Task Manager - Final Project Report

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Github Repo link : https://github.com/ksibbala/CS567_Project

Introduction

The Task Manager project is a comprehensive C++ application designed to manage and organize tasks efficiently. It includes features for adding, updating, deleting, sorting, and searching tasks, among others. It categorizes tasks based on priority, status, and other attributes to provide users with an organized task management experience.

Code Structure

The project is built around the **TaskManager** class and the following key components:

1. **TaskManager Class**

   - Manages all task-related operations.
   - Contains methods for adding, updating, deleting, and displaying tasks.

2. **Task Struct**

   - Represents an individual task with attributes like task_id, title, description, priority and is_completed.

3. **Enums and Helpers**

   - Priority levels: LOW, MEDIUM, HIGH.
   - Helper methods to format priority and status for user-friendly output.

Features and Functionalities

1. **Core Operations**
   - **Add Task:** Adds a new task to the manager with a unique ID.
   - **Delete Task:** Deletes a task based on its ID.
   - **Update Task:** Updates task attributes like title, description, and priority.
   - **Mark as Completed:** Marks a task as completed.

2. **Display Features**

   - **Display All Tasks:** Lists all tasks with key details.
   - **Display Task Details:** Shows detailed information about a specific task.
   - **Display Completed/Incomplete Tasks:** Categorizes tasks based on completion status.

3. **Search and Sorting**

- ○ **Search by Title/Description:** Finds tasks containing specific keywords.
- ○ **Sort by Priority/Title:** Sorts tasks for better visibility and management.

Testing Information

Pre-Testing Process

- Compiled the application using clang++ with appropriate flags.
- Verified functional correctness with a series of manual inputs.
- Pulled Image using **docker pull agroce/deepstate_examples_aflpp**
- Mounted project as a volume onto the container **docker run -it -v /home/arshad/kavya/Assurance/project/:/home/user/deepstate/project / agroce/deepstate_examples_aflpp**

```
arshad@Arshad:~/kavya/Assurance/project$ docker run -it -v /home/arshad/kavya/Assurance/project/:/home/user/deepstate/project/ agroce/deepstate_examples_aflpp
user@81ba9aac2f90:~/deepstate$ ls
CMakeLists.txt  README.md   bin    build_afl       build_libfuzzer  docs      extras       mypy.ini  push  tests
LICENSE         Vagrantfile build  build_deepstate docker           examples  fix_reducer  project   src
user@81ba9aac2f90:~/deepstate$
```

Basic Test Cases

Running basic or default tests **clang++ task_manager.cpp test.cpp -o test -ldeepstate ./test**

```
user@81ba9aac2f90:~/deepstate/project$ clang++ task_manager.cpp test.cpp -o test -ldeepstate
user@81ba9aac2f90:~/deepstate/project$ ./test
TRACE: Running: TaskManagementTest_AddTask from test.cpp(9)
Task added successfully.
TRACE: Passed: TaskManagementTest_AddTask
TRACE: Running: TaskManagementTest_FindTask from test.cpp(24)
Task added successfully.
Task added successfully.
TRACE: Passed: TaskManagementTest_FindTask
TRACE: Running: TaskManagementTest_DeleteTask from test.cpp(53)
Task added successfully.
Task added successfully.
Task 1 deleted successfully.
TRACE: Passed: TaskManagementTest_DeleteTask
TRACE: Running: TaskManagementTest_UpdateTask from test.cpp(73)
Task added successfully.
Task updated successfully.
TRACE: Passed: TaskManagementTest_UpdateTask
TRACE: Running: TaskManagementTest_MarkTaskCompleted from test.cpp(103)
Task added successfully.
Task 1 marked as completed.
TRACE: Passed: TaskManagementTest_MarkTaskCompleted
TRACE: Running: TaskManagementTest_DisplayTaskDetails from test.cpp(129)
Task added successfully.
TRACE: Passed: TaskManagementTest_DisplayTaskDetails
TRACE: Running: TaskManagementTest_FormatPriority from test.cpp(164)
TRACE: Passed: TaskManagementTest_FormatPriority
TRACE: Running: TaskManagementTest_FormatStatus from test.cpp(185)
TRACE: Passed: TaskManagementTest_FormatStatus
TRACE: Running: TaskManagementTest_DisplayAllTasks from test.cpp(198)
Task added successfully.
Task added successfully.
TRACE: Passed: TaskManagementTest_DisplayAllTasks
TRACE: Running: TaskManagementTest_DisplayCompletedTasks from test.cpp(221)
Task added successfully.
Task added successfully.
Task 1 marked as completed.
TRACE: Passed: TaskManagementTest_DisplayCompletedTasks
TRACE: Running: TaskManagementTest_DisplayIncompleteTasks from test.cpp(245)
Task added successfully.
Task added successfully.
Task 1 marked as completed.
TRACE: Passed: TaskManagementTest_DisplayIncompleteTasks
TRACE: Running: TaskManagementTest_CountTasksByStatus from test.cpp(271)
Task added successfully.
Task added successfully.
Task 1 marked as completed.
TRACE: Passed: TaskManagementTest_CountTasksByStatus
TRACE: Running: TaskManagementTest_ClearCompletedTasks from test.cpp(295)
Task added successfully.
```

