Prueba de programa dijkstra

5 Nodos 25 Aristas

``
>>> g=Grafo()
>>> g.conecta('a','b',1)
>>> g.conecta('a','c', 2)
>>> g.conecta('a','d', 3)
>>> g.conecta('a','e', 5)
>>> g.conecta('b','c', 1)
>>> g.conecta('b','d', 4)
>>> g.conecta('b','e', 1)
>>> g.conecta('c','d', 2)
>>> g.conecta('c','e', 1)
>>> g.conecta('d','e', 3)
>>> print(g.shortest('a'))
``
	>>> print(g.shortest('a'))
	{'a': (0, 'a', ['a']), 'b': (1, 'b', ['a', 'b']), 'c': (2, 'c', ['a', 'c']), 'e': (2, 'e', ['a', 'b', 'e']), 'd': (3, 'd', ['a', 'd'])}

	>>> print(g.shortest('b')) {'b': (0, 'b', ['b']), 'a': (1, 'a', ['b', 'a']), 'c': (1, 'c', ['b', 'c']), 'e': (1, 'e', ['b', 'e']), 'd': (3, 'd', ['b', 'c', 'd'])}
	>>> print(g.shortest('c')) {'c': (0, 'c', ['c']), 'b': (1, 'b', ['c', 'b']), 'e': (1, 'e', ['c', 'e']), 'a': (2, 'a', ['c', 'b', 'a']), 'd': (2, 'd', ['c', 'd'])}
	>>> print(g.shortest('d')) {'d': (0, 'd', ['d']), 'c': (2, 'c', ['d', 'c']), 'a': (3, 'a', ['d', 'a']), 'b': (3, 'b', ['d', 'c', 'b']), 'e': (3, 'e', ['d', 'c', 'e'])}
	>>> print(g.shortest('e')) {'e': (0, 'e', ['e']), 'b': (1, 'b', ['e', 'b']), 'c': (1, 'c', ['e', 'c']), 'a': (2, 'a', ['e', 'b', 'a']), 'd': (3, 'd', ['e', 'c', 'd'])}

10 Nodos 20 aristas

``
>>> g=Grafo()
>>> g.conecta('a','b',1)
>>> g.conecta('a','c', 2)
>>> g.conecta('a','d', 3)
>>> g.conecta('a','e', 5)
>>> g.conecta('a','f', 3)
>>> g.conecta('a','g', 1)
>>> g.conecta('a','h', 3)
>>> g.conecta('a','i', 3)
>>> g.conecta('a','j', 2)
>>> g.conecta('b','c', 2)
>>> g.conecta('b','d', 2)
>>> g.conecta('b','e',1)
>>> g.conecta('b','f',4)
>>> g.conecta('b','g',5)
>>> g.conecta('b','h',7)
>>> g.conecta('b','i',4)
>>> g.conecta('b','j',1)
>>> g.conecta('c','d',3)
>>> g.conecta('c','e',5)
>>> g.conecta('c','f',1)
``
	>>> print(g.shortest('a'))
	{'a': (0, 'a', ['a']), 'b': (1, 'b', ['a', 'b']), 'g': (1, 'g', ['a', 'g']), 'c': (2, 'c', ['a', 'c']), 'd': (2, 'd', ['a', 'g', 'd']), 'e': (2, 'e', ['a', 'b', 'e']), 'f': (2, 'f', ['a', 'g', 'f']), 'h': (2, 'h', ['a', 'g', 'h']), 'j': (2, 'j', ['a', 'j']), 'i': (3, 'i', ['a', 'i'])}

	>>> print(g.shortest('b')) {'b': (0, 'b', ['b']), 'a': (1, 'a', ['b', 'a']), 'e': (1, 'e', ['b', 'e']), 'j': (1, 'j', ['b', 'j']), 'c': (2, 'c', ['b', 'c']), 'd': (2, 'd', ['b', 'd']), 'g': (2, 'g', ['b', 'a', 'g']), 'f': (3, 'f', ['b', 'c', 'f']), 'h': (3, 'h', ['b', 'a', 'g', 'h']), 'i': (3, 'i', ['b', 'd', 'i'])}
	>>> print(g.shortest('c')) {'c': (0, 'c', ['c']), 'f': (1, 'f', ['c', 'f']), 'j': (1, 'j', ['c', 'j']), 'a': (2, 'a', ['c', 'a']), 'b': (2, 'b', ['c', 'b']), 'e': (2, 'e', ['c', 'j', 'e']), 'g': (2, 'g', ['c', 'g']), 'h': (2, 'h', ['c', 'h']), 'd': (3, 'd', ['c', 'd']), 'i': (3, 'i', ['c', 'h', 'i'])}
	>>> print(g.shortest('d'))

``
>>> g.conecta('c','g',2)
>>> g.conecta('c','h',2)
>>> g.conecta('c','i',5)
>>> g.conecta('c','j',1)
>>> g.conecta('d','e',2)
>>> g.conecta('d','f',4)
>>> g.conecta('d','g',1)
>>> g.conecta('d','h',5)
>>> g.conecta('d','i',1)
>>> g.conecta('d','j',5)
>>> g.conecta('e','f',2)
>>> g.conecta('e','g',1)
>>> g.conecta('e','h',5)
>>> g.conecta('e','i',5)
>>> g.conecta('e','j',1)
>>> g.conecta('f','g',1)
>>> g.conecta('f','h',1)
>>> g.conecta('f','i',5)
>>> g.conecta('f','j',3)
>>> g.conecta('g','h',1)
>>> g.conecta('g','i',4)
>>> g.conecta('g','j',1)
>>> g.conecta('h','i',1)
>>> g.conecta('h','j',4)
>>> g.conecta('i','j',5)
``
	``
	{'d': (0, 'd', ['d']), 'g': (1, 'g', ['d', 'g']), 'i': (1, 'i',
	['d', 'i']), 'a': (2, 'a', ['d', 'g', 'a']), 'b': (2, 'b', ['d',
	'b']), 'e': (2, 'e', ['d', 'e']), 'f': (2, 'f', ['d', 'g', 'f']),
	'h': (2, 'h', ['d', 'g', 'h']), 'j': (2, 'j', ['d', 'g', 'j']), 'c':
	(3, 'c', ['d', 'c'])}
	>>> print(g.shortest('e'))
	{'e': (0, 'e', ['e']), 'b': (1, 'b', ['e', 'b']), 'g': (1, 'g',
	['e', 'g']), 'j': (1, 'j', ['e', 'j']), 'a': (2, 'a', ['e', 'b',
	'a']), 'c': (2, 'c', ['e', 'j', 'c']), 'd': (2, 'd', ['e', 'd']),
	'f': (2, 'f', ['e', 'f']), 'h': (2, 'h', ['e', 'g', 'h']), 'i': (3,
	'i', ['e', 'd', 'i'])}
	>>> print(g.shortest('f'))
	{'f': (0, 'f', ['f']), 'c': (1, 'c', ['f', 'c']), 'g': (1, 'g', ['f',
	'g']), 'h': (1, 'h', ['f', 'h']), 'a': (2, 'a', ['f', 'g', 'a']),
	'd': (2, 'd', ['f', 'g', 'd']), 'e': (2, 'e', ['f', 'e']), 'i': (2,
	'i', ['f', 'h', 'i']), 'j': (2, 'j', ['f', 'c', 'j']), 'b': (3, 'b',
	['f', 'g', 'a', 'b'])}
	>>> print(g.shortest('g'))
	{'g': (0, 'g', ['g']), 'a': (1, 'a', ['g', 'a']), 'd': (1, 'd',
	['g', 'd']), 'e': (1, 'e', ['g', 'e']), 'f': (1, 'f', ['g', 'f']),
	'h': (1, 'h', ['g', 'h']), 'j': (1, 'j', ['g', 'j']), 'b': (2, 'b',
	['g', 'a', 'b']), 'c': (2, 'c', ['g', 'f', 'c']), 'i': (2, 'i', ['g',
	'd', 'i'])}
	>>> print(g.shortest('h'))
	{'h': (0, 'h', ['h']), 'f': (1, 'f', ['h', 'f']), 'g': (1, 'g',
	['h', 'g']), 'i': (1, 'i', ['h', 'i']), 'a': (2, 'a', ['h', 'g',
	'a']), 'c': (2, 'c', ['h', 'f', 'c']), 'd': (2, 'd', ['h', 'g',
	'd']), 'e': (2, 'e', ['h', 'g', 'e']), 'j': (2, 'j', ['h', 'g',
	'j']), 'b': (3, 'b', ['h', 'g', 'a', 'b'])}
	>>> print(g.shortest('i'))
	{'i': (0, 'i', ['i']), 'd': (1, 'd', ['i', 'd']), 'h': (1, 'h',
	['i', 'h']), 'f': (2, 'f', ['i', 'h', 'f']), 'g': (2, 'g', ['i', 'd',
	'g']), 'a': (3, 'a', ['i', 'd', 'g', 'a']), 'b': (3, 'b', ['i',
	'd', 'b']), 'c': (3, 'c', ['i', 'h', 'f', 'c']), 'e': (3, 'e', ['i',
	'd', 'e']), 'j': (3, 'j', ['i', 'd', 'g', 'j'])}
	>>> print(g.shortest('j'))
	{'j': (0, 'j', ['j']), 'b': (1, 'b', ['j', 'b']), 'c': (1, 'c', ['j',
	'c']), 'e': (1, 'e', ['j', 'e']), 'g': (1, 'g', ['j', 'g']), 'a':
	(2, 'a', ['j', 'b', 'a']), 'd': (2, 'd', ['j', 'g', 'd']), 'f': (2,
	'f', ['j', 'c', 'f']), 'h': (2, 'h', ['j', 'g', 'h']), 'i': (3, 'i',
	['j', 'g', 'd', 'i'])}
	``

