



The 6th Annual Newport News Computer Challenge

Wednesday, February 28, 2007

Team Packet

C++ Problems



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C++ Problems



Ugly Numbers ~ 10 points



The Chinese Animal Zodiac
Year Problem ~ 10 points



The Chinese Animal Zodiac
Age Problem ~ 20 points

$$\begin{array}{r} 1024 \\ 34 \\ \hline 4096 \\ 3072 \\ \hline 34816 \end{array}$$

Annotations:

- multiplicand* (points to 1024)
- multiplier* (points to 34)
- partial products* (points to 4096 and 3072)
- product* (points to 34816)

Long Multiplication ~ 20 points



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Ugly Numbers (10 points)



Ugly numbers are numbers whose only prime factors are 2, 3 or 5.

The sequence

1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 15, ...

shows the first 11 ugly numbers. By convention, 1 is included.

Write a program that prompts the user to input a positive integer n and outputs the n th ugly number followed by the next four ugly numbers.

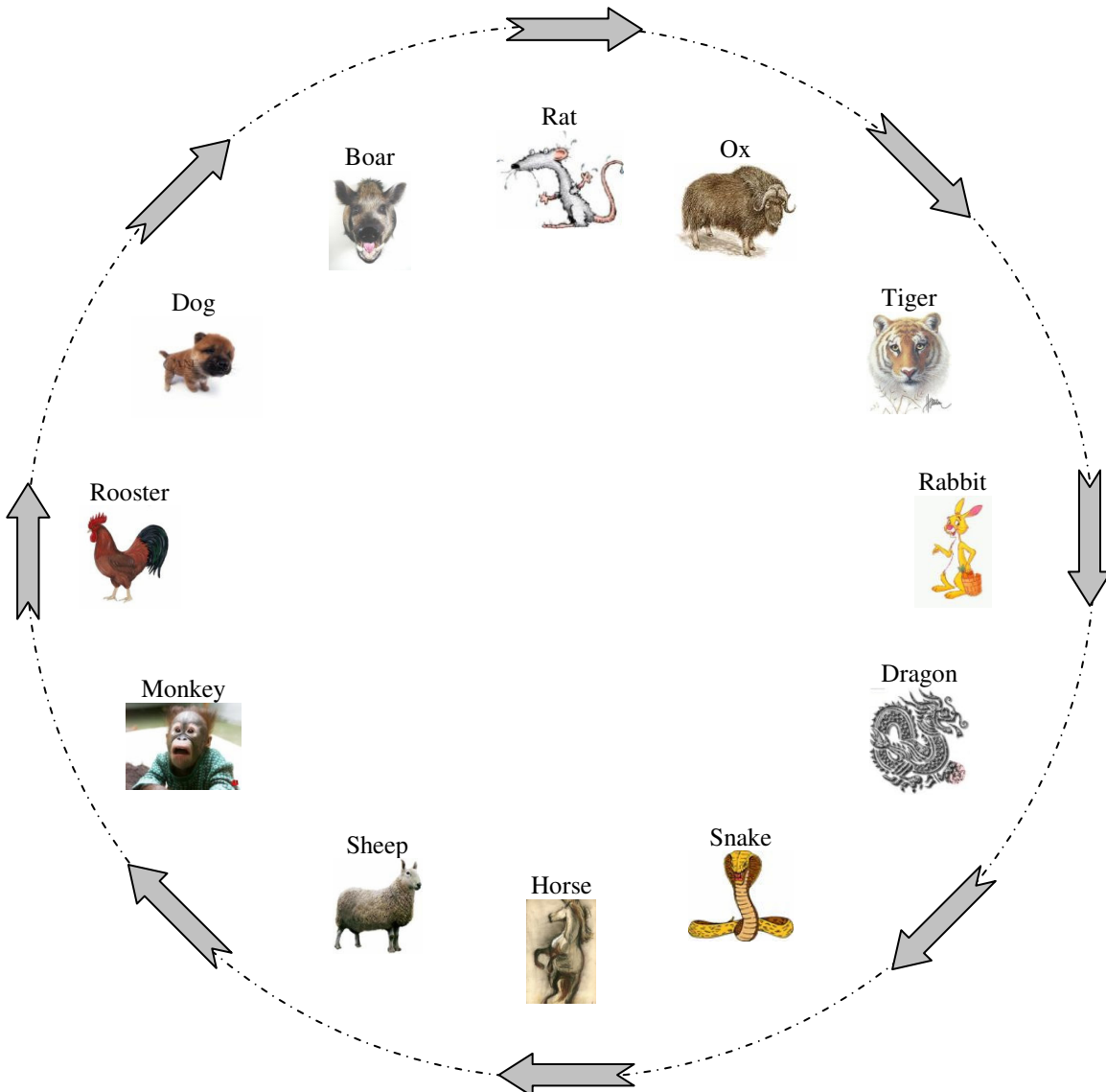


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The Chinese Animal Zodiac Year Problem (10 points)

