lab4

June 1, 2021

[85]:
```
#!pip install transformations
from transformations import *
import os
import pandas as pd
from math import *
import numpy as np
```

0.0.1 Read Taula-DH

[ ]:
```
taula = pd.read_csv("taula-DH", sep=',', names=[0,1,2,3])
```

0.0.2 Find 0_T_Clamp

[81]:
```
origin, xaxis, yaxis, zaxis = [0, 0, 0], [1, 0, 0], [0, 1, 0], [0, 0, 1]

Zero_T_Clamp = t.identity_matrix()

for i in range(0,9):
    Zero_T_Clamp = concatenate_matrices(Zero_T_Clamp,
                                        translation_matrix([taula[1][i], 0, 0]),
                                        rotation_matrix(radians(taula[0][i]),␣
 ↪xaxis),
                                        translation_matrix([0, 0, taula[2][i]]),
                                        rotation_matrix(radians(taula[3][i]),␣
 ↪zaxis)
                                        )
Zero_T_Clamp = concatenate_matrices(Zero_T_Clamp, translation_matrix([1.
 ↪56,0,0]))
print(Zero_T_Clamp)
```

```
[[ 0.50001511  0.86601668  0.          13.00005415]
 [-0.86601668  0.50001511  0.          -0.49982159]
 [ 0.          0.          1.           0.        ]
 [ 0.          0.          0.           1.        ]]
```

0.0.3 Find position of Clamp from 0

[101]:
```
Clamp_0 = np.matmul(Zero_T_Clamp, np.array([[0, 0, 0, 1]]).transpose())
Clamp_0
```

[101]:
```
array([[13.00005415],
       [-0.49982159],
       [ 0.        ],
       [ 1.        ]])
```

0.1 Exercise 2

0.0.1 Compute T and D, for each row of Taula-DH

[179]:
```
def compute_T_and_D (taula):

    T = []
    D = []

    for i in range(0,9):
        T.append(concatenate_matrices(translation_matrix([taula[1][i], 0, 0]),
                                      rotation_matrix(radians(taula[0][i]),␣
↪xaxis),
                                      translation_matrix([0, 0, taula[2][i]]),
                                      rotation_matrix(radians(taula[3][i]),␣
↪zaxis)
                                     )
                )
        D.append(np.array([[-np.sin(radians(taula[3][i])), -np.
↪cos(radians(taula[3][i])), 0, 0],
                           [np.cos(radians(taula[0][i]))*np.
↪cos(radians(taula[3][i])), -np.cos(radians(taula[0][i]))*np.
↪sin(radians(taula[3][i])), 0, 0],
                           [np.sin(radians(taula[0][i]))*np.
↪cos(radians(taula[3][i])), -np.sin(radians(taula[0][i]))*np.
↪sin(radians(taula[3][i])), 0, 0],
                           [0,0,0,0]
                          ]))
    #print(T)
    #print(D)
    return T, D

#compute_T_and_D(taula)
```

0.1.2 Compute J

[159]:
```
def compute_J_pseudoInv (T, D):
    DX = []
    T_8_9 = translation_matrix([1.56,0,0])

    DX.append(D[0] @ T[1] @ T[2] @ T[3] @ T[4] @ T[5] @ T[6] @ T[7] @ T[8] @␣
↪T_8_9)
    DX.append(T[0] @ D[1] @ T[2] @ T[3] @ T[4] @ T[5] @ T[6] @ T[7] @ T[8] @␣
↪T_8_9)
    DX.append(T[0] @ T[1] @ D[2] @ T[3] @ T[4] @ T[5] @ T[6] @ T[7] @ T[8] @␣
↪T_8_9)
    DX.append(T[0] @ T[1] @ T[2] @ D[3] @ T[4] @ T[5] @ T[6] @ T[7] @ T[8] @␣
↪T_8_9)
    DX.append(T[0] @ T[1] @ T[2] @ T[3] @ D[4] @ T[5] @ T[6] @ T[7] @ T[8] @␣
↪T_8_9)
    DX.append(T[0] @ T[1] @ T[2] @ T[3] @ T[4] @ D[5] @ T[6] @ T[7] @ T[8] @␣
↪T_8_9)
    DX.append(T[0] @ T[1] @ T[2] @ T[3] @ T[4] @ T[5] @ D[6] @ T[7] @ T[8] @␣
↪T_8_9)
    DX.append(T[0] @ T[1] @ T[2] @ T[3] @ T[4] @ T[5] @ T[6] @ D[7] @ T[8] @␣
↪T_8_9)
    DX.append(T[0] @ T[1] @ T[2] @ T[3] @ T[4] @ T[5] @ T[6] @ T[7] @ D[8] @␣
↪T_8_9)

    J = [[0 for x in range(9)] for y in range(3)]

    for i in range(0,9):
        J[0][i] = DX[i][0][3]
        J[1][i] = DX[i][1][3]
        J[2][i] = DX[i][0][0]

    J = np.array(J)
    A = J @ J.transpose()
    B = np.linalg.inv(A)

    J_psinv = J.transpose() @ B

    return J_psinv

compute_J_pseudoInv(T, D)
```