15 Nodos 30 aristas

``
>>> g=Grafo()
>>> g.conecta('a','b',1)
>>> g.conecta('a','c', 2)
>>> g.conecta('a','d', 3)
>>> g.conecta('a','e', 5)
``
	``
	>>> print(g.shortest('a'))
	{'a': (0, 'a', ['a']), 'b': (1, 'b', ['a', 'b']), 'g': (1, 'g',
	['a', 'g']), 'c': (2, 'c', ['a', 'c']), 'e': (2, 'e', ['a', 'b',
	'e']), 'f': (2, 'f', ['a', 'f']), 'i': (2, 'i', ['a', 'b', 'i']), 'k':
	(2, 'k', ['a', 'k']), 'l': (2, 'l', ['a', 'l']), 'm': (2, 'm',
	``

```
>>> g.conecta('a','f',2)
>>> g.conecta('a','g',1)
>>> g.conecta('a','h',4)
>>> g.conecta('a','i',4)
>>> g.conecta('a','j',3)
>>> g.conecta('a','k',2)
>>> g.conecta('a','l',2)
>>> g.conecta('a','m',2)
>>> g.conecta('a','n',2)
>>> g.conecta('a','o',2)
>>> g.conecta('b','c', 1)
>>> g.conecta('b','d', 4)
>>> g.conecta('b','e', 1)
>>> g.conecta('b','f',3)
>>> g.conecta('b','g',2)
>>> g.conecta('b','h',2)
>>> g.conecta('b','i',1)
>>> g.conecta('b','j',5)
>>> g.conecta('b','k',1)
>>> g.conecta('b','l',6)
>>> g.conecta('b','m',1)
>>> g.conecta('b','n',1)
>>> g.conecta('b','o',6)
>>> g.conecta('c','d', 2)
>>> g.conecta('c','e', 1)
>>> g.conecta('d','e', 3)
>>> g.conecta('c','f',3)
>>> g.conecta('c','g',4)
>>> g.conecta('c','h',1)
>>> g.conecta('c','i',4)
>>> g.conecta('c','j',5)
>>> g.conecta('c','k',4)
>>> g.conecta('c','l',1)
>>> g.conecta('c','m',3)
>>> g.conecta('c','n',2)
>>> g.conecta('c','o,'1)
SyntaxError: invalid syntax
>>>
KeyboardInterrupt
>>> g.conecta('c','o',2)
>>> g.conecta('d','f',3)
>>> g.conecta('d','g',2)
>>> g.conecta('d','h',3)
>>> g.conecta('d','i',1)
>>> g.conecta('d','j',2)
>>> g.conecta('d','k',5)
>>> g.conecta('d','l',6)
>>> g.conecta('d','m',1)
```

```
['a', 'm']), 'n': (2, 'n', ['a', 'n']), 'o': (2, 'o', ['a',
'o']), 'd': (3, 'd', ['a', 'd']), 'h': (3, 'h', ['a', 'b',
'h']), 'j': (3, 'j', ['a', 'j'])}
>>> print(g.shortest('b'))
{'b': (0, 'b', ['b']), 'a': (1, 'a', ['b', 'a']), 'c': (1, 'c',
['b', 'c']), 'e': (1, 'e', ['b', 'e']), 'i': (1, 'i', ['b', 'i']),
'k': (1, 'k', ['b', 'k']), 'm': (1, 'm', ['b', 'm']), 'n':
(1, 'n', ['b', 'n']), 'd': (2, 'd', ['b', 'i', 'd']), 'g': (2,
'g', ['b', 'a', 'g']), 'h': (2, 'h', ['b', 'h']), 'j': (2, 'j',
['b', 'k', 'j']), 'l': (2, 'l', ['b', 'c', 'l']), 'o': (2, 'o', ['b',
'i', 'o']), 'f': (3, 'f', ['b', 'a', 'f'])}
>>> print(g.shortest('c'))
{'c': (0, 'c', ['c']), 'b': (1, 'b', ['c', 'b']), 'e': (1, 'e',
['c', 'e']), 'h': (1, 'h', ['c', 'h']), 'l': (1, 'l', ['c', 'l']),
'a': (2, 'a', ['c', 'b', 'a']), 'd': (2, 'd', ['c', 'd']), 'g':
(2, 'g', ['c', 'l', 'g']), 'i': (2, 'i', ['c', 'b', 'i']), 'k': (2,
'k', ['c', 'b', 'k']), 'm': (2, 'm', ['c', 'b', 'm']), 'n':
(2, 'n', ['c', 'b', 'n']), 'o': (2, 'o', ['c', 'o']), 'f': (3,
'f', ['c', 'f']), 'j': (3, 'j', ['c', 'h', 'j'])}
>>> print(g.shortest('d'))
{'d': (0, 'd', ['d']), 'i': (1, 'i', ['d', 'i']), 'm': (1, 'm',
['d', 'm']), 'b': (2, 'b', ['d', 'i', 'b']), 'c': (2, 'c', ['d',
'c']), 'g': (2, 'g', ['d', 'g']), 'j': (2, 'j', ['d', 'j']), 'n':
(2, 'n', ['d', 'n']), 'o': (2, 'o', ['d', 'i', 'o']), 'a': (3,
'a', ['d', 'i', 'b', 'a']), 'e': (3, 'e', ['d', 'i', 'b', 'e']),
'f': (3, 'f', ['d', 'f']), 'h': (3, 'h', ['d', 'c', 'h']), 'k':
(3, 'k', ['d', 'i', 'b', 'k']), 'l': (3, 'l', ['d', 'c', 'l'])}
>>> print(g.shortest('e'))
{'e': (0, 'e', ['e']), 'b': (1, 'b', ['e', 'b']), 'c': (1, 'c',
['e', 'c']), 'a': (2, 'a', ['e', 'b', 'a']), 'g': (2, 'g', ['e',
'g']), 'h': (2, 'h', ['e', 'c', 'h']), 'i': (2, 'i', ['e', 'b',
'i']), 'k': (2, 'k', ['e', 'b', 'k']), 'l': (2, 'l', ['e', 'c',
'l']), 'm': (2, 'm', ['e', 'b', 'm']), 'n': (2, 'n', ['e',
'b', 'n']), 'd': (3, 'd', ['e', 'c', 'd']), 'f': (3, 'f', ['e',
'f']), 'j': (3, 'j', ['e', 'b', 'k', 'j']), 'o': (3, 'o', ['e', 'c',
'o'])}
>>> print(g.shortest('f'))
{'f': (0, 'f', ['f']), 'j': (1, 'j', ['f', 'j']), 'o': (1, 'o', ['f',
'o']), 'a': (2, 'a', ['f', 'a']), 'h': (2, 'h', ['f', 'h']), 'i':
(2, 'i', ['f', 'i']), 'k': (2, 'k', ['f', 'j', 'k']), 'l': (2, 'l',
['f', 'l']), 'm': (2, 'm', ['f', 'm']), 'b': (3, 'b', ['f', 'a',
'b']), 'c': (3, 'c', ['f', 'c']), 'd': (3, 'd', ['f', 'd']), 'e':
(3, 'e', ['f', 'e']), 'g': (3, 'g', ['f', 'a', 'g']), 'n': (3,
'n', ['f', 'l', 'n'])}
>>> print(g.shortest('g'))
{'g': (0, 'g', ['g']), 'a': (1, 'a', ['g', 'a']), 'l': (1, 'l',
['g', 'l']), 'b': (2, 'b', ['g', 'a', 'b']), 'c': (2, 'c', ['g',
'l', 'c']), 'd': (2, 'd', ['g', 'd']), 'e': (2, 'e', ['g', 'e']),
```

```
>>> g.conecta('d','n',2)
>>> g.conecta('d','o',4)
>>> g.conecta('e','f',3)
>>> g.conecta('e','g',2)
>>> g.conecta('e','h',5)
>>> g.conecta('e','i',2)
>>> g.conecta('e','j',6)
>>> g.conecta('e','k',2)
>>> g.conecta('e','l',2)
>>> g.conecta('e','m',3)
>>> g.conecta('e','n',2)
>>> g.conecta('e','o',4)
>>> g.conecta('f','g',4)
>>> g.conecta('f','h',2)
>>> g.conecta('f','i',2)
>>> g.conecta('f','j',1)
>>> g.conecta('f','k',5)
>>> g.conecta('f','l',2)
>>> g.conecta('f','m',2)
>>> g.conecta('f','n',7)
>>> g.conecta('f','o',1)
>>> g.conecta('g','h',4)
>>> g.conecta('g','i',5)
>>> g.conecta('g','i
j',1)

SyntaxError: EOL while scanning string literal
>>> g.conecta('g','j',3)
>>> g.conecta('g','k',3)
>>> g.conecta('g','l',1)
>>> g.conecta('g','m',5)
>>> g.conecta('g','n',2)
>>> g.conecta('g','o',3)
>>> g.conecta('h','i',3)
>>> g.conecta('h','j',2)
>>> g.conecta('h','k',4)
>>> g.conecta('h','l',3)
>>> g.conecta('h','m',4)
>>> g.conecta('h','n',2)
>>> g.conecta('h','o',2)
>>> g.conecta('i','j',3)
>>> g.conecta('i','k',2)
>>> g.conecta('i','l',4)
>>> g.conecta('i','m',4)
>>> g.conecta('i','n',6)
>>> g.conecta('i','o',1)
>>> g.conecta('j','k',1)
>>>
```

```
'n': (2, 'n', ['g', 'n']), 'f': (3, 'f', ['g', 'a', 'f']), 'h':
(3, 'h', ['g', 'l', 'c', 'h']), 'i': (3, 'i', ['g', 'a', 'b', 'i']),
'j': (3, 'j', ['g', 'j']), 'k': (3, 'k', ['g', 'a', 'k']), 'm': (3,
'm', ['g', 'a', 'm']), 'o': (3, 'o', ['g', 'a', 'o'])}
>>> print(g.shortest('h'))
{'h': (0, 'h', ['h']), 'c': (1, 'c', ['h', 'c']), 'b': (2, 'b',
['h', 'c', 'b']), 'e': (2, 'e', ['h', 'c', 'e']), 'f': (2, 'f',
['h', 'f']), 'j': (2, 'j', ['h', 'j']), 'l': (2, 'l', ['h', 'c', 'l']),
'n': (2, 'n', ['h', 'n']), 'o': (2, 'o', ['h', 'o']), 'a': (3,
'a', ['h', 'c', 'b', 'a']), 'd': (3, 'd', ['h', 'c', 'd']), 'g':
(3, 'g', ['h', 'c', 'l', 'g']), 'i': (3, 'i', ['h', 'c', 'b', 'i']),
'k': (3, 'k', ['h', 'c', 'b', 'k']), 'm': (3, 'm', ['h', 'c',
'b', 'm'])}
>>> print(g.shortest('i'))
{'i': (0, 'i', ['i']), 'b': (1, 'b', ['i', 'b']), 'd': (1, 'd',
['i', 'd']), 'o': (1, 'o', ['i', 'o']), 'a': (2, 'a', ['i', 'b',
'a']), 'c': (2, 'c', ['i', 'b', 'c']), 'e': (2, 'e', ['i', 'b',
'e']), 'f': (2, 'f', ['i', 'f']), 'k': (2, 'k', ['i', 'b', 'k']),
'm': (2, 'm', ['i', 'b', 'm']), 'n': (2, 'n', ['i', 'b', 'n']),
'g': (3, 'g', ['i', 'b', 'a', 'g']), 'h': (3, 'h', ['i', 'b',
'h']), 'j': (3, 'j', ['i', 'd', 'j']), 'l': (3, 'l', ['i', 'b', 'c',
'l'])}
>>> print(g.shortest('j'))
{'j': (0, 'j', ['j']), 'f': (1, 'f', ['j', 'f']), 'k': (1, 'k', ['j',
'k']), 'b': (2, 'b', ['j', 'k', 'b']), 'd': (2, 'd', ['j', 'd']),
'h': (2, 'h', ['j', 'h']), 'm': (2, 'm', ['j', 'm']), 'o': (2,
'o', ['j', 'f', 'o']), 'a': (3, 'a', ['j', 'k', 'b', 'a']), 'c': (3,
'c', ['j', 'k', 'b', 'c']), 'e': (3, 'e', ['j', 'k', 'b', 'e']),
'g': (3, 'g', ['j', 'g']), 'i': (3, 'i', ['j', 'k', 'b', 'i']), 'l':
(3, 'l', ['j', 'f', 'l']), 'n': (3, 'n', ['j', 'k', 'b', 'n'])}
>>> print(g.shortest('k'))
{'k': (0, 'k', ['k']), 'b': (1, 'b', ['k', 'b']), 'j': (1, 'j',
['k', 'j']), 'o': (1, 'o', ['k', 'o']), 'a': (2, 'a', ['k', 'b',
'a']), 'c': (2, 'c', ['k', 'b', 'c']), 'e': (2, 'e', ['k', 'b',
'e']), 'f': (2, 'f', ['k', 'j', 'f']), 'i': (2, 'i', ['k', 'b', 'i']),
'm': (2, 'm', ['k', 'b', 'm']), 'n': (2, 'n', ['k', 'b',
'n']), 'd': (3, 'd', ['k', 'b', 'i', 'd']), 'g': (3, 'g', ['k',
'b', 'a', 'g']), 'h': (3, 'h', ['k', 'b', 'h']), 'l': (3, 'l',
['k', 'b', 'c', 'l'])}
>>> print(g.shortest('l'))
{'l': (0, 'l', ['l']), 'c': (1, 'c', ['l', 'c']), 'g': (1, 'g', ['l',
'g']), 'n': (1, 'n', ['l', 'n']), 'a': (2, 'a', ['l', 'g', 'a']),
'b': (2, 'b', ['l', 'c', 'b']), 'e': (2, 'e', ['l', 'c', 'e']), 'f':
(2, 'f', ['l', 'f']), 'h': (2, 'h', ['l', 'c', 'h']), 'm': (2,
'm', ['l', 'm']), 'd': (3, 'd', ['l', 'c', 'd']), 'i': (3, 'i',
['l', 'c', 'b', 'i']), 'j': (3, 'j', ['l', 'f', 'j']), 'k': (3, 'k',
['l', 'c', 'b', 'k']), 'o': (3, 'o', ['l', 'c', 'o'])}
>>> print(g.shortest('m'))
```

