SAP data analytics master class
Regex and Sklearn for unexpected travel and expense

25th March 2026 – 9AM EST

Regex and Sklearn matching – case study: Unusual travel and expense

WHAT WILL WE COVER TODAY?

01

Obtain list of invoices and purchases – recap
Import
Concatenate
Join
Create fields
Group by - .agg – make a list
Filter
List from a file

02

HR03_12: Expenses entered as purchases
Using regex

03

HR03_13: Misclassified expenses
Using Cosine

01

Obtain a list of invoices - recap

Obtain a list of invoices - recap

Import the functions that we put in Z_SHARED_FUNCTIONS:

```
# Create the venv: python -m venv venv  ... (Yes)
# Activate the venv: .\venv\Scripts\activate
# Run the requirements: pip install -r requirements.txt
# Set the variables (remember…C:\... Becomes …C:/ …  or use r'C:\.
# Run the program
# Check the output

# 1/ Import python libraries
import polars as PI_POLARS
import regex as PI_RE
import numpy as PI_NUMPY

# 2/ Import shared programs
from Z_SHARED_FUNCTIONS.FC_IMPORT import FC_IMPORT_TEXT
from Z_SHARED_FUNCTIONS.FC_EXPORT import FC_EXPORT_EXCEL
from Z_SHARED_FUNCTIONS.FC_BUILD_TFIDF_AND_COSINE_BEST_MATCH impor
from Z_SHARED_FUNCTIONS.FC_PREPROCESS_TEXT import FC_PREPROCESS_TE
```

Obtain a list of invoices - recap

Now we have quite a lot of files!

```
# 3/ Set variables
ZV_ST_SOURCES_FOLDER = r'C:\300FMASTERCLASS\06_PYTHON_MEETING_MC2
ZV_ST_RESULTS_FOLDER = r'C:\300FMASTERCLASS\06_PYTHON_MEETING_MC2
ZV_ST_NAME_BSIK_FILE = '20251110_153943_1_BSIK.csv'
ZV_ST_NAME_BSAK_FILE = '20251110_153943_1_BSAK.csv'
ZV_ST_NAME_T001_FILE = '20251025_170112_1_T001.csv'
ZV_ST_NAME_BKPF_FILE = '20250911_172412_1_BKPF.csv'
ZV_ST_NAME_BSEG_FILE = '20250910_113032_1_BSEG.csv'
ZV_ST_NAME_SKAT_FILE = '20240513_152943_1_SKAT.csv'
ZV_ST_NAME_SKA1_FILE = '20240513_152943_1_SKA1.csv'
ZV_ST_NAME_SKB1_FILE = '20240513_152943_1_SKB1.csv'
ZV_ST_NAME_T003T_FILE = '20240510_152615_1_T003T.csv'
ZV_ST_NAME_KEYWORD_FILE = 'AM_KEY_WORDS.txt'
ZV_ST_NAME_T706B5_FILE = '20260325_103759_1_T706B5.csv'
```

Obtain a list of invoices - recap

We can quickly do the import by calling our function

```
def HR12_MISSCLASSIFIED_EXPENSES():

    # 4/ Import the files
    ZV_LI_NUM_COLS = [
        'BSAIK_DMBTR'
    ]
    ZV_DF_BSIK = FC_IMPORT_TEXT(ZV_ST_NAME_BSIK_FILE, ZV_ST_SOUR

    ZV_LI_NUM_COLS = [
        'BSAIK_DMBTR'
    ]
    ZV_DF_BSAK = FC_IMPORT_TEXT(ZV_ST_NAME_BSAK_FILE, ZV_ST_SOUR

    ZV_LI_NUM_COLS = []
    ZV_DF_T001 = FC_IMPORT_TEXT(ZV_ST_NAME_T001_FILE, ZV_ST_SOUR
```

Obtain a list of invoices - recap

Concatenate BSIK and BSAK into one table

```
ZV_DF_BSAIK = (
    PI_POLARS.concat(
        [
            ZV_DF_BSIK,
            ZV_DF_BSAK
        ]
    )
)
```

