README for CSE 464
Project Part 3

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GitHub Repository link: https://github.com/shantanushishodia/cse-464-2023-sshishod

Instructions to Run

- Download the cse-464-sshishod.zip file from this repository
- Run mvn package
- This should run all tests for the project
- This command will build the project in the target folder as well
- Alternatively, unzip cse-464-sshishod.zip and then open the GraphHandler folder in IntelliJ

APIs

- void graphImporter(String filePath) - import a directed graph in a dot file
- String toString() - Graph information like number of nodes, edges and their directions
- void saveGraphToFile(String filePath) - Write the graph information to a file
- void addOneNode(String label) - Adds a new node to the graph with the given label if it does not exist

- void addMultipleNodes(ArrayList<String> labels) - Add multiple nodes to the graph

- boolean addEdge(String initialNode, String targetNode) - Returns true if edge is added otherwise returns false if edge exists

- void saveGraphDOT(String filePath) - Outputs the modified graph in DOT format to the specified file

- void saveGraphPNG(String filePath) - Output the modified graph to a PNG file (Graph Visualization)

- Path GraphSearch(String src, String dst, Algorithm algo) - Find a path from src to dst node using BFS or DFS or Random Walk algorithm depending on enum specified. Possible values of the enum can be Algorithm.BFS, Algorithm.DFS or Algorithm.RANDOMWALK

1. **Refactors for the project part 3:**

    1. Refactor 1: Encapsulated pathMap and added getPathMap function. This makes the pathMap variable prive. The getPathMap function acts as a getter for it.
       LINK:
       https://github.com/shantanushishodia/cse-464-2023-sshishod/commit/2ac900198f9723d68b825cb6196b51e70de0a3ea
    2. Refactor 2: renamed functions for better understanding of the code
       LINK:
       https://github.com/shantanushishodia/cse-464-2023-sshishod/commit/723f8a049a2cdcd7e088faec774f4a7fae1d43d6
    3. Refactor 3: improved consistency of exception handling and removed redundancy of performing the same task:
       LINK:
       https://github.com/shantanushishodia/cse-464-2023-sshishod/commit/0005bf761098dcb98dbdecbd2e9b39133e788d9e
    4. Refactor 4: Streamlined graphSearchWithAlgo. Now uses switch case instead of if-else statements.
       LINK:
       https://github.com/shantanushishodia/cse-464-2023-sshishod/commit/b582226fc82054af3234cb1bbd11d6f2a9c19b5b

5. Refactor 5: Used constants for file path for more maintainable code
   LINK:
   https://github.com/shantanushishodia/cse-464-2023-sshishod/commit/07da7b1ecbc4ef1ea0d1c9e42778389c846bedf9
6. Refactor 6: Extracted logic in helper methods
   LINK:
   https://github.com/shantanushishodia/cse-464-2023-sshishod/commit/a2ddc0ee7e5848a14b66101ed15f8a47dae355c7

2. Template design pattern for BFS and DFS:

a. The GraphSearchTemplate class implements the template pattern. This class acts as a template for graph search algorithms, providing the general framework for the search procedure while letting subclasses handle the actual search implementation.

   The template method "findPath" in the template class is responsible for organizing the entire network search procedure. Common actions like verifying the source and destination and looking for nodes in the graph are included. Additionally, the abstract method (search), which is specified as abstract and intended to be implemented by concrete subclasses, receives the basic search logic from the template method.

   LINK:
   https://github.com/shantanushishodia/cse-464-2023-sshishod/commit/84a3895528471b9d74252d25c4394be30d02ca8d

   This commit also contains minor changes for better working of the code like converting any input in selecting the search algo to uppercase, etc.

b. A code snippet showing the use of template pattern:

```
Graph<String, DefaultEdge> currGraph = gh.getGraph();
BFS bfs = new BFS();
Path result = bfs.findPath(currGraph, "Google", "Tesla");
```

3. Strategy design pattern for BFS and DFS:

a First I created an interface “GrpahSearchStrategy” and a class “GraphSearchContext”.

The interface serves as a common interface for all graph search algorithms, declaring a method (findPath) that encapsulates the algorithm's logic. Concrete classes implementing this interface, such as BFS and DFS, provide their specific implementations of the graph search algorithm.

The context class accepts a strategy (an object implementing the GraphSearchStrategy interface) and delegates the graph search task to this strategy.

