1. Problem Analysis

Create a class hierarchy containing citizens which branch off into trolls, dwarfs and humans which branch off into zombies, vampires, and nobbs, and wolfs which branch off into werewolves. Trolls, dwarfs, humans, zombies, vampires, and nobbs will have citizen behaviours while werewolves will have both citizen and wolf behaviours. The wolf and citizen will be base classes so those two objects can never be created. All the other classes will be able to speak, pay taxes, while the werewolf will be able to growl and howl from the wolf class ad speak and pay taxes as well.

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| **Known Facts** | **User Requirements** | **Necessary Processing** | **Alternative Solutions** |
| -Base classes will have virtual functions in them  -2 Bases classes citizen and wolf  -1 derived class from wolf  -6 derived classes from citizen  -Citizens can speak and pay taxes  -Werewolf class inherits both from wolf and citizen class  -Werewolves can speak, pay taxes, howl, and growl.  -Humans pay 15% tax of their dollars  -Werewolves pay 10% taxes  -Trolls pay 10% of their gems where 1 gem is equivalent to 1.50 dollars  -Dwarfs pay their taxes in gold where 1 gold is equivalent to 1.75 dollars  -Tax collector collects taxes as many times as they want until or until a citizen/werewolf has 0 dollars left.  -If one the objects has 0 or less than 0 for the tax input the program doesn’t loop | -Enter “y” or “n” for yes or no to keep taxing the citizens | Declare variables:  -bool to check if taxing can continue  -char to read in the user’s answer  -double to record current tax collected  -double to record how much tax is collected from each citizen  -9 vector arrays in total to for objects in each class  -create as many objects s wish (I chose 1 of each excluding the base classes)  -for loop to call speak function for all citizens  -for loop to call howl and growl function for werewolves.  -do while loop that is used for collecting taxes. It keeps looping until one of the citizen’s money is 0 or less or when the user decides to stop taxing the citizens. When the taxing is done, the bool is set to true to exit the loop.  -output how much tax money was collected.  -2 for loops to delete the citizen and wolf objects since they are dynamically generated.  //processing for classes  **Citizen base class**  For header  Create virtual functions for derived classes to inherit speak and pay taxes function  **Wolf base class**  For header  Create virtual functions for derived classes to inherit growl and howl  **All derived classes** besides wolf  For header  Public:  Create constructor  Create destructor  Private:  Declare int money variable  Declare string name  Declare speak and pay taxes functions  Declare double function to calculate the taxes  Declare double function to calculate the money left over  Declare void function to output unique tax message and money left is set to the money variable  .cpp  Output name for constructor  Output speak message in speak function  Calculate tax need in tax calculation function  Calculate left over money in left over money function  Output unique tax message in tax message function  **Werewolf class**  For header  Public:  Create constructor  Create destructor  Private:  Declare int money variable  Declare string name  Declare speak and pay taxes functions  Declare double function to calculate the taxes  Declare double function to calculate the money left over  Declare void function to output unique tax message  Declare void function for howling  Declare void function for growling  .cpp  Output name for constructor  Output speak message in speak function  Calculate tax need in tax calculation function  Calculate left over money in left over money function  Output unique tax message in tax message function and money left is set to the money varible  Output message in howling function  Output message in howling function | Declare variables:  -bool to check if taxing can continue  -char to read in the user’s answer  -double to record current tax collected  -double to record how much tax is collected from each citizen  -Create as many objects as wish besides citizen and wolf class objects.  -Call functions: speak, pay taxes for citizen derived classes, speak, pay taxes, howl and growl for werewolf class.  //processing for classes  **Citizen base class**  For header  Create virtual functions for derived classes to inherit speak and pay taxes function  **Wolf base class**  For header  Create virtual functions for derived classes to inherit growl and howl  **All derived classes** besides wolf  For header  Public:  Create constructor  Create destructor  Private:  Declare int money variable  Declare string name  Declare speak and pay taxes functions  Declare double function to calculate the taxes  Declare double function to calculate the money left over  Declare void function to output unique tax message  .cpp  Output name for constructor  Output speak message in speak function  Calculate tax need in tax calculation function  Calculate left over money in left over money function  Output unique tax message in tax message function  **Werewolf class**  For header  Public:  Create constructor  Create destructor  Private:  Declare int money variable  Declare string name  Declare speak and pay taxes functions  Declare double function to calculate the taxes  Declare double function to calculate the money left over  Declare void function to output unique tax message  Declare void function for howling  Declare void function for growling  .cpp  Output name for constructor  Output speak message in speak function  Calculate tax need in tax calculation function  Calculate left over money in left over money function  Output unique tax message in tax message function  Output message in howling function  Output message in howling function |

