

09_evaluation

February 28, 2026

1 09 — Formal Evaluation

Compute Precision@K and NDCG@K for all 4 configurations.

Precision@K — fraction of Top-K recommendations matching the user's sector.

NDCG@K — same but position-aware: a relevant article at rank 1 is worth more than at rank 10.

K values tested: 5 and 10.

```
[4]: import sys
sys.path.append('../src')

import pandas as pd
import matplotlib.pyplot as plt
import seaborn as sns

from user_profile import SYNTHETIC_USERS
from evaluator import evaluate_all, summary_table

# Load recommendations saved by notebook 08
CONFIG_Filenames = {
    'W2V - no boost': 'recs_w2v_no_boost.csv',
    'W2V - recency boost': 'recs_w2v_boost.csv',
    'SBERT - no boost': 'recs_sbtert_no_boost.csv',
    'SBERT - recency boost': 'recs_sbtert_boost.csv',
}

all_recs = {}
for config_name, filename in CONFIG_Filenames.items():
    df = pd.read_csv(f'../data/processed/recommendations/{filename}')
    all_recs[config_name] = {
        user_id: group.drop(columns='user_id').reset_index(drop=True)
        for user_id, group in df.groupby('user_id')
    }

print('Loaded configs:', list(all_recs.keys()))
print('Users per config:', [len(v) for v in all_recs.values()])
```

```
Loaded configs: ['W2V - no boost', 'W2V - recency boost', 'SBERT - no boost',
'SBERT - recency boost']
Users per config: [4, 4, 4]
```

1.1 Step 1 — Restore user objects

```
[5]: import copy
from profile_builder import build_profile_vectors

reading_log = pd.read_csv('..../data/processed/reading_log.csv')

# We need two sets - W2V users and SBERT users
# Profile vectors don't matter here, only sector labels are used for evaluation
users_w2v = copy.deepcopy(SYNTHETIC_USERS)
users_sbert = copy.deepcopy(SYNTHETIC_USERS)

for user in users_w2v + users_sbert:
    user.clicked_articles = reading_log[
        reading_log['user_id'] == user.user_id
    ]['article_id'].tolist()

users_by_config = {
    'W2V - no boost': users_w2v,
    'W2V - recency boost': users_w2v,
    'SBERT - no boost': users_sbert,
    'SBERT - recency boost': users_sbert,
}

print('Users ready')
```

Users ready

1.2 Step 2 — Compute Precision@K and NDCG@K

```
[6]: print(all_recs['SBERT - no boost']['User_1'].head())

   rank  article_id                                headline \
0      1        269  ['KSE further up on buying in cement stocks']
1      2       2269  ['KSE ends up cement, power stocks in focus']
2      3        1168  ['KSE committees not yet formed', 'Share price...
3      4        1115  ['KSE extraordinary general meeting adjourned ...
4      5        3586  ['PPL, govt sign concession agreements', 'KSE ...

   primary_tag  similarity  boost  final_score
0 Construction     0.782182    0.0      0.782182
1 Construction     0.767803    0.0      0.767803
2      Other        0.754280    0.0      0.754280
3      Other        0.752579    0.0      0.752579
```

```
4      Energy    0.751302    0.0    0.751302
```

```
[7]: df_eval = evaluate_all(  
    all_recs=all_recs,  
    users_by_config=users_by_config,  
    k_values=[5, 10]  
)  
  
print('Full evaluation results:')
```

```
Full evaluation results:
```

	config	user_id	sector	k	precision	ndcg
W2V	- no boost	User_1	Construction	5	0.0	0.0000
W2V	- no boost	User_1	Construction	10	0.0	0.0000
W2V	- no boost	User_2	Construction	5	0.0	0.0000
W2V	- no boost	User_2	Construction	10	0.0	0.0000
W2V	- no boost	User_3	Banking	5	1.0	1.0000
W2V	- no boost	User_3	Banking	10	1.0	1.0000
W2V	- no boost	User_4	Energy	5	0.6	0.6992
W2V	- no boost	User_4	Energy	10	0.6	0.9146
W2V	- recency boost	User_1	Construction	5	0.0	0.0000
W2V	- recency boost	User_1	Construction	10	0.0	0.0000
W2V	- recency boost	User_2	Construction	5	0.0	0.0000
W2V	- recency boost	User_2	Construction	10	0.0	0.0000
W2V	- recency boost	User_3	Banking	5	0.8	0.6608
W2V	- recency boost	User_3	Banking	10	0.9	0.8329
W2V	- recency boost	User_4	Energy	5	0.6	0.7227
W2V	- recency boost	User_4	Energy	10	0.5	0.9566
SBERT	- no boost	User_1	Construction	5	0.4	0.6367
SBERT	- no boost	User_1	Construction	10	0.4	0.8933
SBERT	- no boost	User_2	Construction	5	0.2	0.6309
SBERT	- no boost	User_2	Construction	10	0.1	0.6309
SBERT	- no boost	User_3	Banking	5	1.0	1.0000
SBERT	- no boost	User_3	Banking	10	1.0	1.0000
SBERT	- no boost	User_4	Energy	5	1.0	1.0000
SBERT	- no boost	User_4	Energy	10	1.0	1.0000
SBERT	- recency boost	User_1	Construction	5	0.0	0.0000
SBERT	- recency boost	User_1	Construction	10	0.1	0.3333
SBERT	- recency boost	User_2	Construction	5	0.0	0.0000
SBERT	- recency boost	User_2	Construction	10	0.1	0.3333
SBERT	- recency boost	User_3	Banking	5	1.0	1.0000
SBERT	- recency boost	User_3	Banking	10	1.0	1.0000
SBERT	- recency boost	User_4	Energy	5	1.0	1.0000
SBERT	- recency boost	User_4	Energy	10	0.9	0.9842

```
[ ]:
```

