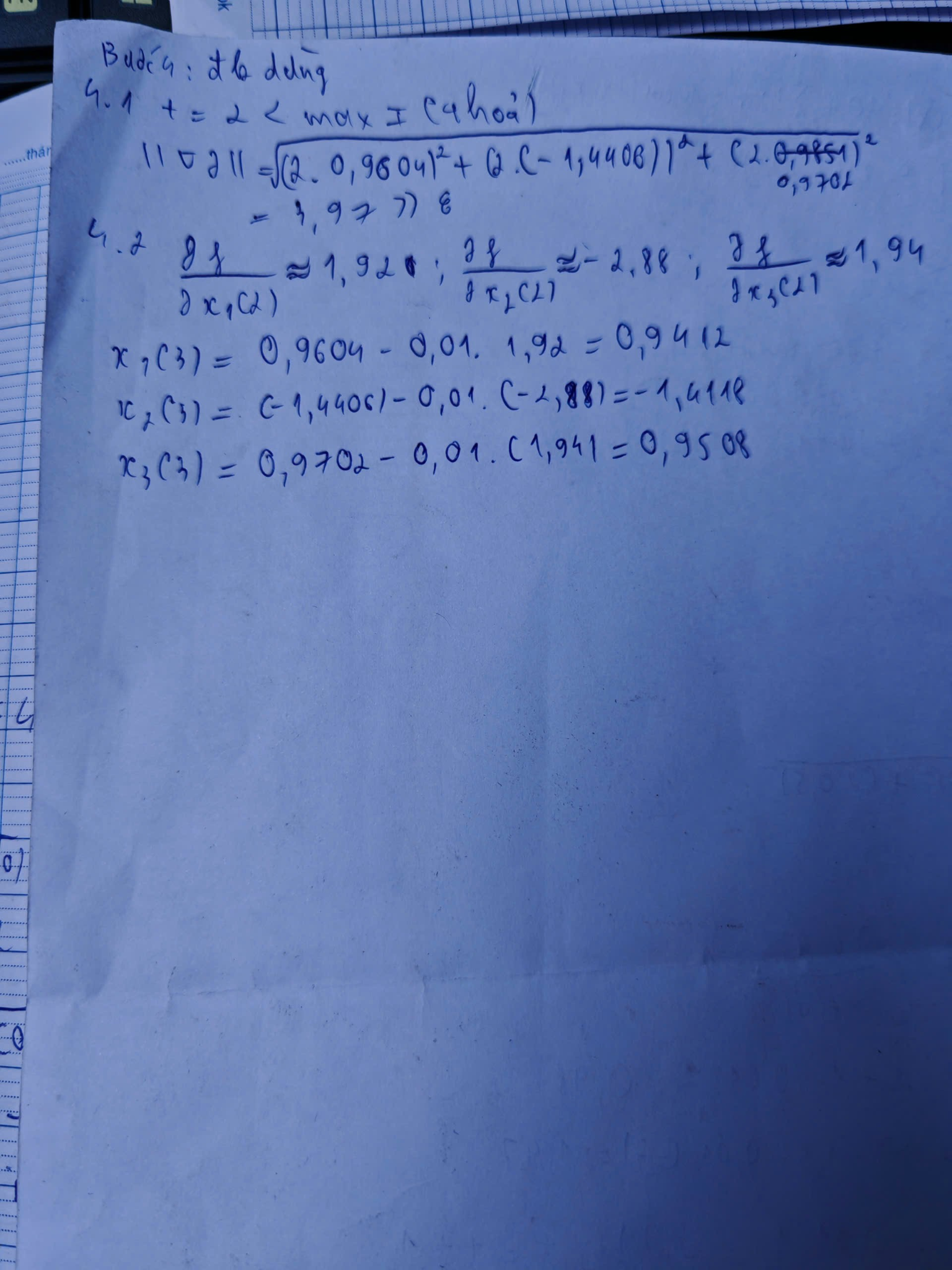