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| --- | --- | --- |
| Input | Processing | Output |
| “y” or “n” for yes or not to keep taxing citizens | -Functions to output messages for speak, howl, growl.  -Functions to calucalte the tax to be paid  -Function to calculate how much money is left  -Do while loop to keep looping until one of the citizens has no more money left or user does not want to keep taking  -Conversions from gem to dollars and gold to dollars  -Messages for constructing and destructing objects | -Message for constructing  -Message for destructing  -Message for speaking  -Message for paying taxes  -Message for growling (werewolves)  -Message for howling(werewolves)  -Tax collected from each citizen  -Total tax collected when looping is done |

Psuedo code for main function

Declare variables:

-bool to check if taxing can continue

-char to read in the user’s answer

-double to record current tax collected

-double to record how much tax is collected from each citizen

Create vector arrays for all 9 classes

Create dynamic objects for any class besides the base classes

For loop that classes the speak, howl and growl functions

Prompt the user asking them if they want to tax the citizens

//do while loop keeps looping until the user chooses to stop or one of the citizen has 0 money

Do while loop

If tax citizens == yes

for calls the money functions and collects the money, outputs the money

double variable that adds the total money for that loop

double variable that adds the total money for all the loops

if citizen money ==0

set the Boolean to stop looping ton true and exit the do while loop

else if tax citizens == no

set the Boolean to stop looping to true and exit the do while loop

output the total money collected from all the loop runs

delete the dynamically generated objects

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| --- |
| Citizen |
|  |
| +Virtual void speak()  +Virutal void payTaxes()  +Virtual double taxCalc()  +Virtual double taxCalc1() |

UML charts

//taxCalc() is calculating the taxes needed

to be paid

//taxCalc1() is calculating the money left over

|  |
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| Wolf |
|  |
| +Virtual void howl()  +Virutal void growl() |

|  |
| --- |
| Human |
| -humanNamestring  -taxInput:double |
| -void speak()  -void payTaxes()  -double taxCalc()  -double taxCalc1() |

|  |
| --- |
| Werewolf |
| -werewlolfNamestring  -taxInput:double |
| -void speak()  -void payTaxes()  -double taxCalc()  -double taxCalc1()  -void howl()  -void growl() |

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| --- |
| Troll |
| -trollNamestring  -taxInput:double |
| -void speak()  -void payTaxes()  -double taxCalc()  -double taxCalc1() |

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| Nobbs |
| -nobbsNamestring  -taxInput:double |
| -void speak()  -void payTaxes()  -double taxCalc()  -double taxCalc1() |

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| Dwarf |
| -dwarfNamestring  -taxInput:double |
| -void speak()  -void payTaxes()  -double taxCalc()  -double taxCalc1() |

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| --- |
| Zombie |
| -zombieNamestring  -taxInput:double |
| -void speak()  -void payTaxes()  -double taxCalc()  -double taxCalc1() |

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| Vampire |
| -vampireNamestring  -taxInput:double |
| -void speak()  -void payTaxes()  -double taxCalc()  -double taxCalc1() |

Testing:

**-Test case 1:Seeing if all constructor messages show up when program runs:**

A Human named tyrone has entered.

A Dwarf named angus has entered.

A Troll named anus has entered.

A nobbs named joe has entered

A Zombie named home has entered.

A Vampire named vamp has entered.

A Werewolf named wolf has entered

**-Test case 2: seeing if all destructor messages show up when program ends:**

SCRUFFY COME BACK HERE NOW!. Well I gotta go chase my pet turtle see y'all later!

tyrone has left.

I should probably be getting back to figuring out how to light trolls on fire...I mean mining diamonds in the mine. Wait is that a cheeto?

angus has left.

Good bye for now! I'm going to enjoy these walnuts.

anus has left.

I should be getting bakc to my job now, goodbye!

joe has left.

Time to go brain hunting!

home has left.

Guess it's time to look for more blood to drink!

vamp has left.

Time to go chicken hunting!

wolf has left

**-Test case 3 checking if speak functions output correct message:**

Howdy there! My name is tyrone and I am a human from Earth. I enjoy country music and riding my tractor throughout the Himalayas.

I make about 10 dollars from selling vegetables at the local farmers market.

I really wish these tractors would go on sale.

My name is angus and I am a Dwarf.

