



# Process Mining a syntéza Petriho sietí

**dus 3**



Software development -

Software engineering

Špecifikácia

Model driven development

Xtreme programming

Rapid system prototyping

Ako vytvoriť softvér – rýchlo, lacno a v dobrej kvalite



Software development -

Software engineering

Špecifikácia

Model driven development

Xtreme programming

Rapid system prototyping

Ako vytvoriť **model** – rýchlo, lacno a v dobrej kvalite



Software development -

Software engineering

Špecifikácia

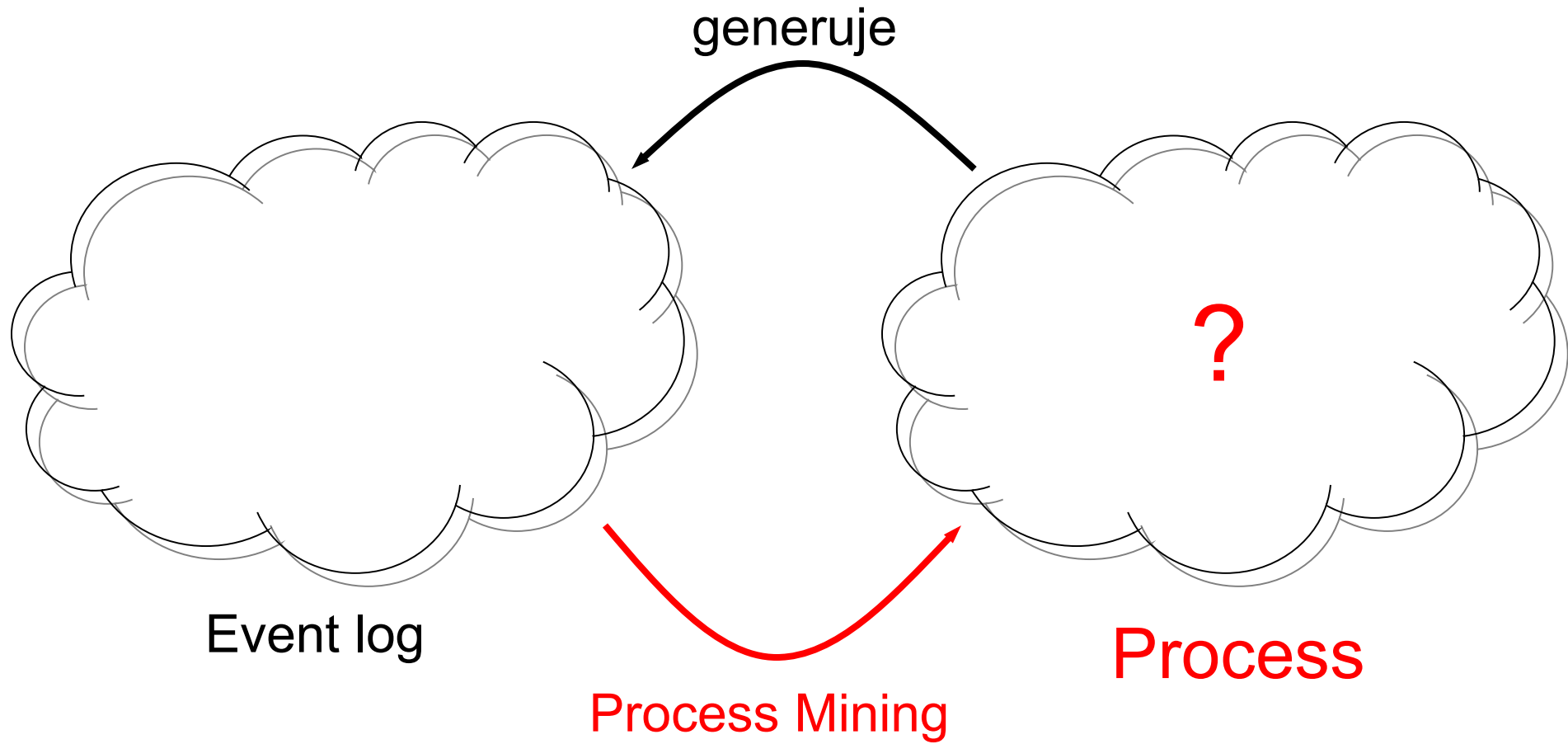
Model driven development

Xtreme programming

Rapid system prototyping

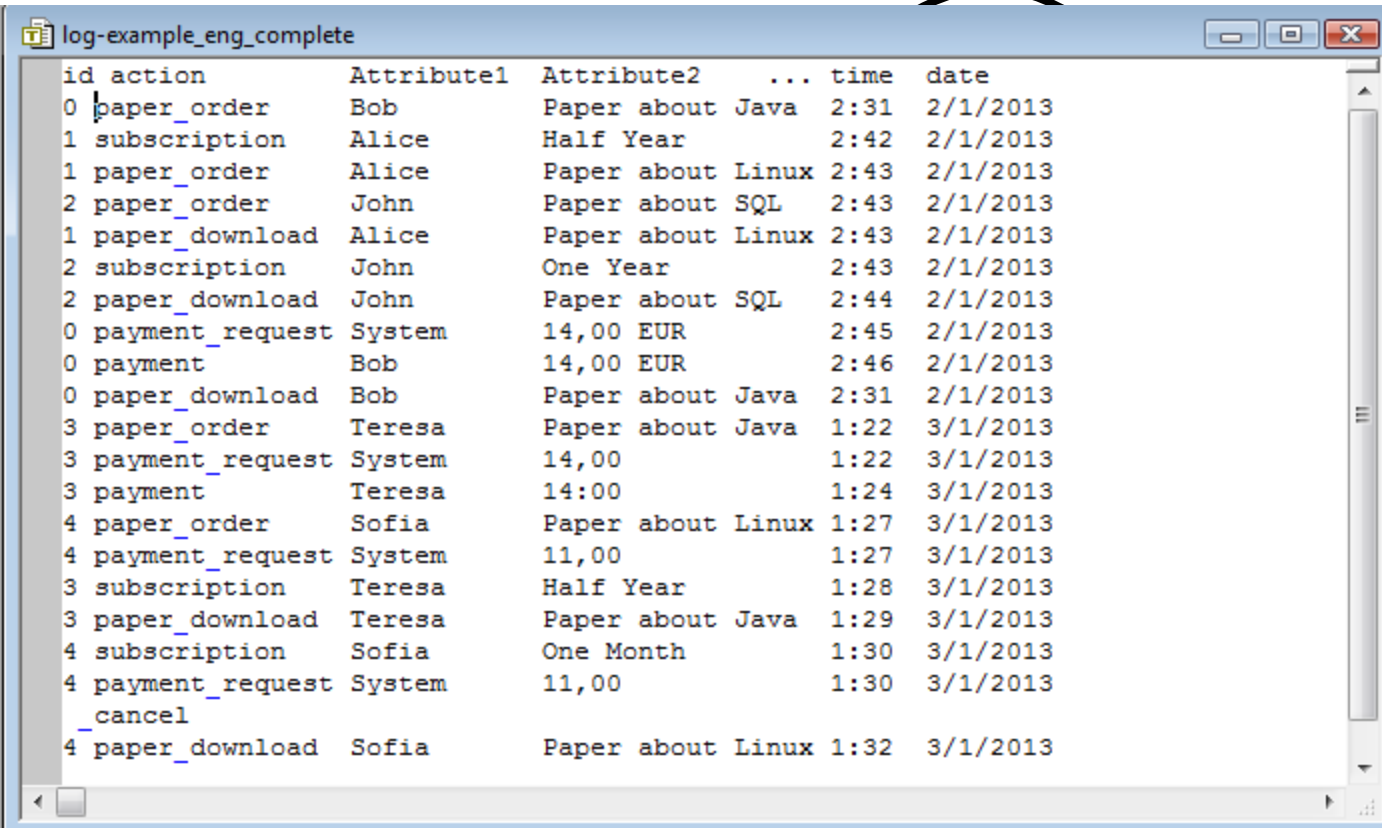
Ako vytvoriť **model** – rýchlo, lacno a v dobrej kvalite (semi) automaticky

# Process Mining – Ako získať Process z Event Logov



# Process Mining – Ako získať Process z Event Logov

generuje



id	action	Attribute1	Attribute2	...	time	date
0	paper_order	Bob	Paper about Java		2:31	2/1/2013
1	subscription	Alice	Half Year		2:42	2/1/2013
1	paper_order	Alice	Paper about Linux		2:43	2/1/2013
2	paper_order	John	Paper about SQL		2:43	2/1/2013
1	paper_download	Alice	Paper about Linux		2:43	2/1/2013
2	subscription	John	One Year		2:43	2/1/2013
2	paper_download	John	Paper about SQL		2:44	2/1/2013
0	payment_request	System	14,00 EUR		2:45	2/1/2013
0	payment	Bob	14,00 EUR		2:46	2/1/2013
0	paper_download	Bob	Paper about Java		2:31	2/1/2013
3	paper_order	Teresa	Paper about Java		1:22	3/1/2013
3	payment_request	System	14,00		1:22	3/1/2013
3	payment	Teresa	14:00		1:24	3/1/2013
4	paper_order	Sofia	Paper about Linux		1:27	3/1/2013
4	payment_request	System	11,00		1:27	3/1/2013
3	subscription	Teresa	Half Year		1:28	3/1/2013
3	paper_download	Teresa	Paper about Java		1:29	3/1/2013
4	subscription	Sofia	One Month		1:30	3/1/2013
4	payment_request	System	11,00		1:30	3/1/2013
4	cancel					
4	paper_download	Sofia	Paper about Linux		1:32	3/1/2013

?