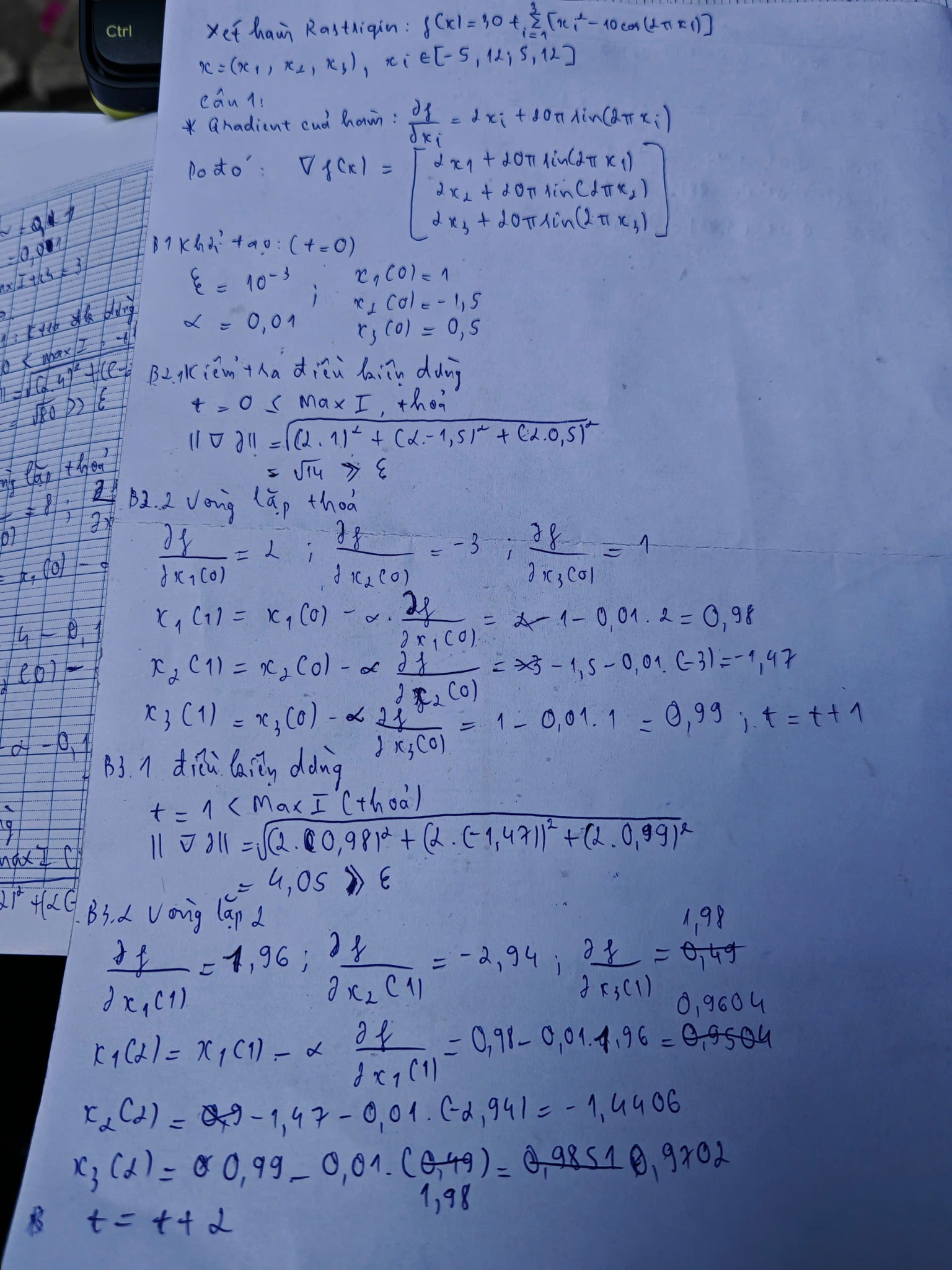
**Bài Tập 1: Gradient Descent**