Obtain a list of invoices - recap

Join BSEG and BKPF

```
ZV_DF_BSEGBKPF = (
    ZV_DF_BSEG
    .join(
        (
            ZV_DF_BKPF
            .filter(
                PI_POLARS.col('BKPF_BSTAT')==''
            )
        ),
        left_on=[
            'BSEG_BUKRS',
            'BSEG_GJAHR',
            'BSEG_BELNR'
        ],
        right_on = [
            'BKPF_BUKRS',
            'BKPF_GJAHR',
            'BKPF_BELNR'
        ],
        how='inner',
        coalesce=False
    )
)
```

Obtain a list of invoices - recap

Add other information:

```
ZV_DF_BSEGBKPF = (
    ZV_DF_BSEGBKPF
    .join(
        ZV_DF_T001,
        left_on = 'BKPF_BUKRS',
        right_on = 'T001_BUKRS',
        how = 'inner'
    )
    .join(
        (
            ZV_DF_SKAT
            .filter(
                (PI_POLARS.col('SKAT_SPRAS') == 'E') |
                (PI_POLARS.col('SKAT_SPRAS') == 'EN')
            )
        ),
        left_on = [
            'T001_KTOPL',
            'BSEG_HKONT'
        ],
        right_on = [
            'SKAT_KTOPL',
            'SKAT_SAKNR'
        ],
        how = 'inner'
    )
```

Obtain a list of invoices - recap

Concatenate text description fields together:

```
ZV_DF_BSEGBKPF_ACC_SCHEMES = (
    ZV_DF_BSEGBKPF
    .with_columns(
        PI_POLARS.concat_str(
            [
                PI_POLARS.col('BSEG_HKONT')
                .str.strip_chars(),

                PI_POLARS.col('SKAT_TXT20')
                .str.strip_chars()
            ],
            separator='-'
        )
        .alias('ZF_BSEGHKONT_SKATTXT20'),
```

Obtain a list of invoices - recap

Select only certain fields:

```
        .select(
            [
                'BSEG_BUKRS',
                'BSEG_GJAHR',
                'BSEG_BELNR',
                'BSEG_SHKZG',
                'BSEG_DMBTR',
                'ZF_BSEGHKONT_SKATTXT20',
                'ZF_BKPFBLART_T003TLTEXT',
                'SKA1_GVTYP',
                'SKB1_XGKON',
                'SKB1_HBKID',
                'BSEG_KOART',
                'BSEG_KTOSL',
                'BKPF_BKTXT'
            ]
        )
```

Obtain a list of invoices - recap

Add up the value on debit… journal entry amount

```
    .group_by(
        [
            'BSEG_BUKRS',
            'BSEG_GJAHR',
            'BSEG_BELNR',
            'BKPF_BKTXT'
        ]
    )
    .agg(
        [
            PI_POLARS.when(
                PI_POLARS.col('BSEG_SHKZG') == 'S'
            )
            .then(
                PI_POLARS.col('BSEG_DMBTR')
            )
            .otherwise(
                PI_POLARS.lit(0)
            )
            .sum()
            .alias('ZF_BSEG_DMBTR'),
```

Obtain a list of invoices - recap

Create list of accounts and account indicators on debit and credit

```
PI_POLARS.col('ZF_BSEGHKONT_SKATTXT20')
.filter(
    PI_POLARS.col('BSEG_SHKZG') == 'S'
)
.sort_by(
    PI_POLARS.col('BSEG_DMBTR')
    .filter(
        PI_POLARS.col('BSEG_SHKZG') == 'S'
    ),
    descending=True
)
.head(10)
.str.join('_')
.alias('ZF_BSEG_HKONTSKAT_DEBIT'),

PI_POLARS.col('ZF_BSEGHKONT_SKATTXT20')
.filter(
    PI_POLARS.col('BSEG_SHKZG') == 'H'
)
.sort_by(
    PI_POLARS.col('BSEG_DMBTR')
    .filter(
        PI_POLARS.col('BSEG_SHKZG') == 'H'
    ),
    descending=True
)
.head(10)
.str.join('_')
.alias('ZF_BSEG_HKONTSKAT_CREDIT'),
```