Process

# Process Mining – Ako získať Process z Event Logov

generuje

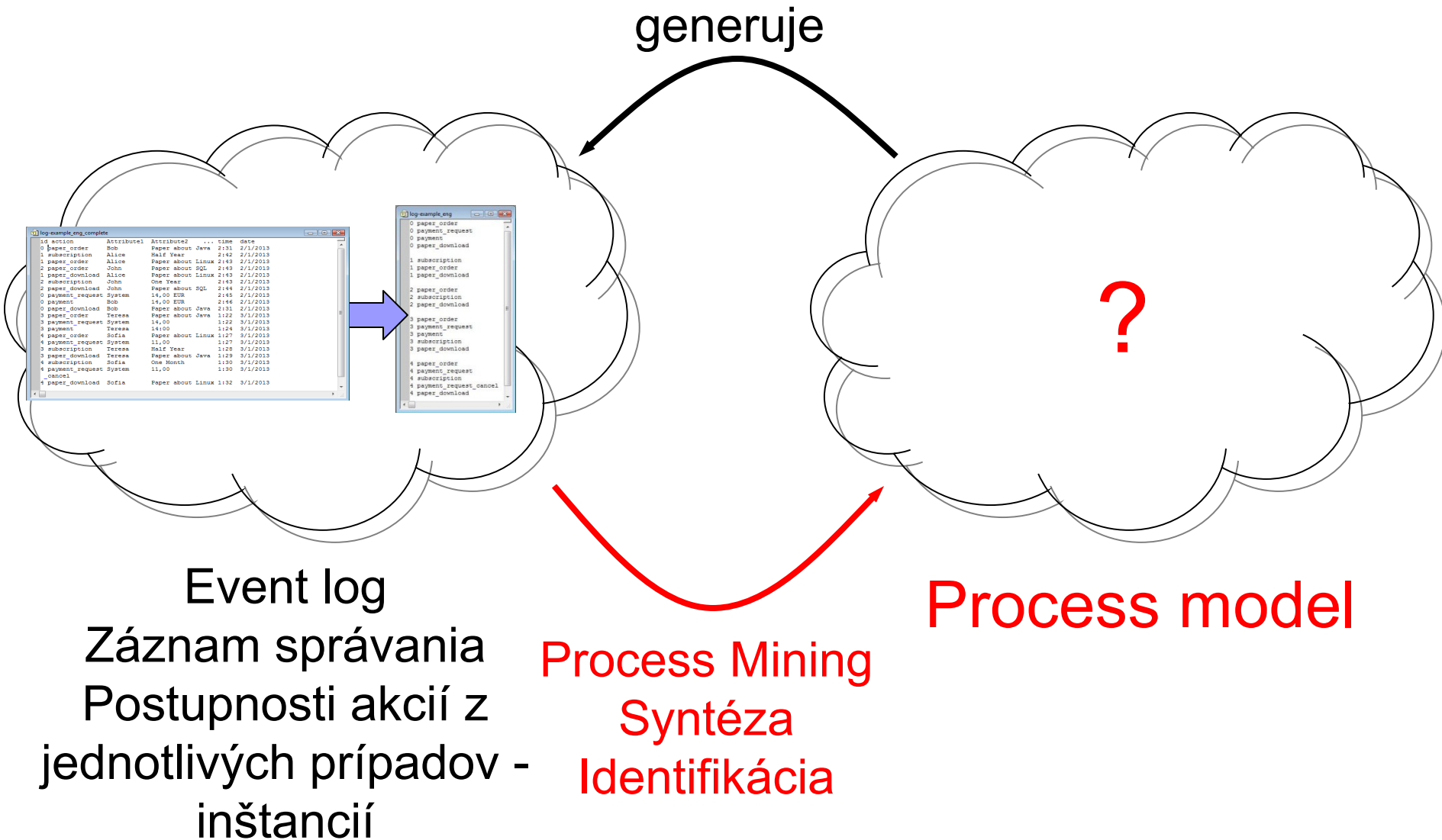
The image shows two windows illustrating the process of generating a process from event logs. The left window, titled 'log-example\_eng\_complete', displays a table of event log entries. The right window, titled 'log-example\_eng', displays a list of actions extracted from the log, ordered by their occurrence.

id	action	Attribute1	Attribute2	...	time	date
0	paper_order	Bob	Paper about Java		2:31	2/1/2013
1	subscription	Alice	Half Year		2:42	2/1/2013
1	paper_order	Alice	Paper about Linux		2:43	2/1/2013
2	paper_order	John	Paper about SQL		2:43	2/1/2013
1	paper_download	Alice	Paper about Linux		2:43	2/1/2013
2	subscription	John	One Year		2:43	2/1/2013
2	paper_download	John	Paper about SQL		2:44	2/1/2013
0	payment_request	System	14,00 EUR		2:45	2/1/2013
0	payment	Bob	14,00 EUR		2:46	2/1/2013
0	paper_download	Bob	Paper about Java		2:31	2/1/2013
3	paper_order	Teresa	Paper about Java		1:22	3/1/2013
3	payment_request	System	14,00		1:22	3/1/2013
3	payment	Teresa	14:00		1:24	3/1/2013
4	paper_order	Sofia	Paper about Linux		1:27	3/1/2013
4	payment_request	System	11,00		1:27	3/1/2013
3	subscription	Teresa	Half Year		1:28	3/1/2013
3	paper_download	Teresa	Paper about Java		1:29	3/1/2013
4	subscription	Sofia	One Month		1:30	3/1/2013
4	payment_request_cancel	System	11,00		1:30	3/1/2013
4	paper_download	Sofia	Paper about Linux		1:32	3/1/2013

The right window shows the following list of actions and their IDs:

- 0 paper\_order
- 0 payment\_request
- 0 payment
- 0 paper\_download
- 1 subscription
- 1 paper\_order
- 1 paper\_download
- 2 paper\_order
- 2 subscription
- 2 paper\_download
- 3 paper\_order
- 3 payment\_request
- 3 payment
- 3 subscription
- 3 paper\_download
- 4 paper\_order
- 4 payment\_request
- 4 subscription
- 4 payment\_request\_cancel
- 4 paper\_download

# Process Mining – Ako získať Process z Event Logov





# Process Mining – Ako získať Process z Event Logov

Ako získať úplný  
log

generuje

```
log-example_eng_complete
Id version  Attribute1  Attribute2  ...  time  date
0 paper_order  Bob  Paper about Java  2131  2/1/2013
1 subscription  Alice  Half Year  2142  2/1/2013
2 paper_order  Alice  Paper about Linux  2143  2/1/2013
3 paper_order  John  Paper about SQL  2149  2/1/2013
1 paper_download  Alice  Paper about Linux  2143  2/1/2013
2 subscription  John  One Year  2143  2/1/2013
0 paper_download  John  Paper about SQL  2144  2/1/2013
0 payment_request  System  14,00 EUR  2145  2/1/2013
0 payment  Bob  14,00 EUR  2146  2/1/2013
0 paper_download  Bob  Paper about Java  2131  2/1/2013
3 paper_order  Teresa  Paper about Java  1122  3/1/2013
3 payment_request  System  14,00  1122  3/1/2013
3 payment  Teresa  14,00  1124  3/1/2013
4 paper_order  Sofia  Paper about Linux  1127  3/1/2013
1 payment_request  System  11,00  1127  3/1/2013
0 subscription  Teresa  Half Year  1128  3/1/2013
3 paper_download  Teresa  Paper about Java  1129  3/1/2013
2 subscription  Sofia  One Month  1130  3/1/2013
4 payment_request  System  11,00  1130  3/1/2013
4 cancel
0 paper_download  Sofia  Paper about Linux  1132  3/1/2013
```

```
log-example_eng
0 paper_order
0 payment_request
0 paper_download
1 subscription
1 paper_order
1 paper_download
2 paper_order
2 subscription
2 paper_download
3 paper_order
3 payment_request
3 payment
3 subscription
3 paper_download
4 paper_order
4 payment_request
4 subscription
4 payment_request_cancel
4 paper_download
```



