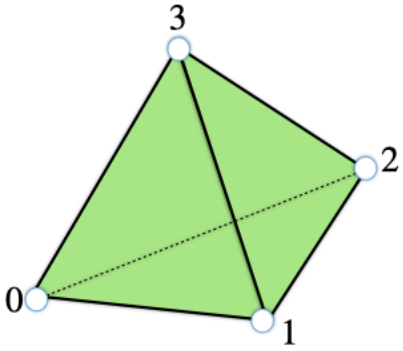
1 Ejemplo 1

Consideramos el 3-símplice (0,1,2,3)



[80]:
```
sc=SimplicialComplex([(0,1,2,3)])
```

2 Conjunto de todas sus caras

[81]:
```
sc.face_set
```

[81]:
```
{(0,),
 (0, 1),
 (0, 1, 2),
 (0, 1, 2, 3),
 (0, 1, 3),
 (0, 2),
 (0, 2, 3),
 (0, 3),
 (1,),
 (1, 2),
 (1, 2, 3),
 (1, 3),
 (2,),
 (2, 3),
 (3,)}
```

3 Dimensión

[82]:
```
sc.dimension
```

[82]:
```
3
```

4 Conjunto de vértices

[83]:
```
sc.n_faces(0)
```

[83]:
```
{(0,), (1,), (2,), (3,)}
```

5 Conjunto de aristas

[84]:
```
sc.n_faces(1)
```

[84]:
```
{(0, 1), (0, 2), (0, 3), (1, 2), (1, 3), (2, 3)}
```

6 Conjunto de 2-símplices

[85]:
```
sc.n_faces(2)
```

[85]:
```
{(0, 1, 2), (0, 1, 3), (0, 2, 3), (1, 2, 3)}
```

7 Conjunto de 3-símplices

[86]:
```
sc.n_faces(3)
```

[86]:
```
{(0, 1, 2, 3)}
```

8 Característica de Euler

[87]:
```
sc.Euler_characteristic
```

[87]:
```
1
```

9 Estrella de la arista (0,1)

[88]:
```
sc.st((0,1))
```

[88]:
```
{(0, 1), (0, 1, 2), (0, 1, 2, 3), (0, 1, 3)}
```

10 Link de la arista (0,1)

[89]:
```
sc.lk((0,1))
```

[89]:
```
{(2,), (2, 3), (3,)}
```

11 Número de componentes conexas

[90]:
```
sc.connected_components()
```

[90]:
```
1
```

[ ]:
```

```

12 Ejemplo 2

Borde del tetraedro (triangula la 2-esfera)

[91]:
```
sc1=SimplicialComplex(list(sc.skeleton(2)))
```

13 Conjunto de todas sus caras

[92]:
```
sc1.face_set
```

[92]:
```
{(0,),
 (0, 1),
 (0, 1, 2),
 (0, 1, 3),
 (0, 2),
 (0, 2, 3),
 (0, 3),
 (1,),
 (1, 2),
 (1, 2, 3),
 (1, 3),
 (2,),
 (2, 3),
 (3,)}
```