[159]:
```
array([[-0.13345677,  0.03321249,  0.34159398],
       [-0.03788145,  0.03139133, -0.00187375],
       [ 0.04149326,  0.02436351, -0.23923073],
       [ 0.07653612,  0.01308676, -0.2730437 ],
       [ 0.08487403,  0.00110736, -0.20036762],
```

```
        [ 0.06584036, -0.01060534, -0.02711381],
        [ 0.02446504, -0.02133091,  0.22155417],
        [-0.03087853, -0.03100458,  0.51359682],
        [-0.09099205, -0.04022063,  0.81959681]])
```

0.2 Exercise 3

[200]:
```
delta_x = np.array([-0.10, 0, 0])
taula = pd.read_csv("taula-DH.0", sep=',', names=[0,1,2,3]);

for i in range(0,90):
    theta = [taula[3][i] for i in range(0,9)];
    T, D = compute_T_and_D(taula);
    J_pseinv = compute_J_pseudoInv(T, D);
    delta_theta = J_pseinv @ delta_x
    theta = np.add(theta, list(map(degrees, delta_theta)))
    taula[3] = theta
    print(taula[3])
    taula.to_csv("taula-DH", sep=',', header=False, index=False)
    os.system("povray jcb.pov")
    command = f"mv jcb.png jcb_{i}.png"
    os.system(command)
```

```
0    83.165651
1   -26.890955
2   -34.352739
3   -16.794520
4   -16.837292
5   -14.408237
6    -9.761174
7    -3.365079
8   -20.754654
Name: 3, dtype: float64
0    83.918191
1   -26.672910
2   -34.583134
3   -17.227278
4   -17.319708
5   -14.782972
6    -9.900420
7    -3.190208
8   -20.240561
Name: 3, dtype: float64
0    84.659221
1   -26.453940
2   -34.806500
3   -17.654497
```

```
4   -17.798404
5   -15.155322
6   -10.038807
7    -3.017343
8   -19.733408
Name: 3, dtype: float64
0    85.389296
1   -26.234112
2   -35.023128
3   -18.076383
4   -18.273530
5   -15.525398
6   -10.176401
7    -2.846438
8   -19.232905
Name: 3, dtype: float64
0    86.108934
1   -26.013485
2   -35.233285
3   -18.493129
4   -18.745230
5   -15.893308
6   -10.313264
7    -2.677454
8   -18.738780
Name: 3, dtype: float64
0    86.818620
1   -25.792110
2   -35.437221
3   -18.904915
4   -19.213637
5   -16.259152
6   -10.449453
7    -2.510351
8   -18.250780
Name: 3, dtype: float64
0    87.518805
1   -25.570032
2   -35.635166
3   -19.311913
4   -19.678880
5   -16.623028
6   -10.585025
7    -2.345092
8   -17.768669
Name: 3, dtype: float64
0    88.209910
1   -25.347291
```

```
2   -35.827332
3   -19.714280
4   -20.141082
5   -16.985028
6   -10.720031
7    -2.181641
8   -17.292224
Name: 3, dtype: float64
0    88.892333
1   -25.123920
2   -36.013920
3   -20.112168
4   -20.600358
5   -17.345242
6   -10.854522
7    -2.019965
8   -16.821238
Name: 3, dtype: float64
0    89.566446
1   -24.899949
2   -36.195113
3   -20.505717
4   -21.056820
5   -17.703756
6   -10.988545
7    -1.860033
8   -16.355514
Name: 3, dtype: float64
0    90.232599
1   -24.675403
2   -36.371084
3   -20.895059
4   -21.510574
5   -18.060650
6   -11.122147
7    -1.701813
8   -15.894869
Name: 3, dtype: float64
0    90.891121
1   -24.450304
2   -36.541994
3   -21.280319
4   -21.961721
5   -18.416004
6   -11.255370
7    -1.545278
8   -15.439129
Name: 3, dtype: float64
```

```
0    91.542323
1   -24.224671
2   -36.707991
3   -21.661616
4   -22.410357
5   -18.769895
6   -11.388258
7    -1.390402
8   -14.988133
Name: 3, dtype: float64
0    92.186499
1   -23.998520
2   -36.869216
3   -22.039060
4   -22.856575
5   -19.122394
6   -11.520851
7    -1.237157
8   -14.541726
Name: 3, dtype: float64
0    92.823927
1   -23.771862