Obtain a list of invoices - recap

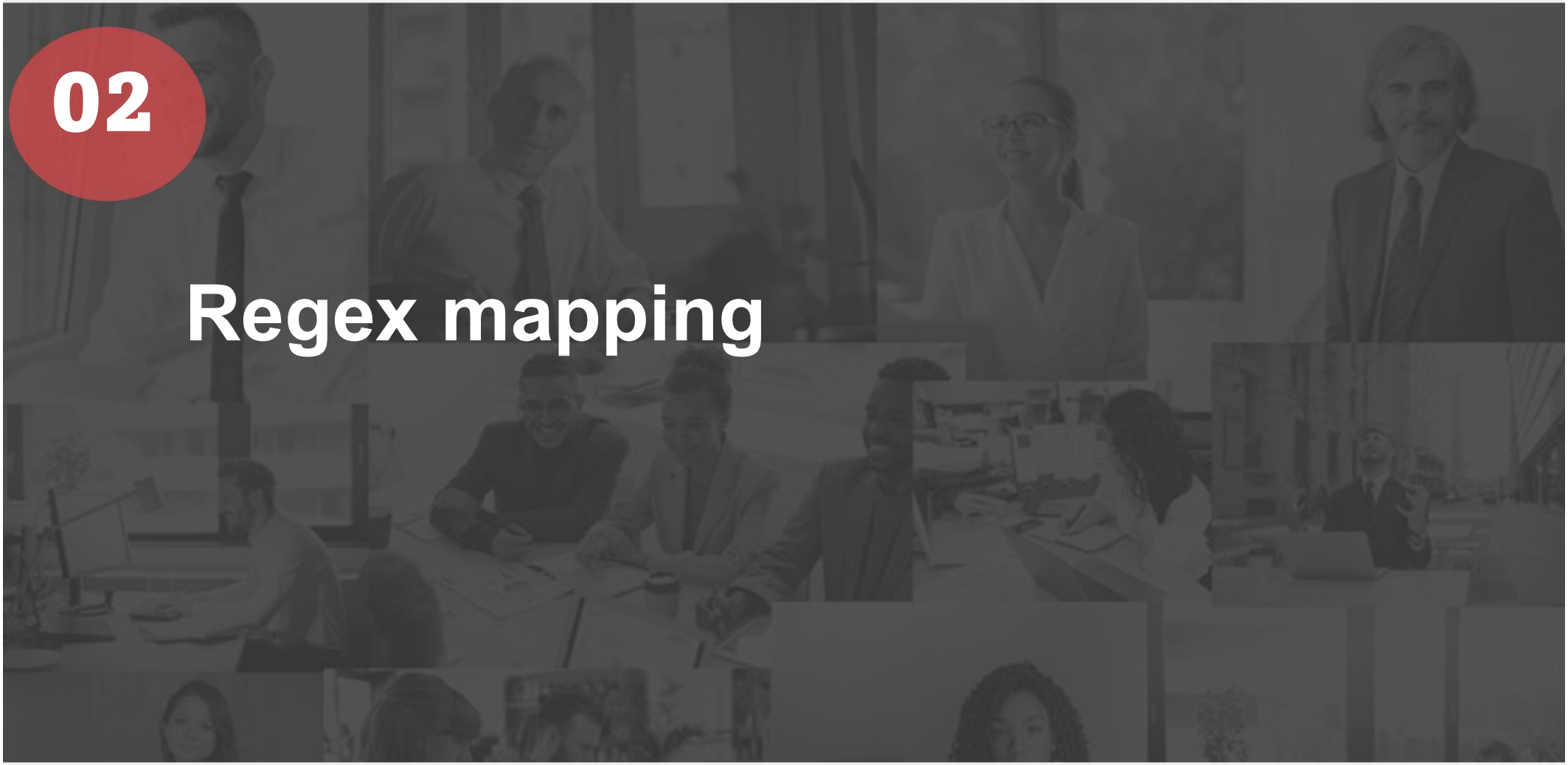
Add the list of accounts back to the general ledger

```
ZV_DF_BSAIK = (
    ZV_DF_BSAIK
    .join(
        ZV_DF_BSEGBKPF_ACC_SCHEMES,
        left_on=[
            'BSAIK_BUKRS',
            'BSAIK_GJAHR',
            'BSAIK_BELNR'
        ],
        right_on=[
            'BSEG_BUKRS',
            'BSEG_GJAHR',
            'BSEG_BELNR'
        ],
        how='inner'
    )
)
```

