

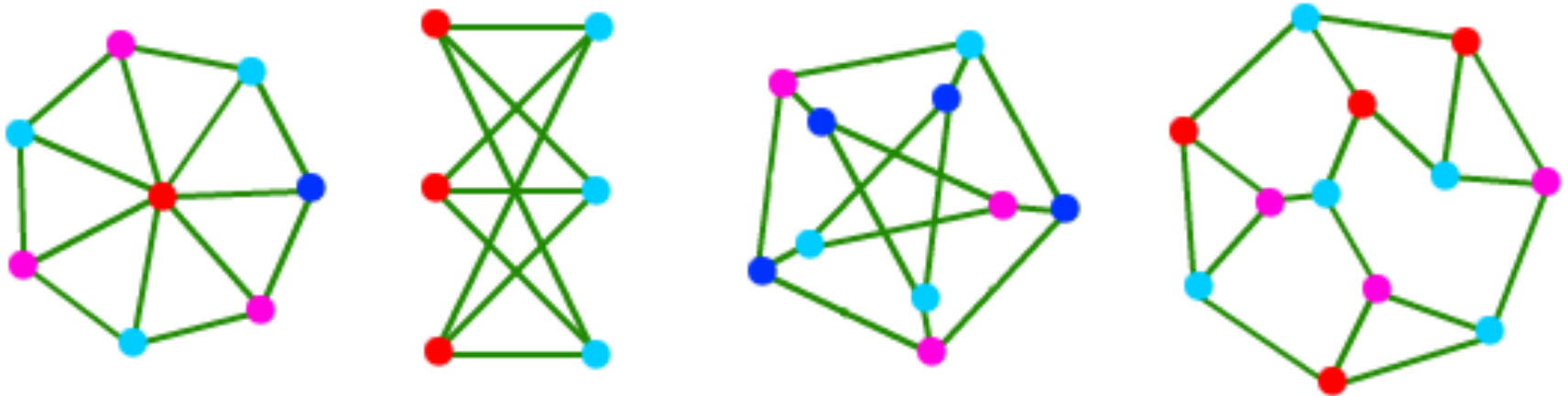
# Distributed Graph Coloring

Jane Bae

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# How to color a graph?



Given a graph  $\mathbf{G} = (V,E)$  with  $|V| = n$ , and maximal degree  $\Delta$ , there is always a  $\Delta+1$  coloring.

# Naïve Algorithm

- Color the graph with  $n$  colors
- Reduce the colors down to  $\Delta+1$ 
  - Requires  $n-\Delta-1$  iterations.Depth:  $O(\Delta \log \Delta)$

Total Depth:  $O(n-\Delta-1)$

# Distributed Algorithm

- Color the graph with  $n$  colors
  - Reduce to  $5\Delta^2 \log n$  colors with *Linial's Algorithm*  
Depth:  $\log^* n + O(1)$
- Reduce the colors down to  $\Delta + 1$  in parallel
  - The number of iterations required becomes  $O(\Delta \log \Delta)$  with *Kuhn-Wattenhofer* reduction  
Depth:  $O(\Delta \log \Delta)$

Total Depth:  $O(\Delta \log \Delta) + \log^* n$

Communication Cost:  $O(\Delta)$  per processor