14 Dimensión

[93]:
```
sc1.dimension
```

[93]: 2

15 Estrella del vértice 0

[94]:
```
sc1.st((0,))
```

[94]: {(0,), (0, 1), (0, 1, 2), (0, 1, 3), (0, 2), (0, 2, 3), (0, 3)}

16 Link del vértice 0

[95]:
```
sc1.lk((0,))
```

[95]: {(1,), (1, 2), (1, 3), (2,), (2, 3), (3,)}

17 Característica de Euler

[96]:
```
sc1.Euler_characteristic
```

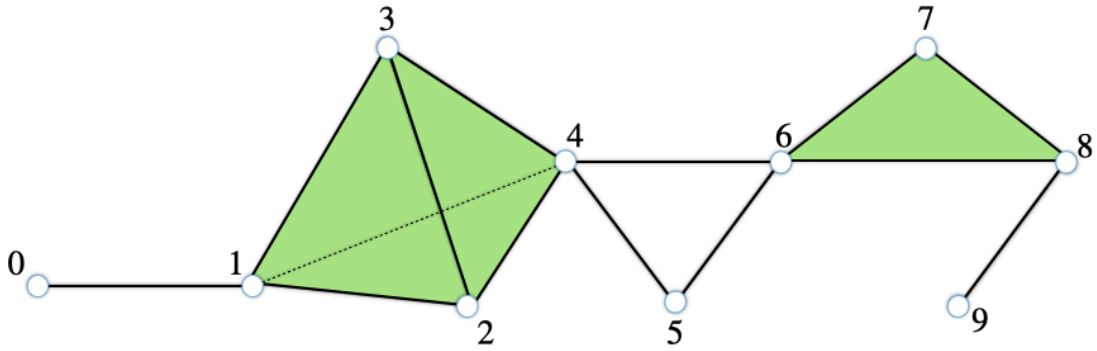
[96]: 2

18 Número de componentes conexas

[97]:
```
sc1.connected_components()
```

[97]: 1

19 Ejemplo 3



Símplices maximales: (0,1), (1,2,3,4), (4,5), (5,6), (4,6), (6,7,8), (8.9)

[98]:
```
sc=SimplicialComplex([(0,1),(1,2,3,4),(4,5),(5,6),(4,6),(6,7,8),(8,9)])
```

20 Conjunto de todas sus caras

[99]:
```
sc.face_set
```

[99]:
```
{(0,),
 (0, 1),
 (1,),
 (1, 2),
 (1, 2, 3),
 (1, 2, 3, 4),
 (1, 2, 4),
 (1, 3),
 (1, 3, 4),
 (1, 4),
 (2,),
 (2, 3),
 (2, 3, 4),
 (2, 4),
 (3,),
 (3, 4),
 (4,),
 (4, 5),
 (4, 6),
 (5,),
 (5, 6),
```

```
 (6,),
 (6, 7),
 (6, 7, 8),
 (6, 8),
 (7,),
 (7, 8),
 (8,),
 (8, 9),
 (9,)}
```

21 Dimensión

[100]:
```
sc.dimension
```

[100]:
```
3
```

22 1-esqueleto

[103]:
```
sc.skeleton(1)
```

[103]:
```
{(0,),
 (0, 1),
 (1,),
 (1, 2),
 (1, 3),
 (1, 4),
 (2,),
 (2, 3),
 (2, 4),
 (3,),
 (3, 4),
 (4,),
 (4, 5),
 (4, 6),
 (5,),
 (5, 6),
 (6,),
 (6, 7),
 (6, 8),
 (7,),
 (7, 8),
 (8,),
 (8, 9),
```

```
 (9,)}
```

23 Estrella del vértice 4

[104]:
```
sc.st((4,))
```

[104]:
```
{(1, 2, 3, 4),
 (1, 2, 4),
 (1, 3, 4),
 (1, 4),
 (2, 3, 4),
 (2, 4),
 (3, 4),
 (4,),
 (4, 5),
 (4, 6)}
```

