Lab 3 – Team 1
Assignment 2 – Develop

Work Breakdown Agreement – Lab 3 Team 1

Members:
1. Yong Jun Ong 31861407
2. Chen Yang Seah 32311168
3. Yuki Yi Wei Wong 32599862

Task Delegation:
Chen Yang: REQ 1, 2
Yong Jun: REQ 3, 4, 7
Yuki: REQ 5, 6

Signatures:
1. I, Yong Jun, accept this WBA.
2. I, Yuki, accept this WBA.
3. I, Chen Yang, accept this WBA.

Requirement 1

Design rationale

In order to implement the three different stages of trees, we create 3 subclasses of the Tree class, by extending the Tree class through polymorphism. These subclasses include Sprout, Sapling and Mature. This allows the subclasses to inherit the common features of a tree, such as having an age and having the same chances to be removed in a reset (implemented in later requirements). This obeys the Single Responsibility Principle and Open-Closed Principle, where the parent Tree class is only responsible for the common features of all trees and adding new features in the extended subclasses will not affect the parent class itself. The Tree class is an abstract class as a Tree object must exist in one of the tree forms implemented as subclasses, thus it cannot be instantiated as a Tree object.

Since all the 3 subclasses have features for spawning other objects into the game, they will all have a dependency with the Location class as it is needed to determine the spawning point.

Sprout spawns Goomba, Sapling spawns Coins and Mature spawns Koopa. Therefore, they will have a dependency relationship with their respective spawns.

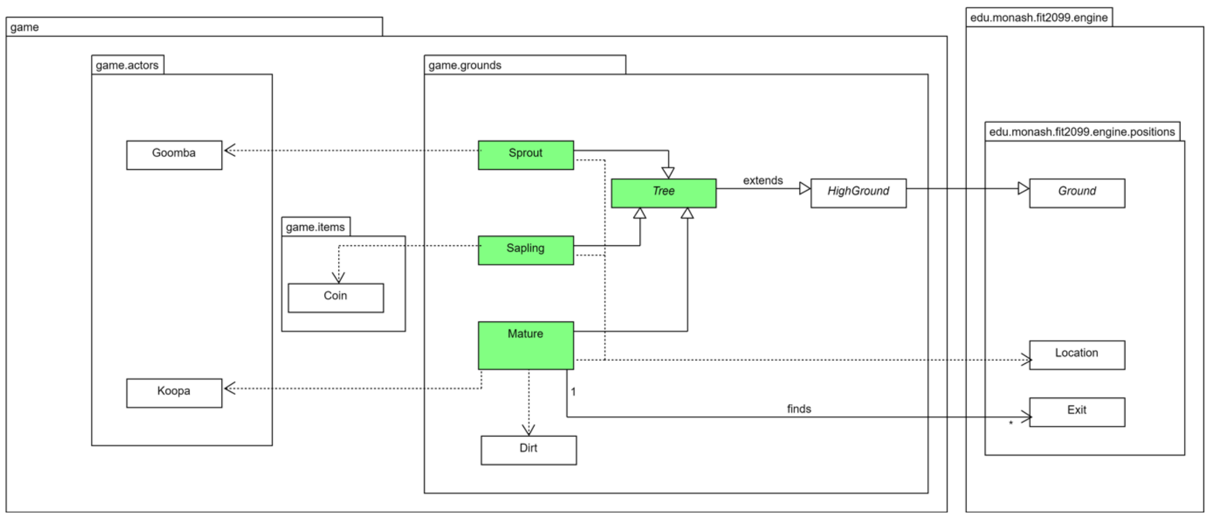
A Sprout will grow into a Sapling, then a Sapling will grow into a Mature, ending with a Mature eventually spawning a new Sprout around itself, creating a loop. Therefore, all of them will also have a dependency relationship with their next form, as this form of growing is essentially just an action of replacing itself with a spawn of the next form.

A Mature replaces itself with Dirt at the end of its life cycle therefore having a dependency relationship with Dirt. Furthermore, a Mature will also search for an exit and spawn more Sprouts, thus it has an association relationship with Exit as each Mature has their own list of exits that are eligible for spawning sprouts in each turn.

Tree is a form of high ground within the game thus it will be implemented as a subclass of the HighGround class, which is already a subclass of the Ground class. This allows the Tree class to inherit the common features of all HighGround classes and add or modify other features exclusive to Tree classes, which include the common features of all trees stated above. The same fact applies on the inheritance of the HighGround class from the Ground class, which will be further explained in Requirement 2.

Assignment 2 Updates:
According to the feedback received for Assignment 1, the circulation dependency among the three types of trees is not encouraged. As such, we removed the dependency relationships in the UML diagram that explain the growing of trees to the next stage as well as the Mature tree spawning sprouts for a clearer image of the UML diagram, as those relationships can be reflected through the inheritance of the three classes from the abstract Tree class.

UML diagram



game
game.actors
Goomba
Koopa
game.items
Coin
game.grounds
Sprout
Sapling
Mature
Tree
extends
HighGround
Dirt
1
finds
*
edu.monash.fit2099.engine
edu.monash.fit2099.engine.positions
Ground
Location
Exit

Requirement 2

<u>Design rationale</u>

The JumpAction class is extended from the Action class through polymorphism to inherit all of its features to allow for modification to cater to JumpAction's exclusive features. It has an association relationship with the Location class as every JumpAction will have its own target location to jump to, which makes it one of JumpAction's instance variables.