LINK:
https://github.com/shantanushishodia/cse-464-2023-sshishod/commit/f91b776c9699fec1048301780d3584802e4b8731

b A code snippet showing the use of strategy pattern:

```
        GraphHandler gh = new GraphHandler();
        gh.graphImporterFromDot("src/test/test1.dot");
        Path result = gh.graphSearchWithAlgo("Google", "Tesla", Main.Algorithm.BFS);
```

4. Tests for BFS and DFS using both patterns:

a I created different tests for BFS and DFS using both strategy and template patterns. You can see code snippets for both in the pattern’s implementation section (2 and 3).

LINK:
https://github.com/shantanushishodia/cse-464-2023-sshishod/commit/f1f4375f79effd205dc1a7ce797e0dc408e24428

5. Implementation for Random Walk Search Algo:

a Created a new for the search algo “RandomWalkSearch”. The RandomWalkSearch class extends the “GraphSearchTemplate” and implements “GraphSearchStrategy”.

The algorithm starts at a given source node and continues traversing the graph until it reaches the specified destination node. During each step, the algorithm selects a random neighbor of the current node, moves to that neighbor, and updates the traversal path accordingly. The process continues until the destination node is reached or there are no unvisited neighbors left for the current node.

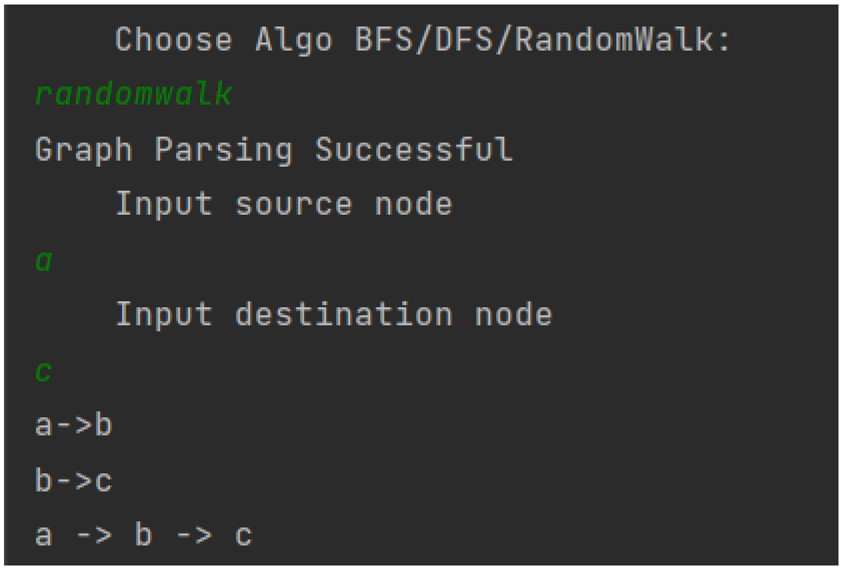
LINK:
https://github.com/shantanushishodia/cse-464-2023-sshishod/commit/f1f4375f79effd205dc1a7ce797e0dc408e24428

b Code Snippet:

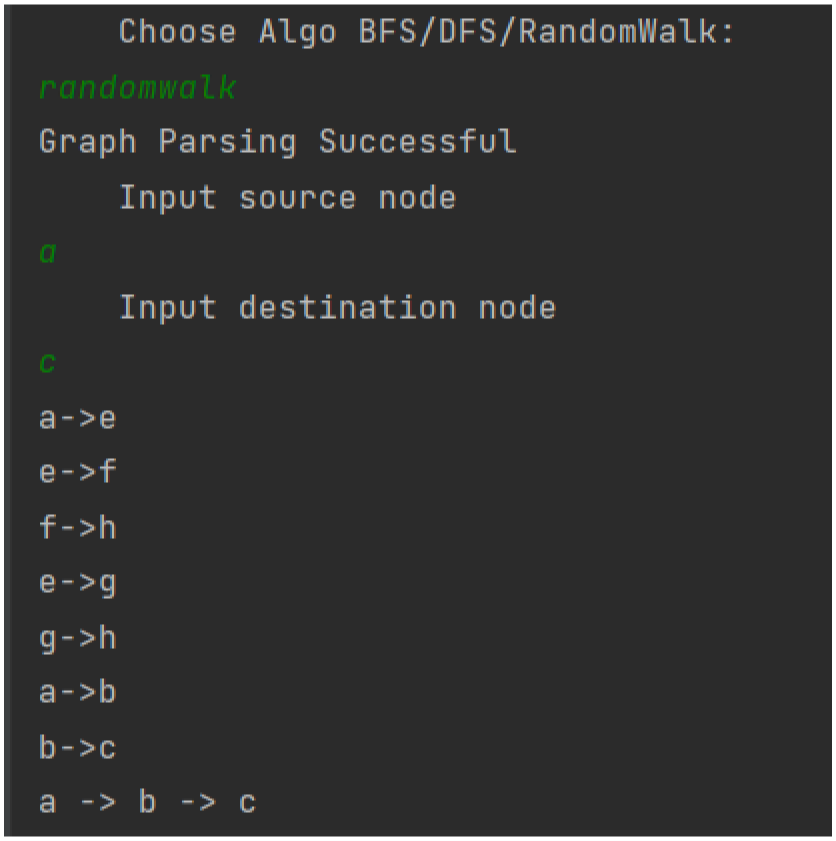
```
while (!neighbors.isEmpty()) {
   int randomIndex = new Random().nextInt(neighbors.size());

   String randomNeighbor = neighbors.get(randomIndex);
   System.out.println(current+ "->"+randomNeighbor);

   path.getPathMap().put(randomNeighbor, current);

   boolean temp =search(graph, randomNeighbor, destination, visited);
   if(temp)
      return true;
   neighbors.remove(randomIndex);
}
```