Fuzzy test:
mkdir failures
./test --fuzz --timeout 60 --output_test_dir failures

```
[user@81ba9aac2f90:~/deepstate/project$ mkdir failures
[user@81ba9aac2f90:~/deepstate/project$ ./test --fuzz --timeout 60 --output_test_dir failures
 INFO: Starting fuzzing
```

Output

```
Task added successfully.
Task added successfully.
Task added successfully.
Task added successfully.
Task added successfully.
Task added successfully.
Task added successfully.
Task added successfully.
INFO: Done fuzzing! Ran 2188856 tests (36480 tests/second) with 0 failed/2188856 passed/0 abandoned tests
user@81ba9aac2f90:~/deepstate/project$
```

Total 2188856 tests has been ran and all are passed with zero failed tests

Generating mutants

mutate task_manager.cpp

```
[user@81ba9aac2f90:~/deepstate/project$
[user@81ba9aac2f90:~/deepstate/project$
[user@81ba9aac2f90:~/deepstate/project$ mutate task_manager.cpp
*** UNIVERSALMUTATOR ***
MUTATING WITH RULES: universal.rules, cpp.rules, c_like.rules
```

Mutation output

```
user@81ba9aac2f90:~/deepstate/project$ mutate task_manager.cpp
*** UNIVERSALMUTATOR ***
MUTATING WITH RULES: universal.rules, cpp.rules, c_like.rules
SKIPPED 15 MUTANTS ONLY CHANGING STRING LITERALS
2461 MUTANTS GENERATED BY RULES
PROCESSING MUTANT: 2: using namespace std;  ==>  using namespace std;
break;...VALID [written to ./task_manager.mutant.0.cpp]
PROCESSING MUTANT: 2: using namespace std;  ==>  using namespace std;
continue;...VALID [written to ./task_manager.mutant.1.cpp]
PROCESSING MUTANT: 2: using namespace std;  ==>  /*using namespace std;*/...VALID [written to ./task_manager.mutant.2.cpp]
PROCESSING MUTANT: 4: TaskManager::TaskManager() : task_counter(0) {}  ==>  TaskManager::TaskManager() : task_counter(1) {}...VALID [written to ./task_manager.mutant.3.cpp]
PROCESSING MUTANT: 4: TaskManager::TaskManager() : task_counter(0) {}  ==>  TaskManager::TaskManager() : task_counter(-1) {}...VALID [written to ./task_manager.mutant.4.cpp]
PROCESSING MUTANT: 4: TaskManager::TaskManager() : task_counter(0) {}  ==>  TaskManager::TaskManager() : task_counter((0+1)) {}...VALID [written to ./task_manager.mutant.5.cpp]
PROCESSING MUTANT: 4: TaskManager::TaskManager() : task_counter(0) {}  ==>  TaskManager::TaskManager() : task_counter((0-1)) {}...VALID [written to ./task_manager.mutant.6.cpp]
PROCESSING MUTANT: 4: TaskManager::TaskManager() : task_counter(0) {}  ==>  TaskManager::TaskManager() : task_counter(0) {}
break;...VALID [written to ./task_manager.mutant.7.cpp]
PROCESSING MUTANT: 4: TaskManager::TaskManager() : task_counter(0) {}  ==>  TaskManager::TaskManager() : task_counter(0) {}
continue;...VALID [written to ./task_manager.mutant.8.cpp]
PROCESSING MUTANT: 4: TaskManager::TaskManager() : task_counter(0) {}  ==>  /*TaskManager::TaskManager() : task_counter(0) {}*/...VALID [written to ./task_manager.mutant.9.cpp]
PROCESSING MUTANT: 6: void TaskManager::addTask(const string &title, const string &description, Priority priority)  ==>  void TaskManager::addTask(const string |title, const string &description, Priority priority)...VALID [written to ./task_manager.mutant.10.cpp]
PROCESSING MUTANT: 6: void TaskManager::addTask(const string &title, const string &description, Priority priority)  ==>  void TaskManager::addTask(const string &title, const string |description, Priority priority)...VALID [written to ./task_manager.mutant.11.cpp]
PROCESSING MUTANT: 6: void TaskManager::addTask(const string &title, const string &description, Priority priority)  ==>  void TaskManager::addTask(const string &title, const string &description, Priority priority)
break;...VALID [written to ./task_manager.mutant.12.cpp]
PROCESSING MUTANT: 6: void TaskManager::addTask(const string &title, const string &description, Priority priority)  ==>  void TaskManager::addTask(const string &title, const string &description, Priority priority)
continue;...VALID [written to ./task_manager.mutant.13.cpp]
