

**Instructions:**

You may use the official course text, your own notes taken in class, and any resources Dr. Barker has made available on BYU Learning Suite. You may use your own homework assignments. You may use Python code you do from scratch to explore ideas. You may not talk with anyone about the exam other than Dr. Barker. You may not use the internet. Please do not talk to classmates about the exam until the exams have been returned to all. **This exam is due at 10:00pm on Thursday, October 27th, 2022.** Please turn it in on Gradescope as an uploaded PDF.

**Sign the following in order to get credit:**

I have not given or received any unauthorized assistance on this exam.

**SIGNATURE:**(5 points)\_\_\_\_\_

1. Let  $n \in \mathbb{N}$ , and let  $x \in \mathbb{R}^n$ . Assume the existence of a square root function satisfying  $\text{fl}(\sqrt{x}) = \sqrt{x}(1 + \epsilon)$  with  $|\epsilon| \leq \varepsilon_{\text{machine}}$ .
  - (a) (5 points) Describe a backward stable algorithm for computing  $\|x\|_2$ .
  - (b) (10 points) Show that your algorithm is backward stable.
2. A matrix  $A$  is called *strictly column diagonally dominant*, if

$$|a_{ii}| > \sum_{j=1, j \neq i}^n |a_{ji}|.$$

- (a) (15 points) Show that  $A$  is nonsingular.
- (b) (15 points) Show that Gaussian elimination with partial pivoting does not actually permute any rows, i.e. that it is identical to Gaussian elimination without pivoting.