

# Resumen de la Guía 2 - Introducción a los elementos Finitos

## Modelización de Propiedades y Procesos 2020

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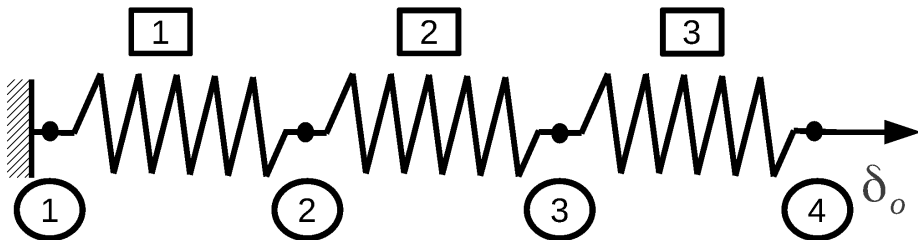
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## Problema 1

## Problema 1 : Resortes



## Resolución (Python)

```
r = [1, 2]
s = [0, 3]
U = np.zeros((4,1))
F = np.zeros((4,1))
U[s] = [0, 0.002]
F[R] = [0, 0]
U[r] = numpy.linalg.solve(K[np.ix_(r,r)], F[r] - K[ np.ix_[r, s].dot(U[s]))
```

## Resolución (Matlab)

```
r = [2, 3]
s = [1, 4]
U = zeros(4,1)
F = zeros(4,1)
U(s) = [0, 0.002]
F(R) = [0, 0]
U(r) = K(r,r)\(F(r) - K(r, s)*U(s))
```

## Resultado

## Desplazamientos (por nodo)

0.000000e+00  
6.666667e-04  
1.333333e-03  
2.000000e-03

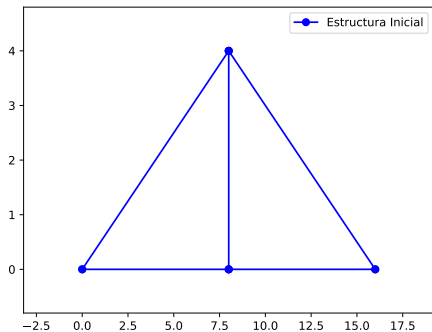
## Fuerzas (por nodo)

-1.333333e-01  
0.000000e+00  
0.000000e+00  
1.333333e-01

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## Problema 2

## Problema 2



GL

2

NODES

4

0. 0. 0

8. 4. 0

16. 0. 0

8. 0. 0

ELEMENTS

5 2

0 1 10e-4 210e9

3 0 10e-4 210e9

3 1 10e-4 210e9

1 2 10e-4 210e9

2 3 10e-4 210e9

VINS

3

0 1 1 0 0

2 -1 1 0 0

3 -1 -1 0 -20e3



## Problema 2: Matrices Elementales

Elemento 0, scale = 1.878297e+07

```
[[ 1.   0.5 -1.   -0.5 ]  
 [ 0.5  0.25 -0.5  -0.25]  
 [-1.  -0.5  1.    0.5 ]  
 [-0.5 -0.25  0.5   0.25]]
```

Elemento 1, scale = 2.625000e+07

```
[[ 1.  0. -1.  0.]  
 [ 0.  0.  0.  0.]  
 [-1.  0.  1.  0.]  
 [ 0.  0.  0.  0.]]
```

Elemento 2, scale = 5.250000e+07

```
[[ 0.  0.  0.  0.]  
 [ 0.  1.  0. -1.]  
 [ 0.  0.  0.  0.]  
 [ 0. -1.  0.  1.]]
```

Elemento 3, scale = 1.878297e+07

```
[[ 1.  -0.5 -1.    0.5 ]  
 [-0.5  0.25  0.5  -0.25]  
 [-1.   0.5  1.   -0.5 ]  
 [ 0.5 -0.25 -0.5   0.25]]
```

Elemento 4, scale = 2.625000e+07

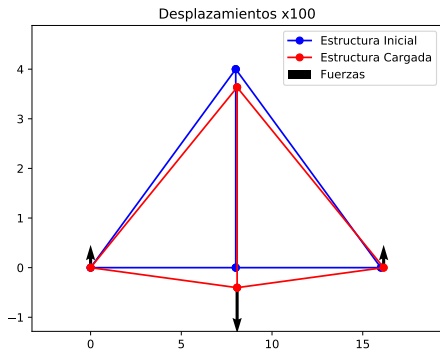
```
[[ 1.  0. -1.  0.]  
 [ 0.  0.  0.  0.]  
 [-1.  0.  1.  0.]  
 [ 0.  0.  0.  0.]]
```

