Project 4 Documentation

02/27/18

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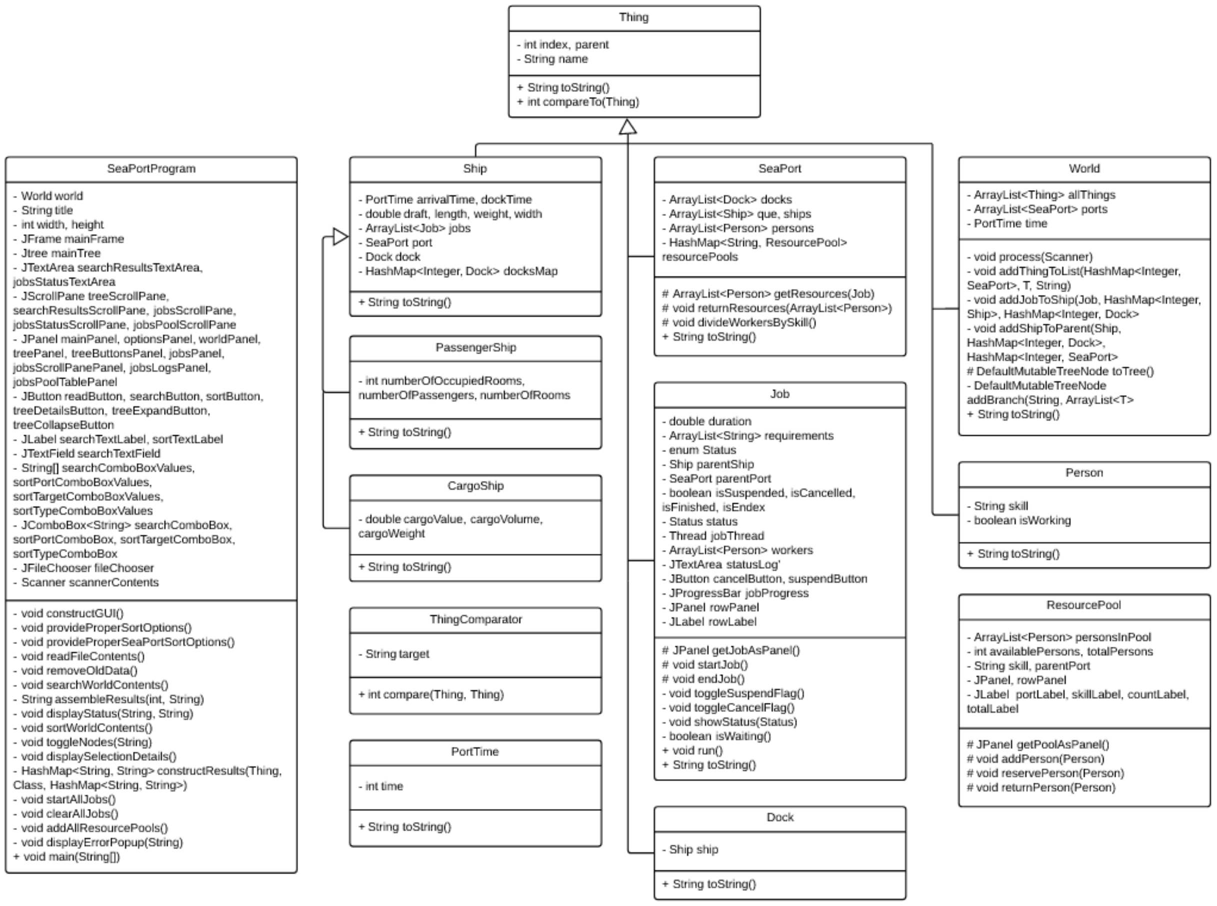
UMUC CMSC 335

