Design Rationale

Zombie Attacks

Class modified: **AttackAction**

Roles and responsibilities:

- In the execute() method, if the actor is a zombie, and if the zombie returns a bite attack, it will have a 25% hit rate, whereas a normal punch will have a 50% hit rate. If the zombie landed a successful bite, it would heal itself by 5hp.

New Class Added: **PickUpWeaponBehaviour**

Roles and responsibilities:

- It implements the Behaviour Class to override the method getAction() from Behaviour class.
- In the override getAction(), there will be a for loop that iterates every item in that specific location.(for (Item item: map.locationOf(actor).getItems()))
- Inside the for loop, portability and weaponization of the item will be checked.
- Method asWeapon() in Item class will be called to check the weaponization of the item.
- Method getPickUpAction() in Item class will be called to check the portability of the item.
- If the item can be weaponized and it is portable, then it returns PickUpItemAction().Otherwise, return null.

New Class Added: **ShoutBehaviour**

Roles and responsibilities:

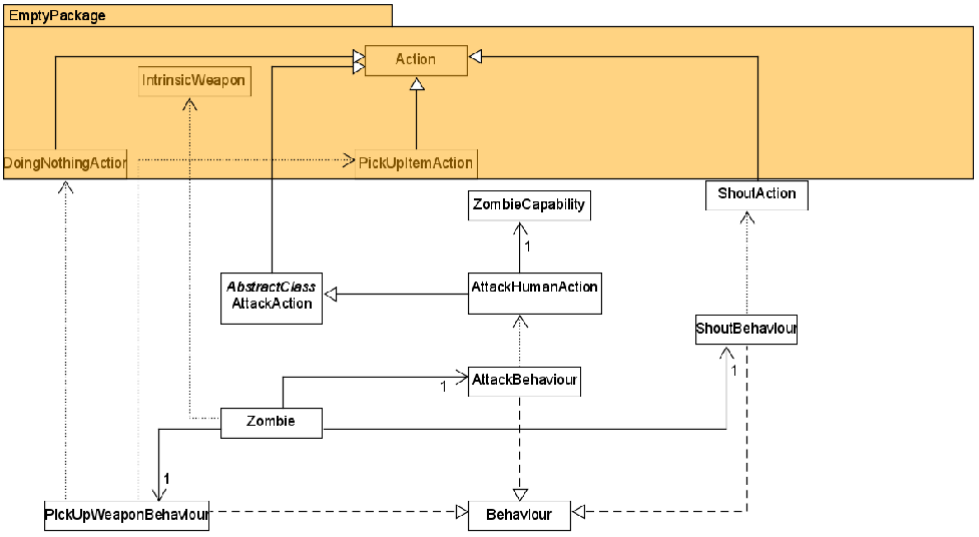
- It is a class that returns ShoutAction that will undergo execute() to print a String.
- It implements Behaviour class to inherit the method getAction().
- It has an attribute with type String Array, called word. It stores every string of words. There is an override method called getAction(). The getAction() has 2 parameters which are Actor and Gamemap.
- In the getAction(), it returns Action shout() which has a parameter Actor.
- The Action shout() returns ShoutAction if the probability of shouting word is achieved.

New Class Added: **ShoutAction**

Roles and responsibilities:

- It extends Action class because they share similar functionality, therefore duplication of code can be reduced, hence it improves reusability in java.
- It has a constructor with parameter String type.
- There are override methods called Execute() to return the description of the shout action and MenuDescription to display a descriptive string about what the actor is performing.

UML for Zombie Attacks



How to achieve the required functionality:

- Zombies should be able to bite. Give the Zombie a bite attack as well, with a 50% probability of using this instead of their normal attack. The bite attack should have a lower chance of hitting than the punch attack, but do more damage.
- To achieve this functionality, in the Zombie class, Bite is added as an intrinsic weapon into getIntrinsicWeapon(). So there are 2 intrinsic weapons which are punch and bite for a zombie. I set the damage of bite as 20 per hit which is higher than punch damage. To make the zombie has 50% probability of using bite attack instead of their normal attack which is punch. An If-else statement has to be implemented in getIntrinsicWeapon(). In the if-else statement, nextDouble() method that is imported from Random class has to be used to check the 50% probability of using bite for

every zombie in each turn.