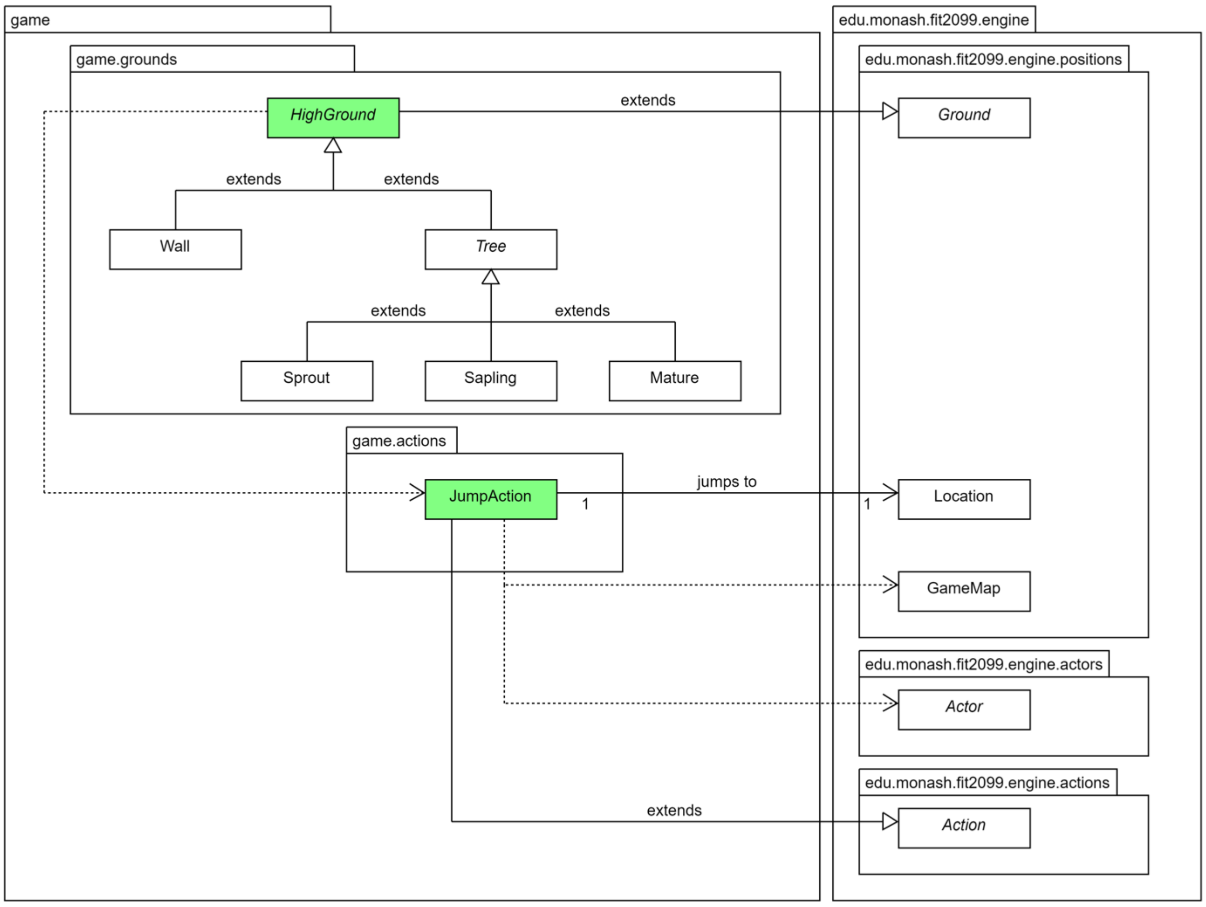
The JumpAction class has dependency relationships with the GameMap class and the Actor class, as the GameMap is needed to check if the target location is occupied with an Actor, as well as to move the actor to the target location, while the Actor class is required to check if the actor has consumed a SuperMushroom, and to hurt the actor in the case of an unsuccessful jump.

The HighGround abstract class is extended from the Ground class, thus inheriting all of Ground's features, as HighGround "is a" Ground. The HighGround class then implements the features common to all high grounds, which include adding a JumpAction to its list of allowable actions, not allowing any actor to enter and many other more. These features can be then inherited by HighGround's subclasses, which in this case includes the Wall and Tree class, which also includes all of Tree class's subclasses. This obeys the SRP and OCP as HighGround class is only responsible for features related to high grounds, and more subclasses of HighGround class can be created without the need to modify the HighGround class. The HighGround class is abstract as it should not be instantiated as an object and must only exist in the form of its subclasses.

The HighGround class has a dependency relationship with the JumpAction class as it will instantiate a JumpAction object to be added into its list of allowable actions.

Assignment 2 Updates:
The feedback received by our team suggested that the relationship between the HighGround class and the JumpAction class should be an association relationship. However, we believe that the relationship stated should indeed be dependency as the JumpAction class already has an association relationship with the Location class, which in turn has an association relationship with the Ground class, which stores information about what Ground a particular Location is. Thus, there is no need for an instance variable of HighGround class for the JumpAction class as the JumpAction class can know what ground the target location is from its instance variable, highLocation, which is of Location class. If our marks for Assignment 1 are affected because of this error, we do hope that it can be modified to reflect our actual marks.

<u>UML diagram</u>


game
game.grounds
HighGround
extends
extends
extends
Wall
Tree
extends
extends
Sprout
Sapling
Mature
game.actions
JumpAction
jumps to
1
1
extends
edu.monash.fit2099.engine
edu.monash.fit2099.engine.positions
Ground
Location
GameMap
edu.monash.fit2099.engine.actors
Actor
edu.monash.fit2099.engine.actions
Action

Requirement 3

<u>Design rationale</u>

The Enemy abstract class inherits all of Actor's features through polymorphism to implement its exclusive features. It has an association relationship with the Behaviour interface as it has a hash map containing behaviours as values and their priorities as keys as an instance variable common to all enemies, which determines what automated action the enemy will initiate each turn. The Enemy class has dependency relationships with the AttackAction, ActionList, AttackBehaviour and FollowBehaviour classes, as an AttackAction may be added into the other actor's ActionList of allowable actions in the case where another actor is in range to attack the enemy. The AttackBehaviour and FollowBehaviour classes are needed as they may be put in the list of behaviours in the case where the enemy comes into contact with another actor.

