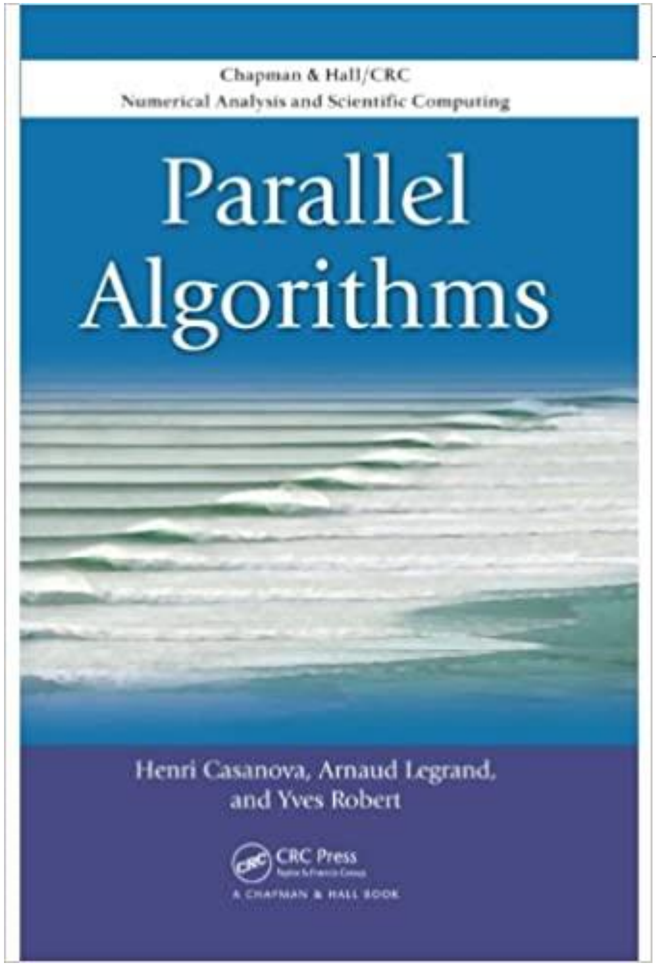
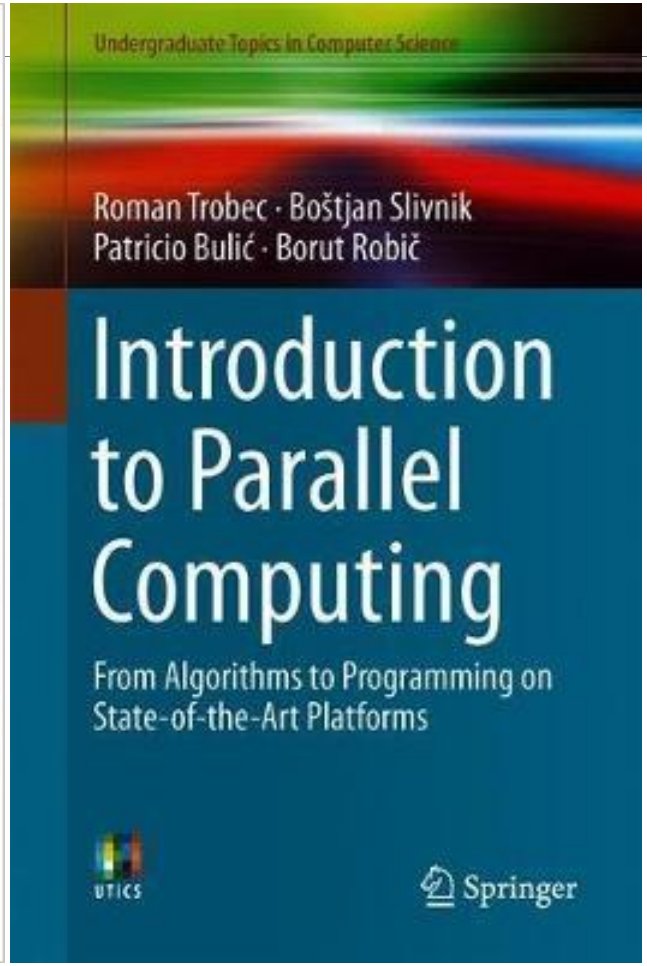
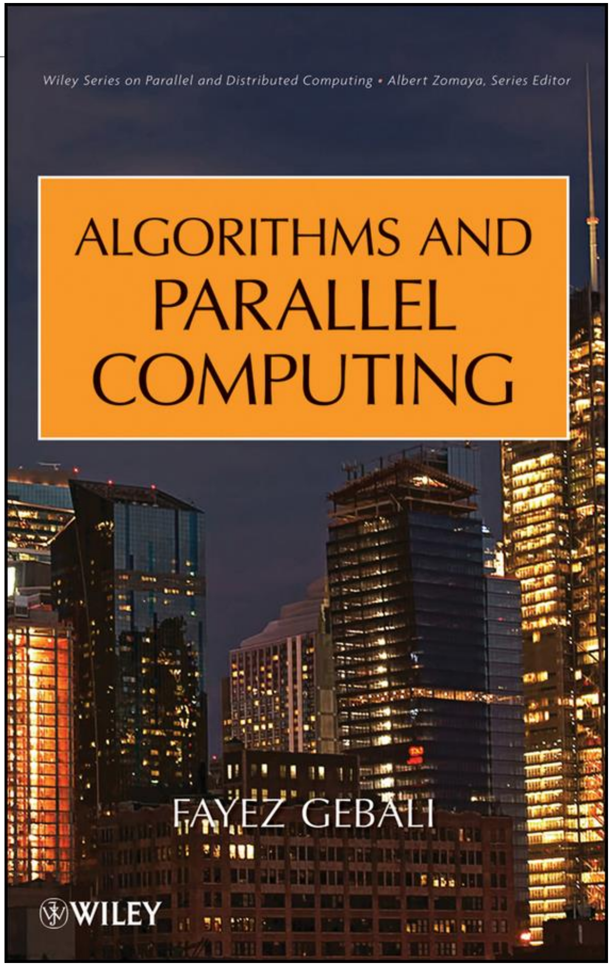
Parallel Programming