c I used the DOT file provided by the professor to use as the graph file for Random Walk search. The program automatically loads the DOT file whenever the user selects RANDOMWALK as the search algo.

d Example output:



```
    Choose Algo BFS/DFS/RandomWalk:
randomwalk
Graph Parsing Successful
    Input source node
a
    Input destination node
c
a->b
b->c
a -> b -> c
```



```
    Choose Algo BFS/DFS/RandomWalk:
randomwalk
Graph Parsing Successful
    Input source node
a
    Input destination node
c
a->e
e->f
f->h
e->g
g->h
a->b
b->c
a -> b -> c
```

e The algorithm tries random paths and displays the path it's taking. When it finds the desired path, it displays it at last.

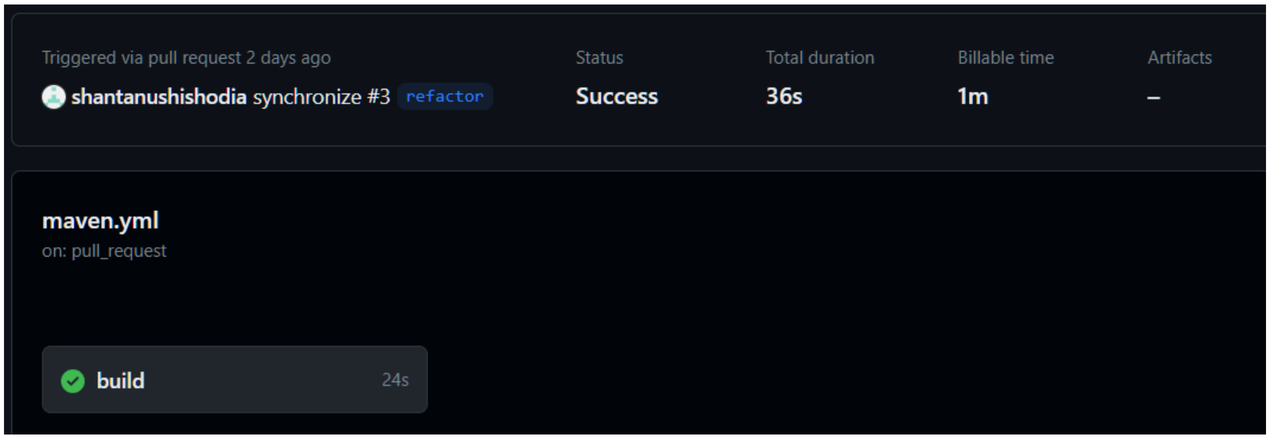
f Didn't add any test cases as the part 3 doc did not ask to. Also since it is a random search, it did not make sense to do it.