My people really enjoy bothering the Trolls by putting watermelon juice on their wooden clubs

I make roughly 100 gold a month from mining diamonds in Crystal Cove.

Guard your life, guard your gold, guard your beard. In that order.

We canÆt bring a troll to the fire, but we can bring the fire to the troll!

Why are there so many mushrooms everywhere? Oh hey there! My name is anus. and I am a troll from Nunavut

I make roughly 1000 gems a month from mowing the lawns and delivering newspaper.

These dwarfs really make me angry. Always putting watermelon juice on me while I'm sleeping.

Hello there, my name is joe and I am a lighthouse watchman from Canada.

I make 1000 dollars a month from watching a lighthouse during the night.

WHOA IS THAT AN AMERICAN SUBMARINE?

Has anyone seen my arm? My name is home and I am a zombie who used to be a human and I like eating brains.

I make 1000 dollars a month from humans paying me not to eat their brains

Humans are afraid of me. I really don't know why all I want to do is to eat their brain.

Just stand still and let me dig deep into your neck! Oh... I didn't notice you there, my name is vampand I am a Vampire if you couldn't already tell.

I work at the local poutierie and I make around 1000 dollars a month.

Have you seen any tender necks by any chance?

Who ate that chicken that was about to lay eggs? Oh my bad, my name is wolf and species, Werewolf, comes from Narnia.

I make roughly 1000 dollars a month at my dry cleaning job at Tim Hortons.

I remember the days when I didn't have hair everywhere. I miss being a human. Although, I do enjoy eating raw chicken now.

**-Test case 4: to see if the growl and howl functions output properly**

GRRRRRRR STOP EATING ALL THE CHICKEN.

I hate it when it's midnight because I'm always in the washroom in the middle of a p... AHOOOOOOOOO

**-Test Case 5: to see if more than 1 character can be made**

2 humans are made:

A Human named tyrone has entered.

A Human named tyrone has entered.

**-Test case 6: to see if human, zombie, nobbs tax calculations are correct**

**(calculation code is exactly the same for the 3 just the unique messages are different)**

Human starts off with $1000

Is it taxing time already? I knew I shouldn't have bought that new tractor. Here's 150 dollars.

Maybe I should invest this 850 dollars that I have left in stocks... OR I COULD JUST BUY ANOTHER TRACTOR.

Checking calculations:

0.15\*1000= 150

1000-150 = 850

**-Test case 7: to see if werewolf tax calculations are correct**

Werewolf starts off with $1000

I hope this tax money goes towards the funding of turning me back into a human so here's 100 dollars.

I told my wife I'd bring more money home for raw chicken, but oh well I guess 900 is enough.

Checking calculations:

0.1\*1000= 100

1000-100 = 900

**-Test case 8: to see if troll tax calculations are correct and the conversions are correct**

Troll starts off with 1000 gems

Is it time to pay taxes already? Well then here's 100 gems which is equivalent to 150 dollars.

I'm going to spend the rest of my 900 gems on walnuts.

Checking calculations:

0.1\*1000= 100 gems

1000-100 = 900 gems left

100\*1.50 =150 dollars

**-Test case 9: to see if dwarf tax calculations are correct**

Dwarf starts off with 1000 gold

I really do not want to pay my taxes, but here's 87.5 dollars in taxes.

I, angus am sad because I only have 950 left in gold. Which is 1662.5 left in dollars.

Checking calculations:

0.05\*1000= 50 gold

1000-50 = 950 gold left

50\*1.75 =87.5 dollars

950\*1.75 = 1662.5 dollars

**-Test case 10:** **to see if taxes for multiple individuals add up**

2 humans start off with $1000

$300 has been collected in taxes today.

Checking calculations:

0.15\*1000= 150

1000-150 = 850

150+150 =300 dollars

**-Test case 11: to see if taxing twice adds up correctly**

1 human starts off with $1000

Is it taxing time already? I knew I shouldn't have bought that new tractor. Here's 150 dollars.

Maybe I should invest this 850 dollars that I have left in stocks... OR I COULD JUST BUY ANOTHER TRACTOR.

First run

Is it taxing time already? I knew I shouldn't have bought that new tractor. Here's 127.5 dollars.

Maybe I should invest this 722.5 dollars that I have left in stocks... OR I COULD JUST BUY ANOTHER TRACTOR.

Second run

Total taxes:

$277.5 has been collected in taxes today.

Checking calculations:

0.15\*1000= 150

1000-150 = 850

Run 2

0.15\*850= 127.5

850-127.5 = 722.5

Total taxes = 127.5 +150 = 277.5 dollars