

These questions refer to the preliminary material and require you to load the skeleton program, but do not require any additional programming.

- 1 This question refers to the `PlayGame` subroutine in the main program.

The subroutine does not currently print out the actual player names when displaying the status at the start of each turn; it just prints out 'Player One' and 'Player Two'.

- a) How could this be corrected so that it would print out the names using the accessor method to the protected attribute `Name` from the `Player` class? [1]
- b) This is an example of using an accessor method. Why are accessor methods required in object-oriented programming? [1]

- 2 This question refers to the `PlayGame` subroutine in the main program.

In the subroutine, the variable `Player1Turn` is set to `True` to indicate that it is Player One's turn. How does the game process Player Two's turn? [2]

- 3 This question refers to the `HasMethod` method within the `Piece` class and the `ExecuteCommandInTile` method in the `HexGrid` class.

Explain how `HasMethod` is used in the `ExecuteCommandInTile` method. [2]

- 4 This question refers to the `GetDistanceToTileT` method in the `Tile` class.

`GetDistanceToTileT` is used to calculate the distance from the current tile to another tile.

- a) Explain how this calculation is performed. [3]
- b) Give a worked example of this calculation if the current tile has coordinates (2,-3,0) and the destination tile has coordinates (4,-4,0). All coordinates are given in (x,y,z) form. [2]

- 5 The `BaronPiece`, `LESSPiece` and `PBDSPiece` classes all inherit from the `Piece` class.

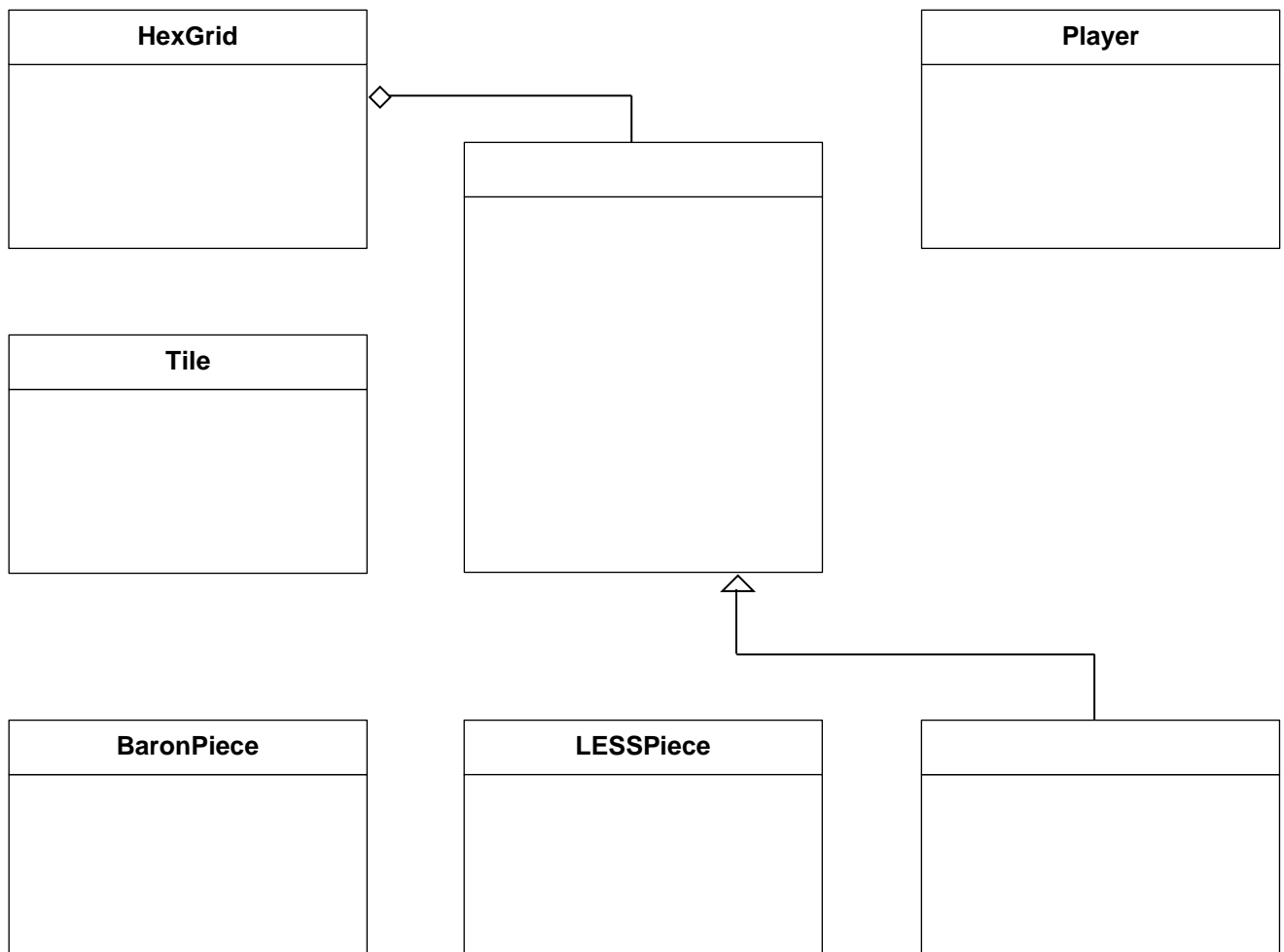
- a) Explain what is meant by 'inheritance'. [1]
- b) Why isn't there a 'SerfPiece' class? [1]