KeyboardInterrupt
>>> g.conecta('j','l',3)
>>> g.conecta('j','m',2)
>>> g.conecta('j','n',3)
>>> g.conecta('j','o',5)
>>> g.conecta('k','l',3)
>>> g.conecta('k','m',2)
>>> g.conecta('k','n',4)
>>> g.conecta('k','o',1)
>>> g.conecta('l','m',2)
>>> g.conecta('l','n',1)
>>> g.conecta('l','o','4)
SyntaxError: invalid syntax
>>> g.conecta('l','o',4)
>>> g.conecta('m','n',2)
>>> g.conecta('m','o',3)
>>> g.conecta('n','o',2)
	{'m': (0, 'm', ['m']), 'b': (1, 'b', ['m', 'b']), 'd': (1, 'd', ['m', 'd']), 'a': (2, 'a', ['m', 'b', 'a']), 'c': (2, 'c', ['m', 'b', 'c']), 'e': (2, 'e', ['m', 'b', 'e']), 'f': (2, 'f', ['m', 'f']), 'i': (2, 'i', ['m', 'b', 'i']), 'j': (2, 'j', ['m', 'j']), 'k': (2, 'k', ['m', 'b', 'k']), 'l': (2, 'l', ['m', 'l']), 'n': (2, 'n', ['m', 'b', 'n']), 'g': (3, 'g', ['m', 'b', 'a', 'g']), 'h': (3, 'h', ['m', 'b', 'h']), 'o': (3, 'o', ['m', 'f', 'o'])}
	>>> print(g.shortest('n'))
	{'n': (0, 'n', ['n']), 'b': (1, 'b', ['n', 'b']), 'l': (1, 'l', ['n', 'l']), 'a': (2, 'a', ['n', 'b', 'a']), 'c': (2, 'c', ['n', 'b', 'c']), 'd': (2, 'd', ['n', 'd']), 'e': (2, 'e', ['n', 'b', 'e']), 'g': (2, 'g', ['n', 'l', 'g']), 'h': (2, 'h', ['n', 'h']), 'i': (2, 'i', ['n', 'b', 'i']), 'k': (2, 'k', ['n', 'b', 'k']), 'm': (2, 'm', ['n', 'b', 'm']), 'o': (2, 'o', ['n', 'o']), 'f': (3, 'f', ['n', 'l', 'f']), 'j': (3, 'j', ['n', 'b', 'k', 'j'])}
	>>> print(g.shortest('o'))
	{'o': (0, 'o', ['o']), 'f': (1, 'f', ['o', 'f']), 'i': (1, 'i', ['o', 'i']), 'k': (1, 'k', ['o', 'k']), 'a': (2, 'a', ['o', 'a']), 'b': (2, 'b', ['o', 'i', 'b']), 'c': (2, 'c', ['o', 'c']), 'd': (2, 'd', ['o', 'i', 'd']), 'h': (2, 'h', ['o', 'h']), 'j': (2, 'j', ['o', 'f', 'j']), 'n': (2, 'n', ['o', 'n']), 'e': (3, 'e', ['o', 'i', 'b', 'e']), 'g': (3, 'g', ['o', 'a', 'g']), 'l': (3, 'l', ['o', 'c', 'l']), 'm': (3, 'm', ['o', 'i', 'b', 'm'])}

