AIC2022: The RPG

1 Lore

Two factions fight for the control of a newly discovered continent. Fight, explore, loot, and form your party of heroes in order for your faction to be victorious!

2 The Game

In this game, two teams compete for power and glory. For this purpose, each team can recruit several heroes to aid them in their quest. If these heroes gather 5000 reputation through their heroic feats, their team wins the game. Conversely, if these heroes are wiped out, their team loses. If no team wins in 1500 rounds, the winner team is chosen according to the following criteria, in order:

1. The team that has more reputation.
2. The team that has more shrines.
3. The team whose sum of resources plus the value of all of its units is the highest.
4. Randomly.

3 Economy

There are two types of resources in the game: gold and reputation, which are mainly used to recruit new heroes and to level them up respectively. Gold is obtained automatically at the beginning of every round at a rate of 1 gold/round, and can also be found in treasure chests. Reputation is obtained by defeating neutral and enemy units, by opening chests, and by protecting shrines. When an enemy or neutral unit is defeated, they give the victor reputation equal to their gold cost. Each team starts the game with 200 gold and 0 reputation.

4 Map

The map consists of a grid of dimensions between 30×30 and 80×80. Each unit occupies exactly one tile and all tiles of the map are accessible by every unit except if there is a mountain. Each tile may also contain a Shrine, a Forest, Water, a Shrine, and/or neutral units. Below the mountains, there might be hidden dungeons. Each one of these dungeons have at least one entrance/exit, and they are guaranteed to contain at least one treasure chest.

Each team starts with exactly one Base and it is guaranteed that all maps are symmetric. This symmetry may be horizontal, vertical or rotational. All tiles of a given map will have a fixed offset between 0 and 1000 (more precisely, the tile that would be $(0, 0)$ is marked as $(offset_x, offset_y)$ instead). This way units cannot guess the map edges without exploring.

5 Neutral Units

Initially, at some tiles of the map (both inside and outside the dungeons), there may be neutral units that chase and attack non-neutral units whenever they enter their vision radius. Their behavior is the following: among all units inside their vision radius, they try to move towards the closest one and attack it (they only move if they are outside of their attack radius). At the end of their turn, they set their orientation towards the unit they are pursuing.

6 Chests

Some of the tiles of the map initially contain chests that may be opened by units in adjacent tiles. Teams that open them are rewarded with gold, reputation, and even some artifacts (see Section 14). There are six types of chests: tiny, small, medium, large, epic and legendary. The gold and reputation obtained are calculated according to the following distributions:

	Tiny	Small	Medium	Large	Epic	Legendary
Gold	10 - 20	20 - 35	35 - 60	60 - 90	90 - 150	150 - 250
Reputation	50	100	200	300	450	700
Chance 1 Art. (%)	20	40	75	100	100	100
Chance 2 Art. (%)	0	0	0	20	50	100
Chance 3 Art. (%)	0	0	0	0	0	50

7 Shrines

Some of the tiles of the map initially have a shrine. Shrines can be attacked by units of either team. When attacked, shrines gain influence of the attacker team equal to the damage received (if the shrine had influence of the opponent team, it loses that amount of influence instead). If the shrine reaches 500 influence of some team, it pledges allegiance to that team and, if it is at full health, awards them with reputation at the beginning of each round. The amount of reputation received follows the following formula:

$$r(d) = 1 + \lfloor d/40 \rfloor,$$

where d is the Manhattan distance between the shrine and the team base (e.g., $|\text{shrine}_x - \text{base}_x| + |\text{shrine}_y - \text{base}_y|$) If a shrine has already 500 influence of some team and that team continues attacking, the shrine loses health points (it originally has 500 health points). If the shrine is destroyed, the attacking team is awarded with 150 gold. Shrines recover 10 health every round.

8 Dungeons

Dungeons are special connected zones that be accessed by a single entry/exit point. If a unit is outside of a dungeon, it cannot sense the tiles inside and viceversa. In fact, if the unit is outside (resp., inside) of a dungeon, all tiles inside (resp., outside) dungeons are seen as *Mountains* by that unit. The same applies for tiles in different dungeons. Dungeon entrances act as a two-way portal between a tile in the overworld and a tile inside the dungeon. Units can enter these *portals* from any adjacent tile, and appear on any adjacent tile in the other end (see the documentation).

Every 400 rounds, the dungeons are reset, which means that chests are refilled, new neutral units spawn in the interior, and **all units that are currently inside are wiped out**. Thus, it is probably wise to retreat before each of these resets happens. It is guaranteed that the chests quality increases with each reset.

9 Units and Structures

Each unit has a unique identifying number (ID) chosen randomly between 1 and 10.000. Whenever a new unit is created, there is a period of 10 turns in which the unit is still in construction and can't move, attack or perform any other action.

