You are taking "Exam (Timed, No Correctness Feedback)" as a timed exam. Show more

End My Exam 43:39:37

Previous Next

10. Directional derivative

Bookmark this page

Calculator Hide Notes

Problem Set A due Aug 18, 2021 20:30 IST Completed

2A-14

5.0/5 points (graded)

Consider the function $g(t,x) = \sin^2(t-x)$, with a given point $P = (\pi/4, 0)$.

(a) Find the maximum and minimum values of $D_{\hat{u}} g(P)$, as $\hat{u}$ varies.

Max: sqrt(2) ✔ **Answer:** sqrt(2)

Min: -sqrt(2) ✔ **Answer:** -sqrt(2)

(b) Give the directions the maximum and minimum occur.

(Directions should be given as a unit vector using square brackets; e.g. `[1,0]` .)

Max direction: [1/sqrt(2),-1/sqrt(2)] ✔ **Answer:** [1/sqrt(2),-1/sqrt(2)]

Min direction: [-1/sqrt(2),1/sqrt(2)] ✔ **Answer:** [-1/sqrt(2),1/sqrt(2)]

(c) Find the direction(s) $\hat{u}$ for which $D_{\hat{u}} g = 0$.

(Directions should be given as a unit vector using square brackets; e.g. `[1,0]` . Separate more than one direction using a semicolon; e.g. `[1,0]; [0,1]` .)

[1/sqrt(2),1/sqrt(2)];[-1/sqrt(2) ✔ **Answer:** [1/sqrt(2),1/sqrt(2)];[-1/sqrt(2),-1/sqrt(2)]

? INPUT HELP

Solution:

(a) The maximum will be in the direction of the gradient:

$$\frac{\nabla g(\pi/4,0) \cdot \nabla g(\pi/4,0)}{|\nabla g(\pi/4,0)|}$$

The minimum will be in the opposite direction of the gradient.

$$\frac{-\nabla g(\pi/4,0) \cdot \nabla g(\pi/4,0)}{|\nabla g(\pi/4,0)|}$$

(b) The maximum occurs in the direction $\nabla g(\pi/4, 0)$. The minimum in the direction $-\nabla g(\pi/4, 0)$.

(c) The gradient is normal to the level curves, thus the tangent to the curve is normal to the gradient. Hence the unit vector normal to the gradient is found by solving the formula

$$\vec{v} \cdot \nabla g(\pi/4, 0) = 0$$

Submit You have used 0 of 9 attempts

Calculator Hide Notes

Submit You have used 0 of 9 attempts

Answers are displayed within the problem

2A-15

4.0/4 points (graded)

Suppose that Larry is hiking on a hilly landscape. At the point (x, y), the height of the landscape is $h(x, y) = xy$. The quantities x, y and $h(x, y)$ are all measured in meters.

a) Larry starts at $(2, 1)$ and walks in a straight line to $(0, 3)$. As he starts walking, he is going:

- (●) uphill
- ( ) downhill
- ( ) neither

✔

b) The slope (rise over run) at the moment he starts walking is

1/sqrt(2) ✔ **Answer:** 1/sqrt(2)

c) Find a unit vector $\hat{u}$ which is tangent to the level curve of h at height 2 at the point $(2, 1)$.

[-2/sqrt(5),1/sqrt(5)] ✔ **Answer:** (1/sqrt(5))*[2,-1]

d) Let $\hat{u}$ be the vector from part c). Compute $D_{\hat{u}} h(2, 1)$,

0 ✔ **Answer:** 0

? INPUT HELP

Solution:

The slope of the function in the direction Larry is walking is given by the directional derivative pointing in the direction $\langle 0 - 2, 3 - 1 \rangle = \langle -2, 2 \rangle$. This is given by

$$\nabla h(2, 1) \cdot \langle \frac{-1}{\sqrt{2}}, \frac{1}{\sqrt{2}} \rangle = \langle 1, 2 \rangle \cdot \langle \frac{-1}{\sqrt{2}}, \frac{1}{\sqrt{2}} \rangle = \frac{1}{\sqrt{2}}$$

Thus the slope is positive, so Larry is walking uphill.

The gradient, which is normal to the level curve is $\langle 1, 2 \rangle$ at the point $(2, 1)$. Therefore the tangent is normal to this, which is $\langle 2, -1 \rangle$. We divide by the length to make it a unit vector. The directional derivative tangent to a level curve is always 0.

Submit You have used 1 of 5 attempts

Answers are displayed within the problem

Calculator Hide Notes

10. Directional derivative

10. Directional derivative

Hide Discussion

Topic: Unit 2: Geometry of Derivatives / 10. Directional derivative

Add a Post

Show all posts by recent activity

?	[Staff] A request for extension. Hi Staff, I am requesting for an extension till the end of day today. I got stuck with some concepts and need a few more hours to co...	1
💬	2A-14 Hey guys, I've been thinking and I still don't understand what they mean with: as hatu varies. I already know the value of the gradien...	3
💬	confused with 2A-15 In part a, Larry starts at a point with 2 positive integers, so h(x, y) is positive. At the end of his hike he's at a point where one of the c...	1
?	[Staff] 2A-14 C partially correct I think the question is still bugged. My answer is marked "partially correct" although I based it on the normal vector I found in the par...	2
?	[Staff] Problem with grader in question 2A-14. Could someone in the staff please check my answers for question 2A-14. I am certain of the results but I am still getting my answers...	3
💬	Typo in 2A-14 (C) Solution > Hence the unit vector normal to the **level curve** is found by solving > the formula I think the author meant **gradient** not **le...	3
?	[Staff] Possible typo in 2A-15 Solution states that slope is negative, but calculated result is positive	4
💬	[Staff] Directions with zero directional derivative	17
💬	Rise over run seems a bad question The rise over run question looks to me useless, because the answer should be negative ,we start at height 2 and end up at height 0,...	3
☑	rise over run Just to point out that the term RISE OVER RUN is a bit confusing. In general rise over run is the slope between two points (the slope ...	2
☑	Direction where derivative is zero for 10. 2A-14, part c, I took the maximum from part b, swapped the x & y, and negated one. There are two directions, each the negat...	9
💬	staff: Please review grader for 2A-14(c) again Something is terribly wrong. This seems to be an easy problem and there seems to be a straightforward solution. Yet the grader is m...	3

‹ Previous

Next Up: Problem Set 2B ›
1 min + 5 activities

Calculator Hide Notes

edX

About
Affiliates
edX for Business
Open edX
Careers
News

Legal

Terms of Service & Honor Code
Privacy Policy
Accessibility Policy
Trademark Policy
Sitemap

Connect

Blog
Contact Us
Help Center
Media Kit
Donate

Calculator Hide Notes