Part I: Design


Thing
- int index, parent
- String name
+ String toString()
+ int compareTo(Thing)
SeaPortProgram
- World world
- String title
- int width, height
- JFrame mainFrame
- Jtree mainTree
- JTextArea searchResultsTextArea, jobsStatusTextArea
- JScrollPane treeScrollPane, searchResultsScrollPane, jobsScrollPane, jobsStatusScrollPane, jobsPoolScrollPane
- JPanel mainPanel, optionsPanel, worldPanel, treePanel, treeButtonsPanel, jobsPanel, jobsScrollPanePanel, jobsLogsPanel, jobsPoolTablePanel
- JButton readButton, searchButton, sortButton, treeDetailsButton, treeExpandButton, treeCollapseButton
- JLabel searchTextLabel, sortTextLabel
- JTextField searchTextField
- String[] searchComboBoxValues, sortPortComboBoxValues, sortTargetComboBoxValues, sortTypeComboBoxValues
- JComboBox<String> searchComboBox, sortPortComboBox, sortTargetComboBox, sortTypeComboBox
- JFileChooser fileChooser
- Scanner scannerContents
- void constructGUI()
- void provideProperSortOptions()
- void provideProperSeaPortSortOptions()
- void readFileContents()
- void removeOldData()
- void searchWorldContents()
- String assembleResults(int, String)
- void displayStatus(String, String)
- void sortWorldContents()
- void toggleNodes(String)
- void displaySelectionDetails()
- HashMap<String, String> constructResults(Thing, Class, HashMap<String, String>)
- void startAllJobs()
- void clearAllJobs()
- void addAllResourcePools()
- void displayErrorPopup(String)
+ void main(String[])
Ship
- PortTime arrivalTime, dockTime
- double draft, length, weight, width
- ArrayList<Job> jobs
- SeaPort port
- Dock dock
- HashMap<Integer, Dock> docksMap
+ String toString()
PassengerShip
- int numberOfOccupiedRooms, numberOfPassengers, numberOfRooms
+ String toString()
CargoShip
- double cargoValue, cargoVolume, cargoWeight
+ String toString()
ThingComparator
- String target
+ int compare(Thing, Thing)
PortTime
- int time
+ String toString()
SeaPort
- ArrayList<Dock> docks
- ArrayList<Ship> que, ships
- ArrayList<Person> persons
- HashMap<String, ResourcePool> resourcePools
# ArrayList<Person> getResources(Job)
# void returnResources(ArrayList<Person>)
# void divideWorkersBySkill()
+ String toString()
Job
- double duration
- ArrayList<String> requirements
- enum Status
- Ship parentShip
- SeaPort parentPort
- boolean isSuspended, isCancelled, isFinished, isEndex
- Status status
- Thread jobThread
- ArrayList<Person> workers
- JTextArea statusLog'
- JButton cancelButton, suspendButton
- JProgressBar jobProgress
- JPanel rowPanel
- JLabel rowLabel
# JPanel getJobAsPanel()
# void startJob()
# void endJob()
- void toggleSuspendFlag()
- void toggleCancelFlag()
- void showStatus(Status)
- boolean isWaiting()
+ void run()
+ String toString()
Dock
- Ship ship
+ String toString()
World
- ArrayList<Thing> allThings
- ArrayList<SeaPort> ports
- PortTime time
- void process(Scanner)
- void addThingToList(HashMap<Integer, SeaPort>, T, String)
- void addJobToShip(Job, HashMap<Integer, Ship>, HashMap<Integer, Dock>)
- void addShipToParent(Ship, HashMap<Integer, Dock>, HashMap<Integer, SeaPort>
# DefaultMutableTreeNode toTree()
- DefaultMutableTreeNode addBranch(String, ArrayList<T>)
+ String toString()
Person
- String skill
- boolean isWorking
+ String toString()
ResourcePool
- ArrayList<Person> personsInPool
- int availablePersons, totalPersons
- String skill, parentPort
- JPanel, rowPanel
- JLabel portLabel, skillLabel, countLabel, totalLabel
# JPanel getPoolAsPanel()
# void addPerson(Person)
# void reservePerson(Person)
# void returnPerson(Person)

(Author note: Getters/setters not included in UML diagram due to a lack of space and an inability to make the entire diagram fit in one frame to screen capture. Relatedly, all images, diagram and screenshots have been included in a zip file for convenient HD viewing.)

As per the first three projects, the only unused class was `PortTime` which was mentioned nowhere in the rubric and was simply included due its mention on the first page. As of the author's second Project 4 submission, the only new class is `ResourcePool`, employed to keep GUI components related to a skill/occupation separate and easier to modify as workers are set to away or back by various jobs.

Part II: User's Guide

Users unfamiliar with the process of running Java programs may have some difficulty running Project 4 without some prior experience and a set of qualifications. Users must have Java installed on their computer and must have administrator privileges on their chosen machine. Pointing the Windows command prompt to the folder containing the files, users must first compile the classes by typing `javac SeaPortProgram.java`. Once compiled, users may enter `java SeaPortProgram` to run the program and begin interacting with the GUI. Alternatively, if users possess an IDE like NetBeans, they can open `SeaPortProgram.java` and run the program from within after creating a new package.

To prevent invalid input, the program will not open non-text files or ill-formatted text files, so users must make an effort to open a file that conforms to the organizational layout of the sample data files. It should be noted that the use of the search bar necessitates the inclusion of proper input. Case and spelling are both integral to retrieving the desired results, as the program will not find or display any results that are improperly formatted as they appear in the text file.

Part III: Test Plan

Upon starting the project, the author discovered he had inadvertently fulfilled most of the Project 4 rubric requirements in his Project 3 submission. As such, the vast majority of the author's initial Project 4 changes were focused on two specific overarching categories, namely, GUI improvements and outstanding bug fixes.

Regarding the aforementioned GUI updates, the author determined that Project 3's largely text-based approach of displaying workers engaged in certain jobs was not the most conducive way of displaying the worker pool. As such, the former workers' status log was merged with the more general job progression log, with the single `JTextArea` now displaying messages related to both ship mooring/unmooring and worker reservation. Though logs are now significantly lengthier, this combination ensures that all relevant messages related to the job progression operations are all visible in a single location.

Secondly, the newfound space where this previous log entry formerly sat was initially replaced by a new `JTable`-esque section, originally listing the names, locations, skills, and availability of all workers in the `World` instance. This section was modelled according to the design ethos of the `Job` listing section from Project 3, wherein each `Person` object possessed a protected method permitting an exterior, GUI class-located method to assemble a pseudo-row `JPanel` for display in a table-like listing. This decision was reached after the author unsuccessfully attempted to implement a similar idea with `JTables` and an `AbstractTableModel` implementation, an approach which technically worked but proved unsatisfactory in the long run. Initially, each `SeaPort` had a specific `JTable` and `AbstractTableModel` of its own in order to more readily demarcate the distinctions between each port's workers, though this was replaced by a global listing created by the GUI class following the removal of the `JTable` implementation.

