

**Programming 1 (PRG1)**

Year 1 (2022/23), Semester 1

**SCHOOL OF INFOCOMM TECHNOLOGY**

Diploma in Cyber Security & Forensics

Diploma in Data Science

Diploma in Immersive Media

Diploma in Information Technology

Common ICT Programme

# ASSIGNMENT

**Due on 7 August 2022 (Sunday), 2359 hours**

**Weightage:** 30% of Module

**Individual/Team/Both:** Individual

**Format:** Programming and Demo with Q&A

Basic Requirements (75%)

Additional Requirements (25%)

**Penalty for late submission:**

* + 10% per day from the due date.
  + NO submission shall be entertained after 7 calendar days of the due date.

There is a total of 13 pages (including this page) in this handout.

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| ***WARNING***  ***If a student is found to have submitted work not done by him/her, he/she will not be awarded any marks for this assignment. Disciplinary action will also be taken.***  ***Similar action will be taken for the student who allows other student(s) to copy his/her work.*** |

**1. OBJECTIVE**

This assignment assesses the student’s ability to apply relevant programming concepts to develop a simple application using Python programming language.

**2. BACKGROUND**

Develop a tower defence game called Desperate Defenders.

**3. SCOPE**

Undead creatures are attacking the city! Position your units to protect the city until you have killed enough of the creatures to drive them off.

In this “tower defence” strategy game, monsters are advancing on the city from right to left across 5 lanes. To kill the monsters, you have to purchase units and place them on the field of battle so that they can shoot or block the monsters. However, you start with 10 gold and only get 1 gold per turn, so spend your precious resources wisely!

There are two types of monsters:

* Zombies (ZOMBI) start with 15 hit points, deal 3-6 damage and move 1 square each turn. They initially give 2 gold as a reward when killed.
* Werewolves (WWOLF) start with 10 hit points, deal 1-4 damage and move 2 squares each turn. They initially give 3 gold as a reward when killed. **Note: Implementing Werewolves is an Advanced Requirement.**

Players can purchase two types of “defender” units:

* Archers (ARCHR) start with 5 hit points. Each turn, they will shoot an arrow down their lane from left to right, dealing 1-4 damage to the first monster it hits. They cost 5 gold to purchase.
* Walls (WALL) start with 20 hit points. They do not deal any damage and serve to block and slow down the monsters. They cost 3 gold to purchase.

Units purchased by the players can only be placed in the first 3 columns of the field.

The assignment consists of “**Basic Requirements**” and “**Advanced Requirements**” as described in sections 4 and 5 respectively. You are advised to complete the basic requirements BEFORE proceeding with the advanced requirements.

For this assignment, you are expected to:

* Understand the problem completely and plan your program layout before you start coding
* Develop the solution for each task by using functions
* Functions developed should be as generic as possible - values used in functions should be passed in as the function parameters
* You may use global variables **sparingly**
* Implement and test each feature as it is developed
* Do all the relevant data validations

**4. BASIC REQUIREMENTS**

The application should provide the following **basic** features:

1. **Display main menu**

When the program is first run, it should display the main menu as shown in Figure 1. When a user enters an option 1, 2 or 3, the program will process the option accordingly.

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| Desperate Defenders  -------------------  Defend the city from undead monsters!  1. Start new game  2. Load saved game  3. Quit  Your choice? |

## Figure 1 - Main Menu

* 1. **Start New Game**

This option starts a new game.

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| --- |
| Your choice? 1  1 2 3  +-----+-----+-----+-----+-----+-----+-----+  A| | | | | | | |  | | | | | | | |  +-----+-----+-----+-----+-----+-----+-----+  B| | | | | | | |  | | | | | | | |  +-----+-----+-----+-----+-----+-----+-----+  C| | | | | | | |  | | | | | | | |  +-----+-----+-----+-----+-----+-----+-----+  D| | | | | | |ZOMBI|  | | | | | | |15/15|  +-----+-----+-----+-----+-----+-----+-----+  E| | | | | | | |  | | | | | | | |  +-----+-----+-----+-----+-----+-----+-----+  Turn 1 Threat = [ ] Danger Level 1  Gold = 10 Monsters killed = 0/20  1. Buy unit 2. End turn  3. Save game 4. Quit  Your choice? |