In the Chinese Animal Zodiac calendar, the years, for which we use numbers, are designated by twelve animals, beginning with the Rat:



Years are called “Year of the Rat”, “Year of the Ox”, etc.

When the “Year of the Boar” is reached, the next year is “Year of the Rat” again and the cycle repeats.

Although the Chinese New Year falls on different days yearly, somewhere between late January and early February based on the cycles of the moon, for the purposes of this problem, we will assume that Chinese Animal Zodiac years correspond exactly to years on our Western calendar (so years begin on January 1).

1996 was "The Year of the Rat".

Write a C++ program that allows the user to input a Western numerical year from 1500 to 2999 inclusive and then outputs the Chinese Animal Zodiac year in the format used in the sample run below. Use "was", "is", or "will be" properly. Replace "Sample" with your school's name.

Input repeats until a year outside the given range is entered.

Sample run:

Program to convert a Western Year
to a Chinese Animal Zodiac Year.
By the C++ team from Sample High School.

```
Enter a year (1500-2999, any other year to quit): 1500
1500 was the Year of the Monkey
Enter a year (1500-2999, any other year to quit): 2006
2006 was the Year of the Dog
Enter a year (1500-2999, any other year to quit): 2007
2007 is the Year of the Boar
Enter a year (1500-2999, any other year to quit): 2008
2008 will be the Year of the Rat
Enter a year (1500-2999, any other year to quit): 2999
2999 will be the Year of the Sheep
Enter a year (1500-2999, any other year to quit): 3000
Press any key to continue . . .
```



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The Chinese Animal Zodiac Age Problem (20 points)

This problem uses the same Chinese Animal Zodiac described in detail in the Chinese Animal Zodiac Year Problem.



The animal signs also serve a useful social function for finding out people's ages. Instead of asking directly how old a person is, people often ask what is his or her animal sign. This would place that person's age within a cycle of 12 years, and with a bit of common sense, we can deduce the exact age.

Given a person's age (under 100 years old) as one of these descriptions:

<i>Description</i>	<i>Years Old</i>
child	1 to 12 years old
teenager	13 to 19 years old
twenty-something	20 to 29 years old
thirty-something	30 to 39 years old
<i>etc. through ninety-something</i>	

and given the Chinese Animal Zodiac year in which the person was born and the current Chinese Animal Zodiac year, tell the person's exact age. Remember to include the fact that in China, when a baby is born, it is considered to be 1 year old.

Samples:

A "child" born in the "Year of the Ox" and it is now the "Year of the Dog" is 10 years old.

A "teenager" born in the "Year of the Ox" and it is now the "Year of the Rabbit" is 15 years old.

A "thirty-something" person born in the "Year of the Ox" and it is now the "Year of the Rat" is 36 years old.

Be careful! Some combinations are not possible. For example, if a teenager was born in the "Year of the Rat" and it is now the "Year of the Dog", the teenager could only be 11 or 23 and thus could not be a teenager according to our chart. In such cases, your program should report "Not Possible!".

A sample run is provided on the next page.

Sample run:

The Chinese Zodiac Age Problem.
By the C++ team at Sample High School.

Age Descriptions:

0 - child	1 to 12 years old.
1 - teenager	13 to 19 years old.
2 - twenty-something	20 to 29 years old.
3 - thirty-something	30 to 39 years old.
4 - forty-something	40 to 49 years old.
5 - fifty-something	50 to 59 years old.
6 - sixty-something	60 to 69 years old.
7 - seventy-something	70 to 79 years old.
8 - eighty-something	80 to 89 years old.
9 - ninety-something	90 to 99 years old.

Enter your age description. (0-9) 5

Chinese Animal Zodiac Years.

