Due Date: 03.01.2025 23:55

CENG211 – Programming Fundamentals
Homework #4

In this homework, you are expected to implement a simple **"Frozen Lake Puzzle App"** in Java. The submitted homework should mainly fulfill the following concepts:

- Collections
- Inheritance
- Generics
- Exception Handling
- Inner Classes

In this application, you will simulate a puzzle involving a frozen lake. Your goal is to help a few Arctic **Researchers** near a FrozenLake so that they can perform their **Experiments** in their Arctic research expedition. They have different types of Equipments to overcome Hazards or perform Experiments. They must also be careful about *sliding* on the lake's icy surface. A Researcher can choose to slide into one of the four main directions when they are on the lake. Trying to go in an unavailable direction will throw an UnavailableDirectionException.

When the app starts, a rectangular FrozenLake of size 8x11 (8 rows & 11 columns) should be created inside the LakePuzzle main class. This lake's upper middle square should be its only entrance. The remaining upper edges are all covered with walls. Then, one of the three remaining sides of the lake is chosen randomly to be a cliffside that is very easy to slide and fall. Then, the last two sides of the lake should be completely covered by regular walls.

8 IceBlocks should also be randomly placed in the FrozenLake at the start. During the placement, ensure that each row only has a single IceBlock. Since the FrozenLake is very slippery, the researchers can use an IceBlock to stop themselves before they reach an edge. Also, make sure that an IceBlock does not block the entrance and that an IceBlock is always placed downwards from the entrance. Thus, the middle column should always have at least one IceBlock that does not block the entrance. Additionally, at least 2 IceBlocks should be at the cliffside squares.

The number of Researchers should be randomly selected as 2, 3, or 4 and stored inside a **Queue** in the LakePuzzle main class. Researchers have unique ids starting from 1. For example, when there are 3 Researchers, their ids should be 1, 2, and 3.

The Experiment goals of the researchers should be randomly generated and kept inside a **Set** in the LakePuzzle main class. The number of experiments is randomly selected to be either the same as the number of researchers or one less than them. There can only be one of each Experiment type among the randomly generated Experiments. For example, if the number of generated Experiments is going to be 4, all 4 types of Experiments are directly selected.

Each experiment has corresponding ResearchEquipment that can only be used for it. Additionally, each experiment has certain specifications for its placement on the FrozenLake. Placing a ResearchEquipment in an incompatible place will throw an IncompatibleResearchEquipmentLocationException.

The **four different types of Experiments** and their corresponding ResearchEquipments:

- TemperatureMeasurement: Place a TemperatureDetector on a square on the lake that is not placed on any of the edges or next to an IceBlock. It will then measure the temperature. To simulate this, generate a random number between -30 and 0 (Celsius degrees). Then, you should record it inside the TemperatureDetector object.
- WindspeedMeasurement: Place a WindSpeedDetector in a square on the lake that is not next to any hazard except for the ice blocks. It will then measure the windSpeed. To simulate this, generate a random number between 0-30 (m/s) and record it inside the WindSpeedDetector object.
- CameraPlacement: Place a camera in a square that can directly view the cliffside without any hazards (including ice blocks) in its line of sight. However, the camera has a 20% chance of not working due to cold weather. A boolean value representing whether the camera started working should be kept inside the Camera object.
- GlacialSampling: Take a glacial ice sample from an IceBlock that can be standing in a square in the lake. A ChiselingEquipment is necessary for this experiment. The ice sample's weight should be randomly generated between 1 and 20 grams and recorded inside the ChiselingEquipment object. Assume that this equipment cannot be reused after taking a sample.

There are also dangerous Hazards on the lake that can cause injuries to a researcher and cause the Arctic expedition to fail. Each Hazard can be overcome using a specific HazardEquipment. A HazardEquipment can only be used once to overcome a single Hazard. If a Researcher has the correct equipment for a Hazard they encounter, they automatically use it.

