Introduction

- Networks appear in many areas such as communication, transportation, and computer systems.
- In these systems, it is not enough for nodes to be connected, but we also need distinct paths to avoid conflicts.
- These kinds of problems can be modeled using graph theory.
- One important concept in this area is called rainbow connection.
- This research focuses on rainbow connection in quadrilateral snake graphs, particularly analyzing their structure and network implications

Rainbow Connection

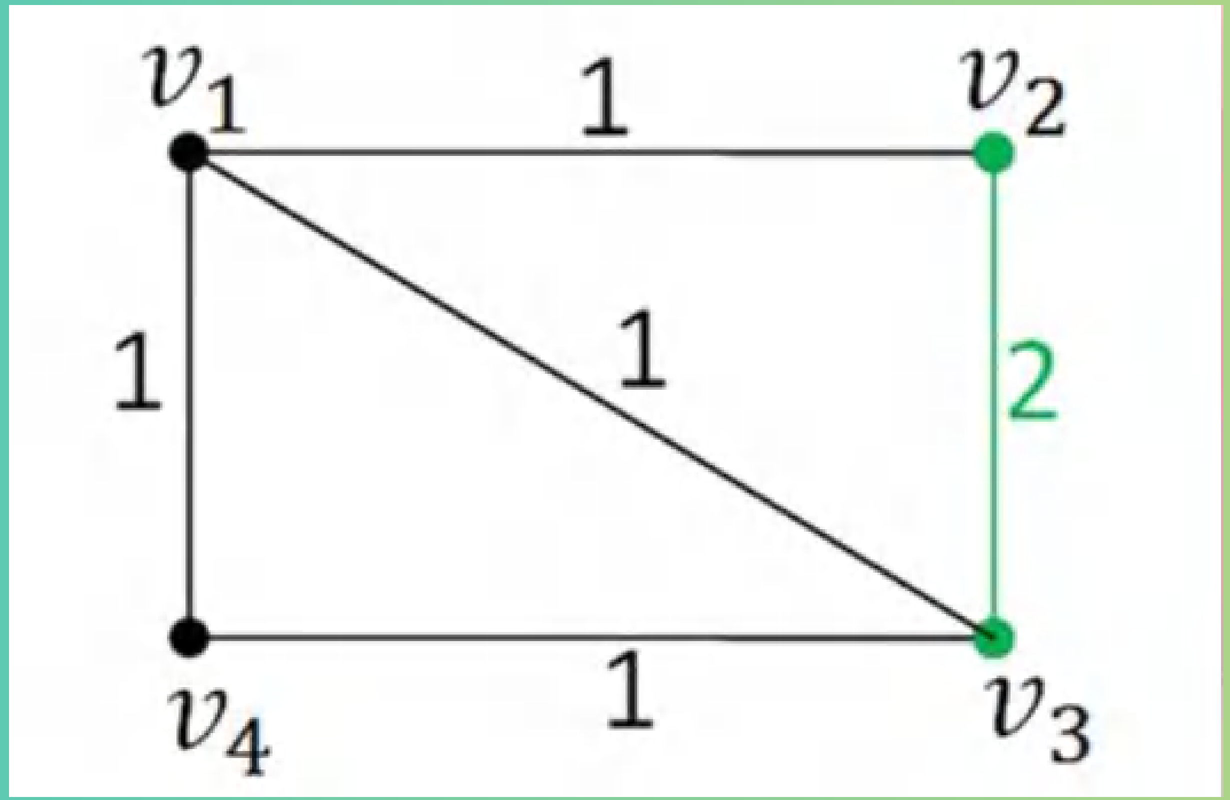
1. A graph is rainbow connected if every pair of vertices is connected by a rainbow path

2. A rainbow path is a path with all edges having distinct colors

3. rc(G) is the minimum number of colors needed to make a graph rainbow connected

Example

- Given a simple graph
- Find the minimum number of colors



- If we use only one color, it is not a rainbow path because colors repeat.
- So, we need at least two colors to make it rainbow connected
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Quadrilateral Snake Graph

- Constructed from a path graph $u_1, u_2, \ldots, u_n$
- Each u_i connected to v_i
- Each u_{i+1} connected to v_i'
- Each v_i connected to v_i'
- Denoted by E_n, for $n \geq 2$

