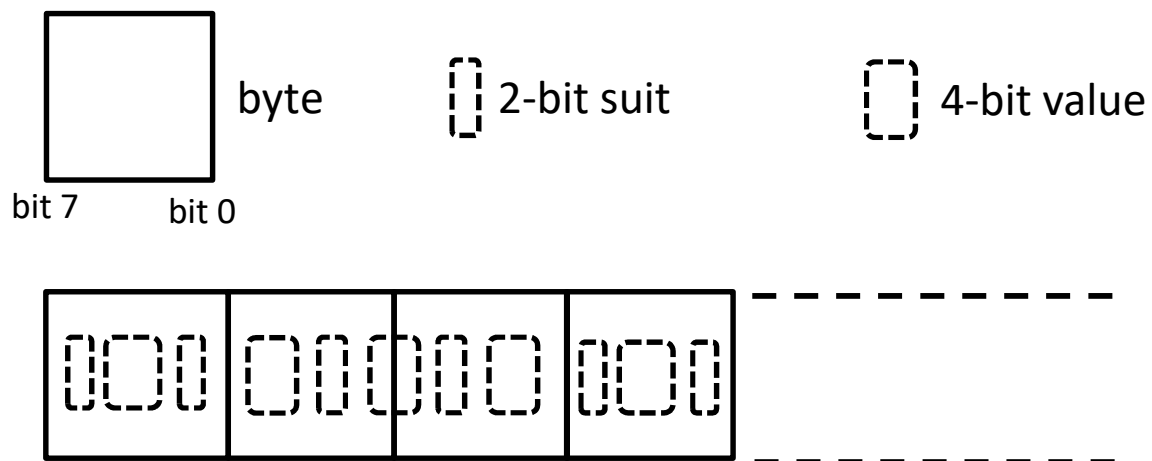


1. Playing cards are used in many card games such as poker, bridge, and blackjack. The most common type of playing cards used in Ireland are an English pattern of French-suited cards, where there are 52 cards in a pack. Each card has a suit, which is one of spades, hearts, diamonds and clubs. Each card also has a value, which is a number in the range 1 to 13 inclusive. A very simple representation of a card in C might use a structure such as:

```
struct playing_card {
    int suit; // number in range 0..3
    int value; // number in range 1..13
};
```

This structure representation uses two integers to store the suit and value of the card, and is suitable representation for most purposes. However, the suit has only four possible values and could therefore be stored in just two bits. Further, the value has only thirteen possible values, and could therefore be stored in just four bits. Thus, the two components could be stored in a total of six bits, and an array of cards could be packed into memory as follows:



Note that in the picture one of the 4-bit values spans across two different bytes. The leftmost bit of each byte is bit-7, and the rightmost bit of each byte is bit-0.

(a) Write a C function with the following prototype:

```
unsigned char * pack_cards(struct playing_cards * cards, int number_of_cards)
```

Where the function `pack_cards` takes an array of playing card structures as a parameter and returns an array of bytes (i.e. unsigned chars) that contains the corresponding packed representation of the cards, where each card is packed into six bits.

[50 marks]

(b) Write a C function with the following prototype:

```
struct playing_card * unpack_cards(unsigned char * packed_cards, int number_of_cards)
```

Where the function `unpack_cards` takes an array of bytes (i.e. unsigned chars) that contains the packed representation of an array of cards, where each card is packed into six bits, and returns a corresponding array of playing card structures.

[50 marks]

You should complete your solution on a computer within files that are available on the CSU22014 Blackboard page. You may define and call additional functions from the two functions (a) and (b). All program code should be commented, indented, and use good programming style.

[Total: 100 marks]