Implementierung der Cut & Count-Technik am Beispiel Steiner tree

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Überblick

Cut & Count-Technik

- Technik um connectivity-type Probleme mithilfe von Randomisierung zu lösen(Marek Cygan, Jesper Nederlof, Marcin Pilipczuk, Michał Pilipczuk, Johan van Rooij, Jakub Onufry Wojtaszczyk)
- angewendet auf viele verschiedene Probleme (z.B. Longest Path, Steiner Tree, Feedback Vertex Set uvm)
- Randomisierung durch Isolation-Lemma
- als Ergebnis ein einseitiger Monte-Carlo-Algorithmus mit Laufzeit $c^{tw(G)}|V|^{\mathcal{O}(1)}$

Cut & Count-Technik

Theorem

There exists a randomized algorithm, which given a graph G with n vertices, a tree decomposition of G of width t and a number k in $3^t n^{\mathcal{O}(1)}$ time either states that there exists a connected vertex cover of size at most k in G, or that it could not verify this hypothesis. If there indeed exists such a cover, the algorithm will return "unable to verify" with probability at most $1/2$.

Steiner Tree

Problem

Input: An undirected graph $G = (V, E)$, a set of terminals $T \subseteq V$ and an integer k.
Question: Is there a set $X \subseteq V$ of cardinality k such that $T \subseteq X$ and $G[X]$ is connected?

Cut (1)

- definiere Gewichtsfunktion $\omega : V \to \{1, \dots, N\}$
- sei $\mathcal{R}_W$ die Menge aller Teilmengen von X aus V mit $T \subseteq X$, $\omega(X) = W$ und $|X| = k$
- sei $\mathcal{S}_W = \{X \in \mathcal{S}_W | G[X] \text{ ist zusammenhängend}\}$
- $\cup_W \mathcal{S}_W$ ist die Menge der Lösungen
- gibt es ein W für das die Menge nichtleer ist, so gibt der Algorithmus eine positive Antwort

Cut (2)

- einen beliebigen Terminalknoten $v \in T$ als v_1 festlegen
- sei $\mathcal{C}_W$ die Menge aller Subgraphen, die einen konsistenten Cut $(X, (X_1, X_2))$ bilden, wobei $X \in \mathcal{R}_W$ und $v_1 \in X_1$

Lemma 3.3

Let $G = (V, E)$ be a graph and let X be a subset of vertices such that $v_1 \in X \subseteq V$. The number of consistently cut subgraphs $(X, (X_1, X_2))$ such that $v_1 \in X_1$ is equal to $2^{cc(G[X])-1}$.

Bullet Points

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- Aliquam blandit faucibus nisi, sit amet dapibus enim tempus eu
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- Nam cursus est eget velit posuere pellentesque
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Multiple Columns

Heading

1. Statement
2. Explanation
3. Example

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Table

Treatments	**Response 1**	**Response 2**
Treatment 1	0.0003262	0.562
Treatment 2	0.0015681	0.910
Treatment 3	0.0009271	0.296

Tabelle : Table caption

Theorem

Theorem (Mass–energy equivalence)

$E = mc^2$

Verbatim

Example (Theorem Slide Code)

```
\begin{frame}
\frametitle{Theorem}
\begin{theorem}[Mass--energy equivalence]
$E = mc^2$
\end{theorem}
\end{frame}
```

Figure

Uncomment the code on this slide to include your own image from the same directory as the template .TeX file.

Citation

An example of the `\cite` command to cite within the presentation:

This statement requires citation [Smith, 2012].

References

John Smith (2012)
Title of the publication
Journal Name 12(3), 45 – 678.

The End