**Design Rationale**

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Zombie attacks

**Zombie [ Existing class ]**

* A type of actor called Zombie.

New Changes and their responsibilities:

1. A new private attribute called PickUpWeaponBehaviour() is added into the existing array of behaviour. Its function is to create a behaviour that allows the **Zombie** to pick up the weapon from its standing location in the map. The order of the array of behaviour is **AttackBehaviour**, **HuntBehaviour**, **PickUpWeaponBehaviour** and **WanderBehaviour**.
2. The existing getIntrinsicWeapon() method is modified  and now has 2 possible types of IntrinsicWeapon called bites and punches  when the method is called. The chances of getting one of them 50%. Math.random() is used to obtain the random probability between the two.
3. The existing playTurn() method is modified to have a 10% chance of printing the line “ Braaaaains ” every turn. Math.random() is used to obtain the probability of saying the phrase.

Design Choice:

1. The behaviour of a **Zombie** in the game should be wanting to attack and hunt humans first as a particular zombie would do. Then only it should have the instinct to pick up weapons and wander around. In a logical standpoint, they should have picked up a weapon first then only started to attack **Human**. However, **Zombie** has no logical sense .

**PickUpWeaponBehaviour [ New Class ]**

* A type of non-player behaviour that picks up weapons from its standing location.

New Changes and their responsibilities:

1. This class implements an interface called **Behaviour**.
2. It has a method called getAction() that takes in two parameters ( **Actor** actor and **GameMap** map ) and returns an Action. Its function is to pick up a weapon that is on the **Actor**’s location in the map. If there is a weapon in the **Actor**’s location, it will instantiate a PickUpItemAction() and return it.

Design Choice:

1. When designing **PickUpWeaponBehaviour**, it implements Behaviour because behaviour serves as a purpose for a non-player to perform actions and is a guidance for all types of behaviour to use its method which is getAction(). This makes the codes for all types of behaviour class understandable and consistent.
2. When the **Zombie** picks up a weapon, the weapon will be stored in the inventory and it will use the weapon instead of the intrinsic weapon.
3. Since a **Zombie** can only use a weapon at a time, if a zombie picks up multiple weapons, it will only use the first weapon that it picks up. It will use the following weapon in order if it drops the first weapon and so on.

**ZombieAttackAction[ New Class]**

* A type of attack action that only Zombie class can have

New Changes and their responsibilities:

1. This is a class that inherits from a class called **AttackAction**.
2. It has a constructor that takes a parameter (**Actor** actor) and its parameter is initialized by the superclass constructor.
3. It has only one method:
4. The execute() method  that takes 2 parameters (**Actor** actor and **GameMap** map) and returns a String. Its function is to execute the attack action that the Zombies have. This class is similar to the **AttackAction** class but with additional features only available for **Zombie**. **Zombie** will miss more bite attacks than punch attacks. A probability is set by Math.random(). Bites will have a missing rate of 75% and 25% for punch. **Zombie** will also heal 5 points if they successfully landed a bite attack. If **Zombie** is using a weapon, the chances of missing is 50%.

Design Choice:

1. When designing **ZombieAttackAction** class, it inherits from **AttackAction** class as it is a type of attack action. This reduces repetition of codes and hence follows the  DRY( Don’t repeat yourself) principle.
2. I have decided to create a new attack action class only for **Zombie** instead of using **AttackAction** class. The reason for this is for better maintainability and extendable. In the future, we can add more **Zombie** related attack action features in this class.

**AttackBehaviour [ Existing Class ]**

New Changes and their responsibilities:

1. The getAction() method is modified and now has another condition in it. If the actor has a capability of ZombieCapability.UNDEAD (enum), it will return a new **ZombieAttackAction**.

Design Choice:

**AttackBehaviour** now has 2 possible types of action, **AttackAction** and **ZombieAttackAction**. **AttackAction** is used by other actors in the game where **ZombieAttackAction** is only used by **Zombie**.