24 Link del vértice 4

[105]:
```
sc.lk((4,))
```

[105]:
```
{(1,), (1, 2), (1, 2, 3), (1, 3), (2,), (2, 3), (3,), (5,), (6,)}
```

25 Característica de Euler

[106]:
```
sc.Euler_characteristic
```

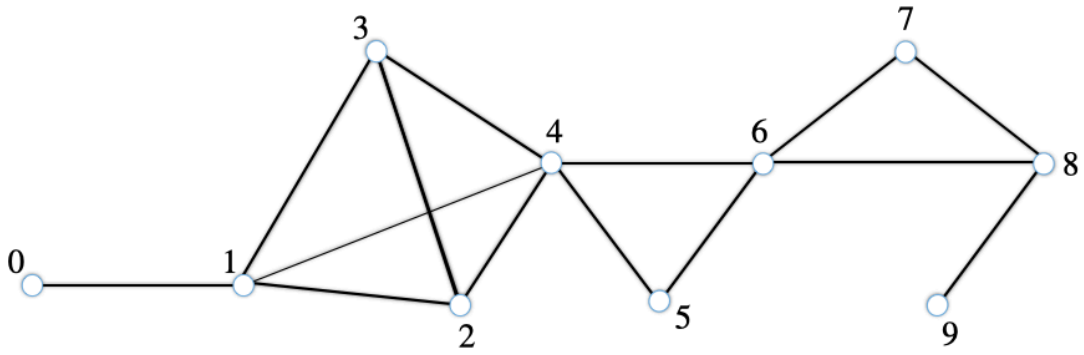
[106]:
```
0
```

26 Número de componentes conexas

[107]:
```
sc.connected_components()
```

[107]:
```
1
```

27 Ejemplo 4



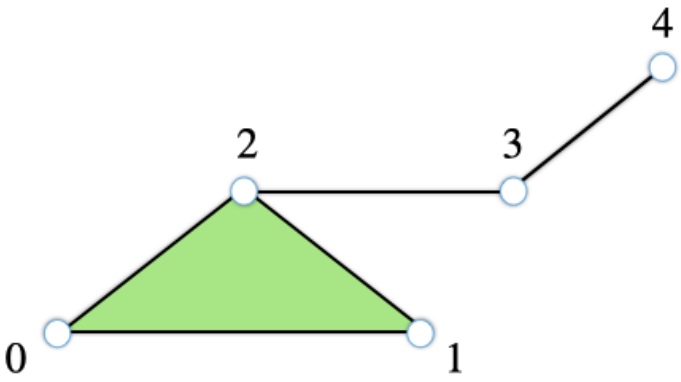
[108]:
```
sc1=SimplicialComplex(list(sc.skeleton(1)))
```

28 Característica de Euler

[109]:
```
sc1.Euler_characteristic
```

[109]: -4

29 Ejemplo 5



Símplices maximales: (0,1,2),(2,3),(3,4)

[110]:
```
sc=SimplicialComplex([(0,1,2),(2,3),(3,4)])
```

30 Conjunto de todos sus símplices

[111]:
```
sc.face_set
```

[111]:
```
{(0,),
 (0, 1),
 (0, 1, 2),
 (0, 2),
 (1,),
 (1, 2),
 (2,),
 (2, 3),
 (3,),
 (3, 4),
 (4,)}
```

31 Dimensión

[112]:
```
sc.dimension
```

[112]:
```
2
```

32 1-esqueleto

[113]:
```
sc.skeleton(1)
```

[113]:
```
{(0,), (0, 1), (0, 2), (1,), (1, 2), (2,), (2, 3), (3,), (3, 4), (4,)}
```

33 Estrella del vértice 2

[116]:
```
sc.st((2,))
```

[116]:
```
{(0, 1, 2), (0, 2), (1, 2), (2,), (2, 3)}
```

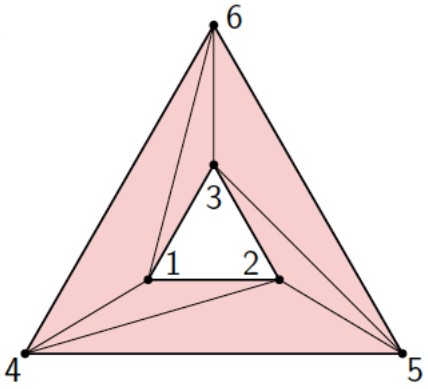
34 Link del vértice 2

[117]:
```
sc.lk((2,))
```

[117]:
```
{(0,), (0, 1), (1,), (3,)}
```

35 Ejemplo 6

Triangulación del anillo cerrado



Símplices maximales: (1,2,4), (1,3,6), (1,4,6), (2,3,5), (2,4,5), (3,5,6)

[118]:
```
sc=SimplicialComplex([(1,2,4),(1,3,6),(1,4,6),(2,3,5),(2,4,5),(3,5,6)])
```