The **four different types of Hazards** and their corresponding HazardEquipments:

- HoleInIce: Since the Researchers cannot stop until they collide with a regular wall or an IceBlock, they cannot stop even if they see a HoleInIce before them. Falling into a hole will lead to injuries. These holes can be overcome using a LargeWoodenBoard to cover them up. After covering the hole with the board, the Researcher can come to a stop on top of the board instead of continuing to slide. Any other Researcher who comes across this board can also benefit from it similarly.
- IceSpikes: There can be IceSpikes on the walls. Colliding with that wall causes the IceSpikes to fall, which causes injuries. Researchers can use a ProtectiveHelmet as a HazardEquipment to protect themselves. After spikes fall, any other Researcher who collides with that wall is safe from injuries.
- CliffEdge: The cliffs in the FrozenLake must be shown using CliffEdge Hazard objects next to the squares on the edge. Falling from the cliffs can lead to injuries. A ClimbingEquipment can be used to climb back up from the cliffs without experiencing injuries. After a Researcher uses their ClimbingEquipment, it stays on that cliff, and any other Researchers can also continue to use that equipment to avoid falling. After automatically climbing from the cliff, the Researcher stands on the edge square directly next to the cliff.
- IceBlocks are non-dangerous Hazards. They do not lead to injuries and can be used to safely stop while sliding. Hence, they do not require Equipments to deal with them. They can be at the cliffside squares as well.

While creating the FrozenLake, randomly place 3 HoleInIce and 3 IceSpikes on the lake after placing 8 IceBlocks. Make sure IceSpikes are next to the walls. Remember to place CliffEdges outside of the lake edge that have been randomly determined as the cliffside. Make sure there are no dangerous Hazards near the entrance of the lake (no closer than 3 squares). Also, make sure no two Hazards occupy the same square. Lastly, the squares next to the cliff cannot have any other dangerous Hazards as well.

After placing a research equipment, a Researcher can occupy the same place with that equipment while waiting for the puzzle game to end. While sliding on the lake, the Researchers can also use placed ResearchEquipments or sitting Researcher to stop themselves similar to how they would use IceBlocks. All these obstacles do not move from their locations after collisions.

Researchers have an EquipmentBag<T extends Equipment> that can contain up to **3 pieces of Equipment**. Before heading off to the lake from the entrance, they can choose either ResearchEquipments or HazardEquipments. Hence, they can either choose to overcome Hazards for other Researchers beforehand or directly focus on the Experiments. If they try to mix different types of Equipments, an IncorrectBagContentsException will be thrown. The same exception is also thrown when they try to leave with an empty or try to take more than 3.

A Researcher out in the lake can stop and sit down in any safe spot they can find. Thus, they let other Researchers continue, even if the sitting Researcher still carries unused ResearchEquipments. Otherwise, he stops moving when he places all the ResearchEquipments he has taken.

There are 2 pieces of each Equipment which can be taken by Researchers at the entrance. All equipments are stored in a Set inside a EquipmentStorage object (inside the main class). If a Researcher tries to take an unavailable Equipment, an UnavailableEquipmentException is thrown. The same exception is also thrown with a different error message when a Researcher tries to perform an experiment while carrying no ResearchEquipment.

Lastly, a Researcher can also stop moving if they reach the entrance while sliding. However, they will refuse to go to the lake again since they will be tired. The unused pieces of Equipment they were carrying can be reused by other Researchers waiting in the Queue.

The puzzle game **ends successfully** if all experiment goals are accomplished. It is okay if one or more Researchers are waiting at the entrance. Also, even if the Camera Equipment fails to work, that experiment is considered complete. When the game ends successfully, the results of the successful experiments are printed. Since there are random factors involved in this game, it is not a problem if you fail to reach a successful scenario while testing the app.

The puzzle game **can fail** due to:

1. All Researchers go out to the lake and stop moving while there are still unaccomplished Experiment goals.
2. A Researcher is injured due to a dangerous Hazard.
3. When a Researcher needs to go into the lake, but no matching ResearchEquipments are left for one of the Experiment goals.

