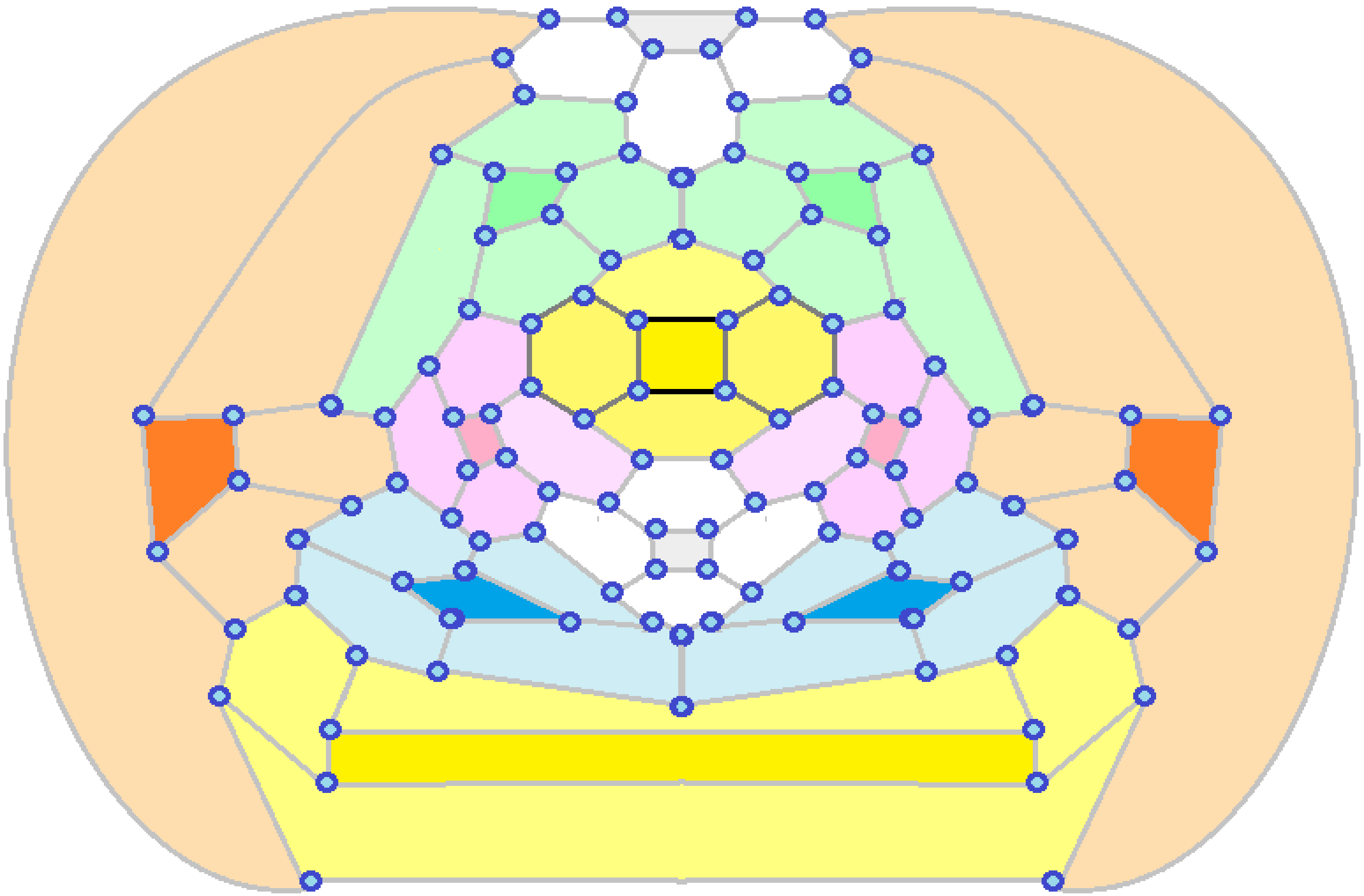
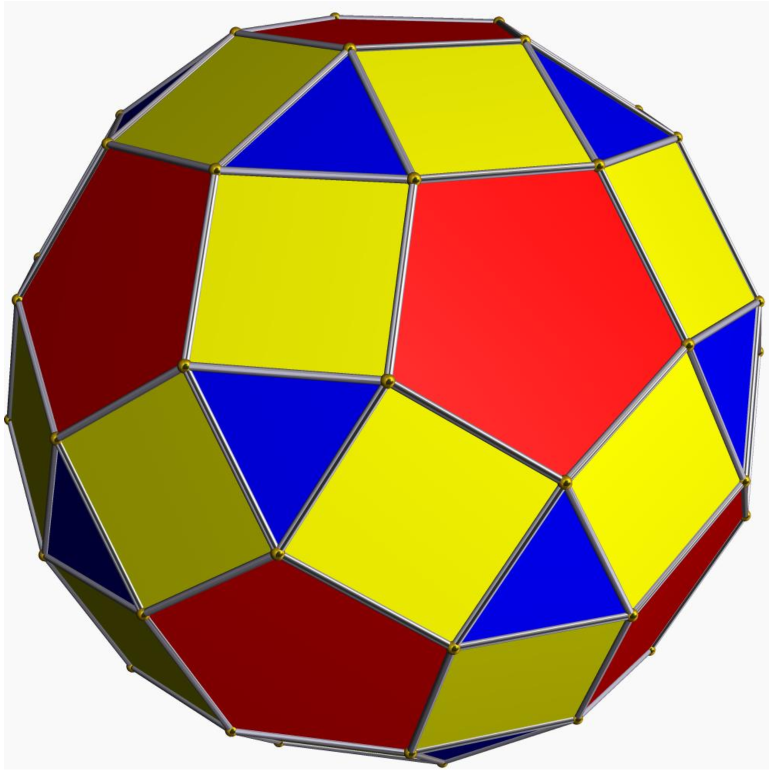