- Bite attack should have a lower chance of hitting than the punch attack. To achieve this functionality, a new class, AttackHumanAction class is created and it inherits AttackAction class. In AttackHumanAction class, there is an override method, execute(). The execute() has an if-else statement to check the probability of bite and punch getting missed. nextDouble() can be implemented in this if-else statement to reach the aim.
- For example, if the weapon is bite and the probability of using bite is checked before the actor returns a String that describes that action.

- If the zombie bites human successfully, it restores 5 health points.
- To achieve this: an if statement is added into a method execute() in AttackHumanAction class.
- The Heal() method from Actor class is being called if the human is bitten by a zombie.

- If there is a weapon at the Zombie's location when its turn starts, the Zombie should pick it up. This means that Zombie will use that weapon instead of its intrinsic weapon like bite or punch. To achieve this functionality, a new class, PickUpWeaponBehaviour is created. It implements Behaviour class to improve the reusability of code. There is an override method called getAction(). In this method, there will be a for loop that iterates every item in that specific location. To pick up the item from a zombie, the item must have the ability to be weaponized and it is portable. To achieve these, getPickUpAction() and asWeapon() from item class will be called to check the requirement before picking up the weapon.
- If the item achieves those requirements, getAction() will return PickUpItemAction.
- If the item cannot be weaponized or it is not portable, getAction() will return null.

- Every turn, each Zombie should have a 10% chance of saying "Braaains". To achieve this functionality, new classes ShoutBehaviour and ShoutAction are created.
- Main function of ShoutBehaviour class is to return ShoutAction.
- ShoutBehaviour class has an override method called getAction() and an attribute with type String Array named as words that store every Word.
- Initializes this String Array with String word called “Brainnn”.
- In the getAction(), it returns a method called SHout() that returns the ShoutAction

if the requirements are fulfilled.

- One of the requirements is to check the probability of shouting words. Therefore, Random class is imported to carry out a method called nextInt() within the for loop that iterates every word that is stored in Array String.
- To allow the zombie to shout a single word, not a sentence. I created an if statement to check if the length of the word is within 10 letters.
- If these requirements are fulfilled, then Shout() returns ShoutAction. Otherwise, it returns null.
- In ShoutAction class, in the execute(), it returns menuDescription() which is a method that prints a string descriptive about what the actor is performing.

Beating up the Zombie

New class added: **IdentityCapability**

Roles and responsibilities:

- It's an enum class
- Store all types of actors in the game, including ZOMBIE, HUMAN, FARMER, MAMBOMARIE and PLAYER.
- Every character will have at least one of the constants upon creation, some will have more than one, for example, farmers will have both HUMAN and FARMER in its capabilities.

New class added: **UpgradableWeapon**

Roles and responsibilities:

- It's an abstract class that inherits WeaponItem class
- It acts as a base class for all weapons that can be upgraded into a superior weapon such as Arm and Leg.
- All upgradable weapons will have a base damage of 20.
- CraftWeaponAction is created and added to this upgradable weapon's allowable actions.
- Has an abstract method called craftWeapon() that return a new weapon (If it's an arm, player can craft it into a ZombieClub, if it's a leg, player can craft it into a ZombieMace)

New class added: **Arm**

Roles and responsibilities:

- A type of weapon that inherits UpgradableWeapon
- Has an attribute of type Weapon called upgradedWeapon that stores the upgraded weapon Arm will become if it's crafted by the player, added notes, only player can craft this Arm into another weapon and zombie can only use this weapon as it is.
- Can be used by both zombie and the player as a weapon with damage of 20 as it inherits UpgradableWeapon class
- Represented by the symbol "A" when it's on the ground
- The method craftWeapon() will return upgradedWeapon which is an object of type ZombieClub and it can only be called by the player when the player has an Arm in their inventory.