Obtain a list of invoices - recap

Create buckets – rules for determining which supplier movements relate to supplier invoices and which relate to supplier payments… and other transactions – for example, foreign exchange adjustments

```
ZV_DF_BSAIK = (
    ZV_DF_BSAIK
    .with_columns(
        [
            PI_POLARS.when(
                (
                    (
                        PI_POLARS.col('ZF_BSEG_KOART_DEBIT')
                        .str.split('_')
                        .list.first()
                    ) == 'S'
                ) &
                (
                    (
                        (
                            PI_POLARS.col('ZF_SKA1_GVTYP_DEBIT')
                            .str.split('_')
                            .list.first()
                            .str.strip_chars()
                        ) != ''
                    ) |
                    (
                        (
                            PI_POLARS.col('ZF_BSEG_KTOSL_DEBIT')
                            .str.split('_')
                            .list.first()
                        ) == 'WRX'
                    )
                ) &
```


02
Regex mapping

Import the list of key words

Now we can obtain a list of key words from our manual list of key words

```
ZV_LI_KEY_WORDS = [
    str(k)
    .strip()
    for k in ZV_DF_AM_KEYWORDS['AMKW_KEY_WORD']
    if k is not None and str(k).strip()!=''
]
```

Next we make a Regex pattern match

Make a regex pattern match from the list of key words (HR03_12):

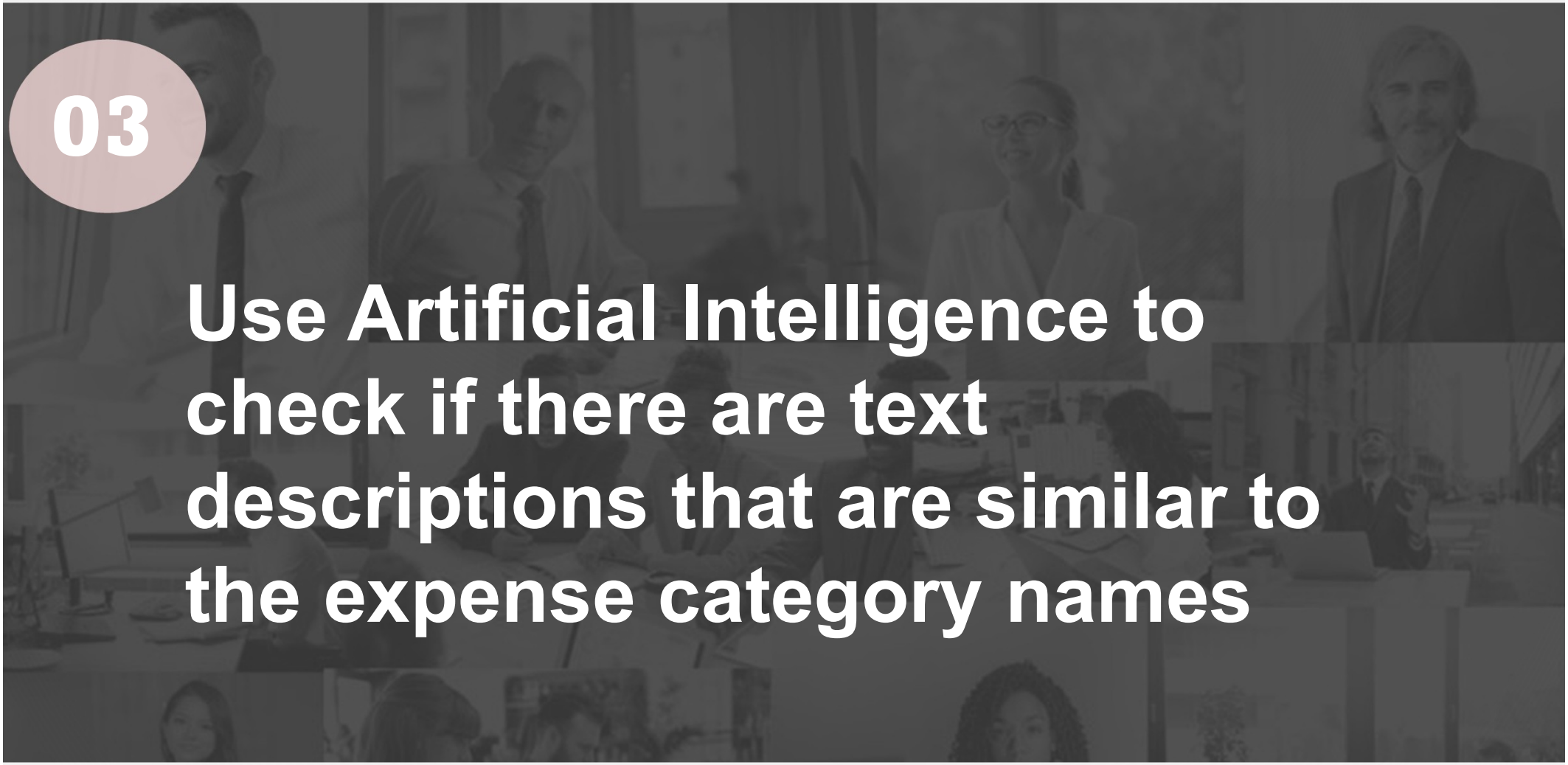
```
if not ZV_LI_KEY_WORDS:
    ZV_RE_FILTER_PATTERN = r'(?!)'
else:
    ZV_RE_KEY_WORDS = '|'.join(PI_RE.escape(k) for k in ZV_LI_KEY_WORDS)
    ZV_RE_FILTER_PATTERN = f'(?i)(?:^|[^A-Za-z0-9_])(?:{ZV_RE_KEY_WORDS})(?:$|[^A-Za
```