Rising from the dead

**Corpse** [New Class]

* An **Item** added to the **GameMap** when an **Actor** (**Human**, **Farmer** and **Zombie**) is killed.

New Changes and their Responsibilities:

* This class inherits from an abstract class called **Item**.
* It has two private attributes (**int** turn and **Actor** initialActor).
  + turn - acts as a counter
  + initialActor - the dead **Actor** who owns the **Corpse**
* It has a constructor that takes in 2 parameters (**String** name and **Actor** initialActor). It initialises initialActor and also makes use of the superclass constructor to initialise name, displayChar and portable.
* It overrides tick() method to fulfil the required functionality for the **Corpse** to “rise from the dead”
  + Parameter: **Location** currentLocation - Current location where the corpse is placed
  + This method is executed every turn in the game.
  + turn increments by 1.
  + If initialActor does not hasCapability(*ZombieCapability.UNDEAD*), in which it is not a **Zombie**, generate a random integer between 5 to 10 inclusive.
  + Then, if the turn equals the random integer and there is no **Actor** on the currentLocation, A new **Zombie** object is instantiated.
  + The **Zombie** is added onto currentLocation and the **Corpse** is removed from currentLocation using methods in **Location** called addActor() and removeItem() respectively.
  + A string is printed to notify the **Player** that a dead **Human** becomes a **Zombie**.
  + This will look as though the **Corpse** becomes a **Zombie** 5 to 10 turns later.

Design Choices / Reasons:

* The design in which the Corpse inherits from Item takes into account the Do Not Repeat Yourself principle because Corpse also uses the features in Item and inheritance helps to avoid repetition of codes.
* **Zombie** objectis instantiated in the method as a local variable instead of as an attribute to follow Declare things in the tightest possible scope principle to lessen the risk that something can depend on it, thus reduce the risk of possible failure in the future.
* initialActor is declared as private to follow the Minimize dependencies that cross encapsulation boundaries principle because if we declare it to be more visible, i.e. public initially, it may break other systems if we change a originally more visible attribute to a lower visibility.

**AttackAction** [Existing Class]

New Changes and their Responsibilities:

* execute() method is modified
  + If an **Actor** is killed after being attacked [existing code], a new **Corpse** object is instantiated [modified] instead of a **PortableItem** [existing code], then added to the **Location** of the dead **Actor** which is removed from the **Location** [existing code].
  + This is because there is a new **Corpse** class created in which it is able to increment the counter every turn in the game to control the turn when it becomes a **Zombie** to fulfil the required functionality.

Design Choices / Reasons:

* **Corpse** is instantiated in the method as a local variable instead of as an attribute because Declare things in the tightest possible scope principle is taken into account in this design.

Farmers and food

**Farmer** [New class]

* A new kind of **Human** who shares the same characteristics and abilities as a **Human** but also able to sow, fertilize and harvest crops.

New changes and their Responsibilities:

1. This class inherits from a class called **Human**.
2. It has four private attributes stored in an array of type **Behaviour** - behaviours

* Its elements are new object instantiated from **HarvestBehaviour**, **FertilizeBehaviour**, **SowBehaviour** and **WanderBehaviour** respectively

1. It has a constructor that takes in one parameter (**String** name). It makes use of the superclass constructor to initialise name, displayChar and hitPoints. It also calls addCapability() method from **Actor** with *ZombieCapability.FARM* as the argument.
2. It overrides playTurn() method.
   1. Parameter:

* Actions actions, Action lastAction, **GameMap** map, Display display
  1. This method executes every turn in the game.
  2. In the method, it first call returnEatAction(map) method which inherits from **Human** [details discussed in the **Human** class], if it is not null, return the return value of this method,

else,

An enhanced for loop is used to loop through the elements in the array of behaviours, and if the return value of getAction(this, map) method from **Behaviour** interface is not null, the action is returned,

else,

continue looping the array based on the sequence of elements in the array

If all getAction(this, map) is null, return a new DoNothingAction() object, in which the Farmer will do nothing in that turn.

