5.2.3 Exam: Multi-dimensional gradient descent question

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Exams due Sep 27, 2023 05:00 IST Completed

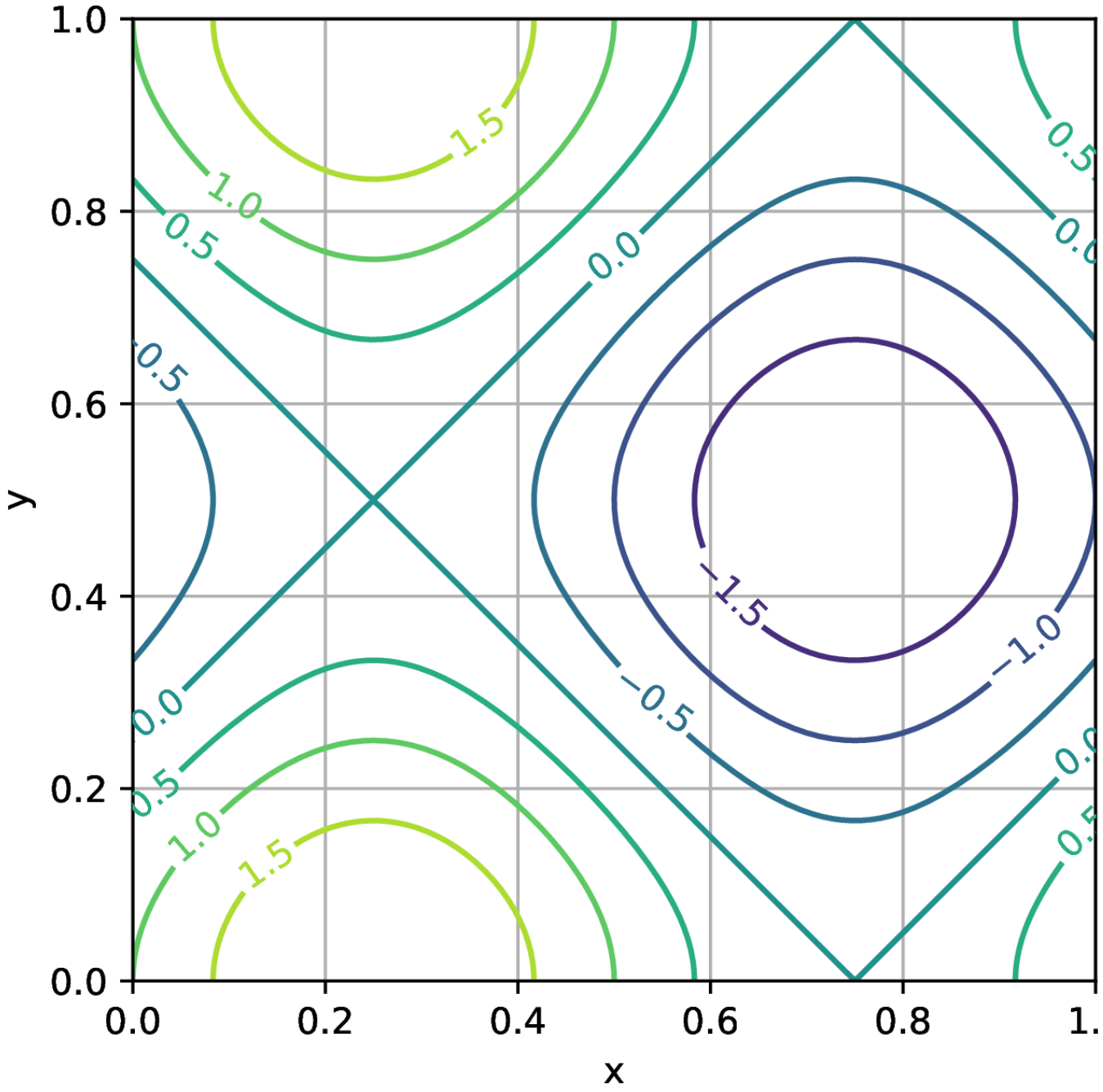
Consider the function

$$J(x, y) = \sin(2\pi x) + \cos(2\pi y) \tag{5.28}$$

with partial derivatives given by:

$$\frac{\partial J}{\partial x} = 2\pi \cos(2\pi x) \qquad \frac{\partial J}{\partial y} = -2\pi \sin(2\pi y) \tag{5.29}$$

A contour plot of this function in the unit square $[0, 1]^2$ is given here:



Problem: Interpreting the gradient

1.0/1.0 point (graded)

Consider $\nabla J(0.6, 0.2)$, the gradient of J at the point $(x, y) = (0.6, 0.2)$. We describe the positive unit y direction as "Up", the negative unit y direction as "Down", the positive unit x direction as "Right", and the negative unit x direction "Left".

In which direction is the gradient of J oriented at the given point?

- Up and to the Right
- Up and to the Left
- Down and to the Right

- Down and to the Left ✔

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Problem: Computing a gradient descent step

2/2 points (graded)

Compute $x^{(1)}, y^{(1)}$, the point reached after performing one iteration of gradient descent with a step size $\alpha = 0.02$, and a starting point given by $(x^{(0)}, y^{(0)}) = (0.6, 0.2)$.

What is the value of $x^{(1)}$? Enter your answer as a float, to two significant digits

0.70166407 ✔ Answer: 0.7017

What is the value of $y^{(1)}$? Enter your answer as a float, to two significant digits

0.31951329 ✔ Answer: 0.3195

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Problem: Expected behavior after many steps

1/1 point (graded)

If we run the gradient descent algorithm with sufficiently small step size (like $\alpha = 0.02$), and for sufficiently many steps (like $N = 100$), starting from $(x^{(0)}, y^{(0)}) = (0.6, 0.2)$, what should we expect to observe?

- Convergence to $(0.25, 0.0)$
- Convergence to $(0.25, 0.5)$
- Convergence to $(0.75, 0.5)$ ✔
- Convergence to some other point inside the unit square
- Convergence to some other point outside the unit square
- Divergence (no convergence to any point)

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