## Figure 1.1 – New Game

The field of battle consists of 5 lanes (labelled A to E), each 7 squares long. When the game starts, a monster is spawned (i.e., created) on the rightmost square in a random lane. **For your Basic Requirements, implement only the Zombie.** The numbers below a monster are its current and maximum hit points. Players begin Turn 1 with 10 gold. **Advanced feature**: the “Threat Metre” is empty, and the Danger Level starts at 1.

* 1. **Load Saved Game**

This option reads the saved file and restores the game state. You can only have one saved game.

* 1. **Exit Game**

This option exits the program.

1. **Playing the Game**

When you are playing the game, it should display the game menu as shown in Figure 1.1. When a user enters an option from 1 to 4, the program will process the option accordingly.

* 1. **Buy Unit**

Option 1 allows the player to purchase and place a unit. The player first selects whether to purchase an Archer (for 5 gold) or a Wall (for 3 gold). The player must then specify which square to place the unit. Note that purchased units can only be placed on an empty square in one of the first 3 columns. An appropriate error message should be shown if the input is invalid.

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| --- |
| 1. Buy unit 2. End turn  3. Save game 4. Quit  Your choice? 1  What unit do you wish to buy?  1. Archer (5 gold)  2. Wall (3 gold)  3. Don't buy  Your choice? 1  Place where? d1  Archer in lane D shoots Zombie for 4 damage!  Zombie in lane D advances!  1 2 3  +-----+-----+-----+-----+-----+-----+-----+  A| | | | | | | |  | | | | | | | |  +-----+-----+-----+-----+-----+-----+-----+  B| | | | | | | |  | | | | | | | |  +-----+-----+-----+-----+-----+-----+-----+  C| | | | | | | |  | | | | | | | |  +-----+-----+-----+-----+-----+-----+-----+  D|ARCHR| | | | |ZOMBI| |  | 5/5 | | | | |11/15| |  +-----+-----+-----+-----+-----+-----+-----+  E| | | | | | | |  | | | | | | | |  +-----+-----+-----+-----+-----+-----+-----+  Turn 2 Threat = [- ] Danger Level 1  Gold = 6 Monsters killed = 0/20  1. Buy unit 2. End turn  3. Save game 4. Quit  Your choice? |

## Figure 2.1 – Buying a unit

If the purchase is successful, time advances and several things happen (see Section 2.2 below). Note that if the purchase is not successful, time does not advance.

* 1. **End Turn**

When the player chooses option 2, time advances in the game, and several things happen. Each lane is checked starting from lane A and ending in lane E. For each lane, consider each unit from left to right:

1. Archers shoot an arrow from left to right, hitting the first monster on its lane that it encounters and dealing 1-4 damage (i.e., deduct that amount of damage from the monster’s hit points). If this reduces the monster’s hit points to zero:
   * The monster is removed from the field
   * The player is given some gold as a reward according to which monster was killed
   * **Advanced feature:** The Threat Metre increases by the same amount as the reward
2. Monsters move a number of spaces equal to their movement speed towards the left.
   * If it would land on a defender unit, it instead deals its damage to the defender. If this kills the defender, it is removed from the field.
   * If it would land on another monster, it is blocked and does nothing.
   * If it would go off the field on the left side, the player has lost the game.

After all the lanes have been checked, the following happens at the end of the turn:

1. If there are no monsters left on the field, a new monster is immediately spawned
2. The player is given 1 gold.
3. **Advanced feature:** The Threat Metre is increased by a random number between 1 and the Danger Level.
4. **Advanced feature:** The Threat Metre has 10 spaces. If the Threat Metre is full, a new monster is spawned, and the Threat Metre is reduced by 10. Note that theoretically, if the Threat Metre is over 20, then multiple monsters will be spawned, reducing the Threat Metre by 10 each time until it is below 10.
5. **Advanced feature:** Every 12 turns, the monsters get stronger. All monsters will add 1 to their minimum and maximum damage (e.g., 3-6 becomes 4-7), their maximum hit points and the amount of reward they give. The increase in hit points do not affect the current hit points of the monsters already on the field. Furthermore, the Danger Level increases by 1, which could make the Threat Metre rise faster.