36 Lista de todas sus caras

[119]:
```
sc.face_set
```

[119]:
```
{(1,),
 (1, 2),
 (1, 2, 4),
 (1, 3),
 (1, 3, 6),
 (1, 4),
 (1, 4, 6),
 (1, 6),
 (2,),
 (2, 3),
 (2, 3, 5),
 (2, 4),
 (2, 4, 5),
 (2, 5),
 (3,),
 (3, 5),
 (3, 5, 6),
 (3, 6),
 (4,),
 (4, 5),
 (4, 6),
```

```
 (5,),
 (5, 6),
 (6,)}
```

37 Dimensión

[120]:
```
sc.dimension
```

[120]:
```
2
```

38 1-esqueleto

[121]:
```
sc.skeleton(1)
```

[121]:
```
{(1,),
 (1, 2),
 (1, 3),
 (1, 4),
 (1, 6),
 (2,),
 (2, 3),
 (2, 4),
 (2, 5),
 (3,),
 (3, 5),
 (3, 6),
 (4,),
 (4, 5),
 (4, 6),
 (5,),
 (5, 6),
 (6,)}
```

39 Estrella de la arista (1,4)

[122]:
```
sc.st((1,4))
```

[122]:
```
{(1, 2, 4), (1, 4), (1, 4, 6)}
```

40 Link de la arista (1,4)

[123]:
```
sc.lk((1,4))
```

[123]:
```
{(2,), (6,)}
```

41 Característica de Euler

[124]:
```
sc.Euler_characteristic
```

[124]:
```
0
```

42 Ejemplo 7

1-esqueleto del anillo

[125]:
```
sc1=SimplicialComplex(list(sc.skeleton(1)))
```

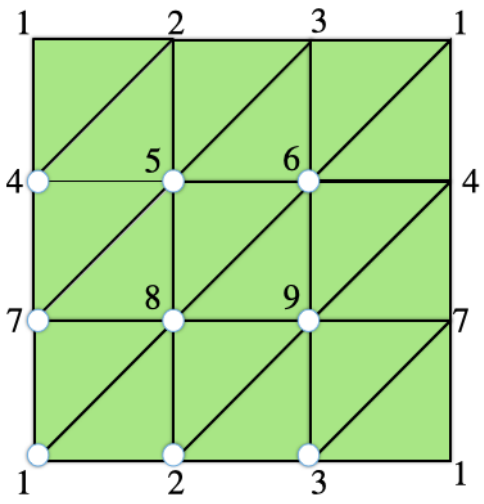
43 Característica de Euler

[126]:
```
sc1.Euler_characteristic
```

[126]:
```
-6
```

44 Ejemplo 8

El toro



Símplices maximales: (1,2,4), (2,4,5), (2,3,5), (3,5,6), (1,3,6), (1,4,6), (4,5,7), (5,7,8),(5,6,8),(6,8,9), (4,6,9), (4,7,9), (1,7,8), (1,2,8), (2,8,9), (2,3,9), (3,7,9), (1,3,7)

[127]:
```
sc=SimplicialComplex([(1,2,4), (2,4,5), (2,3,5), (3,5,6), (1,3,6), (1,4,6),␣
↪(4,5,7), (5,7,8),(5,6,8),(6,8,9), (4,6,9), (4,7,9), (1,7,8), (1,2,8),␣
↪(2,8,9), (2,3,9), (3,7,9), (1,3,7) ])
```

45 Dimensión

[128]:
```
sc.dimension
```

[128]:
```
2
```

46 Conjunto de vértices

[129]:
```
sc.n_faces(0)
```

[129]:
```
{(1,), (2,), (3,), (4,), (5,), (6,), (7,), (8,), (9,)}
```

47 Conjunto de aristas

[130]:
```
sc.n_faces(1)
```

[130]:
```
{(1, 2),
 (1, 3),
```

```
 (1, 4),
 (1, 6),
 (1, 7),
 (1, 8),
 (2, 3),
 (2, 4),
 (2, 5),
 (2, 8),
 (2, 9),
 (3, 5),
 (3, 6),
 (3, 7),
 (3, 9),
 (4, 5),
 (4, 6),
 (4, 7),
 (4, 9),
 (5, 6),
 (5, 7),
 (5, 8),
 (6, 8),
 (6, 9),
 (7, 8),
 (7, 9),
 (8, 9)}
```