0 - Year of the Rat
1 - Year of the Ox
2 - Year of the Tiger
3 - Year of the Rabbit
4 - Year of the Dragon
5 - Year of the Snake
6 - Year of the Horse
7 - Year of the Sheep
8 - Year of the Monkey
9 - Year of the Rooster
10 - Year of the Dog
11 - Year of the Boar

Enter the Chinese Zodiac year in which you were born. (0-11) 10

Enter the current Chinese Zodiac year. (0-11) 2

A fifty-something person born in the Year of the Dog
and it is now the Year of the Tiger
is 53 years old.

Press any key to continue . . .



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Long Multiplication (20 points)

Given two positive integers in either order, display the problem as long multiplication, each line correctly right-justified. The smaller integer should always be displayed as the multiplier. For example, to display 34 times 1024:

```
1024 ← multiplicand
 34 ← multiplier
----
4096 ← partial products
3072 ←
-----
34816 ← product
```



To get maximum points: Partial products equaling zero should be omitted. If the multiplier is a single digit, no partial products should be displayed. The length of the first dashed line (if there) should equal the number of digits in the multiplicand or the first partial product, whichever is larger. The length of the dashed line over the product should equal the number of digits in the product. Input should continue until at least one zero is entered. Negative numbers should be rejected. Do not worry about other invalid input. Do not worry about overflow.

```
Long Multiplication. By the C++ team at Sample High School.
Please enter two positive integers to multiply, either one zero to quit.
-1 234
Please enter two positive integers to multiply, either one zero to quit.
1234 23456
```

```
23456
1234
-----
93824
70368
46912
23456
-----
28944704
```

```
Please enter two positive integers to multiply, either one zero to quit.
20304 102
```

```
20304
 102
-----
40608
20304
-----
2071008
```

```
Please enter two positive integers to multiply, either one zero to quit.
1234 3
```

```
1234
  3
----
3702
```

```
Please enter two positive integers to multiply, either one zero to quit.
0 1
```

Press any key to continue...



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C++ - Ruberics For Teams

Ugly Numbers (10 points)

	Max Points
Heading displays program name and team's name.	1
Prompts user to input a positive integer n .	1
Accepts the positive integer without crashing.	1
Outputs the n th ugly number...	3
...followed by the next four ugly numbers.	4
TOTAL	10

Chinese Animal Zodiac Year Problem (10 points)

	Max Points
Heading displays program name and team name.	1
Correctly prompts user to enter a year from 1500 to 2999, any other year to quit.	1
Displays the correct answer for any valid western year. ("Rat", "Ox", etc.)	5
Displays the correct answer correctly formatted regardless of "was", "is", or "will be".	1
Displays the correct answer correctly formatted including "was", "is", or "will be".	1
If displays a correct answer for years in range, quits if any other year is entered.	1
TOTAL	10

Chinese Animal Zodiac Age Problem (20 points)

	Max Points
Heading displays program name and team name.	1
Displays the list of Age Descriptions.	1
Prompts for and accepts input for the Age Description.*	1
Displays the Chinese Animal Zodiac Years.	1
Prompts for and accepts input for the Chinese Animal Zodiac year of birth.*	1
Prompts for and accepts input for the current Chinese Animal Zodiac year.*	1
Calculates and displays the correct numerical age.	10
Calculates and displays the correct numerical age with correct echoing of input such as in the sample run.	2
Correctly detects impossible combinations and displays "Not Possible!"	2
TOTAL	20

* May use other methods of input besides input by numbers but the prompts must be very clear and user-friendly.

Long Multiplication (20 points)

	Max Points
Heading displays program name and team name.	1
Prompts for two positive integers, either one zero to quit.	1
Re-prompts if either integer is negative.	1
Quits if either integer is zero (provided it doesn't quit for other values).	1
Redisplays multiplicand and multiplier correctly formatted, right-justified, larger on top, with line of dashes drawn underneath. (Correctly right-justifying all three lines sets the right margin by which all other subsequent alignment is determined. If this margin is not correct, all alignment/indention points below are lost.)	1
Correctly displays all partial products on each line below.	5
Correctly displays all partial products on each line below, correctly indented from the right margin set previously.	4
Correctly draws a line of dashes and displays the product underneath the partial products.	2
Correctly draws a line of dashes and displays the product underneath the partial products, right-justified using the right margin set previously.	2
Partial products equaling zero are omitted.	1
If the multiplier is a single digit, no partial product is displayed and only one line of dashes is drawn.	1
TOTAL	20