

CS319: Scientific Computing (with MATLAB)

Class Test (29 March)

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Week 12: **4pm**, 29 March 2023

Answer all 5 questions. Prepare your answers as a single “live” script. Ask for assistance if you have trouble doing that.

Each question would be in a separate “section” of the script. Any functions you write should be contained in an section at the end script.

Upload your solutions to the Class test section of Blackboard by 16.45, and before you leave the lab. You may resubmit your solutions anytime, and any number of times, until the deadline.

until the deadline. Only your final upload will be graded.

During the test, you make use any resources

- ▶ on the CS319 Blackboard site or <https://www.niallmadden.ie/2223-CS319/>
- ▶ in the repository at <https://bitbucket.org/niallmadden/2223-cs319/src/main/>
- ▶ MATLAB documentation, or anything on the Mathworks website:
<https://www.mathworks.com/>

Q1. In the first section of the live script,

- ▶ Give a title for the document
- ▶ Give your name, ID number and email address, each as a separate bullet point. Write your name in **bold**, your ID number in *italic*, and email address in `mono-space`
- ▶ Add a table of contents to this section.

Every other question your answer should in a separate section, each with a title that is formatted as “Heading 1”.

Q2. Write a recursive (file) function called *MyNchooseK* that takes a two integer arguments, *n* and *k*, and returns $\binom{n}{k}$, using the algorithm:

- ▶ If $k = 0$ or $k = n$, then $\binom{n}{k} = 1$ for any $n \geq 0$;
- ▶ $\binom{n}{k} = \binom{n-1}{k-1} + \binom{n-1}{k}$

In your script file, verify that the function works by using a `for`-loop to

check that $\binom{6}{0} + \binom{6}{1} + \binom{6}{2} + \cdots + \binom{6}{6} = 2^6$.

- Q3. (a) Download the MATLAB data file `Q1data.mat` from Blackboard (Class Test... Class Test 29 March 2023). It contains two arrays, `x_data` and `y_data`. Load its contents into MATLAB.
- (b) Create a quadratic least-squares fit to the data.
- (c) Plot the data, and the values of quadratic fit in a graph so that resembles, as closely as possible the image in Figure 1.

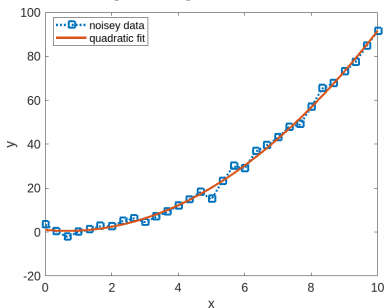


Figure 1: Figure for Q1

Q4. Make two 5×5 matrices, A and B , such that

$$a_{i,j} = b_{i,j} = \begin{cases} 1 & i = j + 1 \\ -1 & i = j - 1 \\ 0 & \text{otherwise} \end{cases},$$

but A is `sparse` while B is full.

How many bytes are required to store each of A and B ? (Give your answer to this as text in the Live Script).

- Q5. (a) Show how to define the anonymous function $f(x) = x^3 \sin(x)$.
(b) Use `fplot()` to plot f on the interval $(0, \pi)$. (Hint, in MATLAB, the constant `pi` is a good approximation to π).
(c) Find out how to use the `integral()` function. Use it to estimate

$$\int_0^{\pi} f(x) dx.$$