Lec 8

Books

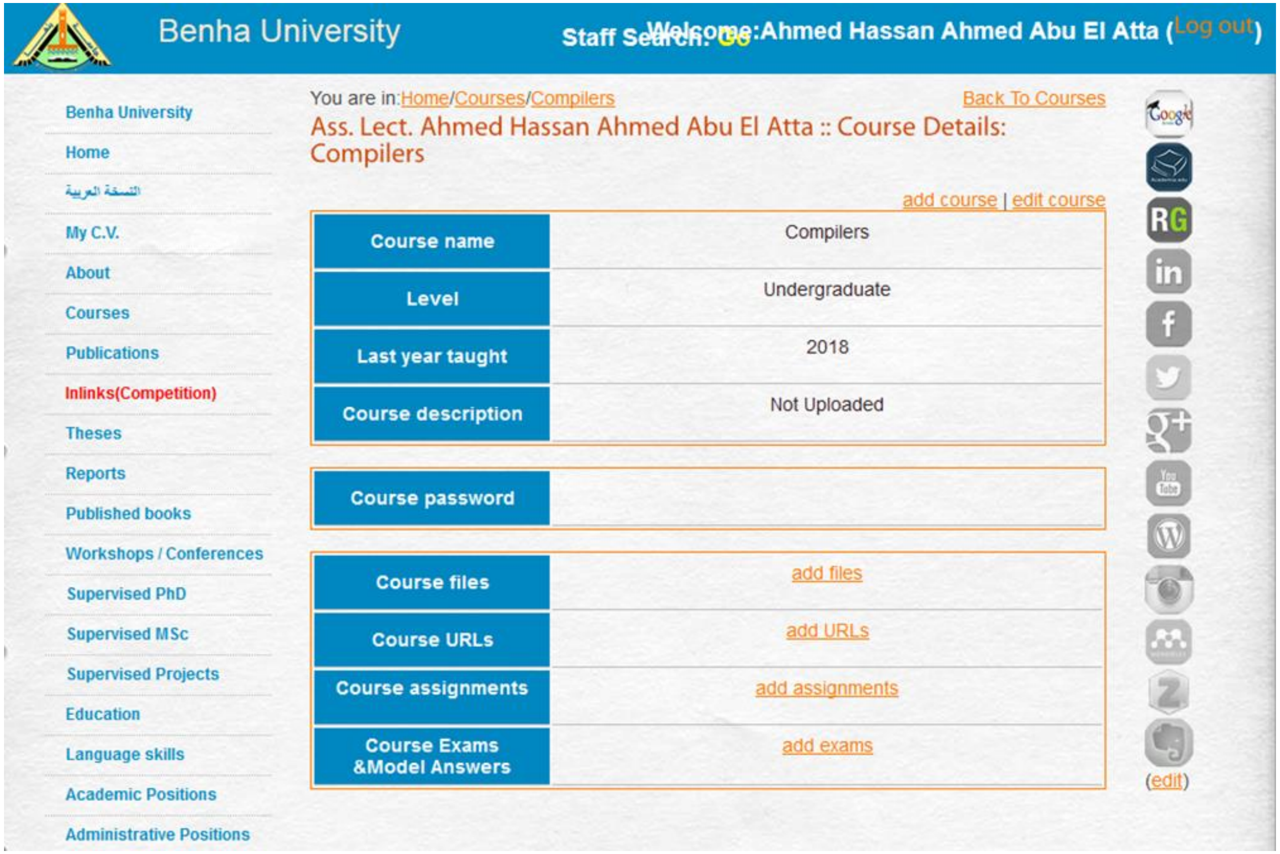

Chapman & Hall/CRC
Numerical Analysis and Scientific Computing
Parallel Algorithms
Henri Casanova, Arnaud Legrand, and Yves Robert
CRC Press
A CHAPMAN & HALL BOOK


Undergraduate Topics in Computer Science
Roman Trobec · Boštjan Slivnik
Patricio Bulić · Borut Robič
Introduction to Parallel Computing
From Algorithms to Programming on State-of-the-Art Platforms
UTICS
Springer


Wiley Series on Parallel and Distributed Computing • Albert Zomaya, Series Editor
ALGORITHMS AND PARALLEL COMPUTING
FAYEZ GEBALI
WILEY

PowerPoint

http://www.bu.edu.eg/staff/ahmedaboalatah14-courses/14779

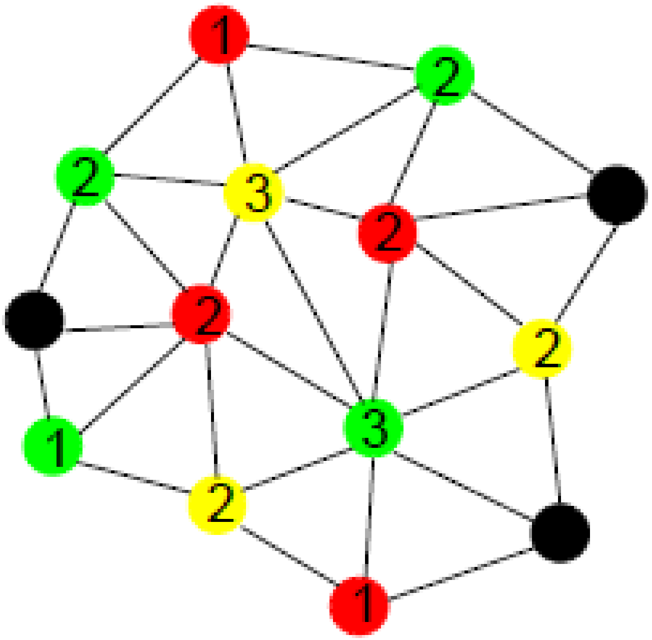


Graph Coloring Algorithms for Shared Memory Architecture

Problem Statement

Given a simple graph G = (V; E).

Assign colors to the vertices of the graph such that no two adjacent vertices are assigned the same color.