48 Estrella del vértice 1

[131]:
```
sc.st((1,))
```

[131]:
```
{(1,),
 (1, 2),
 (1, 2, 4),
 (1, 2, 8),
 (1, 3),
 (1, 3, 6),
 (1, 3, 7),
 (1, 4),
 (1, 4, 6),
 (1, 6),
 (1, 7),
 (1, 7, 8),
 (1, 8)}
```

49 Link del vértice 1

[132]:
```
sc.lk((1,))
```

[132]:
```
{(2,),
 (2, 4),
 (2, 8),
 (3,),
 (3, 6),
 (3, 7),
 (4,),
 (4, 6),
 (6,),
 (7,),
 (7, 8),
 (8,)}
```

50 Característica de Euler

[133]:
```
sc.Euler_characteristic
```

[133]:
```
0
```

51 Número de componentes conexas

[134]:
```
sc.connected_components()
```

[134]:
```
1
```

52 Ejemplo 8

1-esqueleto del toro

[135]:
```
sc1=SimplicialComplex(list(sc.skeleton(1)))
```

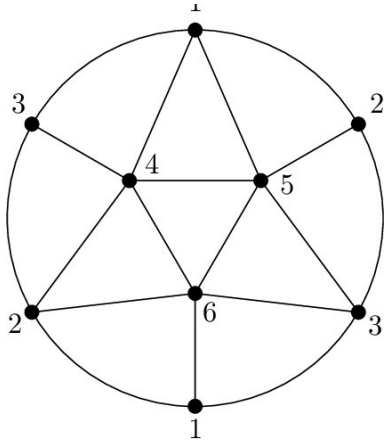
53 Característica de Euler

[136]:
```
sc1.Euler_characteristic
```

[136]:
```
-18
```

54 Ejemplo 9

Triangulación del plano proyectivo



Símplices maximales: (1,2,6), (2,3,4), (1,3,4), (1,2,5), (2,3,5), (1,3,6), (2,4,6), (1,4,5), (3,5,6), (4,5,6)

[137]:
```
sc=SimplicialComplex([(1,2,6), (2,3,4), (1,3,4), (1,2,5), (2,3,5), (1,3,6),␣
↪(2,4,6), (1,4,5), (3,5,6), (4,5,6)])
```

55 Dimensión

[138]:
```
sc.dimension
```

[138]: 2

56 Conjunto de aristas

[140]:
```
sc.n_faces(1)
```

[140]:
```
{(1, 2),
 (1, 3),
 (1, 4),
 (1, 5),
 (1, 6),
 (2, 3),
 (2, 4),
 (2, 5),
 (2, 6),
 (3, 4),
 (3, 5),
```

```
 (3, 6),
 (4, 5),
 (4, 6),
 (5, 6)}
```

57 Estrella del vértice 1

[141]:
```
sc.st((1,))
```

[141]:
```
{(1,),
 (1, 2),
 (1, 2, 5),
 (1, 2, 6),
 (1, 3),
 (1, 3, 4),
 (1, 3, 6),
 (1, 4),
 (1, 4, 5),
 (1, 5),
 (1, 6)}
```

58 Link del vértice 1

[142]:
```
sc.lk((1,))
```

[142]:
```
{(2,), (2, 5), (2, 6), (3,), (3, 4), (3, 6), (4,), (4, 5), (5,), (6,)}
```

