02_preprocessing_feature_eng

April 21, 2025

[1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import os
import sys
from pathlib import Path

# Add project root to sys.path (not src)
project_root = Path.cwd().parent  # Should be RECSYS_FINAL
sys.path.append(str(project_root))

# Import specific modules/functions we want to test
from src import config
from src.data import load_raw
from src.data import utils
from src.data import preprocess  # Import the main preprocessing module

# Set display options
pd.set_option('display.max_columns', 100)
pd.set_option('display.max_rows', 100)
sns.set_style("whitegrid")
print("Setup complete. Modules imported.")
```

```
Loading .env from: /Users/mohit/Desktop/everything/ATLAS/Semester
4/Pinnacle/recsys_final/.env
Database URI configured: Yes
Setup complete. Modules imported.
```

[2]:
```
# Test loading all raw data
try:
    raw_data = load_raw.load_all_raw_data()
    print("\nRaw data loaded successfully into 'raw_data' dictionary.")
    # Display shapes
    for name, df in raw_data.items():
        print(f"- {name}: {df.shape}")
except Exception as e:
    print(f"Error loading raw data: {e}")
```

```
--- Loading All Raw Data ---
All raw data files found.
Loading assessments data from: /Users/mohit/Desktop/everything/ATLAS/Semester
4/Pinnacle/recsys_final/data/raw/assessments.csv
Loaded assessments data shape: (206, 6)
Loading courses data from: /Users/mohit/Desktop/everything/ATLAS/Semester
4/Pinnacle/recsys_final/data/raw/courses.csv
Loaded courses data shape: (22, 3)
Loading student assessment data from:
/Users/mohit/Desktop/everything/ATLAS/Semester
4/Pinnacle/recsys_final/data/raw/studentAssessment.csv
Loaded student assessment data shape: (173912, 5)
Loading student info data from: /Users/mohit/Desktop/everything/ATLAS/Semester
4/Pinnacle/recsys_final/data/raw/studentInfo.csv
Loaded student info data shape: (32593, 12)
Loading student registration data from:
/Users/mohit/Desktop/everything/ATLAS/Semester
4/Pinnacle/recsys_final/data/raw/studentRegistration.csv
Loaded student registration data shape: (32593, 5)
Loading student VLE interaction data from:
/Users/mohit/Desktop/everything/ATLAS/Semester
4/Pinnacle/recsys_final/data/raw/studentVle.csv
Loaded student VLE data shape: (10655280, 6)
Loading VLE metadata from: /Users/mohit/Desktop/everything/ATLAS/Semester
4/Pinnacle/recsys_final/data/raw/vle.csv
Loaded VLE data shape: (6364, 6)
--- Finished Loading All Raw Data ---


Raw data loaded successfully into 'raw_data' dictionary.
- assessments: (206, 6)
- courses: (22, 3)
- student_assessment: (173912, 5)
- student_info: (32593, 12)
- student_registration: (32593, 5)
- student_vle: (10655280, 6)
- vle: (6364, 6)
```

[3]:
```python
# Test cleaning functions (one by one)
print("--- Testing Cleaning Functions ---")
student_info_clean = preprocess.clean_student_info(raw_data['student_info'])
registrations_clean = preprocess.
 ↪clean_registrations(raw_data['student_registration'])
assessments_clean = preprocess.clean_assessments(raw_data['assessments'])
student_assessment_clean = preprocess.
 ↪clean_student_assessment(raw_data['student_assessment'])
```

```
vle_clean = preprocess.clean_vle(raw_data['vle'])
student_vle_clean = preprocess.clean_student_vle(raw_data['student_vle'])
print("--- Finished Testing Cleaning Functions ---")
# Optional: Print heads/info if needed for debugging
# print("\nCleaned studentInfo Head:\n", student_info_clean.head())
# print("\nCleaned registrations Head:\n", registrations_clean.head())
# print("\nCleaned assessments Head:\n", assessments_clean.head())
# print("\nCleaned studentAssessment Head:\n", student_assessment_clean.head())
# print("\nCleaned vle Head:\n", vle_clean.head())
# print("\nCleaned studentVle Head:\n", student_vle_clean.head())
```