20 Nodos 40 aristas

>>> g.conecta('a','p',3)
>>> g.conecta('a','q',3)
>>> g.conecta('a','r',4)
>>> g.conecta('a','s',1)
>>> g.conecta('a','t',2)
>>> g.conecta('b','p',3)
>>> g.conecta('b','q',3)
>>> g.conecta('b','r',1)
>>> g.conecta('b','s',4)
>>> g.conecta('c','p',2)
>>> g.conecta('c','q',3)
>>> g.conecta('c','r',3)
>>> g.conecta('c','s',4)
>>> g.conecta('c','t',1)
>>>
KeyboardInterrupt
>>> g.conecta('b','t',1)
>>> g.conecta('d','p',2)
>>> g.conecta('d','q',3)
>>> g.conecta('d','r',2)
	>>> print(g.shortest('a'))
	{'a': (0, 'a', ['a']), 'b': (1, 'b', ['a', 'b']), 'g': (1, 'g', ['a', 'g']), 's': (1, 's', ['a', 's']), 'c': (2, 'c', ['a', 'c']), 'e': (2, 'e', ['a', 'b', 'e']), 'f': (2, 'f', ['a', 'f']), 'i': (2, 'i', ['a', 'b', 'i']), 'j': (2, 'j', ['a', 's', 'j']), 'k': (2, 'k', ['a', 'k']), 'l': (2, 'l', ['a', 'l']), 'm': (2, 'm', ['a', 'm']), 'n': (2, 'n', ['a', 'n']), 'o': (2, 'o', ['a', 'o']), 'p': (2, 'p', ['a', 'g', 'p']), 'q': (2, 'q', ['a', 'g', 'q']), 'r': (2, 'r', ['a', 'b', 'r']), 't': (2, 't', ['a', 't']), 'd': (3, 'd', ['a', 'd']), 'h': (3, 'h', ['a', 'b', 'h'])}
	>>> print(g.shortest('b'))
	{'b': (0, 'b', ['b']), 'a': (1, 'a', ['b', 'a']), 'c': (1, 'c', ['b', 'c']), 'e': (1, 'e', ['b', 'e']), 'i': (1, 'i', ['b', 'i']), 'k': (1, 'k', ['b', 'k']), 'm': (1, 'm', ['b', 'm']), 'n': (1, 'n', ['b', 'n']), 'r': (1, 'r', ['b', 'r']), 't': (1, 't', ['b', 't']), 'd': (2, 'd', ['b', 'i', 'd']), 'f': (2, 'f', ['b', 'r', 'f']), 'g': (2, 'g', ['b', 'a', 'g']), 'h': (2, 'h', ['b', 'h']), 'j': (2, 'j', ['b', 'k', 'j']), 'l': (2, 'l', ['b', 'c', 'l']), 'o': (2, 'o', ['b', 'i', 'o']), 's': (2, 's', ['b', 'a', 's']), 'p': (3, 'p', ['b', 'p']), 'q': (3, 'q', ['b', 'q'])}

```
>>> g.conecta('d','s',3)
>>> g.conecta('d','t',1)
>>> g.conecta('e','p',2)
>>> g.conecta('e','q',3)
>>> g.conecta('e','r',4)
>>> g.conecta('e','s',5)
>>> g.conecta('e','t',1)
>>> g.conecta('f','g',2)
>>> g.conecta('f','p',3)
>>> g.conecta('f','q',3)
>>> g.conecta('f','r',1)
>>> g.conecta('f','s',2)
>>> g.conecta('f','t',5)
>>> g.conecta('g','p',1)
>>> g.conecta('g','q',1)
>>> g.conecta('g','r',1)
>>> g.conecta('g','s'5)
SyntaxError: invalid syntax
>>> g.conecta('g','t',2)
>>> g.conecta('g','s',5)
>>> g.conecta('h','p',1)
>>> g.conecta('h','q',3)
>>> g.conecta('h','r',3)
>>> g.conecta('h','s',5)
>>> g.conecta('h','t',2)
>>> g.conecta('i','j',5)
>>> g.conecta('i','p',3)
>>> g.conecta('i','q',3)
>>> g.conecta('i','r',2)
>>> g.conecta('i','s',4)
>>> g.conecta('i','t',2)
>>> g.conecta('j','p',3)
>>> g.conecta('j','q',3)
>>> g.conecta('j','r',3)
>>> g.conecta('j','s',1)
>>> g.conecta('j','t',1)
>>> g.conecta('k','p',2)
>>> g.conecta('k','q',2)
>>> g.conecta('k','r',4)
>>> g.conecta('k','s',5)
>>>
KeyboardInterrupt
>>> g.conecta('k','t',1)
>>> g.conecta('l','p',3)
>>> g.conecta('l','q',2)
>>> g.conecta('l','r',2)
>>> g.conecta('l','s',6)
>>> g.conecta('l','t',1)
```

```
>>> print(g.shortest('c'))
{'c': (0, 'c', ['c']), 'b': (1, 'b', ['c', 'b']), 'e': (1, 'e',
['c', 'e']), 'h': (1, 'h', ['c', 'h']), 'l': (1, 'l', ['c', 'l']),
't': (1, 't', ['c', 't']), 'a': (2, 'a', ['c', 'b', 'a']), 'd': (2,
'd', ['c', 'd']), 'g': (2, 'g', ['c', 'l', 'g']), 'i': (2, 'i', ['c',
'b', 'i']), 'j': (2, 'j', ['c', 't', 'j']), 'k': (2, 'k', ['c', 'b',
'k']), 'm': (2, 'm', ['c', 'b', 'm']), 'n': (2, 'n', ['c',
'b', 'n']), 'o': (2, 'o', ['c', 'o']), 'p': (2, 'p', ['c', 'p']),
'r': (2, 'r', ['c', 'b', 'r']), 'f': (3, 'f', ['c', 'f']), 'q': (3,
'q', ['c', 'q']), 's': (3, 's', ['c', 'b', 'a', 's'])}
>>> print(g.shortest('d'))
{'d': (0, 'd', ['d']), 'i': (1, 'i', ['d', 'i']), 'm': (1, 'm',
['d', 'm']), 't': (1, 't', ['d', 't']), 'b': (2, 'b', ['d', 'i',
'b']), 'c': (2, 'c', ['d', 'c']), 'e': (2, 'e', ['d', 't', 'e']),
'g': (2, 'g', ['d', 'g']), 'j': (2, 'j', ['d', 'j']), 'k': (2, 'k',
['d', 't', 'k']), 'l': (2, 'l', ['d', 't', 'l']), 'n': (2, 'n', ['d',
'n']), 'o': (2, 'o', ['d', 'i', 'o']), 'p': (2, 'p', ['d', 'p']),
'r': (2, 'r', ['d', 'r']), 'a': (3, 'a', ['d', 'i', 'b', 'a']), 'f':
(3, 'f', ['d', 'f']), 'h': (3, 'h', ['d', 'c', 'h']), 'q': (3,
'q', ['d', 'q']), 's': (3, 's', ['d', 's'])}
>>> print(g.shortest('e'))
{'e': (0, 'e', ['e']), 'b': (1, 'b', ['e', 'b']), 'c': (1, 'c',
['e', 'c']), 't': (1, 't', ['e', 't']), 'a': (2, 'a', ['e', 'b',
'a']), 'd': (2, 'd', ['e', 't', 'd']), 'g': (2, 'g', ['e', 'g']),
'h': (2, 'h', ['e', 'c', 'h']), 'i': (2, 'i', ['e', 'b', 'i']), 'j':
(2, 'j', ['e', 't', 'j']), 'k': (2, 'k', ['e', 'b', 'k']), 'l': (2,
'l', ['e', 'c', 'l']), 'm': (2, 'm', ['e', 'b', 'm']), 'n': (2,
'n', ['e', 'b', 'n']), 'p': (2, 'p', ['e', 'p']), 'r': (2, 'r',
['e', 'b', 'r']), 'f': (3, 'f', ['e', 'f']), 'o': (3, 'o', ['e',
'c', 'o']), 'q': (3, 'q', ['e', 'q']), 's': (3, 's', ['e', 'b',
'a', 's'])}
>>> print(g.shortest('f'))
{'f': (0, 'f', ['f']), 'j': (1, 'j', ['f', 'j']), 'o': (1, 'o', ['f',
'o']), 'r': (1, 'r', ['f', 'r']), 'a': (2, 'a', ['f', 'a']), 'b':
(2, 'b', ['f', 'r', 'b']), 'g': (2, 'g', ['f', 'g']), 'h': (2,
'h', ['f', 'h']), 'i': (2, 'i', ['f', 'i']), 'k': (2, 'k', ['f', 'j',
'k']), 'l': (2, 'l', ['f', 'l']), 'm': (2, 'm', ['f', 'm']), 's':
(2, 's', ['f', 's']), 't': (2, 't', ['f', 'j', 't']), 'c': (3, 'c',
['f', 'r', 'b', 'c']), 'd': (3, 'd', ['f', 'd']), 'e': (3, 'e',
['f', 'r', 'b', 'e']), 'n': (3, 'n', ['f', 'r', 'b', 'n']), 'p':
(3, 'p', ['f', 'p']), 'q': (3, 'q', ['f', 'q'])}
>>> print(g.shortest('g'))
{'g': (0, 'g', ['g']), 'a': (1, 'a', ['g', 'a']), 'l': (1, 'l',
['g', 'l']), 'p': (1, 'p', ['g', 'p']), 'q': (1, 'q', ['g',
'q']), 'r': (1, 'r', ['g', 'r']), 'b': (2, 'b', ['g', 'a', 'b']),
'c': (2, 'c', ['g', 'l', 'c']), 'd': (2, 'd', ['g', 'd']), 'e':
(2, 'e', ['g', 'e']), 'f': (2, 'f', ['g', 'f']), 'h': (2, 'h',
['g', 'p', 'h']), 'n': (2, 'n', ['g', 'n']), 's': (2, 's', ['g',
```

```
>>> g.conecta('m','p',5)
>>> g.conecta('m','q',3)
>>> g.conecta('m','r',2)
>>> g.conecta('m','s',2)
>>> g.conecta('m','t',1)
>>> g.conecta('n','p',3)
>>> g.conecta('n','q',3)
>>> g.conecta('n','r',3)
>>> g.conecta('n','s',1)
>>> g.conecta('n','t',6)
>>> g.conecta('o','p',3)
>>> g.conecta('o','q',3)
>>> g.conecta('o','r',5)
>>> g.conecta('o','s',4)
>>> g.conecta('o','t',2)
>>> g.conecta('p','q',4)
>>> g.conecta('p','r',3)
>>> g.conecta('p','s',1)
>>> g.conecta('p','t',4)
>>> g.conecta('q','r',3)
>>> g.conecta('q','s',4)
>>> g.conecta('q','t',3)
>>> g.conecta('r','s',4)
>>> g.conecta('r','t',5)
>>> g.conecta('s','t',2)
```

```
'a', 's']), 't': (2, 't', ['g', 't']), 'i': (3, 'i', ['g', 'a', 'b',
'i']), 'j': (3, 'j', ['g', 'f', 'j']), 'k': (3, 'k', ['g', 'a', 'k']),
'm': (3, 'm', ['g', 'a', 'm']), 'o': (3, 'o', ['g', 'a',
'o'])}
>>> print(g.shortest('h'))
{'h': (0, 'h', ['h']), 'c': (1, 'c', ['h', 'c']), 'p': (1, 'p',
['h', 'p']), 'b': (2, 'b', ['h', 'c', 'b']), 'e': (2, 'e', ['h',
'c', 'e']), 'f': (2, 'f', ['h', 'f']), 'g': (2, 'g', ['h', 'p',
'g']), 'j': (2, 'j', ['h', 'j']), 'l': (2, 'l', ['h', 'c', 'l']), 'n':
(2, 'n', ['h', 'n']), 'o': (2, 'o', ['h', 'o']), 's': (2, 's',
['h', 'p', 's']), 't': (2, 't', ['h', 'c', 't']), 'a': (3, 'a',
['h', 'c', 'b', 'a']), 'd': (3, 'd', ['h', 'c', 'd']), 'i': (3,
'i', ['h', 'c', 'b', 'i']), 'k': (3, 'k', ['h', 'c', 'b', 'k']),
'm': (3, 'm', ['h', 'c', 'b', 'm']), 'q': (3, 'q', ['h', 'p',
'g', 'q']), 'r': (3, 'r', ['h', 'c', 'b', 'r'])}
>>> print(g.shortest('i'))
{'i': (0, 'i', ['i']), 'b': (1, 'b', ['i', 'b']), 'd': (1, 'd',
['i', 'd']), 'o': (1, 'o', ['i', 'o']), 'a': (2, 'a', ['i', 'b',
'a']), 'c': (2, 'c', ['i', 'b', 'c']), 'e': (2, 'e', ['i', 'b',
'e']), 'f': (2, 'f', ['i', 'f']), 'k': (2, 'k', ['i', 'b', 'k']),
'm': (2, 'm', ['i', 'b', 'm']), 'n': (2, 'n', ['i', 'b', 'n']),
'r': (2, 'r', ['i', 'b', 'r']), 't': (2, 't', ['i', 'b', 't']), 'g':
(3, 'g', ['i', 'b', 'a', 'g']), 'h': (3, 'h', ['i', 'b', 'h']), 'j':
(3, 'j', ['i', 'd', 'j']), 'l': (3, 'l', ['i', 'b', 'c', 'l']), 'p':
(3, 'p', ['i', 'd', 'p']), 'q': (3, 'q', ['i', 'q']), 's': (3, 's',
['i', 'b', 'a', 's'])}
>>> print(g.shortest('j'))
{'j': (0, 'j', ['j']), 'f': (1, 'f', ['j', 'f']), 'k': (1, 'k', ['j',
'k']), 's': (1, 's', ['j', 's']), 't': (1, 't', ['j', 't']), 'a': (2,
'a', ['j', 's', 'a']), 'b': (2, 'b', ['j', 'k', 'b']), 'c': (2, 'c',
['j', 't', 'c']), 'd': (2, 'd', ['j', 'd']), 'e': (2, 'e', ['j', 't',
'e']), 'h': (2, 'h', ['j', 'h']), 'l': (2, 'l', ['j', 't', 'l']),
'm': (2, 'm', ['j', 'm']), 'n': (2, 'n', ['j', 's', 'n']), 'o':
(2, 'o', ['j', 'f', 'o']), 'p': (2, 'p', ['j', 's', 'p']), 'r': (2,
'r', ['j', 'f', 'r']), 'g': (3, 'g', ['j', 's', 'a', 'g']), 'i': (3,
'i', ['j', 'k', 'b', 'i']), 'q': (3, 'q', ['j', 'q'])}
>>> print(g.shortest('k'))
{'k': (0, 'k', ['k']), 'b': (1, 'b', ['k', 'b']), 'j': (1, 'j',
['k', 'j']), 'o': (1, 'o', ['k', 'o']), 't': (1, 't', ['k', 't']),
'a': (2, 'a', ['k', 'b', 'a']), 'c': (2, 'c', ['k', 'b', 'c']),
'd': (2, 'd', ['k', 't', 'd']), 'e': (2, 'e', ['k', 'b', 'e']),
'f': (2, 'f', ['k', 'j', 'f']), 'i': (2, 'i', ['k', 'b', 'i']), 'l':
(2, 'l', ['k', 't', 'l']), 'm': (2, 'm', ['k', 'b', 'm']), 'n':
(2, 'n', ['k', 'b', 'n']), 'p': (2, 'p', ['k', 'p']), 'q': (2,
'q', ['k', 'q']), 'r': (2, 'r', ['k', 'b', 'r']), 's': (2, 's',
['k', 'j', 's']), 'g': (3, 'g', ['k', 'b', 'a', 'g']), 'h': (3,
'h', ['k', 'b', 'h'])}
>>> print(g.shortest('l'))
```

```
{'l': (0, 'l', ['l']), 'c': (1, 'c', ['l', 'c']), 'g': (1, 'g', ['l',
'g']), 'n': (1, 'n', ['l', 'n']), 't': (1, 't', ['l', 't']), 'a':
(2, 'a', ['l', 'g', 'a']), 'b': (2, 'b', ['l', 'c', 'b']), 'd':
(2, 'd', ['l', 't', 'd']), 'e': (2, 'e', ['l', 'c', 'e']), 'f': (2,
'f', ['l', 'f']), 'h': (2, 'h', ['l', 'c', 'h']), 'j': (2, 'j', ['l',
't', 'j']), 'k': (2, 'k', ['l', 't', 'k']), 'm': (2, 'm', ['l',
'm']), 'p': (2, 'p', ['l', 'g', 'p']), 'q': (2, 'q', ['l', 'g',
'q']), 'r': (2, 'r', ['l', 'g', 'r']), 's': (2, 's', ['l', 'n',
's']), 'i': (3, 'i', ['l', 'c', 'b', 'i']), 'o': (3, 'o', ['l', 'c',
'o'])}
>>> print(g.shortest('m'))
{'m': (0, 'm', ['m']), 'b': (1, 'b', ['m', 'b']), 'd': (1,
'd', ['m', 'd']), 't': (1, 't', ['m', 't']), 'a': (2, 'a',
['m', 'b', 'a']), 'c': (2, 'c', ['m', 'b', 'c']), 'e': (2, 'e',
['m', 'b', 'e']), 'f': (2, 'f', ['m', 'f']), 'i': (2, 'i', ['m',
'b', 'i']), 'j': (2, 'j', ['m', 'j']), 'k': (2, 'k', ['m', 'b',
'k']), 'l': (2, 'l', ['m', 'l']), 'n': (2, 'n', ['m', 'b', 'n']),
'r': (2, 'r', ['m', 'b', 'r']), 's': (2, 's', ['m', 's']), 'g':
(3, 'g', ['m', 'b', 'a', 'g']), 'h': (3, 'h', ['m', 'b', 'h']),
'o': (3, 'o', ['m', 'f', 'o']), 'p': (3, 'p', ['m', 'd', 'p']),
'q': (3, 'q', ['m', 'q'])}
>>> print(g.shortest('n'))
{'n': (0, 'n', ['n']), 'b': (1, 'b', ['n', 'b']), 'l': (1, 'l',
['n', 'l']), 's': (1, 's', ['n', 's']), 'a': (2, 'a', ['n', 'b',
'a']), 'c': (2, 'c', ['n', 'b', 'c']), 'd': (2, 'd', ['n', 'd']),
'e': (2, 'e', ['n', 'b', 'e']), 'g': (2, 'g', ['n', 'l', 'g']),
'h': (2, 'h', ['n', 'h']), 'i': (2, 'i', ['n', 'b', 'i']), 'j': (2,
'j', ['n', 's', 'j']), 'k': (2, 'k', ['n', 'b', 'k']), 'm': (2,
'm', ['n', 'b', 'm']), 'o': (2, 'o', ['n', 'o']), 'p': (2,
'p', ['n', 's', 'p']), 'r': (2, 'r', ['n', 'b', 'r']), 't': (2, 't',
['n', 'b', 't']), 'f': (3, 'f', ['n', 's', 'j', 'f']), 'q': (3, 'q',
['n', 'l', 'g', 'q'])}
>>> print(g.shortest('o'))
{'o': (0, 'o', ['o']), 'f': (1, 'f', ['o', 'f']), 'i': (1, 'i',
['o', 'i']), 'k': (1, 'k', ['o', 'k']), 'a': (2, 'a', ['o', 'a']),
'b': (2, 'b', ['o', 'i', 'b']), 'c': (2, 'c', ['o', 'c']), 'd':
(2, 'd', ['o', 'i', 'd']), 'h': (2, 'h', ['o', 'h']), 'j': (2, 'j',
['o', 'f', 'j']), 'n': (2, 'n', ['o', 'n']), 'r': (2, 'r', ['o',
'f', 'r']), 't': (2, 't', ['o', 'k', 't']), 'e': (3, 'e', ['o', 'i',
'b', 'e']), 'g': (3, 'g', ['o', 'a', 'g']), 'l': (3, 'l', ['o',
'c', 'l']), 'm': (3, 'm', ['o', 'i', 'b', 'm']), 'p': (3, 'p',
['o', 'h', 'p']), 'q': (3, 'q', ['o', 'k', 'q']), 's': (3, 's',
['o', 'a', 's'])}
>>> print(g.shortest('p'))
{'p': (0, 'p', ['p']), 'g': (1, 'g', ['p', 'g']), 'h': (1, 'h',
['p', 'h']), 's': (1, 's', ['p', 's']), 'a': (2, 'a', ['p', 'g',
'a']), 'c': (2, 'c', ['p', 'h', 'c']), 'd': (2, 'd', ['p', 'd']),
'e': (2, 'e', ['p', 'e']), 'j': (2, 'j', ['p', 's', 'j']), 'k': (2,
```

