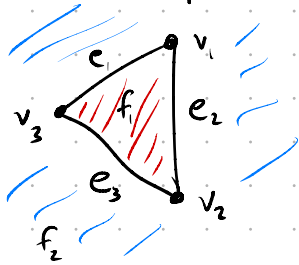


For bipartite graphs, why does $4f \leq 2e$ hold?

For connected planar G , $v + f = e + 2$

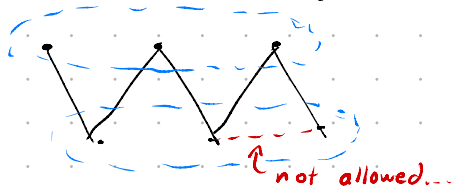


$$\begin{aligned} |V| &= 3 \\ |E| &= 3 \\ |f| &= 2 \\ v + f &= e + 2 \Rightarrow 3 + 2 = 3 + 2 \end{aligned}$$

For any graph, $3f \leq 2e$.

Smallest possible face is a triangle w/ 3 sides
Every edge divides up to 2 faces

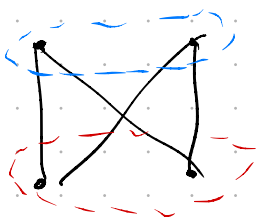
For bipartite graphs, triangle faces are not possible!



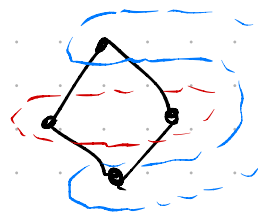
Would have to connect 2 points
in the same set which violates
property of bipartite

The smallest possible face in a bipartite graph has
4 sides \Rightarrow for bipartite graphs: $4f \leq 2e$

Example: $K_{2,2}$



\Rightarrow



$$\begin{aligned} |V| &= 4 \\ |E| &= 4 \\ |f| &= 2 \\ 4f &\leq 2e \Rightarrow 8 \leq 8 \end{aligned}$$