Faculty of Mathematics and Computer Science

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Master thesis

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submitted by

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Application of graph matching

in

Computer Vision

This Master thesis has been carried out by Ekaterina Tikhoncheva

it the

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under the supervision of

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Declaration of Authorship

I confirm that this Master's thesis is my own work and I have documented all sources and material used. This thesis was not previously presented to another examination board and has not been published.

Place and date	Signature

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Abstract. Graph matching is one of the fundamental problems in graph theory and computer vision. Due to its practical relevance this problem is heavily investigated and there are a lot of approximative algorithms for solving it. However a lot of algorithms are able to work efficiently only with small graphs (up to 100 nodes) and scale poorly for bigger graphs. In this thesis we introduce a novel approach for extending the usability of existing graph matching algorithms to bigger graphs. For that we introduce a two level graph matching framework. Two given graphs to match represent the lower level. To reduce the problem size we partition each of the graphs into a fix number of subgraphs and consider each subgraph as a node of a new graph (anchor graph), that is placed on the second higher level. To solve the initial matching problem we iteratively first solve the matching problem on the higher level, which gives us correspondences between nodes of the two anchor graphs. Afterwards we find in parallel correspondences between nodes of the matched subgraph pairs. To improve the initial partition before next iteration we introduce an update rule, which allows the subgraphs to exchange nodes on their border. We demonstrate the effectiveness of our approach in matching synthetic graphs and finding correspondences between pairs of images.

Zusammenfassung. Graph Matching ist eines der grundlegenden Probleme in der Graphentheorie und Computer Vision. Aufgrund seiner praktischen Relevanz ist es auch ein ausgiebig erforschtes Problemfeld. Es existieren viele approximative Algorithmen, die in der Lage sind schnell eine hoch qualitative Lösung zu liefern. Allerdings sind viele der Algorithmen nur für kleine Graphen mit bis zu 100 Knoten geeignet und lassen sich schwer für größere Graphen anwenden. Aus diesem Grund haben wir uns in dieser Masterarbeit mit der Entwicklung eines neuen Ansatzes zum Graph Matching beschäftigt, der die Anwendung von existierenden Algorithmen für große Graphen mittels eines zweistufigen Ansatzes ermöglicht. Zwei gegebene Graphen sind auf der unteren Stufe platziert. Um die Schwierigkeit des Problems zu minimieren, zerlegen wir jeden einzelnen Graphen in eine fixe Anzahl von Teilgraphen, die wir mit einem Knoten eines neuen Graphen (Ankergraphen) erfassen. Die zwei Ankergraphen repräsentieren die zweite Stufe unseres Verfahrens. Zuerst finden wir die Zuordnung zwischen den Knotenmengen der beiden Ankergraphen. Um die Abbildung zwischen den Knoten der ursprünglichen Graphen zu finden lösen wir das Matchingproblem für jedes zugeordnete Paar von Teilgraphen parallel. Die Vorgehensweise wird durch eine Update-Regel erweitert und iterativ wiederholt. Wir demonstrieren die Funktionalität unseres Ansatzes mit Beispielen von künstlich generierten Graphen und der Zuordnung von Merkmalpunkten auf zwei Bildern.