CS2021 Assignment 4 Answers

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1 Ethical issues

1. What should you do if you have come across someone who is logging in an account?

   Answer: I should remind the person that I am here and ask him/her not to type anything. If I have seen the password, I need to remind the person to change his/her password immediately. Then, I have to walk away immediately.

   If I am sitting next to the person, I have to remind him/her not to type anything until my head has been turned away from the screen. If I have seen the password, I need to remind the person to change his/her password immediately. Then, I have to walk away immediately.

2. What should you do if you have come across someone who is reading emails (resp. letters)?

   Answer: I should remind the person that I am here and ask him/her to close the mail box. Then, I have to walk away immediately.

3. You are now in a computer room in the computer center. You would like to access a computer to edit a WORD document for the Assignment 4. You have found that only one computer is not in use. All the others are occupied with students. Let say the one not in use is called Computer X. You find that Computer X has no response to any input, no matter from the mouse clicks and the keyboard typing. Now, what will you do? Shut down and then restart the computer?

   Answer: No, we cannot shut down and restart the computer. We need to ask a technician or other users nearby if the computer has been using for running computer experiment.

4. In the lecture, John Sum has introduced a method to set a secure password. With an aid of example, describe how to set a secure password by using the method.

   Answer: The steps are listed in the following.

   S1: To think of a sentence which is easy to remember. Let say, "I am in love with Venue in 1996."

   S2: Generate a master string by combining the first character of each word with the numbers. For the example, it is "iailwvi1996".

   S3: Generate a binary bit string to indicate which character in the master string has to be typed together with the ENTER key. Let say, the binary bit string is '11000000011'. Here '1' refers to ENTER keying.

   S4: The following string will be the password.

   ```
   IAilwvi19(^
   ```

   The above password setting method can fulfil the high level requirement setting by Google, in which a password has to contain at least (i) one small letter, (ii) one big letter, (iii) one number and (iv) one symbol.

2 Problem Solving

1. You are given a set of 9 balls which are looked and sensed the same. In this set of balls, six of them are normal balls and three of them are abnormal. For the normal balls, each of them weights 2000 grams. For the abnormal balls, they could be 1999 grams or 2001 grams. We do not know how many abnormal balls weight 1999 grams and how many abnormal balls weight 2001 grams. That is to say, it is possible that all abnormal balls are 1999 grams or all abnormal balls are 2001 grams. It is also possible that two abnormal balls are 2001 grams and one abnormal ball is 1999 grams. Describe in detail, the step by step, how do you use the pan balance to find out all the abnormal balls.

   Answer: The key idea to solve this problem is to find the normal balls, instead of the abnormal balls. The algorithm is based on the idea of the Solution 3 for the Question 3 in Assignment 1.

   If B_1 is a normal ball, exactly five '=' signs will appear. The abnormal balls will be those with '$\neq$' signs. Let say, B_5, B_7 and B_9 are abnormal. Here is the outcome.

$(1,2)$	$(1,3)$	$(1,4)$	$(1,5)$	$(1,6)$	$(1,7)$	$(1,8)$	$(1,9)$	A. Ball
$=$	$=$	$=$	$\neq$	$=$	$\neq$	$=$	$\neq$	$5,7,9$

   If B_1 is lighter than normal, at least six '$<$' signs will appear. Let say, B_5 and B_7 are abnormal. There will have four cases.

$(1,2)$	$(1,3)$	$(1,4)$	$(1,5)$	$(1,6)$	$(1,7)$	$(1,8)$	$(1,9)$	A. Ball
$<$	$<$	$<$	$\#$	$<$	$\#$	$<$	$<$	$5,7,9$

The symbols # could be $=$ or $<$.

If B_1 is heavier than normal, at least six '$>$' signs will appear. Let say, B_5 and B_7 are abnormal. There will have four cases.

$(1,2)$	$(1,3)$	$(1,4)$	$(1,5)$	$(1,6)$	$(1,7)$	$(1,8)$	$(1,9)$	A. Ball
$>$	$>$	$>$	$\#$	$>$	$\#$	$>$	$>$	$5,7,9$

The symbols # could be $=$ or $>$.