The Enemy class is abstract as it should not be instantiated and can only exist in the form of one of its subclasses, which for now are Goomba and Koopa. This allows the stated classes to inherit all basic features of an enemy and add in their own features and modifications to suit their exclusive features. This obeys the SRP and OCP as the Enemy class is only responsible for the basic features of an enemy and any subclasses extended from it will not require modifications towards the Enemy class.

The Goomba and Koopa classes have dependency relationships with the IntrinsicWeapon class as they have to implement their own intrinsic weapon based on their specifications. Besides, the Koopa class also has dependency relationships with the Location and SuperMushroom classes as those classes are required to drop a new SuperMushroom object on a specific location the Koopa is on whenever its shell breaks. The three different states of Koopa (shell intact, shell broken, dormant) can be implemented through the use of capabilities in the form of a Status enum, which is not part of the UML diagrams.

The Wrench class is extended from the WeaponItem class, inheriting its features, while also implementing the Valuable interface, which will be explained more in later requirements. The AttackAction class has a dependency relationship to it as it needs to know if the AttackAction inflicted towards a certain target involves a Wrench object, as to break the shell of the Koopa if the target actor is indeed a Koopa instance.

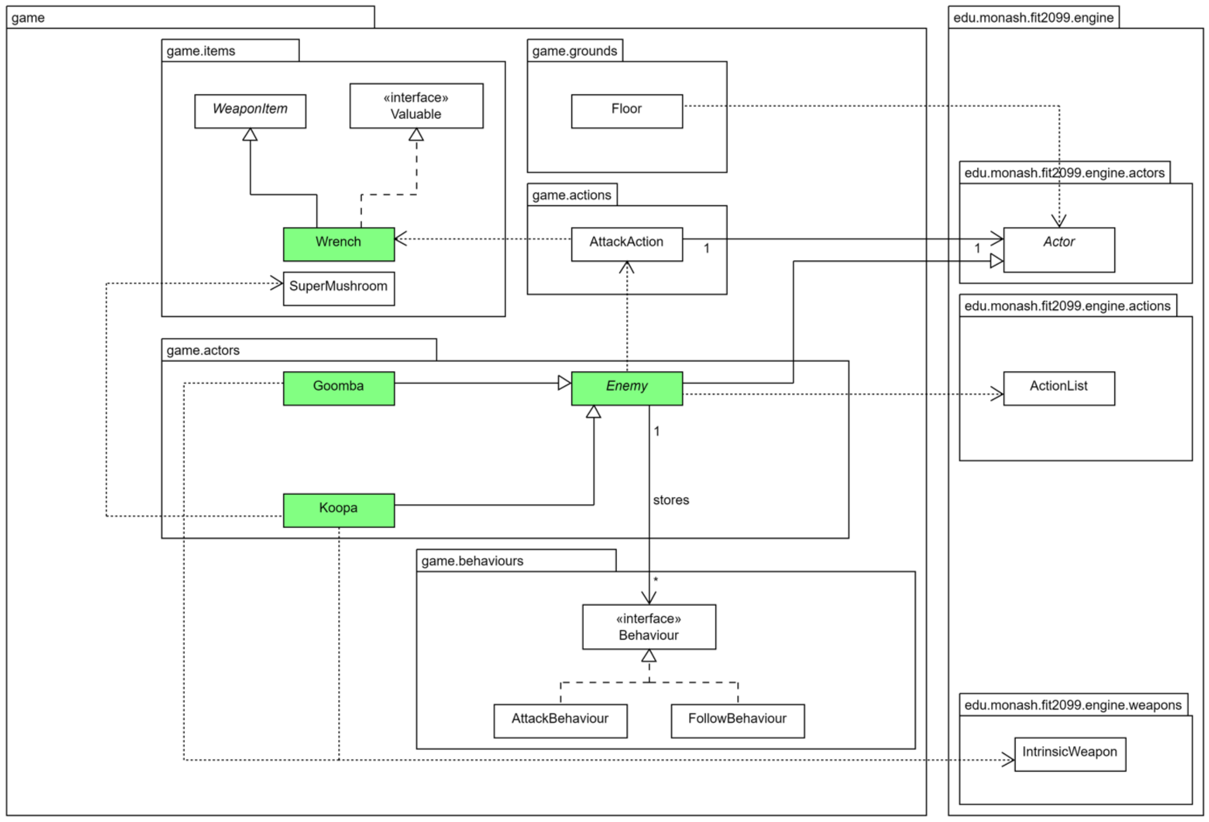
The Floor class is extended from the Ground class. It has a dependency to Actor class as it needs to determine whether the actor wanting to enter the Floor is an enemy or not.

Assignment 2 Updates:

The dependency relationships between the Enemy class with the AttackBehaviour and FollowBehaviour classes have been removed following the feedback, as those relationships are redundant, due to the fact that the Enemy class already has an association relationship with the Behaviour interface to store behaviours.

The Koopa class no longer has a dependency relationship with the Location class, as it no longer needs to know the specific location to spawn a SuperMushroom object. The SuperMushroom object is added to Koopa's inventory at its creation, such that it will be automatically dropped when Koopa dies.

UML diagram


game
game.items
WeaponItem
«interface» Valuable
Wrench
SuperMushroom
game.grounds
Floor
game.actions
AttackAction
1
game.actors
Goomba
Enemy
Koopa
1
stores
*
game.behaviours
«interface» Behaviour
AttackBehaviour
FollowBehaviour
edu.monash.fit2099.engine
edu.monash.fit2099.engine.actors
Actor
1
edu.monash.fit2099.engine.actions
ActionList
edu.monash.fit2099.engine.weapons
IntrinsicWeapon

Requirement 4

<u>Design rationale</u>

The ConsumeAction class is extended from the Action class to inherit all of its features to allow for modification to cater to ConsumeAction's exclusive features. It has an association relationship with the Item class as every consume action consumes an item which is one of its instance variables. It also has a dependency relationship with the Actor class as it needs to add a certain capability to the actor and remove the item consumed from the actor's inventory.