PROCESSING MUTANT: 6: void TaskManager::addTask(const string &title, const string &description, Priority priority)  ==>  void TaskManager::addTask ( const string &description,const string &title, Priority priority)...VALID [written to ./task_manager.mutant.14.cpp]
PROCESSING MUTANT: 6: void TaskManager::addTask(const string &title, const string &description, Priority priority)  ==>  void TaskManager::addTask(const string &title, Priority priority, const string &description))...VALID [written to ./task_manager.mutant.15.cpp]
PROCESSING MUTANT: 6: void TaskManager::addTask(const string &title, const string &description, Priority priority)  ==>  /*void TaskManager::addTask(const string &title, const string &description, Priority priority)*/...VALID [written to ./task_manager.mutant.16.cpp]
PROCESSING MUTANT: 7: {  ==>  {
break;...VALID [written to ./task_manager.mutant.17.cpp]
PROCESSING MUTANT: 7: {  ==>  {
continue;...VALID [written to ./task_manager.mutant.18.cpp]
PROCESSING MUTANT: 8:     if (tasks.size() >= MAX_TASKS)  ==>      if (tasks.size() == MAX_TASKS)...VALID [written to ./task_manager.mutant.19.cpp]
PROCESSING MUTANT: 8:     if (tasks.size() >= MAX_TASKS)  ==>      if (tasks.size() != MAX_TASKS)...VALID [written to ./task_manager.mutant.20.cpp]
PROCESSING MUTANT: 299:     std::cout << "Tasks sorted by title." << std::endl;  ==>      std::cout <= "Tasks sorted by title." << std::endl;...VALID [written to ./task_manager.mutant.2449.cpp]
PROCESSING MUTANT: 299:     std::cout << "Tasks sorted by title." << std::endl;  ==>      std::cout << "Tasks sorted by title." >= std::endl;...VALID [written to ./task_manager.mutant.2450.cpp]
PROCESSING MUTANT: 299:     std::cout << "Tasks sorted by title." << std::endl;  ==>      std::cout << "Tasks sorted by title." <= std::endl;...VALID [written to ./task_manager.mutant.2451.cpp]
PROCESSING MUTANT: 299:     std::cout << "Tasks sorted by title." << std::endl;  ==>      std::cout != "Tasks sorted by title." << std::endl;...VALID [written to ./task_manager.mutant.2452.cpp]
PROCESSING MUTANT: 299:     std::cout << "Tasks sorted by title." << std::endl;  ==>      std::cout <! "Tasks sorted by title." << std::endl;...VALID [written to ./task_manager.mutant.2453.cpp]
PROCESSING MUTANT: 299:     std::cout << "Tasks sorted by title." << std::endl;  ==>      std::cout << "Tasks sorted by title." !< std::endl;...VALID [written to ./task_manager.mutant.2454.cpp]
PROCESSING MUTANT: 299:     std::cout << "Tasks sorted by title." << std::endl;  ==>      std::cout << "Tasks sorted by title." <!= std::endl;...VALID [written to ./task_manager.mutant.2455.cpp]
PROCESSING MUTANT: 299:     std::cout << "Tasks sorted by title." << std::endl;  ==>      std::cout << "Tasks sorted by title." << std::endl;
    break;...VALID [written to ./task_manager.mutant.2456.cpp]
PROCESSING MUTANT: 299:     std::cout << "Tasks sorted by title." << std::endl;  ==>      std::cout << "Tasks sorted by title." << std::endl;
    continue;...VALID [written to ./task_manager.mutant.2457.cpp]
PROCESSING MUTANT: 299:     std::cout << "Tasks sorted by title." << std::endl;  ==>      std::cout << "" << std::endl;...VALID [written to ./task_manager.mutant.2458.cpp]
PROCESSING MUTANT: 299:     std::cout << "Tasks sorted by title." << std::endl;  ==>      std::cout << "Tasks sorted by title." << std::begin1;...VALID [written to ./task_manager.mutant.2459.cpp]
PROCESSING MUTANT: 299:     std::cout << "Tasks sorted by title." << std::endl;  ==>      /*std::cout << "Tasks sorted by title." << std::endl;*/...VALID [written to ./task_manager.mutant.2460.cpp]
2461 VALID MUTANTS
0 INVALID MUTANTS
0 REDUNDANT MUTANTS
Valid Percentage: 100.0%

*************************************************************************
WARNING:  because the handler does not compile and so has no pruning support,
all mutants were considered valid.  Consider using --cmd to build the target!
*************************************************************************

user@81ba9aac2f90:~/deepstate/project$
```