However, the author came to realize that the underlying assumption leading to the birth of this section may have been built on a misunderstanding of the project rubric. The author interpreted the rubric's mention of "resource pools" as a reference to each `SeaPort`'s own `persons` `ArrayList` required by the rubric, itself used to store the individuals located in that port. Ships' jobs would be required to draw from this regional resource pool to find workers capable of completing their jobs. However, after submitting his first attempt, the author realized that he may have misinterpreted the nature of the "resource pool," now believing the rubric to mean the subdivision of local dock workers into resource pools based on the nature of their skill. As such, the author removed the code related to displaying each worker, instead creating a new class, `ResourcePool`, that houses workers of that pool's specific skill or occupation. Each of these class instances possesses a method like that formerly in `Person` that allows an external GUI class like `SeaPortProgram` to construct a pseudo-row for each pool and display its contents in the GUI as a pseudo-`JTable`. Each row lists the number of total workers available for work, as well as the number currently available.

As per this aforementioned external construction process, an additional utility/assembly method was added to the body of `SeaPortProgram` that assembles the individual rows and adds to them to a specific `JPanel` location, thus maintaining some semblance of consistency with the MVC design paradigm by keeping GUI code in the specific GUI-oriented class. As workers are reserved and returned by `Ship`s as their jobs are completed, the color and text of each `Person`'s status `JLabel` were originally changed to reflect the worker's current situation, whether available or employed. However, this functionality was removed with the author's subsequent application of occupation-based resource pools. Instead, the count of available workers of a certain skill is now dynamically changed as workers are returned at their jobs’ end. All `ResourcePools` are organized by the name of their respective `SeaPort` location, the names of which are listed alphabetically.

Concerning bug fixes, the author took the time to look over a number of longstanding bugs that have not been patched, as focus has repeated shifted to more pressing matters over the course of the four projects and left little time for related fixes. One such bug that has persisted since the first project concerned instances wherein the user opened the `JFileChooser` modal but exited out of the window prior to file selection. In such cases, the program failed to check if any file had been selected and generally threw an exception related to the fact that a `World` instance was initialized anyway without any proper `Scanner` data. The author repaired this by initializing the file selection to `null` and checking for null cases after the modal’s close, returning from such cases without creating a new `World` instance.

A bug related to the `Job` progression process that has been known to the author since Project 3 concerns `Job` instances requiring multiple instances of a certain skill (i.e. a job requires an electrician and two clerks). In such cases, the program lists such jobs as forever waiting, as they believe that enough workers with required skills exist in their port, while in actuality this may not be the case. While it is possible that a port may have an electrician and a clerk, for example, there may be only one clerk, not the two the job requires to process. This case would throw a false positive in `SeaPort.getResources` that would essentially indicate that all required workers exist (even if not available), while in actuality all that would be indicated would be that the port has workers matching all skills. The fix for this bug involved the creation of a `HashMap` containing keys of skills whose values represented the number of requested instances of that skill. If that skill's `ResourcePool` persons listing possessed fewer instances of workers in total than the requested number, thus meaning that the job would never have enough workers to complete, the job would terminate rather than wait indefinitely.

Another bug that the author discovered in the course of writing Project 3 is related to cases wherein the port in which the job's ship exists has no workers, available or otherwise, possessing the necessary skills to process the ship's job to completion. Previously in Project 3, the author saw fit to simply pass an empty `ArrayList` bereft of worker candidates back from the `SeaPort.getResources` method to ensure that the ship is not kept waiting indefinitely in `Job.isWaiting`, forbidden from progressing. As this method seemed a bit hacky and long-winded in waiting for said thread to die, the author simplified this by adding a few lines to `SeaPort.getResources` that automatically call `Job.endJob` on the thread at hand if no `ResourcePool` exists for that skill, naturally ending the thread and marking the job as 100% completed and "Done" in the job progression `JPanel` pseudo-table. This behavior was achieved by adding an invocation of the same method used to cancel a thread/job via the cancelation `JButton`, namely, `Job.toggleCancelFlag`, to the body of `Job.endJob`.

Part III b: Test Cases

The test files employed by the author to test the output of the program were mostly unchanged variants of the Project 3 text files, namely `aSPaa.txt` and `aSPae.txt`. However, for the purposes of testing the assorted bug fixes implemented over the course of this project, the author added a few new jobs and persons to the latter file. This was done to test the two specific `Job`-based bug fixes, namely cases wherein jobs require skills not possessed by any workers in the port, and cases wherein jobs require multiple instances of the same skill to finish. As such, a new job was added to the *SS Drones* that requires a clown and a basketweaver, skills not possessed by any workers in the Bergen port, and a new worker, cook Clint, was added to help complete a second new job attached to the *SS Absolution* in Baltimore that requires the services of an inspector and two cooks.

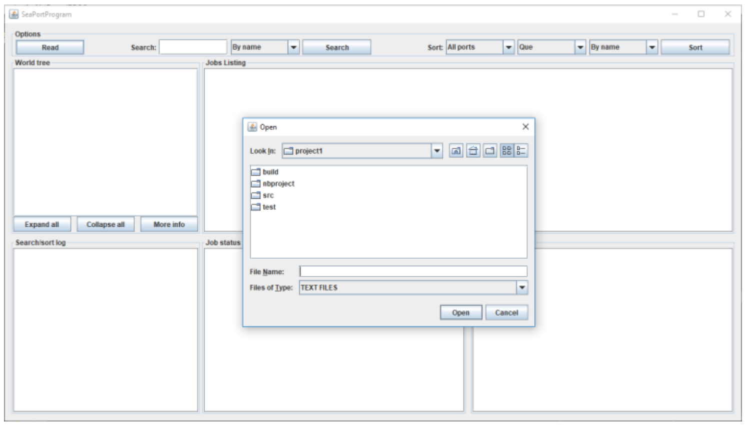
Once again, for the aforementioned reasons listed in the Project 3 documentation file, the author has elected to not include `aSPad.txt` from the Project 2 submission in any of the test cases included herein due to its sheer size and inherent complexity. However, the few tests of that file the author undertook ended successfully, with all specific job instances completing as expected.