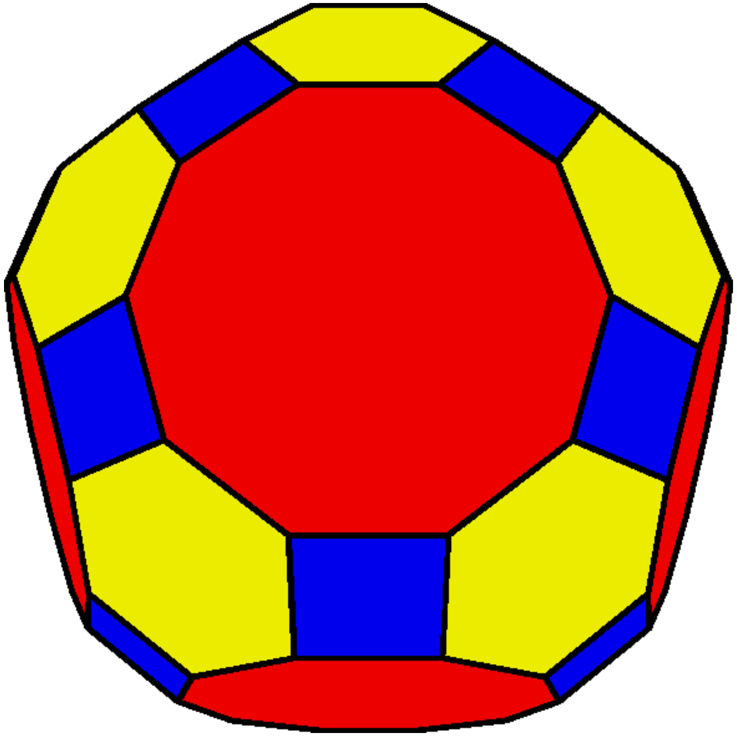
Is bumpy chiral? One picture of bumpy:





Small
Rhombicosadodecahedron
[On Big Bang Theory]



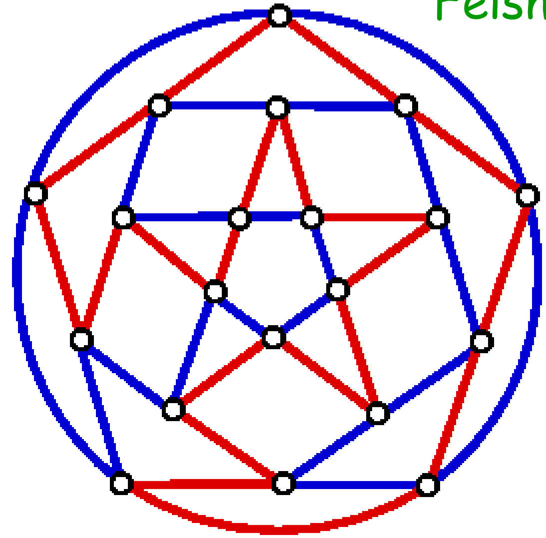
Great
Rhombicosadodecahedron
[rhombi]

Pictures from:

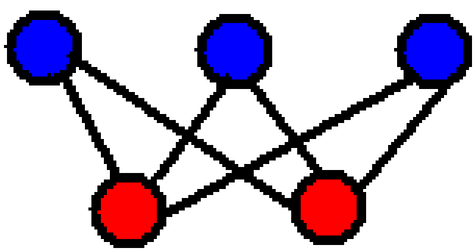
http://upload.wikimedia.org/wikipedia/commons/3/31/Small_rhombicosidodecahedron.png
http://gnu.ist.utl.pt/software/3dldf/grtrhmb.html

Assignment #2 is available from the class web page.

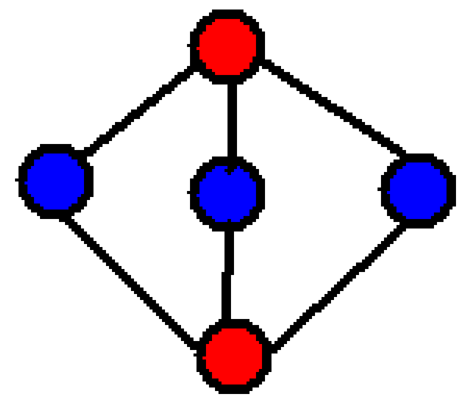
Stefan Felsner



A graph G is planar if it can be drawn on the plane with no crossing edges.



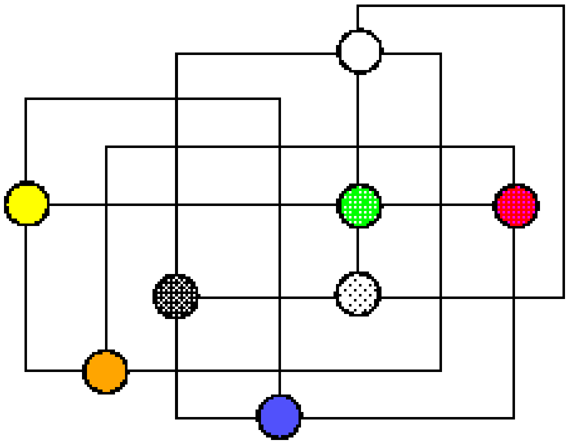
planar graph G



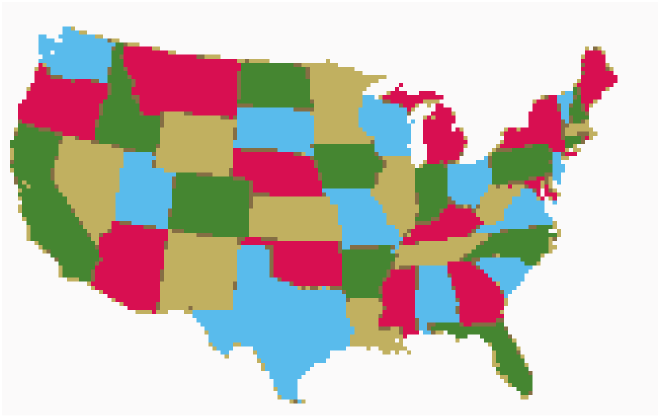
planar embedding of G

Used as a starting point to find nice pictures of non-planar graphs:

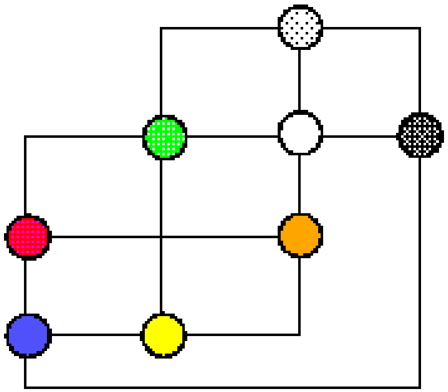
Map 4-colouring:



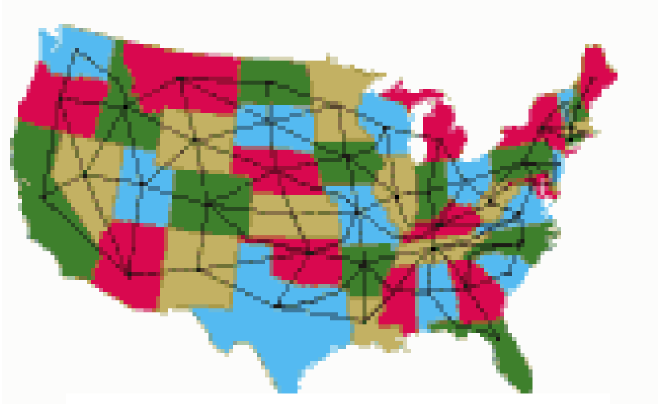
A graph showing normal relationships with lots of crossings in it.

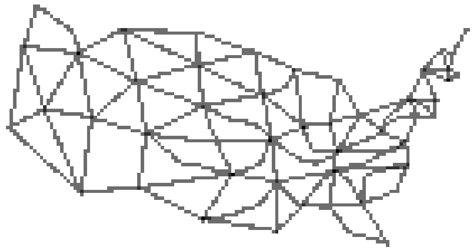


Codeguru



The same graph optimized to show only one crossing in it. The relations are maintained as it is.





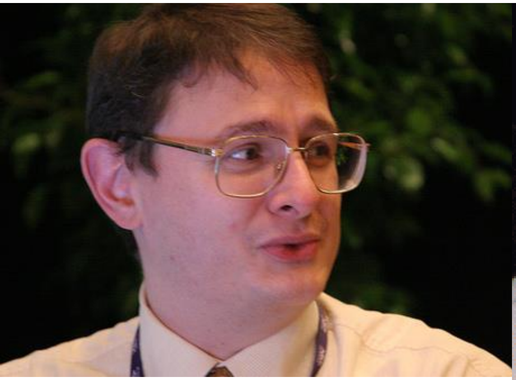
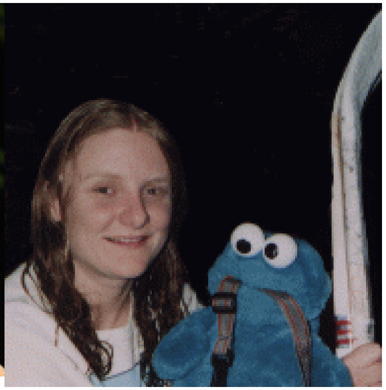
Linear time algorithms for embedding:

Hopcroft & Tarjan, '74

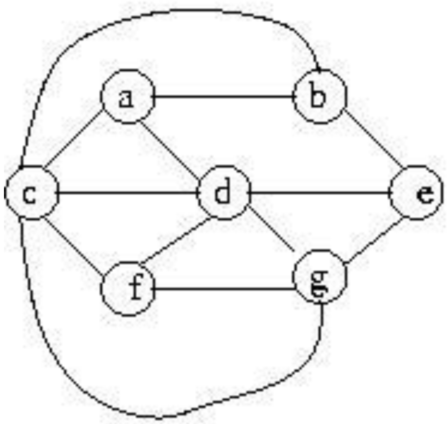
Booth and Lueker, '76

Boyer & Myrvold, '01

OPEN: Find a really simple $O(n)$ or maybe $O(n \log n)$ algorithm.