2   -37.025800
3   -22.412756
4   -23.300464
5   -19.473573
6   -11.653188
7    -1.085522
8   -14.099762
Name: 3, dtype: float64
0    93.454869
1   -23.544709
2   -37.177864
3   -22.782802
4   -23.742109
5   -19.823501
6   -11.785307
7    -0.935473
8   -13.662105
Name: 3, dtype: float64
0    94.079576
1   -23.317068
2   -37.325523
3   -23.149293
4   -24.181591
5   -20.172243
6   -11.917244
7    -0.786989
```

```
8   -13.228624
Name: 3, dtype: float64
0    94.698284
1   -23.088947
2   -37.468883
3   -23.512316
4   -24.618989
5   -20.519864
6   -12.049037
7    -0.640051
8   -12.799198
Name: 3, dtype: float64
0    95.311219
1   -22.860348
2   -37.608045
3   -23.871954
4   -25.054377
5   -20.866425
6   -12.180719
7    -0.494641
8   -12.373709
Name: 3, dtype: float64
0    95.918593
1   -22.631275
2   -37.743102
3   -24.228286
4   -25.487828
5   -21.211988
6   -12.312325
7    -0.350740
8   -11.952048
Name: 3, dtype: float64
0    96.520612
1   -22.401729
2   -37.874141
3   -24.581386
4   -25.919411
5   -21.556612
6   -12.443889
7    -0.208334
8   -11.534110
Name: 3, dtype: float64
0    97.117469
1   -22.171709
2   -38.001245
3   -24.931324
4   -26.349194
5   -21.900352
```

```
6   -12.575442
7    -0.067408
8   -11.119796
Name: 3, dtype: float64
0    97.709351
1   -21.941214
2   -38.124489
3   -25.278166
4   -26.777240
5   -22.243267
6   -12.707018
7     0.072053
8   -10.709011
Name: 3, dtype: float64
0    98.296435
1   -21.710240
2   -38.243946
3   -25.621975
4   -27.203611
5   -22.585410
6   -12.838647
7     0.210061
8   -10.301667
Name: 3, dtype: float64
0    98.878889
1   -21.478783
2   -38.359681
3   -25.962809
4   -27.628367
5   -22.926834
6   -12.970362
7     0.346626
8    -9.897679
Name: 3, dtype: float64
0    99.456877
1   -21.246839
2   -38.471758
3   -26.300724
4   -28.051566
5   -23.267592
6   -13.102192
7     0.481761
8    -9.496966
Name: 3, dtype: float64
0    100.030554
1    -21.014400
2    -38.580235
3    -26.635771
```

```
4    -28.473264
5    -23.607735
6    -13.234169
7      0.615472
8     -9.099451
Name: 3, dtype: float64
0    100.600068
1    -20.781460
2    -38.685165
3    -26.968000
4    -28.893513
5    -23.947314
6    -13.366323
7      0.747770
8     -8.705063
Name: 3, dtype: float64
0    101.165564
1    -20.548011
2    -38.786598
3    -27.297457
4    -29.312367
5    -24.286378
6    -13.498684
7      0.878662
8     -8.313732
Name: 3, dtype: float64
0    101.727178
1    -20.314043
2    -38.884582
3    -27.624183
4    -29.729874
5    -24.624975
6    -13.631282
7      1.008153
8     -7.925391
Name: 3, dtype: float64
0    102.285042
1    -20.079547
2    -38.979159
3    -27.948220
4    -30.146085
5    -24.963154
6    -13.764147
7      1.136249
8     -7.539980
Name: 3, dtype: float64
0    102.839283
1    -19.844512
```

```
2    -39.070368
3    -28.269606
4    -30.561044
5    -25.300962
6    -13.897309
7      1.262955
8     -7.157438
Name: 3, dtype: float64
0    103.390024
1    -19.608928
2    -39.158247
3    -28.588374
4    -30.974798
5    -25.638445
6    -14.030797
7      1.388274
8     -6.777710
Name: 3, dtype: float64
0    103.937382
1    -19.372781
2    -39.242828
3    -28.904557
4    -31.387390
5    -25.975651
6    -14.164642
7      1.512208
8     -6.400741
Name: 3, dtype: float64
0    104.481471
1    -19.136060
2    -39.324143
3    -29.218185
4    -31.798863