So, the problem could be solved by the following algorithm.

```
S1: FOR N = 2 to 9,
        Weight B1 and BN.
        Record the results.
    END
S2: IF the number of '=' sign is five,
       the balls with unequal signs are abnormal. STOP.
    ELSE
       B1 is abnormal. GOTO Step 3.
    ENDIF

S3: FOR N = 3 to 9,
        Weight B2 and BN.
        Record the results.
    END
S4: IF the number of '=' sign is four,
       the balls with unequal signs are abnormal. STOP.
    ELSE
       B2 is abnormal. GOTO Step 5.
    ENDIF

S5: FOR N = 4 to 9,
        Weight B3 and BN.
        Record the results.
    END
S6: IF the number of '=' sign is three,
       the balls with unequal signs are abnormal. STOP.
    ELSE
       B3 is abnormal. STOP.
    ENDIF
```

For the above algorithm, the total number of WEIGHT is no more than 21.

2. Imagine that you are now standing in front of two doors, say X and Y. One of them leads you to heaven and the other leads you to hell. In each door, there is a doorman. Let the doorman standing in front of the door X is A and the doorman standing in front of the door Y is B. For the doormen, it is known that one of them always lies and the other always tells the truth. Besides, the doormen only answer 'Yes' or 'No' to you. For instance, if you ask to a doorman 'the current president of Taiwan is a lady', the liar doorman will answer 'No' and the truth teller doorman will answer 'Yes'.

   (a) Now, if you can ask two questions, what questions you will ask and which doorman you will ask so that you can find out which door is going to heaven?

   Answer: Here is the method.

```
S1: Ask the Doorman X, 'the president of Taiwan is a lady'.
    GOTO Step 2.
S2: IF the answer is 'NO', GOTO Step 3. ELSE GOTO Step 4.
S3: Ask the Doorman X, 'Door X will lead me to heaven'.
    IF the answer is 'YES', walk in Door X.
    ELSE walk in Door Y.
S4: Ask the Doorman Y, 'Door X will lead me to heaven'.
    IF the answer is 'YES', walk in Door X.
    ELSE walk in Door Y.
```

   (b) If you can only ask one question, what question you will ask and which doorman you will ask so that you can find out which door will lead you to heaven?

   Answer: Ask Doorman X the following question: *If I ask Doorman Y, 'Door Y will lead me to heaven', Doorman Y will say 'YES'.*

   Without much information, we could guess what the Doorman X will answer.

Man X	Man Y	Door X	Door Y	Y Answer	X Answer
Liar	Honest	Heaven	Hell	NO	YES
Liar	Honest	Hell	Heaven	YES	NO
Honest	Liar	Heaven	Hell	YES	YES
Honest	Liar	Hell	Heaven	NO	NO

   From the above table, it is clear that if the Doorman X answers 'YES', walk in Door X. If the Doorman X answers 'NO', walk in Door Y.

3 Digital Systems

1. What are the values of 2^{-2}, 2^{-1}, 2^0, 2^1, 2^2, 2^8, 2^{10}, 2^{20}, 2^{30}, 2^{40}?

   Answer: 1/4, 1/2, 1, 2, 4, 256, 1024, 1024^2, 1024^3, 1024^4.

2. How many bits refer to one byte?

   Answer: 8 bits.

3. How many bytes is 1Mbytes?

   Answer: 1024^2 bytes.

4. How many bytes is 1Gbytes?

   Answer: 1024^3 bytes.

5. How many bytes is 1Tbytes?

   Answer: 1024^4 bytes.

6. For a character to be encoded in ASCII format, how many bytes are needed?

   Answer: One byte.

7. To encode the four-character string 'John' in ASCII format, what exactly the binary string is it?

   Answer: $4A6F686E \rightarrow 01001010011011110110100001101110$.

8. To encode the three-character string 'C S' in ASCII format, what exactly the binary string is it?

   Answer: $432053 \rightarrow 010000110010000001010011$.