GCSE
COMPUTER SCIENCE
8520/CA/CB/CC/CD/CE

Sample NEA Task (Task 3 – Card Trick)

V1.0

For candidates entering for the XXXX examination
To be issued to candidates at the start of the final academic year of their course of study

Instructions

- Evidence for assessment must include a complete listing of all program code, and a report describing the design of the solution, any features of the coded solution which are not evident from the listing, the testing and any potential enhancements and refinements to the solution.

Information

- The assessment is designed to be completed in 20 hours.
- The assessment period is not required to be continuous.
- There are restrictions on when and where students can work on this problem. Please see the Teachers' Notes which accompany this task for more information about these restrictions.
- Students may need to use the Internet to research certain parts of the problem. This must be within the 20 hours.
- Submission may be paper-based or electronic using CD/DVD.
- Students will need to complete and sign a Candidate Record Form which declares that the work is their own. This must be countersigned by the teacher and a member of the senior leadership team at your school or college.

Students must use one of the following programming languages:

- C#
- Java
- Pascal/Delphi
- Python
- VB.Net.

Centres will be asked to indicate their programming language choice(s) for each cohort at the start of the course.

The Card Trick

An algorithmic card trick works as follows:

1. The magician deals 21 shuffled playing cards face up into three piles working left-to-right row-by-row. The first time the magician does this an audience member is asked to choose one of the cards and keep their choice secret.
2. The magician asks the audience member to say whether their card is in the first, second or third pile.
3. The magician collects the cards pile by pile ensuring the selected pile is placed in between the other two piles.
4. Steps 1-3 are repeated 2 more times.
5. Once these steps are completed, the chosen card will 'magically' be in the middle of the deck of 21 cards.

For example, the first deal could be this (colours are used to show how the cards are handled the first time the piles are picked up and re-dealt):

Pile 1	Pile 2	Pile 3
Ace diamonds	7 clubs	3 diamonds
Ace spades	4 clubs	Ace clubs
5 clubs	2 diamonds	2 spades
6 diamonds	5 spades	4 diamonds
6 spades	7 spades	7 diamonds
5 diamonds	3 clubs	3 spades
6 clubs	4 spades	2 clubs

If the audience member has chosen the Ace of spades as their card they would tell the magician that their card is in **Pile 1**. The magician would then pick the cards up but would ensure that **Pile 1** is in between **Pile 2** and **Pile 3**. If the magician picks up **Pile 2** first then the order of the cards would be:

Deck
7 clubs
4 clubs
2 diamonds
5 spades
7 spades
3 clubs
4 spades
Ace diamonds
Ace spades
5 clubs
6 diamonds
6 spades
5 diamonds
6 clubs
3 diamonds
Ace clubs
2 spades
4 diamonds
7 diamonds
3 spades
2 clubs

The cards are again dealt into three piles starting from the top of the deck. The three piles would be:

Pile 1	Pile 2	Pile 3
7 clubs	4 clubs	2 diamonds
5 spades	7 spades	3 clubs
4 spades	Ace diamonds	Ace spades
5 clubs	6 diamonds	6 spades
5 diamonds	6 clubs	3 diamonds
Ace clubs	2 spades	4 diamonds
7 diamonds	3 spades	2 clubs

The audience member would now inform the magician that their card (the Ace of spades) is in **Pile 3**. The magician would pick up the cards ensuring that **Pile 3** goes between **Pile 1** and **Pile 2**. Assuming that **Pile 1** was picked up first then the deck would now be:

Deck
7 clubs
5 spades
4 spades
5 clubs
5 diamonds
Ace clubs
7 diamonds
2 diamonds
3 clubs
Ace spades
6 spades
3 diamonds
4 diamonds
2 clubs
4 clubs
7 spades
Ace diamonds
6 diamonds
6 clubs
2 spades
3 spades

The cards are dealt once more in the same way as before:

Pile 1	Pile 2	Pile 3
7 clubs	5 spades	4 spades
5 clubs	5 diamonds	Ace clubs
7 diamonds	2 diamonds	3 clubs
Ace spades	6 spades	3 diamonds
4 diamonds	2 clubs	4 clubs
7 spades	Ace diamonds	6 diamonds
6 clubs	2 spades	3 spades

The audience member would tell the magician that their card is in **Pile 1** and again the magician would pick up the piles ensuring that **Pile 1** was between the other two. Assuming the magician picks up **Pile 2** first then the cards would be in this order:

Deck
5 spades
5 diamonds
2 diamonds
6 spades
2 clubs
Ace diamonds
2 spades
7 clubs
5 clubs
7 diamonds
Ace spades
4 diamonds
7 spades
6 clubs
4 spades
Ace clubs
3 clubs
3 diamonds
4 clubs
6 diamonds
3 spades

The Ace of Spades is ‘magically’ in the middle of the deck.

Based on http://www.cs4fn.org/mathemagic/cardshuffle.php

Tasks

1. Develop the part of the program that displays 21 different playing cards in a random order. The order of the cards should be randomly generated at the start of every new trick.
2. Develop the part of the program that deals the 21 cards into three piles from left-to-right and top to bottom and displays them to the user. The first time this happens the user should be prompted to think of a card although they are not required to enter their choice into the program.
3. Develop the part of the program that asks the user to enter which one of the three piles their card is in. The user should only be able to enter 1, 2 or 3.
4. Develop the part of the program that combines the three piles ensuring the user’s choice of pile is in between the other two piles.
5. Develop the part of the program that repeats steps 2 to 4 two more times.
6. Develop the part of the program that outputs the chosen card (i.e. the card in the middle of the 21 cards).