5    -26.312624
6    -14.298874
7      1.634760
8     -6.026482
Name: 3, dtype: float64
0    105.022401
1    -18.898750
2    -39.402218
3    -29.529286
4    -32.209258
5    -26.649410
6    -14.433523
7      1.755929
8     -5.654883
Name: 3, dtype: float64
```

```
0    105.560276
1    -18.660840
2    -39.477079
3    -29.837884
4    -32.618615
5    -26.986054
6    -14.568620
7      1.875716
8     -5.285901
Name: 3, dtype: float64
0    106.095199
1    -18.422312
2    -39.548747
3    -30.144002
4    -33.026971
5    -27.322600
6    -14.704195
7      1.994119
8     -4.919490
Name: 3, dtype: float64
0    106.627269
1    -18.183154
2    -39.617242
3    -30.447661
4    -33.434364
5    -27.659094
6    -14.840279
7      2.111137
8     -4.555611
Name: 3, dtype: float64
0    107.156580
1    -17.943348
2    -39.682580
3    -30.748879
4    -33.840831
5    -27.995580
6    -14.976903
7      2.226766
8     -4.194225
Name: 3, dtype: float64
0    107.683226
1    -17.702878
2    -39.744777
3    -31.047671
4    -34.246405
5    -28.332101
6    -15.114100
7      2.341002
```

```
8     -3.835296
Name: 3, dtype: float64
0    108.207296
1    -17.461728
2    -39.803844
3    -31.344052
4    -34.651121
5    -28.668702
6    -15.251901
7      2.453841
8     -3.478788
Name: 3, dtype: float64
0    108.728875
1    -17.219881
2    -39.859790
3    -31.638032
4    -35.055011
5    -29.005428
6    -15.390339
7      2.565278
8     -3.124671
Name: 3, dtype: float64
0    109.248048
1    -16.977318
2    -39.912624
3    -31.929623
4    -35.458107
5    -29.342321
6    -15.529447
7      2.675304
8     -2.772912
Name: 3, dtype: float64
0    109.764896
1    -16.734021
2    -39.962349
3    -32.218830
4    -35.860439
5    -29.679428
6    -15.669259
7      2.783914
8     -2.423485
Name: 3, dtype: float64
0    110.279498
1    -16.489970
2    -40.008969
3    -32.505658
4    -36.262037
5    -30.016792
```

```
6    -15.809808
7      2.891097
8     -2.076361
Name: 3, dtype: float64
0    110.791929
1    -16.245147
2    -40.052483
3    -32.790112
4    -36.662928
5    -30.354457
6    -15.951131
7      2.996846
8     -1.731517
Name: 3, dtype: float64
0    111.302265
1    -15.999531
2    -40.092890
3    -33.072191
4    -37.063141
5    -30.692469
6    -16.093262
7      3.101149
8     -1.388929
Name: 3, dtype: float64
0    111.810577
1    -15.753102
2    -40.130186
3    -33.351895
4    -37.462701
5    -31.030873
6    -16.236238
7      3.203995
8     -1.048576
Name: 3, dtype: float64
0    112.316934
1    -15.505838
2    -40.164365
3    -33.629219
4    -37.861635
5    -31.369715
6    -16.380096
7      3.305372
8     -0.710438
Name: 3, dtype: float64
0    112.821405
1    -15.257719
2    -40.195417
3    -33.904159
```

```
4    -38.259965
5    -31.709039
6    -16.524875
7      3.405265
8     -0.374497
Name: 3, dtype: float64
0    113.324055
1    -15.008721
2    -40.223333
3    -34.176705
4    -38.657717
5    -32.048894
6    -16.670612
7      3.503662
8     -0.040736
Name: 3, dtype: float64
0    113.824948
1    -14.758822
2    -40.248099
3    -34.446848
4    -39.054911
5    -32.389325
6    -16.817348
7      3.600547
8      0.290859
Name: 3, dtype: float64
0    114.324145
1    -14.507999
2    -40.269700
3    -34.714575
4    -39.451570
5    -32.730380
6    -16.965125
7      3.695902
8      0.620302
Name: 3, dtype: float64
