Quiz 1: MT3164: Numerical Analysis

10:00 am to 10:50 am on 22^{nd} August, 2025

The documents contain series of instructions, questions, and skeleton of the problem. Do not change the input format.

The commands assumes that your enrollment number is 20301234.
Please change 20301234 to your enrollment number.

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1. (a) Open Visual Studio Code (or some other editor) to create a new file `20301234-q1p1.py` and save it on Desktop. Write a python program to solve the following question.

   (b) **Collatz Conjecture Sequence** Consider an algorithm that takes as input a positive integer n. If n is even, the algorithm divides it by two, and if n is odd, the algorithm multiplies it by three and adds one. The algorithm repeats this, until n is one. For example, the sequence for $n = 3$ is as follows:

   $$3 \to 10 \to 5 \to 16 \to 8 \to 4 \to 2 \to 1$$

   Define $\psi(n)$ is the number of steps it takes for the algorithm to start at n and end at 1. For example, $\psi(3) = 7$.

   Write a program that takes as input an integer n and your name and roll number in the first line and $\psi(n)$ in the next line.

   (c) To obtain a sample input, run the following command.

   ```
   cp /nfscommon/common/prafullkumar/public/input-q1p1.txt ./
   ```

   (d) Following is a skeleton of the problem.

   ```
   1
   2  def collatz(n):
   3      // Write your function here.
   4
   5
   6  n = int(input())
   7
   8  print("20301234 \t Alan Turing")
   9  # Replace 20301234 by your roll number and 'Alan Turing' by your
         name.
   10 collatz(n)
   ```

   (e) Check the output of your program using the following command.

   ```
   python3 20301234-q1p1.py < input-q1p1.txt
   ```

   (f) Show your working code to the instructor.

   (g) Submit the solutions only if you are confident with it. **You are only allowed to submit code once**. Use the following command for submission.

   ```
   /nfscommon/common/prafullkumar/submit 20301234-q1p1.py
   ```

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2. (a) Open Visual Studio Code (or some other editor) to create a new file 20301234-q1p2.py and save it on Desktop. Write a python program to solve the following question.

   (b) Write a program that takes as input an integer M and float values x_0, δ, ϵ and computes a 'reasonable' root of the following function using Newton-Raphson method.

$$f(x) = (x-1)^3.$$

   Input: M, x_0, δ, ϵ
   Output: Your name and roll number in the first line. Next, print the number of iterations so far and the corresponding approximation of the root, in each line.

   (c) To obtain a sample input, run the following command.

   `cp /nfscommon/common/prafullkumar/public/input-q1p2.txt ./`

   (d) Following is a skeleton of the problem.

```
1
2  def netwon_raphson(M, x0, delta, epsilon):
3      // Write your function here.
4
5
6  M = int(input())
7  x0 = float(input())
8  delta = float(input())
9  epsilon = float(input())
10
11 print("20301234 \t Alan Turing")
12 # Replace 20301234 by your roll number and 'Alan Turing' by your
       name.
13 netwon_raphson(M, x0, delta, epsilon)
```

   (e) Check the output of your program using the following command.

   `python3 20301234-q1p2.py < input-q1p2.txt`

   (f) Show your working code to the instructor.

   (g) Submit the solutions only if you are confident with it. **You are only allowed to submit code once**. Use the following command for submission.

   `/nfscommon/common/prafullkumar/submit 20301234-q1p2.py`

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3. (a) Open Visual Studio Code (or some other editor) to create a new file 20301234-q1p3.py and save it on Desktop. Write a python program to solve the following question.

   (b) Write a program that takes as input an integer M and float values x_0, δ, ϵ and computes a 'reasonable' root of the following function using Newton-Raphson method.

$$f(x) = 2x^4 + 24x^3 + 61x^2 - 16x + 1.$$

   Input: $M, x_0, x_1, \delta, \epsilon$
   Output: Your name and roll number in the first line. Next, print the number of iterations so far and the corresponding approximation of the root, in each line.

   (c) To obtain a sample input, run the following command.

   ```
   cp /nfscommon/common/prafullkumar/public/input-q1p3.txt ./
   ```

   (d) Following is a skeleton of the problem.

```
1
2  def secant_method(M, x0, x1 delta, epsilon):
3      // Write your function here.
4
5
6  M = int(input())
7  x0 = float(input())
8  x1 = float(input())
9  delta = float(input())
10 epsilon = float(input())
11
12 print("20301234 \t Alan Turing")
13 # Replace 20301234- by your roll number and 'Alan Turing' by your
       name.
14 secant_method(M, x0, x1, delta, epsilon)
```

   (e) Check the output of your program using the following command.

   ```
   python3 20301234-q1p3.py < input-q1p3.txt
   ```

   (f) Show your working code to the instructor.

   (g) Submit the solutions only if you are confident with it. **You are only allowed to submit code once**. Use the following command for submission.

   ```
   /nfscommon/common/prafullkumar/submit 20301234-q1p3.py
   ```