Sequential Algorithms

Greedy Sequential

Greedy Sequential

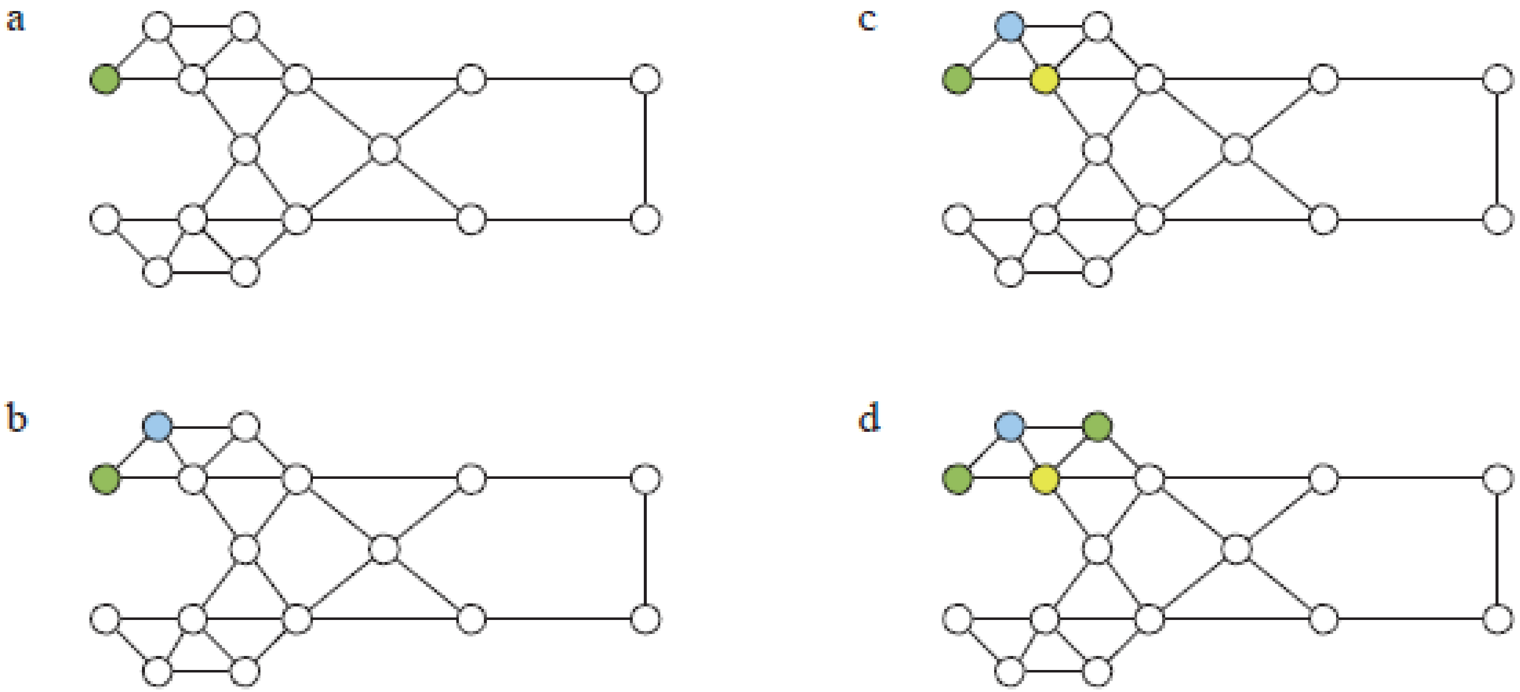
1: while ∃ uncolored vertex v do

2: color v with the minimal color (number) that does not conflict with the already colored neighbors