* 1. Overall, this method will return the first **Action** which is not null following the sequence which is the return value of returnEatAction method, then the return value of getAction method called by **HarvestBehaviour**, **FertilizeBehaviour**, **SowBehaviour**, **WanderBehaviour** and lastly **DoNothingAction**.

Design Choices / Reasons:

* The design where **Farmer** inherits from **Human** follows the Do Not Repeat Yourself principle because **Farmer** also uses the features in **Human** and inheritance helps to avoid repetition of codes.
* behaviours are declared as private to follow the Minimize dependencies that cross encapsulation boundaries principle because if we declare it to be more visible, i.e. public initially, it may break other systems if we change a originally more visible attribute to a lower visibility.
* *ZombieCapability* is an Enum and defines a collection of constants to indicate the capability of an **Actor**. **Farmer** is designed to have the capability *ZombieCapability.FARM* to follow the Do Not Repeat Yourself, Reduce dependencies as much as possible and Avoid excessive use of literals principle. It is designed to avoid repetition of code when checking whether an **Actor** is a **Farmer**, and also to avoid using the getDisplayChar method from **Actor** whether it is equal to the displayChar of **Farmer**, since if displayChar is changed, we would have to hunt for every place it occurs in the code and change all of them. It would help to avoid having such indirect dependencies in the system.
* returnEatAction method in Human class is called in the playTurn method instead of instantiating a new **EatBehaviour** object which calls the getAction method to return its **Action.** This is to follow the principle:
  + Do Not Repeat Yourself as to avoid repetition of codes since **Human** and **Farmer** can both eat **Food** when they are damaged [details for method discussed in Human class]
  + Reduce Dependencies as much as possible since it reduces the dependency to EatBehaviour
* An enhanced for loop is used as stated above to avoid repetition of code on checking whether the **Action** returned by the elements in behaviours is null or not and this is also where Do Not Repeat Yourself principle is taken into account in this design.

**Human** [Existing Class]

New Changes and their Responsibilities:

* returnEatAction method is added
  + Visibility: protected, Parameter: **GameMap** map, Return type: **Action**
  + This method is to return an **Action** to eat if this **Actor** is damaged and when the **Actor** is able to own **EatBehaviour**.
  + It is called in the playTurn method in both **Human** and **Farmer** class, thus also executed at every turn in the game.
  + If hitPoints is smaller than maxHitPoints, and if the **Action** get from new EatBehaviour().getAction(this, map) is not null, the **Action** is returned,
  + Else, return null
    - hitPoints and maxHitPoints are protected attributes in **Actor**
* playTurn method is modified
  + Before returning **Action** get from the getAction method called by the attribute in Human(behaviour- new **WanderBehaviour** object)[existing code], returnEatAction(map) method is called to return its return value if it is not null [modified].

Design Choices / Reasons:

* returnEatAction method is created to avoid duplicated code since this behaviour is shared by both **Human** and its subclass, **Farmer** if they are damaged. This follows the design principle Do Not Repeat Yourself.
* New **EatBehaviour** object is instantiated in returnEatAction method to follow Declare things in the tightest possible scope principle since it is declared as a local variable instead of as an attribute.

**SowBehaviour** [New class]

- A type of non-player behaviour to sow a crop on a patch of dirt if the actor is next to it.

- **Farmer** owns this behaviour

New changes and their Responsibilities:

* This class implements an interface called **Behaviour**.
* It overrides getAction() method.
  + Parameter: **Actor** actor, **GameMap** map
  + Return type: **Action**
  + Use an enhanced for loop to get the **Exit** from the location of actor on the map and call getDestination and getGround method to check whether the **Actor** is standing next to a **Dirt**, if so it will have 33% probability that a new **SowAction** object is returned, else return null.