Rotation Systems



a: b d c
b: a c e
c: a d f g b
d: a e g f c
e: b g d
f: c d g
g: c f d e

G connected on an orientable surface:

g= (2 - n + m - f)/2

0 plane

1 torus

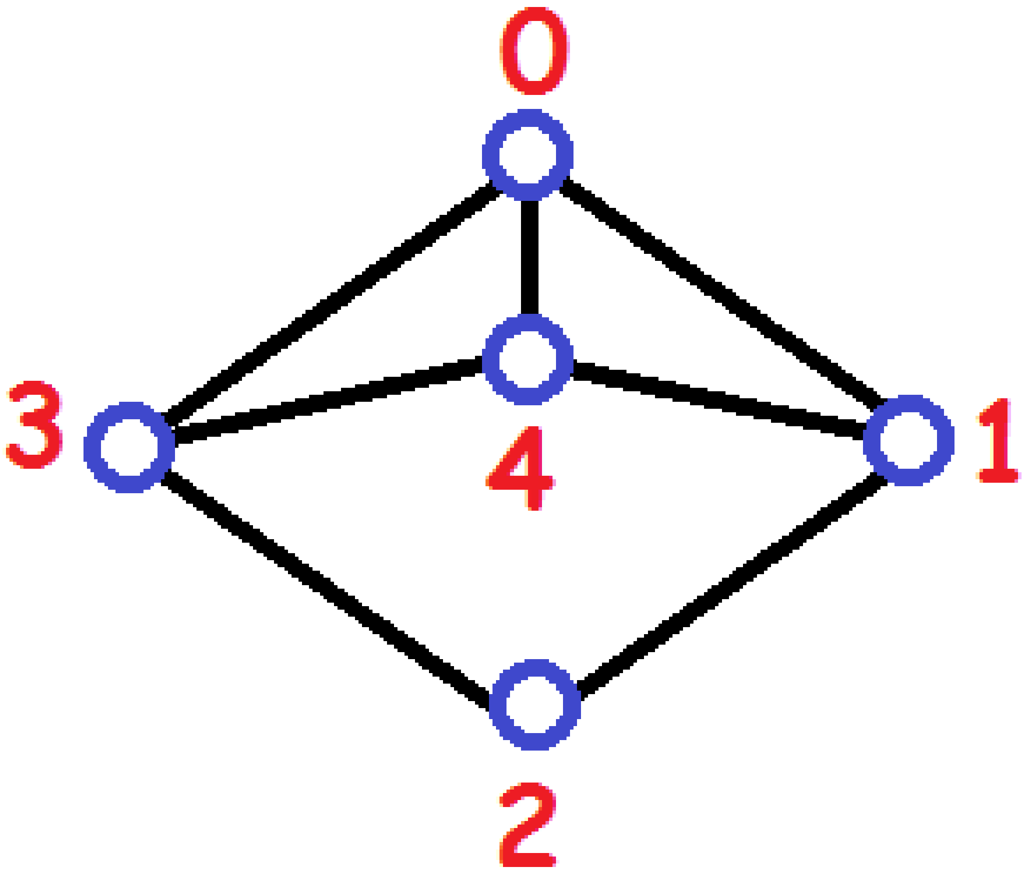
2

Greg McShane

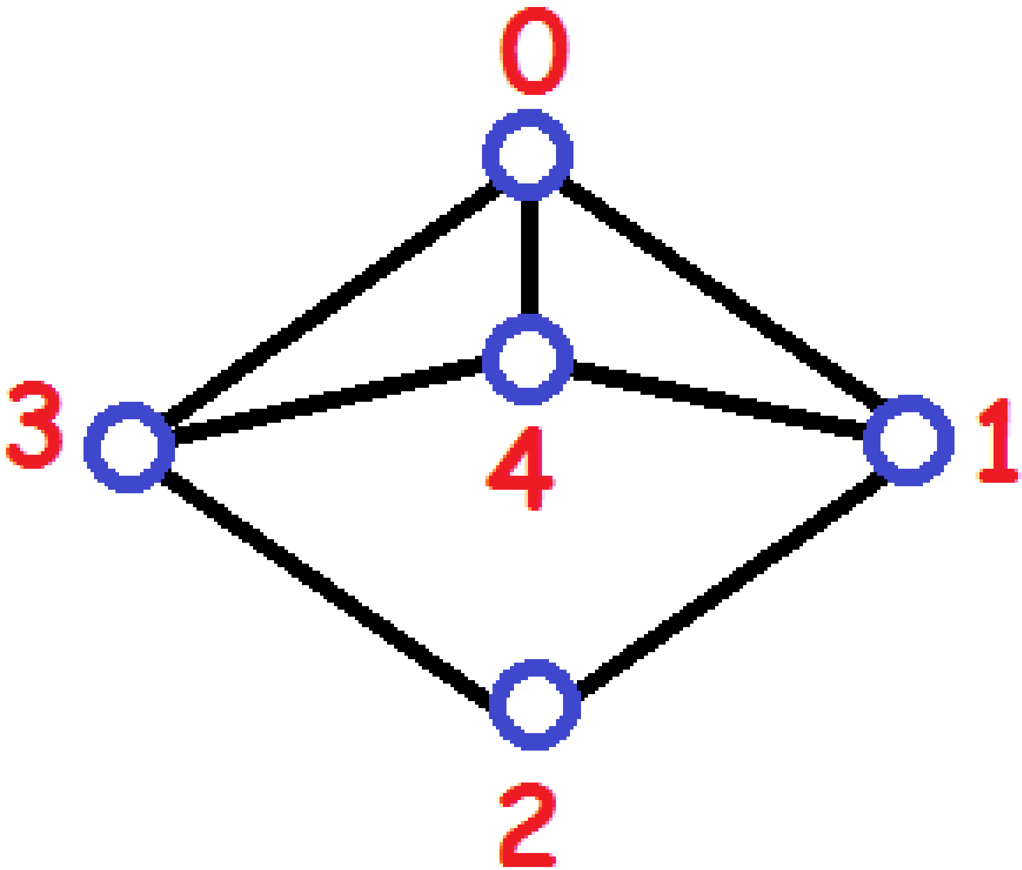
F0: (a, b)(b, c)(c, a)(a, b)

