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import numpy as np
import time

def matricesegalesmodn(m1,m2,n):
    if ((m1[0,0]%n) == (m2[0,0]%n)) and ((m1[1,0]%n) == (m2[1,0]%n)) and
    ((m1[0,1]%n) == (m2[0,1]%n)) and ((m1[1,1]%n) == (m2[1,1]%n)):
        return True
    else:
        return False

def matmodn(m,n):
    return(np.array([[m[0,0]%n,m[0,1]%n],[m[1,0]%n,m[1,1]%n]],dtype='int'))

tic = time.time()
n = 13
mat = np.zeros(((n-1)*n,2,2),dtype='int')
raccub = [1]
for x in range(2,n):
    if (x*x*x)%n == 1:
        raccub.append(x)
print('les racines cubiques sont ',raccub)
indice = 0
for x in range(1,n):
    for y in range(n):
        mat[indice] = np.array([[x,y],[0,1]], dtype='int')
        indice = indice+1
print(n,'::: les fgh')
lesfgh = np.zeros((((n-1)*n)**3,3,2,2),dtype = 'int')
indice = 0
for a1 in range(2,n):
    for b1 in range(n):
        f = np.array([[a1,b1],[0,1]])
        for a2 in range(2,n):
            for b2 in range(n):
                g = np.array([[a2,b2],[0,1]])
                for a3 in range(2,n):
                    for b3 in range(n):
                        h = np.array([[a3,b3],[0,1]])
                        lesfgh[indice,0] = f
                        lesfgh[indice,1] = g
                        lesfgh[indice,2] = h
                        indice = indice+1
print('indice = ',indice)
compteverif = 0
for k in range(indice):
    f = lesfgh[k,0]
    g = lesfgh[k,1]
    h = lesfgh[k,2]
    fg = matmodn(f @ g, n)
    gh = matmodn(g @ h, n)
    hf = matmodn(h @ f, n)
    #print('f = ',f)
    #print('g = ',g)
    #print('h = ',h)
    #print('fg = ',fg)
    #print('gh = ',gh)
    #print('hf = ',hf)
    if matricesegalesmodn(f@g@h, np.array([[raccub[1],0],[0,1]]),n):
        if matricesegalesmodn(f@f@g@g@g@h@h@h, np.array([[1,0],[0,1]]),n):
            if not matricesegalesmodn(f@g@h,np.array([[1,0],[0,1]]),n) and not
matricesegalesmodn(f,np.array([[1,0],[0,1]]),n) and not
matricesegalesmodn(g,np.array([[1,0],[0,1]]),n) and not
matricesegalesmodn(h,np.array([[1,0],[0,1]]),n) and not
matricesegalesmodn(fg,np.array([[1,0],[0,1]]),n) and not

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matricesegalesmodn(gh,np.array([[1,0],[0,1]]),n) and not
matricesegalesmodn(hf,np.array([[1,0],[0,1]]),n) :
    ens1 = []
    ens2 = []
    ens3 = []
    y = fg
    for k in range(1,n):
        if y[0,0] != 1:
            if (k*y[0,0]+y[0,1]) %n == k:
                ens1.append(k)
    y = gh
    for k in range(1,n):
        if y[0,0] != 1:
            if (k*y[0,0]+y[0,1]) %n == k:
                ens2.append(k)
    y = hf
    for k in range(1,n):
        if y[0,0] != 1:
            if (k*y[0,0]+y[0,1]) %n == k:
                ens3.append(k)
    for p in ens1:
        for q in ens2:
            for r in ens3:
                t = raccub[1]
                print('\n\nverif numero ',compteverif)
                compteverif = compteverif+1
                print('fg = \n',fg)
                print('gh = \n',gh)
                print('hf = \n',hf)
                print('p = ',p)
                print('q = ',q)
                print('r = ',r)
                print('la racine cubique est ',t)
                print('au carre = ',t*t)
                print('(p.1+q.t+r.t^2 = ',(p+q*t+r*t*t) % n)
    print('nombre de verifications = ',compteverif)
    tac = time.time()
    print(tac-tic,' s.')

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