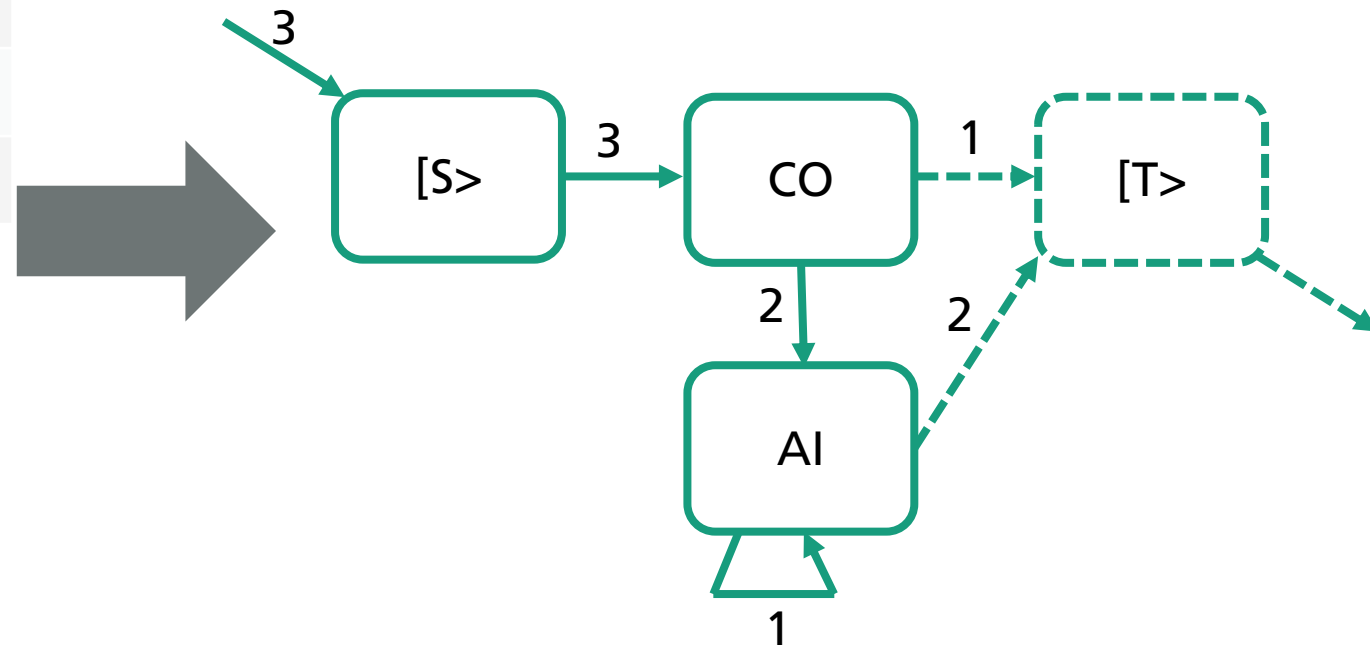


Online Process Discovery – Abstraction (DFG) Approach

New Event: ("G468RGE6W", "SUBMIT ORDER")

Window size: 3 (out of k)

