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Table Of Contents

Preface

This volume contains the proceedings of the 2nd Computer Science Student Workshop (CSW). The workshop took place on April 9th, 2011 at the Microsoft Istanbul Office.

CSW aims to bring the Computer Science and Engineering graduate students in Istanbul together in a semiformal workshop atmosphere. This workshop exposes the graduate students to the concepts of academic writing, peer review, research presentation, critical thinking as well as academic way of thinking in general. The students also establish connections in this semiformal environment via meeting each other, sharing ideas, and getting feedback on their work. The ultimate goal of this workshop series is to form a network of young researchers who will support each other and establish a core group of senior graduate student leaders, who will serve as mentors and role models for the coming generation. Therefore, the workshop is organized by graduate students for graduate students.

There were three oral presentation sessions in total, three poster sessions in between and one academic panel session. We thank Prof. Dr. Levent H. Akın (Boğaziçi University), Prof. Dr. Oğuz Dikenelli (Ege University), Prof. Dr. Cem Ersoy (Boğaziçi University) and Assoc. Prof. Albert Levi (Sabancı University) for participating as our panelists. There were 30 submissions in total and 10 of the submissions were accepted for oral presentation while 10 of them were accepted to be presented as posters.

Several contributors of the CSW, either as authors or Program Committee members, were awarded in the "Best Original Research Paper", the "Best Previously Published Paper", the "Best Poster", the "Best Presentation", and the "Best Reviewer" categories.

This successful workshop would not be possible without the initiation and support of our professors Esra Erdem and Metin Sezgin, and the hard work of all members of the Organizing Committee and the Program Committee. We would also like to sincerely thank to Microsoft, Forum Nokia, Logo Business Solutions and Pozitron for being the sponsors of the workshop.

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An Ensembling Approach to Turkish Keyphrase Extraction

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Abstract

Keyphrases are successful indicators of text contents. There exists huge amount of digital documents of which keyphrases are not assigned. Finding keyphrases manually by people requires great labor. Therefore, keyphrase extraction process needs to be automated. Many algorithms are proposed for this purpose; but the number of matches between algorithmically generated and author-assigned keyphrases is extremely low. In this work, it is aimed to increase the match by employing an ensembling algorithm for keyphrase extraction from Turkish scientific articles. It is found that ensembling cannot be proposed as a solution of low-precision problem of keyphrase extraction algorithms.

1.Introduction

The amount of digital sources is increasing every day. Making search and finding desired information in digital documents becomes indispensable for daily lives. Common ways of gathering information is using web search engines, like Google, Bing and Yahoo! Search, and online question answering systems, ask.com and START. To facilitate efficient retrieval of information in terms of time and space, digital sources should be represented in some other way so that it does not require examining whole content of a source for each information need, which is very costly. Using keywords for digital sources is very economic way of finding desired information for the user. Instead of considering the whole content, only checking keywords are very helpful to decide whether the resource is a true candidate to be included the desired information. Being aware of the fact that keywords are successful indicators for general content of text sources, keywords are tried to be assigned to online sources in these days. However, there exists huge digital resource of which keywords are not known. As manually finding keywords of documents requires great human labor, it is required to automate the process of keyword assignment of digital documents.

In this study, it is aimed to develop a keyphrase assignment system for Turkish scientific digital documents. In the literature, a number of algorithms are proposed for this purpose. Most of them are not mentioned whether they are usable for every language. They are only evaluated on English datasets. This work focuses on the algorithm that are designed for considering Turkish linguistic model. In addition, it is aimed to increase the number of matches between algorithmically generated and author-assigned keyphrases. Therefore, an ensembling method is implemented. In this study, the algorithm Turkish Keyphrase Extraction using KEA is implemented as a base algorithm of ensembling method (Pala et al., 2007).

2. Related Work

There are two different approaches for choosing keywords; generating from the meaning of text and extraction from the content. Generation of keywords require a vocabulary which is specific to the topic of documents of which keywords are tried to be assigned. Keywords are selected from this vocabulary by using previously trained system. Such a system includes a classifier for each phrase in the vocabulary. For each keyword assignment, these classifiers are run on the document and a keyphrase from the vocabulary is assigned if its corresponding classifier finds the document acceptable. It is important to note that only the phrases that exist in trained vocabulary can be assigned to new documents. The latter one, keyword extraction is basically selects phrases from the vocabulary of the text by using some lexical information and Machine Learning (ML) techniques.

The most commonly used algorithm for keyphrase extraction is Keyphrase Extraction Algorithm (KEA) (Witten et al., 1999). KEA is mainly designed for automation of text summarization, because finding keyphrases are crucial part of summarization. Its approach to keyphrase extraction process is learning a model from text documents with keyphrases. Using this model, it aims to find the keyphrases of new documents. KEA uses a ML algorithm to generate a function that finds keyphrases. Therefore, it has two phases: training and keyphrase extraction on new texts. KEA is improved for Turkish by changing some small details (Pala et al., 2007). The most important difference between these two versions of KEA is that this algorithm considers another feature for each possible keyphrase, namely, relative length. Pala and Cicekli state that this feature improves the performance of the basic KEA algorithm.

A different algorithm from KEA is GenEx (Turney, 2000). GenEx includes two different algorithms, Extractor and Genitor. Extractor is the actual keyphrase extraction algorithm which employs twelve parameters. Whitley's Genitor algorithm tunes these parameters (Whitley, 1989).

3. Experimental Environment

3.1 Experimental Work

The algorithm Turkish Keyphrase Extraction using KEA (Pala et al., 2007) employs a supervised ML algorithm. Therefore, it has two phases; training and keyphrase extraction. In training phase, it tries to find a model as accurate as possible from training data set. This model reflects the occurrence of keyphrase patterns in the texts of training data set. In extraction phase, the algorithm finds keyphrases from the texts of which

keyphrases are not known as priory. Generated model is used to estimate which phrases are successful candidates for being keyphrase of a text.

In training phase of Turkish Keyphrase Extraction using KEA, the text of training data set articles are processed to eliminate all punctuation marks, apostrophes, brackets, and numbers from the text. The words which do not contain any letter are removed. It also separates hyphenated words. In other words, the tokens which include nothing than letters are remained.

Training phase continues with extraction of possible phrases. A phrase is a sequence of tokens. The sequences which include at most 3 tokens are selected as a phrase. It is checked that the first and last words of a phrase should not be a stop word, like, birkaç, çünkü, diğeri, etc… The stopword list for Turkish is taken from Fatih University Natural Language Processing Study Group (The Natural Language Processing Group). This list contains 190 words. Then, all the words are converted into lower-case. As a last step, they are stemmed. Zemberek is used for stemming the words of the text (Zemberek). Generally, it gives a list of possible stems for each word. To develop a more accurate system, the stem which has smallest length is considered as the root of word.

As a last step, each extracted phrase is seen as a different feature. Each feature is represented by a word and a score. This score is composed of 3 different numbers. These numbers are found by calculating TFxIDF, first occurrence and relative length. TFxIDF is a metric which considers two frequency calculations; the frequency of a phrase in the text and the frequency in training corpus. To indicate a phrase's importance for a text, occurrence number of a phrase should be high in specific text(s) and low in all other texts in the training set. The formula for TFxIDF is as follows:

$$TFxIDF = \frac{freq(P,D)}{size(D)} \times -\log_2 \frac{df(P)}{N} \qquad (1)$$

where P is the phrase and D is the document. $freq(P, D)$ is the number of occurrence of P in document D. $df(P)$ is the number of documents which includes the phrase P in the training corpus. Training corpus contains N documents with keyphrases.

The other feature for scoring a phrase is first occurrence. First occurrence is the fraction of the number of words in front of the phrase to the document size in token number. Lastly, relative length is calculated as the number of characters in P divided by the maximum length of all possible phrases in the corpus.

After calculating these features for each phrase, they are examined whether it is a correct phrase or not. To make this decision, extracted keyphrases are compared with author-assigned ones for each training document. If the extracted phrase from the text match with any author-assigned keyphrase, then the phrase's class value is decided as 1; otherwise 0. Rather than the exact matching, stemmed versions of author-assigned keyphrases are compared with extracted possible phrases. In this way, training data are prepared for Naïve Bayes algorithm. However, the values are continuous and the algorithm cannot work with these values effectively. Pala and Cicekli does not mention about how continuous valued features are used in Naïve Bayes algorithm. However, Turney states that Multi-Interval Discretization is used (Fayyad et al., 1993). This algorithm is based on the idea that discretization bins should be formed so that each bin's entropy, i.e. inhomogeneous, is minimized. This algorithm does not work very well for this case, because there are many phrases, which have different class labels but same feature values to be discretized. Therefore, discretization thresholds are not meaningful for this situation. Another approach is studied for discretization of continuous values. The feature values are sorted in ascending order with their corresponding class values. From the beginning, the whole list of labels is checked to find successive labels that are different from each other. If their corresponding feature values are also different, the average of these values is included as a threshold. After finding all threshold values for a particular feature, the feature values are labeled as integers from 0 to the number of threshold values. In other words, the phrases are separated into different bins by their particular feature values. This approach also aims to minimize entropy for each bin, but it employs more trivial solution for real world data.

The features and their class values are now ready to be applied Naïve Bayes algorithm. The prior probabilities of classes, 1 and 0 and posterior probabilities of discretized features are calculated. These statistics are recorded for extraction stage of Turkish Keyphrase Extraction Using KEA algorithm.

In extraction stage of Turkish Keyphrase Extraction Using KEA algorithm, possible phrases are found from the text of which keyphrases are not known. All phrases of the text are extracted. Then, each phrase's TFxIDF, first occurrence, and relative length values are calculated. By using the thresholds of discretization, which are found in training stage, are used to make feature values of phrases nominal. Then, keyphrase extraction algorithm tries to predict whether an extracted phrase is a correct phrase or not. Its prediction is based on the multiplication of feature value probabilities of a possible phrase. The prediction is made by evaluating the results of formula (4):

$$P[Yes] = \frac{P(Yes)}{P(Yes)+P(No)} \times P_{TFxIDF}[t|Yes] \times P_{firstOccurrence}[f|Yes] P_{relativeLength}[r|Yes] \qquad (2)$$

$$P[No] = \frac{P(No)}{P(Yes)+P(No)} \times P_{TFxIDF}[t|No] \times P_{firstOccurrence}[f|No] P_{relativeLength}[r|No] \qquad (3)$$

$$p = \frac{P[Yes]}{P[Yes]+P[No]} \qquad (4)$$

Turkish Keyphrase Extraction Using KEA algorithm employs these formulas, t is TFxIDF, f first occurrence and r relative length of the phrase. All of them are discretized using the thresholds from training stage. By multiplying these probabilities with prior probability of class value, the probability of being a keyphrase (P[Yes]) or not (P[No]) are found. By substituting these values into formula (4), each possible phrase's score is found. Then, all phrases are ranked according to their scores (p). The phrases which are included in another one in lower ranks, higher ranked one, which is subpart of lower ranked, is eliminated. Top N phrases are selected as possible keyphrases.