Example Scenario Output (Very Detailed):

```
Welcome to Frozen Lake Puzzle App. There are 2 researchers waiting at the lake entrance.

There are 2 experiment(s) that must be completed:
- Wind Speed Measurement
- Camera Placement

The initial map of the frozen lake:

-------------------------------     --------------------------------
| IS  |     |     |     |     | R1  |     |     |     | IS  | IB  |  CE
-----------------------------------------------------------------------
|     |     |     |     |     |     | IB  |     |     |     |     |  CE
-----------------------------------------------------------------------
|     |     |     |     |     |     | IB  |     |     |     |     |  CE
```

```
-------------------------------------------------------------------
|     |     |     |     |     |     |     |     | IB  |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     | IB  |     | HI  |     |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     | HI  |     |     |     |     |     | IB  |  CE
-------------------------------------------------------------------
| IB  |     |     |     |     |     |     |     |     |     |     |  CE
-------------------------------------------------------------------
| HI  | IB  |     |     |     |     |     |     |     | IS  |     |  CE
-------------------------------------------------------------------

=====> Researcher 1 starts waiting at the entrance and can select up to 3 pieces of equipment of the
same type. Here are the shorter notations of the equipments:
[td] Temperature detector
[ws] Wind speed detector
[cm] Camera
[ch] Chiseling equipment
[cl] Climbing equipment
[wb] Large wooden board
[ph] Protective helmet
[no] Stop taking equipment and head out to the lake

Enter the short name of an equipment: no

*** Researchers cannot head to the lake with an empty bag.

Enter the short name of an equipment: wb

- Contents of the bag of Researcher 1: wb

Enter the short name of an equipment: wb

- Contents of the bag of Researcher 1: wb, wb

Enter the short name of an equipment: wb

*** There no more wb left in the Equipment Storage.

Enter the short name of an equipment: ws

*** Researchers cannot carry different types of equipment in their bags.

Enter the short name of an equipment: no

- The final contents of the bag of Researcher 1: wb, wb


=====> Researcher 1 heads out to the lake. Select a direction to slide ([U] Up, [D] Down, [L] Left,
[R] Right): Y

*** Invalid input. Please reenter your input: U

*** The input direction is unavailable. Please enter an available direction: D

---------------------------------   ---------------------------------
| IS  |     |     |     |     |     |     |     | IS  | IB  |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     | R1  | IB  |     |     |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     | IB  |     |     |     |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     |     |     |     | IB  |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     | IB  |     | HI  |     |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     | HI  |     |     |     |     |     | IB  |  CE
-------------------------------------------------------------------
| IB  |     |     |     |     |     |     |     |     |     |     |  CE
-------------------------------------------------------------------
| HI  | IB  |     |     |     |     |     |     |     | IS  |     |  CE
-------------------------------------------------------------------

=====> Researcher 1 manages to stop safely.
[1] Continue moving on the ice.
[2] Choose experiment equipment and perform an experiment.
[3] Sit on the ground and let the other researchers head out to the lake.
Choose the action of Researcher 1: 2

*** Researcher 1 is not carrying any research equipment.
```

```
Choose the action of Researcher 1: 1

Select a direction to slide: L

---------------------------------   ---------------------------------
| IS  |     |     |     |     |     |     |     |     | IS  | IB  |  CE
---------------------------------------------------------------------
| R1  |     |     |     |     |     | IB  |     |     |     |     |  CE
---------------------------------------------------------------------
|     |     |     |     |     |     | IB  |     |     |     |     |  CE
---------------------------------------------------------------------
|     |     |     |     |     |     |     |     | IB  |     |     |  CE
---------------------------------------------------------------------
|     |     |     |     |     |     | IB  |     | HI  |     |     |  CE
---------------------------------------------------------------------
|     |     |     |     |     | HI  |     |     |     |     |     | IB  |  CE
---------------------------------------------------------------------
| IB  |     |     |     |     |     |     |     |     |     |     |  CE
---------------------------------------------------------------------
| HI  | IB  |     |     |     |     |     |     |     | IS  |     |  CE
---------------------------------------------------------------------

=====> Researcher 1 manages to stop safely.
[1] Continue moving on the ice.
[2] Choose experiment equipment and perform an experiment.
[3] Sit on the ground and let the other researchers head out to the lake.
Choose the action of Researcher 1: 1

Select a direction to slide: D

---------------------------------   ---------------------------------
| IS  |     |     |     |     |     |     |     |     | IS  | IB  |  CE
