

請照題號次序作答

Please use C, C++, Java or Python programming language to design your computer programs.

1. (20%)
 - a. Given n k -digit numbers. Please implement the **radix sort** function `radix_sort()`, to sort the list of these n numbers.
 - b. Given the list is {123, 654, 946, 394, 978, 273, 573, 672}. Show the result after sort each digit step-by-step.

2. (20%) In mathematics, a **perfect number** is a positive integer that is the sum of its proper positive divisors, that is, the sum of the positive divisors excluding the number itself. The first perfect number is 6, because 1, 2, and 3 are its proper positive divisors, and $1 + 2 + 3 = 6$. Equivalently, the number 6 is equal to half the sum of all its positive divisors: $(1 + 2 + 3 + 6) / 2 = 6$.
Please write a program `perfect_number()` which can list all the perfect numbers between 1 and k .

3. (20%) A DNA sequence or genetic sequence is a succession of letters representing the primary structure of a real or hypothetical DNA molecule or strand, with the capacity to carry information as described by the central dogma of molecular biology. The possible letters are A, C, G, and T, representing the four nucleotide bases of a DNA strand — adenine, cytosine, guanine, thymine — covalently linked to a phosphodiester backbone.
Given a string of DNA strand, for example, ACTTACATTA... Please write a program `gc_ratio()` to report how GC-rich some sequence is. (In other words, just give the percentage of G and C in the DNA.)

4. (20%) Given an array of words and a length L , format the text such that each line has exactly L characters and is fully (left and right) justified. You should pack your words in a greedy approach; that is, pack as many words as you can in each line. Pad extra spaces ' ' when necessary so that each line has exactly L characters. Extra spaces between words should be distributed as evenly as possible. If the number of spaces on a line do not divide evenly between words, the empty slots on the left will be assigned more spaces than the slots on the right. For the last line of text, it should be left justified and no extra space is inserted between words.
For example,
words: ["This", "is", "an", "example", "of", "text", "justification."]

L: 16.
Return the formatted lines as:


```
[
  "This   is   an",
  "example of text",
  "justification. "
]
```

 Please write a program `text_justify()` to generate the list of formatted lines from a list of words.

5. (20%) Terminology explanations
 - a. What is **polymorphism**? Write some sample codes in OO language to describe the **polymorphism** in object-orientation program.
 - b. What is the **recursion**? How can we convert a **recursive** program into an **iterative** program?
 - c. What is the **virtual address**? Given a page/frame of 4kilobytes. How do we solve the problem that **virtual address table** could not be put in one page?
 - d. What is the **cache** in CPU/computer? Why does the **cache** work?