0    114.821707
1    -14.256229
2    -40.288119
3    -34.979871
4    -39.847714
5    -33.072107
6    -17.113983
7      3.789711
8      0.947605
Name: 3, dtype: float64
0    115.317693
1    -14.003487
```

```
2    -40.303336
3    -35.242719
4    -40.243362
5    -33.414555
6    -17.263967
7      3.881954
8      1.272779
Name: 3, dtype: float64
0    115.812158
1    -13.749748
2    -40.315329
3    -35.503099
4    -40.638532
5    -33.757773
6    -17.415120
7      3.972613
8      1.595831
Name: 3, dtype: float64
0    116.305158
1    -13.494988
2    -40.324075
3    -35.760989
4    -41.033241
5    -34.101812
6    -17.567489
7      4.061666
8      1.916770
Name: 3, dtype: float64
0    116.796745
1    -13.239180
2    -40.329546
3    -36.016364
4    -41.427507
5    -34.446722
6    -17.721119
7      4.149091
8      2.235603
Name: 3, dtype: float64
0    117.286971
1    -12.982299
2    -40.331713
3    -36.269197
4    -41.821343
5    -34.792556
6    -17.876060
7      4.234864
8      2.552333
Name: 3, dtype: float64
```

```
0    117.775886
1    -12.724317
2    -40.330547
3    -36.519456
4    -42.214764
5    -35.139366
6    -18.032362
7      4.318962
8      2.866964
Name: 3, dtype: float64
0    118.263537
1    -12.465208
2    -40.326013
3    -36.767110
4    -42.607782
5    -35.487207
6    -18.190075
7      4.401359
8      3.179498
Name: 3, dtype: float64
0    118.749972
1    -12.204945
2    -40.318075
3    -37.012123
4    -43.000409
5    -35.836132
6    -18.349253
7      4.482028
8      3.489937
Name: 3, dtype: float64
0    119.235233
1    -11.943498
2    -40.306694
3    -37.254455
4    -43.392655
5    -36.186199
6    -18.509951
7      4.560940
8      3.798279
Name: 3, dtype: float64
0    119.719365
1    -11.680840
2    -40.291831
3    -37.494065
4    -43.784529
5    -36.537465
6    -18.672225
7      4.638066
```

```
8      4.104523
Name: 3, dtype: float64
0    120.202408
1    -11.416941
2    -40.273441
3    -37.730908
4    -44.176038
5    -36.889988
6    -18.836133
7      4.713375
8      4.408665
Name: 3, dtype: float64
0    120.684402
1    -11.151772
2    -40.251477
3    -37.964935
4    -44.567189
5    -37.243829
6    -19.001736
7      4.786835
8      4.710702
Name: 3, dtype: float64
0    121.165385
1    -10.885304
2    -40.225892
3    -38.196096
4    -44.957986
5    -37.599048
6    -19.169097
7      4.858411
8      5.010628
Name: 3, dtype: float64
0    121.645390
1    -10.617506
2    -40.196634
3    -38.424334
4    -45.348433
5    -37.955709
6    -19.338280
7      4.928069
8      5.308435
Name: 3, dtype: float64
0    122.124454
1    -10.348348
2    -40.163648
3    -38.649590
4    -45.738530
5    -38.313876
```

```
6    -19.509351
7      4.995771
8      5.604118
Name: 3, dtype: float64
0    122.602606
1    -10.077799
2    -40.126877
3    -38.871803
4    -46.128278
5    -38.673615
6    -19.682381
7      5.061481
8      5.897666
Name: 3, dtype: float64
0    123.079877
1     -9.805827
2    -40.086261
3    -39.090906
4    -46.517675
5    -39.034994
6    -19.857440
7      5.125156
8      6.189069
Name: 3, dtype: float64
0    123.556294
1     -9.532402
2    -40.041737
3    -39.306828
4    -46.906716
5    -39.398082
6    -20.034604
7      5.186757
8      6.478318
Name: 3, dtype: float64
0    124.031882
1     -9.257492
2    -39.993239
3    -39.519494
4    -47.295396
5    -39.762951
6    -20.213949