---------------------------------------------------------------------
|     |     |     |     |     |     | IB  |     |     |     |     |  CE
---------------------------------------------------------------------
|     |     |     |     |     |     | IB  |     |     |     |     |  CE
---------------------------------------------------------------------
|     |     |     |     |     |     |     |     | IB  |     |     |  CE
---------------------------------------------------------------------
|     |     |     |     |     |     | IB  |     | HI  |     |     |  CE
---------------------------------------------------------------------
| R1  |     |     |     | HI  |     |     |     |     |     | IB  |  CE
---------------------------------------------------------------------
| IB  |     |     |     |     |     |     |     |     |     |     |  CE
---------------------------------------------------------------------
| HI  | IB  |     |     |     |     |     |     |     | IS  |     |  CE
---------------------------------------------------------------------

=====> Researcher 1 manages to stop safely.
[1] Continue moving on the ice.
[2] Choose experiment equipment and perform an experiment.
[3] Sit on the ground and let the other researchers head out to the lake.
Choose the action of Researcher 1: 1

Select a direction to slide: R

!!! Researcher 1 comes across a hole in ice. However, Researcher 1 is carrying a Large Wooden Board.
Researcher 1 covers the ice with the board and starts standing on it.

- The updated contents of the bag of Researcher 1: wb

---------------------------------   ---------------------------------
| IS  |     |     |     |     |     |     |     |     | IS  | IB  |  CE
---------------------------------------------------------------------
|     |     |     |     |     |     | IB  |     |     |     |     |  CE
---------------------------------------------------------------------
|     |     |     |     |     |     | IB  |     |     |     |     |  CE
---------------------------------------------------------------------
|     |     |     |     |     |     |     |     | IB  |     |     |  CE
---------------------------------------------------------------------
|     |     |     |     |     |     | IB  |     | HI  |     |     |  CE
---------------------------------------------------------------------
|     |     |     |     |R1-WB|     |     |     |     |     | IB  |  CE
---------------------------------------------------------------------
| IB  |     |     |     |     |     |     |     |     |     |     |  CE
---------------------------------------------------------------------
| HI  | IB  |     |     |     |     |     |     |     | IS  |     |  CE
---------------------------------------------------------------------

=====> Researcher 1 manages to stop safely.
```

```
[1] Continue moving on the ice.
[2] Choose experiment equipment and perform an experiment.
[3] Sit on the ground and let the other researchers head out to the lake.
Choose the action of Researcher 1: 1

Select a direction to slide: R

---------------------------------   ---------------------------------
| IS  |     |     |     |     |     |     |     |     | IS  | IB  |  CE
-------------------------------------------------------------------
|     |     |     |     |     |     | IB  |     |     |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     | IB  |     |     |     |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     |     |     |     | IB  |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     | IB  |     | HI  |     |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     | WB  |     |     |     |     | R1  | IB  |  CE
-------------------------------------------------------------------
| IB  |     |     |     |     |     |     |     |     |     |     |  CE
-------------------------------------------------------------------
| HI  | IB  |     |     |     |     |     |     |     | IS  |     |  CE
-------------------------------------------------------------------

=====> Researcher 1 manages to stop safely.
[1] Continue moving on the ice.
[2] Choose experiment equipment and perform an experiment.
[3] Sit on the ground and let the other researchers head out to the lake.
Choose the action of Researcher 1: 3


=====> Researcher 1 stops moving, and Researcher 2 starts waiting at the entrance.

---------------------------------   ---------------------------------
| IS  |     |     |     |     | R2  |     |     |     | IS  | IB  |  CE
-------------------------------------------------------------------
|     |     |     |     |     |     | IB  |     |     |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     | IB  |     |     |     |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     |     |     |     | IB  |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     | IB  |     | HI  |     |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     | WB  |     |     |     |     | R1  | IB  |  CE
-------------------------------------------------------------------
| IB  |     |     |     |     |     |     |     |     |     |     |  CE
-------------------------------------------------------------------
| HI  | IB  |     |     |     |     |     |     |     | IS  |     |  CE
-------------------------------------------------------------------

Researcher 2 can select up to 3 pieces of equipment of the same type. Enter the short name of an
equipment: cm