See Appendix A for an example of what happens when a turn ends.

* 1. **Save Game**

This saves the current state of the game, so that after the player quits the game, they can return to the current state by selecting “Load Saved Game” in the main menu (see 1.2).

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| Enter choice: 3  Game saved! |

## Figure 2.3 – Save Game

* 1. **Quit**

This option exits the program.

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| --- |
| Your choice? 4  See you next time! |

## Figure 2.4 – Quit

1. **End of Game**

The player loses if any monster exits the left side of the field.

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| --- |
| 1 2 3  +-----+-----+-----+-----+-----+-----+-----+  A|ARCHR| |WALL | | | | |  | 5/5 | |11/20| | | | |  +-----+-----+-----+-----+-----+-----+-----+  B| | | | | | | |  | | | | | | | |  +-----+-----+-----+-----+-----+-----+-----+  C|ARCHR| |WALL | | | | |  | 5/5 | |11/20| | | | |  +-----+-----+-----+-----+-----+-----+-----+  D| |WWOLF| | | | | |  | |7/11 | | | | | |  +-----+-----+-----+-----+-----+-----+-----+  E| | | | | | | |  | | | | | | | |  +-----+-----+-----+-----+-----+-----+-----+  Turn 13 Threat = [-------- ] Danger Level 2  Gold = 6 Monsters killed = 2/20  1. Buy unit 2. End turn  3. Save game 4. Quit  Your choice? 2  Werewolf in lane D advances!  A Werewolf has reached the city! All is lost!  You have lost the game. :( |

## Figure 3.1 – Player Loses

In the example in Figure 3.1, the Werewolf in Lane D advances twice and exits the field from the left. The player has therefore lost the game.

The player wins once 20 monsters have been killed.

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| --- |
| 1 2 3  +-----+-----+-----+-----+-----+-----+-----+  A|ARCHR|ARCHR|WALL |ZOMBI| | | |  | 5/5 | 5/5 |16/20|3/18 | | | |  +-----+-----+-----+-----+-----+-----+-----+  B|ARCHR|ARCHR|WALL | | | | |  | 5/5 | 5/5 |7/20 | | | | |  +-----+-----+-----+-----+-----+-----+-----+  C|ARCHR|WALL |WWOLF| | | | |  | 5/5 |5/20 |7/13 | | | | |  +-----+-----+-----+-----+-----+-----+-----+  D|ARCHR|ARCHR|WALL | | | | |  | 5/5 | 5/5 |7/20 | | | | |  +-----+-----+-----+-----+-----+-----+-----+  E|ARCHR|ARCHR|WALL | | | | |  | 5/5 | 5/5 |9/20 | | | | |  +-----+-----+-----+-----+-----+-----+-----+  Turn 66 Threat = [--------- ] Danger Level 5  Gold = 78 Monsters killed = 19/20  1. Buy unit 2. End turn  3. Save game 4. Quit  Your choice? 2  Archer in lane A shoots Zombie for 4 damage!  Zombie dies!  You gain 5 gold as a reward.  You have protected the city! You win! |

## Figure 3.2 – Player Wins

In the example in Figure 3.2, the Zombie in Lane A was killed by an Archer. Since this was the 20th monster killed, the player wins the game.

1. **Program documentation**

The program should have sufficient comments, which includes your name, class, date, overall description of what the program does, as well as the description of the functions.

**5. ADVANCED REQUIREMENTS**

* **Program validation -- 10 marks**

Add appropriate validation for the basic requirements of the program.