Turkish Keyphrase Extraction Using KEA algorithm is used as a base algorithm of the ensemble approach of this study. Instead of training one keyphrase extraction system, many number of systems are trained at the same time. Training

dataset is divided into these systems as each system is trained with equal sized dataset. Then, all the test dataset is given as an input to the group of trained keyphrase extraction systems. If the group is composed of 5 systems and the desired number of extracted keyphrase is 20, then top 4 keyphrases from 5 systems are merged.

3.2 Corpus

The experiments are performed on a data set which includes Turkish academic articles from wide range of topics. 60 different articles are retrieved from online archive of Journal of The Faculty of Engineering and Architecture of Gazi University. This dataset is used in Pala and Cicekli's work. It is provided me by Cicekli. In addition, another set of 24 Turkish articles are used. They are taken from Arastirmax Scientific Publication Archive (Arastirmax Scientific Publication Archive). The datasets are prepared to discard English abstract and keyphrases. Turkish keyphrases of the articles are moved in another file. As the studied algorithms are supervised learning algorithms, 67 of articles are used to train the systems and 17 ones are used to test.

4. Evaluation

The experiments are done on two systems, trained on whole dataset with Turkish Keyphrase Extraction Using KEA algorithm and ensemble version of it. 5 different systems are trained for ensemble keyphrase extraction. Top 20 keyphrases are extracted from the prior system whereas top 4 keyphrases are retrieved from the members of ensemble. The number of matches between algorithmically generated and author-assigned keyphrases is seen in Table 1.

#Author Assigned Keyphrases	#Matches with KEA	#Matches with Ensemble of KEAs
5	0	1
3	1	1
5	3	0
4	3	1
4	2	2
3	2	1
3	1	0
4	1	0
3	2	1
3	1	2
4	2	2
6	2	1
3	2	1
3	1	1
4	2	1
4	1	1
4	0	0

Table 1. Comparison of two methods in number of matches between author-assigned and algorithmically generated keyphrases

As the results indicate, the ensemble version of KEA is not working well. There are some strong evidences to get such a result. The most important thing is that each member of ensemble is trained 13 or 14 articles whereas the compared system is trained with 67 articles. The size of training dataset dramatically affects the performance. As opposed to taking top 20 phrases from the result list, top 4 phrases are retrieved from 5weak learners, summed to 20. It means that phrases are selected from ensemble of KEAs in more restricted way than original KEA. Thus, ensembling is not a solution for increasing the precision for keyphrase extraction process.

Although original KEA algorithm's precision values are too low, extracted keyphrases are acceptable for the context. Table 2 shows the author assigned keyphrases and KEA's extracted keyphrases for a test article in the left and right column respectively. KEA's keyphrases are also meaningful for the article.

Bir Tabu Arama Uygulaması: Esnek İmalat Sistemleri'nde Parça Seçimi ve Takım Magazini Yerleşimi	
esnek imalat sistemleri	Tabu arama
parça seçimi	esnek imalat sistemleri
matematiksel programlama	parça seçimi
tabu arama	kombinatoryal
	değişken planlama

5. Conclusion

This study proves that Turkish Keyphrase Extraction Using KEA algorithm is affected by the training dataset size. More number of trained documents leads higher precision values. The weak learners of the ensemble are affected dramatically by the size of training set. Therefore, ensembling cannot be a solution to the problem of low precision values of keyphrase extraction algorithms.

Acknowledgment

Thanks to Professor Ilyas Cicekli to provide the dataset of Turkish scientific articles to use in this study.

References

Arastirmax Scientific Publication Archive. http://www.arastirmax.com/ Accessed March 9, 2011.

Fayyad, U. M., Irani, K. B., (1993). Multi-Interval Discretization of Continuous-Valued Attributes for Classification Learning. *Proceedings of 13th International Joint Conferences on Artificial Intelligence*, (pp. 1022-1029), Chambery, France.

Journal of The Faculty of Engineering and Architecture of Gazi University, Vol. 21 Nr. 1, Nr. 2, Nr. 3, Nr. 4 and Vol. 20 Nr. 1, Nr. 2, Nr. 3, 2006.

Pala, N. & Cicekli, I., (2007). Turkish keyphrase extraction using KEA. *Proceedings of the 22nd International Symposium on Computer and Information Sciences* (pp. 1-5).

The Natural LanguageProcessing Group. http://nlp.ceng.fatih.edu.tr/ Accessed Dec. 11, 2010

Turney, P.D. (2000). Learning algorithms for keyphrase extraction" in Information Retrieval, vol. 2, Kluwer Academic Publishers (pp. 303-336).

Whitley, D. (1989). The GENITOR algorithm and selection pressure: why rank-based allocation of reproductive trials is best. *Proceedings of 3rd International Conference on Genetic Algorithms* (pp.116-121).

Witten, I. H., Paynter, G. W., Frank, E., Gutwin, C. & Nevill-Manning, C. G. (1999). KEA: practical automatic keyphrase extraction. *Proceedings of the Fourth ACM Conference on Digital Libraries*, (pp. 254-256).

zemberek-Home. https://zemberek.dev.java.net/ Accessed Dec. 25, 2010.

Market-Driven Multi-Agent Collaboration for Extinguishing Fires in the RoboCup Rescue Simulation Domain

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Abstract

Market-driven methods are the applications of basic free market economy principles to multi-agent planning tasks. They take advantage of the communication among the team members for maximizing the overall utility of a team of agents, one example of which is the rescue agents competing in the RoboCup Rescue Simulation League. In this paper, a modified market-driven algorithm and its integration to the behavioral architecture implemented for fire brigade agents of the rescue team are described. The algorithm is shown to provide a remarkable increase in the overall profit of the team.

1. Introduction

RoboCup Rescue Simulation (RSL) is one of the competitions in RoboCup (RoboCup-Rescue, 2008). Impacts of an earthquake such as collapsed buildings with civilians buried under them causing roads to close, and fires caused by gas leakages constitute the main theme of the competition (Morimoto, 2002). In order to minimize the damage associated with the disaster, rescue agents with different specializations and various responsibilities are employed. Ambulance teams are responsible for saving civilians under collapsed buildings, fire brigades are responsible for extinguishing fires, and police forces are responsible for clearing road blockades. The RSL team of Boğaziçi University, RoboAKUT, is a multi-agent rescue team developed for this competition and has been competing since 2002, and won the first place in the RSL Agent Competition in 2010. This paper presents the improvement achieved in multi-agent planning by using an integrated application of Market-Driven Methods (MDM) and Behavior-Based (BB) approach.

2. Approaches to Search and Rescue Mission

There are several approaches to solve the optimum utility problem in the RSL domain. In one extreme, there are the "every man for himself" kind of algorithms that are only based on individual utilities and costs in planning. In the other extreme, there are algorithms aimed at optimizing the overall utility through consideration of the overall utility of the team. BB approach is a good example for the former kind and MDM is a classic case for the latter.

2.1 Behavioral Method

BB architectures stem from the need due to the lack of performance and robustness of deliberative architectures which are simply sense-plan-act loops. They depend on principles of decomposing intelligence, distributing planning over acting, and taking advantage of emergent behaviors; henceforth achieving a reactive and robust planning. Disjoint behaviors form the basis of this method. Arbitration mechanisms, such as subsumption, are used to regulate the precedence of behaviors (Brooks, 1991). RSL domain consists of tasks of varying complexity for agents specialized in performing those tasks. Decomposition method used in construction of the BB model for RoboAkut 2010 is as shown in Figure 1 (Yılmaz & Sevim, 2010).

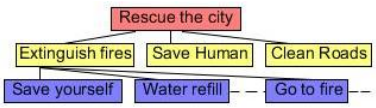


Figure 1. Pure behavioral method.

2.2 Market-Driven Method

MDM aims at maximizing the overall gain of a group of robots by cooperation, collaboration, and/or competition between them. This cannot be achieved merely by maximizing the profits of all individuals in a group; rather, it

is necessary to take the total profit of that group into consideration while planning. The key to "deciding for all" is the communication between the robots for trading jobs, power, and information. Distributed or centralized decision mechanisms may be used depending on the structures of teams (Kose et al., 2005).

3. Proposed Application of MDM

The proposed improvement on the former system is the integration of the MDM and BB methods to the system. This will be achieved as shown in Figure 2. As can be observed, an extra behavior, compared to the pure behavioral approach in Figure 1, that applies the market logic is added to the system. For every task, this market implementation will be specialized in order to meet the specific needs of that task.

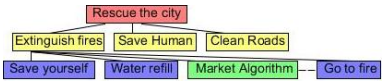


Figure 2. Market-driven method included into the current behavioral one.

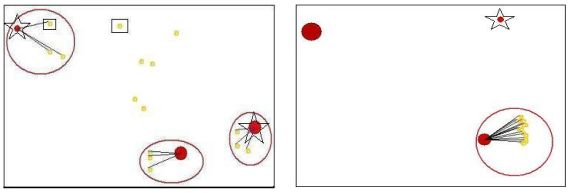
In the implemented market algorithm, every agent without an assignment calculates the costs for its known fires, and sends the best two of these costs to the center. The center, using its auction tools adds those bids to the appropriate auctions and gathers results for the auctions. If according to the results one agent is assigned to more than one building, an auction weighing the priority of the building and the cost for agent in taking action against that building is held on those results and the final decision is sent to the agent. If according to the results one agent is not assigned to any building, it is added in the auctions held for three buildings with the highest priority and no utilization, and the results involving more than one agent are interpreted using the method described above. During the cycles of central decision, an agent starts its action for the building with the least cost to it and according to the final decision by the center, it either preempts its current action or not. We believe that this algorithm is one of the best alternatives for RoboAKUT as it does not put much strain on the current communication structure and it is easily applicable to the current infrastructure.

