CSE 6324

Advanced Topics in Software Engineering

Semantic Code Search

Iteration 2

Team 7

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GitHub Repository:
https://github.com/rifatarefin/semantic-code-search

Project Plan

Features: Iteration 1

- Train a 1D-CNN model
  - Embed code and query in a joint vector space
  - Retrieve Code with the most similar vector with the vector representation of query
  - Only on Python data of the CodeSearchNet [4] dataset
- Build a command-line code search tool
  - A Jupyter notebook to perform demo code search

Features: Iteration 2

- Use the state of the art ML model from iteration 1
  - Neural bag of words model
- Train on all available six programming languages
  - Python, Javascript, Ruby, Go, Java, and PHP
- Command line code search tool for demo purpose
  - Supports programming language selection with query

Features: Planned for Future Iterations (Iteration 3)

1. Exploit State of the art language models for code search
    - Generative Pretrained Transformer(GPT) 2&3
        - Unsupervised technique
        - Transformer-based
        - Not used for semantic code search yet
        - GPT-3 Model not published yet
    - Code2Vec [11]
        - Promising for capturing code semantics

Features: Planned for Future Iterations (Iteration 3)

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2. Develop a web app and host it online

Features: Planned for Future Iterations (Final Iteration)

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3. Comparison between the two approaches:
    - Code & Query Encoders developed <u>separately</u> [3]
        - Code Encoder -> Representation mapped to the vector space of the Natural language model
    - End-2-End training for Code & Query Encoders [4]
        - Loss function is being calculated jointly.
4. Least priority:
    - Train a language model with Stackoverflow [7] data

Competitors

- Information retrieval based approach:
    - Reformulate queries with natural language phrasal representations of method signatures [14]
    - Recommend reformulation strategy based on query properties: uses ML [15]
    - Extend a query with synonyms generated from WordNet [16]
- Considering data and evaluation metrics:
    - Leaderboard of Code Search Net Challenge [6]

Risks: Already Encountered

1. Insufficient Hardware Resources
2. Very Large size of data

Solution

Set up the project on TACC clusters: Maverick2 [12]

- Does not provide root privilege
- Migrated to Singularity [13] from Docker for containerized environment: additional 15 hours of work

Risks (Current)

3. Insufficient/Improper Data & Modelling Techniques

    - Redirect efforts towards improving the database retrieval system
    - Developing a good UI
    - Probability: 50%, Risk effect: 40 hrs, Risk exposure: 20 hrs

4. Performance Deterioration when when adding more programming languages

    - Fine-tune models
    - Probability: 40%, Risk effect: 30 hrs, Risk exposure: 12 hrs

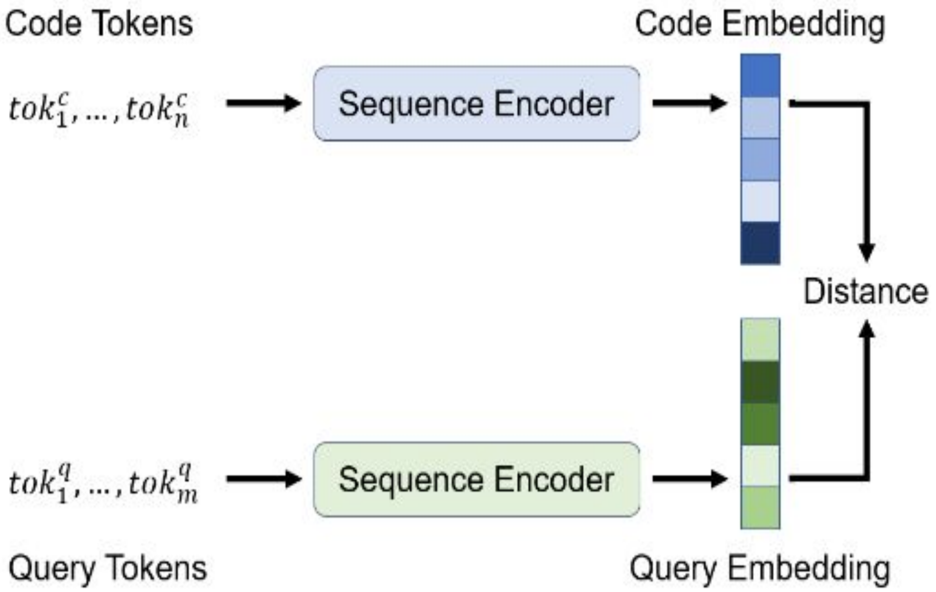
Risks (Current)

5. Host a web app version online
    - Hosting service -> must have adequate resources
    - Probability: 70%, Risk effect: 15 hrs, Risk exposure: 10.5 hrs
6. Adding additional packages in Singularity containers
    - Rebuild containers
    - Probability: 50%, Risk effect: 6 hrs, Risk exposure: 2 hrs