Order-id	Activity
G468RGE6W	ADD ITEM
ZHT4574658	CREATE ORDER
RTH468RTH4	ADD ITEM

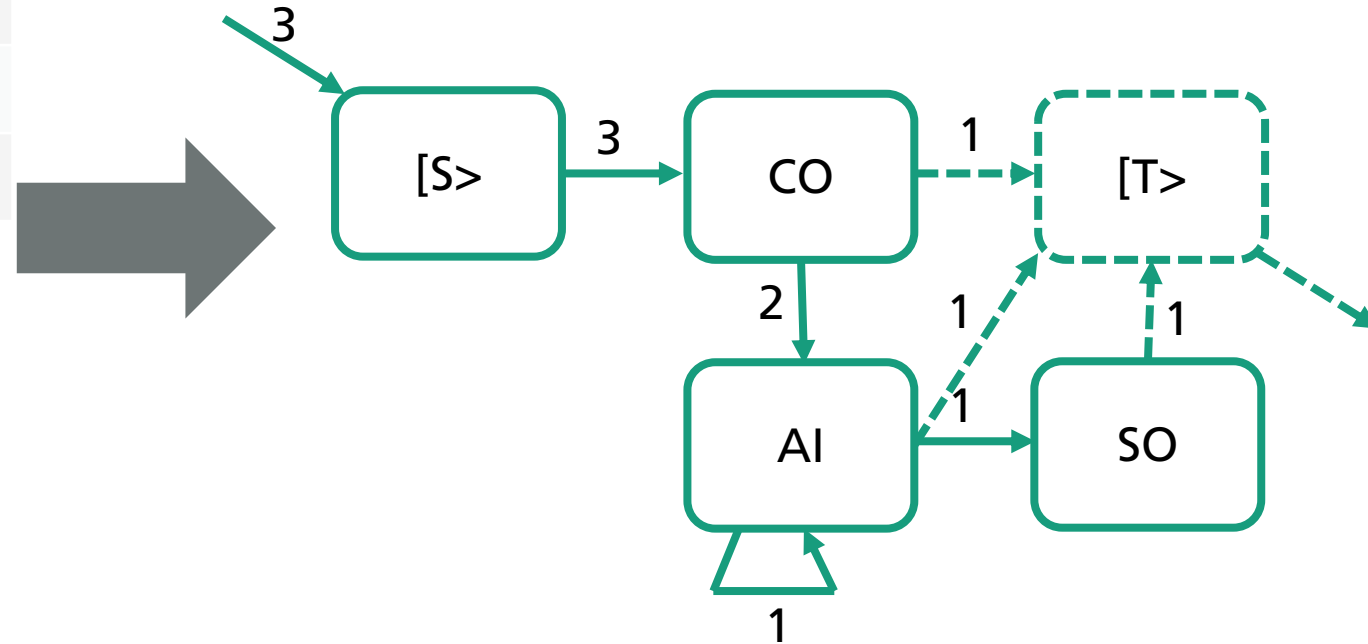


Online Process Discovery – Abstraction (DFG) Approach

New Event: ("G468RGE6W", "SUBMIT ORDER")

Window size: 3 (out of k)

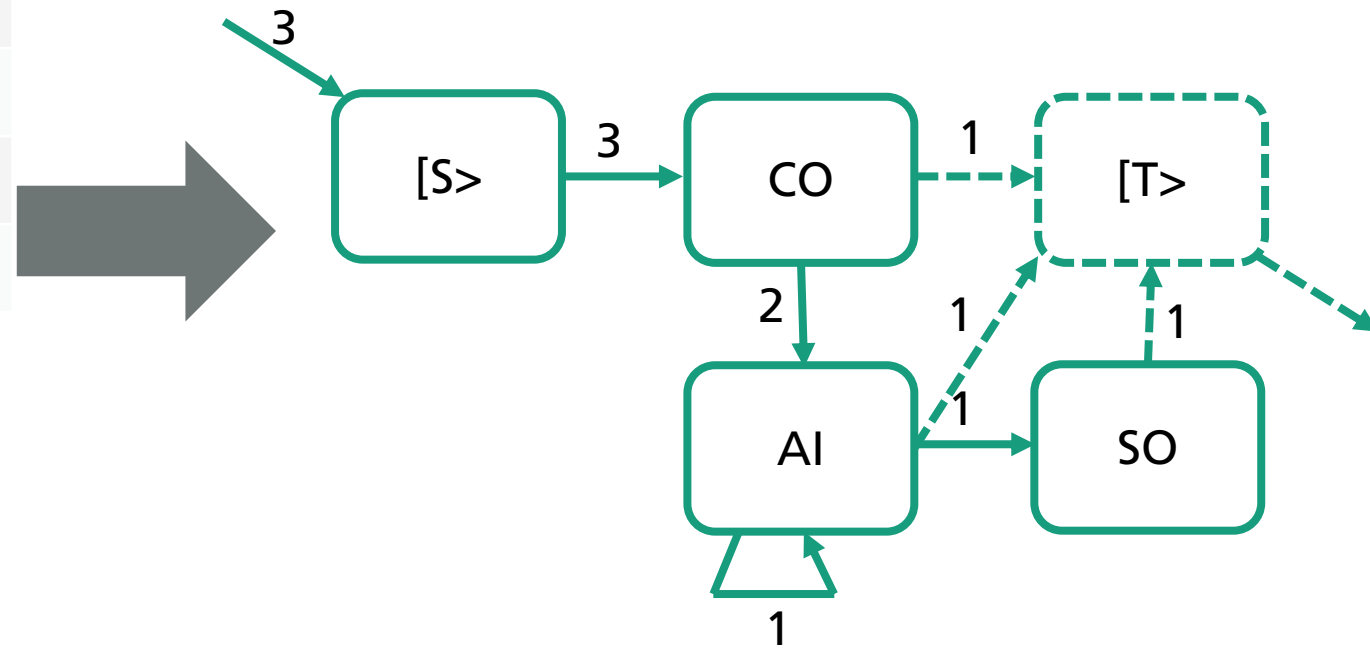
Order-id	Activity
G468RGE6W	SUBMIT ORDER
ZHT4574658	CREATE ORDER
RTH468RTH4	ADD ITEM



Online Process Discovery – Abstraction (DFG) Approach

...

