

Math 230 — Hour Exam 2

November 19, 2014

General Directions. This is an open-book, open-notes, open-computer test. However, you may not communicate with any person, except me, during the test. You have the full class period (50 minutes) in which to do the test. Put your answer to each question in the space provided (use the backs of pages if you need more space). Be sure to **show your work!** I give partial credit for incorrect answers if you show correct steps leading up to them; conversely, I do not give full credit even for correct answers if it is not clear that you understand where those answers come from. Good luck.

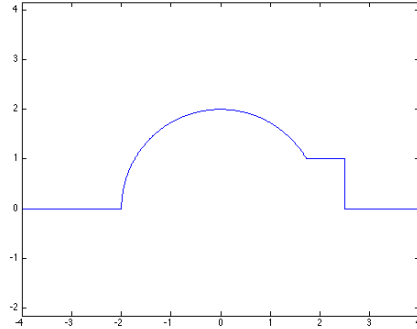
This test contains 4 questions on 4 pages.

Question 1 (10 Points). Imagine that there is a Matlab function **noVectors(x)** that does not vectorize, i.e., it only works if x is a single number. Nonetheless, you have a vector **V** and want to create another vector **W** containing the result of **noVectors** applied to each element of **V**—in other words, you want the i^{th} element of **W** to be the result of calling **noVectors** on the i^{th} element of **V**. Write a Matlab “for” loop that does this.

Question 2 (15 Points). Define the “igloo” function, I , to be the following piecewise function:

$$\begin{aligned} I(x) &= \sqrt{4 - x^2} \text{ if } -2 \leq x \leq \sqrt{3} \\ I(x) &= 1 \text{ if } \sqrt{3} < x \leq 2.5 \\ I(x) &= 0 \text{ otherwise} \end{aligned}$$

I call this the “igloo” function because when plotted it looks a little bit like an igloo:



Write a Matlab function “igloo” that computes the value of $I(x)$ for any Matlab-representable real number x .

Question 3 (15 Points). Consider the following problem: given a positive real number, x , how many times can you take the square root of the square root of the square root ... etc. of x before you get a number less than 2? For example, if $x = 3$ the answer is 1, because $\sqrt{3} = 1.732$ which is less than 2. On the other hand, if $x = 9$ the answer is 2, because $\sqrt{9} = 3$ which is bigger than 2, but $\sqrt{(\sqrt{9})}$ is less than 2, and the answer for $x = 100$ is 3. For values of x less than 2, e.g., $x = 1$, the answer is 0.

Write a Matlab function that takes x as its argument and that returns the answer to the above problem for x (i.e., returns the number of times you can take the square root of the square root ... of x before the result is less than 2). You may assume without checking that x is a positive real number.

Question 4 (10 Points). Suppose you want to use the bisection method on the interval $[0, 3/2]$ with the function

$$\begin{aligned} f(x) &= -1 \text{ if } x < 1 \\ f(x) &= 1 \text{ if } x > 1 \end{aligned}$$

Notice that f does not meet the requirement that functions used with bisection be continuous on the interval within which you expect to find a zero. Explain in a couple of sentences what bisection will converge towards as an “answer” in this case and why.