There are seven classes of heroes: Scouts, Barbarians, Rangers, Knights, Mages, Assassins and Clerics. The parameters of each of these types are as indicated in the following table. All distances are shown in squared units. For instance, a unit with 12 attack range at $(0, 0)$ can attack a unit at $(2, 1)$ since $2^2 + 1^2 \leq 12$, but it cannot attack a unit at $(2, 3)$ since $2^2 + 3^2 > 12$. A $(*)$ indicates that this unit follows a special mechanic (see Section 12).

	Base	Scout	Barbarian	Ranger	Mage	Knight	Assassin	Cleric
Gold Cost	0	40	60	70	80	90	85	100
Rep. for Lv. 2	0	20	60	40	80	60	100	80
Rep. for Lv. 3	0	20	60	40	50	60	80	60
Rep. for Lv. 4	0	40	40	40	60	60	60	100
Maximum Health	5000	300	750	350	250	1000	280	400
Attack	70	22	70	45	120	48	160	$-10^{(*)}$
Attack range	32	13	8	32	$18^{(*)}$	5	2	8
Defense	32	10	20	12	5	30	12	5
Minimum attack range	0	0	0	9	0	0	0	1
Attack cooldown	2	1	4	2	9	3	10	2
Vision range	61	82	32	50	34	50	41	32
Movement cooldown	1	1	2	2.5	3	1.5	1	3
Movement range	0	2	2	2	2	2	2	2
Ability I range$^{(*)}$	-1	2	0	32	32	2	13	18
Ability I cooldown$^{(*)}$	1	4	6	7	8	6	10	8
Ability II range$^{(*)}$	-1	0	0	2	32	13	-1	13
Ability II cooldown$^{(*)}$	1	5	8	7	8	6	1	11

10 Movement, Attack and Cooldowns

Each unit has a movement, attack, and ability cooldowns. They can only move, attack or use their abilities when their respective cooldown is inferior to 1. In particular, if all of its cooldowns are inferior to 1, the unit can attack, move and use both of its abilities (whenever they exist) on the same turn.

Every time that the unit attacks, moves, or uses an ability, it adds cooldown to its respective value. The amount added is the one given in the table in Section 9. If the unit moves in a diagonal direction, the movement cooldown added is multiplied by 1.4142, which is approximately $\sqrt{2}$. Moving to a tile with a forest multiplies the added cooldown by 1.5. At the beginning of every turn, all cooldowns decrease by 1.

Units cannot attack or use abilities through mountains. More precisely, if the segment that goes from the center of the unit's tile to the center of the target passes through the interior of a tile with a mountain, the attack cannot be performed. However, it is allowed that the segment passes through the boundary of such tiles. For instance, a unit at $(0, 0)$ can attack a unit at $(1, 1)$ even if there is an obstacle at $(0, 1)$.

11 Unit orientation and Damage

Whenever a unit attacks another unit, it deals a damage equal to the difference between the attack power of the attacking unit, and the defense of the defending unit.

All units in the game are oriented. At any point during the turn of the unit, the unit can change its orientation to any of the eight non-zero main directions. Whenever the unit is attacked (whether by an attack or by an ability), the damage taken (after applying the defense reduction), is then multiplied by a factor depending on the angle between the vector from the defender to the attacker and the orientation vector. If this angle is 0, the defender takes only 75% damage. If this angle is 180°, the defender takes double damage. Anything in between is scaled linearly.

If the unit is in a forest tile, the damage is reduced by 20% (applied after defense and orientation modifiers). Regardless of orientation or defense or if the unit is in a forest tile, all attacks are guaranteed to do at least 4 damage.

When a unit moves, its orientation automatically changes to the direction it is moving to (it can be changed later).

12 Special Mechanics

Each unit also has the following special mechanics:

Base: They can build any of the other units by spending the necessary gold. It cannot increase its level.

Explorers: If at the end of its turn there is no enemy or neutral unit in vision range, it recovers 16 health points.

- **Level 2:** Unlocks its ability *Chop tree*: Removes target adjacent tree.
- **Level 3:** Unlocks its *Sense* ability: For the rest of its turn, all units in its vision range are detectable, regardless of their passives.
- **Level 4:** If this unit's attack cooldown is 0, it cannot be detected by neutral units. This unit cannot open chests.

Barbarian: Increases its attack damage by 10 points for every 150 missing health points.

- **Level 2:** Unlocks its *Ragnarok* ability: Deals damage equal to its attack power to all units inside its attack radius.
- **Level 3:** Unlocks its ability *Enrage* All damage done this round is multiplied by 1.5.
- **Level 4:** If the barbarian received damage since its last turn, all of its damage is increased by 20% during this turn.

Ranger: Rangers don't get penalized by moving to forest tiles.

- **Level 2:** Unlocks its *Tangle* ability: Increases target unit's movement cooldown by 3.
- **Level 3:** Summon a forest.
- **Level 4:** Forests reduce 50% of the damage taken instead of 20%.