6. Code Review

a After pushing my commits to the refactor branch, I raised a pull request for merging the refactor to master branch.
LINK: https://github.com/shantanushishodia/cse-464-2023-sshishod/pull/3

b Verified the working of CI. Tests passed and there were no conflicts.
LINK:
https://github.com/shantanushishodia/cse-464-2023-sshishod/actions/runs/6985883549/job/19010700636

c Screenshot for the workflow build success:



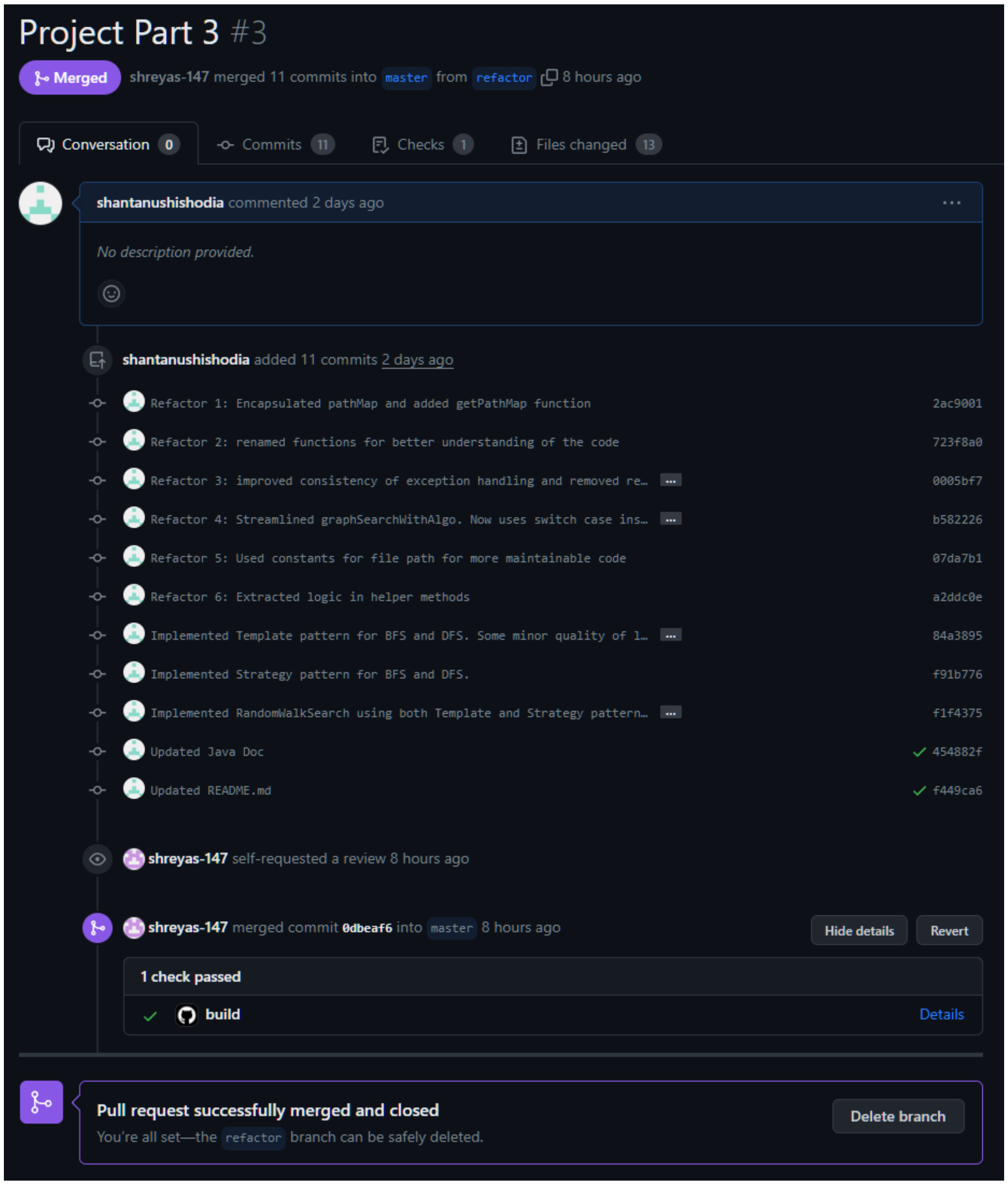
Triggered via pull request 2 days ago
shantanushishodia synchronize #3 refactor

Status: Success
Total duration: 36s
Billable time: 1m
Artifacts: –

maven.yml
on: pull_request

build 24s

d The PR was merged successfully. [Reviewed by: Shreyas Kolte (shreyas-147)]
LINK: https://github.com/shantanushishodia/cse-464-2023-sshishod/pull/3



Project Part 3 #3

Merged shreyas-147 merged 11 commits into master from refactor 8 hours ago

Conversation 0 · Commits 11 · Checks 1 · Files changed 13

shantanushishodia commented 2 days ago

No description provided.