New class added: **Leg**

Roles and responsibilities:

- A type of weapon that inherits UpgradableWeapon
- Has an attribute of type Weapon called upgradedWeapon that stores the upgraded weapon Leg will become if it's crafted by the player, similar to Arm, only the player can craft this Arm into another weapon and zombie can only use this weapon as it is.
- Can be used by both zombie and the player as a weapon with damage of 20 as it inherits UpgradableWeapon class
- Represented by the symbol "L" when it's on the ground
- The method craftWeapon() will return upgradedWeapon which is an object of type ZombieMace and it can only be called by the player when the player has an Arm in their inventory.

Class modified: **AttackAction**

Roles and responsibility:

- In the execute method, when the player strikes the zombie, it will have a 60% hit rate. Next, if the player successfully lands a hit on the zombie, it will call a method from Zombie class called zombieIsAttacked() and it will return a string that indicates whether the Zombie loses an arm, a leg or none after being attacked.
- Has a private method called dropLimb(String, Zombie, GameMap) that will get Exits of the zombie, and randomly drop the newly created limb on the adjacent location of the zombie. Then it will decide if the Zombie will drop the first weapon it currently

has in its inventory if the Zombie only has one arm left after being attacked, or it will drop all the items in its inventory if the Zombie has no arm left.

Class modified: **Zombie**

Roles and responsibilities:

- Add ShoutBehaviour, PickUpWeaponBehaviour and CrippledBehaviour to the private attribute Behaviours.
- Has a field of type int called arm to store the number of arms that are still attached to the zombie.
- Has a field of type int called leg to store the number of legs that are still attached to the zombie.
- Both field arm and leg are initialised to 2 to represent all zombies will have 2 arms and 2 legs upon creation.
- Has a field of type Boolean called isCrippled which is initialised to false.
- Has private loseArm(int) method that deduct the number of arm lost from its arm attribute if and only if arm – arm lost >= 0. Throw an exception if the precondition is not satisfied.
- Has private loseLeg(int) method that deduct the number of legs lost from its leg attribute if and only if leg – leg lost >= 0. Throw an exception if the precondition is not satisfied.
- Has a public getArm() method that returns the number of arms that are still attached to the zombie.
- Has a public getLeg() method that returns the number of legs that are still attached to the zombie.
- Has negateIsCrippled() method that negates the status of isCrippled when it's called.
- In the getIntrinsicWeapon() method, Bite action is implemented as an intrinsic weapon of zombies. Zombie has 50% probability of using bite attack instead of punch if the Zombie still have both arms. If the Zombie loses one arm and only has another one arm left, the probability of returning a punch is halved. In other words, the probability of returning bite action is increased to 75%. If the Zombie has no arm left, it will not return a punch and will return bite 100% of the time.
- Has a public zombieIsAttacked() method that will decide if the Zombie will lose a limb or not after being attacked and deduct the Zombie's arm or leg attribute by the number of limbs lost if the Zombie actually loses a limb. It will return a string that

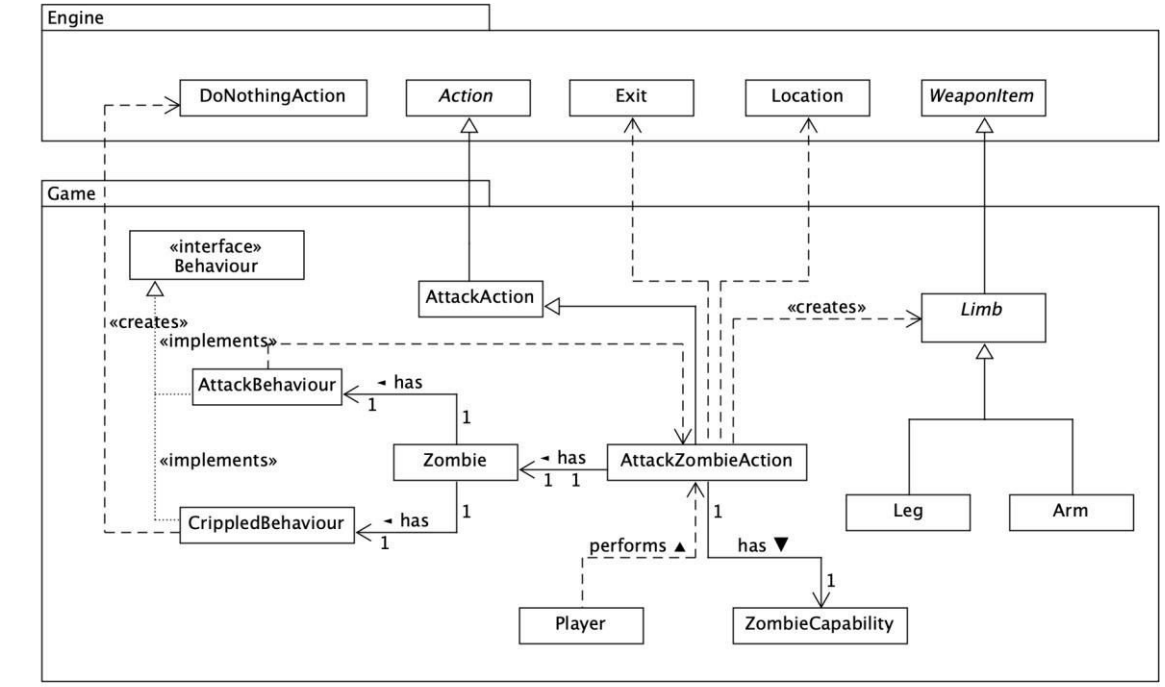
indicates the result of this action, so it will return “Arm”, “Leg” or null.