- 6 This question refers to the `BaronPiece` class and the `Piece` class.

The `BaronPiece` class overrides the public method `CheckMoveIsValid` from its parent.

- a) Explain what is meant by 'overriding'. [2]
- b) Explain why the method was overridden in this case. [2]

- 7 Big-O notation is used to measure the time complexity of algorithms.
- Examine the `SetUpNeighbours` method in the `HexGrid` class. State its time complexity. [1]
  - Which other method is used as a measure of the complexity of algorithms? [1]
- 8 The skeleton program uses a Comma Separated Values (CSV) file as the data structure for a saved game. Explain why a CSV file is suitable for cross-platform applications. [1]
- 9 Class diagrams can be represented using Unified Modeling Language (UML).  
Add the missing class names and relationships to the diagram below: [4]



- 10 This question refers to the `ExecuteUpgradeCommand` method of the `HexGrid` class.
- What does a return value of -1 from this method mean? [1]
  - What does a return value of 5 from this method mean? [1]
- 11 This question refers to the `Dig` method of the `PBDSPiece` class and the `ExecuteCommandInTile` method of the `HexGrid` class.
- When a 'dig' command is issued by a player, it is possible that the tile will be changed from a peat bog to a field and that they will receive 5 fuel instead of the normal 1.
- Explain how this eventuality is processed in the code with specific references to the variables used, function calls made and return values. [4]

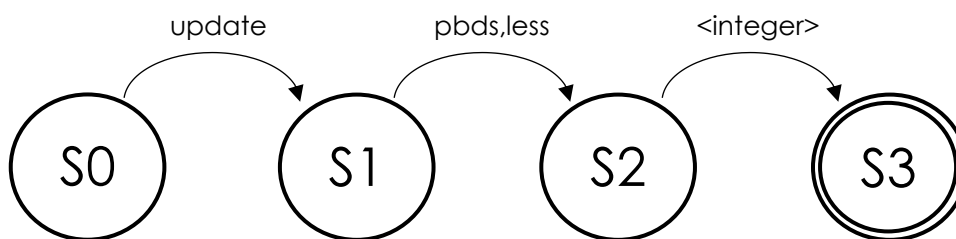
**12** This question refers to the `DestroyPiecesAndCountVPs` method of the `HexGrid` class and to the `Piece` class.

For a piece to be destroyed in the game, it needs to have two connections to immediate neighbours (i.e. pieces in two of the tiles that share a side with it).

- a) Explain how the `DestroyPiecesAndCountVPs` method uses polymorphism to access the protected attribute `ConnectionsToDestroy` of the `Piece` class. [2]
- b) Why is polymorphism not possible for private attributes? [1]

**13** This question refers to the `CheckUpgradeCommandFormat` subroutine in the main program.

Currently the validation performed by this subroutine could be represented using the following FSM (note that the 0 or higher condition is not currently checked in the code but needs to be part of the answer).



Where `<integer>` is any valid (0 or higher) integer.

- a) Write down the regular expression that is the equivalent of this FSM. [3]
  - b) Improve your regular expression so that it only accepts integers from 0 to 99. [1]
  - c) What is the definition of a regular language? [1]
- 14** This question refers to the `GetGridAsString` method of the `HexGrid` class.
- a) State the identifier for a local variable used in this method. [1]
  - b) What are the advantages of using local variables? [3]
  - c) This method uses one private and two protected attributes. What is the difference between a private and a protected attribute? [2]
- 15** This question refers to the `ExecuteSpawnCommand` method of the `HexGrid` class.
- Explain how the method works, including reference to how it meets the success condition for spawning a new Serf (it must be on an empty square adjacent to that player's Baron). [6]