59 Característica de Euler

[143]:
```
sc.Euler_characteristic
```

[143]:
```
1
```

60 Componentes conexas

[144]:
```
sc.connected_components()
```

[144]:
```
1
```

61 Ejemplo 10

1-esqueleto del plano proyectivo

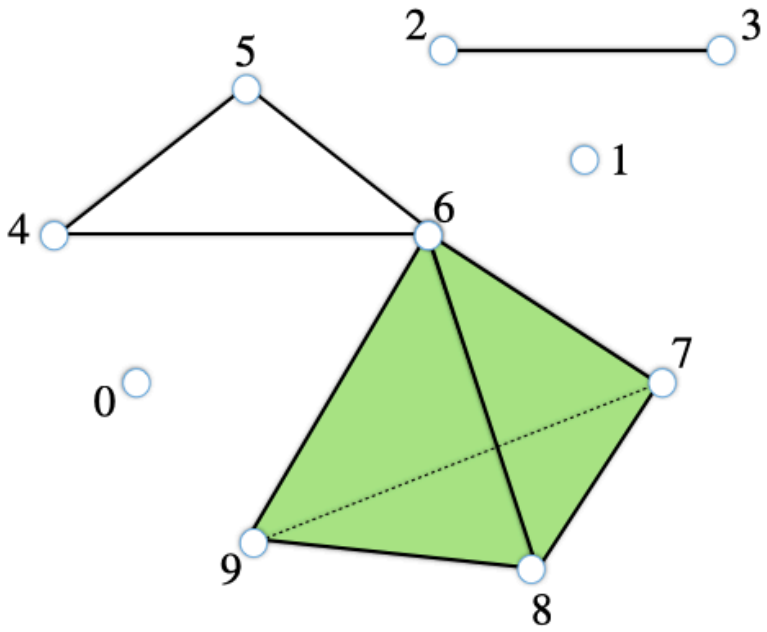
[145]:
```
sc1=SimplicialComplex(list(sc.skeleton(1)))
```

62 Característica de Euler

[146]:
```
sc1.Euler_characteristic
```

[146]: -9

63 Ejemplo 11



Símplices maximales: (0,), (1,), (2,3), (4,5), (5,6), (4,6), (6,7,8,9)

[147]:
```
sc=SimplicialComplex([(0,), (1,), (2,3), (4,5), (5,6), (4,6), (6,7,8,9)])
```

64 Conjunto de todas las caras

[148]:
```
sc.face_set
```

[148]:
```
{(0,),
 (1,),
 (2,),
 (2, 3),
 (3,),
 (4,),
 (4, 5),
 (4, 6),
 (5,),
 (5, 6),
 (6,),
 (6, 7),
 (6, 7, 8),
 (6, 7, 8, 9),
 (6, 7, 9),
 (6, 8),
 (6, 8, 9),
 (6, 9),
 (7,),
 (7, 8),
 (7, 8, 9),
 (7, 9),
 (8,),
 (8, 9),
 (9,)}
```

65 Dimensión

[149]:
```
sc.dimension
```

[149]:
```
3
```

66 Conjunto de vértices

[150]:
```
sc.n_faces(0)
```

[150]:
```
{(0,), (1,), (2,), (3,), (4,), (5,), (6,), (7,), (8,), (9,)}
```

67 Conjunto de aristas

[151]:
```
sc.n_faces(1)
```

[151]:
```
{(2, 3),
 (4, 5),
 (4, 6),
 (5, 6),
 (6, 7),
 (6, 8),
 (6, 9),
 (7, 8),
 (7, 9),
 (8, 9)}
```

68 Conjunto de 2-símplices

[154]:
```
sc.n_faces(2)
```

[154]:
```
{(6, 7, 8), (6, 7, 9), (6, 8, 9), (7, 8, 9)}
```

69 Conjunto de 3-símplices

[153]:
```
sc.n_faces(3)
```

[153]:
```
{(6, 7, 8, 9)}
```

70 Estrella del vértice 6

[155]:
```
sc.st((6,))
```

[155]:
```
{(4, 6),
 (5, 6),
 (6,),
 (6, 7),
 (6, 7, 8),
 (6, 7, 8, 9),
 (6, 7, 9),
 (6, 8),
 (6, 8, 9),
 (6, 9)}
```

71 Link del vértice 6

[156]:
```
sc.lk((6,))
```

[156]:
```
{(4,), (5,), (7,), (7, 8), (7, 8, 9), (7, 9), (8,), (8, 9), (9,)}
```

72 Característica de Euler

[157]:
```
sc.Euler_characteristic
```

[157]:
```
3
```

73 Número de componentes conexas

[159]:
```
sc.connected_components()
```

[159]:
```
4
```