Class added: **CrippledBehaviour**

Roles and responsibility:

- Inherit Behaviour class, and this behaviour will take into account the number of legs this zombie has, and the isCrippled attribute of zombie to determine if the zombie can move in that turn or not.
- Has a getAction method that will get the number of leg. of the zombie, and return either Null or DoNothingAction based on the number of legs.

UML for Beating up the Zombies



How to achieve the required functionality:

- In order to provide more details on the action of player attacking the zombie, AttackZombieAction class is created and inherits from AttackAction class, at the same time, AttackAction class has to be made abstract to increase its reusability and its child class can share some of the same functionalities without duplication of code. For example, the methods targetIsDead(Actor, GameMap) and dropWeapon(Actor, GameMap) are used by all its subclasses. AttackAction is split into AttackZombieAction and AttackHumanAction so that they only handle one responsibility, hence Single Responsibility Principle (SRP) is followed.

1. **Cast off Zombie limbs can be wielded as simple clubs**

- Limb class is an abstract class so that Arm and Leg can inherit it, and increase the

code reusability since both Arm and Leg are quite similar with a key difference of what their upgraded weapon will be.

2. **Zombies will have exactly 2 arms and 2 legs on creation.**

- The number of arms and legs are hard-coded to 2 upon creation of any zombie. Although hard-coding is not a preferable practice in object-oriented design, however, this can be justified as the number of arms and legs are supposed to be a class variable and should be the same for all zombies when a new zombie object is created.

3. **Any attacks on a Zombie that causes damage will have a chance to knock at least one of its limbs off. If the Zombie loses one arm, the probability of punching is halved and has a 50% chance of dropping any weapon it is holding. If it loses both arms, it definitely drops any weapon it was holding. Lost limb drops onto the ground at an adjacent location to the Zombie.**

- In the AttackAction class, any attack on the Zombie will have a 60% successful hit rate. If the attack is successful, it will deduct the Zombie's hit points by the damage of the attack. Then, the execute function will call the zombieIsAttack() method from Zombie class and determine if the attack results in the dropping of a limb from the Zombie. It will call the dropLimb(String, Zombie, GameMap) function to drop the limb at the adjacent location of the Zombie. The dropLimb(String, Zombie, GameMap) function will also determine if the Zombie should drop the weapon it's holding alongside with the limb. If the limb is indeed dropped by the Zombie, a new limb will be created and placed randomly at the adjacent location to the zombie. The dropLimb(String, Zombie, GameMap) function is created to increase the readability and avoid the execute() function from being too cluttered.
- The getIntrinsicWeapon in zombie class is modified so that it uses simple if-else based on the number of arms of the zombie before returning Punch or Bite, where both belong to type IntrinsicWeapon. If the number of arms == 2, it's 50-50 for Punch and Bite, if the number of arms == 1, it's 25-75 for Punch and Bite. Lastly, if the Zombie has no arm, it will only return bite.