The SuperMushroom and PowerStar classes are extended from the Item class through polymorphism, inheriting the basic features of an Item class. They also implement the Valuable interface, which will be further explained in the later requirements. They both have dependency relationships with the ConsumeAction class as it adds a consume action option to its allowable actions in the case of being in the inventory of an actor. This obeys the SRP as each magical item is responsible for their own specifications and buffs, without the need to modify its parent class in the case of a new subclass creation.

Besides, the PowerStar class has dependency relationships with the Actor and Location class as power stars have a time limit before they fade away regardless of whether they are on the ground in a location or being carried in the inventory of an actor, which requires those classes to check if the power star should fade away or not in every turn.

To implement the buffs given by the magical items, the AttackAction class will have an association relationship with the Actor class as it needs to check if its target instance variable, which is an actor, possesses a buff that makes it immune to any attack. Besides, the JumpAction will have a dependency with the Actor class as it needs to check if the actor possesses a buff that makes its success rate of jumping 100%.

Moreover, the HighGround class will have dependency relationships with the Actor, Coin and Dirt classes, as it needs to check if the actor entering the high ground possesses a buff, which destroys the high ground and converting it into a Dirt instance, while also spawning a Coin instance on the ground.

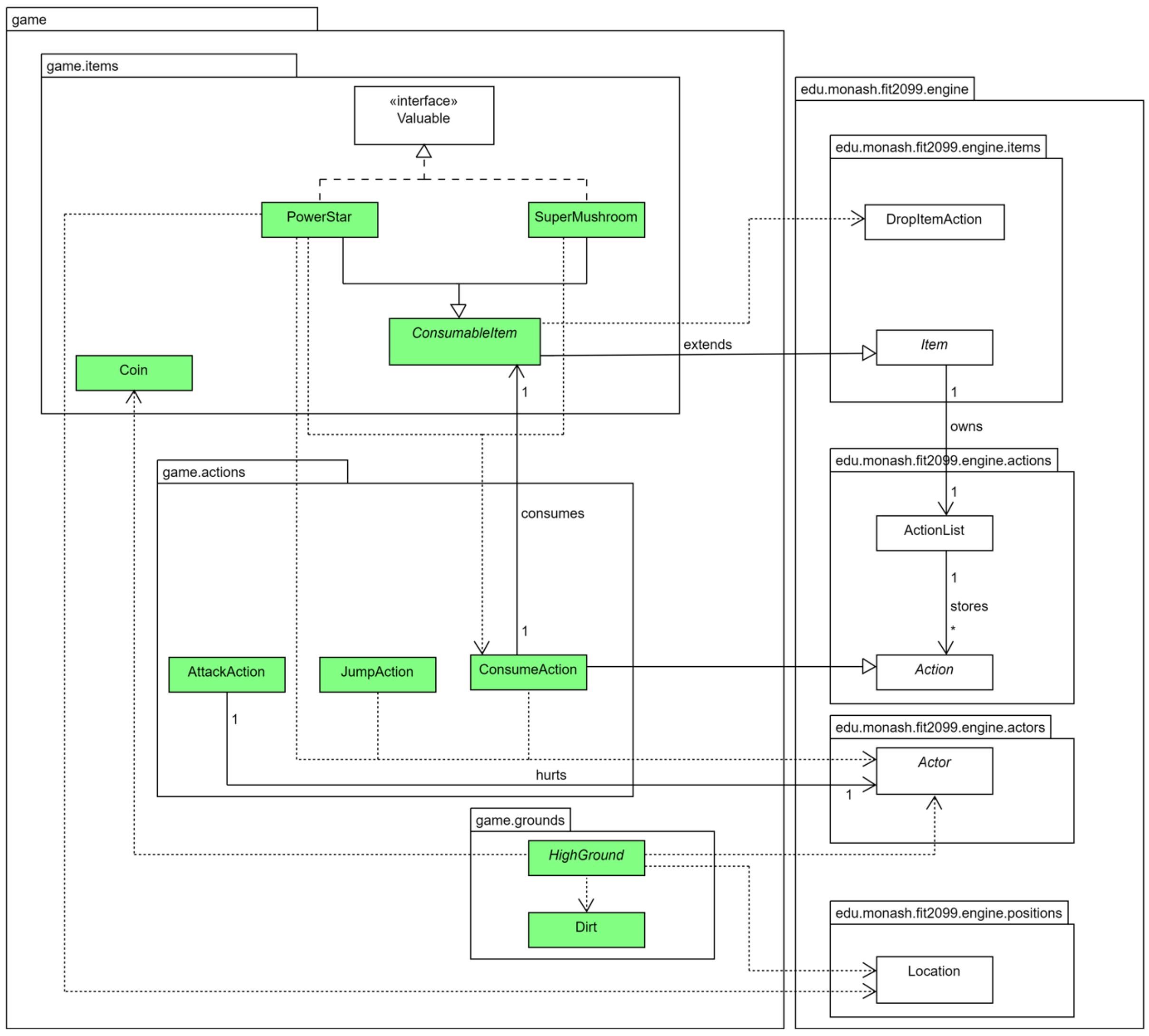
Assignment 2 Updates:
The SuperMushroom and PowerStar classes are now extended from the ConsumableItem abstract class as both classes are consumable items that give buffs to actors, and also implement the Valuable interface. As a result, an inheritance relationship is formed. Both of these classes have distinct responsibilities (the buff after consumption and its duration), hence they are implemented as separate classes in accordance with the single responsibility principle (SRP). The ConsumableItem class is abstract as it can only exist in the form of its subclasses.

Open-closed principle (OCP) can be applied to abstract ConsumableItem class. This class should be extendable so that more classes (PowerStar, SuperMushroom) can be added in the future without having to modify abstract methods (common methods – getDropAction(), getBuff()) in other subclasses.