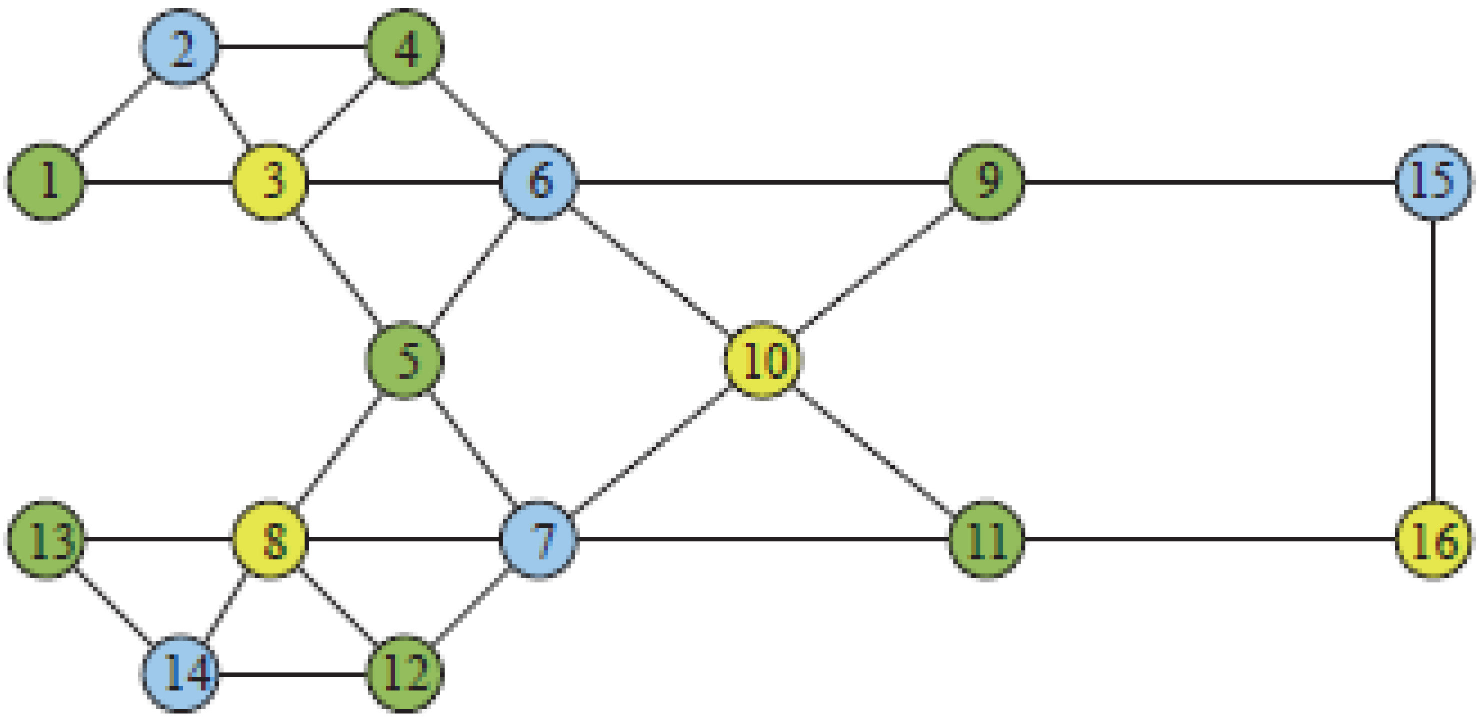
3: end while

$T(n) = O(n^2)$ in complete graphs and with $|V| = n$.