F1: (a, d)(d, e)(e, b)(b, a)(a, d)

What is the rotation system for this graph?



What is the rotation system for this graph?



0: 1 4 3
1: 0 2 4
2: 1 3
3: 0 4 2
4: 0 1 3

To walk the faces from a rotation system:

Treat each edge as two arcs:
(u,v) → (u, v) and (v,u).

Mark all arcs as not visited.

For each unvisited arc (u,v) do:
walk the face with (u, v).

To walk the face with (u,v):

Arcs traversed are marked as visited.

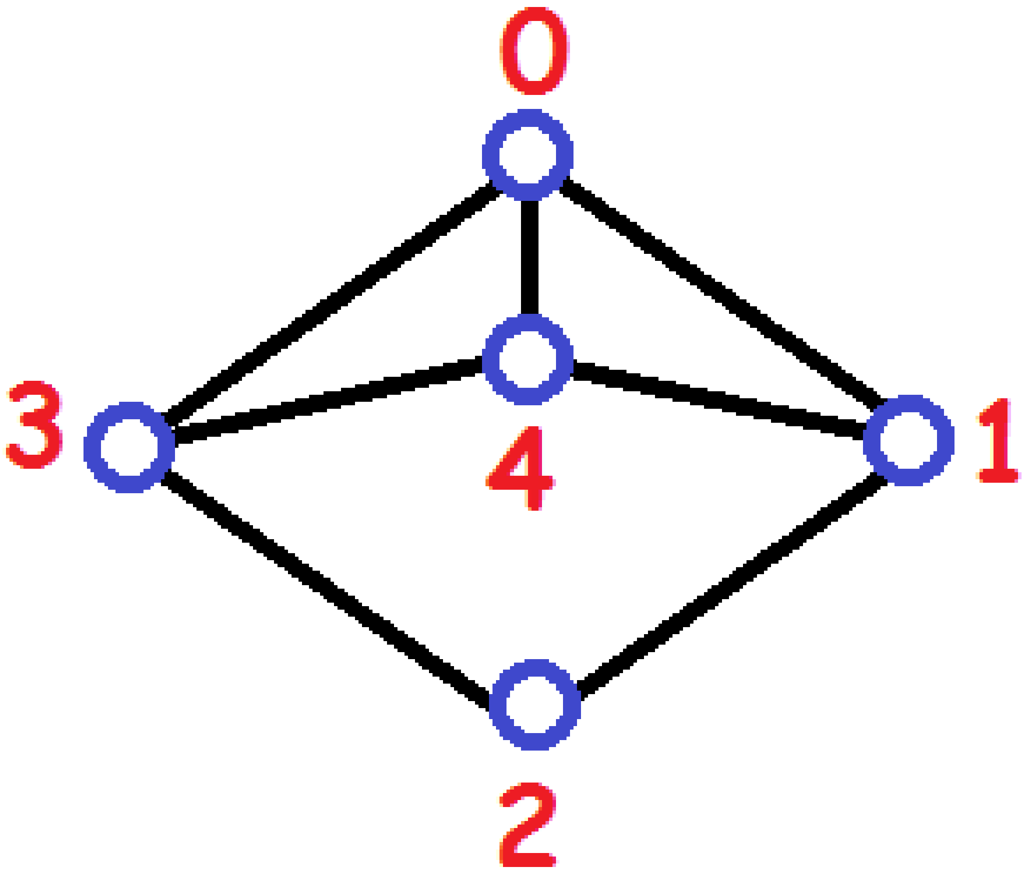
The next arc to choose after an arc (u,v) is the arc (v,w) such that w is the vertex in the list of neighbours of v that comes after u in cyclic order.