4. Tests and Results

For testing the effectiveness of MDM in the RSL domain, scenarios associated with fires around a city have been extracted and used in the construction of a standalone system simulating only fires (some snaphots are given in Figure 3). During the tests a simple BB algorithm is compared with the variations of MDM algorithms.

4.1 Test Environment

For testing purposes a separate simulator working on a simple task, which we call "Extinguishing Fires Around a City", is developed and used (Figure 3). This task is chosen because it is simple to work on, hence can improve the productivity; yet even in a city with a small number of buildings and fire brigade agents there are many possible scenarios which enhance our testing abilities. It also provides a great environment as some of the factors that seriously affect the whole process but also those ones that are hard to observe in a complex structure become obvious in it. An example to these is the clustering tendency of agents, which can be explained as the physical grouping of agents around fires due to lack of communication between them. In MDM, the agents do not group as in Figure 3(a). However, this is an important problem in a simple BB implementation where the agents hardly know about each other. Grouped agents probably miss some other fires, as can be seen in Figure 3(b).



(a) MDM Screenshot (b) BB Screenshot

Figure 3. Screenshots of the test tool (Spots in squares: Agents, Filled Circles in Star:Fires, Strokes:Assignments, Big Hollow Circles:"Clustering effect")

4.2 Test Cases

In the testing phase the aim is to observe whether there is any difference between a system using a pure BB architecture and a system using some combination of MDM and BB approaches. Another objective is to observe the improvement in MDM algorithms as the parameters of the cost function are varied to find the optimal solution.

We tested various versions of the market-driven algorithms combined with behavioral structure against a purely behavioral one. Across the versions, there are both algorithm and parameter variations. There are some major versions that determine the main algorithmics and some minor versions that investigate the changes in market-driven method's results across different size of clusters where a cluster size represents the maximum number of agents allowed to engage in a particular fire event.

- $Version_1$ is the purely behavioral one hence it is used as the control group.
- $Version_2$ is the implementation of the algorithm

explained under the Application of Market-Driven Method section. $Version_{2-sv1}$, $Version_{2-sv2}$, $Version_{2-sv3}$, $Version_{2-sv4}$ and $Version_{2-sv5}$ are the variations of $Version_2$ where the cluster size is limited to one, two, three, five, and eight, respectively. This way we get to observe the effect of the size of a group on the overall performance.

- $Version_3$ is a variation of $Version_2$ in which the agents wait until the decision of the center. $Version_{3-sv1}$, $Version_{3-sv2}$, $Version_{3-sv3}$, $Version_{3-sv4}$, and $Version_{3-sv5}$ are the variations of $Version_3$ where, as in the case for $Version_2$, the cluster size is limited to one, two, three, five, and eight, respectively.

Along with $Version_2$ and $Version_3$ there are two other versions, namely $Version_{2-m}$ and $Version_{3-m}$. In these versions due to some changes in the associated parameters, a standard fire brigade's extinguishing capacity is decreased. The same versioning applied to $Version_2$ and $Version_3$ is applied to these versions as well. Every test is tried on 100 different scenarios. Those results are interpreted statistically using their averages and standard deviations.

4.3 Results

For interpreting Table 1 and Figure 4, we should consider the explanations provided in the former section. In Table 1 concatenating the row headings with column headings we can obtain associated results in the intersections of those rows and columns.

Table 1. Test results: "Average scores gained"

Ver.	*sv.1*	*sv.2*	*sv.3*	*sv.4*	*sv.5*	*Inactive*	
1						-36.62	
2	72.05	59.35	37.43	8.07	-8.33		
2-m	22.75	33.95	21.00	0.34	-15.00		
3	72.35	55.81	33.59	5.72	-11.40		
3-m	23.71	31.01	18.11	2.03	-17.50		

In all 100 scenarios we applied our tests on, there were, on average, 89 fires. The scores in the table represent the difference between the fires that were extinguished and those that were not. Observing the results in Figure 4 and Table 1 we see that there is a significant difference between $Version_1$ and all others. This is to an extent due to the low scores of the behavioral planner; partly because it is not a robust, and a fully developed planner yet, but this does not pose a problem since the market algorithm is integrated just on this planner and all that differs in the results are due to the market approach. Apart from that, a very important reason for the significant difference is the fact that in $Version_1$ all the agents go to the same fire due to the "grouping tendency" explained in Section 4.1. Since

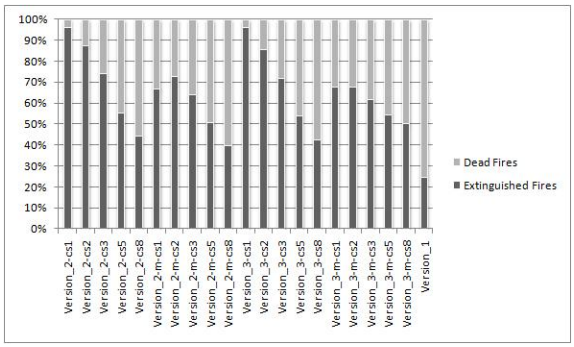
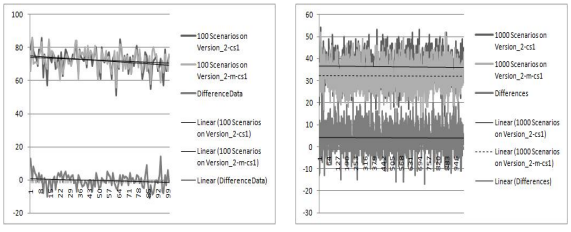


Figure 4. Results, Proportion of Extinguished Fires (darker) to Dead Fires (lighter) and All the Fires can be observed

the agents group around earlier fires, they cannot manage other fires easily. In the implementations of the market-driven approach, since all the agents are in contact with a center, they are directed by the center to wherever they are needed. This way, physically close agents form a team directed by the center and since they are distributed better on the map they get better results.

Between $Version_2$ and $Version_3$, the effect of an extra degree of reactivity (starting an action without waiting the center's permission) provided to the agents is tested. For interpretation, the average of the differences between the corresponding scenarios is used. The results seem to be too close when only 100 scenarios are considered (Figure 5(a)). However the more reactive approach proves to be useful when 1000 scenarios are considered as the difference becomes significantly larger than 0 (Figure 5(b)) supporting the superiority of the relatively more reactive approach over the relatively less reactive one. For example, in an experiment run on 1000 separate scenarios for $Version_{2-sv3}$ and $Version_{3-sv3}$ it is observed that the average of differences of scores is 4.022 (Figure 5(b)) although it is 0.3 (Figure 5(a)) in a test involving only 100 scenarios.



(a) For 100 scenarios, Avg. of Differences is 0.3 (lower trendline)

(b) For 1000 scenarios, Avg. of Differences is 4.022 (lower trendline)

Figure 5. Difference between all the results of $Version_{2-sv3}$ and $Version_{3-sv3}$. Average of differences can be observed with the help of trendlines

$Version_{2-m}$ and $Version_{3-m}$ are included to emphasize

the results of different versions. These cases are obtained by decreasing the capacities of the agents by half. As can be seen although the results for $Version_2$ and $Version_3$ imply that as the cluster size (mentioned in the section for the test cases) becomes smaller the scores tend to increase, the results for $Version_{2-m}$ and $Version_{3-m}$ show us that there is no such pattern since the results for clusters of size one are not better than the results for clusters of size two. This result points to a relation between the chunk size and the capacity of agents and it should be utilized in the cost function.

5. Conclusion

As can be seen in the test results, the market algorithm is a very important factor in enhancing the scores through communication between the agents which leads to cooperation and collaboration. Collaboration improves scores by avoiding "excessive clustering" around disaster events and provides a close-to-optimum distribution of work, man, and power resources around jobs in an intelligent manner, taking into consideration the important factors like collective capacities of a groups versus jobs.

Due to the complex nature of the search and rescue task there are many additional parameters that need to be considered which will be covered in future work.

References

Brooks, R. A. (1991). Intelligence without representation. *Artificial Intelligence*, 139–159.

Kose, H., Kaplan, K., Mericli, C., Tatlidede, U., & Akin, L. (2005). Market-driven multi-agent collaboration in robot soccer domain. In *Cutting edge robotics*, 407–416. pIV pro literatur Verlag.

Morimoto, T. (2002). *How to develop a robocuprescue agent* (Technical Report).

RoboCup-Rescue (2008). Building rescue systems of the future.

Yılmaz, O., & Sevim, M. M. (2010). *The development of intelligent agents for robocup rescue simulation league* (Technical Report). Bogazici University.

A Novel Meta-heuristic for Graph Coloring Problem:Simulated Annealing with Backtracking(SABT)

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Abstract

Hybridization of local search algorithms yields promising algorithms for combinatorial optimization problems such as Graph Coloring Problem (GCP). This paper presents *Simulated Annealing with Backtracking* (SABT), a new meta-heuristic for solving GCP. The proposed algorithm combines simulated annealing approach (SA) with a backtracking mechanism. SABT is a hybrid general purpose algorithm designed to solve any grouping problem. It does not exploit any domain-specific information. Several tests on a collection of benchmarks from the DIMACS challenge suite are run, giving promising results.

1. Introduction

Graph coloring problem (GCP) is one of the most extensively studied NP-complete problems (Karp, 1972). Given an undirected graph $G = (V, E)$ where V is a set of vertices and E is a set of edges, GCP is a grouping problem in which the set V is partitioned into a minimum number (the chromatic number χ(G)) of subsets of non-adjacent vertices.

GCP is famous for its easiness to be utilized to model many real-world applications. Many applications such as timetabling (Burke et al., 2007), frequency assignment problem (FAP) (Weicker et al., 2003), register allocation (de Werra et al., 1999) and air traffic flow management (Barnier & Brisset, 2002) are modeled using GCP.

In this paper, a new meta-heuristic algorithm named *Simulated Annealing with Backtracking* (SABT) is proposed to solve GCP. The algorithm utilizes simulated annealing (SA) algorithm as the local search mechanism while making use of a simple backtracking algorithm when the search is stuck. SABT is quite simple and efficient. At every iteration a single candidate solution (individual) is updated. The algorithm accepts individuals only with a legal coloring (i.e. there are no conflicting vertices in an individual). The algorithm constructs individuals with a variable length at every iteration.