'k', ['p', 'k']), 'l': (2, 'l', ['p', 'g', 'l']), 'n': (2, 'n', ['p', 's', 'n']), 'q': (2, 'q', ['p', 'g', 'q']), 'r': (2, 'r', ['p', 'g', 'r']), 'b': (3, 'b', ['p', 'g', 'a', 'b']), 'f': (3, 'f', ['p', 'g', 'f']), 'i': (3, 'i', ['p', 'd', 'i']), 'm': (3, 'm', ['p', 'd', 'm']), 'o': (3, 'o', ['p', 'h', 'o']), 't': (3, 't', ['p', 'h', 'c', 't'])}

```
>>> print(g.shortest('q'))
```
{'q': (0, 'q', ['q']), 'g': (1, 'g', ['q', 'g']), 'a': (2, 'a', ['q', 'g', 'a']), 'k': (2, 'k', ['q', 'k']), 'l': (2, 'l', ['q', 'g', 'l']), 'p': (2, 'p', ['q', 'g', 'p']), 'r': (2, 'r', ['q', 'g', 'r']), 'b': (3, 'b', ['q', 'g', 'a', 'b']), 'c': (3, 'c', ['q', 'g', 'l', 'c']), 'd': (3, 'd', ['q', 'g', 'd']), 'e': (3, 'e', ['q', 'g', 'e']), 'f': (3, 'f', ['q', 'g', 'f']), 'h': (3, 'h', ['q', 'g', 'p', 'h']), 'i': (3, 'i', ['q', 'i']), 'j': (3, 'j', ['q', 'k', 'j']), 'm': (3, 'm', ['q', 'm']), 'n': (3, 'n', ['q', 'g', 'n']), 'o': (3, 'o', ['q', 'k', 'o']), 's': (3, 's', ['q', 'g', 'a', 's']), 't': (3, 't', ['q', 'g', 't'])}

```
>>> print(g.shortest('r'))
```
{'r': (0, 'r', ['r']), 'b': (1, 'b', ['r', 'b']), 'f': (1, 'f', ['r', 'f']), 'g': (1, 'g', ['r', 'g']), 'a': (2, 'a', ['r', 'b', 'a']), 'c': (2, 'c', ['r', 'b', 'c']), 'd': (2, 'd', ['r', 'd']), 'e': (2, 'e', ['r', 'b', 'e']), 'i': (2, 'i', ['r', 'b', 'i']), 'j': (2, 'j', ['r', 'f', 'j']), 'k': (2, 'k', ['r', 'b', 'k']), 'l': (2, 'l', ['r', 'g', 'l']), 'm': (2, 'm', ['r', 'b', 'm']), 'n': (2, 'n', ['r', 'b', 'n']), 'o': (2, 'o', ['r', 'f', 'o']), 'p': (2, 'p', ['r', 'g', 'p']), 'q': (2, 'q', ['r', 'g', 'q']), 't': (2, 't', ['r', 'b', 't']), 'h': (3, 'h', ['r', 'b', 'h']), 's': (3, 's', ['r', 'b', 'a', 's'])}

```
>>> print(g.shortest('s'))
```
{'s': (0, 's', ['s']), 'a': (1, 'a', ['s', 'a']), 'j': (1, 'j', ['s', 'j']), 'n': (1, 'n', ['s', 'n']), 'p': (1, 'p', ['s', 'p']), 'b': (2, 'b', ['s', 'a', 'b']), 'f': (2, 'f', ['s', 'j', 'f']), 'g': (2, 'g', ['s', 'a', 'g']), 'h': (2, 'h', ['s', 'p', 'h']), 'k': (2, 'k', ['s', 'j', 'k']), 'l': (2, 'l', ['s', 'n', 'l']), 'm': (2, 'm', ['s', 'm']), 't': (2, 't', ['s', 'j', 't']), 'c': (3, 'c', ['s', 'a', 'c']), 'd': (3, 'd', ['s', 'j', 'd']), 'e': (3, 'e', ['s', 'a', 'b', 'e']), 'i': (3, 'i', ['s', 'a', 'b', 'i']), 'o': (3, 'o', ['s', 'a', 'o']), 'q': (3, 'q', ['s', 'a', 'g', 'q']), 'r': (3, 'r', ['s', 'a', 'b', 'r'])}

```
>>> print(g.shortest('t'))
```
{'t': (0, 't', ['t']), 'b': (1, 'b', ['t', 'b']), 'c': (1, 'c', ['t', 'c']), 'd': (1, 'd', ['t', 'd']), 'e': (1, 'e', ['t', 'e']), 'j': (1, 'j', ['t', 'j']), 'k': (1, 'k', ['t', 'k']), 'l': (1, 'l', ['t', 'l']), 'm': (1, 'm', ['t', 'm']), 'a': (2, 'a', ['t', 'b', 'a']), 'f': (2, 'f', ['t', 'j', 'f']), 'g': (2, 'g', ['t', 'l', 'g']), 'h': (2, 'h', ['t', 'c', 'h']), 'i': (2, 'i', ['t', 'b', 'i']), 'n': (2, 'n', ['t', 'b', 'n']), 'o': (2, 'o', ['t', 'k', 'o']), 'r':