4. **Loses one leg, movement speed is halved; loses both legs, it cannot move at all.**

- The attribute Behaviours is an array of behaviours that are arranged such that the Zombie will have a 10% chance of shouting something every turn regardless of the

conditions the Zombie is in. Then it is followed by pick up weapon behavior and attack behavior, so that the zombie will pick up the weapon first before attacking a human nearby. The crippled behavior if placed right before both movement behaviors which are hunt behavior and wander behavior so that the Zombie will move in alternating turns if it has only one leg or cannot move at all if it has no leg.

- At each turn, zombie will go through its behaviours and return the first allowable action it can take. CrippledBehaviour is created to determine if the zombie can move in that turn or not based on the number of legs the zombie has. It is placed right before the two movement behaviours which are HuntBehaviour and WanderBehaviour so that the zombie can return DoNothingAction if it's not supposed to be moving during that turn, or return null if it should be able to move.
- If the number of legs is equal to 2, return null. If the number of legs is equal to 0, return DoNothingAction. Lastly, if it's equal to 1, it will use the getIsCrippled() method from zombie class to determine if this zombie can move or not. Since the isCrippled attribute of a zombie is initialised to false, and the zombie shouldn't be able to move in the first turn after the zombie loses one leg, it will negate the isCrippled attribute of the zombie and return DoNothingAction. The next turn, the isCrippled attribute of the zombie is now true, and this zombie should be able to move, so it will negate the isCrippled again and return null.
- Since CrippledBehaviour is placed right before HuntBehaviour and WanderBehaviour so that it can interfere with the movement behaviour and return the appropriate action.

Crafting weapons

New class added: **CraftWeaponAction**

Roles and responsibilities:

- Inherits Action class so it can be used as an action by the player.
- Has a constructor CraftWeaponAction(Limb).
- In the execute() method, it will first remove this current weapon from the actor's inventory, then it will call this weapon's craftWeapon method which will return a superior weapon. Finally, this superior weapon will be added into this actor's inventory.

- Has menuDescription() method that returns a string Original weapon + “is crafted into “ + New weapon.

New class added: **ZombieClub**

Roles and responsibilities:

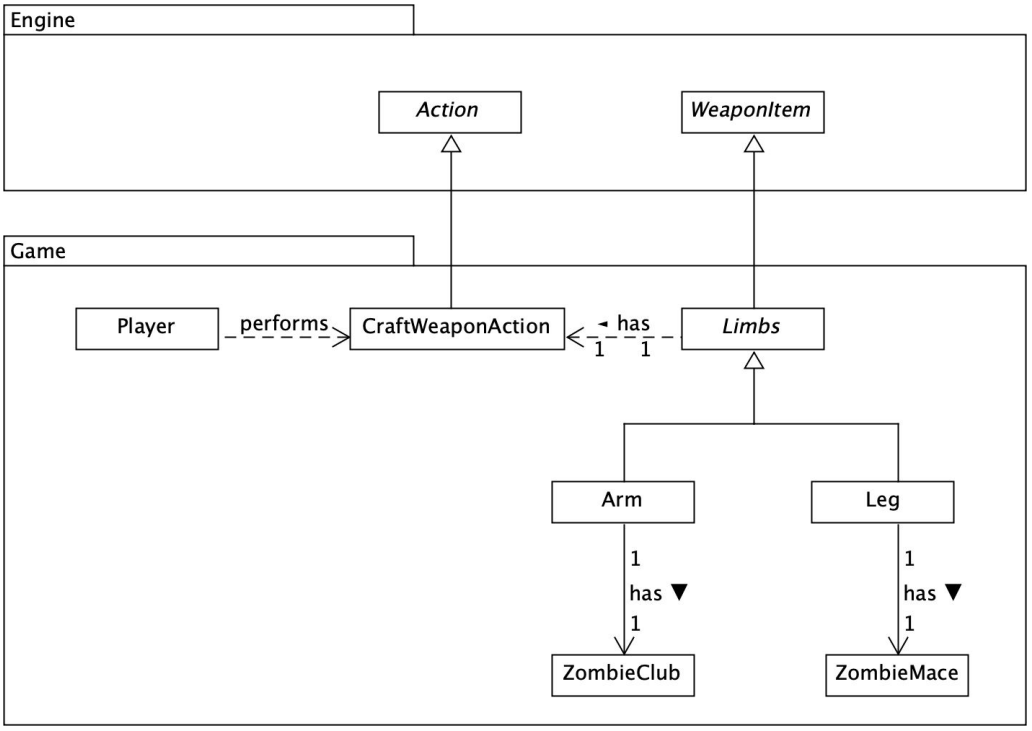
- Inherits WeaponItem class
- It is represented by the letter “B” when it’s on the ground
- Has a damage of 35