We propose a new exponential function for the cooling down schedule in the SA algorithm. It is a simple exponential function that avoids heavy computations, and contributes to the performance of the algorithm. Backtracking mechanism also makes use of this function to determine the amount of backtracking. This approach provides a balance between diversification (exploration of the search space) and intensification (exploitation of the previous solutions).

Some existing algorithms use domain-specific information extracted from the graph in order to deal with difficult instances (Hertz et al., 1994). This information is then exploited to enhance the algorithm (Porumbel et al., 2010). In addition, many researchers utilize an initialization phase in their algorithms as in (B. & Zufferey, 2008). An important attribute worth mentioning about SABT is that it is designed as a general-purpose algorithm for any grouping problem as it does not exploit any domain-specific information. And it does not use any initialization phase for dealing with the large instances.

In this study, several tests have been run on a collection of benchmark graphs from the DIMACS Challenge Suite. The results match many of the best solutions presented in the literature. Thus it is proved that the algorithm is competitive with other state-of-the-art algorithms.

2. Related Work

Exact algorithms are able to color small graphs with at most 100 vertices. For larger graphs, heuristics and meta-heuristics have been widely utilized to attack GCP. First heuristics mainly have a greedy approach. DSATUR (Brélaz, 1979), RLF and XRLF (Leighton, 1979) are examples of this approach. Although these are fast algorithms, their efficiency is not satisfactory in terms of solution quality. For better solutions, local search based meta-heuristics

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Initialize V_{Vset};
Construct the individual;
$iterCnt \leftarrow 0$;
while *There are uncolored vertices in* V_{Vset} **do**
  Select a $backtrackAmount$ determined by $\frac{f(iterCnt)}{iterCnt_{max}}$;
  Move all vertices till backtrackPoint from $Ind_{current}$ to V_{Vset};
  Reconstruct $Ind_{current}$;
  $\Delta E \leftarrow elementCount_{old} - elementCount_{current}$;
  if $\Delta E > 0$ **then**
    Accept $Ind_{current}$ only with probability $iterCnt_{max} - iterCnt^{power} * \frac{f(iterCnt)}{iterCnt_{max}{}^{power}}$;
  end
  $iterCnt \leftarrow iterCnt + 1$;
  if $iterCnt == iterCnt_{max}$ **then**
    break;
  end
end

Algorithm 1: General algorithm for SABT

have been utilized. The most well-known are Tabu search (TS) (Hertz & de Werra, 1987) and simulated annealing (SA) (Chams et al., 1987). Although these heuristics are favored, they have a low performance on some large random graphs. Thus, several approaches have been proposed to deal with these difficult instances also resulting in the emergence of a third group of methods. The third category includes population based algorithms (Yilmaz & Korkmaz, 2010) and evolutionary hybrid algorithms (Galinier & Hao, 1999). The technique of utilizing algorithms together (hybrid algorithms) has proved to be promising especially when dealing with very large random graphs.

3. Main Scheme

The algorithm starts with a randomly created valid k-coloring. Then, at each iteration, a new individual is constructed out of the previous in the following way: A backtracking amount is calculated by a stochastic backtracking mechanism which is based on the evaluation function of SA algorithm. Based on the backtracking amount, some randomly selected groups are removed from the current individual and the vertices in these groups are put back into the set containing the uncolored vertices. Then the new individual is constructed by using the vertices in the uncolored vertices set. At this point, using the SA approach, SABT decides whether to accept the reconstructed individual or not. In this approach, if the reconstructed individual is better than the previous one, it is always accepted. If it is worse, it is accepted with the probability given by the evaluation function of SA.

Current and next (reconstructed) individuals are compared using their utility values (element counts). The algorithm terminates if either the graph has been succesfully colored with k colors or the maximum number of iterations has been reached.

The SABT algorithm is given in Algorithm 1, V_{Vset} is the set containing the vertices to be colored and separators used to indicate the groups. $Ind_{current}$ and Ind_{old} refer to the individuals constructed in the current and previous iterations. $elementCount_{current}$ refers to the number of vertices (utility value) in $Ind_{current}$ and so does $elementCount_{old}$ for Ind_{old}. The utility values of $Ind_{current}$ and Ind_{old} are compared by setting ΔE to the difference between $elementCount_{old}$ and $elementCount_{current}$. If ΔE is a positive value, then $Ind_{current}$ is worse than Ind_{old}. Hence, it is accepted with a probability given by the evaluation function of SA. The probability of accepting a worse individual decreases with time.

3.1 Evaluation function of SA

The most well-know evaluation function used for the cooling down schedule of simulated annealing is $e^{-\frac{\Delta E}{T}}$. This function has a logarithmic behavior and it converges to zero as T (temperature for SA algorithm) goes to zero. In this study, we propose a simple evaluation function denoted as $f(iterCnt)$ based on the iteration count only that approximates $e^{-\frac{\Delta E}{T}}$. Since the difference between the utility values of current and next individuals is considerably small, it is neglected. The behavior of the function depends on parameter $power$. It is possible to adjust the pace of the function by alternating this parameter. The evaluation function is explained below:

$$f(iterCnt) = iterCnt_{max} - iterCnt^{power} * \frac{iterCnt_{max}}{iterCnt_{max}{}^{power}} \quad (1)$$

where $power = 0.25$ and $iterCnt = 0, 1, ..., iterCnt_{max}$

Note that, $iterCnt^{power}$ grows slowly as $iterCnt$ goes to $iterCnt_{max}$ and $iterCnt^{power} \in [0, iterCnt_{max}{}^{power}]$. The evaluation function $f(x)$ makes use of $iterCnt^{power}$ to obtain a function decreasing gradually. To obtain a function slowly dropping down from $iterCnt_{max}$ to 0, scaling coefficient ($\frac{iterCnt_{max}}{iterCnt_{max}{}^{power}}$) is used.

The evaluation function should decrease gradually so that at the beginning, the algorithm is more likely to accept bad moves. This is a simple diversification phase. The ratio of accepting the bad moves decreases with time allowing the algorithm to intensify the search on individuals with higher utility value.

4. Experimental Results

All problem instances that we use in our experiments are from DIMACS challenge suite. They are solved 20 times independently with different random seeds. The parameter

$power$ utilized in the evaluation function of SA is set to 0.25 for all the experiments.

Table 1. Best colorings for SABT

Instances	n	dens.	χ/k^*	SABT	Diff.
DSJC125.5	125	0.50	?/17	**17**	–
DSJC125.9	125	0.89	?/44	**44**	–
DSJC250.1	250	0.10	?/8	**8**	–
DSJC250.9	250	0.90	?/72	**72**	–
DSJC500.5	500	0.50	?/48	51	3
DSJC1000.1	1000	0.10	?/20	21	1
DSJR500.1	500	0.03	?/12	**12**	–
R250.5	250	0.48	65/65	68	3
le450_15b	450	0.08	15/15	16	1
le450_25c	450	0.17	25/25	27	2
flat300.20	300	0.48	20/20	**20**	–
school1_nsh	352	0.24	14/14	**14**	–
fpsol2.i.2	451	0.08	30/30	**30**	–
inithx.i.2	645	0.07	31/31	**31**	–
mulsol.i.1	197	0.20	49/49	**49**	–
zeroin.i.1	211	0.18	49/49	**49**	–

In Table 1, the instances used in the experiments and best colorings that SABT has found are presented. In the first column, the names of the instances are given. Second and third columns denote the number of vertices for each instance and the density of the graph. The fourth column represents the chromatic number of the instance (χ) and the minimum number of colors reported so far (k^*). If (χ) for an instance is unknown (denoted by ?), k^* is taken into consideration. The following column gives the best number of colors for each instance that SABT has found. The colors matching χ or k^* are indicated in bold face. The sixth column gives the difference between SABT and χ/k^* in terms of number of colors. From table 1 it is seen that SABT matches many of χ/k^* in the literature. However, for some of difficult instances, the results are slightly worse. This is due to the fact that no initialization phase or domain-specific information is utilized.

5. CONCLUSION

In this study, a new hybrid meta-heuristic named SABT is proposed and applied on GCP. SABT is based on SA and backtracking algorithms. A new exponential function that avoids heavy calculations is also proposed. SABT is a fast and efficient algorithm. It does not have an initialization phase and no domain-specific knowledge is utilized in the algorithm. Hence SABT proposes a framework which can be applied to other grouping problems. Promising experiment results are obtained, hence SABT is competitive with other state-of-the-art algorithms.

References

B., I., & Zufferey, N. (2008). A graph coloring heuristic using partial solutions and a reactive tabu scheme. *Comput. Oper. Res.*, *35*, 960–975.

Barnier, N., & Brisset, P. (2002). Graph coloring for air traffic flow management.

Brélaz, D. (1979). New methods to color the vertices of a graph. *Commun. ACM*, *22*, 251–256.

Burke, E., MacCloumn, B., Meisels, A., Petrovic, S., & Qu, R. (2007). A graph-based hyper heuristic for timetabling problems.

Chams, M., Hertz, A., & de Werra, D. (1987). Some experiments with simulated annealing for coloring graphs. *Eu. Journ. of Op. Res.*, *32*, 260 – 266. Third EURO Summer Institute Special Issue Decision Making.

de Werra, D., Eisenbeis, C., Lelait, S., & Marmol, B. (1999). On a graph-theoretical model for cyclic register allocation. *Discrete Appl. Math.*, *93*, 191 – 203.

Galinier, P., & Hao, J. (1999). Hybrid evolutionary algorithms for graph coloring. *Journal of Combinatorial Optimization*, *3*, 379–397.

Hertz, A., & de Werra, D. (1987). Using tabu search techniques for graph coloring. *Computing*, *39*, 345–351.

Hertz, A., Jaumard, B., & de Aragao, M. P. (1994). Local optima topology for the k-coloring problem. *Discrete Applied Mathematics*, *49*, 257 – 280.

Karp, R. M. (1972). Reducibility among combinatorial problems. In R. E. Miller and J. W. Thatcher (Eds.), *Complexity of computer computations*, 85–103. New York, USA: Plenum Press.

Leighton, F. T. (1979). A graph coloring algorithm for large scheduling problems. *Journal of Research of the National Bureau of Standards*, *84*, 489–506.

Porumbel, D. C., Hao, J.-K., & Kuntz, P. (2010). A search space "cartography "for guiding graph coloring heuristics. *Computers & Operations Research*, *37*, 769 – 778.

Weicker, N., Szabo, G., Weicker, K., & Widmayer, P. (2003). Evolutionary multiobjective optimization for base station transmitter placement with frequency assignment. *IEEE Transactions on Evolutionary Computation*, *7*, 2003.

