

1. Please answer two of the following questions:

- (i) Write or modify a computer program to implement Newton's method and use it to approximate the solution to  $x^3 = \cos x$  starting with an initial guess of  $x_0 = 1$ . Print the first 5 iterations of the method.
- (ii) Write or modify a computer program to implement Mueller's method and use it to approximate the solution to  $1 + z + z^2 + z^3 + z^4 = 0$  starting with an initial guess of  $p_0 = 1$ ,  $p_1 = 2$  and  $p_2 = 3$ . Print the first 6 iterations of the method, or in other words print  $p_n$  for  $n = 3, \dots, 8$ .
- (iii) Write or modify a computer program to compute the Frobenious norm

$$\|A\|_F = \sqrt{\sum_{i,j} |A_{ij}|^2}$$

of the  $4 \times 4$  matrix  $A$  with entries given by the formula  $A_{ij} = \sqrt{i + 2j}$ .

- (iv) Consider the approximation

$$f''(x) \approx \frac{f(x+h) - 2f(x) + f(x-h)}{h^2}.$$

Let  $f(x) = \sin(x^2)$ . Write or modify a computer program to create a table showing the approximation and the errors in the approximation when  $x = 2$  and  $h = 2^{-n}$  for  $n = 0, 1, \dots, 30$ .

- 2. [Extra Credit and Math/CS 666] Compute the spectral norm of the matrix appearing in problem (iii). All necessary source code should be combined into one file.

Submit your program and output using the commands

```
$ submit -q1 prog1.c
$ submit -q2 output1.txt
$ submit -q3 prog2.c
$ submit -q4 output2.txt
```

Here `prog1.c` and `prog2.c` are the programs answering the two questions selected above and `output1.txt` and `output2.txt` are the respective outputs of those programs. In general the output may be obtained by compiling and running the program as

```
$ gcc -std=gnu99 -o prog1 prog1.c -lm
$ ./prog1 >output1.txt
```

Submit the extra-credit problem using

```
$ submit -q5 prog3.c
$ submit -q6 output3.txt
```

If you wish to change any part of your submission simply retype the appropriate submit command again. You may check each of your submissions with the command

```
$ submit -pn
```

where `n` is equal the number used in submit command.