shantanushishodia added 11 commits 2 days ago

```
Refactor 1: Encapsulated pathMap and added getPathMap function                 2ac9001
Refactor 2: renamed functions for better understanding of the code             723f8a0
Refactor 3: improved consistency of exception handling and removed re… …       0005bf7
Refactor 4: Streamlined graphSearchWithAlgo. Now uses switch case ins… …       b582226
Refactor 5: Used constants for file path for more maintainable code            07da7b1
Refactor 6: Extracted logic in helper methods                                  a2ddc0e
Implemented Template pattern for BFS and DFS. Some minor quality of l… …       84a3895
Implemented Strategy pattern for BFS and DFS.                                  f91b776
Implemented RandomWalkSearch using both Template and Strategy pattern… …       f1f4375
Updated Java Doc                                                             ✓ 454882f
Updated README.md                                                            ✓ f449ca6
```

shreyas-147 self-requested a review 8 hours ago

shreyas-147 merged commit 0dbeaf6 into master 8 hours ago

Hide details · Revert

1 check passed

✓ build Details

Pull request successfully merged and closed

You're all set—the refactor branch can be safely deleted.

Delete branch

7. Appendix

a Final output after running the program using “mvn package” in IntelliJ:

```
[INFO] -------------------------------------------------------
[INFO]  T E S T S
[INFO] -------------------------------------------------------
[INFO] Running GraphHandlerTest
Graph Parsing Successful
output: src/outputDOTFile.dot
Graph Parsing Successful
Nodes Count: 6
Label of nodes:
Google
Meta
Ford
Tesla
NXP
Asus
Edges count: 6
Directional edges with nodes:
Google -> Meta
Meta -> Ford
Tesla -> NXP
NXP -> Asus
Ford -> Tesla
Google -> Ford

        Edge already present in the graph
Graph Parsing Successful
File save is a success src/testSaveGraphFile.txt
Graph Parsing Successful
Graph Parsing Successful
Google -> Meta -> Ford -> Tesla
No Path found
Graph Parsing Successful
Graph Parsing Successful
Google -> Meta -> Ford -> Tesla
No Path found
Graph Parsing Successful
Graph Parsing Successful
Graph Parsing Successful
Nodes Count: 6
Label of nodes:
Google
```

```
Meta
Ford
Tesla
NXP
Asus
Edges count: 5
Directional edges with nodes:
Google -> Meta
Meta -> Ford
Tesla -> NXP
NXP -> Asus
Ford -> Tesla

Graph Parsing Successful
Graph Parsing Successful
Graph Parsing Successful
Google -> Meta -> Ford -> Tesla
No Path found
Graph Parsing Successful
Nodes Count: 7
Label of nodes:
Google
Meta
Ford
Tesla
NXP
Asus
NASA
Edges count: 5
Directional edges with nodes:
Google -> Meta
Meta -> Ford
Tesla -> NXP
NXP -> Asus
Ford -> Tesla

Graph Parsing Successful
Nodes Count: 6
Label of nodes:
Google
Meta
Ford
Tesla
NXP
Asus
Edges count: 4
```

```
Directional edges with nodes:
Google -> Meta
Tesla -> NXP
NXP -> Asus
Ford -> Tesla

Graph Parsing Successful
Nodes Count: 5
Label of nodes:
Meta
Ford
Tesla
NXP
Asus
Edges count: 4
Directional edges with nodes:
Meta -> Ford
Tesla -> NXP
NXP -> Asus
Ford -> Tesla

Graph Parsing Successful
Graph Parsing Successful
Google -> Meta -> Ford -> Tesla
No Path found
[INFO] Tests run: 14, Failures: 0, Errors: 0, Skipped: 0, Time elapsed: 0.248 s -
in GraphHandlerTest
[INFO]
[INFO] Results:
[INFO]
[INFO] Tests run: 14, Failures: 0, Errors: 0, Skipped: 0
[INFO]
[INFO]
[INFO] --- maven-jar-plugin:2.4:jar (default-jar) @ SS_P1 ---
[INFO] Building jar:
C:\Users\shant\IdeaProjects\SS_P1\target\SS_P1-1.0-SNAPSHOT.jar
[INFO] ------------------------------------------------------------------------
[INFO] BUILD SUCCESS
[INFO] ------------------------------------------------------------------------
[INFO] Total time:  3.493 s
[INFO] Finished at: 2023-11-25T01:46:49-07:00
[INFO] ------------------------------------------------------------------------

Process finished with exit code 0
```