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*There are many notes in the instructions to help you earn marks for the questions below.*

Exercise One of Two – **integer overflow** (80 points)

1) 🡺 (7.5 points) ) If a variable counting seconds is stored in a signed **long** 32-bit integer, how many **days** will it take until that integer overflows? (to one decimal place)

Value for a 32-bit integer is 2,147,483,647 seconds recorded in hundreds, therefore 2,147,483,647/100 = 21,474,836.47

There are 86,400 seconds in a day. 21,474,836.47 / 86,400 = 248.5 (to the nearest tenth)

2) 🡺 (15 points) Convert the maximum value of an unsigned **long** 32-bit integer, representing hundredths of a second, into whole numbers of  
 days : hours : minutes : seconds . hundredths of a second.   
After *n* days, how many hours remain? After *n* hours, how many minutes remain? etc.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **248** | **13** | **13** | **55** | **47** |
| **DAYS** | **HOURS :** | **MINUTES :** | **SECONDS .** | **HUNDREDTHS** |

3) 🡺 (2.5 points) What are the maximum and minimum values that can be stored in a **short** 16-bit signed integer?

16-bit signed integer maximum = 32767 … minimum = -32768

-32767 + -1 are two negative values causing overflow when added together.

4) 🡺 (5+5 points) Give examples of two **short** 16-bit signed integers that when added together would cause overflow.

 Addition of the positive numbers 32767 + 1 results in an overflow.

When two negative values are joined together, they produce the overflow value -32767 + -1.

Binary Search Bug

5) 🡺 (10 points) What is potentially wrong with the **(low + high) / 2** calculation to find the middle point? Under what conditions would the calculation go wrong?

The calculation is incorrect because (low+high) is already greater than the capacity, resulting in an overflow.

6) 🡺 (10 points) REWRITE themidcalculation to prevent overflow*from*mid = (low + high) / 2;*to*  **mid = mid = low + (high – low) / 2 ;**

7) 🡺 (25 points)Write a 250+ word “reflection”(similar to a workshop in your programming class) describing the steps you used to develop and test your solution to the calculation bug.

In order to get the midpoint between two values, the formula (low + high) / 2 is typically applied. But when dealing with integer data, there can be a problem with this strategy. When low plus high add to an odd number, a problem results. When this occurs, the division will reduce the decimal component, giving rise to an inaccurate middle point.

For instance, low is equal to 5, whereas high is equal to 9. The predicted midpoint is 7, so. The right answer is 7, although if the low and high values are 5 and 10, the predicted intermediate value is 7.5 when using the calculation (5 + 9) / 2. However, employing the formula (5+ 10) / 2 will get the wrong value 7, as a result of the reduction.

This problem can be solved using a different strategy. We can add 0.5 to the sum before dividing it, as opposed to simply multiplying it by 2. As a result, the result will be accurately rounded to the closest middle point. The correct middle point will be obtained in both instances by applying the modified formula (low + high + 0.5) / 2.

When I was attempting to complete Workshop 2 for IPC class, I made this error!

Exercise Two of Two – **Numbering Systems and Conversions (20 points)**

8) 🡺 (10 points ) What is the hex value for these colours?

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Red decimal | Green decimal | Blue decimal | Hex triplet | Colour Description |
| 15 | 245 | 231 | #0FF5E7 | Vivid Cyan |
| 192 | 255 | 238 | #C0FFEE | Pale Cyan |
| 208 | 13 | 30 | #D00D1E | Vivid Red |
| 186 | 187 | 30 | #BABB1E | Strong Yellow |
| 126 | 164 | 112 | #7EA470 | Grayish Green |

9) 🡺 (10 points)Fill in this chart as per the column headings

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Hex triplet | Red decimal | Green decimal | Blue decimal | Describe the Final Colour *and* change the cell's background colour, i.e. R-click and see MS Word 'Shading' |
| #302432 | 48 | 36 | 50 |  |
| #204C02 | 36 | 76 | 2 |  |
| #D64A53 | 214 | 74 | 83 |  |
| #404891 | 64 | 72 | 145 |  |