Continue traversing arcs until returning to arc (u,v).

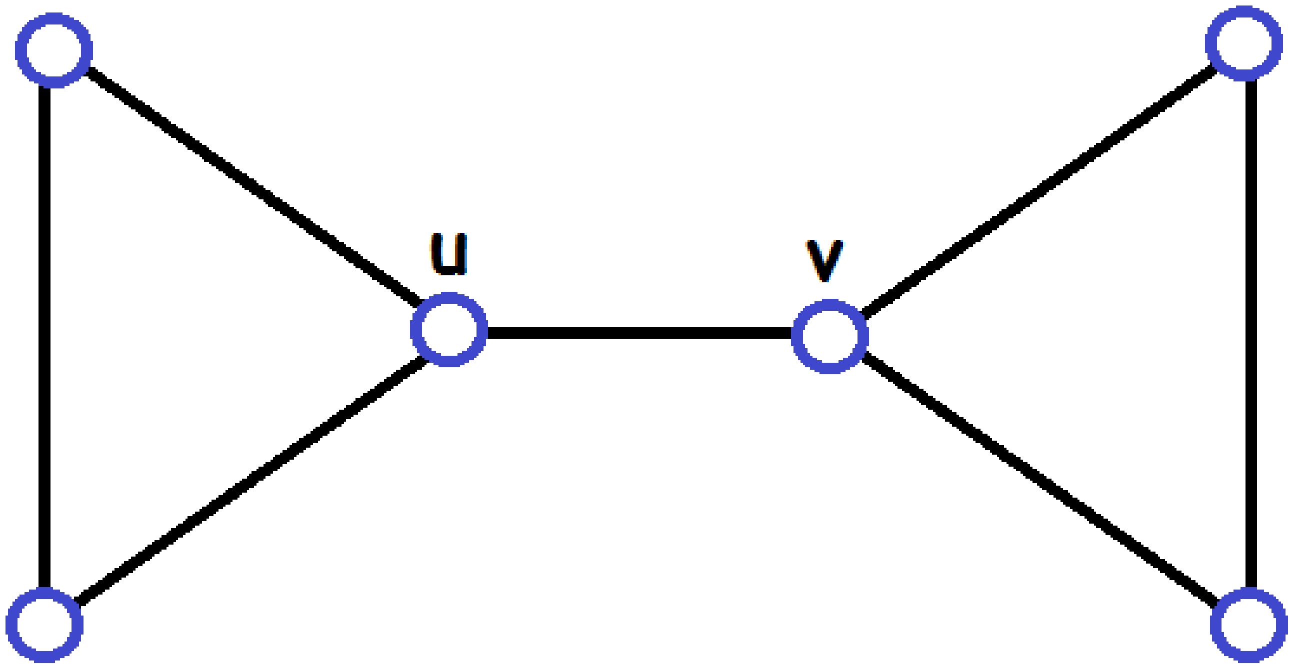
Walk the faces of this planar embedding of a graph:

0: 1 4 3
1: 0 2 4
2: 1 3
3: 0 4 2
4: 0 1 3

This graph has 4 faces.



0: 1 4 3
1: 0 2 4
2: 1 3
3: 0 4 2
4: 0 1 3



Important: Do not stop until seeing the starting ARC again. It's possible to have both (u,v) and (v,u) on the same face.