* **Werewolves -- 5 marks**

Implement the Werewolf monster

* **Threat -- 10 marks**

Implement the **threat metre** and **danger level**. This includes:

* + The threat metre that contains 10 spaces and shows the current threat amount. When it fills up, a new monster is spawned and the threat amount is reduced by 10.
  + When a monster is killed, the threat amount is increased by the monster’s reward.
  + At the end of each turn, the threat amount is increased by a random number between 1 and the danger level, inclusive.
  + Every 12 turns, the danger level is increased by 1. This causes the minimum damage, maximum damage, maximum hit points and reward for all monsters to increase by 1.
* **Additional features – up to 10 BONUS marks**

You may gain up to 10 bonus marks if you implement additional features to improve the game. The following are some suggestions. Feel free to devise your own additional features.

* + **Upgrade Unit –** Allow players to upgrade their Archer units, which increases their minimum damage, maximum damage and hit points by 1. This costs 8 gold the first time, and an extra 2 gold each time after that (8, 10, 12 …)

Similarly, players can upgrade their Walls with an extra 5 hit points by spending gold equal to 6, 8, 10 …

* + **Mine –** New defender unit Mine (MINE) that costs 8 gold. When a monster walks onto a mine, it explodes to deal 10 damage to all monsters in the 9 squares surrounding it (including its own position). It does not damage defenders.
  + **Heal/Repair** – Allow players to spend 5 gold to allow all defender units in a 3x3 square to recover 5 hit points.
  + **Cannon** – New defender unit Cannon (CANON) that costs 7 gold. It has 8 hit points, deals 3-5 damage, but can only fire every other turn. It also has a 50% chance to push a monster backwards by one square.

* + **Skeleton** – New monster unit Skeleton (SKELE). It has 10 hit points and deals 1-3 damage, but it only takes half damage from Archers. This monster should only be included if you have already implemented some other defender unit that can deal damage (like the Mine or Cannon).
  + **Game Options –** Allow players to specify various game options, such as the board dimensions (number of lanes and length of each lane), number of kills needed to win, Threat Metre length, etc.
  + **Challenge Scenarios** – Allow players to play games that have a specific set of monster spawns in a fixed sequence every time. The game records when the player has successfully beaten a scenario.

**Note:**

* ***You are expected to follow naming conventions introduced in this module.***
* ***You are encouraged to implement all the basic features before you implement the advanced features.***
* ***You should think carefully what input is required for each option if there is any.***
* ***You are allowed to customize your own output for the advanced features.***
* ***You are required to present your solution to your tutor. Your tutor may ask you questions to verify and assess your understanding of your work. Your tutor may ask you to make some changes to your program to handle another similar feature.***
* ***NO MARKS will be awarded for the advanced features if all the basic features have NOT been fully implemented (and fully working).***
* ***Marks will be deducted if you are not able to show your understanding of the program, both basic and advanced features (if applicable), during the demo.***

**6. DELIVERABLES**

* Name the file **"S10009999A\_Assignment.py"** where **"S10009999A"** is your student ID.
* Submit your program into **POLITEMall > Assignment > PRG1 Assignment Submission** by **7 August 2022, 2359 hours.**
* Demonstrate your application to your tutor during your PRG1 lessons (and other timeslots scheduled by tutor) starting **8 August 2022.**

**7. ASSESSMENT**

This assignment constitutes 30% of this module.

Performance Criteria for grading the assignment is as described below. Marks awarded will be based on **program code** as well as student’s degree of understanding of work done as assessed during the **demo**.

### A Grade

* Program implements the Basic Requirements with input validation successfully
* Program implements the Advanced Requirements successfully
* Program demonstrates good design with the correct use of functions
* Program complete with good documentation
* Program has been tested adequately
* Program is coded with good application of fundamental concepts
* Excellent demonstration of program and showing excellent understanding of work done during the demo

### B Grade

* Program implements the Basic Requirements with input validation successfully
* Program implements the Advanced Requirements with partial success
* Program demonstrates good design with the correct use of functions
* Program complete with good documentation
* Program has been tested adequately
* Program is coded with good application of fundamental concepts
* Good demonstration of program and showing good understanding of work done during the demo

