University of Science and Technology of Hanoi ******* **Mid-term** **Subject: Algorithms and Data Structures** Sheet: 02 No of pages: 02		***Academic year**: 2024–2025* ***Date**: 01/10/2024* ***Time**: 45 minutes* ***Important instructions*** *(according to lecturer's decision)* 1. No documents or communication devices are allowed. 2. Copying or using Internet will lead to heavy penalty	
Pathway coordinator		**Lecturer (or Head of Subject)**	**Dr. Đoàn Nhật Quang**
Student name		**Student's ID**	

Follow this instruction:
- Create a folder "ADS_YOURNAME_STUDENTID" in the Desktop.
*- Create the source files **question1.c** (or cpp) and **question2.c** for the corresponding problems.*
*- **Remove the executable files** (.exe) and **zip** all your source codes, and submit it in Google classroom.*
- Verify your name in the files and mails, un-named or incorrect-name files lead to 0.

Problem:
In this problem, we try to convert a decimal fraction into binary number. In the input, we are given an fraction decimal number n and integer k, convert decimal number n into equivalent binary number up-to k precision after decimal point.

We have to follow the algorithm:

1. Convert the integral part of decimal to binary equivalent:
    - Divide the decimal number by 2 and store remainders in array.
    - Divide the quotient by 2.
    - Repeat step 2 until we get the quotient equal to zero.
    - Equivalent binary number would be reverse of all remainders of step 1.
2. Convert the fractional part of decimal to binary equivalent
    - Multiply the fractional decimal number by 2.
    - Integral part of resultant decimal number will be first digit of fraction binary number.
    - Repeat step 1 using only fractional part of decimal number and then step 2.

Let's take an example for n = 4.47, k = 4

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Step 1: Conversion of 4 to binary
1. 4/2 : Remainder = 0 : Quotient = 2
2. 2/2 : Remainder = 0 : Quotient = 1
3. 1/2 : Remainder = 1 : Quotient = 0
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So equivalent binary of integral part of decimal is 100.
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Step 2: Conversion of .47 to binary
1. 0.47 * 2 = 0.94, Integral part: 0
2. 0.94 * 2 = 1.88, Integral part: 1
3. 0.88 * 2 = 1.76, Integral part: 1
4. 0.76 * 2 = 1.52, Integral part: 1

So equivalent binary of fractional part of decimal is .0111
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The final result of conversion n = 4.47 (with precision k = 4): 100.0111

Question 1 (12 pts)

- Write a pseudo-code to convert a natural number into binary using Iteration. (2pts)
- Implement your proposed algorithm in C/C++. (8pts)
- Calculate the complexity of your algorithm. Justify the answer (comment directly in your source files). (2pts)

Question 2 (8 pts)

- Propose another algorithm using **recursive** functions and implement in C/C++ to perform the above problem. (4pts)
- Calculate the complexity of your algorithm. Justify the answer (comment directly in your source files). (2pts)

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