Teorema

"For $n \geq 2$, the rainbow connection number of the quadrilateral snake graph E_n is given by"

$$rc(E_n) = \begin{cases} 2, & \text{for } n = 2 \\ n+1, & \text{for } n \geq 3 \end{cases}$$

Example

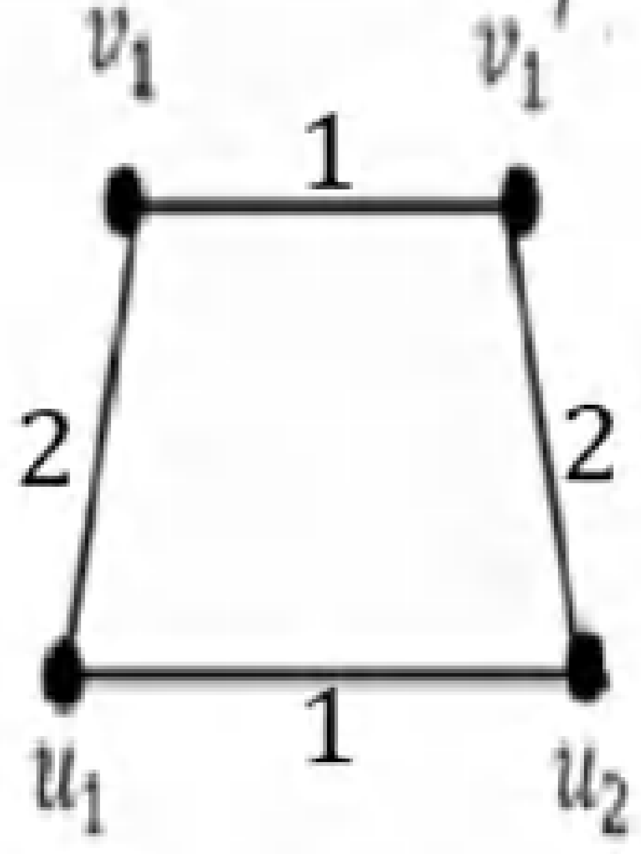

Figure 1. $rc(E_2) = 2$

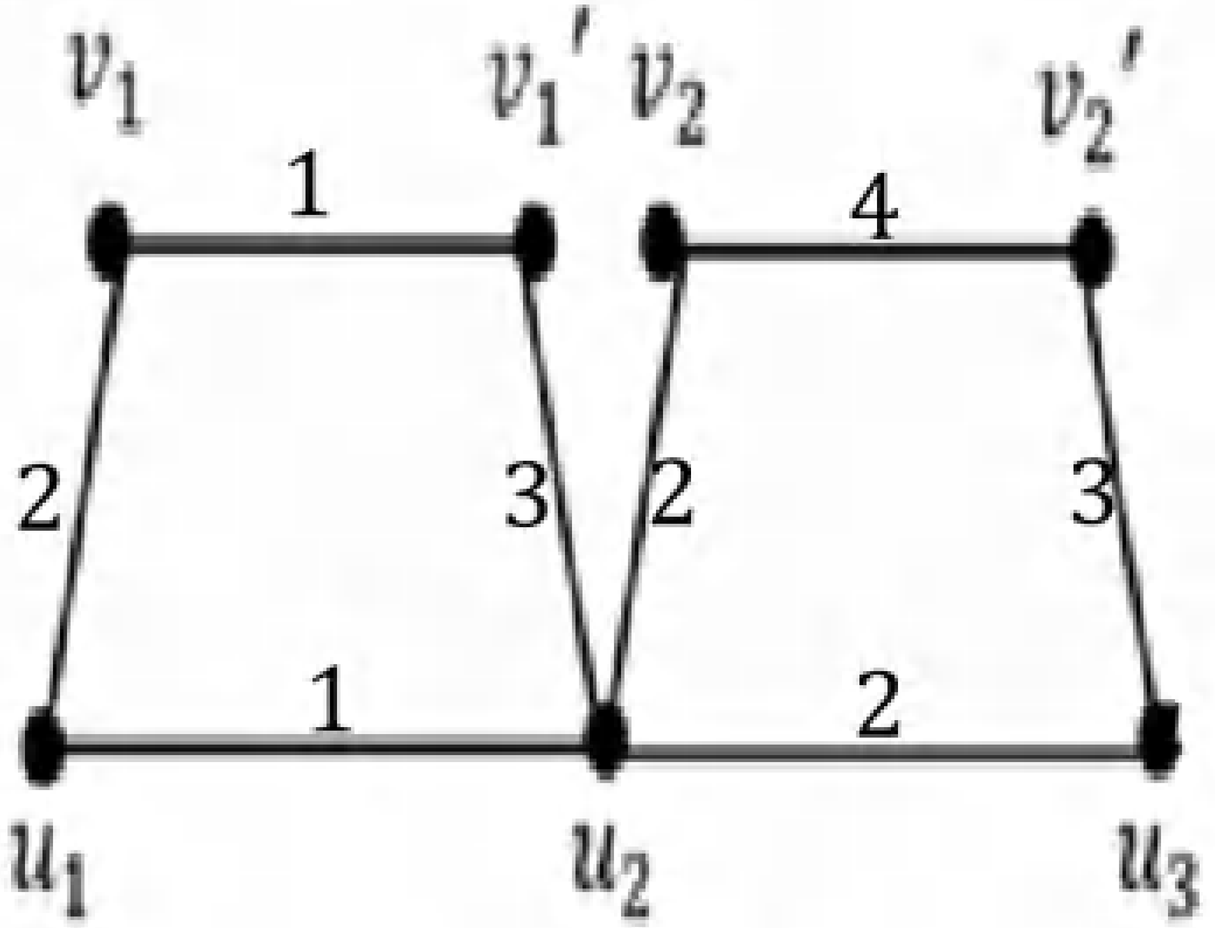

