main

August 27, 2023

0.1 Import event log

[108]:

```
import pm4py
import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns
import warnings
%matplotlib inline
warnings.filterwarnings('ignore')
```

[109]:

```
domestic_path = 'data/DomesticDeclarations.xes'
international_path = 'data/InternationalDeclarations.xes'

log= pm4py.read_xes(domestic_path);
```

```
parsing log, completed traces ::   0%|          | 0/10500 [00:00<?, ?it/s]
```

0.2 Statistical Analysis of Event Data

[124]:

```
log.head(10)
```

[124]:

```
                        id  org:resource                  concept:name  \
0          st_step 86794_0  STAFF MEMBER         SUBMITTED by EMPLOYEE
1          st_step 86793_0  STAFF MEMBER  FINAL_APPROVED by SUPERVISOR
2  dd_declaration 86791_19        SYSTEM               Request Payment
3  dd_declaration 86791_20        SYSTEM               Payment Handled
4          st_step 86798_0  STAFF MEMBER         SUBMITTED by EMPLOYEE
5          st_step 86799_0  STAFF MEMBER      APPROVED by PRE_APPROVER
6          st_step 86797_0  STAFF MEMBER  FINAL_APPROVED by SUPERVISOR
7  dd_declaration 86795_19        SYSTEM               Request Payment
8  dd_declaration 86795_20        SYSTEM               Payment Handled
9          st_step 86804_0  STAFF MEMBER         SUBMITTED by EMPLOYEE

             time:timestamp      org:role            case:id  \
0 2017-01-09 08:49:50+00:00      EMPLOYEE  declaration 86791
1 2017-01-09 10:27:48+00:00    SUPERVISOR  declaration 86791
2 2017-01-10 08:34:44+00:00     UNDEFINED  declaration 86791
3 2017-01-12 16:31:22+00:00     UNDEFINED  declaration 86791
```

```
4 2017-01-09 09:26:14+00:00      EMPLOYEE  declaration 86795
5 2017-02-22 09:29:21+00:00  PRE_APPROVER  declaration 86795
6 2017-02-23 07:14:45+00:00    SUPERVISOR  declaration 86795
7 2017-03-06 13:07:25+00:00     UNDEFINED  declaration 86795
8 2017-03-13 16:30:59+00:00     UNDEFINED  declaration 86795
9 2017-01-09 10:13:33+00:00      EMPLOYEE  declaration 86800

  case:concept:name case:BudgetNumber    case:DeclarationNumber  case:Amount
0 declaration 86791      budget 86566  declaration number 86792    26.851205
1 declaration 86791      budget 86566  declaration number 86792    26.851205
2 declaration 86791      budget 86566  declaration number 86792    26.851205
3 declaration 86791      budget 86566  declaration number 86792    26.851205
4 declaration 86795      budget 86566  declaration number 86796   182.464172
5 declaration 86795      budget 86566  declaration number 86796   182.464172
6 declaration 86795      budget 86566  declaration number 86796   182.464172
7 declaration 86795      budget 86566  declaration number 86796   182.464172
8 declaration 86795      budget 86566  declaration number 86796   182.464172
9 declaration 86800      budget 86566  declaration number 86801   320.646137
```

[111]:

```
# to improve readability we trim the word 'Declaration' out of concept:name␣
 ↪column, if it exists
log['concept:name'] = log['concept:name'].str.replace('Declaration ', '')
```

[112]:

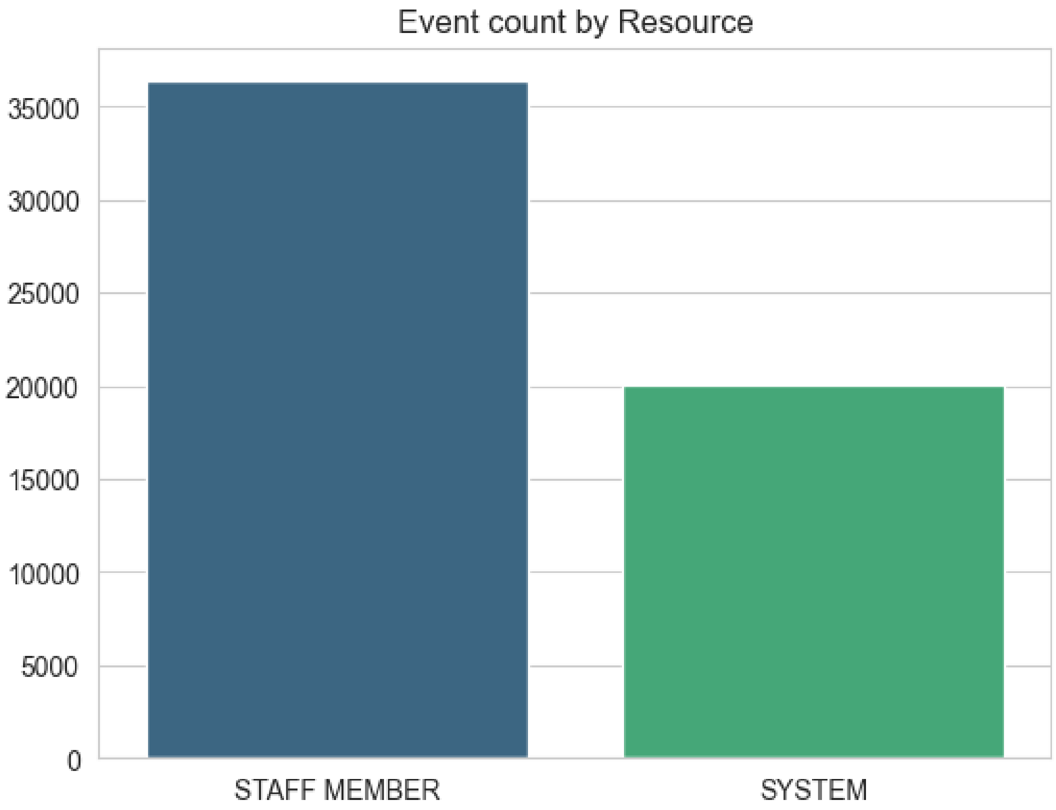
```
cases = log['case:id'].unique()
len(cases)
```