- Ignore case (?i)
- If it does not have a word character before it ... ^|[^A-Za-z0-9_] ... and it does not have a word character after it $|[^A-Za-z0-9_]
- .. or in other words, find me all the cases where the word is found and it is not part of another word.
- ... for example, if my word is "tool", find it where you see " tool " but not where you see "machinetool"

Use the regex pattern…

Then we use .str.contains … with literal = False to search for our key words… and filter out supplier invoices that may be travel and expenses

```
ZV_DF_BSAIK_INVOICES_TANDE = (
    ZV_DF_BSAIK_INVOICES
    .filter(
        (
            (
                PI_POLARS.col('BSAIK_SGTXT')
                .str.contains(ZV_RE_FILTER_PATTERN, literal=False)
            )
            (
                PI_POLARS.col('BKPF_BKTXT')
                .str.contains(ZV_RE_FILTER_PATTERN, literal=False)
            )
        )
    )
)
```



03

Use Artificial Intelligence to check if there are text descriptions that are similar to the expense category names

Obtain a list of travel and expense category names SAP

Better than having to invent our manual file!

```
ZV_LI_T706B5_SPTXT = (
    ZV_DF_T706B5
    .filter(
        (PI_POLARS.col('T706B5_SPRAS') == 'E') |
        (PI_POLARS.col('T706B5_SPRAS') == 'EN')
    )
    .unique(subset='T706B5_SPTXT')
    .get_column('T706B5_SPTXT')
    .to_list()
)
```

Obtain a list of travel and expense category names SAP

Obtain a list of words from our text descriptions:

```
ZV_LI_BSAIKSGTXT_BKPFBKTXT = (
    (
        ZV_DF_BSAIK_INVOICES
        .select(
            [
                'ZF_BSAIKSGTXT_BKPFBKTXT'
            ]
        )
        .filter(
            (
                (
                    PI_POLARS.col('ZF_BSAIKSGTXT_BKPFBKTXT')
                    .fill_null('')
                    .str.strip_chars() != ''
                )
            )
        )
        .unique()
        .get_column('ZF_BSAIKSGTXT_BKPFBKTXT')
        .to_list()
    )
)
```

Obtain a list of travel and expense category names SAP

Use a function to clean-up the list of words for both lists:

```
# 14/ Process text to new lists
ZV_LI_T706B5_SPTXT_PREP = []
for ZV_ST_TXT in ZV_LI_T706B5_SPTXT:
    ZV_LI_T706B5_SPTXT_PREP.append(
        FC_PREPROCESS_TEXT(ZV_ST_TXT)
    )

ZV_LI_BSAIKSGTXT_BKPFBKTXT_PREP = []
for ZV_ST_TXT in ZV_LI_BSAIKSGTXT_BKPFBKTXT:
    ZV_LI_BSAIKSGTXT_BKPFBKTXT_PREP.append(
        FC_PREPROCESS_TEXT(ZV_ST_TXT)
    )
```

```
def FC_PREPROCESS_TEXT(ZVFCI_ST_TXT: str) -> str:

    if ZVFCI_ST_TXT is None:
        return ''

    ZV_ST_TXT = str(ZVFCI_ST_TXT).strip().lower()

    ZV_ST_TXT = ZV_ST_TXT.replace('/', ' ').replace('-', ' ').repl

    ZV_ST_TXT = PI_RE.sub(r'[^a-z0-9\s]', ' ', ZV_ST_TXT)

    ZV_ST_TXT = PI_RE.sub(r'\s+', ' ', ZV_ST_TXT).strip()

    return ZV_ST_TXT
```