As was the case with the first three project documentation files, the author will not include tests of previously tested functionality, such as the search/sort functions, as no major changes have been made to the underlying methods. Only tests of the `Job` progression-related features and functionality will be included. For details regarding the other functionality, the author recommends a look back at the specific cases included in the Projects 1, 2, and 3 documentation files.

Lastly, due to the inherent complexity of displaying images of processes that occur in real time and would be better suited to `.gif` files, the author has included a bit of verbal discussion charting the specific operations and actions of the various progressions that may be encountered for each of the text files. As was the case for the Project 3 submission, multiple run-throughs of the program are possible depending entirely upon which threads gain mutually exclusive access to their ports' resources first.

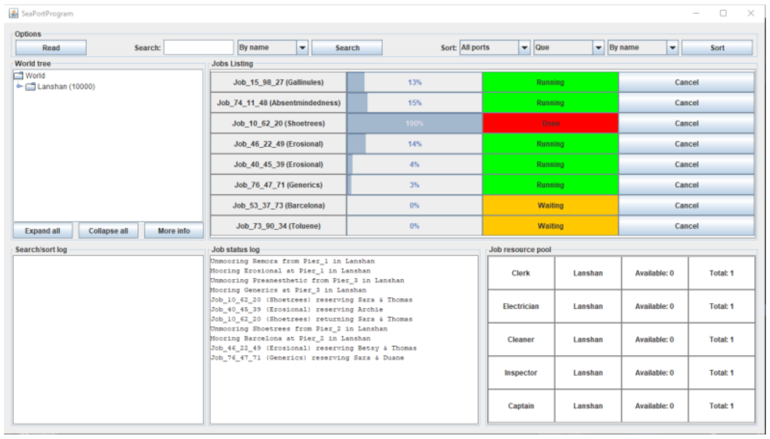
Text File	**Input**	**Expected Output**	**Output**
N/a	Closing `JFileChooser` w/o selecting file	No error message shown or exception thrown	No error message shown or exception thrown
`aSPaa.txt`	"Cancel" button on *Shoetrees*	Ship's progression is halted, button color/text is changed.	Ship's progression is halted, button color/text is changed.
`aSPae.txt`	"Suspend" button on all running jobs	Progression is paused, button color/text is changed.	Progression is paused, button color/text is changed.
`aSPaa.txt`	No input	Differs depending on which job gets SeaPort access first; see associated discussion	Differs depending on which job gets SeaPort access first; see associated discussion
`aSPae.txt`	No input	Differs depending on which job gets SeaPort access first; see associated discussion	Differs depending on which job gets SeaPort access first; see associated discussion

Test Case 1



In the first test case, the author tested a fix for a longstanding issue, namely the opening of a `JFileChooser` modal and exit prior to file selection. This fix results in a simple return from the method without any erroneous error message displayed or `World` constructed.

Test Case 2



Jobs Listing

Job_15_98_27 (Gallinules)	13%	Running	Cancel
Job_74_11_48 (Absentmindedness)	15%	Running	Cancel
Job_10_62_20 (Shoetrees)	100%	Done	Cancel
Job_46_22_49 (Erosional)	14%	Running	Cancel
Job_40_45_39 (Erosional)	4%	Running	Cancel
Job_76_47_71 (Generics)	3%	Running	Cancel
Job_53_37_73 (Barcelona)	0%	Waiting	Cancel
Job_73_90_34 (Toluene)	0%	Waiting	Cancel

Job status log

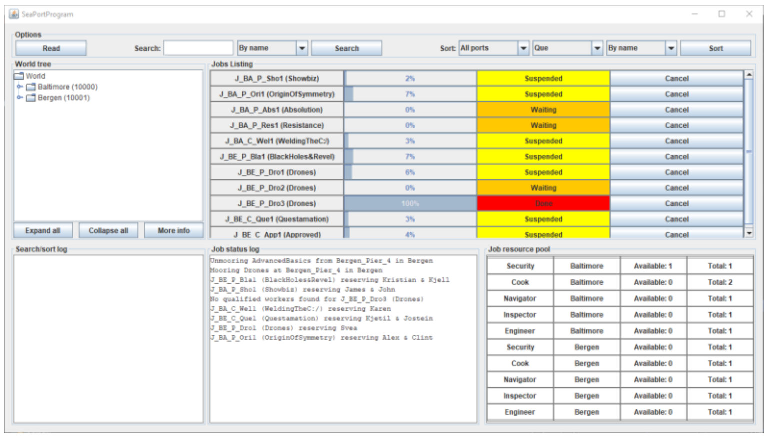
```
Unmooring Remora from Pier_1 in Lanshan
Mooring Erosional at Pier_1 in Lanshan
Unmooring Preanesthetic from Pier_3 in Lanshan
Mooring Generics at Pier_3 in Lanshan
Job_10_62_20 (Shoetrees) reserving Sara & Thomas
Job_40_45_39 (Erosional) reserving Archie
Job_10_62_20 (Shoetrees) returning Sara & Thomas
Unmooring Shoetrees from Pier_2 in Lanshan
Mooring Barcelona at Pier_2 in Lanshan
Job_46_22_49 (Erosional) reserving Betsy & Thomas
Job_76_47_71 (Generics) reserving Sara & Duane
```

Job resource pool

Clerk	Lanshan	Available: 0	Total: 1
Electrician	Lanshan	Available: 0	Total: 1
Cleaner	Lanshan	Available: 0	Total: 1
Inspector	Lanshan	Available: 0	Total: 1
Captain	Lanshan	Available: 0	Total: 1

This test case, like that following it, is somewhat of a duplicate of a set of tests run in the Project 3 documentation. It tests the standard function of the "Cancel" button, ending the job attached to the SS *Shoetrees* and displaying it as "Done."