PowerStar and SuperMushroom share some characteristics and are designed as child classes of the abstract class ConsumableItem. Replacing PowerStar and SuperMushroom with ConsumableItem should not cause any unknown behaviour. This is how the Liskov substitution principle is put into practise (LSP).

Upon implementation, the ConsumeAction ended up with two constructors; one for consumable items that have a limited lifespan, one for consumable items that can exist forever. This is necessary as the menu option displayed for consume actions should be appended with the items remaining lifespans if appropriate, such that the lifespan of those consumable items that can exist forever can be set to an invalid value to indicate that they do not have lifespans.

UML diagram



Requirement 5

Design rationale

Certain items in the game are given value such as [Coin], [SuperMushroom], [SuperStar], and [Wrench]. So when implementing these classes, value should be given to them. There are 3 approaches in doing so.

Approach 1:
They will inherit from the abstract [Item] class because they perform similar functions to the [Item] class but have the added functionality of defining their own value/price through the assigning value in constructor, whereas the [Wrench] class will inherit from the abstract [WeaponItem] class because it is a weapon but also has the ability to define its own value/price through constructor. This shows that all these classes have an inheritance relationship with their respective parent class. It also demonstrates the application of the SPR principle, as each child class is responsible for defining its own value.

Approach 2:
They will implement an abstract [ValuableItem] class inherited from the [Item] class, as this class provides value to all items with value via the getValue() method, except the [Wrench]. Only the [Wrench] class will be extended from [WeaponItem], and its value will be defined via its constructor because [Wrench] is a weapon and must follow the default behaviour of [WeaponItem]. This design obeys the Open-closed Principle where all traded item classes can extend the behaviour in their respective parent class with abstraction.

Approach 3:
Regardless of which class they extended, they must implement the interface [Valuable] as this interface aided them in defining the item's value via the getValue() method. This adheres to the Interface Segregation Principle, as the interface [Valuable] only has the function of obtaining the value of an item.

Which is better?
Approach 3
This is due to the fact that all of the traded items have a similar implementation for obtaining the value, so an interface would be the best choice due to the benefit of allowing multiple classes to implement that interface. It also enabled the traded item to have multiple interfaces implemented for different functionality, which is preferable than approach 2 of having an abstract class. Since [Wrench] class must inherit [WeaponItem] class because it is a weapon item, it cannot inherit from abstract [ValuableItem] class because one class can only inherit one parent class, the solution is to have value as an input parameter value when constructing constructor in [Wrench] class, hence approach 2 is not a good idea. For approach 1, it tends to repeat the codes, so it violates Don’t Repeat Yourself, hence approach 3 is the best choice.

Since the value of coins in this game changes as coins are traded, generated, and collected, the [Coin] class uses a wallet to store the balance. A [WalletManager] is required to keep track of the total balance of a [Player], as well as a hasWallet interface, which will be implemented in the [Player] class. In this game, the player can trade with Toad(O) to obtain necessary items. The [Toad] class extends from the abstract [Actor] class and will allow the execute() method in [TradingAction] to be called in [Player] class for trading purposes, resulting in a dependency relationship between [Toad] and [TradingAction]. As a result, whenever there is trading, [TradingAction] class that extends from [Action] is called. A [ValuableItems] containing a list of [Valuable] interface implemented objects is required to keep track of all instances that implement the [Valuable] interface. Thus, [TradingAction] class also has a dependency relationship with [ValuableItems] to get the value of the item that implements the [Valuable] interface. In an execution of [TradingAction], it will first be informed of the balance in the wallet by [Player] via [WalletManager], and if the balance is greater than the value of the traded item gotten via [ValuableItems], the player is permitted to trade. If they are traded, the traded item will be added to the inventory list and the balance in the wallet will be deducted. Otherwise, the message "You don't have enough coins!" will appear, and the player will be unable to obtain the item. This demonstrates that [WalletManager] has an association relationship with [hasWallet]. When coins are collected from the map, the [CollectAction] class, which extends from [PickUpItemAction], picks up the coin, and the player calls walletAdd() in the interface to increase the amount. This demonstrates that [Coin] is dependent on [CollectAction].

Updated version

I implemented Coin as a subclass of the abstract class Item as stated in REQ1. Its primary purpose is to serve as a value to be stored in the player's wallet in order for the player to purchase items. Hence, it must implement a Valuable interface to define its value. The player can pick up the Coin from the ground by using the CollectAction class, which results in a dependency relationship with CollectAction. When a Coin is picked up, it is added to the wallet balance. It must do so by implementing the hasWallet interface. In our feedback received for Assignment 1, it is stated that we lack a PickUpCoinAction. However, our submission contains CollectAction, which acts as our PickUpCoinAction.

As described in REQ4, PowerStar and SuperMushroom will be implemented as subclasses of the ConsumableItem abstract class. Wrench will be implemented as a subclass of the WeaponItem abstract class, as mentioned in REQ3. However, in order to get their value when the trading happens, they must implement the interface Valuable, which helps them define the value of the items via the getValue() method. This follows the Interface Segregation Principle (ISP) because the interface Valuable has functions/methods to get the value of an item. The ValuableItem class acts as a manager of all valuable items.

According to the feedback received for Assignment 1, it is stated that the Valuable interface should be done as an abstract class instead of an interface. However, we believe that it should indeed be done as an interface as the Wrench class already inherits from the WeaponItem abstract class and inheritance from two parent classes is not possible.