Specifications & Design

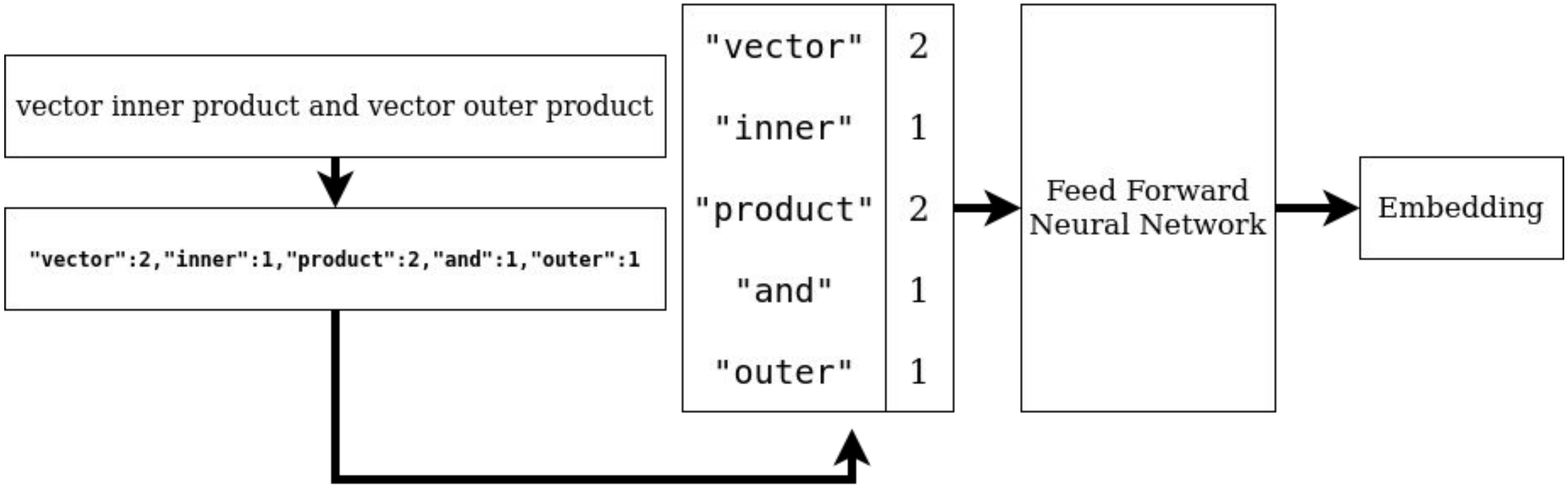
Use-Case

- Query Token Sequence
- Code Snippet Token Sequence
- Cosine Distance
- Return Code Snippet
  - Smaller Distance from the Query



[4]

Method - Neural Bag Of Words (NBOW)

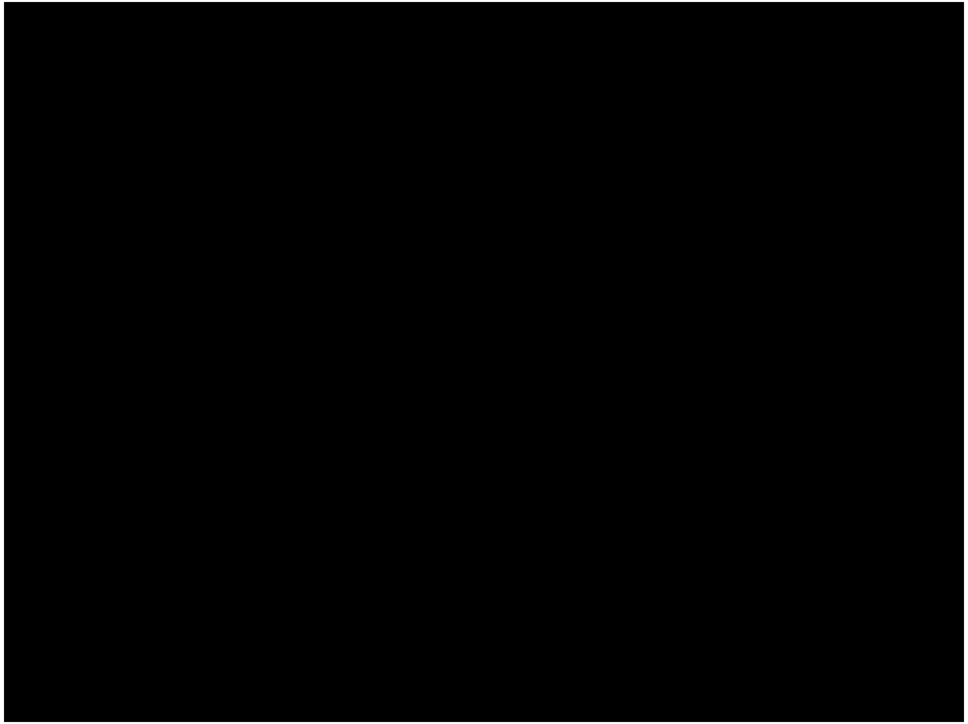


Optimization[4]:

- Max (QueryEmbedding * CodeEmbeddings)
- Min (CodeSnippetEmbedding * DistractorCodeEmbedding)

Testing

Testing - NBOW model (state-of-the-art)



Customers and Users

Customers & Users

- Code Hosting & Versioning services
  - Github, Gitlab, etc
- General Purpose Search Engines
  - Google, Bing, etc
- IDEs with integrated code search engines

Feedback

Feedback

- Initial User Experience Feedback (Iteration 1&2)
    - Team Members
- Future User Experience Feedback (Iteration 3)
    - Classmates
- Project Management Feedback
    - Project Mentor

References

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[5] Radford, A.; Wu, J.; Child, R.; Luan, D.; Amodei, D. & Sutskever, I. (2018), 'Language Models are Unsupervised Multitask Learners', OpenAI blog 1.8 (2019): 9.

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Thank you!

Tech Comics: "The Software Project, Pt. 1"