[112]:

```
10500
```

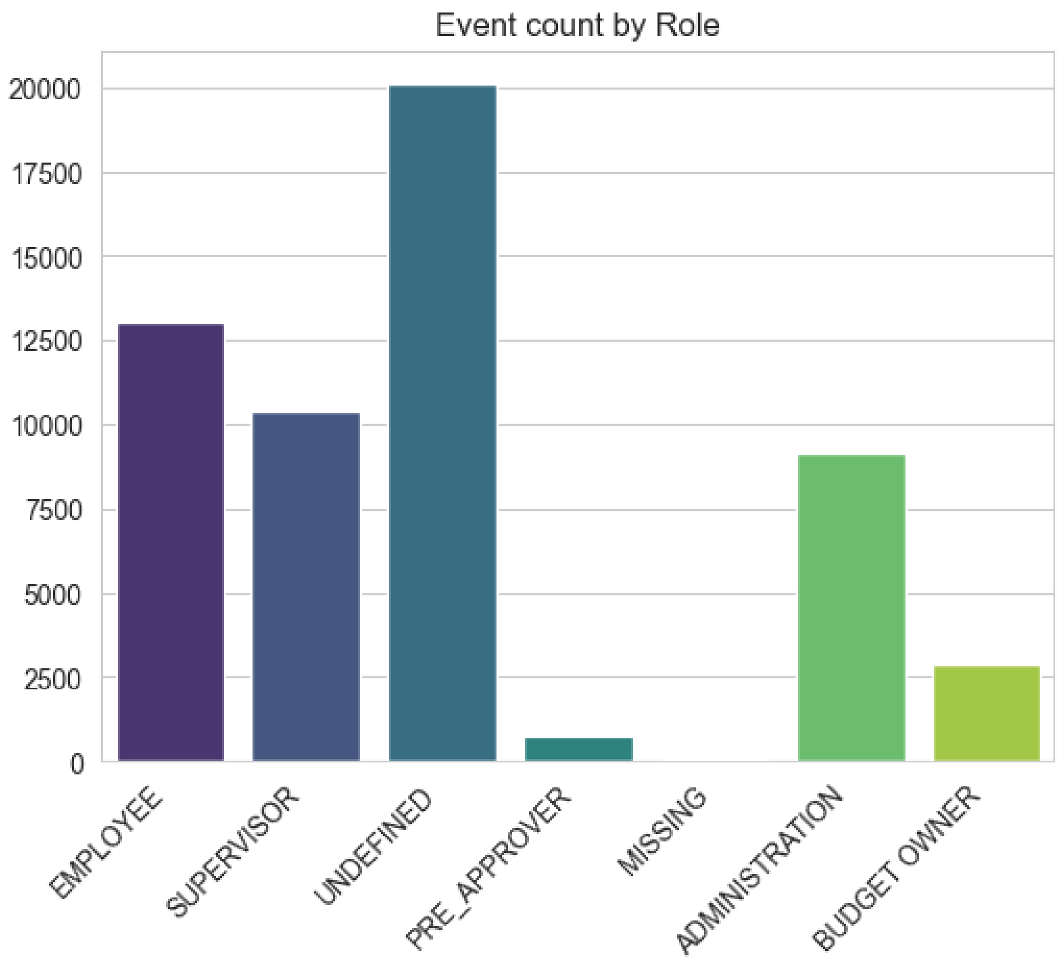
[113]:

```
resources = log['org:resource'].unique()
sns.countplot(x='org:resource', data=log, palette='viridis').set(title='Event␣
 ↪count by Resource', xlabel='', ylabel='');
```