- Contents of the bag of Researcher 2: cm

Enter the short name of an equipment: ws

- Contents of the bag of Researcher 2: cm, ws

Enter the short name of an equipment: no

- The final contents of the bag of Researcher 2: cm, ws


=====> Researcher 2 heads out to the lake. Select a direction to slide: D

---------------------------------   ---------------------------------
| IS  |     |     |     |     |     |     |     |     | IS  | IB  |  CE
-------------------------------------------------------------------
|     |     |     |     |     | R2  | IB  |     |     |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     | IB  |     |     |     |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     |     |     |     | IB  |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     | IB  |     | HI  |     |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     | WB  |     |     |     |     | R1  | IB  |  CE
```

```
-------------------------------------------------------------------
| IB  |     |     |     |     |     |     |     |     |     |  CE
-------------------------------------------------------------------
| HI  | IB  |     |     |     |     |     |     | IS  |     |  CE
-------------------------------------------------------------------

=====> Researcher 2 manages to stop safely.
[1] Continue moving on the ice.
[2] Choose experiment equipment and perform an experiment.
[3] Sit on the ground and let the other researchers head out to the lake.
Choose the action of Researcher 2: 1

Select a direction to slide: L

---------------------------------   ---------------------------------
| IS  |     |     |     |     |     |     |     | IS  | IB  |  CE
-------------------------------------------------------------------
| R2  |     |     |     |     |     | IB  |     |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     | IB  |     |     |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     |     |     | IB  |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     | IB  |     | HI  |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     | WB  |     |     |     |     | R1  | IB  |  CE
-------------------------------------------------------------------
| IB  |     |     |     |     |     |     |     |     |     |  CE
-------------------------------------------------------------------
| HI  | IB  |     |     |     |     |     |     | IS  |     |  CE
-------------------------------------------------------------------

=====> Researcher 2 manages to stop safely.
[1] Continue moving on the ice.
[2] Choose experiment equipment and perform an experiment.
[3] Sit on the ground and let the other researchers head out to the lake.
Choose the action of Researcher 2: 1

Select a direction to slide: D

---------------------------------   ---------------------------------
| IS  |     |     |     |     |     |     |     | IS  | IB  |  CE
-------------------------------------------------------------------
|     |     |     |     |     |     | IB  |     |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     | IB  |     |     |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     |     |     | IB  |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     | IB  |     | HI  |     |     |  CE
-------------------------------------------------------------------
| R2  |     |     |     | WB  |     |     |     |     | R1  | IB  |  CE
-------------------------------------------------------------------
| IB  |     |     |     |     |     |     |     |     |     |  CE
-------------------------------------------------------------------
| HI  | IB  |     |     |     |     |     |     | IS  |     |  CE
-------------------------------------------------------------------

=====> Researcher 2 manages to stop safely.
[1] Continue moving on the ice.
[2] Choose experiment equipment and perform an experiment.
[3] Sit on the ground and let the other researchers head out to the lake.
Choose the action of Researcher 2: 2

=====> Enter the name of the research equipment: cm

*** The selected research equipment is incompatible with the current location.

[1] Continue moving on the ice.
[2] Choose experiment equipment and perform an experiment.
[3] Sit on the ground and let the other researchers head out to the lake.
Choose the action of Researcher 2: 2

=====> Enter the name of the research equipment: ws

--- The selected research equipment has been placed in the current location.

---------------------------------   ---------------------------------
| IS  |     |     |     |     |     |     |     | IS  | IB  |  CE
-------------------------------------------------------------------
```

```
|     |     |     |     |     |     | IB  |     |     |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     | IB  |     |     |     |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     |     |     |     | IB  |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     | IB  |     | HI  |     |     |     |  CE
-------------------------------------------------------------------
|R2-WS|     |     |     | WB  |     |     |     |     | R1  | IB  |  CE
-------------------------------------------------------------------
| IB  |     |     |     |     |     |     |     |     |     |     |  CE
-------------------------------------------------------------------
| HI  | IB  |     |     |     |     |     |     |     | IS  |     |  CE
-------------------------------------------------------------------
```