Obtain a list of travel and expense category names SAP

Use a function to compute the cosine for the word in the expense descriptions that best matches the words in the supplier invoice text descriptions: -- ZV_AR_BEST_IDX puts the index from the list of expense category words that best matched the supplier invoice text.

```
ZV_AR_BEST_COS = PI_NUMPY.array([], dtype=float)
ZV_AR_BEST_IDX = PI_NUMPY.array([], dtype=int)

if (
    len(ZV_LI_T706B5_SPTXT_PREP) > 0 and
    len(ZV_LI_BSAIKSGTXT_BKPFBKTXT_PREP) > 0
):
    ZV_AR_BEST_COS, ZV_AR_BEST_IDX = FC_BUILD_TFIDF_AND_COSINE_BEST_MATCH(
        PI_LI_CATEGORIES=ZV_LI_T706B5_SPTXT_PREP,
        PI_LI_TEXTS=ZV_LI_BSAIKSGTXT_BKPFBKTXT_PREP,
        PI_ST_NGRAM='1,2',
        PI_I_MIN_DF=1
    )
```

Obtain a list of travel and expense category names SAP

Get the list of best matching words – using the array of indexes – look-up the word that matched the best from the list of expense category descriptions

```
ZV_LI_T706B5_SPTXT_BEST_MATCH = []
for ZV_I in range(0, len(ZV_AR_BEST_IDX)):
    ZV_LI_T706B5_SPTXT_BEST_MATCH.append(
        ZV_LI_T706B5_SPTXT[int(ZV_AR_BEST_IDX[ZV_I])]
    )
```

Create a list of scores for each supplier invoice description

Here we put the lists – that are all of the same length – into a dictionary… - which has three nodes …- and then we convert this 2-dimensional dictionary into a table – where the nodes become field names:

```
ZV_DF_BSAIK_TEXTS_MATCH = PI_POLARS.DataFrame(
    {
        'ZF_BSAIKSGTXT_BKPFBKTXT': ZV_LI_BSAIKSGTXT_BKPFBKTXT,
        'ZF_T706B5_SPTXT_BEST_MATCH': ZV_LI_T706B5_SPTXT_BEST_MATCH,
        'ZF_T706B5_BSAIK_COSINE': ZV_AR_BEST_COS.tolist()
    }
).with_columns(
    (
        PI_POLARS.col('ZF_T706B5_BSAIK_COSINE') < 0.35
    )
    .alias('ZF_BO_SGTXTBKTXT_NOTIN_T706B5SPTXT')
)
```

Create a list of scores for each supplier invoice description

And finally, we add the score back to the final table

```
ZV_DF_BSAIK_INVOICES  = (
    ZV_DF_BSAIK_INVOICES
    .join(
        ZV_DF_BSAIK_TEXTS_MATCH,
        on=[
            'ZF_BSAIKSGTXT_BKPFBKTXT'
        ],
        how='left'
    )
)
```

Check the results

Where our supplier invoices had a description, we can see the score that was given to the text field:

	BC	BD	BE	BF
	ZF_BSAIKSGTXT_BKPFBKTXT	ZF_T706B5_SPTXT_BEST_MATCH	ZF_T706B5_BSAIK_COSINE	ZF_BO_SGTXTBKTXT_NOTIN_T706B5SPTXT
in	FAC ELEC JANV	Payment in Kind for All Meals	0	TRUE
in	non PO INvoice directly ordered Flight ticket	Flight	0.222898635	TRUE
in	flight tickets	Flight	0.488655564	FALSE
in	Blocked for payment - Vendor dispute Header Text	Payment in Kind for All Meals	0.112912287	TRUE

Our cut-off score was .35… meaning some similarity… however, since we have a long text description in line 2 above, the score was only 0.22


Questions?