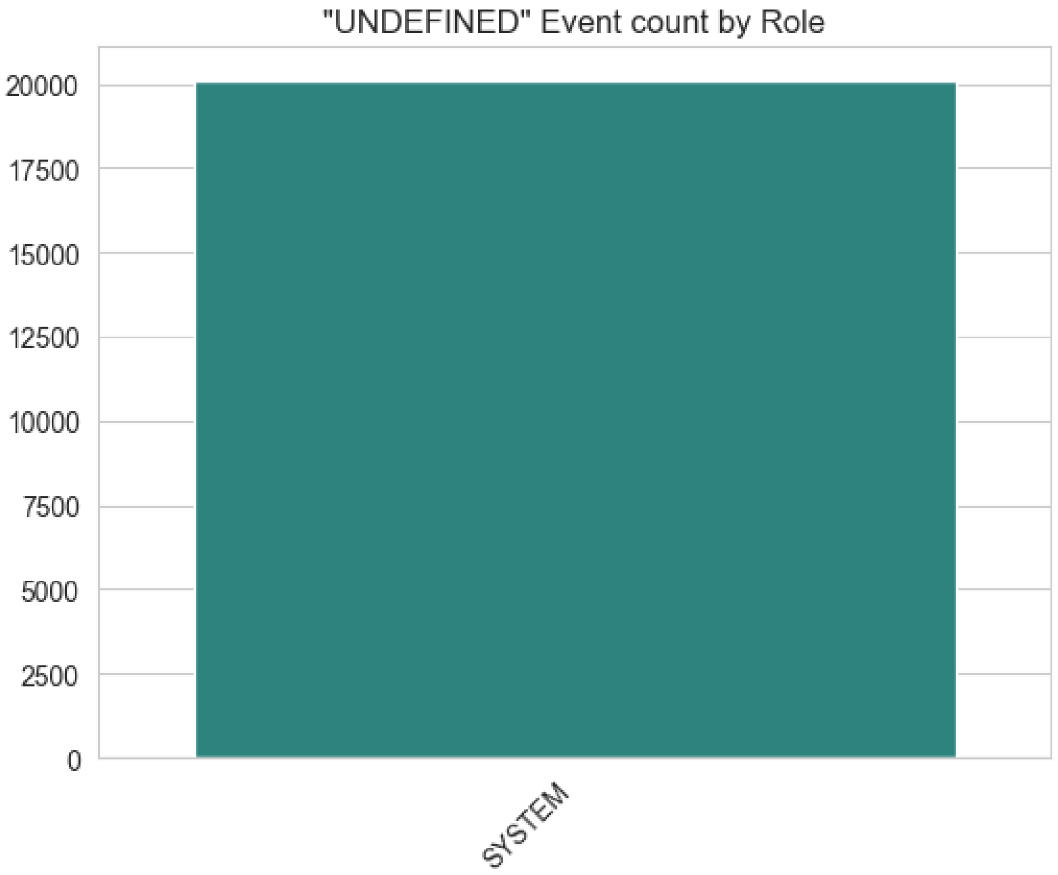


[114]:

```
roles = log['org:role'].unique()
sns.countplot(x='org:role', data=log, palette='viridis').set(title='Event count␣
  ↪by Role', xlabel='', ylabel='')
plt.xticks(rotation=45, ha='right');
```