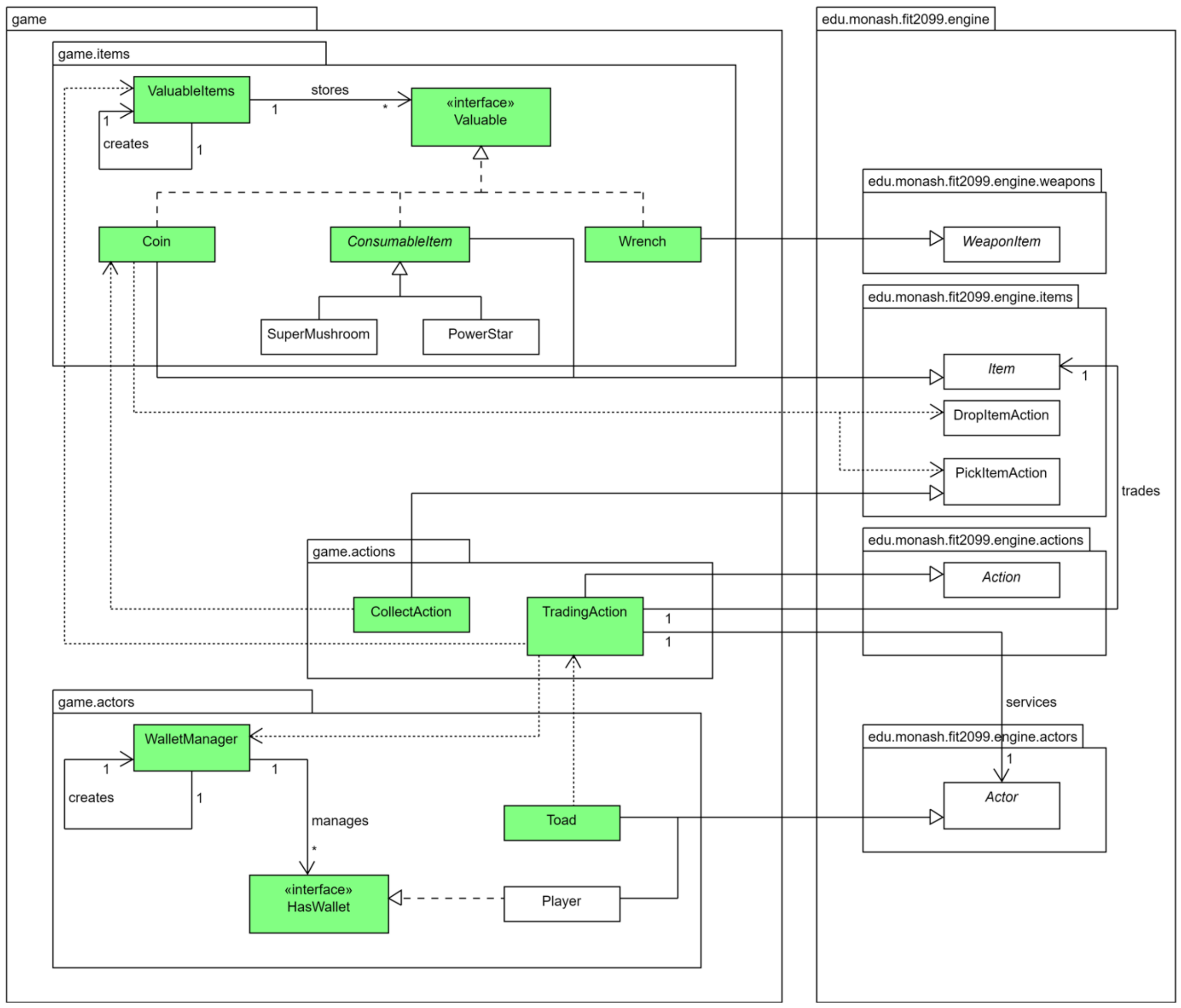
The TradingAction class is implemented as a subclass of the Action abstract class. TradingAction's objects can be thought of as Action, implying that TradingAction has an inheritance relationship with Action. TradingAction has the specific responsibility of trading with Toad and is implemented as a class in accordance with the principle of single responsibility (SRP). TradingAction inherits all methods from Action, but with the addition of trading features. This class will have an association relationship with Item and Actor as the item traded is stored into the player's inventory once after trading.

After the Player buys a Power Star, the Player will only have 9 turns left to consume the Power Star. This is totally appropriate as creating and trading the Power Star already counts as one turn of existence for the Power Star.

HasWallet is an interface that the player can use to refresh the wallet balance after picking a coin or trading. WalletManager, on the other hand, acts as a manager to manage the player's wallet. WalletManager has an association relationship with hasWallet because its class contains an arraylist of instances that implement hasWallet.

If our marks for Assignment 1 are affected because of the errors stated above, we do hope that it can be modified to reflect our actual marks.