Analyzing the mutants :

```
RUNNING ./task_manager.mutant.116.cpp...
./task_manager.mutant.116.cpp KILLED IN 0.754481315612793 (RETURN CODE 1)
   RUNNING SCORE: 1.0
=================================================================
#3: [1.62s 0.08% DONE]
RUNNING ./task_manager.mutant.1253.cpp...
./task_manager.mutant.1253.cpp KILLED IN 0.7552108764648438 (RETURN CODE 1)
   RUNNING SCORE: 1.0
=================================================================
#4: [2.38s 0.12% DONE]
RUNNING ./task_manager.mutant.330.cpp...
./task_manager.mutant.330.cpp KILLED IN 0.8080124855041504 (RETURN CODE 1)
   RUNNING SCORE: 1.0
=================================================================
#5: [3.19s 0.16% DONE]
RUNNING ./task_manager.mutant.807.cpp...
./task_manager.mutant.807.cpp KILLED IN 0.7555637359619141 (RETURN CODE 1)
   RUNNING SCORE: 1.0
=================================================================
#6: [3.95s 0.2% DONE]
RUNNING ./task_manager.mutant.1502.cpp...
./task_manager.mutant.1502.cpp KILLED IN 0.7551891803741455 (RETURN CODE 1)
   RUNNING SCORE: 1.0
=================================================================
#7: [4.71s 0.24% DONE]
RUNNING ./task_manager.mutant.1482.cpp...
./task_manager.mutant.1482.cpp KILLED IN 0.8047537803649902 (RETURN CODE 1)
   RUNNING SCORE: 1.0
=================================================================
#8: [5.52s 0.28% DONE]
RUNNING ./task_manager.mutant.1003.cpp...
./task_manager.mutant.1003.cpp NOT KILLED
   RUNNING SCORE: 0.875
=================================================================
#9: [6.43s 0.33% DONE]
RUNNING ./task_manager.mutant.206.cpp...
./task_manager.mutant.206.cpp KILLED IN 1.007190227508545 (RETURN CODE 1)
   RUNNING SCORE: 0.8888888888888888
=================================================================
#10: [7.44s 0.37% DONE]
RUNNING ./task_manager.mutant.1724.cpp...
./task_manager.mutant.1724.cpp KILLED IN 0.8051333427429199 (RETURN CODE 1)
   RUNNING SCORE: 0.9
=================================================================
#11: [8.25s 0.41% DONE]
RUNNING ./task_manager.mutant.920.cpp...
./task_manager.mutant.920.cpp KILLED IN 0.8556392192840576 (RETURN CODE 1)
   RUNNING SCORE: 0.9090909090909091
=================================================================
#12: [9.1s 0.45% DONE]
```

```
#2452: [2259.97s 99.59% DONE]
RUNNING ./task_manager.mutant.2402.cpp...
./task_manager.mutant.2402.cpp KILLED IN 1.259821891784668 (RETURN CODE 1)