Yilmaz, B., & Korkmaz, E. (2010). Representation issue in graph coloring. *The Tenth International Conference on Intelligent System Design and Applications (ISDA 2010)*. Cairo, Egypt.

Towards A Self-Organized Agent-Based Simulation Model for Exploration of Human Synaptic Connections

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Abstract

In this paper, the early design of our self-organized agent-based simulation model for exploration of synaptic connections that faithfully generates what is observed in natural situation is given. While we take inspiration from neuroscience, our intent is not to create a veridical model of processes in neurodevelopmental biology, nor to represent a real biological system. Instead, our goal is to design a simulation model that learns acting in the same way of human nervous system by using findings on human subjects using reflex methodologies in order to estimate unknown connections.

1. Introduction

The enormous complexity and the incredible precision of neuronal connectivity have fascinated researchers for a long time. Although considerable advances have been made during last decades in determining this cellular machinery, understanding how neuronal circuits are wired is still one of the holy grails of neuroscience. Neuroscientists still rely upon the knowledge that is obtained in animal studies. Thus, there remains a lack for human studies revealing functional connectivity at the network level. This lack might be bridged by novel computational modeling approaches that learn the dynamics of the networks over time. Such computational models can be used to put current findings together to obtain the global picture and to predict hypotheses to lead future experiments. In this sense, a self-organized agent-based simulation model for exploration of synaptic connectivity is designed that faithfully generates what is observed in natural situation. The simulation model uses findings on human subjects using reflex methodologies to the computer simulations in order to estimate unknown connections.

Remaining of this paper is organized as follows. Section 2 gives background information, section 3 introduces our simulation model and section 4 summarizes the related work. Finally, section 5 gives the future work and concludes the paper.

2. Background

Roughly speaking, the central nervous system (CNS) is composed of excitable cells: neurons & muscles. A typical neuron can be divided into three functionally distinct parts, dendrites, soma and axon. The dendrites collect synaptic potentials from other neurons and transmits them to the soma. The soma performs an important non-linear processing step (called *integrate & fire model*): If the total synaptic potential exceeds a certain threshold (makes the neuron membrane potential to *depolarize* to the threshold), then a spike is generated (Gerstner & Kistler, 2002). A spike is transmitted to another neurons via synapses. Most synapses occur between an axon terminal of one (presynaptic) neuron and a dendrite or the soma of a second (postsynaptic) neuron, or between an axon terminal and a second axon terminal (presynaptic modulation). When a spike transmitted by the presynaptic neuron reaches to a synapse, a post-synaptic potential (PSP) occurs on the postsynaptic neuron. This PSP can either excite or inhibit a postsynaptic neuron's ability to generate a spike.

To study functional connection of neurons in human subjects it has been customary to use stimulus-evoked changes in the discharge probability and rate of one or more *motor units* in response to stimulation of a set of peripheral

afferents or cortico-spinal fibers. These are the most common ways to investigate the workings of peripheral and central pathways in human subjects. Although these are indirect methods of studying human nervous system, they are nevertheless extremely useful as there is no other method available yet to record synaptic properties directly in human subjects. Motor units are composed of one or more alpha-motoneurons and all of the corresponding muscle fibers they innervate. When motor units are activated, all of the muscle fibers they innervate contract. The output from the system is through the motoneurons, which is measured by reflex recordings from muscle. As output, the instantaneous discharge frequency values against the time of the stimulus and has recently been used to examine reflex effects on motoneurons, as well as the sign of the net common input that underlies the synchronous discharge of human motor units (for a review, see (Türker & Powers, 2005)). However, most of the synaptic input to motoneurons from peripheral neurons does not go directly to motoneurons, but rather to interneurons (whose synaptic connectivity is unknown) that synapse with the motoneurons.

3. An Agent-based Simulation Model for Human Motor Units

For exploring synaptic connectivity in human CNS, we designed and implemented a self-organized agent-based simulation model. Since it seems as a strong candidate for the simulation work and hence the solution to the problem of putting information together to predict hypotheses for future studies (Gürcan et al., 2010), we have chosen agent-based modeling and simulation (ABMS) technique. ABMS is a new approach to modeling systems and is composed of interacting, autonomous agents (Macal & North, 2006). It is a powerful and flexible tool for understanding complex adaptive systems such as biological systems.

3.1 Approach to Self-Organization

Our agent-based simulation model uses the AMAS theory (Capera et al., 2003) to provide agents with adaptive capabilities. This adaptiveness is based on cooperative behavior which, in this context, means that an agent does all it can to always help the most annoyed agent (including itself) in the system. When faced with several problems at the same time, an agent is able to compute a degree of criticality in order to express how much these problems are harmful for its own local goal. Considering this criticality, as well as those of the agents it interacts with, an agent is therefore able to decide what is the most cooperative action it has to undertake. The importance of the anomalies and how they are combined emerges from a cooperative self-adjusting process taking feedbacks into account.

Bernon et al. (Bernon et al., 2009) proposed an approach

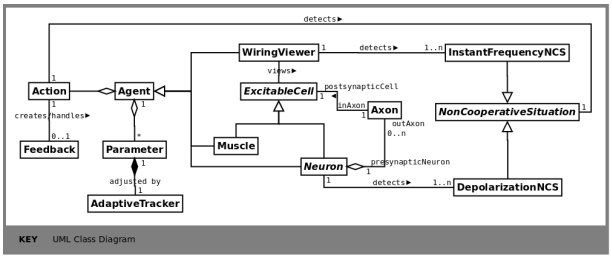

Figure 1. The simulation model for Self-Organizing Agents.

resting on this theory for engineering self-modeling systems, inwhich same type of agents are all designed alike and all agents consist of four behavioral layers. An agent owns first a *nominal behavior* which represents its behavior when no situations that are harmful for its cooperative state are encountered. If a harmful situation occurs (such a situation is called a *non-cooperative situation*, or NCS) it has to be avoided or overcome by every cooperative agent. Therefore, when an agent detects a NCS, at any time during its lifecycle, it has to adopt a behavior that is able to process this NCS for coming back to a cooperative state. This provides an agent with learning capabilities and makes it constantly adapt to new situations that are judged harmful. The first behavior an agent tries to adopt to overcome a NCS is a *tuning behavior* in which it tries to adjust its internal parameters. If this tuning is impossible because a limit is reached or the agent knows that a worst situation will occur if it adjusts in a given way, it may propagate the NCS (or an interpretation of it) to other agents that will try to help it. If such a behavior of tuning fails, an agent adopts a *reorganisation behavior* in which it tries to change the way in which it interacts with others (e.g., by changing a link with another agent, by creating a new one, by changing the way in which it communicates with another one and so on). In the same way, for many reasons, this behavior may fail counteracting the NCS and the last kind of behavior may be adopted by the agent, the one of *evolution*. In this last step, an agent may create a new one (e.g., for helping it because it found nobody else) or may accept to disappear (e.g., it was totally useless). In these two last levels, propagation of a problem to other agents is always possible if a local processing is not achieved.

3.2 The Simulation Model

Figure 1 shows the conceptual model of our simulation. *Neuron* and *Muscle* agents are treated as *ExcitableCell*s. *Axon*s are represented as connectors between neurons and excitable cells. Unitary behaviors that an agent is able to do are defined as *Action*s. These actions can be either for one shot or can be repeated with a specific interval. Each *Agent* is able to memorize, forget and spontaneously send feedbacks related to non-desired configuration of inputs (by de-

tecting NCSs). Each agent has various internal parameters (*Parameter*). When an agent receives feedbacks from one or more incoming entries, it is able to adjust its internal parameters or retro-propagates a *Feedback* to its own entries. For adjusting parameters of agents we used *AdaptiveTracker*s. Tuning a parameter for an agent consists in finding its right value within an interval considering that this value may evolve with time (Lemouzy et al., 2010). Adaptive trackers allow this tuning depending on the feedbacks the agent gets from its environment.

In the AMAS approach, a system is said *functionally adequate* if it produces the function for which it was conceived, according to the viewpoint of an external observer who knows its finality. The external observer in our model is a *WiringViewer* agent. A *WiringViewer* agent is used to trigger the recruitment of synaptic connections and the functional connectivity of the neural system. It monitors and records the outputs of the neural system that take place over time to compare the simulated (running) data to reference data for detecting NCSs. Reference data could be either experimental data or a statistical mean of several experimental data. the *WiringViewer* agent detects a *InstantFrequencyNCS* when an instant frequency of the spike produced by a *Neuron* agent it views is not good.

The nominal behaviour of a *Neuron* agent is to realize *integrate & fire model*. As a cooperative behaviour it detects *DepolarizationNCS* (the depolarization of a *Neuron* agent can be either lower than needed, higher than needed or good). Since "neurons fire together, wire together", depolarization is crucial for *Neuron* agents. After this detection, it sends feedbacks to all its presynaptic agents. A *Neuron* agent, receiving either a *DepolarizationNCS* or *InstantFrequencyNCS* feedback, tries to increase its PSP or tries to find another *Neuron* agent to help it.

4. Related Work

In the literature, there are many models for the self-organization of neuronal networks. Schoenharl et al. (Schoenharl, 2005) developed a toolkit for computational neuroscientists to explore developmental changes in biological neural networks. However, details of the methodology used (e.g., how the initial random network is constructed) and of simulation parameters (e.g., how the threshold parameter for pruning is obtained) are not clear. Mano et al. (Mano & Glize, 2005) present an approach to self-organization in a dynamic neural network by assembling cooperative neuro-agents. However, their intent is not to explore synaptic connectivity. Maniadakis et al. (Maniadakis & Trahanias, 2009) addresses the development of brain-inspired models that will be embedded in robotic systems to support their cognitive abilities. However, this work focuses on brain slices rather than reflex pathways and aims to improve cognitive capabilities of robotic systems rather than exploring synaptic functional connectivity.

5. Conclusion & Future Work

Up until now, we have established and implemented a preliminary agent-based simulation model. The next step will be to enhance and to calibrate the proposed model. We will then compare *in silico* experiments with *in vitro* biological experiments. As a result of comparison we will either adjust our computatinal model or develop new/improved biological experiments to revise the biological model. This cycle will proceed until we get satisfactory results.

References

Bernon, C., Capera, D., & Mano, J.-P. (2009). Engineering self-modeling systems: Application to biology. 248–263.

