PandaRec - A Recipe-Based Recommendation System for the Pandas Library

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Overview

- **Introduction**
- Approach
- Evaluation
- Conclusion
- References

Pandas

- Python library for data manipulation and analysis
- Works with DataFrames
- Existing recommendation systems don't work well with Pandas

Code Recommendation Systems

- Help developers to write code
- Design dimensions:
  - Input
  - Recommendation Engine
  - Output
  - User Feedback

Existing Code Recommendation Systems

- Code completion
  - Part of most IDEs
  - not that useful for Pandas
- Code generation
  - Boilerplate automation
  - Generative AI
    - ChatGPT
    - Copilot

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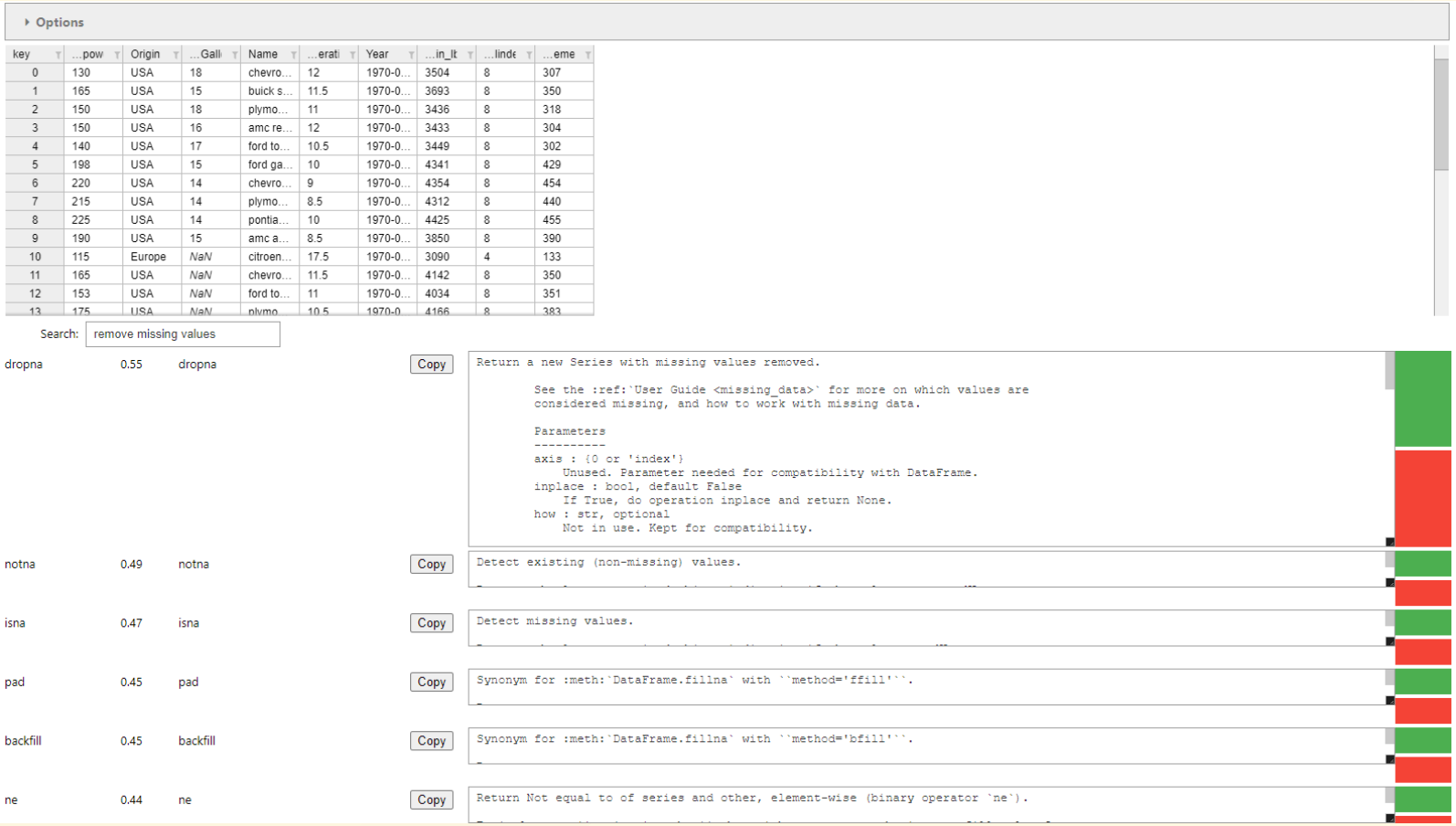
My Solution

- Jupyter Notebook
- Recipe-based recommendation system
- Swappable recommendation engine

Jupyter Notebook



Recipes

- A data structure that describes a task
- Contains:
  - Name
  - Code snippet
  - Description
- saved in JSON format
- Generated from: dir() function, existing code snippets, hand-written

The Recommendation Engine

- Strategy pattern
- Gets current context
- Search function that returns a ranked list of recipes

Ranking Strategies: Lexical Search

- Name Search
- Fuzzy Search
  - Levenshtein distance
- Index Search
  - Lemmatize words
  - Build an inverted index

Ranking Strategies: Semantic Search

- Use a NLP model to calculate the similarity between the query and the recipe descriptions
- BERT: Bidirectional Encoder Representations from Transformers
- Sentence-BERT: Sentence Embeddings using Siamese BERT-Networks

Ranking Strategies: Other

- OpenAI Embeddings
- OpenAI Chat Completion
- Websocket

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Metrics

- Speed:
  - Setup and search time
  - Under 100ms for search time is acceptable
- Accuracy:
  - NDCG

NDCG

- Normalized Discounted Cumulative Gain
- Measures the ranking quality

$$DCG = \sum_{i=1}^{k} \frac{gains}{log_2(i+1)}$$

$$NDCG = \frac{DCG}{IDCG}$$

- Last rank k is important: NDCG@k

Speed

Name	Setup Delay	Search Delay
Name Search	68ns ± 0.2ns	**6.53µs ± 0.08µs**
Fuzzy Name Search	68.4ns ± 0.5ns	**756µs ± 1.3µs**
Fuzzy Description Search	276ns ± 0.8ns	**10ms ± 0.05ms**
Index Search	7.87s ± 0.08s	**1.74ms ± 0.01ms**
Semantic Search	85s ± 1s	**38.2ms ± 0.9ms**
OpenAI Embedding	3s ± 1s	668ms ± 949ms
OpenAI Chat Completion	530ns ± 14.9ns	27.4s ± 3.7s
Saved Index/ Embedding		
Index Search	1.5ms ± 0.03ms	-
Semantic Search	682ms ± 10ms	-
OpenAI Embedding	27.5ms ± 0.25ms	-

Accuracy

Name	NDCG@5
Name Search	0.0
Fuzzy Name Search	0.41
Fuzzy Description Search	0.27
Index Search	0.22
Semantic Search	**0.64**
OpenAI Embedding	0.57

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