1.3 Step 3 — Summary table

```
[8]: summary = summary_table(df_eval)
print('== Mean Precision@K and NDCG@K per Configuration ===')
print(summary.to_string())

# Best config at K=10
at_10 = summary.xs(10, level='k')
print(f'\n→ Best Precision@10: {at_10["precision"].idxmax()} ↴\n↳ ({at_10["precision"].max()})')
print(f'→ Best NDCG@10:      {at_10["ndcg"].idxmax()} ({at_10["ndcg"].max()})')

==== Mean Precision@K and NDCG@K per Configuration ===
                precision      ndcg
config           k
SBERT - no boost   5     0.650  0.8169
                  10    0.625  0.8810
SBERT - recency boost 5     0.500  0.5000
                  10    0.525  0.6627
W2V - no boost     5     0.400  0.4248
                  10    0.400  0.4786
W2V - recency boost 5     0.350  0.3459
                  10    0.350  0.4474

→ Best Precision@10: SBERT - no boost (0.625)
→ Best NDCG@10:      SBERT - no boost (0.881)
```

1.4 Step 4 — Visualize

```
[9]: # Precision@K and NDCG@K side by side for K=5 and K=10
fig, axes = plt.subplots(2, 2, figsize=(14, 10))

config_order = ['W2V - no boost', 'W2V - recency boost', 'SBERT - no boost', 'SBERT - recency boost']

for row, k in enumerate([5, 10]):
    subset = df_eval[df_eval['k'] == k]

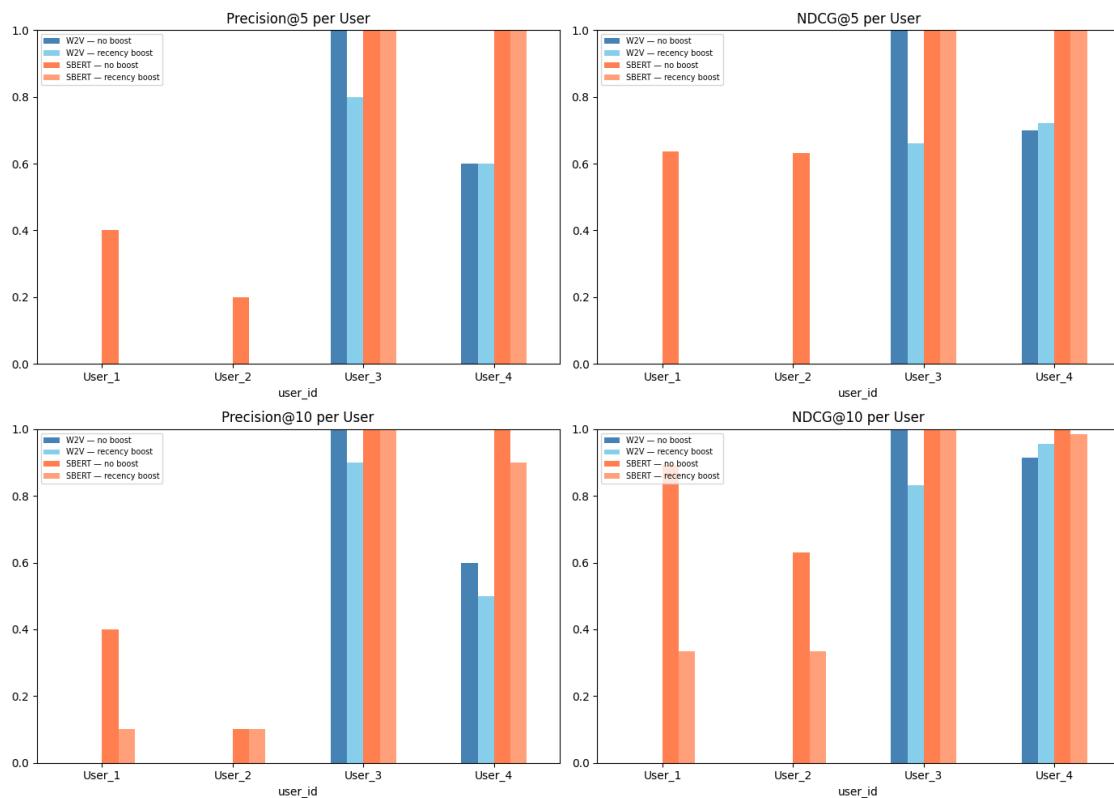
    # Precision@K
    pivot_p = subset.pivot(index='user_id', columns='config', values='precision')[config_order]
    pivot_p.plot(kind='bar', ax=axes[row, 0],
                 title=f'Precision@{k} per User',
                 ylim=(0, 1),
                 color=['steelblue', 'skyblue', 'coral', 'lightsalmon'])
    axes[row, 0].tick_params(axis='x', rotation=0)
    axes[row, 0].legend(fontsize=7)
```

```

# NDCG@K
pivot_n = subset.pivot(index='user_id', columns='config',
values='ndcg')[config_order]
pivot_n.plot(kind='bar', ax=axes[row, 1],
             title=f'NDCG@{k} per User',
             ylim=(0, 1),
             color=['steelblue', 'skyblue', 'coral', 'lightsalmon'])
axes[row, 1].tick_params(axis='x', rotation=0)
axes[row, 1].legend(fontsize=7)

plt.tight_layout()
plt.show()