Capera, D., Georgé, J., Gleizes, M., & Glize, P. (2003). The amas theory for complex problem solving based on self-organizing cooperative agents. *WETICE'03* (p. 383). Washington, DC, USA: IEEE Computer Society.

Gerstner, W., & Kistler, W. (2002). *Spiking neuron models*. Cambridge University Press.

Gürcan, O., Dikenelli, O., & Türker, K. S. (2010). Agent-based exploration of wiring of biological neural networks: Position paper. *20th European Meeting on Cybernetics and Systems Research* (pp. 509–514).

Lemouzy, S., Camps, V., & Glize, P. (2010). Real time learning of behaviour features for personalised interest assessment. In *Adv. in practical app. of agents and multiagent systems*, vol. 70 of *Adv. in Soft Comp.*, 5–14.

Macal, C., & North, M. (2006). Tutorial on agent-based modeling and simulation part 2: how to model with agents. *WSC'06: Proc. of the 38th conf. on Winter simulation* (pp. 73–83).

Maniadakis, M., & Trahanias, P. (2009). Agent-based brain modeling by means of hierarchical cooperative coevolution. *Artificial Life*, *15*, 293–336.

Mano, J., & Glize, P. (2005). Organization properties of open networks of cooperative neuro-agents. *ESANN* (pp. 73–78).

Schoenharl, T. (2005). An Agent Based Approach for the Exploration of Self-Organizing Neural Networks. Master's thesis, the Grad. Sch. of the Univ. of Notre Dame.

Türker, K., & Powers, R. (2005). Black box revisited: a technique for estimating postsynaptic potentials in neurons. *Trends in neurosciences*, *28*, 379–386.

Comparing the Efficiency of Abstract Feature Extractor with Other Dimension Reduction Methods on Reuters-21578 Dataset

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Abstract

We introduce abstract feature extraction (AFE) method and compare its efficiency with other dimension reduction techniques on text classification. Using AFE, we project high dimensional attributes in bag-of-words space onto a new hyper plane having dimensions equal to the number of classes. We show the impact of AFE on classification accuracies using different classifiers. We also test the robustness to data sparsity against the state-of-the-art text classification techniques. We also compare AFE with other popular dimension reduction schemes. We use Reuters-21578 as a standard text dataset. Results show that AFE gives encouraging enhancements in classification accuracies.

1.Introduction

Text classification is an information retrieval task in which documents are grouped into different classes or categories. The grouping task classifies documents into a fixed number of predefined categories (Joachims, 1997). One of the models widely used in text classification is the vector space model in which the documents are represented as vectors described by a set of identifiers, for example, words as terms. This model is also known as bag-of-words model. According to this model, every document acts as a bin containing its words. Thinking in the vector space, each term is a dimension for the document vectors. The nature of this representation causes a very high-dimensional and sparse feature space, which is a common problem to deal with when using bag-of-words model. There are two effective ways to overcome this dimensionality problem: Feature selection and feature extraction.
Feature selection algorithms output a subset of the input features, results in a lower dimensional space. Instead of using all words, feature selection algorithms evaluate features on a specific classifier to find the best subset of terms (Yiming and Pedersen, 1997). This results in reduced cost for classification and better classification accuracy. The most popular feature selection algorithms include document frequency, chi statistic, information gain, term strength and mutual information (Zhu, et.al., 2006). Chi-square and correlation coefficient methods have been shown to produce better results than document frequency (Jensen and Shen, 2008). The lack of feature selection algorithms is that the selection procedure is evaluated on a certain classifier. Hence, the produced subset may not be suitable for another classifier to improve its performance.
Feature extraction algorithms simplify the amount of resource required to describe a large set of data. The high-dimensional and sparse structure of vector space model requires large amount of memory and computation power. The aim of feature extraction is to combine terms to form a new description for the data with sufficient accuracy. Feature extraction works by projecting the high-dimensional data into a new, lower-dimensional hyperspace. Mostly used techniques are Principal Components Analysis (PCA), Isomap, Self-Organizing Maps and Latent Semantic Analysis (LSA). Latent Semantic Indexing is based on LSA and it is the most commonly used algorithm in text mining tasks nowadays.
This paper is organized as follows. In section 2, we introduce our evaluation dataset and the preprocessing steps. Section 3 gives brief description about related attribute extraction algorithms and introduces AFE method. In section 4 we discuss our experimental results. Section 5 addresses conclusions and future work.

2. Evaluation Dataset and Preprocessing

We prepare our dataset from news feeds of Reuters-21578 dataset, which is a standard test collection for text categorization tasks in information retrieval and machine learning. The dataset contains 21578 documents collected from Reuters newswire in 1987. There are 135 topics to label the categories of the news. While some documents may have one or more topic labels, there are ones that do not contain even a single entry.
We discard the documents with multiple topic entries as well as the documents without topics. Some documents in the dataset contain short description for the news and do not have news body section. We also filter these ones. After this elimination step, we have 12297 documents in 81 topics, each having exactly one topic label and news body section.
We use Porter's (1980) stemmer to stem the terms of the documents in the dataset. We remove stopwords, numbers and all punctuation marks after stemming. We have 9554 unique documents in hand when we remove the duplicate documents grew out of this process. If we look through the distribution of filtered samples, we see that documents are unevenly distributed among classes. This situation is inconvenient for classification tasks because heterogeneous distributions over classes generally decrease classification accuracies.
A filter similar to Box-Plot is used to find the outlying classes in this distribution. The mean and standard deviation of the y-axis are calculated and a box is drawn on the distribution with the center $mean_y$ and boundaries 0,2 x σ_y. The classes that fall into the area within the boundaries are used as the dataset classes; the ones outside these are considered as outliers and cleared. This filter gives us 21 classes out of the dataset, each containing approximately equal number of instances. We use 1623 documents that belong to the filtered classes as our input dataset. Our filtered input dataset contains 8120 words.
Number of documents per class after pre-processing step is given in Figure 1.

Looking from the bag-of-words view, we have a term-document matrix with 8120 rows and 1623 columns. The cells of the matrix contain tf-idf values of terms calculated by (1), where n_i is the number of occurrences of the considered term in document d_j, $|D|$ is the total number of documents, $|\{d_j:t_i \in d_j\}|$ is the number of documents where term t_i appears.

$$tfidf_{i,j} = \frac{n_{i,j}}{\sum_k n_{k,j}} \times \log\left(\frac{|D|}{|\{d_j : t_i \in d_j\}|}\right) \quad (1)$$

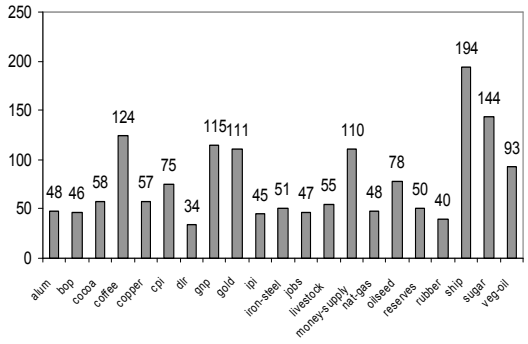

Figure 1. Distribution of documents among filtered classes after pre-processing step

3. Related Work and AFE Method

We can find many implementations of feature selection and feature extraction algorithms in literature. Here we list most commonly used and widely known methods, which we also choose for comparison.

3.1 Methods Chosen for Comparison

Chi-square is a popular feature selection method which evaluates features individually by computing chi-squared statistic with respect to the classes (Hall, 1998). This means that the chi-square score for a term in a class measures the dependency between that term in that class. If the term is independent from the class, then its score is equal to zero. A term with a higher chi-square score is more informative.
The correlation coefficient is in fact a variant of Chi-square, where $CC^2 = x^2$. This method evaluates the worth of a subset of attributes by considering the individual predictive ability of each term along with the degree of redundancy between them (Hall, 1999). The preferred subset of attributes is the one having high correlation within the class and low correlation between different classes.
Principal Component Analysis (PCA) transforms correlate variables into a smaller number of correlated variables-principal components. Invented by Pearson in 1901, it is generally used for exploratory data analysis. PCA is used for attribute extraction by retaining the characteristics of the dataset that contribute most to its variance, by keeping lower order principals, which tend to have the most important aspects of data. This is accomplished by a projection into a new hyper plane using Eigen values and Eigen vectors. PCA is a popular technique in pattern recognition, but its applications are not very common because it is not optimized for class separability (Fukunaga, 1990). It is widely used in image processing.

Patented in 1988, LSA is a technique that analyzes relationships between a document set and the terms they contain. This analyze is by producing a set of concepts related to documents and terms (Landauer & Dumais, 1997). LSA uses singular value decomposition (SVD) method to find the relationships between documents. Singular value decomposition breaks term-document matrix down into a set of smaller components. The algorithm alters one of these components (reduces the number of dimensions), and then recombines them into a matrix of the same shape as the original, so we can use it again as a lookup grid. The matrix we get back is an approximation of the original. LSA is mostly used for page retrieval systems and document clustering purposes. It is also used for document classification, or information filtering. Many algorithms utilize LSA in order to improve performance by working in a less complex hyperspace.

3.2 Abstract Feature Extraction Method

In this section we introduce AFE method. Unless other popular extraction methods, this algorithm does not depend on SVD. Input features are projected to the new feature space by using term probabilities. In this method, weights of terms and their probabilistic distribution over the classes are taken into account. We project term probabilities to classes, and sum up those probabilities to get the impact of each term to each class (Biricik & Diri, 2009).
Assume we have a total of I features, J instances and K classes. Let $n_{i,j}$ be the number of occurrences of feature f_i in instance d_j and N_i be the total number of instances that contain f_i. At first we calculate $nc_{i,k}$, the total number of occurrences of a feature f_i in class c_k with (2).

$$nc_{i,k} = \sum_j^{'} n_{i,j} \quad , \quad d_j \in c_k \quad (2)$$

After the first step, we calculate $w_{i,k}$, the weight of feature f_i (in an instance d_j) that affects class c_k with (3):

$$w_{i,k} = \log(nc_{i,k} + 1) \times \log\left(\frac{N}{N_i}\right) \quad (3)$$

Now we have the weights of the input features. These weights indicate how much a feature has effect in a class. In the third stage we calculate $Y_{j,k}$, the total effect of features in an instance d_j over a class c_k with (4).

$$Y_{j,k} = \sum_i w_{i,k} \quad , \quad w_i \in d_j \quad (4)$$

At the end, I features are projected onto a new hyper space, with K dimensions; we have K features extracted in hand for the instances. Repeating this procedure for all samples gives us a reduced matrix with J rows (one row per instance) and K columns (number of extracted features equals the number of classes). Finally, we normalize the reduced K features T_k with (5).

$$T_k = \frac{Y_k}{\sum_k Y_k} \quad (5)$$

The main difference from other popular linear feature extraction methods is that AFE requires a labeled dataset to form the projection hyper space. Instead of utilizing a ranking strategy to choose the most distinguishing extracted features; AFE depends on number of classes because the main idea is to find the probabilistic distribution of input features over the classes. Once the distribution is calculated, we can easily produce extracted features for the instances in the dataset. The extracted K features T_k for an instance d_j can be seen as the membership probabilities of d_j to K classes.

