Control Flow - Loop Statements

CSC10012 - Fundamentals of Programming

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Prepare your submission

1. **For multiple-choice and essay questions**: Present your work to the PDF file whose name is ⟨StudentID⟩.pdf, where StudentID is your student number. The following guide you how to treat with different types of questions
   - Single-choice questions: Each choice is indicated by the circle ◯. Pick the most correct choice and explain for every other choice (i.e., why you did not choose it)
   - Multiple-choice questions: Each choice is indicated by the square ☐ Pick one or many correct choices and explain for every other choice
   - Essay questions: Give a comprehensive answer that covers all aspects of the problem
2. **For C/C++ programming questions**: Present your source codes in C/C++. Do not use any additional libraries/open sources without permission
   - Prepare a separate folder for each question. Name the folder as ⟨StudentID_⟩⟨i⟩ where StudentID is your student number and i is the question index. For example, 24120001_1, 24120001_2, etc.
   - Put all corresponding files (i.e., files of extensions *.cpp, *.h, and data files, etc.) to each folder. Do not include the intermediate files generated by the Visual Studio compiler. Do not include the execution files since they are easily affected by viruses.
   - Programming questions sometimes require brief explanation. In those cases, present your arguments to the report file described above.
3. Solutions for multiple-choice and essay questions will be provided after the submission deadlines, while for programming questions, solutions can be alternatively algorithms or C/C++ source codes.
4. Assignment will have too many questions. Don't worry about this. Please complete as many questions as you can.
5. Students contact TA through Moodle forum or email (Mr. Le Nhut Nam: lnnam@fit...).

1 Programming questions (10pts)

2.1. Write a program to receive two integer numbers, M and N, and calculate the product of M and N. You must not use the * operator or any supporting library for multiplication.

Test Data:

Input the two numbers: 3 5

Expected output:

The product is 15

2.2. Write a program to check whether a given positive integer number is a perfect number. Knowing that a perfect number is a positive integer that is equal to the sum of its positive divisors, excluding the number itself, for instance, 6 has divisors 1, 2 and 3 (excluding itself), and 1 + 2 + 3 = 6, so 6 is a perfect number.

Test Data:

Input a number: 6

Expected output:

6 is a perfect number.

2.3. Each new term in the Fibonacci sequence is generated by adding the previous two terms. By starting with 1 and 2, the first 10 terms will be:

$$1, 2, 3, 5, 8, 13, 31, 34, 55, 89, \ldots$$

.By considering the terms in the Fibonacci sequence whose values do not exceed four million, find the sum of the even-valued terms.

Expected output:

4613732

2.4 The prime factors of 13195 are $5, 7, 13$ and 29. What is the largest prime factor of the number 600851475143.

Expected output:

6857

2.5 Pentagonal numbers are generated by the formula, $P_n = n(3n-1)/2$. The first ten pentagonal numbers are:

$$1, 5, 12, 22, 35, 51, 70, 92, 117, 145, \ldots$$

It can be seen that $P_4 + P_7 = 22 + 70 = 92 = P_8$. However, their difference, $70 - 22 = 48$, is not pentagonal. Find the pair of pentagonal numbers, P_j and P_k, for which their sum and difference are pentagonal and $D = |P_k - P_j|$ is minimised; what is the value of D?

Expected output:

5482660

2.6 A happy number is a number defined by the following process:

- Starting with any positive integer, replace the number by the sum of the squares of its digits.
- Repeat the process until the number equals 1 (where it will stay), or it loops endlessly in a cycle which does not include 1.
- Those numbers for which this process ends in 1 are happy.

With given a number $n(1 \leq n \leq 2^{31} - 1)$, print "yes" if it is a happy number, and print "no" otherwise.