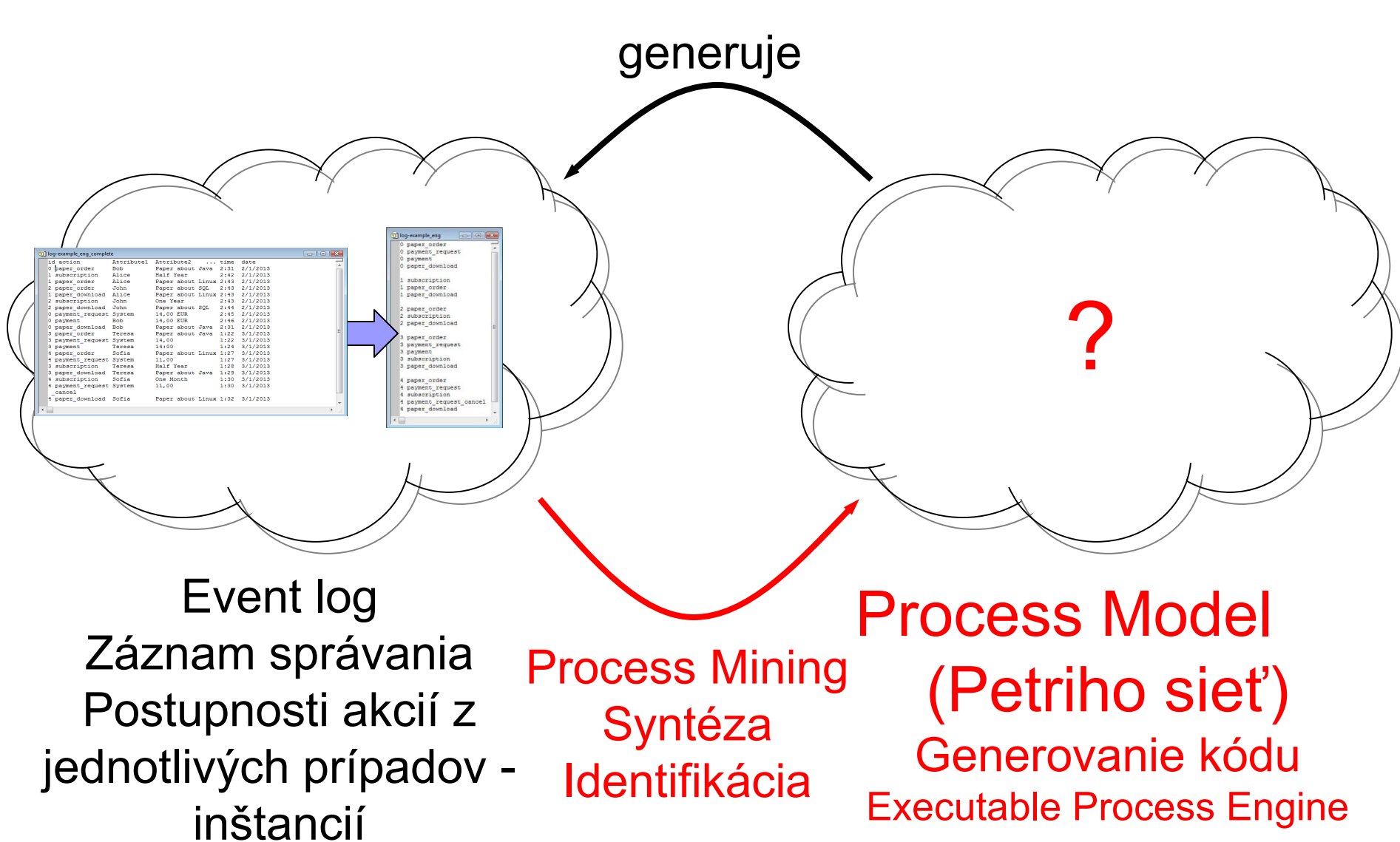
Event log

Process model

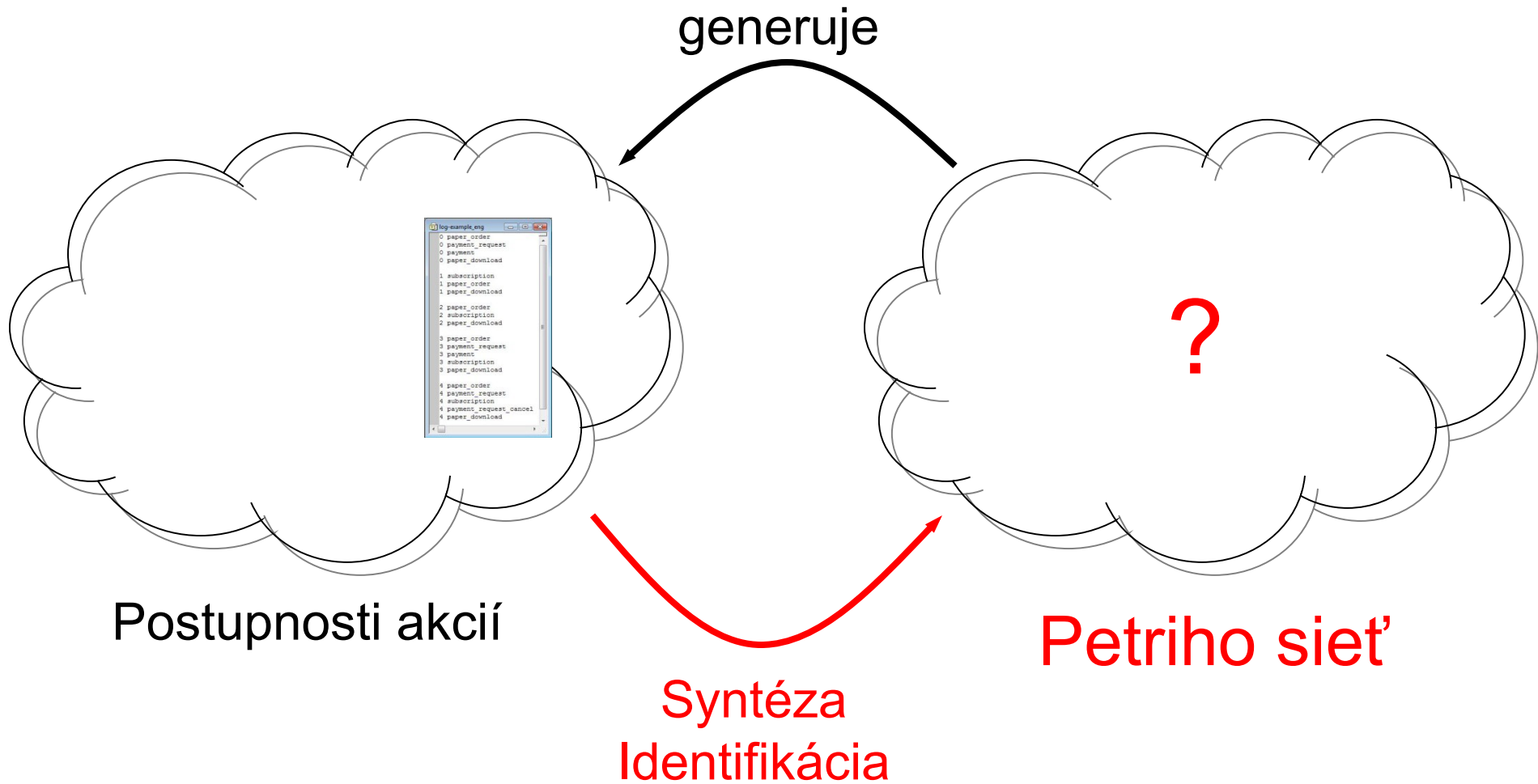
Záznam správania  
Postupnosti akcií z  
jednotlivých prípadov -  
inštancií

Process Mining  
Syntéza  
Identifikácia

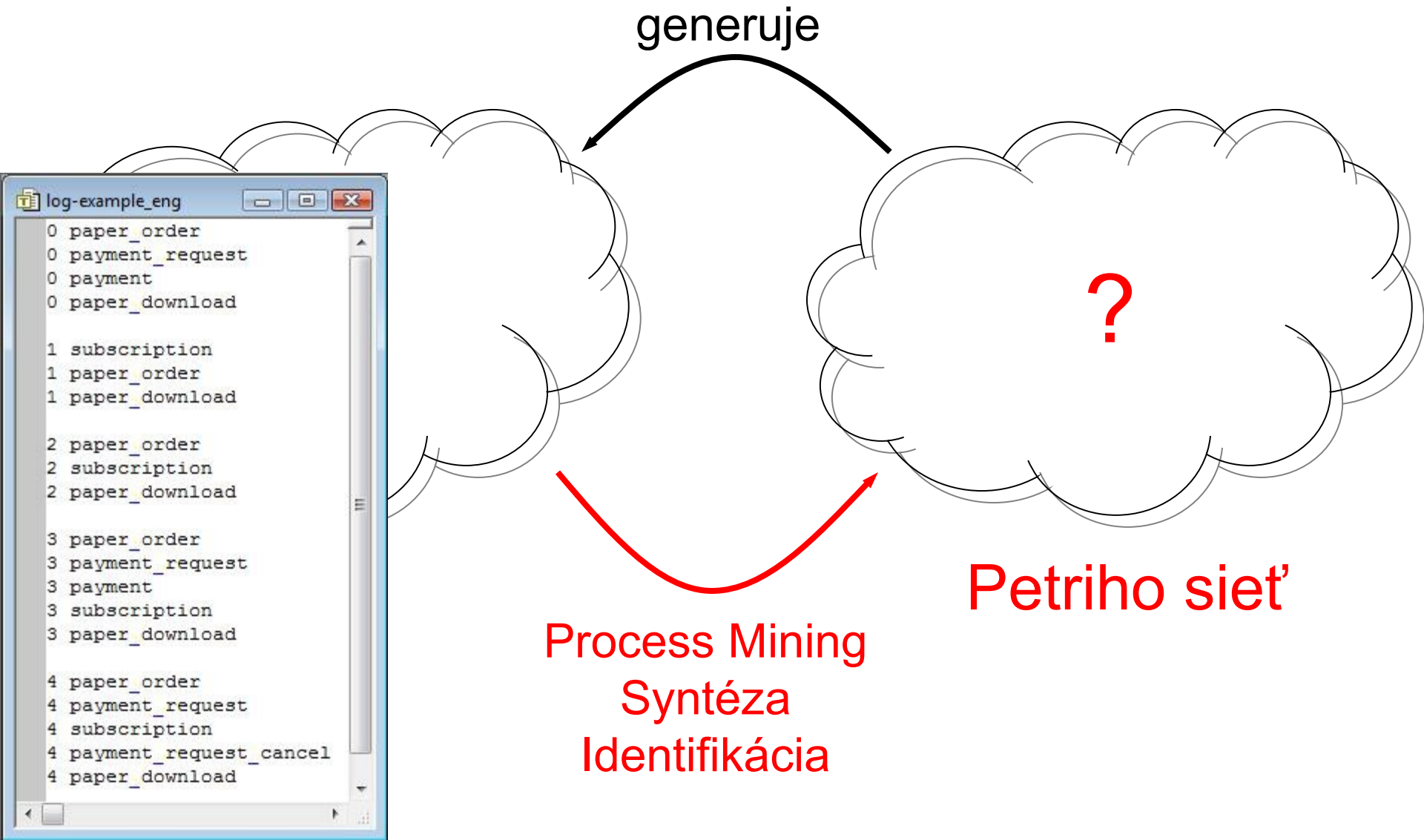
# Process Mining – Ako získať Process z Event Logov