Matriz Global , scale factor = 6.189149e+07

```
[[ 0.73  0.15 -0.3  -0.15  0.    0.   -0.42  0.  ]  
 [ 0.15  0.08 -0.15 -0.08  0.    0.    0.    0.  ]  
 [-0.3  -0.15  0.61  0.   -0.3   0.15  0.    0.  ]  
 [-0.15 -0.08  0.    1.    0.15 -0.08  0.   -0.85]  
 [ 0.    0.   -0.3   0.15  0.73 -0.15 -0.42  0.  ]  
 [ 0.    0.    0.15 -0.08 -0.15  0.08  0.    0.  ]  
 [-0.42  0.    0.    0.   -0.42  0.    0.85  0.  ]  
 [ 0.    0.    0.   -0.85  0.    0.    0.    0.85]]
```

su determinante: 0.000000e+00

# Problema 2: Puente



## Desplazamientos

(0,0)	x	0.000000e+00
	y	0.000000e+00
(8,4)	x	7.619048e-04
	y	-3.653398e-03
(16,0)	x	1.1523810e-03
	y	0.000000e+00
(8,0)	x	7.619048e-04
	y	-4.034350e-03

## Fuerzas

1.455192e-11
1.000000e+04
0.000000e+00
0.000000e+00
0.000000e+00
1.000000e+04
0.000000e+00
-2.000000e+04

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## Problema 3

## Problema 3: Fuerzas Distribuidas

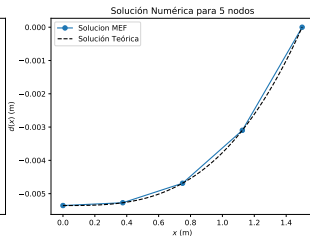
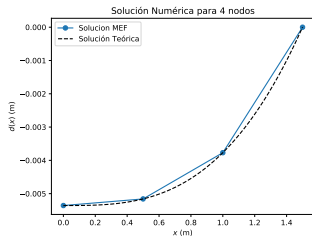
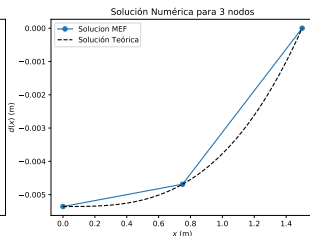
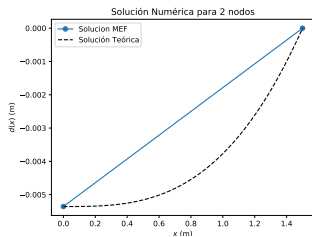
$$F_e = \int_{elemento} \begin{bmatrix} N_1(x) \\ N_2(x) \end{bmatrix} f(x) dx$$

# Calculo de fuerzas Directo

```
def NI(x, l):  
    return 1. - x/l  
  
def ND(x, l):  
    return x/l  
  
def Tx(x):  
    return -C*x  
  
def dfI(x, a, l):  
    return NI(x-a, l) * Tx(x)  
  
def dfD(x, a, l):  
    return ND(x-a, l)*Tx(x)  
  
def dfI(x, a, l):  
    return NI(x-a, l) * Tx(x)  
  
def dfD(x, a, l):  
    return ND(x-a, l)*Tx(x)
```

```
def fuerza():  
    """  
    define las fuerzas equivalentes sobre los nodos para la  
    distribucúon de fuerzas  $T(x) = - C*x$   
    """  
    F = np.zeros((len(MN), 1))  
    for i in range(len(MN)-1):  
        a = MN[i, 0]  
        b = MN[i+1, 0]  
        li = b - a  
        F[i] += quad(lambda x: dfI(x, a, li), a, b)[0]  
        F[i+1] += quad(lambda x: dfD(x, a, li), a, b)[0]  
    return F
```

# Desplazamientos



## Tensiones

$$\tau = \frac{\Delta l_e}{l_e} E$$