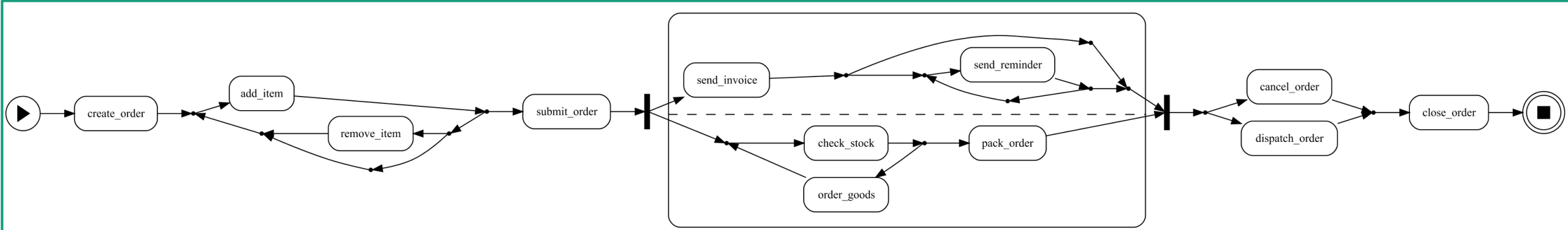
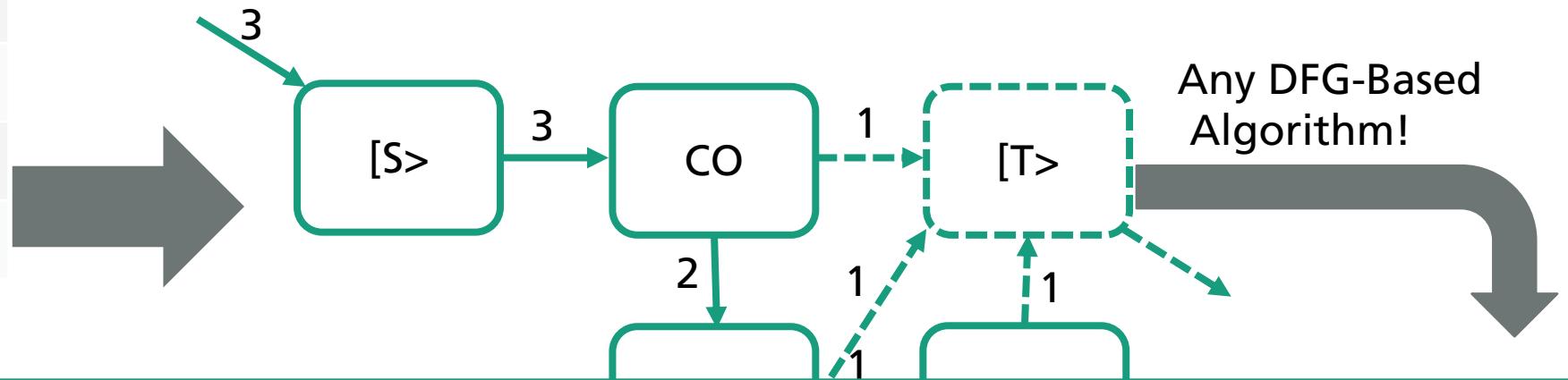
Order-id	Activity
G468RGE6W	SUBMIT ORDER
ZHT4574658	CREATE ORDER
RTH468RTH4	ADD ITEM
...	...



Online Process Discovery – Abstraction (DFG) Approach

...

Order-id	Activity
G468RGE6W	SUBMIT ORDER
ZHT4574658	CREATE ORDER
RTH468RTH4	ADD ITEM
...	...