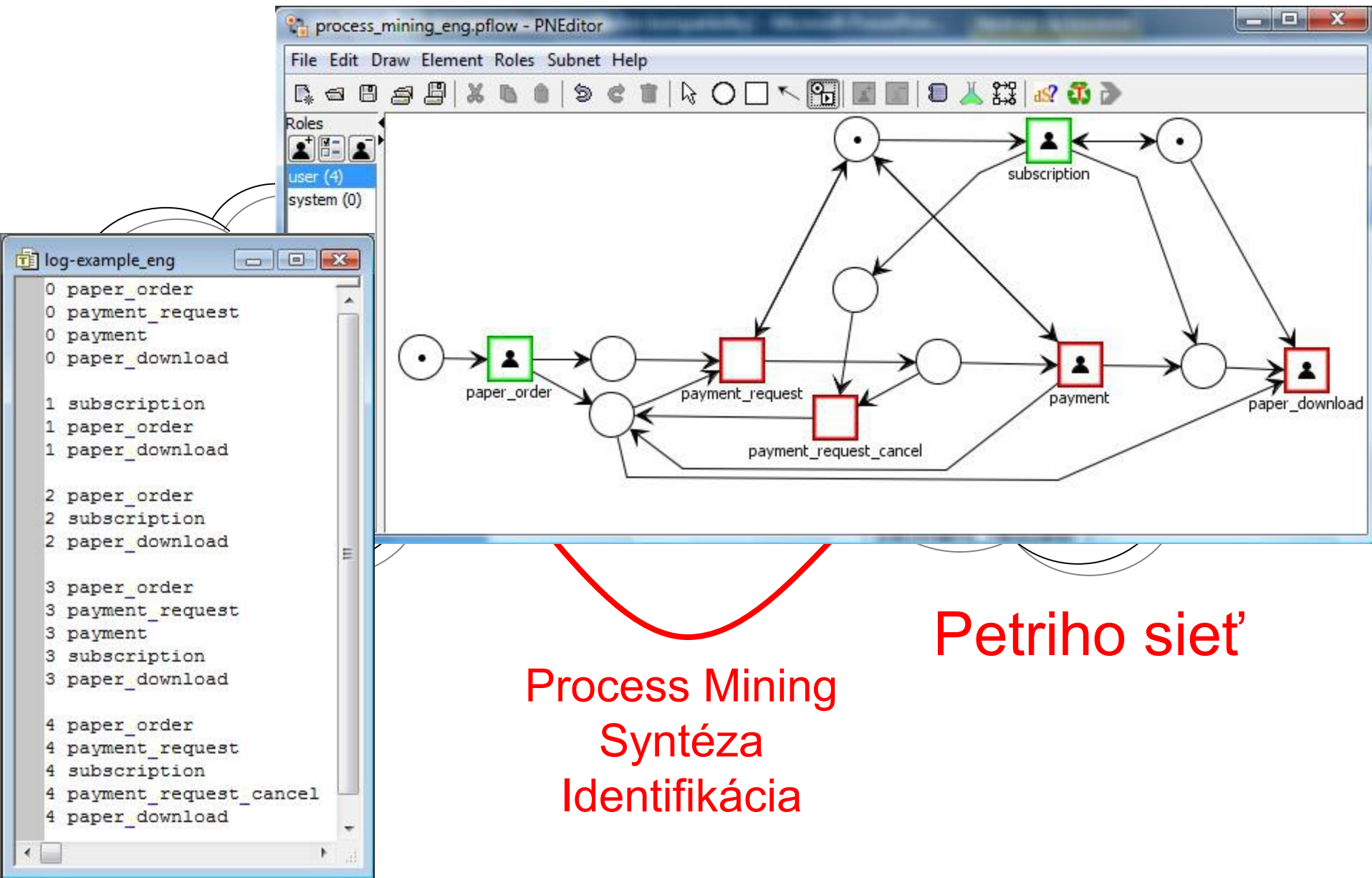
# Process Mining – Ako získať Process z Event Logov