   RUNNING SCORE: 0.9053833605220228
=================================================================
#2453: [2261.24s 99.63% DONE]
RUNNING ./task_manager.mutant.349.cpp...
./task_manager.mutant.349.cpp KILLED IN 1.2089052200317383 (RETURN CODE 1)
   RUNNING SCORE: 0.9054219323277619
=================================================================
#2454: [2262.45s 99.67% DONE]
RUNNING ./task_manager.mutant.1523.cpp...
./task_manager.mutant.1523.cpp KILLED IN 1.3096351623535156 (RETURN CODE 1)
   RUNNING SCORE: 0.9054604726976365
=================================================================
#2455: [2263.77s 99.72% DONE]
RUNNING ./task_manager.mutant.2357.cpp...
./task_manager.mutant.2357.cpp KILLED IN 1.2102820873260498 (RETURN CODE 1)
   RUNNING SCORE: 0.9054989816700612
=================================================================
#2456: [2264.98s 99.76% DONE]
RUNNING ./task_manager.mutant.1220.cpp...
./task_manager.mutant.1220.cpp KILLED IN 1.2641377449035645 (RETURN CODE 1)
   RUNNING SCORE: 0.9055374592833876
=================================================================
#2457: [2266.25s 99.8% DONE]
RUNNING ./task_manager.mutant.1582.cpp...
./task_manager.mutant.1582.cpp KILLED IN 1.1592516899108887 (RETURN CODE 1)
   RUNNING SCORE: 0.9055759055759056
=================================================================
#2458: [2267.41s 99.84% DONE]
RUNNING ./task_manager.mutant.1990.cpp...
./task_manager.mutant.1990.cpp KILLED IN 1.2636349201202393 (RETURN CODE 1)
   RUNNING SCORE: 0.9056143205858421
=================================================================
#2459: [2268.68s 99.88% DONE]
RUNNING ./task_manager.mutant.515.cpp...
./task_manager.mutant.515.cpp NOT KILLED
   RUNNING SCORE: 0.9052460349735665
=================================================================
#2460: [2270.25s 99.92% DONE]
RUNNING ./task_manager.mutant.145.cpp...
./task_manager.mutant.145.cpp KILLED IN 1.4150242805480957 (RETURN CODE 3)
   RUNNING SCORE: 0.9052845528455284
=================================================================
#2461: [2271.66s 99.96% DONE]
RUNNING ./task_manager.mutant.1456.cpp...
./task_manager.mutant.1456.cpp KILLED IN 1.2116694450378418 (RETURN CODE 1)
   RUNNING SCORE: 0.905323039414872
=================================================================
MUTATION SCORE: 0.905323039414872
user@111f5610679d:~/deepstate/project$
```