Mage: Whenever a mage attacks it hits all units in a 3×3 square around the target location.

- **Level 2:** Unlocks its ability *Swap*: Swaps position with target unit.
- **Level 3:** Unlocks its ability *Implosion*: Implodes target allied unit, hitting all adjacent units for twice its attack power.
- **Level 4:** All damage done by the mage cannot be reduced by orientation, forest tiles or defense.

Knight: Knights count as Mountains when enemy units attack (i.e., enemy attack lines cannot go through knights).

- **Level 2:** Unlocks its ability *Quick step*: Moves to target adjacent location and sets the knight's movement cooldown to 0.
- **Level 3:** All of target unit cooldowns increase by 1.
- **Level 4:** Every time the knight is attacked, the attacking unit receives 6 damage. This damage ignores defense and all modifiers.

Assassin: Assassins are rewarded by 50% more reputation points when killing a unit.

- **Level 2:** Unlocks its ability *Shadow Step*: Instantly moves to target location (it can move even if the path is obstructed).
- **Level 3:** When the difference between this unit's current attack cooldown and its intrinsecal attack cooldown (the amount added after attacking) is more than 1, assassins can only be detected by adjacent enemy units.
- **Level 4:** The maximum damage that this unit can do because of orientation is 3 instead of 2.

Cleric: When clerics attack, they heal target unit instead of dealing damage.

- **Level 2:** All allied units at distance at most 18 have their intrinsic attack cooldown decreased by 20% (not stackable).
- **Level 3:** Unlocks its ability *Pacify*: Increases target unit's attack cooldown by 3.
- **Level 4:** Unlocks its ability *Reinvigorate*: Schedules target unit immediately after the cleric's turn and decreases all of its cooldowns by 1.5 (this does not modify the unit's actual turn in the schedule queue. If a unit was originally going to be scheduled later in the current round, it will still be scheduled then.).

13 Communication and Vision

Each unit can only sense the objects (units, terrain, etc.) that are inside its vision radius. Vision is not shared. This means that objects detected by a given unit might not be detected by others. Units outside of the dungeons cannot sense anything inside the dungeons, and units inside a particular dungeon cannot sense anything inside the other dungeons.

Units run independently and they don't share memory. However, units can communicate by reading and writing on a shared array of 1000000 elements. The elements of this array are initialized at 0. Both reading and writing on this array can be performed using the methods at *UnitController*.

14 Artifacts

Artifacts can be found in chests across the map. Each artifact can be carried by units or consumed (units can also give their artifacts to other units. When consumed, the unit that carries it gains a permanent bonus to its attributes that depends on the artifact. All attributes except the gold costs, reputation costs, minimum attack range, vision range and movement range can be modified. The bonus can range from 20% to 40% of its original value (if the attribute is a cooldown, the artifact decreases the value instead of increasing it). Consuming an artifact is permanent, and the bonus is given as a function of the unit stats at the moment of the consumption. When a unit dies, all of its artifacts (both carried and consumed) are lost.

15 Energy

Energy is an approximate indicator of the number of basic instructions that each unit performs. More precisely, each bytecode instruction performed by a given unit consumes one unit of energy (except internal operations of the methods provided in the documentation, these consume a constant amount of bytecode which is given in the documentation). For users not familiarized with Java, it is not necessary to know how bytecode works, however it is good to have in mind that it is somewhat proportional to the number of code instructions. The amount of energy consumed up to a certain instruction can be accessed at any time using the methods in *UnitController*. Whenever a unit surpasses the amount of energy allowed (currently set to 30000), the unit pauses and continues running the remaining instructions during its next turn.

16 User Instructions

Players must fill the *run* method of the *UnitPlayer* class, which is run independently by all units of the player's team. This function has a *UnitController* as input, which is used to give orders to the given unit and to get information of the visible tiles or the common array, among others (check the documentation for more details).

Run does the following: Whenever a new unit is created and finishes its construction period (10 turns), its *run* method is executed until either the unit finishes its turn by calling the *yield* method, or when it surpasses the amount of allowed energy. If a unit returns from its run method, it dies. Because of this it is suggested to keep its instructions inside a *while(true)* statement, and to finish each iteration with a call to *yield* (check *nullplayer* and *demoplayer*).

17 Implementation info.

You may skip this section if you're not enough familiarized with Java.

Each unit is run in an independent thread. Each of these threads gets reactivated every time the unit is scheduled (once every round, following the same relative order every round). For safety reasons, it is forbidden to use any method or class outside *java/lang*, *java/math* and *java/util* (and some of the sub-classes of these). It is also forbidden to use static variables (which include switch statements, since they internally do so).

Even though codes that break these rules are automatically detected the instrumenter, we are going to check all the finalists' codes manually to be sure that everyone is playing a fair game. If a team breaks any of these rules without informing any of the devs, it will be disqualified.