### C Grade

* Program implements the Basic Requirements with input validation successfully
* Program demonstrates good design with the use of functions
* Program complete with some documentation
* Program has been tested adequately
* Some demonstration of program and showing some understanding of work done during the demo

### D Grade

* Program implements the Basic Requirementssuccessfully
* Program complete with some documentation
* Program has been tested adequately
* Able to answer some questions during the demo

name contains what is entered, the ser is asked to

**Appendix A**

|  |
| --- |
| 1 2 3  +-----+-----+-----+-----+-----+-----+-----+  A|ARCHR| |WALL |WWOLF| | | |  | 5/5 | |3/20 |6/10 | | | |  +-----+-----+-----+-----+-----+-----+-----+  B| | | | | | | |  | | | | | | | |  +-----+-----+-----+-----+-----+-----+-----+  C|ARCHR|ARCHR| |ZOMBI| | | |  | 5/5 | 5/5 | |4/15 | | | |  +-----+-----+-----+-----+-----+-----+-----+  D|ARCHR| | | | |ZOMBI|WWOLF|  | 5/5 | | | | |13/15|10/10|  +-----+-----+-----+-----+-----+-----+-----+  E| | | | | | | |  | | | | | | | |  +-----+-----+-----+-----+-----+-----+-----+  Turn 11 Threat = [--------- ] Danger Level 1  Gold = 10 Monsters killed = 3/20  1. Buy unit 2. End turn  3. Save game 4. Quit  Your choice? 2  Archer in lane A shoots Werewolf for 2 damage!  Werewolf in lane A hits Wall for 3 damage!  Wall dies!  Werewolf in lane A advances!  Archer in lane C shoots Zombie for 2 damage!  Archer in lane C shoots Zombie for 4 damage!  Zombie dies!  You gain 2 gold as a reward.  Archer in lane D shoots Zombie for 1 damage!  Zombie in lane D advances!  Werewolf in lane D advances!  Werewolf in lane D is blocked from advancing.  The evil grows stronger!  1 2 3  +-----+-----+-----+-----+-----+-----+-----+  A|ARCHR| |WWOLF| | | | |  | 5/5 | |4/11 | | | | |  +-----+-----+-----+-----+-----+-----+-----+  B| | | | | | | |  | | | | | | | |  +-----+-----+-----+-----+-----+-----+-----+  C|ARCHR|ARCHR| | | | | |  | 5/5 | 5/5 | | | | | |  +-----+-----+-----+-----+-----+-----+-----+  D|ARCHR| | | |ZOMBI|WWOLF| |  | 5/5 | | | |12/16|10/11| |  +-----+-----+-----+-----+-----+-----+-----+  E| | | | | | |WWOLF|  | | | | | | |11/11|  +-----+-----+-----+-----+-----+-----+-----+  Turn 12 Threat = [-- ] Danger Level 2  Gold = 13 Monsters killed = 4/20  1. Buy unit 2. End turn  3. Save game 4. Quit  Your choice? |

## Figure A.1 – Turn end example

Refer to Figure A.1, which shows an example of ending your turn:

1. **Lane A**: The Archer shoots the Werewolf for 2 damage, which does not kill it. The Wall does not block the Archer’s shot. Next, the Werewolf moves twice. It is blocked by the Wall for its first move, and it deals 3 damage to it, which destroys it. It then moves forward for its second move.
2. **Lane C**: Both Archers shoot the Zombie for a total of 6 damage, which kills it. The player is rewarded with 2 gold, and the Threat Metre is increased by 2 (from 9 to 11).
3. **Lane D**: The Archer shoots the Zombie for 1 damage; the Werewolf is not hit. Then the Zombie advances one space. Finally, the Werewolf attempts to advance 2 spaces. It is able to move one space, but is stopped from moving its second space by the Zombie.
4. The next turn starts, which is Turn 12. The monsters grow stronger, gaining 1 to their damage and hit points. On the plus side, they also provide an extra 1 gold reward when killed.
5. The Threat Metre is increased by 1, bringing it to 12. Since it is greater than 10, a new monster is spawned (the new Werewolf in Lane E). The Threat Metre is then reduced by 10, setting it to 2.