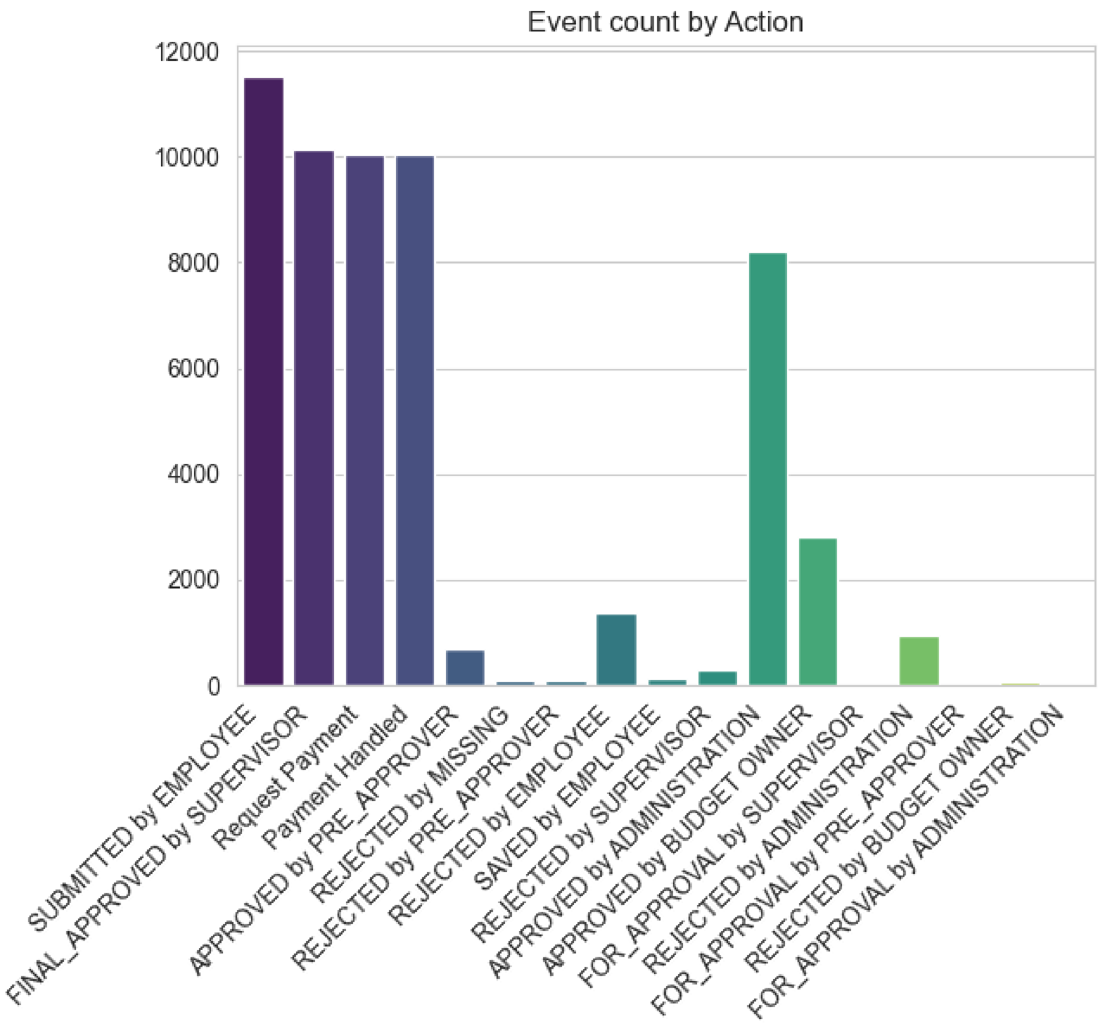


[115]:
```
log_i = log[log['org:role'] == 'UNDEFINED']
sns.countplot(x='org:resource', data=log_i, palette='viridis').
 ↪set(title='"UNDEFINED" Event count by Role', xlabel='', ylabel='')
plt.xticks(rotation=45, ha='right');