Test Case 3



Jobs Listing

J_BA_P_Sho1 (Showbiz)	2%	Suspended	Cancel
J_BA_P_Ori1 (OriginOfSymmetry)	7%	Suspended	Cancel
J_BA_P_Abs1 (Absolution)	0%	Waiting	Cancel
J_BA_P_Res1 (Resistance)	0%	Waiting	Cancel
J_BA_C_Wel1 (WeldingTheC:/)	3%	Suspended	Cancel
J_BE_P_Bla1 (BlackHoles&Revel)	7%	Suspended	Cancel
J_BE_P_Dro1 (Drones)	6%	Suspended	Cancel
J_BE_P_Dro2 (Drones)	0%	Waiting	Cancel
J_BE_P_Dro3 (Drones)	100%	Done	Cancel
J_BE_C_Que1 (Questamation)	3%	Suspended	Cancel
J_BE_C_App1 (Approved)	4%	Suspended	Cancel

Job status log

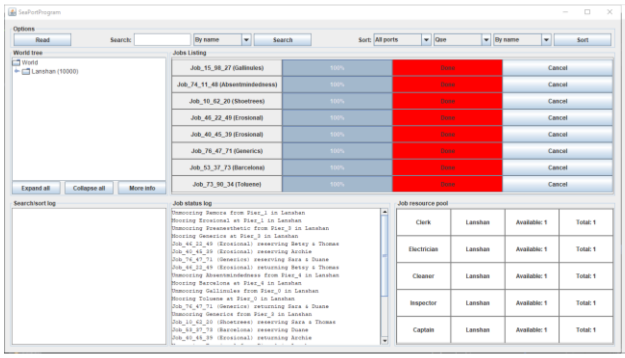
```
Unmooring AdvancedBasics from Bergen_Pier_4 in Bergen
Mooring Drones at Bergen_Pier_4 in Bergen
J_BE_P_Bla1 (BlackHoles&Revel) reserving Kristian & Kjell
J_BA_P_Sho1 (Showbiz) reserving James & John
No qualified workers found for J_BE_P_Dro3 (Drones)
J_BA_C_Wel1 (WeldingTheC:/) reserving Karen
J_BE_C_Que1 (Questamation) reserving Kjetil & Jostein
J_BE_P_Dro1 (Drones) reserving Svea
J_BA_P_Ori1 (OriginOfSymmetry) reserving Alex & Clint
```

Job resource pool

Security	Baltimore	Available: 1	Total: 1
Cook	Baltimore	Available: 0	Total: 2
Navigator	Baltimore	Available: 0	Total: 1
Inspector	Baltimore	Available: 0	Total: 1
Engineer	Baltimore	Available: 0	Total: 1
Security	Bergen	Available: 0	Total: 1
Cook	Bergen	Available: 0	Total: 1
Navigator	Bergen	Available: 0	Total: 1
Inspector	Bergen	Available: 0	Total: 1
Engineer	Bergen	Available: 0	Total: 1

Like the above case, this test ensures that the "Suspend" button operates as intended, pausing all running threads until pressed again. To denote this change of status to the user, the text is replaced with "Suspend" and the background color is changed accordingly.

Test Case 4: Extended discussion



Jobs Listing

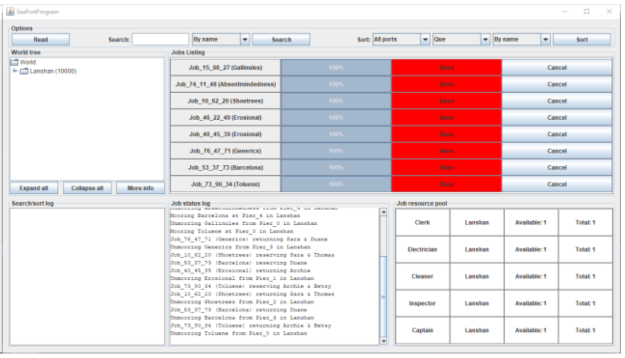
Job_15_98_27 (Gallinules)	100%	Done	Cancel
Job_74_11_48 (Absentmindedness)	100%	Done	Cancel
Job_10_62_20 (Shoetrees)	100%	Done	Cancel
Job_46_22_49 (Erosional)	100%	Done	Cancel
Job_40_45_39 (Erosional)	100%	Done	Cancel
Job_76_47_71 (Generics)	100%	Done	Cancel
Job_53_37_73 (Barcelona)	100%	Done	Cancel
Job_73_90_34 (Toluene)	100%	Done	Cancel