New class added: **ZombieMace**

Roles and responsibilities:

- Inherits WeaponItem class
- It is represented by the letter “M” when it’s on the ground
- Has a damage of 50

UML for Crafting Weapons



How to achieve the required functionality:

1. **Players holding an Arm or a Leg can craft it into Zombie club and Zombie mace respectively.**

- Arm class has a private attribute of type ZombieClub which stores a new ZombieClub

object. This ZombieClub is the successor of Arm and has a damage of 35.

- Similarly, Leg class has a private attribute of type ZombieMace which stores a new ZombieMace object. This ZombieMace is the successor of Leg and has a damage of 50.
- When the player has either an Arm or a Leg in the inventory, since both Arm and Leg have CraftWeaponAction in their allowableActions, the player will have a choice to craft them into a better weapon respectively.
- If CraftWeaponAction if executed, it will remove the weapon from the player's inventory, then it will call the craftWeapon method in Arm or Leg which will return a new weapon, either a ZombieArm or a ZombieMace depending on the weapon wished to be upgraded. Lastly, it will add this new weapon into the player's inventory.

Rising from the Dead

New class added: HumanCorpse

Roles and responsibilities:

- Extends Item abstract class to reduce code duplication as it has the same functionality.
- It is used to represent a dead Human which has health points < = 0. If the target is Zombie type, it will create a new corpse item with displayChar='&' to represent dead zombies. when a Human is killed by Zombie, the HumanCorpse item is dropped where a new object is created of type HumanCorpse and added onto the map location.
- Has attributes String name = humanCorpse, char displayChar = 'X', portable = false.
- It has a new attribute of type int, countdown = 5-10, randomly generated between 5 to 10 turns, where this represents the number of turns before it spawns a Zombie at the original location.
- Modifies the method tick() in Item abstract class which decreases the countdown by 1 every time tick is called. When the countdown reaches 0, it will call spawnZombie() method.
- Has a new method spawnZombie() that creates a zombie at the current location and removes the HumanCorpse object.

Farmers and Food

New class added: Farmer

Roles and responsibilities:

- Extends Human class as they share the same characteristics and abilities as humans and therefore reduce the need of repeating codes.
- It has an attribute, Behaviour[] behaviours, which stores the Farmbehaviour and other behaviour that Human has.
- It uses the parent class constructor which is human to initialise 3 attributes; String name, char displayChar = 'F' , and int hitpoints= 50.
- has an @override playturn method that loops through the Behaviour[] behaviours and returns an action to be performed at that turn.

New class added: FarmBehaviour

Roles and responsibilities:

- Implements Behaviour interface as it is a new type of behaviour for Farmer.
- @Overrides the super class's getAction method in Behaviour Interface which returns an action such as SowAction, FertiliseAction, HarvestAction or Null if the Farmer cannot do these.
- It is used to create actions that Farmer can do such as sowing crops if Farmer actor is standing near a patch of dirt, which drops Crop item from inventory to the dirt ;Harvesting fully grown Wheat and drops it to the ground ;Fertilising crops to reduce the amount of turn required for it to be a fully grown Wheat.

New class added: SowAction

Roles and responsibilities:

- Extends Action abstract class as it is also a new type of action and therefore help to reduce duplication of code.
- Has an attribute of Exit exit which is the surrounding exit for Farmer to sow Crops.
- -@Overrides super class's execute method to sow crops by changing the Dirt into Crop which the Farmer performs and displays the result in the I/O.
- @Overrides super class's menuDescription method which returns a string of a description to be displayed in the menu.