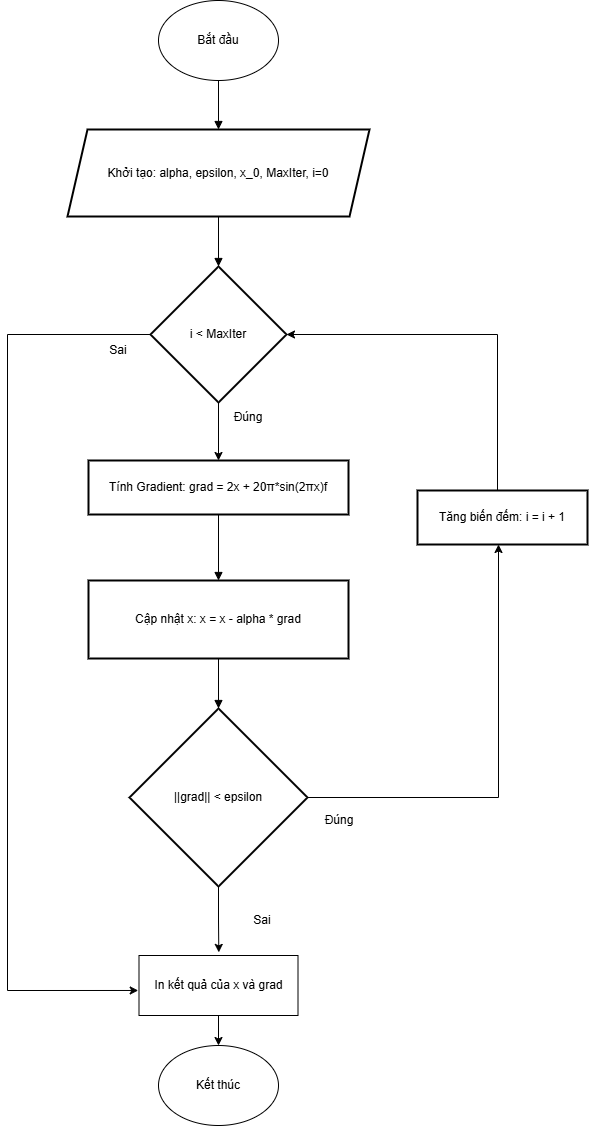
**Bài 1:**

Giải tay trên giấy



**Bài 2:**

Vẽ lưu đồ của thuật toán Gradient Descent để tối ưu hàm Rastrigin

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**Bài 3:**

import numpy as np

toc\_do\_hoc = 0.01

sai\_so\_cho\_phep = 1e-3

chay\_toi\_da = 1000

so\_lan\_thu = 20

so\_bien = 3

vung\_gia\_tri = [-5.12, 5.12]

def tinh\_ham\_so(x):

return 30 + np.sum(x\*\*2 - 10 \* np.cos(2 \* np.pi \* x))

def tinh\_dao\_ham(x):

return 2 \* x + 20 \* np.pi \* np.sin(2 \* np.pi \* x)

danh\_sach\_kq = []

for lan in range(so\_lan\_thu):

x = np.random.uniform(vung\_gia\_tri[0], vung\_gia\_tri[1], so\_bien)

for vong in range(chay\_toi\_da):

grad = tinh\_dao\_ham(x)

x\_moi = x - toc\_do\_hoc \* grad

if np.linalg.norm(grad) < sai\_so\_cho\_phep:

x = x\_moi

break

x = x\_moi

kq\_cuoi = tinh\_ham\_so(x)

danh\_sach\_kq.append(kq\_cuoi)

print(f"Lan {lan+1}: {kq\_cuoi:.4f}")

mang\_so = np.array(danh\_sach\_kq)

print(f"Nho nhat (Min): {np.min(mang\_so):.4f}")

print(f"Lon nhat (Max): {np.max(mang\_so):.4f}")

print(f"Trung binh (Mean): {np.mean(mang\_so):.4f}")

print(f"Do lech (Std): {np.std(mang\_so):.4f}")

**Bài 4:**import numpy as np

import matplotlib.pyplot as plt

toc\_do\_hoc = 0.01

sai\_so\_cho\_phep = 1e-3

chay\_toi\_da = 1000

so\_lan\_thu = 20

so\_bien = 3

vung\_gia\_tri = [-5.12, 5.12]

def tinh\_ham\_so(x):

return 30 + np.sum(x\*\*2 - 10 \* np.cos(2 \* np.pi \* x))

def tinh\_dao\_ham(x):

return 2 \* x + 20 \* np.pi \* np.sin(2 \* np.pi \* x)

danh\_sach\_kq = []

lich\_su\_tot\_nhat = []

kq\_tot\_nhat = float('inf')

print(f"Dang thuc hien {so\_lan\_thu} lan chay thu nghiem...")

for lan in range(so\_lan\_thu):

x = np.random.uniform(vung\_gia\_tri[0], vung\_gia\_tri[1], so\_bien)

lich\_su\_hien\_tai = []

for vong in range(chay\_toi\_da):

val = tinh\_ham\_so(x)

lich\_su\_hien\_tai.append(val)

grad = tinh\_dao\_ham(x)

x\_moi = x - toc\_do\_hoc \* grad

if np.linalg.norm(grad) < sai\_so\_cho\_phep:

x = x\_moi

break

x = x\_moi

kq\_cuoi = tinh\_ham\_so(x)

danh\_sach\_kq.append(kq\_cuoi)

if kq\_cuoi < kq\_tot\_nhat:

kq\_tot\_nhat = kq\_cuoi

lich\_su\_tot\_nhat = lich\_su\_hien\_tai

print(f"Lan {lan+1}: {kq\_cuoi:.4f}")

plt.figure(figsize=(10, 6))

plt.plot(lich\_su\_tot\_nhat, color='blue', linewidth=2)

plt.title('Qua trinh hoi tu')

plt.xlabel('So vong lap')

plt.ylabel('Gia tri f(x)')

plt.grid(True)

plt.savefig('bieudo.png')

plt.show()