Figure 2. $rc(E_3) = 4$

Example

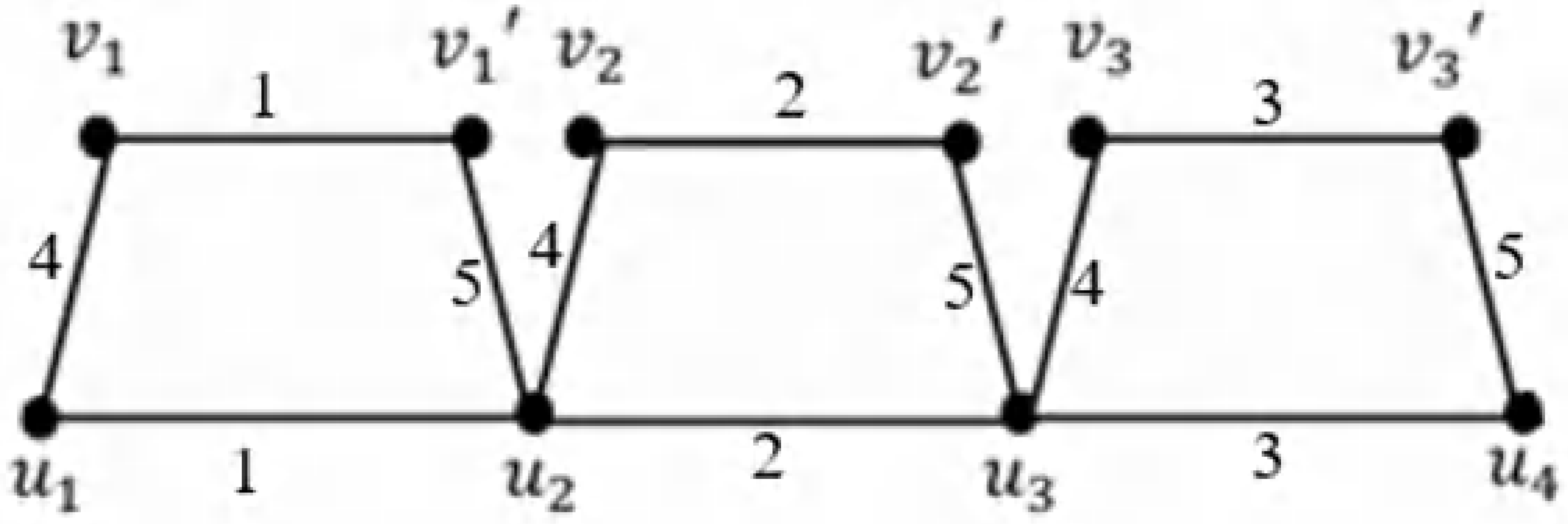

Figure 3. $rc(E_4) = 5$

Structural Insight

- Linear growth: $rc(E_n)=n+1$
- Structure determines connectivity
- Repeating quadrilateral pattern

Network Implications

- More nodes → more independent paths
- Reduced path conflicts
- Improved robustness

Thank You