```



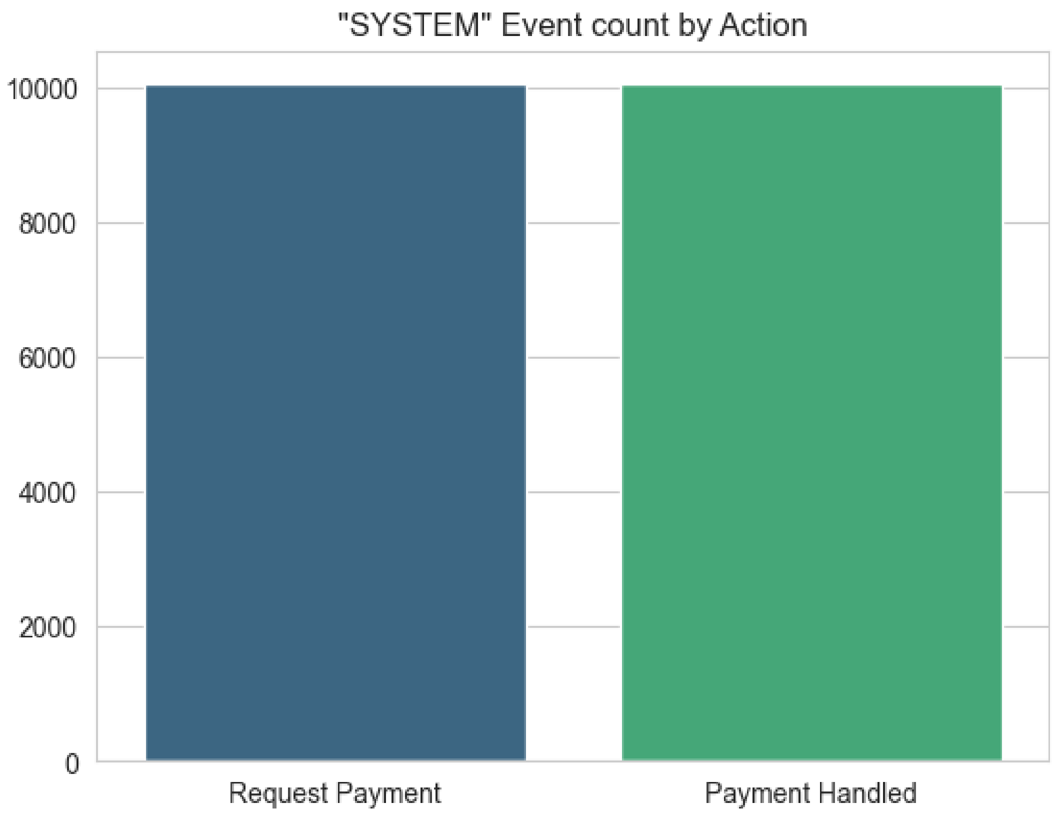
[116]:

```
actions = log['concept:name'].unique()
sns.countplot(x='concept:name', data=log, palette='viridis').set(title='Event␣
  ↪count by Action', xlabel='', ylabel='')
plt.xticks(rotation=45, ha='right');
```