# Process Mining – Ako získať Process z Event Logov

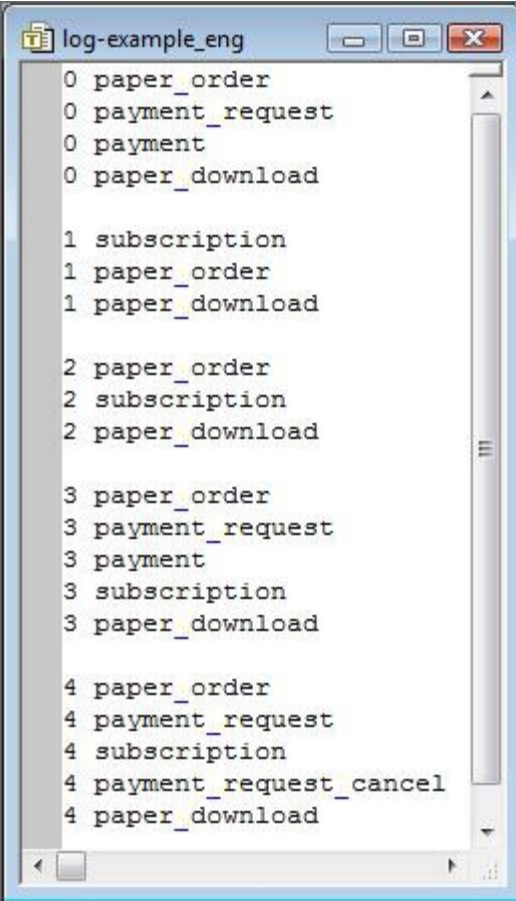


# Process Mining – Ako získať Process z Event Logov

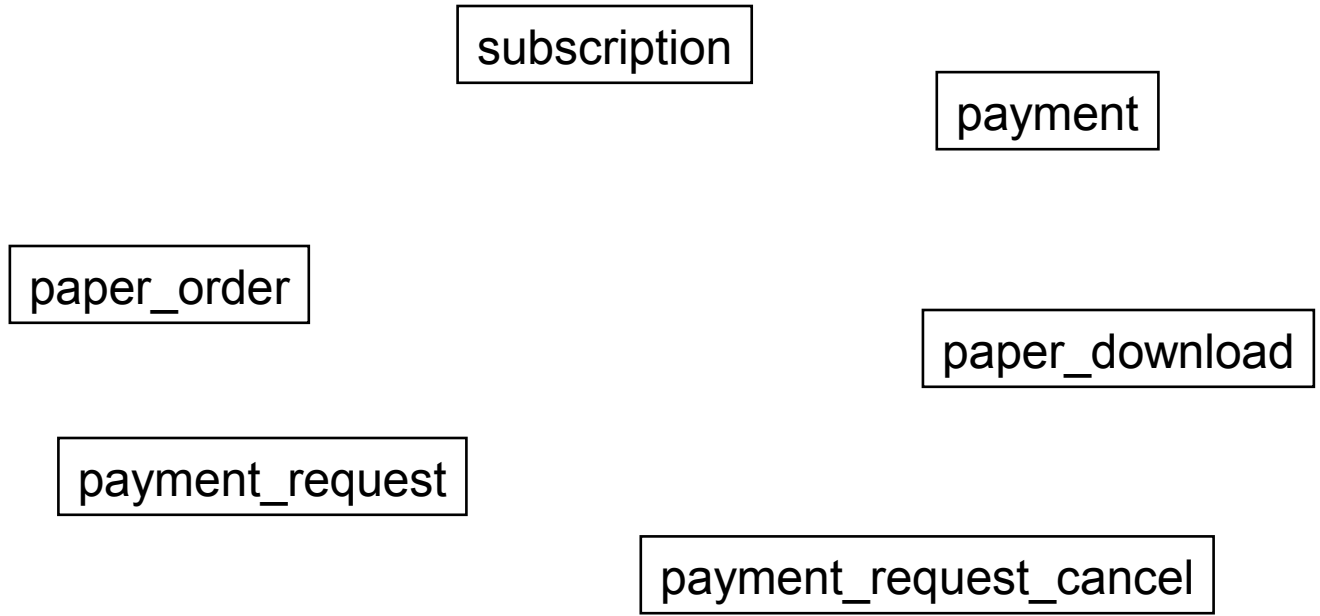


# Process Mining – Ako získať Process z Event Logov

Začni s aktivitami ako prechodmi



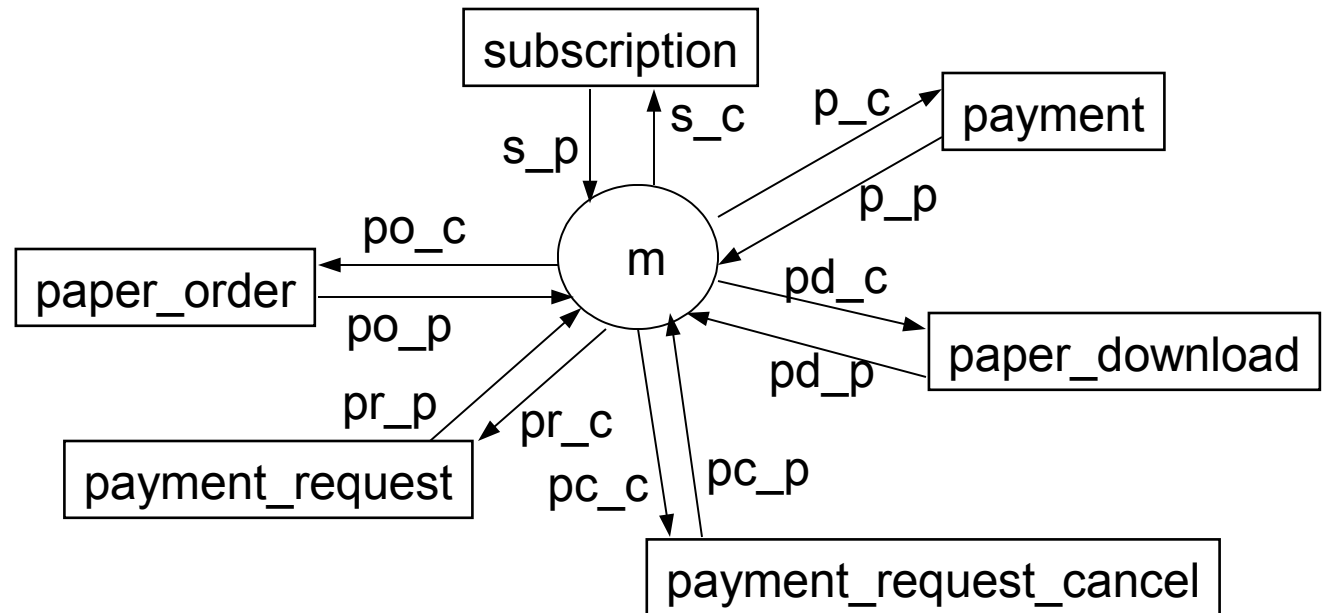
```
log-example_eng
0 paper_order
0 payment_request
0 payment
0 paper_download
1 subscription
1 paper_order
1 paper_download
2 paper_order
2 subscription
2 paper_download
3 paper_order
3 payment_request
3 payment
3 subscription
3 paper_download
4 paper_order
4 payment_request
4 subscription
4 payment_request_cancel
4 paper_download
```



# Process Mining – Ako získať Process z Event Logov

Nájdí miesta (dané množinou neznámych popisujúcich počítačové značkovania a násobnosť hrán)

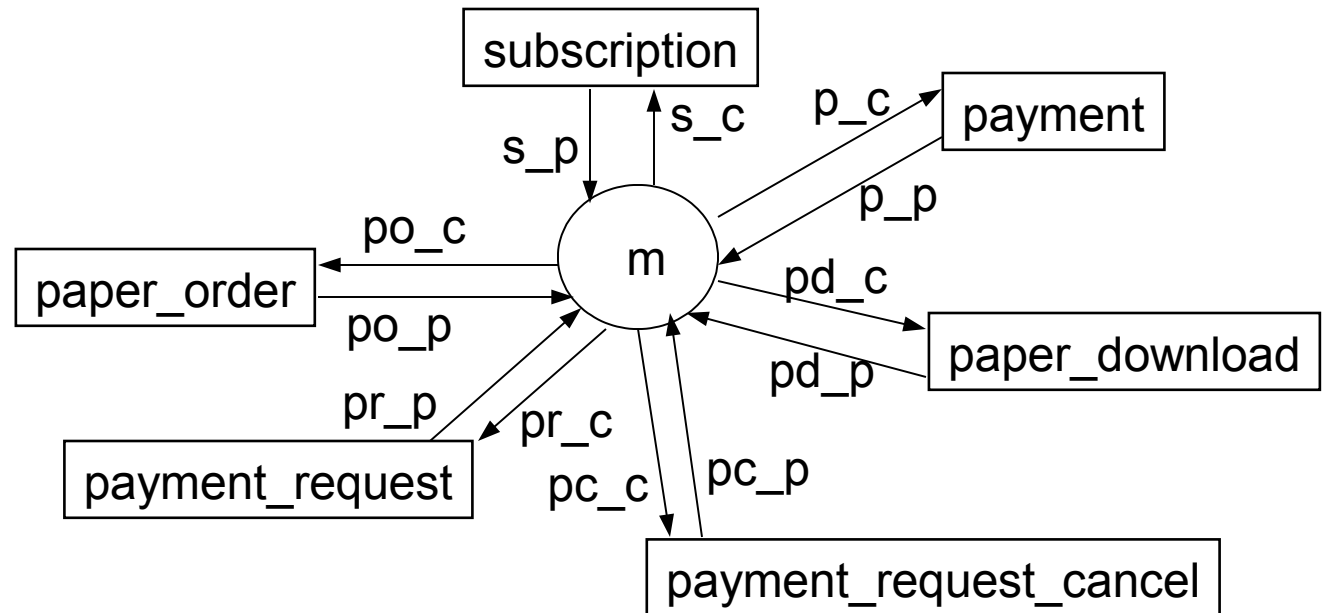
```
log-example_eng
0 paper_order
0 payment_request
0 payment
0 paper_download
1 subscription
1 paper_order
1 paper_download
2 paper_order
2 subscription
2 paper_download
3 paper_order
3 payment_request
3 payment
3 subscription
3 paper_download
4 paper_order
4 payment_request
4 subscription
4 payment_request_cancel
4 paper_download
```



# Process Mining – Ako získať Process z Event Logov

Nájdí miesta (dané množinou neznámych popisujúcich počítačové značkovania a násobnosť hrán)

```
log-example_eng
0 paper_order
0 payment_request
0 payment
0 paper_download
1 subscription
1 paper_order
1 paper_download
2 paper_order
2 subscription
2 paper_download
3 paper_order
3 payment_request
3 payment
3 subscription
3 paper_download
4 paper_order
4 payment_request
4 subscription
4 payment_request_cancel
4 paper_download
```

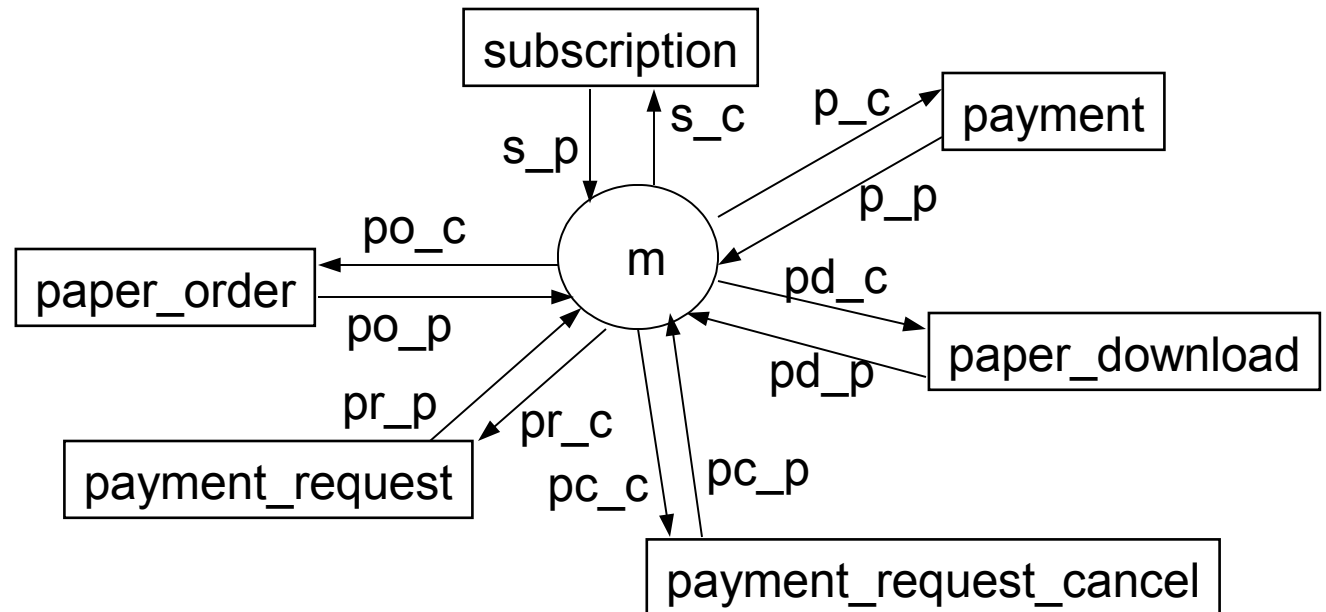




# Process Mining – Ako získať Process z Event Logov

Nájdi miesta (dané množinou neznámych popisujúcich počítačové značkovania a násobnosť hrán)

```
log-example_eng
0 paper_order
0 payment_request
0 payment
0 paper_download
1 subscription
1 paper_order
1 paper_download
2 paper_order
2 subscription
2 paper_download
3 paper_order
3 payment_request
3 payment
3 subscription
3 paper_download
4 paper_order
4 payment_request
4 subscription
4 payment_request_cancel
4 paper_download
```