25 Nodos 50 aristas

```
>>> g.conecta('a','u',3)
>>> g.conecta('a','v',2)
>>> g.conecta('a','w',4)
>>> g.conecta('a','x',4)
>>> g.conecta('a','y',5)
>>> g.conecta('b','u',4)
>>> g.conecta('b','v',3)
>>> g.conecta('b','w',3)
>>> g.conecta('b','x',1)
>>> g.conecta('b','y',6)
>>> g.conecta('c','u',4)
>>> g.conecta('c','v',3)
>>> g.conecta('c','w',3)
>>> g.conecta('c','x',1)
>>> g.conecta('c','y',2)
>>> g.conecta('d','u',2)
>>> g.conecta('d','v',3)
>>> g.conecta('d','w',2)
>>> g.conecta('d','x',5)
>>> g.conecta('d','y',5)
>>> g.conecta('e','u',4)
>>> g.conecta('e','v',4)
>>> g.conecta('e','w',3)
>>> g.conecta('e','x',4)
>>> g.conecta('e','y',6)
>>> g.conecta('f','u',3)
>>> g.conecta('f','v',4)
>>> g.conecta('f','w',3)
>>> g.conecta('f','x',2)
>>> g.conecta('f','y',6)
>>> g.conecta('g','u',3)
>>> g.conecta('g','v',3)
>>> g.conecta('g','w',1)
>>> g.conecta('g','x',4)
>>> g.conecta('g','y',3)
>>> g.conecta('h','u',4)
>>> g.conecta('h','v',3)
>>> g.conecta('h','w',6)
>>> g.conecta('h','x',2)
>>> g.conecta('h','y',3)
>>> g.conecta('i','u',3)
>>> g.conecta('i','v',2)
```

```
>>> print(g.shortest('a'))
{'a': (0, 'a', ['a']), 'b': (1, 'b', ['a', 'b']), 'g': (1, 'g',
['a', 'g']), 's': (1, 's', ['a', 's']), 'c': (2, 'c', ['a', 'c']),
'e': (2, 'e', ['a', 'b', 'e']), 'f': (2, 'f', ['a', 'f']), 'i': (2,
'i', ['a', 'b', 'i']), 'j': (2, 'j', ['a', 's', 'j']), 'k': (2, 'k',
['a', 'k']), 'l': (2, 'l', ['a', 'l']), 'm': (2, 'm', ['a',
'm']), 'n': (2, 'n', ['a', 'n']), 'o': (2, 'o', ['a', 'o']),
'p': (2, 'p', ['a', 'g', 'p']), 'q': (2, 'q', ['a', 'g', 'q']),
'r': (2, 'r', ['a', 'b', 'r']), 't': (2, 't', ['a', 't']), 'v': (2,
'v', ['a', 'v']), 'w': (2, 'w', ['a', 'g', 'w']), 'x': (2, 'x',
['a', 'b', 'x']), '': (3, '', ['a', 'g', 'p', '']), 'd': (3, 'd',
['a', 'd']), 'h': (3, 'h', ['a', 'b', 'h']), 'u': (3, 'u', ['a',
'u']), 'y': (3, 'y', ['a', 's', 'j', 'y'])}
>>> print(g.shortest('b'))
{'b': (0, 'b', ['b']), 'a': (1, 'a', ['b', 'a']), 'c': (1, 'c',
['b', 'c']), 'e': (1, 'e', ['b', 'e']), 'i': (1, 'i', ['b', 'i']),
'k': (1, 'k', ['b', 'k']), 'm': (1, 'm', ['b', 'm']), 'n':
(1, 'n', ['b', 'n']), 'r': (1, 'r', ['b', 'r']), 't': (1, 't',
['b', 't']), 'x': (1, 'x', ['b', 'x']), 'd': (2, 'd', ['b', 'i',
'd']), 'f': (2, 'f', ['b', 'r', 'f']), 'g': (2, 'g', ['b', 'a',
'g']), 'h': (2, 'h', ['b', 'h']), 'j': (2, 'j', ['b', 'k', 'j']),
'l': (2, 'l', ['b', 'c', 'l']), 'o': (2, 'o', ['b', 'i', 'o']), 'p':
(2, 'p', ['b', 'x', 'p']), 's': (2, 's', ['b', 'a', 's']), 'u':
(2, 'u', ['b', 't', 'u']), 'v': (2, 'v', ['b', 't', 'v']), 'w':
(2, 'w', ['b', 'x', 'w']), 'y': (2, 'y', ['b', 'r', 'y']), '':
(3, '', ['b', 'x', 'p', '']), 'q': (3, 'q', ['b', 'q'])}
>>> print(g.shortest('c'))
{'c': (0, 'c', ['c']), 'b': (1, 'b', ['c', 'b']), 'e': (1, 'e',
['c', 'e']), 'h': (1, 'h', ['c', 'h']), 'l': (1, 'l', ['c', 'l']),
't': (1, 't', ['c', 't']), 'x': (1, 'x', ['c', 'x']), 'a': (2, 'a',
['c', 'b', 'a']), 'd': (2, 'd', ['c', 'd']), 'g': (2, 'g', ['c',
'l', 'g']), 'i': (2, 'i', ['c', 'b', 'i']), 'j': (2, 'j', ['c', 't',
'j']), 'k': (2, 'k', ['c', 'b', 'k']), 'm': (2, 'm', ['c', 'b',
'm']), 'n': (2, 'n', ['c', 'b', 'n']), 'o': (2, 'o', ['c',
'o']), 'p': (2, 'p', ['c', 'p']), 'r': (2, 'r', ['c', 'b', 'r']),
'u': (2, 'u', ['c', 't', 'u']), 'v': (2, 'v', ['c', 't', 'v']),
'w': (2, 'w', ['c', 'x', 'w']), 'y': (2, 'y', ['c', 'y']), '':
(3, '', ['c', 'p', '']), 'f': (3, 'f', ['c', 'f']), 'q': (3, 'q',
['c', 'q']), 's': (3, 's', ['c', 'b', 'a', 's'])}
>>> print(g.shortest('d'))
{'d': (0, 'd', ['d']), 'i': (1, 'i', ['d', 'i']), 'm': (1, 'm',
['d', 'm']), 't': (1, 't', ['d', 't']), 'b': (2, 'b', ['d', 'i',
```

```
>>> g.conecta('i','w',4)
>>> g.conecta('i','x',3)
>>> g.conecta('i','y',3)
>>> g.conecta('j','u',3)
>>> g.conecta('j','v',6)
>>> g.conecta('j','w',3)
>>> g.conecta('j','x',1)
>>> g.conecta('j','y',1)
>>> g.conecta('k','u',2)
>>> g.conecta('k','v',2)
>>> g.conecta('k','w',4)
>>> g.conecta('k','x',1)
>>> g.conecta('k','y',3)
>>> g.conecta('l','u',2)
>>> g.conecta('l','v',2)
>>> g.conecta('l','w',4)
>>> g.conecta('l','x',6)
>>> g.conecta('l','y',3)
>>> g.conecta('m','u',3)
>>> g.conecta('m','v',3)
>>> g.conecta('m','w',3)
>>> g.conecta('m','x',1)
>>> g.conecta('m','y',3)
>>> g.conecta('n','u',5)
>>> g.conecta('n','v',4)
>>> g.conecta('n','w',4)
>>> g.conecta('n','x',1)
>>> g.conecta('n','y',2)
>>> g.conecta('o','u',6)
>>> g.conecta('o','v'6)
SyntaxError: invalid syntax
>>> g.conecta('o','v',6)
>>> g.conecta('o','w',2)
>>> g.conecta('o','x',3)
>>> g.conecta('o','y',2)
>>>
KeyboardInterrupt
>>> g.conecta('p','u',3)
>>> g.conecta('p','',1)
>>> g.conecta('p','v',1)
>>> g.conecta('p','w',1)
>>> g.conecta('p','x',1)
>>> g.conecta('p','y',1)
>>> g.conecta('q','u',1)
>>> g.conecta('q','v',2)
>>> g.conecta('q','w',2)
>>> g.conecta('q','x',3)
>>> g.conecta('q','y',1)
```

```
'b']), 'c': (2, 'c', ['d', 'c']), 'e': (2, 'e', ['d', 't', 'e']),
'g': (2, 'g', ['d', 'g']), 'j': (2, 'j', ['d', 'j']), 'k': (2, 'k',
['d', 't', 'k']), 'l': (2, 'l', ['d', 't', 'l']), 'n': (2, 'n', ['d',
'n']), 'o': (2, 'o', ['d', 'i', 'o']), 'p': (2, 'p', ['d', 'p']),
'r': (2, 'r', ['d', 'r']), 'u': (2, 'u', ['d', 'u']), 'v': (2,
'v', ['d', 't', 'v']), 'w': (2, 'w', ['d', 'w']), 'x': (2, 'x',
['d', 'm', 'x']), 'y': (2, 'y', ['d', 't', 'y']), '': (3, '',
['d', 'p', '']), 'a': (3, 'a', ['d', 'i', 'b', 'a']), 'f': (3, 'f',
['d', 'f']), 'h': (3, 'h', ['d', 'c', 'h']), 'q': (3, 'q', ['d',
'q']), 's': (3, 's', ['d', 's'])}
>>> print(g.shortest('f'))
{'f': (0, 'f', ['f']), 'j': (1, 'j', ['f', 'j']), 'o': (1, 'o', ['f',
'o']), 'r': (1, 'r', ['f', 'r']), 'a': (2, 'a', ['f', 'a']), 'b':
(2, 'b', ['f', 'r', 'b']), 'g': (2, 'g', ['f', 'g']), 'h': (2,
'h', ['f', 'h']), 'i': (2, 'i', ['f', 'i']), 'k': (2, 'k', ['f', 'j',
'k']), 'l': (2, 'l', ['f', 'l']), 'm': (2, 'm', ['f', 'm']), 's':
(2, 's', ['f', 's']), 't': (2, 't', ['f', 'j', 't']), 'x': (2, 'x',
['f', 'x']), 'y': (2, 'y', ['f', 'j', 'y']), 'c': (3, 'c', ['f', 'r',
'b', 'c']), 'd': (3, 'd', ['f', 'd']), 'e': (3, 'e', ['f', 'r',
'b', 'e']), 'n': (3, 'n', ['f', 'r', 'b', 'n']), 'p': (3, 'p',
['f', 'p']), 'q': (3, 'q', ['f', 'q']), 'u': (3, 'u', ['f', 'u']),
'v': (3, 'v', ['f', 'j', 't', 'v']), 'w': (3, 'w', ['f', 'w']), '':
(4, '', ['f', 'p', ''])}
>>> print(g.shortest('g'))
{'g': (0, 'g', ['g']), 'a': (1, 'a', ['g', 'a']), 'l': (1, 'l',
['g', 'l']), 'p': (1, 'p', ['g', 'p']), 'q': (1, 'q', ['g',
'q']), 'r': (1, 'r', ['g', 'r']), 'w': (1, 'w', ['g', 'w']), '':
(2, '', ['g', 'p', '']), 'b': (2, 'b', ['g', 'a', 'b']), 'c': (2,
'c', ['g', 'l', 'c']), 'd': (2, 'd', ['g', 'd']), 'e': (2, 'e',
['g', 'e']), 'f': (2, 'f', ['g', 'f']), 'h': (2, 'h', ['g', 'p',
'h']), 'n': (2, 'n', ['g', 'n']), 's': (2, 's', ['g', 'a', 's']),
't': (2, 't', ['g', 't']), 'u': (2, 'u', ['g', 'q', 'u']), 'v':
(2, 'v', ['g', 'p', 'v']), 'x': (2, 'x', ['g', 'p', 'x']), 'y': (2,
2, 'y', ['g', 'p', 'y']), 'i': (3, 'i', ['g', 'a', 'b', 'i']), 'j':
(3, 'j', ['g', 'f', 'j']), 'k': (3, 'k', ['g', 'a', 'k']), 'm': (3,
'm', ['g', 'a', 'm']), 'o': (3, 'o', ['g', 'a', 'o'])}
>>> print(g.shortest('h'))
{'h': (0, 'h', ['h']), 'c': (1, 'c', ['h', 'c']), 'p': (1, 'p',
['h', 'p']), '': (2, '', ['h', 'p', '']), 'b': (2, 'b', ['h', 'c',
'b']), 'e': (2, 'e', ['h', 'c', 'e']), 'f': (2, 'f', ['h', 'f']),
'g': (2, 'g', ['h', 'p', 'g']), 'j': (2, 'j', ['h', 'j']), 'l': (2,
'l', ['h', 'c', 'l']), 'n': (2, 'n', ['h', 'n']), 'o': (2, 'o',
['h', 'o']), 's': (2, 's', ['h', 'p', 's']), 't': (2, 't', ['h',
'c', 't']), 'v': (2, 'v', ['h', 'p', 'v']), 'w': (2, 'w', ['h',
'p', 'w']), 'x': (2, 'x', ['h', 'c', 'x']), 'y': (2, 'y', ['h',
'p', 'y']), 'a': (3, 'a', ['h', 'c', 'b', 'a']), 'd': (3, 'd',
['h', 'c', 'd']), 'i': (3, 'i', ['h', 'c', 'b', 'i']), 'k': (3, 'k',
['h', 'c', 'b', 'k']), 'm': (3, 'm', ['h', 'c', 'b', 'm']),
```

```
>>> g.conecta('r','u',2)
>>> g.conecta('r','v',2)
>>> g.conecta('r','w',2)
>>> g.conecta('r','x',2)
>>> g.conecta('r','y',2)
>>> g.conecta('s','u',2)
>>> g.conecta('r','v',3)
>>> g.conecta('r','w',5)
>>> g.conecta('r','x',5)
>>> g.conecta('r','y',1)
>>> g.conecta('s','v',3)
>>> g.conecta('s','w',1)
>>> g.conecta('s','x',4)
>>> g.conecta('s','y',2)
>>> g.conecta('t','u',1)
>>> g.conecta('t','v',1)
>>> g.conecta('t','w',3)
>>> g.conecta('t','x',5)
>>> g.conecta('t','y',1)
>>> g.conecta('u','v',1)
>>> g.conecta('u','w',2)
>>> g.conecta('u','x',3)
>>> g.conecta('u','y',4)
>>> g.conecta('v','w',3)
>>> g.conecta('v','x',3)
>>> g.conecta('v','y',4)
>>> g.conecta('w','x',1)
>>> g.conecta('w','y',4)
>>> g.conecta('x','y',2)
```

```
'q': (3, 'q', ['h', 'p', 'g', 'q']), 'r': (3, 'r', ['h', 'c', 'b',
'r']), 'u': (3, 'u', ['h', 'c', 't', 'u'])}
>>> print(g.shortest('i'))
{'i': (0, 'i', ['i']), 'b': (1, 'b', ['i', 'b']), 'd': (1, 'd',
['i', 'd']), 'o': (1, 'o', ['i', 'o']), 'a': (2, 'a', ['i', 'b',
'a']), 'c': (2, 'c', ['i', 'b', 'c']), 'e': (2, 'e', ['i', 'b',
'e']), 'f': (2, 'f', ['i', 'f']), 'k': (2, 'k', ['i', 'b', 'k']),
'm': (2, 'm', ['i', 'b', 'm']), 'n': (2, 'n', ['i', 'b', 'n']),
'r': (2, 'r', ['i', 'b', 'r']), 't': (2, 't', ['i', 'b', 't']), 'v':
(2, 'v', ['i', 'v']), 'x': (2, 'x', ['i', 'b', 'x']), 'g': (3, 'g',
['i', 'b', 'a', 'g']), 'h': (3, 'h', ['i', 'b', 'h']), 'j': (3, 'j',
['i', 'd', 'j']), 'l': (3, 'l', ['i', 'b', 'c', 'l']), 'p': (3, 'p',
['i', 'd', 'p']), 'q': (3, 'q', ['i', 'q']), 's': (3, 's', ['i',
'b', 'a', 's']), 'u': (3, 'u', ['i', 'd', 'u']), 'w': (3, 'w',
['i', 'd', 'w']), 'y': (3, 'y', ['i', 'y']), '': (4, '', ['i', 'd',
'p', ''])}
>>> print(g.shortest('j'))
{'j': (0, 'j', ['j']), 'f': (1, 'f', ['j', 'f']), 'k': (1, 'k', ['j',
'k']), 's': (1, 's', ['j', 's']), 't': (1, 't', ['j', 't']), 'x': (1,
'x', ['j', 'x']), 'y': (1, 'y', ['j', 'y']), 'a': (2, 'a', ['j', 's',
'a']), 'b': (2, 'b', ['j', 'k', 'b']), 'c': (2, 'c', ['j', 't',
'c']), 'd': (2, 'd', ['j', 'd']), 'e': (2, 'e', ['j', 't', 'e']),
'h': (2, 'h', ['j', 'h']), 'l': (2, 'l', ['j', 't', 'l']), 'm': (2,
'm', ['j', 'm']), 'n': (2, 'n', ['j', 's', 'n']), 'o': (2, 'o',
['j', 'f', 'o']), 'p': (2, 'p', ['j', 's', 'p']), 'q': (2, 'q',
['j', 'y', 'q']), 'r': (2, 'r', ['j', 'f', 'r']), 'u': (2, 'u', ['j',
't', 'u']), 'v': (2, 'v', ['j', 't', 'v']), 'w': (2, 'w', ['j',
's', 'w']), '': (3, '', ['j', 's', 'p', '']), 'g': (3, 'g', ['j', 's',
'a', 'g']), 'i': (3, 'i', ['j', 'k', 'b', 'i'])}
>>> print(g.shortest('k'))
{'k': (0, 'k', ['k']), 'b': (1, 'b', ['k', 'b']), 'j': (1, 'j',
['k', 'j']), 'o': (1, 'o', ['k', 'o']), 't': (1, 't', ['k', 't']),
'x': (1, 'x', ['k', 'x']), 'a': (2, 'a', ['k', 'b', 'a']), 'c':
(2, 'c', ['k', 'b', 'c']), 'd': (2, 'd', ['k', 't', 'd']), 'e':
(2, 'e', ['k', 'b', 'e']), 'f': (2, 'f', ['k', 'j', 'f']), 'i': (2,
'i', ['k', 'b', 'i']), 'l': (2, 'l', ['k', 't', 'l']), 'm': (2, 'm',
['k', 'b', 'm']), 'n': (2, 'n', ['k', 'b', 'n']), 'p': (2, 'p',
['k', 'p']), 'q': (2, 'q', ['k', 'q']), 'r': (2, 'r', ['k', 'b',
'r']), 's': (2, 's', ['k', 'j', 's']), 'u': (2, 'u', ['k', 'u']),
'v': (2, 'v', ['k', 'v']), 'w': (2, 'w', ['k', 'x', 'w']), 'y':
(2, 'y', ['k', 'j', 'y']), '': (3, '', ['k', 'p', '']), 'g': (3,
'g', ['k', 'b', 'a', 'g']), 'h': (3, 'h', ['k', 'b', 'h'])}
>>> print(g.shortest('l'))
{'l': (0, 'l', ['l']), 'c': (1, 'c', ['l', 'c']), 'g': (1, 'g', ['l',
'g']), 'n': (1, 'n', ['l', 'n']), 't': (1, 't', ['l', 't']), 'a':
(2, 'a', ['l', 'g', 'a']), 'b': (2, 'b', ['l', 'c', 'b']), 'd':
(2, 'd', ['l', 't', 'd']), 'e': (2, 'e', ['l', 'c', 'e']), 'f': (2,
'f', ['l', 'f']), 'h': (2, 'h', ['l', 'c', 'h']), 'j': (2, 'j', ['l',
```