7      5.246240
8      6.765398
Name: 3, dtype: float64
0    124.506664
1     -8.981065
2    -39.940698
3    -39.728824
```

```
4    -47.683706
5    -40.129675
6    -20.395555
7      5.303560
8      7.050299
Name: 3, dtype: float64
0    124.980660
1     -8.703090
2    -39.884042
3    -39.934736
4    -48.071636
5    -40.498328
6    -20.579505
7      5.358671
8      7.333005
Name: 3, dtype: float64
0    125.453888
1     -8.423534
2    -39.823196
3    -40.137141
4    -48.459173
5    -40.868988
6    -20.765885
7      5.411525
8      7.613503
Name: 3, dtype: float64
0    125.926363
1     -8.142367
2    -39.758079
3    -40.335944
4    -48.846302
5    -41.241736
6    -20.954783
7      5.462072
8      7.891777
Name: 3, dtype: float64
0    126.398096
1     -7.859556
2    -39.688612
3    -40.531048
4    -49.233005
5    -41.616652
6    -21.146294
7      5.510259
8      8.167811
Name: 3, dtype: float64
0    126.869098
1     -7.575069
```

```
2    -39.614707
3    -40.722348
4    -49.619260
5    -41.993823
6    -21.340511
7      5.556034
8      8.441588
Name: 3, dtype: float64
0    127.339372
1     -7.288877
2    -39.536277
3    -40.909735
4    -50.005045
5    -42.373333
6    -21.537536
7      5.599341
8      8.713091
Name: 3, dtype: float64
0    127.808921
1     -7.000948
2    -39.453229
3    -41.093093
4    -50.390332
5    -42.755274
6    -21.737471
7      5.640122
8      8.982303
Name: 3, dtype: float64
0    128.277745
1     -6.711253
2    -39.365467
3    -41.272301
4    -50.775090
5    -43.139737
6    -21.940423
7      5.678319
8      9.249206
Name: 3, dtype: float64
0    128.745836
1     -6.419761
2    -39.272892
3    -41.447232
4    -51.159285
5    -43.526816
6    -22.146505
7      5.713871
8      9.513783
Name: 3, dtype: float64
```

```
0    129.213187
1     -6.126445
2    -39.175401
3    -41.617750
4    -51.542878
5    -43.916609
6    -22.355832
7      5.746714
8      9.776015
Name: 3, dtype: float64
0    129.679782
1     -5.831278
2    -39.072887
3    -41.783716
4    -51.925828
5    -44.309217
6    -22.568523
7      5.776783
8     10.035885
Name: 3, dtype: float64
0    130.145602
1     -5.534232
2    -38.965241
3    -41.944982
4    -52.308088
5    -44.704743
6    -22.784704
7      5.804013
8     10.293376
Name: 3, dtype: float64
0    130.610624
1     -5.235284
2    -38.852349
3    -42.101393
4    -52.689606
5    -45.103294
6    -23.004504
7      5.828334
8     10.548471
Name: 3, dtype: float64
0    131.074819
1     -4.934410
2    -38.734094
3    -42.252787
4    -53.070325
5    -45.504978
6    -23.228056
7      5.849676
```

```
8     10.801154
Name: 3, dtype: float64
0    131.538152
1     -4.631589
2    -38.610354
3    -42.398993
4    -53.450185
5    -45.909908
6    -23.455501
7      5.867967
8     11.051412
Name: 3, dtype: float64
```

[175]:
```
os.system("povray jcb.pov")
taula
```

[175]:

	0	1	2	3
0	0.0	0.0	0.0	82.387654
1	0.0	2.0	0.0	-27.111788
2	0.0	2.0	0.0	-34.110851
3	0.0	2.0	0.0	-16.348346
4	0.0	2.0	0.0	-16.342513
5	0.0	2.0	0.0	-14.024416
6	0.0	2.0	0.0	-9.618553
7	0.0	2.0	0.0	-3.545088
8	0.0	2.0	0.0	-21.285099

[76]:
```
taula
```

[76]:

	0	1	2	3
0	0.0	0.0	0.0	82.401
1	0.0	2.0	0.0	-27.108
2	0.0	2.0	0.0	-34.115
3	0.0	2.0	0.0	-16.356
4	0.0	2.0	0.0	-16.351
5	0.0	2.0	0.0	-14.031
6	0.0	2.0	0.0	-9.621
7	0.0	2.0	0.0	-3.542
8	0.0	2.0	0.0	-21.276

[ ]:
```

```