UML diagram



Requirement 6

Design rationale

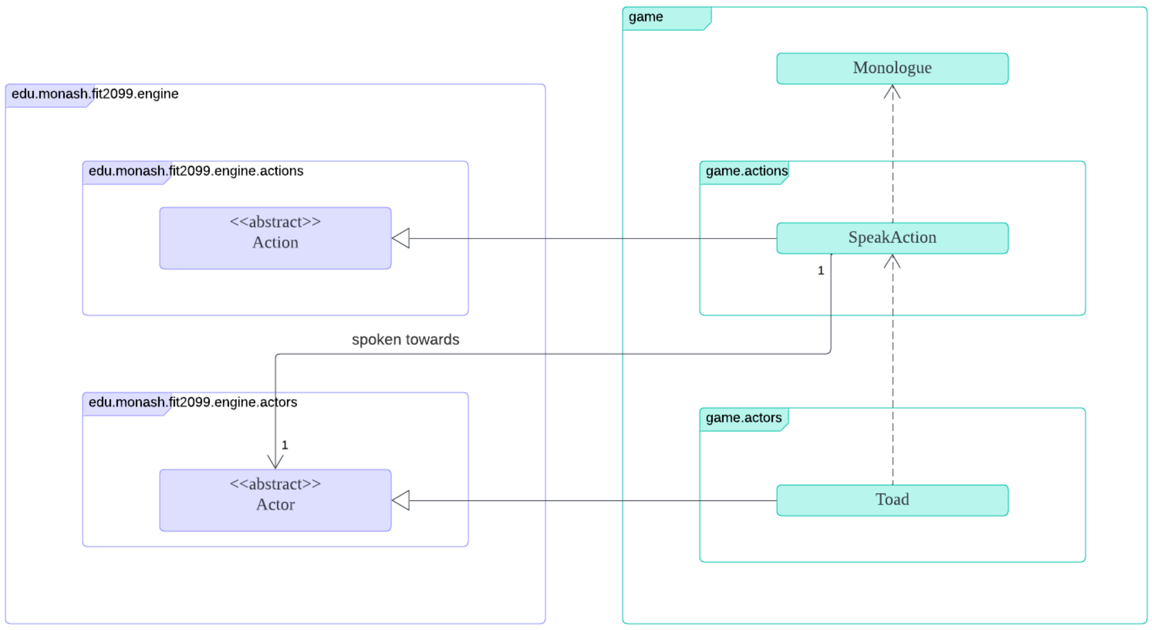
In this game, whenever the player walks near [Toad], it can speak with [Toad], and [Toad] will randomly speak one sentence at a time. To accomplish this, a [SpeakAction] will be created that extends from [Action]. It works in the same way as [AttackAction]. It is designed in such a way that four sentences are chosen at random from an arraylist that contain the sentences. But we know that in this game, once the player has a Wrench, he will not say, "You might need a wrench to smash Koopa's hard shells." To do so, he must first determine the player's capability, such as whether it has the status of having Wrench. If it doesn't, this sentence will be added to the arraylist because there's a chance he'll speak it; otherwise, it won't. The same goes for PowerStar. The sentence "You better get back to finding the Power Stars." will not be spoken once the Power Star effect is activated. The same approach is used, but this time it determines the player's capability, whether it has the status of activating [PowerStar]. The other two sentences, on the other hand, will be added to the arraylist regardless of what happens. When [SpeakAction] is called, he will select one at random from the arraylist to speak, indicating that [Toad] has a dependency on [SpeakAction].

Updated version

The SpeakAction class is implemented as a subclass of the Action abstract class. SpeakAction's objects can be thought of as Action, implying that SpeakAction has an inheritance relationship with Action. SpeakAction has the specific responsibility of speaking with Toad and is implemented as a class in accordance with the principle of single responsibility (SRP). SpeakAction inherits all methods from Action, but with the addition of speaking features.

Monologue class is implemented to store different speech texts rather than in the SpeakAction class because the SpeakAction class serves the purpose of the player speaking with Toad and the logic to output a list of relevant monologue strings/ speech text should be done in the Monologue class in accordance with the single responsibility principle (SPR). This indicates that Monologue has a dependency relationship with SpeakAction.

UML diagram


game
Monologue
edu.monash.fit2099.engine
edu.monash.fit2099.engine.actions
<<abstract>>
Action
game.actions
SpeakAction
1
spoken towards
edu.monash.fit2099.engine.actors
1
<<abstract>>
Actor
game.actors
Toad

Requirement 7

<u>Design rationale</u>

The Resettable interface requires the classes that implement it to implement a resetInstance() method that resets an instance of the class. Thus, the Coin, Tree, Player, and Enemy classes and their respective subclasses if any will implement the Resettable interface as they are the classes that are resettable.

For the Coin, Tree, and Enemy classes, their implementation of resetInstance() will only involve adding a status called RESET into its list of capabilities, indicating that the instance is to be reset. Their respective implementations of resetting will be done in their playTurn() or tick() methods as they require other properties like location to convert the ground into Dirt and remove coins, map to remove enemies and many more. These reset implementations will only be conducted if the instance possesses the RESET status, indicating that the Player has decided to reset the game.

For the Player class, its implementation can be done right in resetInstance() as it only involves healing and removing capabilities. To ensure that the Player only gets to reset once in the entire game, it can be given a capability called CAN_RESET and that capability can be removed in the implementation of resetInstance().

The ResetManager class has a list of Resettable instances as an instance variable, to keep track of all instances that are resettable, thus it has an association relationship with the Resettable interface. It is responsible to run the resetInstance() implementations of all resettable instances to reset them in an event where the player resets the game.

The ResetAction class executes by running the ResetManager's run method and it needs to know which actor initiated the reset action, thus it has dependency relationships with both the Actor and ResetManager class.

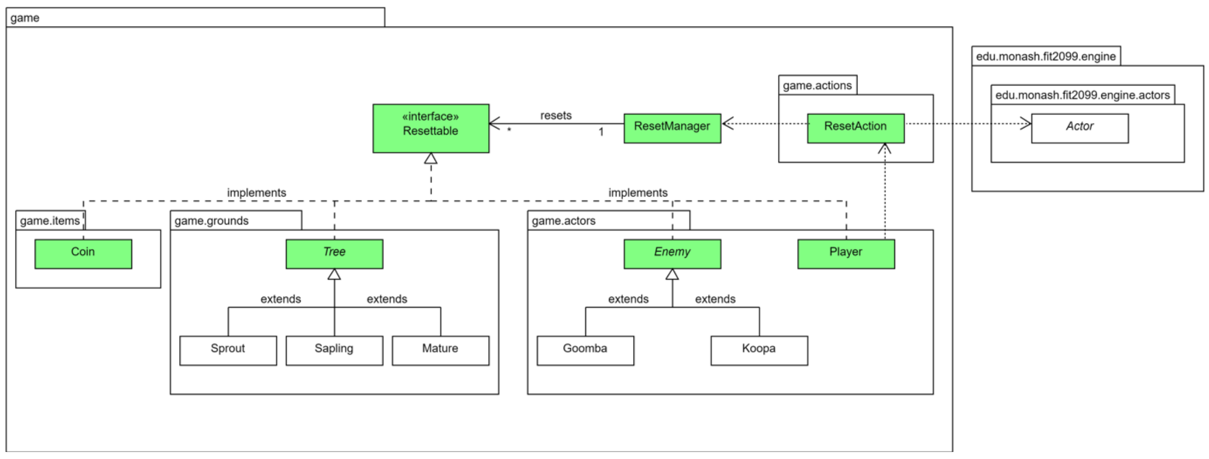
To allow the player to be given a reset option in the menu, the ResetAction class is created as an allowable action in Player's playTurn, thus the Player class has a dependency relationship with the ResetAction class.

