# Advanced Algorithms

# Assignment 3:
# Minimum cut

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# Contents

# 1 Introduction

For this assignment, we implemented and analyzed the performance of two algorithms for the min-cut problem for weighted graphs. The algorithms implemented are:

1. Stoer and Wagner's Deterministic Algorithm;

2. Karger and Stein's Randomized Algorithm.

# 2 Stoer and Wagner's Deterministic Algorithm

## 2.1 Data Structure

## 2.2 Implementation

## 2.3 Complexity

# 3   Karger and Stein's Randomized Algorithm

```
1    KARGER (G, k) :
2    A = +∞
3    for i = 1 to k :
4        t = RECURSIVE_CONTRACT(G)
5            if t < min :
6                    min = t
7    return min
8
9    RECURSIVE_CONTRACT(G=(D,W) ) :
10   n= number of vertices in G
11   if n<=6:
12       Gp= CONTRACT(G, 2 )
13       return weight of the only edge (u, v) in Gp
14   t = n/√2+1
15   for i = 1 to 2 :
16       Gi = CONTRACT(G, t )
17       wi = RECURSIVE_CONTRACT(Gi)
18   return min(w1 ,w2)
19
20   CONTRACT(G=(D,W) , k ) :
21   n= number of vertices in G
22   for i = 1 to n−k :
23       (u, v) = EDGE_SELECT(D,W)
24       CONTRACT_EDGE(u, v )
25   return D,W
26
27   CONTRACT_EDGE(u, v ) :
28   D[ u ] = D[ u]+D[ v]−2W[ u , v ]
29   D[ v ] = 0
30   W[ u , v ] = W[ v , u ] = 0
31   for each vertex w ∈ V: except u and v :
32       W[ u , v ] = W[ u ,w] + W[ v ,w]
33       W[w, u ] = W[w, u ] + W[w, v ]
34       W[ v ,w] = W[w, v ] = 0
35
36   EDGE_SELECT(D,W)
37   1. Choose u with probability proportional to D[ u ]
38   2. Once u is fixed , choose v with probability proportional to W[ u , v ]
39   3. return the edge (u, v )
```

This is a randomized algorithm for the computation of a graph. In the next subsections we explain how we have implemented the data structure and the functions of the algorithm.

## 3.1   Data Structure

## 3.2   Implementation

## 3.3   Complexity

# 4 Results

## 4.1 Table with Min-Cut results

## 4.2 Graph of the Time Cost of the two Algorithms

## 4.3 Graph of the Time Cost compared to the Discovery Time of Karger and Stein Algorithm

## 4.4 Graph of the Time Cost compared to the Asymptotic Complexity of the two Algorithms

# 5    Conclusion