```
--- Testing Cleaning Functions ---
Cleaning studentInfo data…
Creating 'presentation_id' column.
Cleaned studentInfo shape: (32593, 13)
Cleaning studentRegistration data…
Dropped 45 rows with missing date_registration.
Creating 'presentation_id' column.
Cleaned studentRegistration shape: (32548, 7)
Cleaning assessments data…
Dropped 11 assessments with missing date (deadline).
Creating 'presentation_id' column.
Cleaned assessments shape: (195, 7)
Cleaning studentAssessment data…
Dropped 173 student assessment records with missing score.
Cleaned studentAssessment shape: (173739, 5)
Cleaning VLE data…
Creating 'presentation_id' column.
Cleaned VLE shape: (6364, 7)
Cleaning studentVle data…
Creating 'presentation_id' column.
Cleaned studentVle shape: (10655280, 7)
--- Finished Testing Cleaning Functions ---
```

[4]:
```
# Test filtering interactions by registration dates
print("\n--- Testing Registration Filtering ---")
interactions_filtered = preprocess.filter_interactions_by_registration(
    student_vle_clean, registrations_clean
)
print("\nFiltered Interactions Head:\n", interactions_filtered.head())
print(f"\nShape after filtering by registration: {interactions_filtered.shape}")
print("--- Finished Testing Registration Filtering ---")
```

```
--- Testing Registration Filtering ---
Filtering VLE interactions based on registration dates…
Filtered out 35231 interactions falling outside registration periods.
Filtered interactions shape: (10619446, 7)
```

```
Filtered Interactions Head:
   code_module code_presentation  id_student  id_site  date  sum_click  \
0          AAA             2013J       28400   546652   -10          4
1          AAA             2013J       28400   546652   -10          1
2          AAA             2013J       28400   546652   -10          1
3          AAA             2013J       28400   546614   -10         11
4          AAA             2013J       28400   546714   -10          1

  presentation_id
0       AAA_2013J
1       AAA_2013J
2       AAA_2013J
3       AAA_2013J
4       AAA_2013J

Shape after filtering by registration: (10619446, 7)
--- Finished Testing Registration Filtering ---
```

[5]:
```
# Test applying interaction count filters (BEFORE aggregation)
print("\n--- Testing Interaction Count Filtering ---")
# Use the default thresholds from config.py
interactions_count_filtered = preprocess.apply_interaction_count_filters(
    interactions_filtered # Apply to the output of the previous step
)
print("\nInteractions after Interaction Count Filters Head:\n",␣
 ↪interactions_count_filtered.head())
print(f"\nShape after interaction count filters: {interactions_count_filtered.
 ↪shape}")
print(f"\nUnique users remaining: {interactions_count_filtered['id_student'].
 ↪nunique()}")
print(f"Unique items remaining: {interactions_count_filtered['presentation_id'].
 ↪nunique()}")
print("--- Finished Testing Interaction Count Filtering ---")
```

```
--- Testing Interaction Count Filtering ---
Applying interaction count filters (min_records_per_user=5,
min_users_per_item=5)…
Finished interaction count filtering. Removed 1192 interaction records.
Final filtered interactions shape before aggregation: (10618254, 7)

Interactions after Interaction Count Filters Head:
   code_module code_presentation  id_student  id_site  date  sum_click  \
0          AAA             2013J       28400   546652   -10          4
1          AAA             2013J       28400   546652   -10          1
2          AAA             2013J       28400   546652   -10          1
3          AAA             2013J       28400   546614   -10         11
```

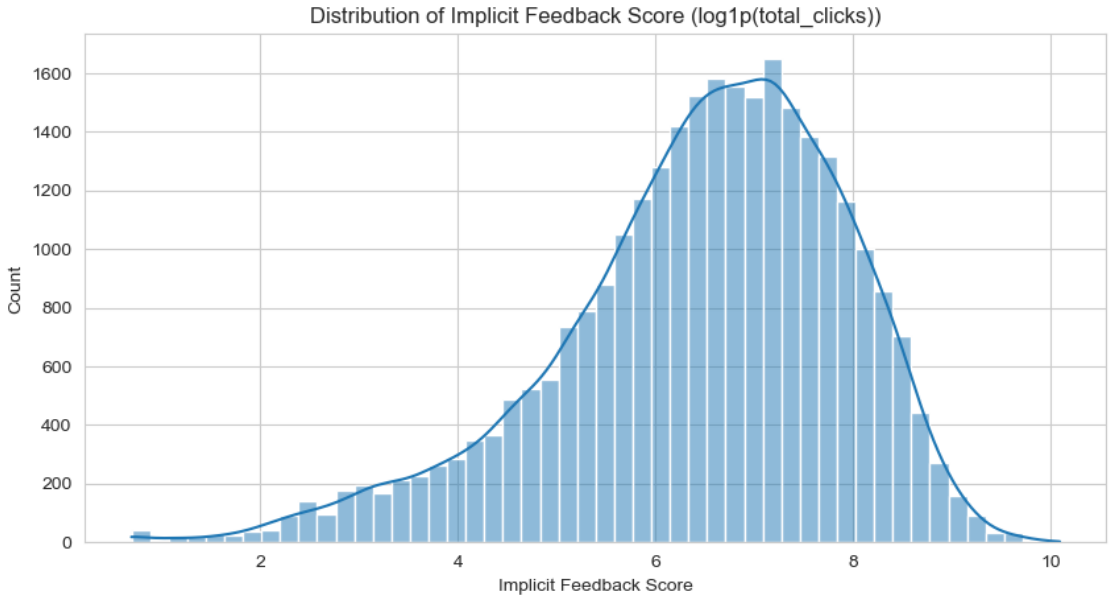
```
4          AAA              2013J        28400    546714    -10           1