4. Experimental Results

We test the efficiency of AFE using seven different classification algorithms. We also compare AFE with other dimension reduction methods introduced in Section 3.1 using the Reuters-21578 dataset. We use 10-fold cross validation on our tests. We use classification accuracy metric given in (6) to quantify our results (*tp*: number of true positives, *fp*: number of false positives, *fn*: number of false negatives, *tn*: number of true negatives).

$$accuracy = \frac{TP + TN}{TP + FP + FN + TN} \quad (6)$$

We use Naïve Bayes as a simple probabilistic classifier, which is based on applying Bayes' theorem with strong independence assumptions (McCallum & Nigam, 1998). We choose Quinlan's (1993) C4.5 decision tree algorithm for a basic tree based classifier, RIPPER (1995) for a rule-based learner, 10-nearest neighbour algorithm to test instance-based classifiers and a random forest with 10 trees to construct a collection of decision trees with controlled variations (Breiman, 2001). We choose SVM (Cortes & Vapnik, 1995) for a kernel based learner which is also robust to data sparsity and LINEAR (Fan et.al, 2008) for a linear classifier which is known to be accurate especially on large and sparse datasets.

We give the classification accuracies derived from the tests using Reuters-21578 dataset in Table 1. We see that AFE improves the accuracies of Naive Bayes, C4.5, RIPPER, 10-Nearest neighbor and random forest classifiers in comparison with the other dimension reduction schemes. On the other hand, chi-squared feature selection, correlation coefficient feature selection, principal component analysis and no reduction over SVM and LINEAR classifiers give better accuracies than AFE while AFE surpasses LSA. The number of extracted features with AFE is too few for SVM and LINEAR classifiers to work effectively. That is the reason for failure of AFE on these algorithms.

The best accuracy, 96.9%, is achieved with AFE applied prior to 10-Nearest neighbor classifier. The following highest accuracy is 93.1%, which is achieved with AFE applied before Naive Bayes, chi-squared feature selection applied before LINEAR, and LINEAR with no dimension reduction.

Table 1. Accuracy comparisons of dimension reduction schemes, applied before classification of Reuters-21578 dataset.

	NR	AFE	CS	CC	PCA	LSA
Naïve Bayes	0,708	0,931	0,776	0,649	0,481	0,519
C4.5	0,835	0,913	0,836	0,807	0,567	0,680
RIPPER	0,808	0,918	0,826	0,776	0,483	0,638
10-NN	0,619	0,969	0,506	0,844	0,687	0,088
Random Forest	0,545	0,929	0,606	0,845	0,678	0,366
SVM	0,913	0,319	0,913	0,871	0,873	0,258
LINEAR	0,931	0,852	0,931	0,868	0,866	0,739
Average	0,766	0,833	0,771	0,809	0,662	0,470

4. Conclusion and Future Work

We introduce an algorithm for feature extraction and test its efficiency using different classifiers. We also compare our method with other popular dimension reduction schemes. We use the well-known Reuters-21758 as our dataset. We work on vector space model with tf-idf term weighting. Using AFE, we project words in documents onto a new hyper plane having dimensions equal to the number of classes. Results show that accuracies of the classification algorithms increase compared to tests run without using the proposed reduction algorithm. AFE gives better classification accuracies than the tested popular methods on the Reuters-21578 dataset.

We plan to improve our method to fit hierarchical classes as a future work. Furthermore, we schedule time-based tests to quantify how our method shortens process running times.

References

Biricik G., Diri, B., Sönmez, A.C.(2009). A New Method for Attribute Extraction with Application on Text Classification. In 5th Int. Conf. on Soft Computing, Computing with Words and Perceptions in System Analysis, Decision and Control, (pp.72-75). IEEE Press, New York.

Breiman, L. (2001). Random Forests. Machine Learning 45(1), 5-32.

Cohen, W.W. (1995). Fast Effective Rule Induction. In 12th Int. Conf. on Machine Learning, (pp.115-123). Morgan Kaufmann, San Francisco.

Cortes, C., Vapnik, V. (1995). Support-Vector Networks. Machine Learning 20(3), 273-297.

Fan, R.E., Chang, K.W., Hsieh, X.R., Wang, Lin, C.J. (2008). LIBLINEAR: A Library for Large Linear Classification. J. of Machine Learning Research (9), 1871-1874.

Fukunaga, K. (1990). Introduction to statistical pattern recognition. Academic Press.

Hall, M.A., Smith, L.A. (1998). Practical Feature Subset Selection for Machine Learning. In 21st Australian Computer Science Conference, (pp.181-191). Springer.

Hall, M.A. (1999). Correlation-based Feature Subset Selection for Machine Learning. PhD Dissertation, University of Waikato.

Jensen, R., Shen, Q. (2008). Computational Intelligence and Feature Selection: Rough and Fuzzy Approaches. IEEE-Wiley, New Jersey.

Joachims, T. (1997). A Probabilistic Analysis of the Rocchio Algorithm with TFIDF for Text Categorization. In 14th Int.Conf. on Machine Learning. (pp.143-151). Morgan Kaufmann, San Mateo.

Landauer, T.K., Dumais, S.T. (1997). Solution to Plato's Problem: The Latent Semantic Analysis Theory of Acquisition, Induction and Representation of Knowledge. Psychological Review 104(2), 211-240.

McCallum, A., Nigam, K. (1998). A Comparison of Event models for Naïve Bayes Text Classification. In AAAI/ICML-98 Workshop on Learning for Text Categorization, (pp.41-48). AAAI Press, Madison.

Porter, M.F. (1980). An Algorithm for Suffix Stripping. Program 14(3), 130-137.

Quinlan, J.R. (1993). Programs for Machine Learning. Morgan Kaufmann, San Francisco.

Yiming, Y., Pedersen, J.O. (1997). A Comparative Study on Feature Selection in Text Categorization. In 14th Int.Conf. on Machine Learning. (pp.412-420). Morgan Kaufmann, San Francisco.

Zhu, J., Wang, H., Zhang, X. (2006). Discrimination-based Feature Selection for Multinomial Naïve Bayes Text Classification. In Matsumoto, Y., et.al. (eds.) LNAI, vol.4285, 149-156.

Abstracts of the Talks

Dependency Patterns in Class Diagrams and Their Detection

Tolga Ovatman, Feza Buzluca and Thomas Weigert

Dependencies between classes give key information about the static structure of an object oriented software system. For industrially sized systems it is difficult for the developer to visually analyze the dependencies between classes and to detect patterns of dependencies that frequently occur throughout UML class diagrams. In this paper, automatically detecting dependency patterns in software designs is focused. After applying graph clustering techniques to dependency graphs extracted from class diagrams it has been found that these techniques were not able to detect key dependency patterns that relied on characteristic relationships of classes within a cluster to classes outside of that cluster. An algorithm is proposed to detect such dependencies. Our experiments show that this algorithm not only detects these elements, but also improves on the studied graph clustering techniques when applied to dependency analysis of class diagrams.

Adaptive MVV Distribution using P2P Networks

Cihat Göktuğ Gürler and Sedef Savas

Inspired by the growing interest in 3D media, researchers are now focusing on solutions to bring next generation 3D entertainment to our homes. In this paper, we propose a novel solution for the adaptive streaming of 3-D representations in the form of Multi-view video by utilizing P2P overlay networks to assist the media delivery and minimize the bandwidth requirement at the server side. Adaptation to diverse network conditions is performed regarding the features of human perception to maximize the perceived 3D. Simulcast scalable video coding is used to enable view and SNR scalability. Moreover, windowing mechanism is utilized over Torrent-like P2P solution to ensure timely delivery of the content over. The paper also describes the techniques generating scalable video chunks and methods for determining system parameters such as chunk size and window length.

Extending the Wireless Monitoring Period for E-Health Applications

Ozgun Pinarer, Atay Ozgovde and Burak Arslan

A continually growing interest in Ambient Assisted Living (AAL) is observed which aims to provide solutions for elderly, children and patients with chronic diseases. The topic attracts both the academia and the industry. In a typical AAL application, the goal is to deduce the state of the patient and its environment through the use of wearable sensor hardware and further initiate alarms whenever deemed necessary. In this work, the widely known SHIMMER e-health sensor nodes are employed where the monitoring period for the ECG sensing mode is elongated. RF messaging is reduced by employing on-board computation techniques and the energy efficiency is increased without affecting the application performance. Monitoring period of the nodes is demonstrated to be extended up to 6.5 times by programming the shimmer nodes using the TinyOS development environment. Monitoring period, which implies the time duration for which a node continues to function without the need for recharging, is a crucial factor on the applicability of the AAL as a real life technology.

An Interference Aware Throughput Maximizing Scheduler for Centralized Cognitive Radio Networks
Didem Gözüpek and Fatih Alagoz

In this paper, we propose an interference aware throughput maximizing scheduler for cognitive radio networks (CRNs) as part of a MAC layer resource allocation framework. In the considered CRN scenario, the cognitive users with multiple antennas are coordinated by a centralized cognitive base station. We evaluate the performance of our proposed scheme using analysis of variation (ANOVA) technique. We also show experimental results for the total throughput for varying number of cognitive users and frequencies.

Correspondence by Exploiting Isometry
Yusuf Sahillioglu and Yucel Yemez

A novel, robust, and fast 3D shape correspondence algorithm applicable to two (nearly) isometric shapes in arbitrary non-rigid deformation is given. To this end, we define and minimize an isometric distortion cost. Our method first samples so-called base vertices among which a (not necessarily one-to-one) mapping is sought. In the first step towards optimizing our isometry cost, bases are sent to the spectral domain, where minimum-weight perfect matching algorithm creates a one-to-one mapping that minimizes the the isometry errors. This one-to-one mapping initializes the second step of optimization where we explicitly minimize the isometry cost by our greedy optimizer.