=====> Researcher 2 manages to stop safely.
[1] Continue moving on the ice.
[2] Choose experiment equipment and perform an experiment.
[3] Sit on the ground and let the other researchers head out to the lake.
Choose the action of Researcher 2: 1

Select a direction to slide: R

```
---------------------------------   ---------------------------------
| IS  |     |     |     |     |     |     |     |     | IS  | IB  |  CE
-------------------------------------------------------------------
|     |     |     |     |     |     | IB  |     |     |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     | IB  |     |     |     |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     |     |     |     | IB  |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     | IB  |     | HI  |     |     |     |  CE
-------------------------------------------------------------------
| WS  |     |     |     |R2-WB|     |     |     |     | R1  | IB  |  CE
-------------------------------------------------------------------
| IB  |     |     |     |     |     |     |     |     |     |     |  CE
-------------------------------------------------------------------
| HI  | IB  |     |     |     |     |     |     |     | IS  |     |  CE
-------------------------------------------------------------------
```

=====> Researcher 2 manages to stop safely on a Wooden Board.
[1] Continue moving on the ice.
[2] Choose experiment equipment and perform an experiment.
[3] Sit on the ground and let the other researchers head out to the lake.
Choose the action of Researcher 2: 1

Select a direction to slide: R

```
---------------------------------   ---------------------------------
| IS  |     |     |     |     |     |     |     |     | IS  | IB  |  CE
-------------------------------------------------------------------
|     |     |     |     |     |     | IB  |     |     |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     | IB  |     |     |     |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     |     |     |     | IB  |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     | IB  |     | HI  |     |     |     |  CE
-------------------------------------------------------------------
| WS  |     |     |     | WB  |     |     |     | R2  | R1  | IB  |  CE
-------------------------------------------------------------------
| IB  |     |     |     |     |     |     |     |     |     |     |  CE
-------------------------------------------------------------------
| HI  | IB  |     |     |     |     |     |     |     | IS  |     |  CE
-------------------------------------------------------------------
```

=====> Researcher 2 manages to stop safely on a Wooden Board.
[1] Continue moving on the ice.
[2] Choose experiment equipment and perform an experiment.
[3] Sit on the ground and let the other researchers head out to the lake.
Choose the action of Researcher 2: 1

Select a direction to slide: U

```
---------------------------------   ---------------------------------
| IS  |     |     |     |     |     |     |     |     | IS  | IB  |  CE
-------------------------------------------------------------------
```

```
|     |     |     |     |     |     | IB  |     |     |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     | IB  |     |     |     |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     |     |     |     | IB  |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     | IB  |     | HI  | R2  |     |     |  CE
-------------------------------------------------------------------
| WS  |     |     |     | WB  |     |     |     |     | R1  | IB  |  CE
-------------------------------------------------------------------
| IB  |     |     |     |     |     |     |     |     |     |     |  CE
-------------------------------------------------------------------
| HI  | IB  |     |     |     |     |     |     |     | IS  |     |  CE
-------------------------------------------------------------------
```

```
=====> Researcher 2 manages to stop safely.
[1] Continue moving on the ice.
[2] Choose experiment equipment and perform an experiment.
[3] Sit on the ground and let the other researchers head out to the lake.
Choose the action of Researcher 2: 2

=====> Enter the name of the research equipment: cm

--- The selected research equipment has been placed in the current location.
```

```
---------------------------------   ---------------------------------
| IS  |     |     |     |     |     |     |     |     | IS  | IB  |  CE
-------------------------------------------------------------------
|     |     |     |     |     |     | IB  |     |     |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     | IB  |     |     |     |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     |     |     |     | IB  |     |     |  CE
-------------------------------------------------------------------
|     |     |     |     |     | IB  |     | HI  |R2-CM|     |     |  CE
-------------------------------------------------------------------
| WS  |     |     |     | WB  |     |     |     |     | R1  | IB  |  CE
-------------------------------------------------------------------
| IB  |     |     |     |     |     |     |     |     |     |     |  CE
-------------------------------------------------------------------
| HI  | IB  |     |     |     |     |     |     |     | IS  |     |  CE
-------------------------------------------------------------------
```

```
-----------> Research goal(s) have been accomplished. Here are their results:

-- Wind Speed Measurement: 11 m/s
-- Camera Placement: The camera failed to start recording.

-----------> SUCCESSFUL
```