't', 'j']), 'k': (2, 'k', ['l', 't', 'k']), 'm': (2, 'm', ['l', 'm']), 'p': (2, 'p', ['l', 'g', 'p']), 'q': (2, 'q', ['l', 'g', 'q']), 'r': (2, 'r', ['l', 'g', 'r']), 's': (2, 's', ['l', 'n', 's']), 'u': (2, 'u', ['l', 'u']), 'v': (2, 'v', ['l', 'v']), 'w': (2, 'w', ['l', 'g', 'w']), 'x': (2, 'x', ['l', 'c', 'x']), 'y': (2, 'y', ['l', 't', 'y']), '': (3, '', ['l', 'g', 'p', '']), 'i': (3, 'i', ['l', 'c', 'b', 'i']), 'o': (3, 'o', ['l', 'c', 'o'])}

```
>>> print(g.shortest('m'))
```

{'m': (0, 'm', ['m']), 'b': (1, 'b', ['m', 'b']), 'd': (1, 'd', ['m', 'd']), 't': (1, 't', ['m', 't']), 'x': (1, 'x', ['m', 'x']), 'a': (2, 'a', ['m', 'b', 'a']), 'c': (2, 'c', ['m', 'b', 'c']), 'e': (2, 'e', ['m', 'b', 'e']), 'f': (2, 'f', ['m', 'f']), 'i': (2, 'i', ['m', 'b', 'i']), 'j': (2, 'j', ['m', 'j']), 'k': (2, 'k', ['m', 'b', 'k']), 'l': (2, 'l', ['m', 'l']), 'n': (2, 'n', ['m', 'b', 'n']), 'p': (2, 'p', ['m', 'x', 'p']), 'r': (2, 'r', ['m', 'b', 'r']), 's': (2, 's', ['m', 's']), 'u': (2, 'u', ['m', 't', 'u']), 'v': (2, 'v', ['m', 't', 'v']), 'w': (2, 'w', ['m', 'x', 'w']), 'y': (2, 'y', ['m', 't', 'y']), '': (3, '', ['m', 'x', 'p', '']), 'g': (3, 'g', ['m', 'b', 'a', 'g']), 'h': (3, 'h', ['m', 'b', 'h']), 'o': (3, 'o', ['m', 'f', 'o']), 'q': (3, 'q', ['m', 'q'])}

```
>>> print(g.shortest('n'))
```

{'n': (0, 'n', ['n']), 'b': (1, 'b', ['n', 'b']), 'l': (1, 'l', ['n', 'l']), 's': (1, 's', ['n', 's']), 'x': (1, 'x', ['n', 'x']), 'a': (2, 'a', ['n', 'b', 'a']), 'c': (2, 'c', ['n', 'b', 'c']), 'd': (2, 'd', ['n', 'd']), 'e': (2, 'e', ['n', 'b', 'e']), 'g': (2, 'g', ['n', 'l', 'g']), 'h': (2, 'h', ['n', 'h']), 'i': (2, 'i', ['n', 'b', 'i']), 'j': (2, 'j', ['n', 's', 'j']), 'k': (2, 'k', ['n', 'b', 'k']), 'm': (2, 'm', ['n', 'b', 'm']), 'o': (2, 'o', ['n', 'o']), 'p': (2, 'p', ['n', 's', 'p']), 'r': (2, 'r', ['n', 'b', 'r']), 't': (2, 't', ['n', 'b', 't']), 'w': (2, 'w', ['n', 's', 'w']), 'y': (2, 'y', ['n', 'y']), '': (3, '', ['n', 's', 'p', '']), 'f': (3, 'f', ['n', 's', 'j', 'f']), 'q': (3, 'q', ['n', 'l', 'g', 'q']), 'u': (3, 'u', ['n', 'l', 'u']), 'v': (3, 'v', ['n', 'l', 'v'])}

```
>>> print(g.shortest('o'))
```

{'o': (0, 'o', ['o']), 'f': (1, 'f', ['o', 'f']), 'i': (1, 'i', ['o', 'i']), 'k': (1, 'k', ['o', 'k']), 'a': (2, 'a', ['o', 'a']), 'b': (2, 'b', ['o', 'i', 'b']), 'c': (2, 'c', ['o', 'c']), 'd': (2, 'd', ['o', 'i', 'd']), 'h': (2, 'h', ['o', 'h']), 'j': (2, 'j', ['o', 'f', 'j']), 'n': (2, 'n', ['o', 'n']), 'r': (2, 'r', ['o', 'f', 'r']), 't': (2, 't', ['o', 'k', 't']), 'w': (2, 'w', ['o', 'w']), 'x': (2, 'x', ['o', 'k', 'x']), 'y': (2, 'y', ['o', 'y']), 'e': (3, 'e', ['o', 'i', 'b', 'e']), 'g': (3, 'g', ['o', 'a', 'g']), 'l': (3, 'l', ['o', 'c', 'l']), 'm': (3, 'm', ['o', 'i', 'b', 'm']), 'p': (3, 'p', ['o', 'h', 'p']), 'q': (3, 'q', ['o', 'k', 'q']), 's': (3, 's', ['o', 'a', 's']), 'u': (3, 'u', ['o',

```
'k', 'u']), 'v': (3, 'v', ['o', 'i', 'v']), '': (4, '', ['o', 'h',
'p', ''])}
>>> print(g.shortest('p'))
{'p': (0, 'p', ['p']), '': (1, '', ['p', '']), 'g': (1, 'g', ['p',
'g']), 'h': (1, 'h', ['p', 'h']), 's': (1, 's', ['p', 's']), 'v':
(1, 'v', ['p', 'v']), 'w': (1, 'w', ['p', 'w']), 'x': (1, 'x',
['p', 'x']), 'y': (1, 'y', ['p', 'y']), 'a': (2, 'a', ['p', 'g',
'a']), 'b': (2, 'b', ['p', 'x', 'b']), 'c': (2, 'c', ['p', 'h',
'c']), 'd': (2, 'd', ['p', 'd']), 'e': (2, 'e', ['p', 'e']), 'j':
(2, 'j', ['p', 's', 'j']), 'k': (2, 'k', ['p', 'k']), 'l': (2, 'l',
['p', 'g', 'l']), 'm': (2, 'm', ['p', 'x', 'm']), 'n': (2, 'n',
['p', 's', 'n']), 'q': (2, 'q', ['p', 'g', 'q']), 'r': (2, 'r',
['p', 'g', 'r']), 't': (2, 't', ['p', 'v', 't']), 'u': (2, 'u',
['p', 'v', 'u']), 'f': (3, 'f', ['p', 'g', 'f']), 'i': (3, 'i', ['p',
'x', 'b', 'i']), 'o': (3, 'o', ['p', 'h', 'o'])}
>>> print(g.shortest('q'))
{'q': (0, 'q', ['q']), 'g': (1, 'g', ['q', 'g']), 'u': (1, 'u',
['q', 'u']), 'y': (1, 'y', ['q', 'y']), 'a': (2, 'a', ['q', 'g',
'a']), 'j': (2, 'j', ['q', 'y', 'j']), 'k': (2, 'k', ['q', 'k']),
'l': (2, 'l', ['q', 'g', 'l']), 'p': (2, 'p', ['q', 'g', 'p']), 'r':
(2, 'r', ['q', 'g', 'r']), 't': (2, 't', ['q', 'u', 't']), 'v': (2,
'v', ['q', 'v']), 'w': (2, 'w', ['q', 'g', 'w']), '': (3, '',
['q', 'g', 'p', '']), 'b': (3, 'b', ['q', 'g', 'a', 'b']), 'c':
(3, 'c', ['q', 'g', 'l', 'c']), 'd': (3, 'd', ['q', 'g', 'd']),
'e': (3, 'e', ['q', 'g', 'e']), 'f': (3, 'f', ['q', 'g', 'f']),
'h': (3, 'h', ['q', 'g', 'p', 'h']), 'i': (3, 'i', ['q', 'i']),
'm': (3, 'm', ['q', 'm']), 'n': (3, 'n', ['q', 'g', 'n']),
'o': (3, 'o', ['q', 'k', 'o']), 's': (3, 's', ['q', 'g', 'a',
's']), 'x': (3, 'x', ['q', 'y', 'j', 'x'])}
>>> print(g.shortest('r'))
{'r': (0, 'r', ['r']), 'b': (1, 'b', ['r', 'b']), 'f': (1, 'f',
['r', 'f']), 'g': (1, 'g', ['r', 'g']), 'y': (1, 'y', ['r', 'y']),
'a': (2, 'a', ['r', 'b', 'a']), 'c': (2, 'c', ['r', 'b', 'c']),
'd': (2, 'd', ['r', 'd']), 'e': (2, 'e', ['r', 'b', 'e']), 'i':
(2, 'i', ['r', 'b', 'i']), 'j': (2, 'j', ['r', 'f', 'j']), 'k': (2,
'k', ['r', 'b', 'k']), 'l': (2, 'l', ['r', 'g', 'l']), 'm': (2,
'm', ['r', 'b', 'm']), 'n': (2, 'n', ['r', 'b', 'n']), 'o': (2,
'o', ['r', 'f', 'o']), 'p': (2, 'p', ['r', 'g', 'p']), 'q': (2,
'q', ['r', 'g', 'q']), 't': (2, 't', ['r', 'b', 't']), 'u': (2,
'u', ['r', 'u']), 'w': (2, 'w', ['r', 'g', 'w']), 'x': (2, 'x',
['r', 'b', 'x']), '': (3, '', ['r', 'g', 'p', '']), 'h': (3, 'h',
['r', 'b', 'h']), 's': (3, 's', ['r', 'b', 'a', 's']), 'v': (3,
'v', ['r', 'g', 'p', 'v'])}
>>> print(g.shortest('s'))
{'s': (0, 's', ['s']), 'a': (1, 'a', ['s', 'a']), 'j': (1, 'j',
['s', 'j']), 'n': (1, 'n', ['s', 'n']), 'p': (1, 'p', ['s', 'p']),
'w': (1, 'w', ['s', 'w']), '': (2, '', ['s', 'p', '']), 'b': (2,
'b', ['s', 'a', 'b']), 'f': (2, 'f', ['s', 'j', 'f']), 'g': (2, 'g',
```

