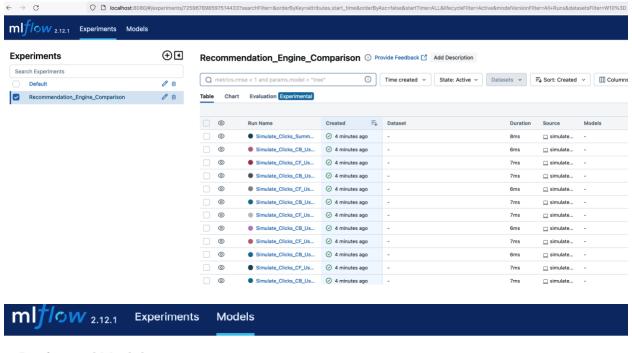```
→ simulation git:(main) ✗ mlflow server --host 127.0.0.1 --port 8080
/opt/homebrew/anaconda3/lib/python3.11/site-packages/pydantic/_internal/_config.py:321:
ng: Valid config keys have changed in V2:
* 'schema_extra' has been renamed to 'json_schema_extra'
  warnings.warn(message, UserWarning)
[2024-05-14 16:20:52 -0500] [22862] [INFO] Starting gunicorn 20.1.0
[2024-05-14 16:20:52 -0500] [22862] [INFO] Listening at: http://127.0.0.1:8080 (22862)
[2024-05-14 16:20:52 -0500] [22862] [INFO] Using worker: sync
[2024-05-14 16:20:52 -0500] [22863] [INFO] Booting worker with pid: 22863
[2024-05-14 16:20:53 -0500] [22864] [INFO] Booting worker with pid: 22864
[2024-05-14 16:20:53 -0500] [22865] [INFO] Booting worker with pid: 22865
[2024-05-14 16:20:53 -0500] [22866] [INFO] Booting worker with pid: 22866
[2024-05-14 16:21:00 -0500] [22862] [INFO] Handling signal: winch
[2024-05-14 16:21:23 -0500] [22862] [INFO] Handling signal: winch
```

```
→  simulation git:(main) ✗ python train_models.py
2024/05/14 16:20:59 INFO mlflow.tracking.fluent: Experiment with name 'Recomm
iment.
/opt/homebrew/anaconda3/lib/python3.11/site-packages/_distutils_hack/__init_
  warnings.warn("Setuptools is replacing distutils.")
Successfully registered model 'CollaborativeFilteringModel'.
Created version '1' of model 'CollaborativeFilteringModel'.
Successfully registered model 'ContentBasedModel'.
Created version '1' of model 'ContentBasedModel'.
→  simulation git:(main) ✗ python simulate_user_clicks.py
Downloaded content-based model artifacts to: /Users/apujari/Documents/courses
3/bb771684d0e14c788b9bf232903d3305/artifacts/cosine_similarities
Total clicks for Collaborative Filtering Model: 91
Total clicks for Content-Based Model: 95
→  simulation git:(main) ✗ python analysis.py
Index(['run_id', 'experiment_id', 'status', 'artifact_uri', 'start_time',
       'end_time', 'metrics.total_clicks_cb', 'metrics.total_clicks_cf',
       'metrics.user_clicks', 'params.total_users', 'params.user_id',
       'params.model', 'params.model_type', 'tags.mlflow.source.name',
       'tags.mlflow.source.type', 'tags.mlflow.runName',
       'tags.mlflow.source.git.commit', 'tags.mlflow.user',
       'tags.mlflow.log-model.history'],
      dtype='object')
                              run_id  ...  metrics.total_clicks_cb
0    8264563ce7364261816708d0d2b2779f  ...                     95.0
1    40db923219d74548bc161c99eed59a0f  ...                      NaN
2    300a6a4867f446c08802f83755829e8e  ...                      NaN
3    f332a15ee33046cd9d24207203c84f57  ...                      NaN
4    5bfc2d5bcfcc44a793bbc7a2182a3ec8  ...                      NaN
..                               ...  ...                      ...
198  8feafd55ff46428ca97e4fa3c2791fd0  ...                      NaN
199  a348dc5be3474bbd94f62025869cab56  ...                      NaN
200  580b6c89bb484f5f8bba87d8f0b3e4d8  ...                      NaN
201  bb771684d0e14c788b9bf232903d3305  ...                      NaN
202  a21a2763f87349d58b2d3863b7d08411  ...                      NaN

[203 rows x 3 columns]
Total clicks for Collaborative Filtering Model: 91.0
Total clicks for Content-Based Model: 95.0
Z-test statistic: -0.30796394599962623, p-value: 0.758109766802451
There is no significant difference between the two models.
```

ml *flow* 2.12.1   Experiments   Models

Experiments ⊕ ◁

Search Experiments

☐ Default   ✎ 🗑
☑ Recommendation_Engine_Comparison   ✎ 🗑

Recommendation_Engine_Comparison ⓘ Provide Feedback ↗ Add Description

🔍 metrics.rmse < 1 and params.model = "tree"   ⓘ | Time created ⌄ | State: Active ⌄ | Datasets ⌄ | ⇅ Sort: Created ⌄ | ▥ Columns

Table   Chart   Evaluation   **Experimental**

☐	👁	Run Name	Created	⇅	Dataset	Duration	Source	Models
☐	👁	● Simulate_Clicks_Summ…	⊘ 4 minutes ago		-	8ms	▭ simulate…	-
☐	👁	● Simulate_Clicks_CB_Us…	⊘ 4 minutes ago		-	6ms	▭ simulate…	-
☐	👁	● Simulate_Clicks_CF_Us…	⊘ 4 minutes ago		-	7ms	▭ simulate…	-
☐	👁	● Simulate_Clicks_CB_Us…	⊘ 4 minutes ago		-	7ms	▭ simulate…	-
☐	👁	● Simulate_Clicks_CF_Us…	⊘ 4 minutes ago		-	6ms	▭ simulate…	-
☐	👁	● Simulate_Clicks_CB_Us…	⊘ 4 minutes ago		-	7ms	▭ simulate…	-
☐	👁	● Simulate_Clicks_CF_Us…	⊘ 4 minutes ago		-	7ms	▭ simulate…	-
☐	👁	● Simulate_Clicks_CB_Us…	⊘ 4 minutes ago		-	6ms	▭ simulate…	-
☐	👁	● Simulate_Clicks_CF_Us…	⊘ 4 minutes ago		-	7ms	▭ simulate…	-
☐	👁	● Simulate_Clicks_CB_Us…	⊘ 4 minutes ago		-	6ms	▭ simulate…	-
☐	👁	● Simulate_Clicks_CF_Us…	⊘ 4 minutes ago		-	7ms	▭ simulate…	-
☐	👁	● Simulate_Clicks_CB_Us…	⊘ 4 minutes ago		-	7ms	▭ simulate…	-

ml *flow* 2.12.1   Experiments   **Models**

Registered Models

Filter registered models by name or tags   ⓘ   🔍

Name ⇅↑	Latest version	Aliased versions
CollaborativeFilteringModel	**Version 1**	
ContentBasedModel	**Version 1**	