Online Process Discovery – Abstraction (DFG) Approach

- Works for several existing abstractions
- Aging can be applied on the abstraction as well
- Advantages:
 - We can 'maintain' case information longer
 - Less Issues on 'cutting' at the beginning
 - Translation to internal representation no longer needed
- Disadvantages:
 - Loss in generality of the approach (tied to specific algorithms)
 - Incompleteness on the "end" of traces not solved

Online Process Discovery – Novel Developments

- Current work (co-op with MSc student)
 - Accurate detection of trace completeness
 - Both start- and end of traces
 - Greatly enhances the **precision/accuracy** of discovered models

Online Conformance Checking – Overview

■ “2 Flavors”

■ Alignment-Based

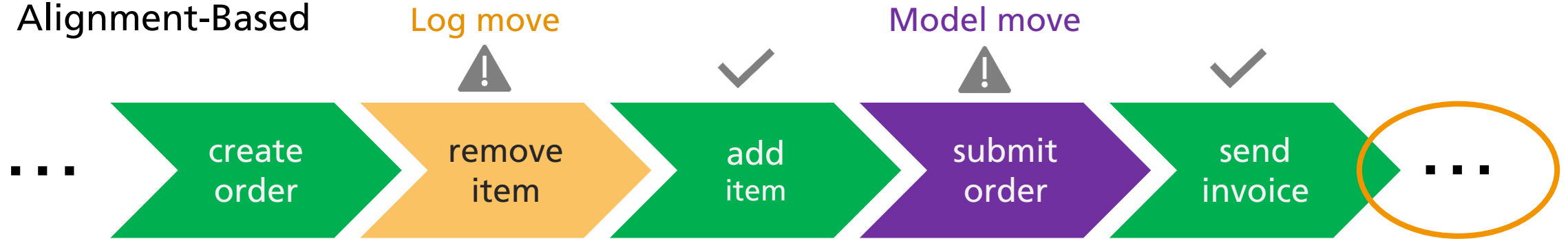


■ Abstraction Based

- Checking on the basis of “Abstractions”, e.g., the DFG
- Pre-computing the state-space of a model...

Online Conformance Checking – Overview

■ Alignment-Based

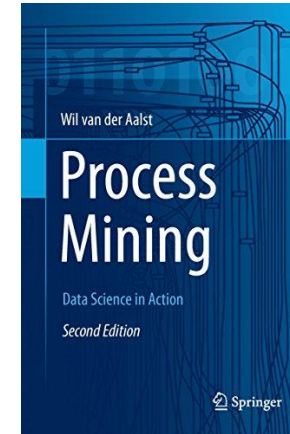


- We compute **prefix-alignments**: We do not punish for non-completeness of traces
 - 2017: Proof (very easy 😊) that prefix alignments are an underestimate of normal alignments
 - 2017: Online Approximation Scheme
 - 2019: Online Exact Solution (→ in some cases comparable / faster than approx.)
 - Under Review

Some Pointers

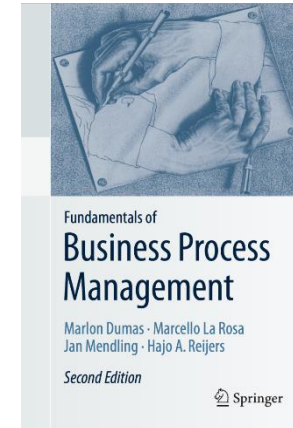
- Process Mining; Data Science in Action
Wil van der Aalst
 - Gentle introduction to the topic of process mining

- Conformance Checking; Relating Processes and Models
Josep Carmona et al.
 - Covers alignments in greate detail!



Some Pointers

- Fundamentals of Business Process Management
Marlon Dumas et al.
 - *Covers general BPM, provides good perspective for the application of PM*
- Process Mining with Streaming Data
 -
 - *Covering Discovery / Conformance Checking / Enhancement*



Some Pointers

- Author(s) working on the area (sadly not so many ☹)
- Andrea Burattin (together with: Sperduti / Carmona)
 - <https://dblp.uni-trier.de/pers/hd/b/Burattin:Andrea>
 - <https://scholar.google.com/citations?user=gaiAPWYAAAAJ&hl=en&oi=ao>
- —
 - https://dblp.uni-trier.de/pers/hd/z/Zelst:Sebastiaan_J=van
 - <https://scholar.google.com/citations?user=MwMohwcAAAAJ&hl=en>

Some Publicity 😊

- We develop **PM4Py**, an open-source process mining library for Python
 - >80K Downloads
 - First release in December 2018





<https://goodjobpal.com/wp-content/uploads/2019/01/Thank-you-word-cloud.jpg>