```



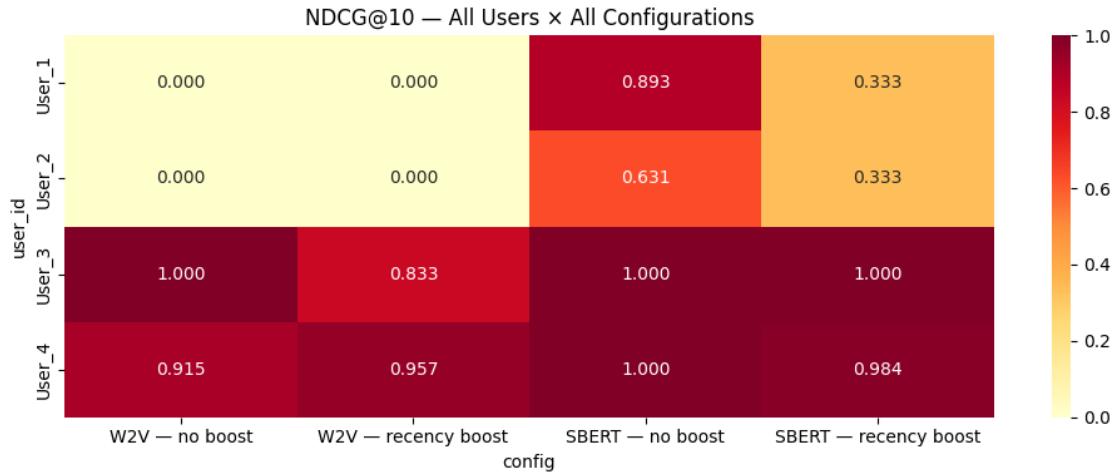
```

[10]: # Heatmap - NDCG@10 per user per config
ndcg_10 = df_eval[df_eval['k'] == 10].pivot(index='user_id', columns='config',
values='ndcg')[config_order]

plt.figure(figsize=(10, 4))
sns.heatmap(ndcg_10, annot=True, fmt='.3f', cmap='YlOrRd', vmin=0, vmax=1)
plt.title('NDCG@10 - All Users x All Configurations')
plt.tight_layout()

```

```
plt.show()
```



```
[11]: # Save evaluation results
df_eval.to_csv('../data/processed/evaluation_results.csv', index=False)
print('Evaluation results saved to data/processed/evaluation_results.csv')
```

Evaluation results saved to data/processed/evaluation_results.csv

1.5 Conclusions

- Best Precision@5: ...
- Best Precision@10: ...
- Best NDCG@5: ...
- Best NDCG@10: ...
- Construction users (User_1, User_2) performance: ...
- Banking/Energy users (User_3, User_4) performance: ...
- Overall best config: ...
- Ready for Streamlit (notebook 10 / app.py): yes/no