Assignment 2 Updates:
In the feedback we received for Assignment 1, it is stated that PowerStar should implement the Resettable interface. However, we believe that it is not needed as resetting the player's status from the active buffs only involves removing all the player's capabilities, which can be fully done in the Player class.

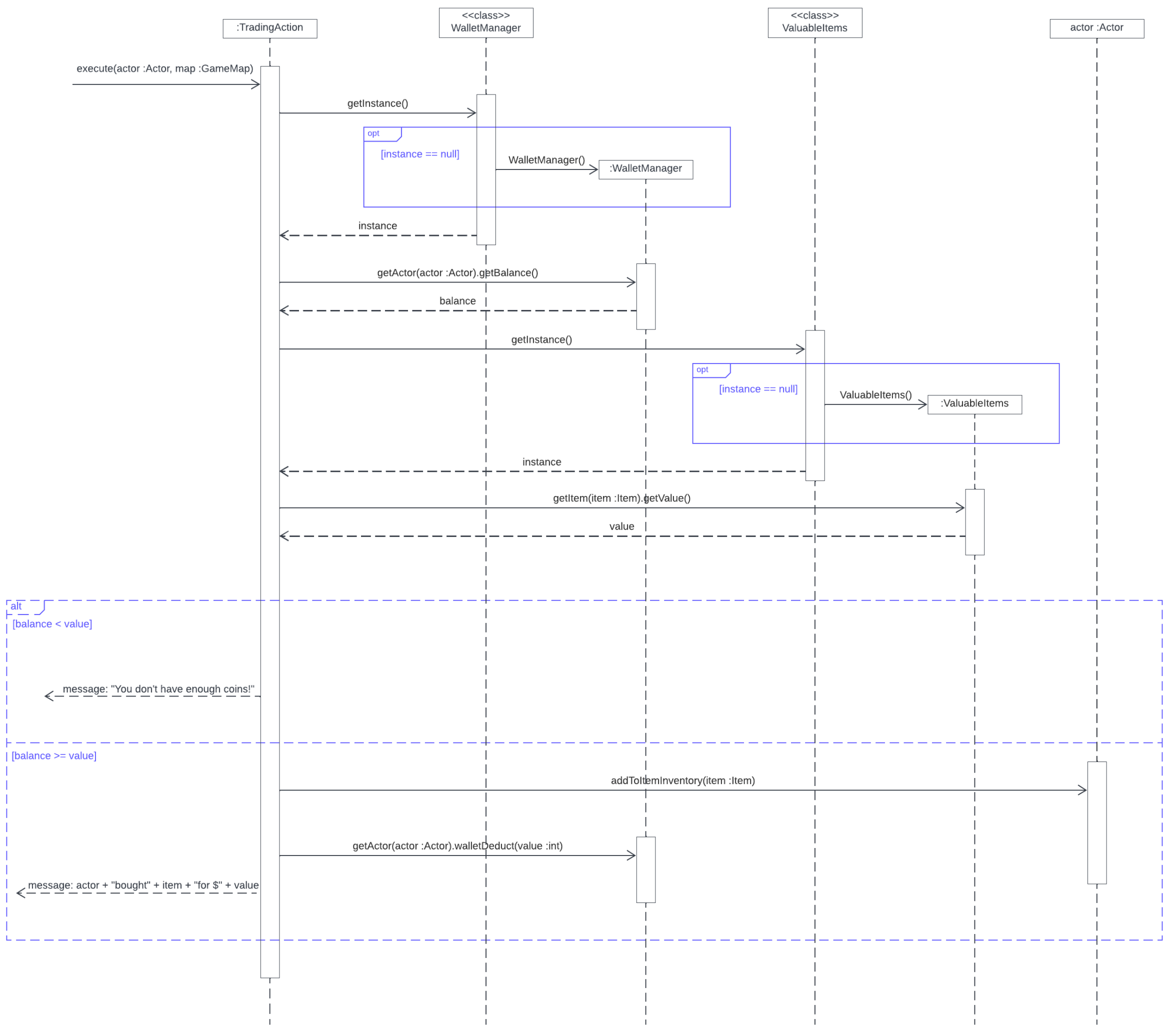
All Power Stars are not needed to be removed from the map in a reset, thus there really is no need for the PowerStar class to implement the Resettable interface.

If our marks for Assignment 1 are affected because of this error, we do hope that it can be modified to reflect our actual marks.

<u>UML diagram</u>


game
edu.monash.fit2099.engine
edu.monash.fit2099.engine.actors
Actor
game.actions
ResetAction
ResetManager
«interface» Resettable
resets
*
1
implements
implements
game.items
Coin
game.grounds
Tree
extends
extends
Sprout
Sapling
Mature
game.actors
Enemy
Player
extends
extends
Goomba
Koopa

Sequence diagram for TradingAction execute()



:TradingAction
<<class>> WalletManager
<<class>> ValuableItems
actor :Actor
execute(actor :Actor, map :GameMap)
getInstance()
opt
[instance == null]
WalletManager()
:WalletManager
instance
getActor(actor :Actor).getBalance()
balance
getInstance()
opt
[instance == null]
ValuableItems()
:ValuableItems
instance
getItem(item :Item).getValue()
value
alt
[balance < value]
message: "You don't have enough coins!"
[balance >= value]
addToItemInventory(item :Item)
getActor(actor :Actor).walletDeduct(value :int)
message: actor + "bought" + item + "for $" + value