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['s', 'a', 'g']), 'h': (2, 'h', ['s', 'p', 'h']), 'k': (2, 'k',
['s', 'j', 'k']), 'l': (2, 'l', ['s', 'n', 'l']), 'm': (2, 'm',
['s', 'm']), 't': (2, 't', ['s', 'j', 't']), 'u': (2, 'u', ['s',
'u']), 'v': (2, 'v', ['s', 'p', 'v']), 'x': (2, 'x', ['s', 'j',
'x']), 'y': (2, 'y', ['s', 'j', 'y']), 'c': (3, 'c', ['s', 'a',
'c']), 'd': (3, 'd', ['s', 'j', 'd']), 'e': (3, 'e', ['s', 'a',
'b', 'e']), 'i': (3, 'i', ['s', 'a', 'b', 'i']), 'o': (3, 'o', ['s',
'a', 'o']), 'q': (3, 'q', ['s', 'a', 'g', 'q']), 'r': (3, 'r',
['s', 'a', 'b', 'r'])}
>>> print(g.shortest('t'))
{'t': (0, 't', ['t']), 'b': (1, 'b', ['t', 'b']), 'c': (1, 'c',
['t', 'c']), 'd': (1, 'd', ['t', 'd']), 'e': (1, 'e', ['t', 'e']),
'j': (1, 'j', ['t', 'j']), 'k': (1, 'k', ['t', 'k']), 'l': (1, 'l',
['t', 'l']), 'm': (1, 'm', ['t', 'm']), 'u': (1, 'u', ['t',
'u']), 'v': (1, 'v', ['t', 'v']), 'y': (1, 'y', ['t', 'y']), 'a':
(2, 'a', ['t', 'b', 'a']), 'f': (2, 'f', ['t', 'j', 'f']), 'g': (2,
'g', ['t', 'l', 'g']), 'h': (2, 'h', ['t', 'c', 'h']), 'i': (2, 'i',
['t', 'b', 'i']), 'n': (2, 'n', ['t', 'b', 'n']), 'o': (2, 'o',
['t', 'k', 'o']), 'p': (2, 'p', ['t', 'v', 'p']), 'q': (2, 'q',
['t', 'u', 'q']), 'r': (2, 'r', ['t', 'b', 'r']), 's': (2, 's', ['t',
'j', 's']), 'x': (2, 'x', ['t', 'b', 'x']), '': (3, '', ['t', 'v',
'p', '']), 'w': (3, 'w', ['t', 'd', 'w'])}
>>> print(g.shortest('u'))
{'u': (0, 'u', ['u']), 'q': (1, 'q', ['u', 'q']), 't': (1, 't',
['u', 't']), 'v': (1, 'v', ['u', 'v']), 'b': (2, 'b', ['u', 't',
'b']), 'c': (2, 'c', ['u', 't', 'c']), 'd': (2, 'd', ['u', 't',
'd']), 'e': (2, 'e', ['u', 't', 'e']), 'g': (2, 'g', ['u', 'q',
'g']), 'j': (2, 'j', ['u', 't', 'j']), 'k': (2, 'k', ['u', 't',
'k']), 'l': (2, 'l', ['u', 't', 'l']), 'm': (2, 'm', ['u', 't',
'm']), 'p': (2, 'p', ['u', 'v', 'p']), 'r': (2, 'r', ['u', 'r']),
's': (2, 's', ['u', 's']), 'w': (2, 'w', ['u', 'w']), 'y': (2,
'y', ['u', 'q', 'y']), '': (3, '', ['u', 'v', 'p', '']), 'a': (3,
'a', ['u', 't', 'b', 'a']), 'f': (3, 'f', ['u', 't', 'j', 'f']), 'h':
(3, 'h', ['u', 't', 'c', 'h']), 'i': (3, 'i', ['u', 't', 'b', 'i']),
'n': (3, 'n', ['u', 't', 'b', 'n']), 'o': (3, 'o', ['u', 't', 'k',
'o']), 'x': (3, 'x', ['u', 't', 'b', 'x'])}
>>> print(g.shortest('v'))
{'v': (0, 'v', ['v']), 'p': (1, 'p', ['v', 'p']), 't': (1, 't',
['v', 't']), 'u': (1, 'u', ['v', 'u']), '': (2, '', ['v', 'p', '']),
'a': (2, 'a', ['v', 'a']), 'b': (2, 'b', ['v', 't', 'b']), 'c':
(2, 'c', ['v', 't', 'c']), 'd': (2, 'd', ['v', 't', 'd']), 'e':
(2, 'e', ['v', 't', 'e']), 'g': (2, 'g', ['v', 'p', 'g']), 'h':
(2, 'h', ['v', 'p', 'h']), 'i': (2, 'i', ['v', 'i']), 'j': (2, 'j',
['v', 't', 'j']), 'k': (2, 'k', ['v', 't', 'k']), 'l': (2, 'l', ['v',
't', 'l']), 'm': (2, 'm', ['v', 't', 'm']), 'q': (2, 'q', ['v',
'u', 'q']), 's': (2, 's', ['v', 'p', 's']), 'w': (2, 'w', ['v',
'p', 'w']), 'x': (2, 'x', ['v', 'p', 'x']), 'y': (2, 'y', ['v',
'p', 'y']), 'f': (3, 'f', ['v', 't', 'j', 'f']), 'n': (3, 'n', ['v',
```

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't', 'b', 'n']), 'o': (3, 'o', ['v', 'i', 'o']), 'r': (3, 'r',
['v', 't', 'b', 'r'])}
>>> print(g.shortest('w'))
{'w': (0, 'w', ['w']), 'g': (1, 'g', ['w', 'g']), 'p': (1,
'p', ['w', 'p']), 's': (1, 's', ['w', 's']), 'x': (1, 'x', ['w',
'x']), '': (2, '', ['w', 'p', '']), 'a': (2, 'a', ['w', 'g',
'a']), 'b': (2, 'b', ['w', 'x', 'b']), 'c': (2, 'c', ['w', 'x',
'c']), 'd': (2, 'd', ['w', 'd']), 'h': (2, 'h', ['w', 'p',
'h']), 'j': (2, 'j', ['w', 's', 'j']), 'k': (2, 'k', ['w', 'x',
'k']), 'l': (2, 'l', ['w', 'g', 'l']), 'm': (2, 'm', ['w', 'x',
'm']), 'n': (2, 'n', ['w', 's', 'n']), 'o': (2, 'o', ['w',
'o']), 'q': (2, 'q', ['w', 'g', 'q']), 'r': (2, 'r', ['w', 'g',
'r']), 'u': (2, 'u', ['w', 'u']), 'v': (2, 'v', ['w', 'p',
'v']), 'y': (2, 'y', ['w', 'p', 'y']), 'e': (3, 'e', ['w', 'x',
'b', 'e']), 'f': (3, 'f', ['w', 'g', 'f']), 'i': (3, 'i', ['w', 'x',
'b', 'i']), 't': (3, 't', ['w', 'x', 'b', 't'])}
>>> print(g.shortest(''x'))

SyntaxError: invalid syntax
>>> print(g.shortest('x'))
{'x': (0, 'x', ['x']), 'b': (1, 'b', ['x', 'b']), 'c': (1, 'c',
['x', 'c']), 'j': (1, 'j', ['x', 'j']), 'k': (1, 'k', ['x', 'k']),
'm': (1, 'm', ['x', 'm']), 'n': (1, 'n', ['x', 'n']), 'p':
(1, 'p', ['x', 'p']), 'w': (1, 'w', ['x', 'w']), '': (2, '',
['x', 'p', '']), 'a': (2, 'a', ['x', 'b', 'a']), 'd': (2, 'd',
['x', 'm', 'd']), 'e': (2, 'e', ['x', 'b', 'e']), 'f': (2, 'f',
['x', 'j', 'f']), 'g': (2, 'g', ['x', 'p', 'g']), 'h': (2, 'h',
['x', 'c', 'h']), 'i': (2, 'i', ['x', 'b', 'i']), 'l': (2, 'l', ['x',
'c', 'l']), 'o': (2, 'o', ['x', 'k', 'o']), 'r': (2, 'r', ['x', 'b',
'r']), 's': (2, 's', ['x', 'j', 's']), 't': (2, 't', ['x', 'b', 't']),
'v': (2, 'v', ['x', 'p', 'v']), 'y': (2, 'y', ['x', 'j', 'y']),
'q': (3, 'q', ['x', 'p', 'g', 'q']), 'u': (3, 'u', ['x', 'k',
'u'])}
>>> print(g.shortest('y'))
{'y': (0, 'y', ['y']), 'j': (1, 'j', ['y', 'j']), 'p': (1, 'p',
['y', 'p']), 'q': (1, 'q', ['y', 'q']), 'r': (1, 'r', ['y', 'r']),
't': (1, 't', ['y', 't']), '': (2, '', ['y', 'p', '']), 'b': (2,
'b', ['y', 'r', 'b']), 'c': (2, 'c', ['y', 't', 'c']), 'd': (2,
'd', ['y', 't', 'd']), 'e': (2, 'e', ['y', 't', 'e']), 'f': (2, 'f',
['y', 'j', 'f']), 'g': (2, 'g', ['y', 'p', 'g']), 'h': (2, 'h',
['y', 'p', 'h']), 'k': (2, 'k', ['y', 'j', 'k']), 'l': (2, 'l', ['y',
't', 'l']), 'm': (2, 'm', ['y', 't', 'm']), 'n': (2, 'n', ['y',
'n']), 'o': (2, 'o', ['y', 'o']), 's': (2, 's', ['y', 'j', 's']),
'u': (2, 'u', ['y', 'q', 'u']), 'v': (2, 'v', ['y', 'p', 'v']),
'w': (2, 'w', ['y', 'p', 'w']), 'x': (2, 'x', ['y', 'j', 'x']),
'a': (3, 'a', ['y', 'r', 'b', 'a']), 'i': (3, 'i', ['y', 'r', 'b',
'i'])}
```