Job status log

```
Unmooring Remora from Pier_1 in Lanshan
Mooring Erosional at Pier_1 in Lanshan
Unmooring Preanesthetic from Pier_3 in Lanshan
Mooring Generics at Pier_3 in Lanshan
Job_46_22_49 (Erosional) reserving Betsy & Thomas
Job_40_45_39 (Erosional) reserving Archie
Job_76_47_71 (Generics) reserving Sara & Duane
Job_46_22_49 (Erosional) returning Betsy & Thomas
Unmooring Absentmindedness from Pier_4 in Lanshan
Mooring Barcelona at Pier_4 in Lanshan
Unmooring Gallinules from Pier_0 in Lanshan
Mooring Toluene at Pier_0 in Lanshan
Job_76_47_71 (Generics) returning Sara & Duane
Unmooring Generics from Pier_3 in Lanshan
Job_10_62_20 (Shoetrees) reserving Sara & Thomas
Job_53_37_73 (Barcelona) reserving Duane
Job_40_45_39 (Erosional) returning Archie
```

Job resource pool

Clerk	Lanshan	Available: 1	Total: 1
Electrician	Lanshan	Available: 1	Total: 1
Cleaner	Lanshan	Available: 1	Total: 1
Inspector	Lanshan	Available: 1	Total: 1
Captain	Lanshan	Available: 1	Total: 1



Jobs Listing

Job_15_98_27 (Gallinules)	100%	Done	Cancel
Job_74_11_48 (Absentmindedness)	100%	Done	Cancel
Job_10_62_20 (Shoetrees)	100%	Done	Cancel
Job_46_22_49 (Erosional)	100%	Done	Cancel
Job_40_45_39 (Erosional)	100%	Done	Cancel
Job_76_47_71 (Generics)	100%	Done	Cancel
Job_53_37_73 (Barcelona)	100%	Done	Cancel
Job_73_90_34 (Toluene)	100%	Done	Cancel

Job status log

```
Mooring Barcelona at Pier_4 in Lanshan
Unmooring Gallinules from Pier_0 in Lanshan
Mooring Toluene at Pier_0 in Lanshan
Job_76_47_71 (Generics) returning Sara & Duane
Unmooring Generics from Pier_3 in Lanshan
Job_10_62_20 (Shoetrees) reserving Sara & Thomas
Job_53_37_73 (Barcelona) reserving Duane
Job_40_45_39 (Erosional) returning Archie
Unmooring Erosional from Pier_1 in Lanshan
Job_73_90_34 (Toluene) reserving Archie & Betsy
Job_10_62_20 (Shoetrees) returning Sara & Thomas
Unmooring Shoetrees from Pier_2 in Lanshan
Job_53_37_73 (Barcelona) returning Duane
Unmooring Barcelona from Pier_4 in Lanshan
Job_73_90_34 (Toluene) returning Archie & Betsy
Unmooring Toluene from Pier_0 in Lanshan
```

Job resource pool

Clerk	Lanshan	Available: 1	Total: 1
Electrician	Lanshan	Available: 1	Total: 1
Cleaner	Lanshan	Available: 1	Total: 1
Inspector	Lanshan	Available: 1	Total: 1
Captain	Lanshan	Available: 1	Total: 1

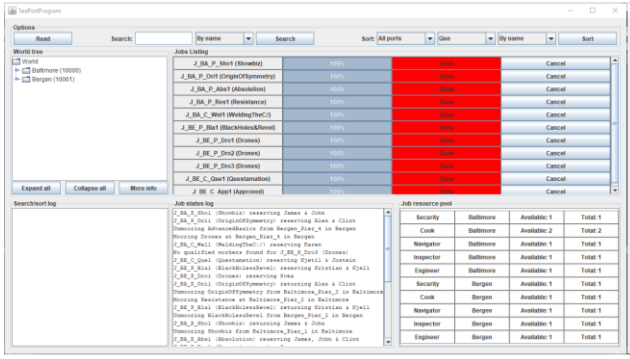
The first extended test case concerns the default file formerly employed in the Project 3 test series, namely `aSPaa.txt`. A default run-through of the program's most basic functions, the job progression in question begins first with the unmooring of two ships bereft of extant jobs, namely SS *Remora* and SS *Preanesthetic*, from their `Docks`, replacing them with the SS *Generics* and SS *Erosional*. Immediately upon docking, these two new vessels reserve the entirety of the worker pool at the Lanshan port, blocking other already-moored vessels from beginning their own jobs. The first of *Erosional's* two jobs is completed first, releasing cleaner Betsy and clerk Thomas back into the worker pool.

Meanwhile, the SS *Absentmindedness*, whose job requires no workers to complete, finishes its job and unmoors from its dock, making room for the SS *Barcelona*. Likewise, the SS *Gallinules*, also possessing a job requiring no workers, completes its job and unmoors to make room for the SS *Toluene*. Both new vessels remain waiting for their required workers to become available before commencing their jobs.

Generics finally completes its job and unmoors, returning electrician Sara and inspector Duane to the job pool. With its workers finally made available, the SS *Shoetrees*, one of the initially-moored vessels, reserves Sara and Thomas and begins its sole job. Meanwhile, the *Barcelona* reserves its only required worker, Duane, and begins its only job. Eventually, the *Erosional* completes the second of its two required jobs and unmoors, freeing up Captain Archie and Betsy for use by the *Toluene*. One by one, the *Shoetrees*, *Barcelona*, and *Toluene* complete their jobs and unmoor, leaving all workers available and all docks devoid of ships.

Alternate arrangements are also possible, depending on which job thread is granted access to its port's resources first. The author encourages the reader to examine the associated screenshots closer for confirmation of this arrangement, and suggests a perusal of the Project 3 documentation for a number of alternate arrangements using this file.