Design Choices / Reasons:

* It implements **Behaviour** because **Behaviour** is the objective an **Actor** has to help decide which **Action** is to be performed next by overriding the getAction method in **Behaviour**.
* For the **Actor** (**Farmer** in this case) to sow, it will return a new SowAction object in the method.
* It follows the Declare things in the tightest possible scope principle since **Exit** is declared in the enhanced for loop instead of at the beginning of the method.
* It uses the *GroundCapability* enum to check whether a **Ground** is capable of being sowed. [Details of design reasons discussed in **Dirt**]

**FertilizeBehaviour** [New class]

* A type of non-player behaviour to fertilize an unripe crop if the actor is standing on it.
* **Farmer** owns this behaviour

New Changes and Responsibilities:

* This class implements an interface called **Behaviour**.
* It overrides getAction() method.
  + Parameter: **Actor** actor, **GameMap** map
  + Return type: **Action**
  + Use an enhanced for loop to get the **Item** from the location of the actor on the map by calling getItems method and check whether the item is capable of being fertilized , if so it will return a new **FertilizeAction** object, else return null.

Design Choices / Reasons:

* It implements **Behaviour** because **Behaviour** is the objective an **Actor** has to help decide which **Action** is to be performed next by overriding the getAction method in **Behaviour**.
* For the **Actor** (**Farmer** in this case) to fertilize, it will return a new **FertilizeAction** object in the method.
* It follows the Declare things in the tightest possible scope principle since **Item** is declared in the enhanced for loop instead of at the beginning of the method.
* It uses the *ItemCapability* enum to check whether an **Item** is capable of being fertilized. [Details of design reasons discussed in **Crop**]

**HarvestBehaviour** [New class]

* A type of non-player behaviour to harvest a ripe crop if the actor is standing on it or next to it.
* **Farmer** owns this behaviour

New Changes and Responsibilities:

* This class implements an interface called **Behaviour**.
* It overrides getAction() method.
  + Parameter: **Actor** actor, **GameMap** map
  + Return type: **Action**
  + An ArrayList of type **Location,** locationList is created to store all the location and adjacent locations of the actor.
  + locationList stores the location of the actor on the map.
  + Use an enhanced for loop to get the **Exit** from the location of the actor on the map and call getDestination to get the adjacent locations and store them in the locationList.
  + Use another enhanced for loop to get the **Item** from the element in the locationList by calling getItems method, if it is capable of being harvested, it will return a new **HarvestAction** object, else return null.

Design Choices / Reasons:

* It implements **Behaviour** because **Behaviour** is the objective an **Actor** has to help decide which **Action** is to be performed next by overriding the getAction method in **Behaviour**.
* For the **Actor** (**Farmer** in this case) to harvest, it will return a new **HarvestAction** object in the method.
* It follows the Declare things in the tightest possible scope principle since **Exit** and **Item** are declared in the enhanced for loop instead of at the beginning of the method.
* It uses the *ItemCapability* enum to check whether an **Item** is capable of being harvested. [Details of design reasons discussed in **Crop**]

**EatBehaviour** [New class]

* A type of non-player behaviour to fertilize an unripe crop if the actor is standing on it.
* **Human** and **Farmer** own this behaviour

New Changes and Responsibilities:

* This class implements an interface called **Behaviour**.
* It overrides getAction() method.
  + Parameter: **Actor** actor, **GameMap** map
  + Return type: **Action**
  + An enhanced for loop is used to get the **Item** from the location of the actor on the map by calling getItems method and check whether the item is edible, if so it will return a new **EatAction** object, else return null.

Design Choices / Reasons:

* It implements **Behaviour** because **Behaviour** is the objective an **Actor** has to help decide which **Action** is to be performed next by overriding the getAction method in **Behaviour**.
* For the **Actor** (**Farmer** and **Human** in this case) to eat, it will return a new **EatAction** object in the method.
* It follows the Declare things in the tightest possible scope principle since **Item** is declared in the enhanced for loop instead of at the beginning of the method.
* It uses the *ItemCapability* enum to check whether an **Item** is edible. [Details of design reasons discussed in **Food**]