Legend for Frozen Lake Map Notations:

IB: Ice Block

IS: Ice Spike

CE: Cliff Edge

HI: Hole in Ice

R1: Researcher 1

WB: Large Wooden Board

R1-WB: Researcher 1 standing on a Large Wooden Board

CL: A climbing equipment installed on the Cliff Edge. Replaces a CE on the map (not shown in the example).

WS: Wind speed detector placed on the lake

CM: Camera placed on the lake

TD: Temperature detector placed on the lake

```
CH: Chiseling equipment placed on the lake

R2-CM: Researcher 1 standing next to a Camera on the same square
```

Important Notes:

1. You can use standard **java.io** packages to read files. You are also free to use anything inside **java.util** packages (including Collections). Do NOT use other 3rd party libraries.
2. You are expected to **write clean, readable, and tester-friendly** code. Please try to maximize reusability and prevent redundancy in your methods.
3. To increase the readability of the code, you are expected to **comment on** your code as much as possible. You can simply use Copilot to generate comments as well. However, it is up to you to make sure that the comments generated are correct.
4. You should **adhere to object-oriented principles as much as possible**. For example, you should place your files inside a proper package structure instead of putting everything into a single package.
5. We advise you to **plan how to write your code beforehand** since you have access to generative AI tools like Copilot.
6. All **incorrect inputs should be handled** by asking the user to enter the input again. After analyzing the example scenario, you can see which inputs could be incorrect if entered differently. **Also, the inputs should not be case-sensitive.** For example, directional inputs "D" and "d" should both be accepted.
7. **Your menus are expected to be almost the same as the given example scenario**. Naturally, some situations are not shown in the example. Your menus should also handle them while not straying too far from the menu style shown in the example. **Significant point deductions will be applied if difficulties arise while navigating your menus.**
8. **Unlike the previous homeworks, we expect you to perform your menu operations inside an inner class in the main class.**
9. **When throwing exceptions, you should always handle them. The application should never terminate due to an exception.**

Assignment Rules:

1. In this lecture's homework, cheating is not allowed. If cheating has been detected, the homework will be graded as 0 and there will be no further discussion on this.
2. You are expected to submit your homework in groups. Therefore, only one of you is sufficient to submit your homework.
3. Make sure you export your homework as a Visual Studio Code Java project. You can use other IDEs as well; however, you must test if it **can be executed** in Visual Studio Code. It is a good idea to check your exported project on another group member's PC.
4. Submit your homework through Microsoft Teams.
5. Your exported Java Project should have the following naming format with your assigned group ID (which will be announced on MS Teams) as given below:

G05_CENG211_HW4

Also, the zip folder that your project is in should have the same name.

G05_CENG211_HW4.zip

6. Please beware that if you do not follow the assignment rules for exporting and naming conventions, you will lose points.
7. Please be informed that your submissions may be anonymously used in software testing and maintenance research studies. Your names and student IDs will be replaced with non-identifying strings. If you do not want your submissions to be used in research studies, please inform the instructor (Dr. Tuğlular) via e-mail.