  presentation_id
0       AAA_2013J
1       AAA_2013J
2       AAA_2013J
3       AAA_2013J
4       AAA_2013J

Shape after interaction count filters: (10618254, 7)

Unique users remaining: 25364
Unique items remaining: 22
--- Finished Testing Interaction Count Filtering ---
```

[6]:
```python
# Test creating aggregated interaction features (AFTER count filtering)
print("\n--- Testing Interaction Aggregation ---")
aggregated_interactions = preprocess.create_interaction_features(
    interactions_count_filtered # Apply to the output of the previous step
)
print("\nAggregated Interactions Head:\n", aggregated_interactions.head())
print(f"\nShape of aggregated interactions: {aggregated_interactions.shape}")

# Plot distribution of implicit feedback score if aggregation is not empty
if not aggregated_interactions.empty:
    plt.figure(figsize=(10, 5))
    sns.histplot(aggregated_interactions['implicit_feedback'], bins=50,␣
 ↪kde=True)
    plt.title('Distribution of Implicit Feedback Score (log1p(total_clicks))')
    plt.xlabel('Implicit Feedback Score')
    plt.ylabel('Count')
    plt.show()
else:
    print("\nAggregated interactions DataFrame is empty, skipping plot.")
print("--- Finished Testing Interaction Aggregation ---")
```

```
--- Testing Interaction Aggregation ---
Creating aggregated interaction features (implicit feedback)…
Created aggregated interaction features. Shape: (28466, 7)

Aggregated Interactions Head:
    id_student presentation_id  total_clicks  interaction_days  \
0        6516       AAA_2014J          2791               159
1        8462       DDD_2013J           646                56
2        8462       DDD_2014J            10                 1
3       11391       AAA_2013J           934                40
4       23629       BBB_2013B           161                16
```

	first_interaction_date	last_interaction_date	implicit_feedback
0	-23	269	7.934513
1	-6	118	6.472346
2	10	10	2.397895
3	-5	253	6.840547
4	-6	87	5.087596

```
Shape of aggregated interactions: (28466, 7)
```




```
--- Finished Testing Interaction Aggregation ---
```

[7]:
```
print("\n--- Testing User Feature Generation ---")
# Generate user features for the valid users found *after filtering and␣
 ↪aggregation*
if not aggregated_interactions.empty:
    valid_user_ids_test = aggregated_interactions['id_student'].unique()
    print(f"Number of valid users for feature generation:␣
 ↪{len(valid_user_ids_test)}")
    users_features_test = preprocess.generate_user_features(
        student_info_clean, # Pass the cleaned student info
        valid_user_ids_test # Pass the list of valid IDs
    )
    print("\nUser Features Head:\n", users_features_test.head())
    print(f"\nShape of user features: {users_features_test.shape}")
    # Verify shape matches unique user count
    assert users_features_test.shape[0] == len(valid_user_ids_test)
```

```
else:
    print("Skipping user feature generation as aggregated_interactions is empty.
 ↪")
    users_features_test = pd.DataFrame() # Assign empty dataframe
print("--- Finished Testing User Feature Generation ---")
```

```
--- Testing User Feature Generation ---
Number of valid users for feature generation: 25364
Generating user features for 25364 valid users…
Generated user features table. Shape: (25364, 8)

User Features Head:
             num_of_prev_attempts  studied_credits  gender_mapped  \
id_student
6516                            0               60              0
8462                            1               60              0
11391                           0              240              0
23629                           2               60              1
23698                           0              120              1

            highest_education_mapped  imd_band_mapped  age_band_mapped  \
id_student
6516                               3                9                2
8462                               3                4                2
11391                              3               10                2
23629                              1                3                0
23698                              2                6                0

            disability_mapped               region
id_student
6516                        0              Scotland
8462                        0         London Region
11391                       0  East Anglian Region
23629                       0  East Anglian Region
23698                       0  East Anglian Region