New class added: FertiliseAction

Roles and responsibilities:

- Extends Action abstract class as it is also a new type of action that Farmer can do and therefore help to reduce duplication of code.
- It has the attribute Crop crop, which is the crop that will be fertilised.
- -@Overrides super class's execute method to fertilise crops by decrementing the countdown of Crop so that it will ripe faster and displays the result in the I/O.
- @Overrides super class's menuDescription method which returns a string of a description to be displayed in the menu.

New class added: HarvestAction

Roles and responsibilities:

- Extends Action abstract class as it is a new type of action that Farmer can do and therefore help to reduce duplication of code.
- It has attribute Location harvestLocation, which is the location of the crop to be fertilised.
- -@Overrides super class's execute method to harvest crops by setting the location of the ground type back to dirt. If the actor is a player, it will create a Wheat item and add it into the Player's inventory. If the actor is a Farmer, it will drop the newly created Wheat item at the harvestLocation instead. This will then display the result in the I/O.
- @Overrides super class's menuDescription method which returns a string of a description to be displayed in the menu.

New class added: Food Interface

Roles and responsibilities:

- It is an interface that is used to determine whether an item can be used as a food.
- Has methods -public int hpRecover(), which is the amount of health points it will restore when being consumed by Human or Player.
- Has another method- public String verb(), which is the verb used when displaying the results after consuming this Food. For example, "chews" and "drinks".
-

New class added: FoodItem

Roles and responsibilities:

- Extends Item abstract class and implements Food interface.
- Contains 2 attributes- int hpRecover and String verb.
- Used to represent items that are used as a food that can be consumed to recover health points.
- Has 3 accessor methods heal(), verb() and name() which returns the amount of hit points recovered ,the verb to be used to display and the name of the item. For Example, "Player drinks milk and recovers for 20 hit points."

New class added: Crop

Roles and responsibilities:

- Extends Ground abstract class.
- Is an item with attributes, displaychar = ‘c’.
- It also has an int countdown =20, attribute that records the number of turns required to grow into a ripe crop which is Wheat. This countdown is updated using the tick() method in Item abstract class.
- It has a method getCountdown() which returns the int countdown.
- It also has a method decrementCountdown(int number) which takes the number as input and decreases the countdown int variable of the crop object.
- @Overrides super class’s tick() method in Item abstract class and decreases the countdown by 1 each time the tick() method is called. When the countdown attribute is 0 , it will call cropRipens method
- Has a new cropRipens() method that changes the displayChar to ‘C’ to represent the crop is fully grown.
- @Overrides super class’s allowableActions that checks if the adjacent location to the actor has a ripe crop and adds it into the Action actions and returns the new collection of actions.

New class added: Wheat

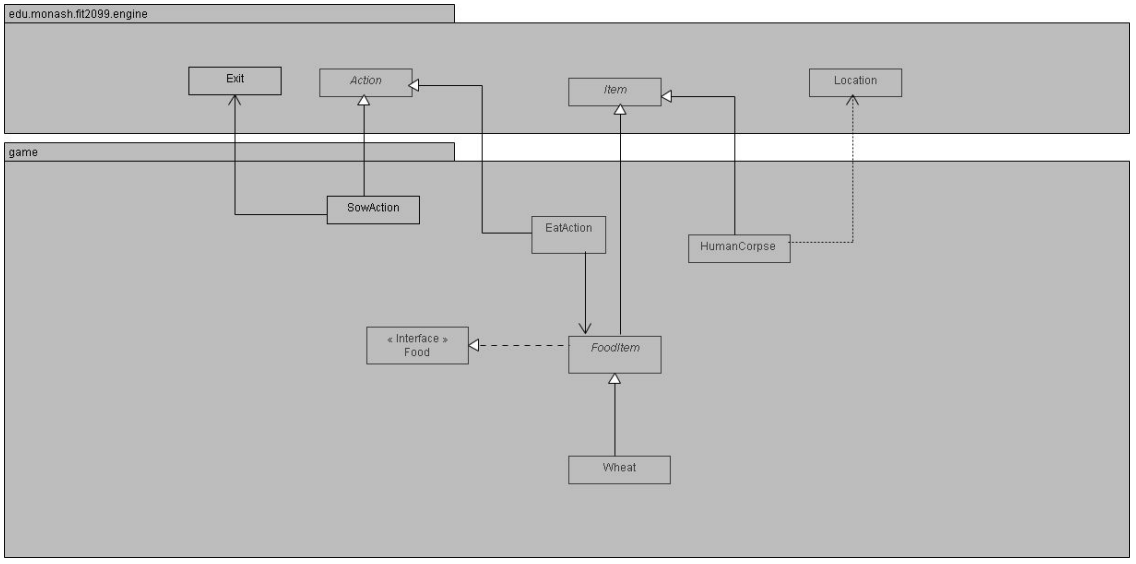
Roles and responsibilities:

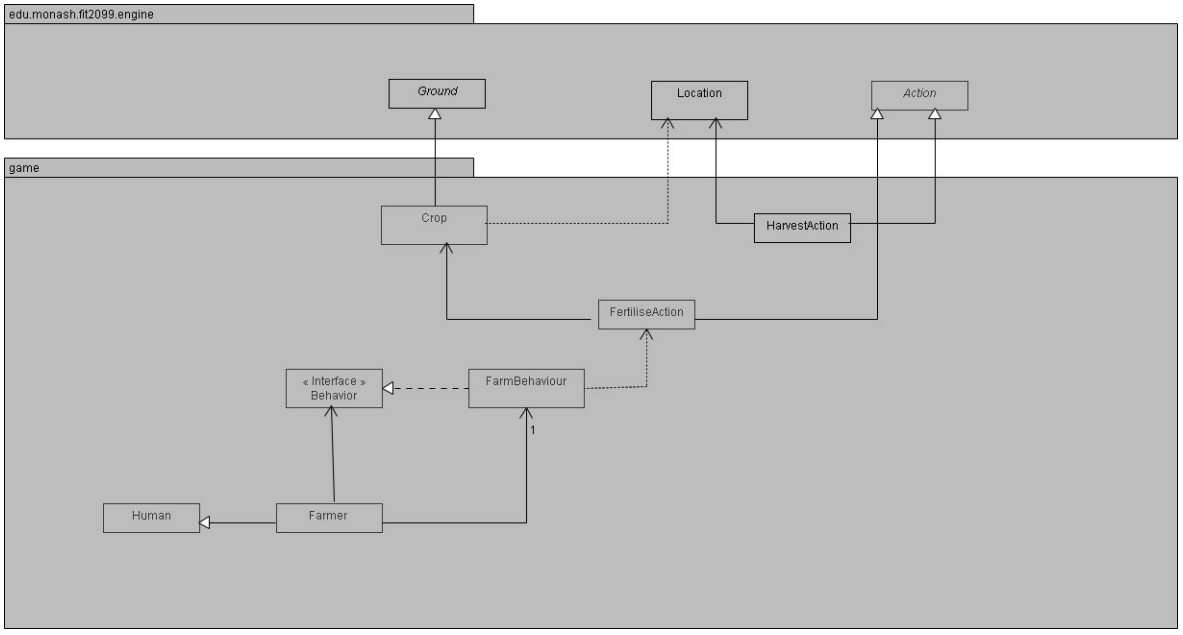
- Extends fooditem abstract class.
- It is the type of food dropped when a ripe crop is harvested
- The Wheat Constructor initialise the attributes such as name = Wheat, displaychar = ‘w’, int hpRecover = 20, String verb= “chews”.
- It also has allowableActions.add(new(eatAction(this)) so that this Wheat can be consumed by Player and Human.

New class added: EatAction

Roles and responsibilities:

- Extends Action abstract class and therefore can reduce duplication of code.
- It is an action that allows an actor to consume Food.by removing it from an actor's or player's inventory and recover some health points of the actor.
- It has an attribute FoodItem fooditem which represents the FoodItem to be consumed.
- @Overrides the super class's execute method in Action to use the FoodItem by removing it from actor's inventory and heal the actor by the amount indicated by hpRecover, then returns a String to be displayed to the user at the end of each turn.
- @Overrides menuDescription method which returns a String of a description to be displayed in the menu. For example, "Player consumes Wheat and recovered 20 health points."

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