Adaptive stereoscopic 3D video streaming
Tolga Bağcı and Göktuğ Gürler

This paper presents a comparative analysis of scalable stereoscopic video coding strategies for adaptive streaming. In particular, we compare scalable simulcast coding of both views using SVC with scalable coding of one view with SVC and non-scalable coding of the other view using H.264/AVC, and benchmark them against non-scalable dependent coding of both views using the MVC. All of these coding options allow both symmetric and asymmetric coding of stereo videos. In addition, we propose a lightweight and periodic feedback mechanism for rate estimation and a strategy to adapt the total stereo source rate using SNR scalability option of SVC, while minimizing the loss rate of non-discardable packets. Experimental results show that dynamic rate scaling of only one view provides sufficient rate adaptation capability and better overall compression efficiency compared to scaling both of the views.

Intention Recognition for Role Exchange in Haptic Human-Computer Collaboration
Ayse Kucukyilmaz, T. Metin Sezgin and Cagatay Basdogan

This paper presents the key results of an experimental study on the utility of a role exchange mechanism that enables human-computer collaboration as a shared control scheme. We defined leader and follower roles for the user and the computer in a dynamic board game application. Using the role exchange mechanism, the partners negotiate through force information to change their control levels on the task. Such a negotiation scheme lets the users interact dynamically and smoothly with the computer. We also investigated the benefits of

adding visual and vibrotactile cues on top of the role exchange mechanism to directly inform the users on their and the computer's control levels at a given time during the task. We observed that the role exchange mechanism improves task performance and maximizes the efficiency of the user when compared to an equal control guidance condition and a condition in which no guidance exists. Also, we observed that the additional cues slightly decrease the user's efficiency, but improve the sense of collaboration and the level of interaction during the task. The users additionally reported that they found the task more comfortable and easier to perform in the existence of these cues, and stated that it was significantly easier to understand the interaction state and their control levels on the task. Finally we observed that the users' trust towards computer's guidance capability was significantly higher when informative cues were displayed to them.

Information Extraction from Turkish Radiology Reports using Local Rules on Turkish Grammar

Kerem Hadımlı and Meltem Turhan Yöndem

Radiology reports contain a vast amount of medical information, and assume shared knowledge between writer and reader. In spite of this assumption, it has come to our attention that a person with no medical knowledge can still understand the basic relations within report sentences. Then these relations can be used to deduce if a phrase shows an anatomic location, a finding, or a quality; even if a small percent of these deductions are incorrect due to missing medical education.

In this paper we propose a method for structured information extraction from free-text Turkish radiology reports using only local rules on Turkish grammar and no other medical information (including any ontology). The extracted information consists of conceptual relations (e.g. placement, possession, quality) between different phrases within the sentence. Performance is measured and evaluated by embedding the method in a retrieval problem. The results are promising, approximately 68% recall and 31% precision on a dataset consisting of 100 positive and 4900 negative search queries in 53 radiology reports.

Dysphonic Speech Reconstruction

H. İrem Turkmen and M. Elif Karslıgi

The chronic dysphonia is the result of neural, structural or pathological effects on the vocal cords or larynx and as a result of it, the voice comes out as whisper. Mechanical and medical solutions such as electro larynx or voice prosthesis are used by the patients to regain their speaking ability as they have lost their voice permanently aftermath of a total laryngectomy. However, these solutions can not be applied to the patients with throat cancer who are treated with partial laryngectomy and have completely lost their speaking ability due to vocal cord paralysis or organic lesions on the vocal cord.
In this paper, we present a real time system, which delivers real-like synthetic voice by reconstructing the dysphonic voice of the patients that show an inability to speak using signal processing techniques.
Spectral distance measurements were made and subjective listening tests were applied for assessing the quality of the produced synthetic speech. The test results show that, synthetic speech produced this way is preferable compared to dysphonic speech especially in terms of timbre, recognition and naturalness.

Timetable Optimization with Genetic Algorithm and Local Search
Özcan Dülger

Scheduling of a project is difficult because of its constraints and complex structure. At first, mathematical methods were used but they failed because of these. Nowadays, heuristic methods have been used with a well-determined heuristic function. One of the problems of scheduling is timetabling problems. In these problems, the courses are assigned to the time slots by taking consideration to the constraints. Some of these constraints are hard constraints which should be satisfied, some of them are soft constraints which would be good if it is satisfied. In this paper, first, the definition of a timetable problem for a university department and its constraints are told. Then, proposed representation, fitness function and the other genetic algorithms operators are explained. Although genetic algorithms are well-suited for the global exploration, they usually fail in local exploitation. Because of this, some hybridization methods are designed to improve the genetic algorithm's performance. The experiment results show that these proposed methods increase genetic algorithm's performance incredibly. To test these methods with real data, Pamukkale University Computer Engineering Department's data are used.

A Spectrum Decision Mechanism for Cognitive Radio Ad-Hoc Networks
Berk Canberk and Sema Oktug

The spectrum decision concept in Cognitive Radio Ad-Hoc Networks (CRAHNs) introduces important challenges. These include the time-dependent SNR observations of CRAHN users due to the fading and shadowing effects in the licensed channels, the necessity of fusion mechanisms for accurate decisions, and the difficulties depending on multi-hop deployment. Considering these challenges, in this paper, we propose a dynamic, cooperative and distributed spectrum decision mechanism in order to decide the channel usage in CRAHNs accurately. The proposed mechanism considers the time-varying local SNR observations and decisions of the CRAHN users and employs a distributed Weighted Fusion Scheme (WFS), to combine the individual decisions and hence, to obtain the cooperative decision.

Effect Of Packet Losses On Visual Perception Of Stereoscopic Video
Goktug Gurler and Sedef Savas

There are various studies on visual perception of stereoscopic video, evaluating symmetric vs. asymmetric rate allocation among the right and left views. However, the effect of network packet losses/delay on visual perception of stereoscopic video and whether the human visual system can compensate for the artifacts generated by concealment methods has not been studied. This paper investigates the perception of stereoscopic video that is distorted by the packet losses at various rates and suggests means for both source and channel coding using the multi-view video coding (MVC) standard and raptor coding techniques to achieve the best perceived video quality for a given channel condition. The visual perception of applying channel coding symmetrically or asymmetrically to right and left views is also investigated.

ProSVM AND ProK-Means: Novel Methods For Promoter Prediction
Hilal Arslan

It is important to identify promoter regions to improve genome annotation and understand transcriptional regulation. In order to identify such regions accurately, transcription start sites (TSS) need to be identified correctly. Looking at the current genome annotation projects, it is not yet a common solution for the problem which is about identification of the transcription initiation regions. There are some drawbacks of the current methods which identify the core promoter regions. First, most of such methods require huge amounts of training data. Second, they are similar to black box methods, so output predictions are difficult to interpret. In this work, for identification of core-promoter regions, we propose a supervised and an unsupervised method. We use support vector machines as a supervised method and k-means as an unsupervised method using physical properties of DNA sequences. Finally, we evaluate and compare our results with ProSOM (Abeel et al,2008) results. We show that ProSVM is able to achieve much higher recall rates compared to ProSOM and, therefore, is more accurate compared to ProSOM overall.

ProFID: Practical Frequent Item Set Discovery in Peer-to-Peer Networks
Emrah Cem and Oznur Ozkasap

This study addresses the problem of discovering frequent items in unstructured P2P networks. This problem is relevant for several distributed services such as cache management, data replication, sensor networks and security. We make the following contributions to the current state of the art. First, we propose a fully distributed Protocol for Frequent Item set Discovery (ProFID) where the result is produced at every peer. ProFID uses a novel pairwise averaging function and network size estimation together to discover frequent items in an unstructured P2P network. We also propose a practical rule for convergence of the algorithm. Finally, we evaluate the eficiency of our approach and compare it with Push-sum protocol through an extensive simulation study on PeerSim and present our conclusions.

Energy-Efficient Multi-Threaded Video Decoding
Damla Kılıçarslan, Göktuğ Gürler, Öznur Özkasap and Murat Tekalp

Super high resolution or 3D media applications require data rates which necessitate higher computing performance and increased energy consumption for real-time video decoding. With the growing availability of multi-core processors for fixed and mobile terminals, multi-threaded decoding offers an effective solution to both performance speed-up and energy efficiency. In this study, we propose new multithreaded video decoding solutions with frame level and macroblock level task parallelism to provide real-time decoding performance with reduced energy consumption on multi-core processors. We propose two approaches for
MPEG SVC standard compliant video decoding. The former is based on a coarse-grained frame level, and the latter is a fine-grained macroblock level parallelism. They are implemented on a shared memory multi-core platform as an all software solution for real-time scalable video decoding.
Our results demonstrate that multi-threaded decoding not
only provides speed-up in decoding performance but also
reduces energy consumption.

Automatic Recognition of Turkish Fingerspelling
Furkan Isikdogan

Finger-spelling is a manual representation of alphabet letters and used in sign language to spell out words, especially private names. In Turkish Sign Language it is a challenging task due to the ambiguity of the fingerspelling representation of the letters with diacritic marks and complex hand configurations. In this paper we propose a Turkish fingerspelling recognition system based on extraction of the most effective features that help disambiguation of the signs. Our approach is fundamentally based on feature extraction by Histograms of Oriented Gradients (HOG) [1] and dimension reduction by Principal Component Analysis (PCA). Use of internal features instead of outer projection of the image enhances the performance on disambiguation. The test dataset consists of 493 fingerspelling images created by 4 different signers and the test results indicate an average success rate of classification of 99.39%.

Agent-based offline electronic voting
Mehmet Tahir Sandikkaya

Many electronic voting systems, classified mainly as homomorphic cryptography based, mix-net based and blind signature based, appear after the eighties when zero knowledge proofs were introduced. The common ground for all these three systems is that none of them works without real time cryptologic calculations that should be held on a server. Another classification is possible since some of these systems make people use voting booths as in conventional systems and the others let people vote at home. As far as known, the agent-based approach has not been used in a secure electronic voting system, yet. In this study, an agent-based electronic voting schema, which does not contain real time calculations on the server side and which lets people vote at home, is proposed. Conventional cryptologic methods are used in the proposed schema to satisfy the requirements of an electronic voting system. The schema rendered secure if the used cryptologic methods are secure.