Greedy Sequential



Greedy Sequential



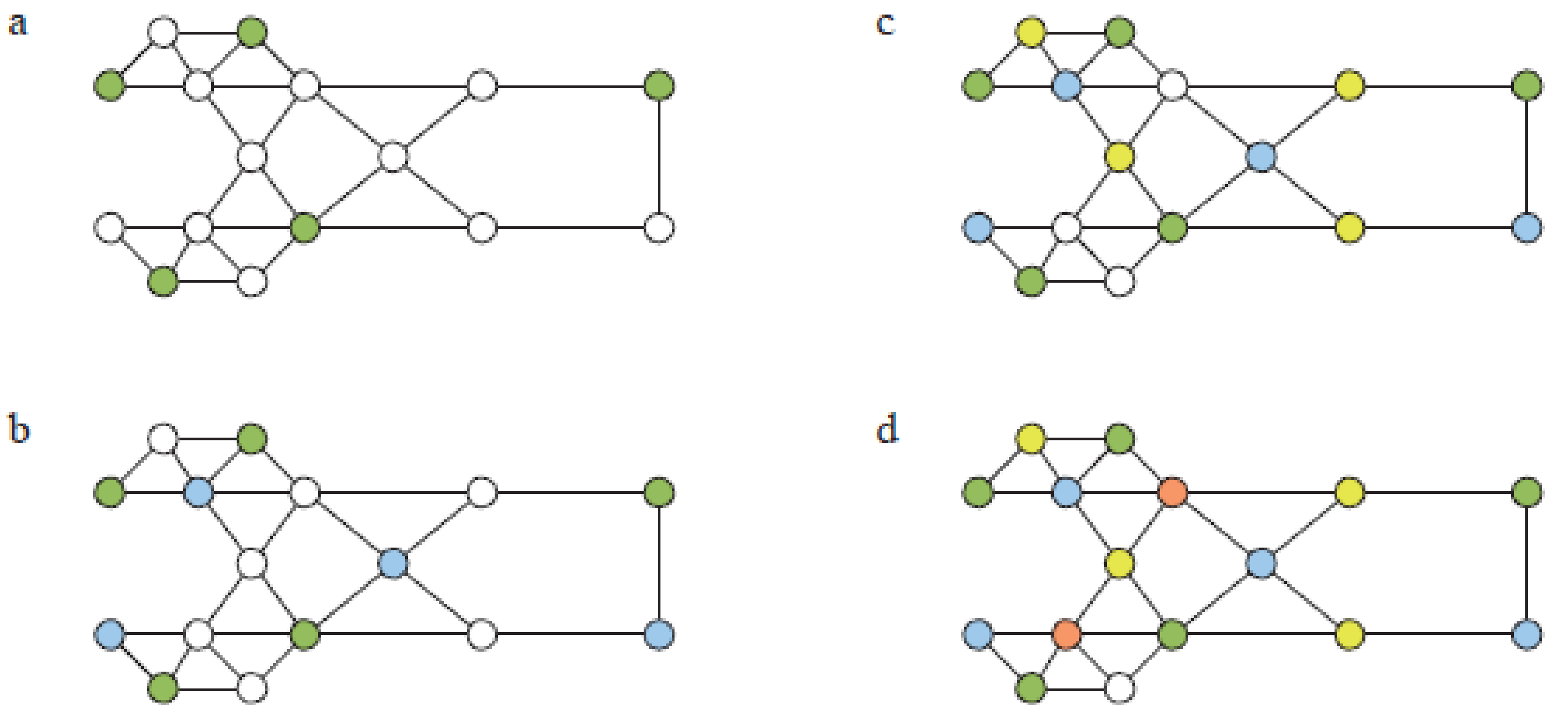
Luby Jones Algorithm

Luby Jones Algorithm

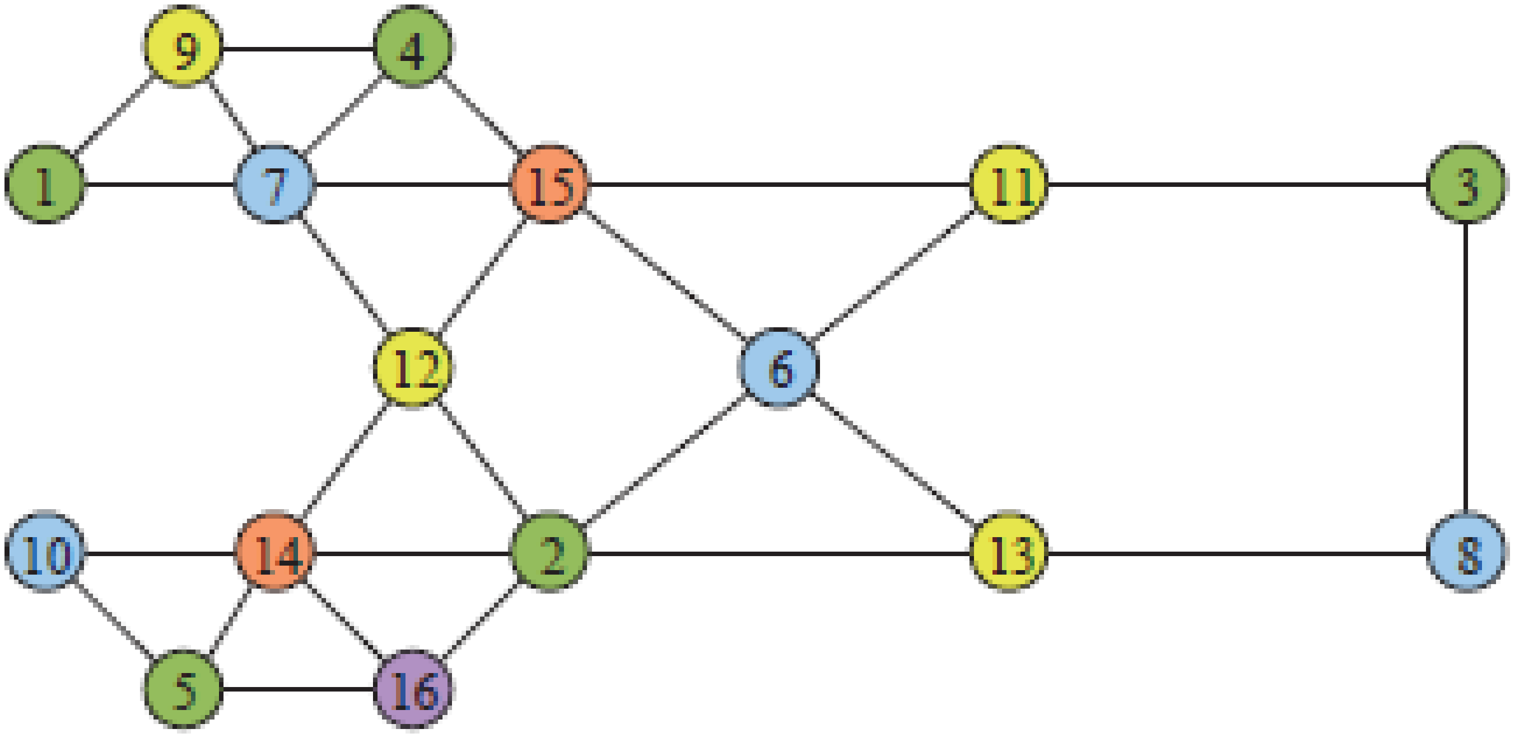
```
color = 0
∀ Vi assign random numbers
while ∃color(Vi) = 0 do
    for Vi do
        for Vj adjacent to Vi do
            if color(Vi)= 0 and color(Vj) = 0 and random(Vi) > ∀random(Vj)
                color(Vi) = color
            end if
        end for
    end for
    color++
end while
```