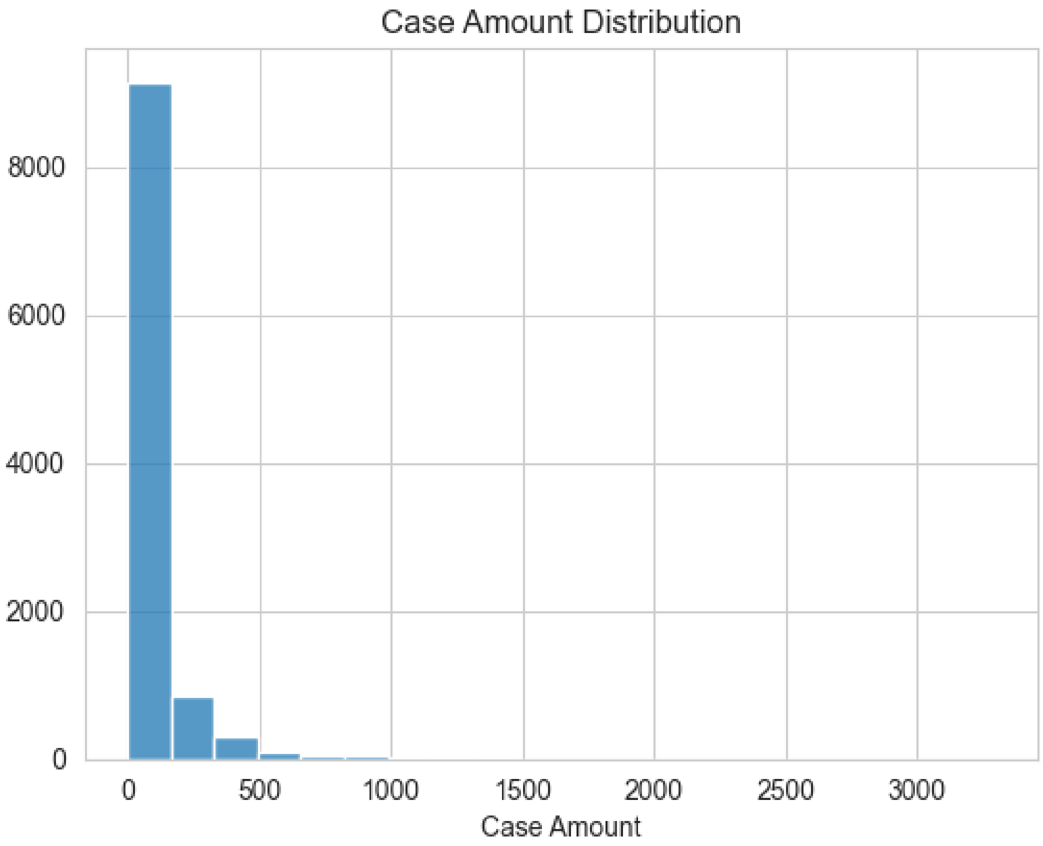


[117]:

```
# System Events
log_s = log[log['org:resource'] == 'SYSTEM']
sns.countplot(x='concept:name', data=log_s, palette='viridis').
 ↪set(title='"SYSTEM" Event count by Action', xlabel='', ylabel='');
```



```
[118]: # case amount distribution for distinct case:id
       distinct_case_amounts = log.groupby('case:id')['case:Amount'].max()
       sns.histplot(distinct_case_amounts, kde=False, bins=20).set(title='Case Amount␣
        ↪Distribution', xlabel='Case Amount', ylabel='');
```



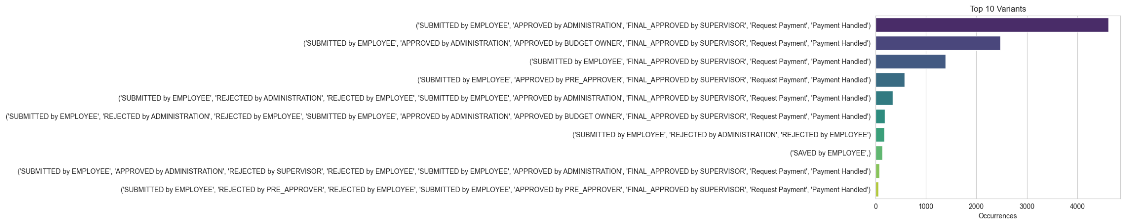
0.3 Process Discovery

Having mined the model we may vizualize it as a Process Tree or Petri Net.

[119]:

```
variants_dict = pm4py.get_variants(log)

variants_arr = []
idx = 1
for variant, n in variants_dict.items():
    variant_in_dict = {}
    variant_in_dict['variant_number'] = idx
    variant_in_dict['variant_count'] = n
    variant_in_dict['variant_trace'] = variant

    variants_arr.append(variant_in_dict)

    idx += 1


variants_df = pd.DataFrame(variants_arr)
```

```python
variants_df = variants_df.sort_values(by='variant_count', ascending=False)

sns.barplot(x='variant_count', y='variant_trace', data=variants_df[:10], palette='viridis').set(title='Top 10 Variants', xlabel='Occurrences', ylabel='');
```



[120]:
```python
count_cases_top_10 = variants_df[:10]['variant_count'].sum()
print(f'Top 10 variants account for {count_cases_top_10:,} cases out of {len(cases):,}.')
```

```
Top 10 variants account for 10,033 cases out of 10,500.
```

[121]:
```python
from pm4py.algo.discovery.inductive import algorithm as inductive_miner

process_tree = inductive_miner.apply(log)
process_tree
```

[121]:
```
->( X( tau, 'SAVED by EMPLOYEE' ), X( tau, +( X( tau, *( 'REJECTED by EMPLOYEE',
tau ) ), ->( +( X( tau, *( 'REJECTED by MISSING', tau ) ), ->( X( tau, *( ->( *(
'SUBMITTED by EMPLOYEE', 'FOR_APPROVAL by ADMINISTRATION' ), X( tau, X(
'REJECTED by ADMINISTRATION', +( X( tau, 'REJECTED by BUDGET OWNER' ), ->( X(
tau, X( ->( 'APPROVED by ADMINISTRATION', X( tau, 'APPROVED by BUDGET OWNER' )
), 'APPROVED by PRE_APPROVER' ) ), X( tau, X( 'FINAL_APPROVED by SUPERVISOR',
'REJECTED by SUPERVISOR' ) ) ) ) ), 'REJECTED by PRE_APPROVER' ) ) ), tau ) ), X(
tau, X( 'FOR_APPROVAL by PRE_APPROVER', 'FOR_APPROVAL by SUPERVISOR', 'Request
Payment' ) ) ) ), X( tau, 'Payment Handled' ) ) ) ) )
```