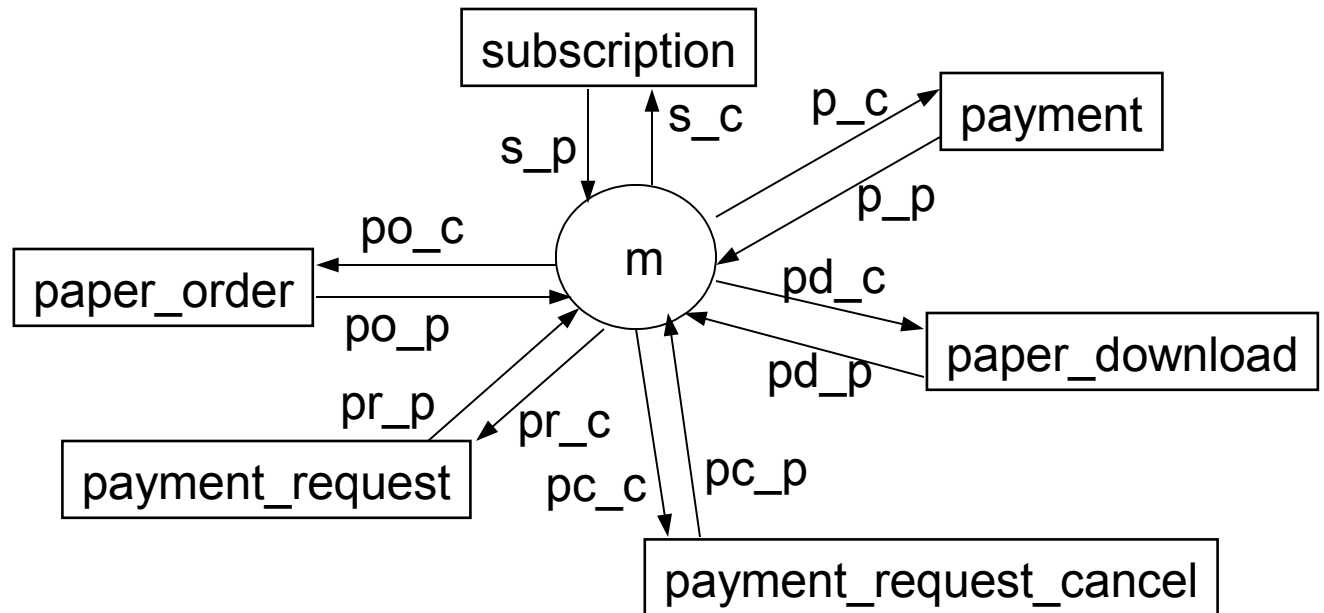


$$m \geq po_c$$

# Process Mining – Ako získať Process z Event Logov

Nájdi miesta (dané množinou neznámych popisujúcich počítačové značkovania a násobnosť hrán)

```
log-example_eng
0 paper_order
0 payment_request
0 payment
0 paper_download
1 subscription
1 paper_order
1 paper_download
2 paper_order
2 subscription
2 paper_download
3 paper_order
3 payment_request
3 payment
3 subscription
3 paper_download
4 paper_order
4 payment_request
4 subscription
4 payment_request_cancel
4 paper_download
```



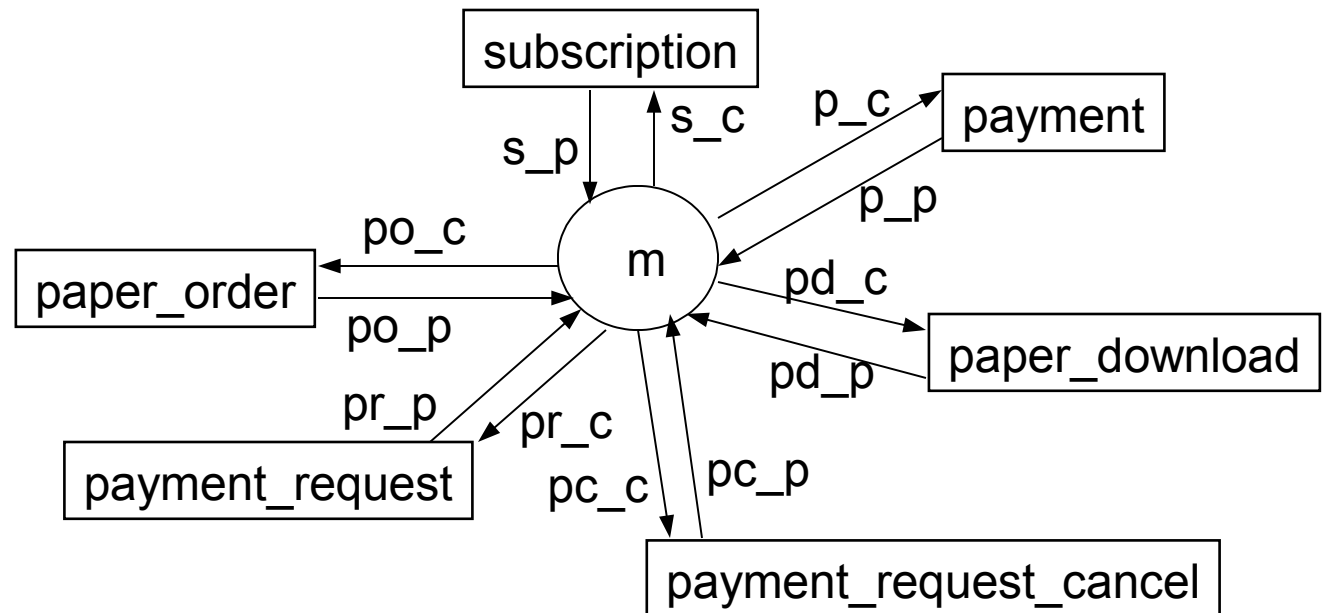
$$m \geq po\_c$$

$$m - po\_c + po\_p \geq pr\_c$$

# Process Mining – Ako získať Process z Event Logov

Nájdi miesta (dané množinou neznámych popisujúcich počítačové značkovania a násobnosť hrán)

```
log-example_eng
0 paper_order
0 payment_request
0 payment
0 paper_download
1 subscription
1 paper_order
1 paper_download
2 paper_order
2 subscription
2 paper_download
3 paper_order
3 payment_request
3 payment
3 subscription
3 paper_download
4 paper_order
4 payment_request
4 subscription
4 payment_request_cancel
4 paper_download
```



$$m \geq po\_c$$

$$m - po\_c + po\_p \geq pr\_c$$

$$m - po\_c + po\_p - pr\_c + pr\_p \geq p\_c$$

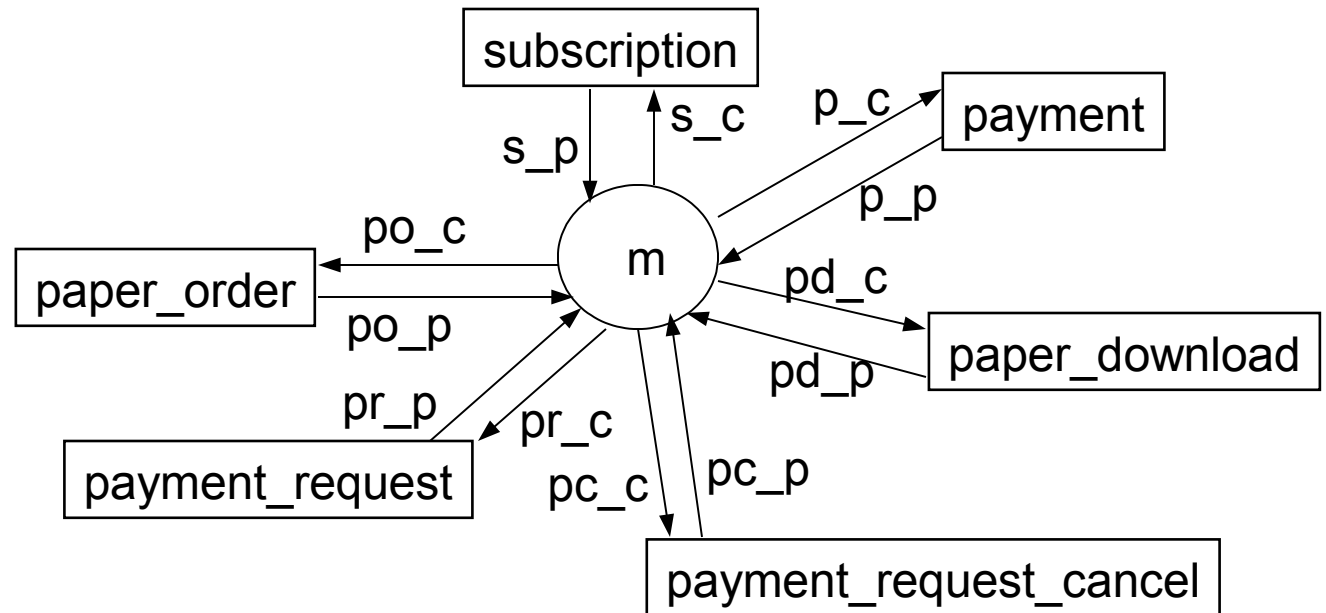
$$m - po\_c + po\_p - pr\_c + pr\_p - p\_c + p\_p \geq pd\_c$$

