

UNIVERSITY OF NOTRE DAME
Aerospace and Mechanical Engineering

**AME 20314: Introduction to Engineering Computing
First Exam**

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October 7-10, 2008

NAME: _____

COURSE WEB PAGE LOGIN NAME: _____

- Do not start until instructed to do so.
 - You have 60 minutes to complete this exam.
 - This is an open book exam. You may consult the course text and your course notes, but nothing else.
 - You may **not** run any computer programs other than the editor you use to write the program and the compiler. After you have finished the exam, you may start a web browser to upload your programs.
 - Your grade on this exam will constitute 20% of your total grade for the course.
 - Problem 1 is worth 100 points.
 - Problem 2 is optional and is worth 10 points extra credit.
 - When you are finished, upload your program(s) to the course web page. Be sure to name it “prog1.f”, “prog2.f” *etc.*
 - You may not discuss this exam with anyone other than the instructor until after 5:30pm Friday, October 10, 2008.
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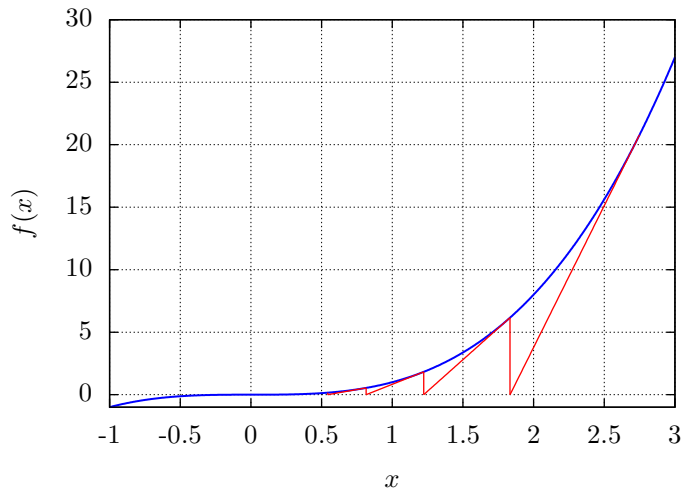


Figure 1. Newton's method to find where $f(x) = x^3$ is equal to zero with initial guess of $x = 2.75$.

Both problems are to use Newton's method to find where a function is equal to zero. The formula for Newton's method is

$$x_{n+1} = x_n - \frac{f(x_n)}{f'(x_n)}.$$

The idea behind it is illustrated in Figure 1. In that example the function $f(x) = x^3$, and the initial guess was $x_1 = 2.75$. Using the formula, $x_2 \approx 1.833$, $x_3 \approx 1.25$ etc.

1. Write a FORTRAN program to find where the function

$$f(x) = x^3 \cos(x) - 1$$

is equal to zero.

The program should:

- (a) prompt the user for the initial guess for x ;
- (b) stop iterating when the difference between two successive values computed for x is less than 10^{-4} or if the number of iterations has exceeded 25;
- (c) print the value computed and the number of iterations used to compute it or a message saying that the program quit because too many iterations was required; and,
- (d) if it prints the value it should do so with the correct precision, *i.e.*, it should print the proper number of digits in the answer.

After your program is running, use it to fill in the following blanks.

Initial guess	computed answer	steps required
1		
-1		
0.01		
-0.01		

2. This problem optional and is worth 10 points *extra credit*. Modify your program to allow the user to specify both the precision and maximum number of iterations. Be sure the answer is printed with the correct precision.