$T(n) = O(n^2)$ in complete graphs and with $|V| = n$.

Luby Jones Algorithm



Luby Jones Algorithm



Parallel Algorithms

Jones Plassman Algorithm

Jones Plassman Algorithm

Assign a random priority to each vertex given by w(v)

$U := V$

while ($|U| > 0$) **do**

    for all vertices $v \in U$ **do in parallel**

        $I := \{v$ such that $w(v) > w(u) \forall$ neighbors $u \in U\}$

        for all vertices $v' \in I$ **do in parallel**

            $S := \{$colors of all neighbors of $v'\}$

            $c(v') :=$ minimum color not in S

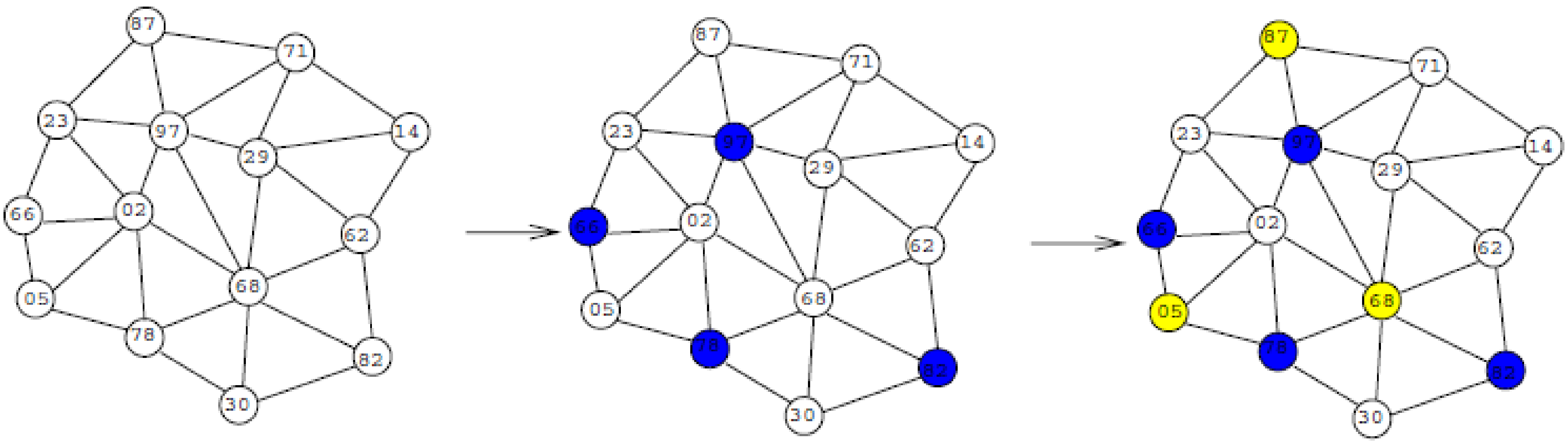
        end do

    end do

    $U := U - I$

end do

Jones Plassman Algorithm



Initially Assigned Random Numbers

Each vertex looks at its neighbors and if it has the highest number gets assigned the lowest available color

Each uncolored vertex looks at its uncolored neighbors and gets colored with the lowest available color if has the highest number, and so on...