$$m \geq s\_c$$

# Process Mining – Ako získať Process z Event Logov

Nájdí miesta, ktoré umožňujú spustiť každú spustiteľnú postupnosť prechodov a **zabránia spusteniu nepozorovaného prechodu po spustení spustiteľnej sekvencie**

```
log-example_eng
0 paper_order
0 payment_request
0 payment
0 paper_download
1 subscription
1 paper_order
1 paper_download
2 paper_order
2 subscription
2 paper_download
3 paper_order
3 payment_request
3 payment
3 subscription
3 paper_download
4 paper_order
4 payment_request
4 subscription
4 payment_request_cancel
4 paper_download
```



$$m \geq po\_c$$

$$m - po\_c + po\_p \geq pr\_c$$

$$m - po\_c + po\_p - pr\_c + pr\_p \geq p\_c$$

$$m - po\_c + po\_p - pr\_c + pr\_p - p\_c + p\_p \geq pd\_c$$

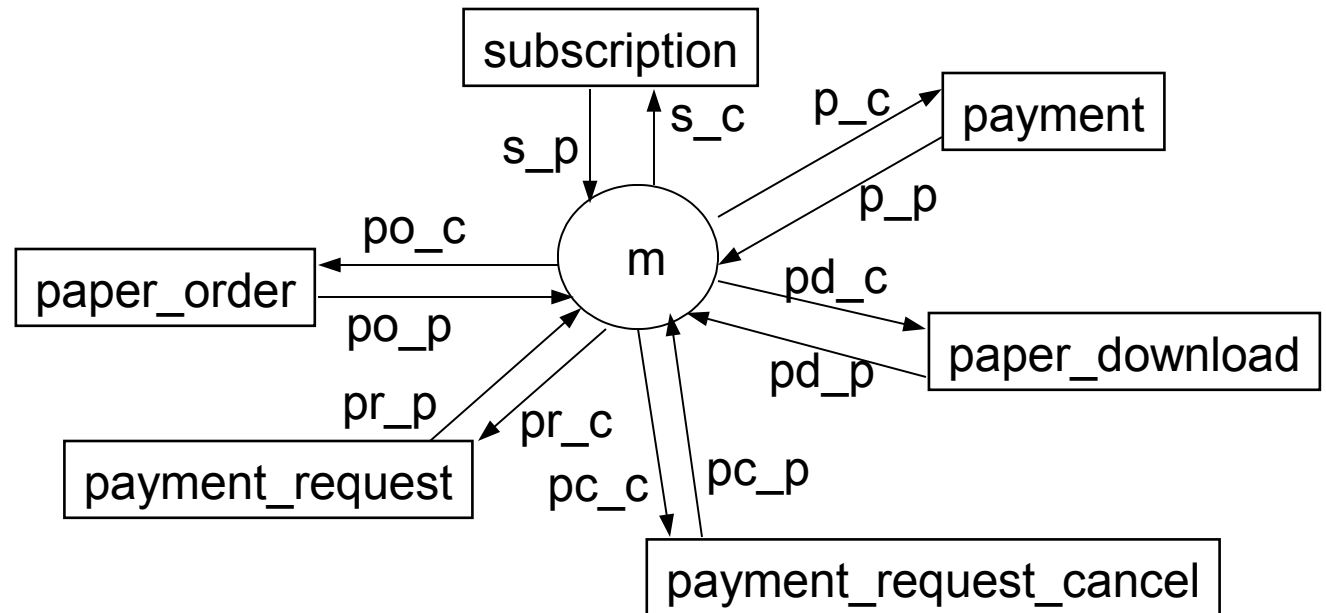
$$m \geq s\_c$$

**Žiadna akcia payment\_request v počiatocnom značkovani:  $pr\_c > m$**

# Process Mining – Ako získať Process z Event Logov

Nájdí miesta, ktoré umožňujú spustiť každú spustiteľnú postupnosť prechodov a **zabránia spusteniu nepozorovaného prechodu po spustení inej spustiteľnej sekvencie**

```
log-example_eng
0 paper_order
0 payment_request
0 payment
0 paper_download
1 subscription
1 paper_order
1 paper_download
2 paper_order
2 subscription
2 paper_download
3 paper_order
3 payment_request
3 payment
3 subscription
3 paper_download
4 paper_order
4 payment_request
4 subscription
4 payment_request_cancel
4 paper_download
```



$$m \geq po\_c$$

$$m - po\_c + po\_p \geq pr\_c$$

$$m - po\_c + po\_p - pr\_c + pr\_p \geq p\_c$$

$$m - po\_c + po\_p - pr\_c + pr\_p - p\_c + p\_p \geq pd\_c$$

$$m \geq s\_c$$

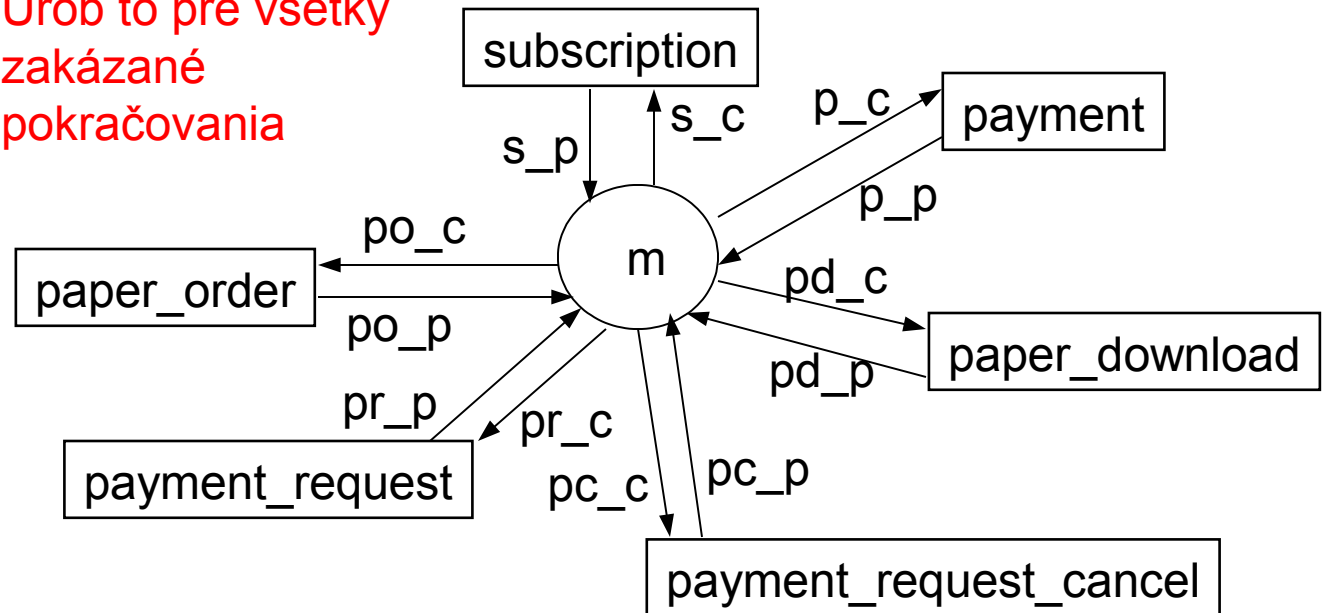
**Žiadna akcia payment po spustení paper\_order**  
 $p\_c > m - po\_c + po\_p$