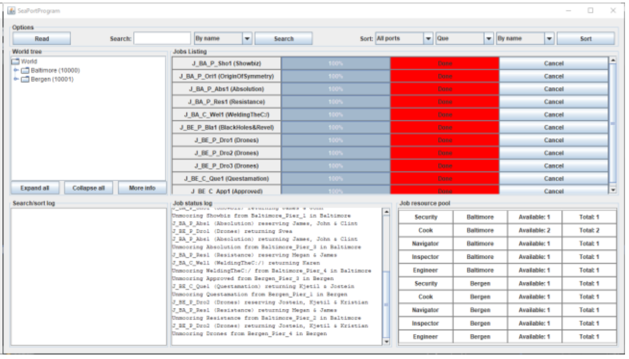
Test Case 5: Extended discussion



J_BA_P_Sho1 (Showbiz)	100%	Done	Cancel
J_BA_P_Ori1 (OriginOfSymmetry)	100%	Done	Cancel
J_BA_P_Abs1 (Absolution)	100%	Done	Cancel
J_BA_P_Res1 (Resistance)	100%	Done	Cancel
J_BA_C_Wel1 (WeldingTheC:/)	100%	Done	Cancel
J_BE_P_Bla1 (BlackHoles&Revel)	100%	Done	Cancel
J_BE_P_Dro1 (Drones)	100%	Done	Cancel
J_BE_P_Dro2 (Drones)	100%	Done	Cancel
J_BE_P_Dro3 (Drones)	100%	Done	Cancel
J_BE_C_Que1 (Questamation)	100%	Done	Cancel
J_BE_C_App1 (Approved)	100%	Done	Cancel

```
J_BA_P_Sho1 (Showbiz) reserving James & John
J_BA_P_Ori1 (OriginOfSymmetry) reserving Alex & Clint
Unmooring AdvancedBasics from Bergen_Pier_4 in Bergen
Mooring Drones at Bergen_Pier_4 in Bergen
J_BA_C_Wel1 (WeldingTheC:/) reserving Karen
No qualified workers found for J_BE_P_Dro3 (Drones)
J_BE_C_Que1 (Questamation) reserving Kjetil & Jostein
J_BE_P_Bla1 (BlackHoles&Revel) reserving Kristian & Kjell
J_BE_P_Dro1 (Drones) reserving Svea
J_BA_P_Ori1 (OriginOfSymmetry) returning Alex & Clint
Unmooring OriginOfSymmetry from Baltimore_Pier_2 in Baltimore
Mooring Resistance at Baltimore_Pier_2 in Baltimore
J_BE_P_Bla1 (BlackHoles&Revel) returning Kristian & Kjell
Unmooring BlackHoles&Revel from Bergen_Pier_2 in Bergen
J_BA_P_Sho1 (Showbiz) returning James & John
Unmooring Showbiz from Baltimore_Pier_1 in Baltimore
J_BA_P_Abs1 (Absolution) reserving James, John & Clint
```

Security	Baltimore	Available: 1	Total: 1
Cook	Baltimore	Available: 2	Total: 2
Navigator	Baltimore	Available: 1	Total: 1
Inspector	Baltimore	Available: 1	Total: 1
Engineer	Baltimore	Available: 1	Total: 1
Security	Bergen	Available: 1	Total: 1
Cook	Bergen	Available: 1	Total: 1
Navigator	Bergen	Available: 1	Total: 1
Inspector	Bergen	Available: 1	Total: 1
Engineer	Bergen	Available: 1	Total: 1



J_BA_P_Sho1 (Showbiz)	100%	Done	Cancel
J_BA_P_Ori1 (OriginOfSymmetry)	100%	Done	Cancel
J_BA_P_Abs1 (Absolution)	100%	Done	Cancel
J_BA_P_Res1 (Resistance)	100%	Done	Cancel
J_BA_C_Wel1 (WeldingTheC:/)	100%	Done	Cancel
J_BE_P_Bla1 (BlackHoles&Revel)	100%	Done	Cancel
J_BE_P_Dro1 (Drones)	100%	Done	Cancel
J_BE_P_Dro2 (Drones)	100%	Done	Cancel
J_BE_P_Dro3 (Drones)	100%	Done	Cancel
J_BE_C_Que1 (Questamation)	100%	Done	Cancel
J_BE_C_App1 (Approved)	100%	Done	Cancel

```
Unmooring Showbiz from Baltimore_Pier_1 in Baltimore
J_BA_P_Abs1 (Absolution) reserving James, John & Clint
J_BE_P_Dro1 (Drones) returning Svea
J_BA_P_Abs1 (Absolution) returning James, John & Clint
Unmooring Absolution from Baltimore_Pier_3 in Baltimore
J_BA_P_Res1 (Resistance) reserving Megan & James
J_BA_C_Wel1 (WeldingTheC:/) returning Karen
Unmooring WeldingTheC:/ from Baltimore_Pier_4 in Baltimore
Unmooring Approved from Bergen_Pier_3 in Bergen
J_BE_C_Que1 (Questamation) returning Kjetil & Jostein
Unmooring Questamation from Bergen_Pier_1 in Bergen
J_BE_P_Dro2 (Drones) reserving Jostein, Kjetil & Kristian
J_BA_P_Res1 (Resistance) returning Megan & James
Unmooring Resistance from Baltimore_Pier_2 in Baltimore
J_BE_P_Dro2 (Drones) returning Jostein, Kjetil & Kristian
Unmooring Drones from Bergen_Pier_4 in Bergen
```