The Mutation Score is 0.9

Code Coverage

Code coverage (deleted all the mutant files before checking the coverage)

clang++ task_manager.cpp test.cpp -o test -ldeepstate --coverage

./test

```
user@81ba9aac2f90:~/deepstate/project$ clang++ task_manager.cpp test.cpp -o test -ldeepstate --coverage
user@81ba9aac2f90:~/deepstate/project$ ./test
TRACE: Running: TaskManagementTest_AddTask from test.cpp(9)
Task added successfully.
TRACE: Passed: TaskManagementTest_AddTask
TRACE: Running: TaskManagementTest_FindTask from test.cpp(24)
Task added successfully.
Task added successfully.
TRACE: Passed: TaskManagementTest_FindTask
TRACE: Running: TaskManagementTest_DeleteTask from test.cpp(53)
Task added successfully.
Task added successfully.
Task 1 deleted successfully.
TRACE: Passed: TaskManagementTest_DeleteTask
TRACE: Running: TaskManagementTest_UpdateTask from test.cpp(73)
Task added successfully.
Task updated successfully.
TRACE: Passed: TaskManagementTest_UpdateTask
TRACE: Running: TaskManagementTest_MarkTaskCompleted from test.cpp(103)
```

llvm-cov-9 gcov task_manager.cpp

```
user@81ba9aac2f90:~/deepstate/project$ llvm-cov-9 gcov task_manager.cpp
File './task_manager.h'
Lines executed:100.00% of 1
./task_manager.h:creating 'task_manager.h.gcov'

File '/usr/bin/../lib/gcc/x86_64-linux-gnu/7.5.0/../../../../include/c++/7.5.0/bits/alloc_traits.h'
Lines executed:100.00% of 10
/usr/bin/../lib/gcc/x86_64-linux-gnu/7.5.0/../../../../include/c++/7.5.0/bits/alloc_traits.h:creating 'alloc_traits.h.gcov'

File '/usr/bin/../lib/gcc/x86_64-linux-gnu/7.5.0/../../../../include/c++/7.5.0/bits/allocator.h'
Lines executed:100.00% of 1
/usr/bin/../lib/gcc/x86_64-linux-gnu/7.5.0/../../../../include/c++/7.5.0/bits/allocator.h:creating 'allocator.h.gcov'
```

```
Lines executed:75.00% of 20
/usr/bin/../lib/gcc/x86_64-linux-gnu/7.5.0/../../../../include/c++/7.5.0/bits/stl_uninitialized.h:creating 'stl_uninitialized.h.gcov'

File '/usr/bin/../lib/gcc/x86_64-linux-gnu/7.5.0/../../../../include/c++/7.5.0/bits/stl_vector.h'
Lines executed:98.08% of 52
/usr/bin/../lib/gcc/x86_64-linux-gnu/7.5.0/../../../../include/c++/7.5.0/bits/stl_vector.h:creating 'stl_vector.h.gcov'

File '/usr/bin/../lib/gcc/x86_64-linux-gnu/7.5.0/../../../../include/c++/7.5.0/bits/vector.tcc'
Lines executed:82.98% of 47
/usr/bin/../lib/gcc/x86_64-linux-gnu/7.5.0/../../../../include/c++/7.5.0/bits/vector.tcc:creating 'vector.tcc.gcov'

File '/usr/bin/../lib/gcc/x86_64-linux-gnu/7.5.0/../../../../include/c++/7.5.0/ext/new_allocator.h'
Lines executed:92.31% of 13
/usr/bin/../lib/gcc/x86_64-linux-gnu/7.5.0/../../../../include/c++/7.5.0/ext/new_allocator.h:creating 'new_allocator.h.gcov'

File '/usr/bin/../lib/gcc/x86_64-linux-gnu/7.5.0/../../../../include/c++/7.5.0/iostream'
Lines executed:100.00% of 1
/usr/bin/../lib/gcc/x86_64-linux-gnu/7.5.0/../../../../include/c++/7.5.0/iostream:creating 'iostream.gcov'

File 'task_manager.cpp'
Lines executed:81.38% of 188
task_manager.cpp:creating 'task_manager.cpp.gcov'

user@81ba9aac2f90:~/deepstate/project$
```

Unit testing ensured approximately **82% code coverage**, with focus on all major functionalities.