Jones Plassman Algorithm Drawback

If the input graph is a chain of vertices and the numbering of vertices correspond to their priorities, then there is no parallelism exhibited by this algorithm

Parallel Multi-Coloring Algorithm

Parallel Multi-Coloring Algorithm

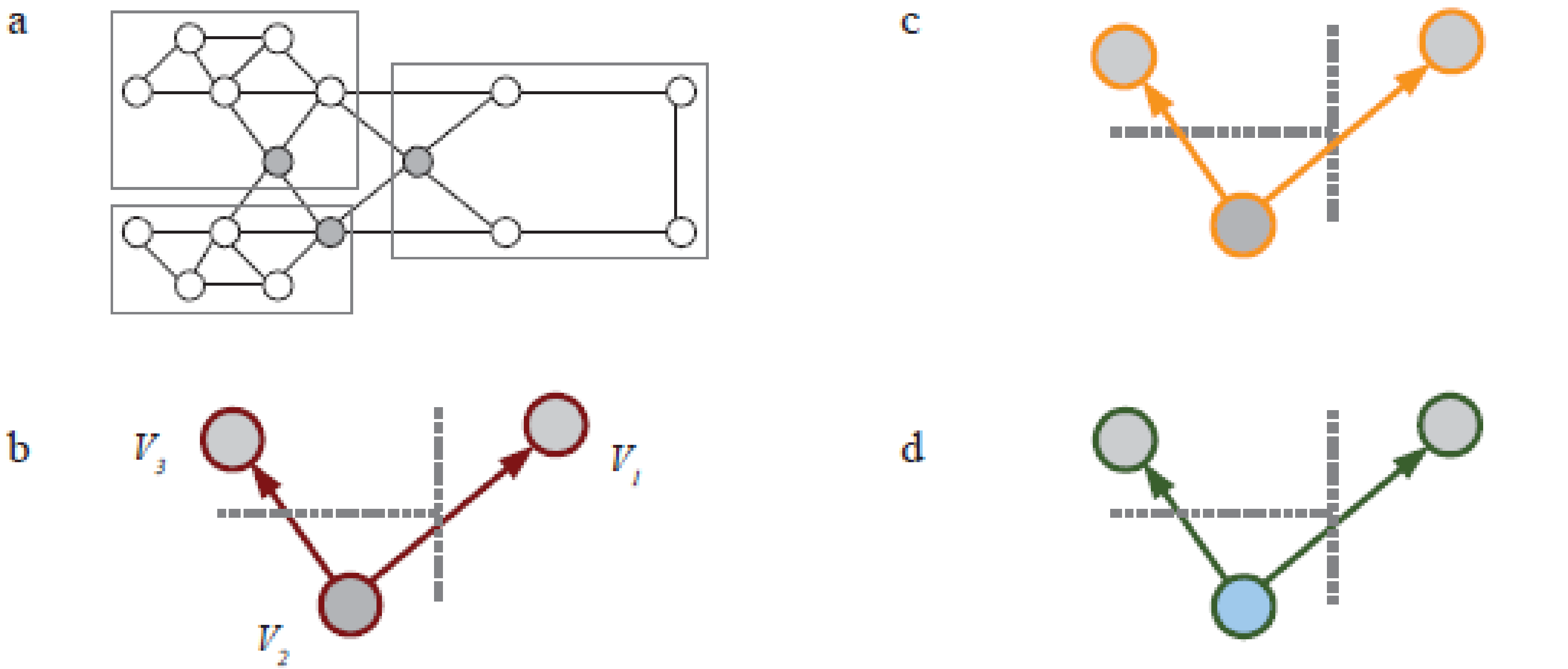


Figure 2.4 *The colors depicts: red = lock, orange = check and green = unlock. The dotted line is the interface between the mesh parts. a) A graph is divided. b) Looks are applied on sensitive vertices around V_2. c) V_2 reads colors in adjacent vertices. d) When V_2 has been colored the locks on adjacent vertices are released.*

Parallel Multi-Coloring Algorithm

Initiation
Divide Matrix *M* intervals of *I*
for V_i **do in parallel**
  color(V_i) = *0*
end for

Parallel Multi-Coloring Algorithm

coloring phase

a. invoking

```
for V_i do in parallel
    for V_j adjacent to V_i do
        if ((V_j adjacent to V_i) ∈ I)
            color(V_i) = min{ m > 0 | m ≠ color(V_j), ∀ V_j adjacent to V_i }
        else if ((V_j adjacent to V_i) ∉ I)
            lock(dependent V_j adjacent to V_i)
            dependent = true
    end for
```

b. thread safe

```
    if(dependent)
        for V_j adjacent to V_i do
            color(V_i) = min{ m > 0 | m ≠ color(V_j), ∀ V_j adjacent to V_i }
            unlock(V_j)
        end for
end for
```

Parallel Multi-Coloring Algorithm

Strength	Weakness
Parallel Multi-Coloring	
Low number of colors	Dependent on locks

not much parallelism exploited