# Process Mining – Ako získať Process z Event Logov

Nájdí miesta, ktoré umožňujú spustiť každú spustiteľnú postupnosť prechodov a **zabránia spusteniu nepozorovaného prechodu po spustení spustiteľnej sekvencie**  
**Urob to pre všetky zakázané pokračovania**

```

log-example_eng
0 paper_order
0 payment_request
0 payment
0 paper_download
1 subscription
1 paper_order
1 paper_download
2 paper_order
2 subscription
2 paper_download
3 paper_order
3 payment_request
3 payment
3 subscription
3 paper_download
4 paper_order
4 payment_request
4 subscription
4 payment_request_cancel
4 paper_download
    
```



$$m \geq po\_c$$

$$m - po\_c + po\_p \geq pr\_c$$

$$m - po\_c + po\_p - pr\_c + pr\_p \geq p\_c$$

$$m - po\_c + po\_p - pr\_c + pr\_p - p\_c + p\_p \geq pd\_c$$

$$m \geq s\_c$$

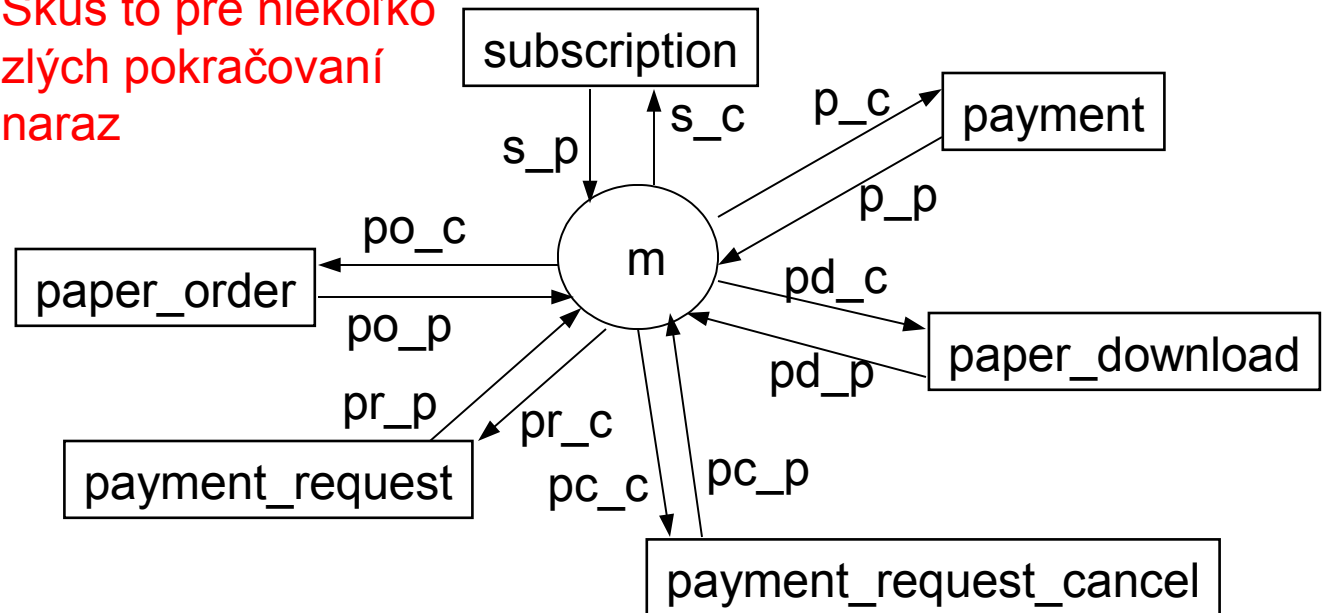
**Žiadna akcia payment po spustení paper\_order**  
 $p\_c > m - po\_c + po\_p$

# Process Mining – Ako získať Process z Event Logov

Nájdí miesta, ktoré umožňujú spustiť každú spustiteľnú postupnosť prechodov a **zabránia spusteniu nepozorovaného prechodu po spustení spustiteľnej sekvencie**  
**Skús to pre niekoľko zlých pokračovaní naraz**

```

log-example_eng
0 paper_order
0 payment_request
0 payment
0 paper_download
1 subscription
1 paper_order
1 paper_download
2 paper_order
2 subscription
2 paper_download
3 paper_order
3 payment_request
3 payment
3 subscription
3 paper_download
4 paper_order
4 payment_request
4 subscription
4 payment_request_cancel
4 paper_download
    
```



$$m \geq po\_c$$

$$m - po\_c + po\_p \geq pr\_c$$

$$m - po\_c + po\_p - pr\_c + pr\_p \geq p\_c$$

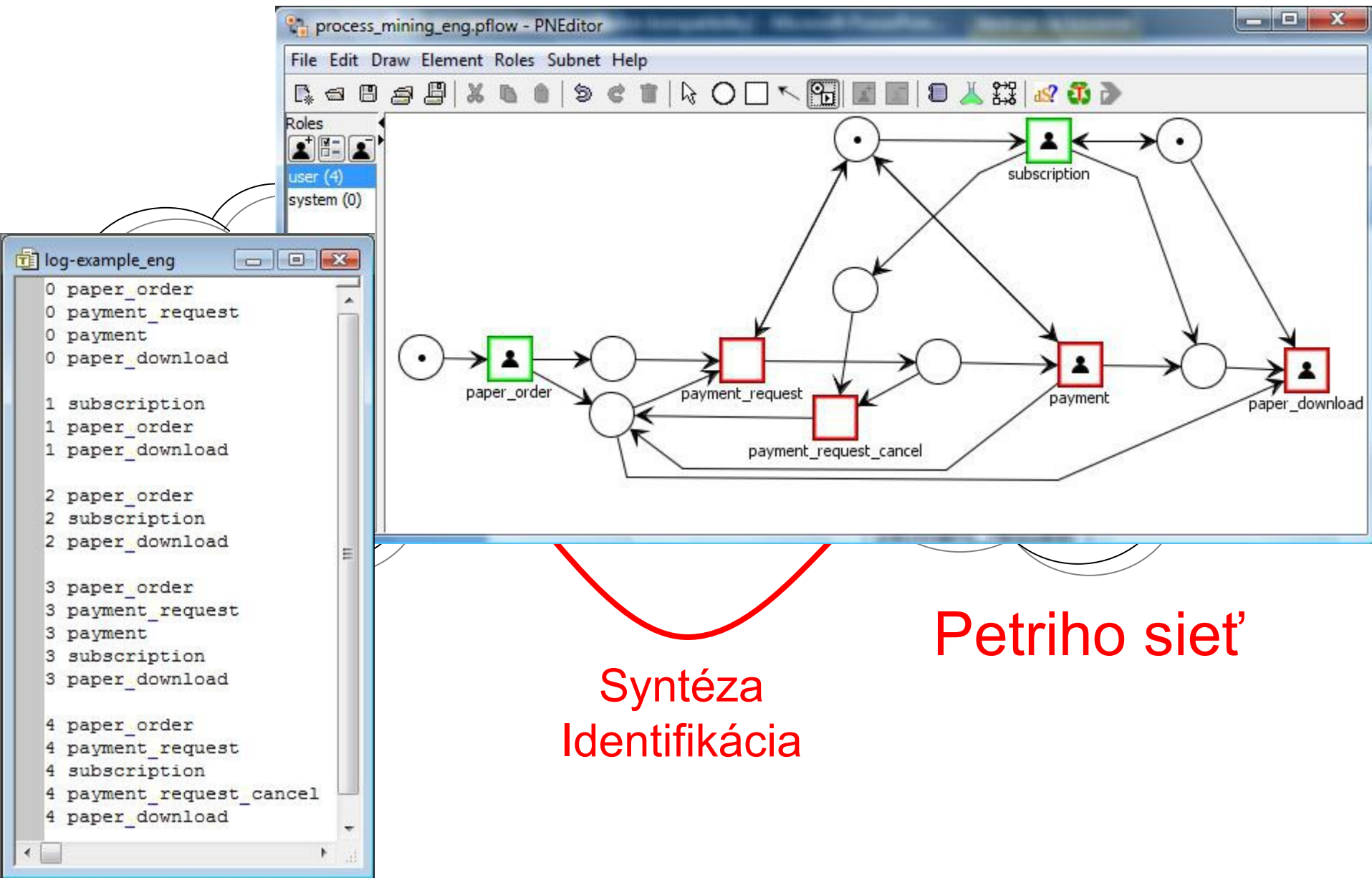
$$m - po\_c + po\_p - pr\_c + pr\_p - p\_c + p\_p \geq pd\_c$$

$$m \geq s\_c$$

$$pr\_c > m$$

$$p\_c > m - po\_c + po\_p$$

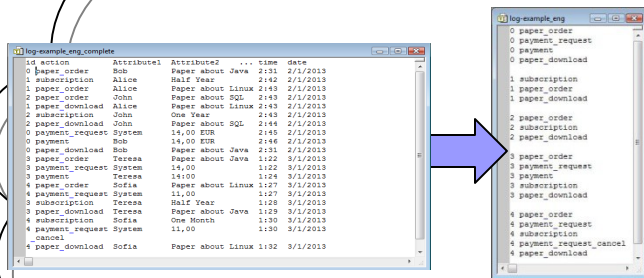
# Process Mining – Ako získať Process z Event Logov





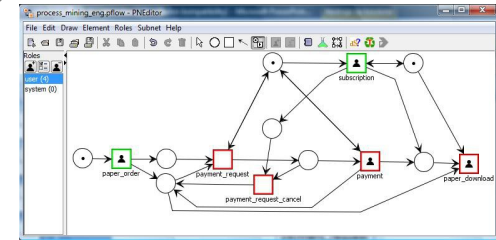
# Process Mining – Ako získať Process z Event Logov

generate



Event logs

Behaviour description  
Sequences of actions  
Cases/Instances  
Identification



Process Model  
(Petriho siet')  
Generovanie kódu  
Executable Process Engine

Process Mining  
Synthesis  
Identification