Security	Baltimore	Available: 1	Total: 1
Cook	Baltimore	Available: 2	Total: 2
Navigator	Baltimore	Available: 1	Total: 1
Inspector	Baltimore	Available: 1	Total: 1
Engineer	Baltimore	Available: 1	Total: 1
Security	Bergen	Available: 1	Total: 1
Cook	Bergen	Available: 1	Total: 1
Navigator	Bergen	Available: 1	Total: 1
Inspector	Bergen	Available: 1	Total: 1
Engineer	Bergen	Available: 1	Total: 1

The second extended test case makes use of the author-created test file `aSPae.txt`, the contents of which have been modified since Project 3 to test issues related to the aforementioned bugs that previously affected certain types of jobs, such as jobs requiring multiple instances of a skill or jobs that can never be completed due to a lack of qualified workers. For ease of readability, job progression will be discussed by individual port.

Starting first in Baltimore, all ships initially moored at their respective piers have jobs in need of processing. The SS *Showbiz* is first to successfully acquire its needed dock workers, removing inspector James and cook John from the resource pool. The SS *WeldingTheC:/* reserves navigator Karen, while the SS *OriginOfSymmetry* reserves the second cook Clint and engineer Alex, leaving only security guard Megan in the worker pool.

Eventually, the *OriginOfSymmetry* and *Showbiz* complete their sole jobs, releasing their workers and unmooring from their piers. The SS *Resistance* takes the *OriginOfSymmetry's* place at its dock, but is unable to proceed with its job requiring an inspector and security guard until James becomes available. However, inspector James, along with cooks John and Clint, are first reserved by the SS *Absolution*, which blocks the remaining ships from continuing with their jobs until its conclusion. This vessel's job in particular was included to test formerly buggy cases involving jobs requiring more than one of a certain skill, in this case, cooks.

With the *Absolution's* unmooring, the *Resistance* is finally able to begin its own job. With the return of its workers and the conclusion of the long-running *WeldingTheC:/* job, all workers are returned to the Baltimore job pool and execution of all Baltimore-bound ship threads draws to a close.

Meanwhile in Bergen, Norway, the job progression begins with the unmooring of the SS *AdvancedBasics*, a vessel initially moored at a `Dock` but bereft of any jobs to complete. Its place is taken by the SS *Drones*, which begins the first of its three jobs alongside the SS *BlackHoles&Revel* and SS *Questamation*. Between the three vessels, the entire Bergen worker pool is drained, though the SS *Approved*, requiring no workers to complete its job, continues to progress with its job. As these jobs are begun, the third of the *Drones'* jobs, requiring a clown and a basketweaver, is automatically cancelled due to a distinct lack of workers possessing such skills in the worker pool. This was included to test the behavior required by the Project 4 rubric to automatically end a job if the job's requirements could never be met.

The remaining *Drones* job requiring Jostein, Kjetil, and Kristian does not begin until the first three aforementioned jobs on the *Drones*, *BlackHoles&Revel*, and *Questamation* are completed. With the completion of this remaining job, the vessel unmoors, returning all workers to the pool and leaving the piers devoid of vessels.

Alternate arrangements are also possible, depending on which job thread is granted access to its port's resources first. The author encourages the reader to examine the associated screenshots closer for confirmation of this arrangement, and suggests a perusal of the Project 3 documentation for a number of alternate arrangements using this file.

Part IV: Comments

Overall, the author is generally pleased with the manner in which the SeaPort project series has turned out. A few areas of interest for expansion or revamp are listed herein simply for the purposes of conceptual theorization; in all likelihood, the author will probably never touch this program again after submission.

As far as the GUI design goes, the author is generally satisfied with its overall appearance and layout, though the application of a more advanced layout manager from the start may have been a better option that the overlapping mass of `GridLayout` and `FlowLayout` arrangements currently present in the program's GUI class. The author does wish that more functionality had been added to the `JTree` section, perhaps updating its contents in real time depending on the location of each specific ship (i.e. rebuilding or refreshing the `JTree` every time a ship is docked, processed, and moved out of the queue, etc.).

As far as back-end code is concerned, the author would likely have expanded upon the sorting function added in Project 2 to include more parameters and variability for users to employ. Relatedly, both the sort and search functions should probably have included more information pertaining to each desired entry, such as location of the `Thing` in question, its skills/requirements, etc. to prove more useful to users. At present, only the name and the associated index ID are displayed for users, which offers little actual information about the item in question and makes searching rather worthless.

Part V: Lessons Learned

As per the third project, the author once again learned a fair bit about the specifics of `JTables` and their specific uses and disadvantages in such cases as the listing of `Persons`. Though the author was successfully able to assemble and display a set of `JTable`s pertaining the individual workers in each `SeaPort`, the display was less than optimal and subsequently replaced by a pseudo-row implementation similar in design to that seen in the `Job` progression panel. Though the research and experimentation undertaken by the author to attempt this method in Project 4 was ultimately not employed herein, the author nonetheless managed to solidify his understanding of `JTable`s' usefulness in displaying data in an organized, coherent fashion.

Furthermore, use of the NetBeans JConsole plugin was helpful in the course of testing the program's reaction to hard-stop thread cancellation orders, as it provided the author with a more concrete means of monitoring thread operation in real time. The independent research undertaken to better understand this useful tool provided invaluable in this case, and the author wishes he had had access to JConsole for the previous project, the writing of which was largely done blind.