Shape of user features: (25364, 8)
--- Finished Testing User Feature Generation ---
```

[8]:
```
print("\n--- Testing Item Feature Generation ---")
# Generate item features for the valid items found *after filtering and␣
 ↪aggregation*
if not aggregated_interactions.empty:
    valid_item_ids_test = aggregated_interactions['presentation_id'].unique()
    print(f"Number of valid items for feature generation:␣
 ↪{len(valid_item_ids_test)}")
```

```
    # Need courses_df with presentation_id
    courses_with_pres_id = utils.create_presentation_id(raw_data['courses'])
    items_features_test = preprocess.generate_item_features(
        courses_with_pres_id, # Pass cleaned courses
        vle_clean, # Pass cleaned VLE info
        valid_item_ids_test # Pass the list of valid IDs
    )
    print("\nItem Features Head:\n", items_features_test.head())
    print(f"\nShape of item features: {items_features_test.shape}")
    # Verify shape matches unique item count
    assert items_features_test.shape[0] == len(valid_item_ids_test)
else:
    print("Skipping item feature generation as aggregated_interactions is empty.
 ↪")
    items_features_test = pd.DataFrame() # Assign empty dataframe
print("--- Finished Testing Item Feature Generation ---")
```

```
--- Testing Item Feature Generation ---
Number of valid items for feature generation: 22
Creating 'presentation_id' column.
Generating item (presentation) features…
Generated item features table. Shape: (22, 21)

Item Features Head:
                 module_presentation_length  vle_prop_dataplus  \
presentation_id
AAA_2013J                               268           0.018957
AAA_2014J                               269           0.019802
BBB_2013J                               268           0.000000
BBB_2014J                               262           0.000000
BBB_2013B                               240           0.000000

                vle_prop_dualpane  vle_prop_externalquiz  vle_prop_folder  \
presentation_id
AAA_2013J                     0.0                    0.0              0.0
AAA_2014J                     0.0                    0.0              0.0
BBB_2013J                     0.0                    0.0              0.0
BBB_2014J                     0.0                    0.0              0.0
BBB_2013B                     0.0                    0.0              0.0

                vle_prop_forumng  vle_prop_glossary  vle_prop_homepage  \
presentation_id
AAA_2013J               0.071090           0.009479           0.004739
AAA_2014J               0.029703           0.009901           0.004950
BBB_2013J               0.059190           0.003115           0.003115
BBB_2014J               0.014493           0.009662           0.004831
BBB_2013B               0.053968           0.003175           0.003175
```

```
                vle_prop_htmlactivity  vle_prop_oucollaborate  \
presentation_id
AAA_2013J                         0.0                0.009479
AAA_2014J                         0.0                0.009901
BBB_2013J                         0.0                0.006231
BBB_2014J                         0.0                0.014493
BBB_2013B                         0.0                0.000000

                vle_prop_oucontent  vle_prop_ouelluminate  vle_prop_ouwiki  \
presentation_id
AAA_2013J                 0.322275               0.000000              0.0
AAA_2014J                 0.336634               0.000000              0.0
BBB_2013J                 0.009346               0.000000              0.0
BBB_2014J                 0.338164               0.000000              0.0
BBB_2013B                 0.003175               0.003175              0.0

                vle_prop_page  vle_prop_questionnaire  vle_prop_quiz  \
presentation_id
AAA_2013J                 0.0                0.000000       0.000000
AAA_2014J                 0.0                0.000000       0.000000
BBB_2013J                 0.0                0.000000       0.015576
BBB_2014J                 0.0                0.019324       0.019324
BBB_2013B                 0.0                0.000000       0.015873

                vle_prop_repeatactivity  vle_prop_resource  \
presentation_id
AAA_2013J                           0.0           0.450237
AAA_2014J                           0.0           0.460396
BBB_2013J                           0.0           0.735202
BBB_2014J                           0.0           0.502415
BBB_2013B                           0.0           0.749206

                vle_prop_sharedsubpage  vle_prop_subpage  vle_prop_url
presentation_id
AAA_2013J                     0.000000          0.028436      0.085308
AAA_2014J                     0.000000          0.029703      0.099010
BBB_2013J                     0.003115          0.118380      0.046729
BBB_2014J                     0.000000          0.048309      0.028986
BBB_2013B                     0.003175          0.117460      0.047619

Shape of item features: (22, 21)
--- Finished Testing Item Feature Generation ---
```

[9]:
```
# Cell [9] - Optional: Test Full Pipeline
# print("\n--- Testing full preprocess_all_data() function ---")
# processed_data_test = preprocess.preprocess_all_data()
```

```
# print("\n--- Full pipeline test finished ---")
# print(f"Final Users shape: {processed_data_test['users'].shape}")
# print(f"Final Items shape: {processed_data_test['items'].shape}")
# print(f"Final Interactions shape: {processed_data_test['interactions'].
  ↪shape}")
```