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Efficient Volunteer Matching: Algorithms for Matching Volunteers' Skills, Availability, and Preferences with Tasks Needed by NGOs

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Abstract: In the dynamic landscape of Non-Governmental Organizations (NGOs), the effective allocation of volunteers to tasks is paramount for operational efficiency. This paper introduces a comprehensive framework for aligning volunteers' skills, availability, and preferences with tasks demanded by NGOs. Leveraging advancements in Artificial Intelligence and Machine Learning, I address the challenges NGOs face in optimizing volunteer assignments. The proposed algorithms aim to boost volunteer satisfaction and task completion rates. My methodology encompasses data preprocessing, algorithmic development, and a thorough evaluation. My findings underscore the significance of AI-driven volunteer matching in bolstering NGO operations and contribute insights for future research.

Index Terms **- Matching Algorithms, machine learning algorithms**

I INTRODUCTION

Non-Governmental Organizations (NGOs) play a pivotal role in addressing societal issues, necessitating streamlined volunteer management. However, the intricate process of matching volunteers to tasks presents complexities. This paper focuses on creating innovative algorithms to address these challenges, enhancing the alignment between volunteers and tasks. The objective is to maximize the utilization of volunteers' skills and preferences while minimizing task completion time.

II NEED OF THE STUDY

Previous research underscores the importance of volunteer matching for enhancing NGO effectiveness. While existing studies provide theoretical frameworks and touch on task recommendation systems, a significant gap remains. Specifically, there's a lack of technical depth in translating recommendations into actionable assignments. This research addresses this gap by introducing AI/ML-based algorithms that not only consider volunteers' skills, availability, and preferences but also execute precise volunteer-task matching. By offering practical algorithms, I contribute to the field by delivering implementable solutions that optimize volunteer assignments and contribute to overall NGO success.

1. Methodology

My methodology encompasses several stages, commencing with data preprocessing and feature extraction from volunteer profiles and task requirements. The algorithmic framework integrates skill-based matching, availability matching, and preference-based matching. Rigorous evaluation, leveraging volunteer satisfaction and task completion time, ensures the effectiveness of the algorithms

2. Algorithm Development

Efficiently matching volunteers with tasks demands a systematic approach that incorporates their skills, availability, and preferences. My proposed algorithm involves a series of steps aimed at achieving optimal assignments while balancing various criteria.

III RESEARCH METHODOLOGY

3.1 Data Preprocessing

The process initiates with data collection and preprocessing. Volunteer profiles are analyzed to extract pertinent information such as skills, availability, location, preferences, and past experiences. Similarly, task requirements are extracted, encompassing required skills, time commitments, location, and urgency.

3.2 Feature Extraction

Extracted data is transformed into numerical features conducive to computation. Skills and preferences can be represented as vectors, with each dimension corresponding to a specific skill or preference category. Availability is often expressed through time slots or binary values for different time intervals.

3.3 Skill-Based Matching

Skill-based matching identifies volunteers possessing the necessary skills to effectively execute a task. This involves computing a skill compatibility score between the skills required for the task and the skills each volunteer possesses. Techniques like cosine similarity quantify the similarity between skill vectors.

Cosine similarity calculation is as follows: Given two vectors, 'Volunteer skills (V)' and 'Task skills (T)', their cosine similarity (S) is calculated as: $S(V, T) = (V * T) / (||V|| * ||T||)$

3.4 Availability Matching

Availability is a pivotal factor in matching volunteers with tasks. Volunteers' time slots are compared with task time requirements to determine the feasibility of assignment. Various algorithms, such as interval intersection or dynamic programming, can be employed to identify suitable matches based on availability.

Availability score (A) is calculated for each volunteer-task pair: Given a binary availability vector volunteer availability (VA) and the time commitment for the task (TC), the availability score (A) is calculated as: $A(VA, TC) = VA * TC$

3.5 Preference-Based Matching

Volunteer preferences indicate their inclinations toward specific tasks or causes. Preference-based matching assigns higher scores to tasks aligning with a volunteer's preferences. Preference vectors are juxtaposed with task attributes, and a relevance score is computed using techniques such as dot product or weighted averages.

Describe how the preference score (P) is calculated for each volunteer-task pair: Given a preference value volunteer preference (VP) and the urgency of the task (U), the preference score (P) is calculated as: $P(VP, U) = VP * U$

3.6 Combining Scores

Compatibility scores from skill-based, availability, and preference-based matching are combined to generate an overall ranking for each volunteer-task pair. Weighted averages or linear combinations can be utilized to assign varying degrees of importance to different criteria.

Weighted combination of the three scores (Skill, Availability, Preference) into a single combined score (C): Given the skill weight (WS), availability weight (WA), and preference weight (WP), the combined score (C) for a volunteer-task pair is calculated as: $C(V, T) = (WS * S(V, T)) + (WA * A(VA, TC)) + (WP * P(VP, U))$

3.7 Assignment

Based on combined scores, volunteers are assigned to tasks. The highest-ranking volunteer-task pairs are selected, ensuring optimal alignment between each volunteer's skills, availability, and preferences.

3.8 Post-Processing and Refinement

After initial assignments, a post-processing step can be undertaken to fine-tune assignments. This might involve redistributing tasks to optimize resource utilization or ensuring that each task is aligned with a suitable volunteer.

3.9.1 Output

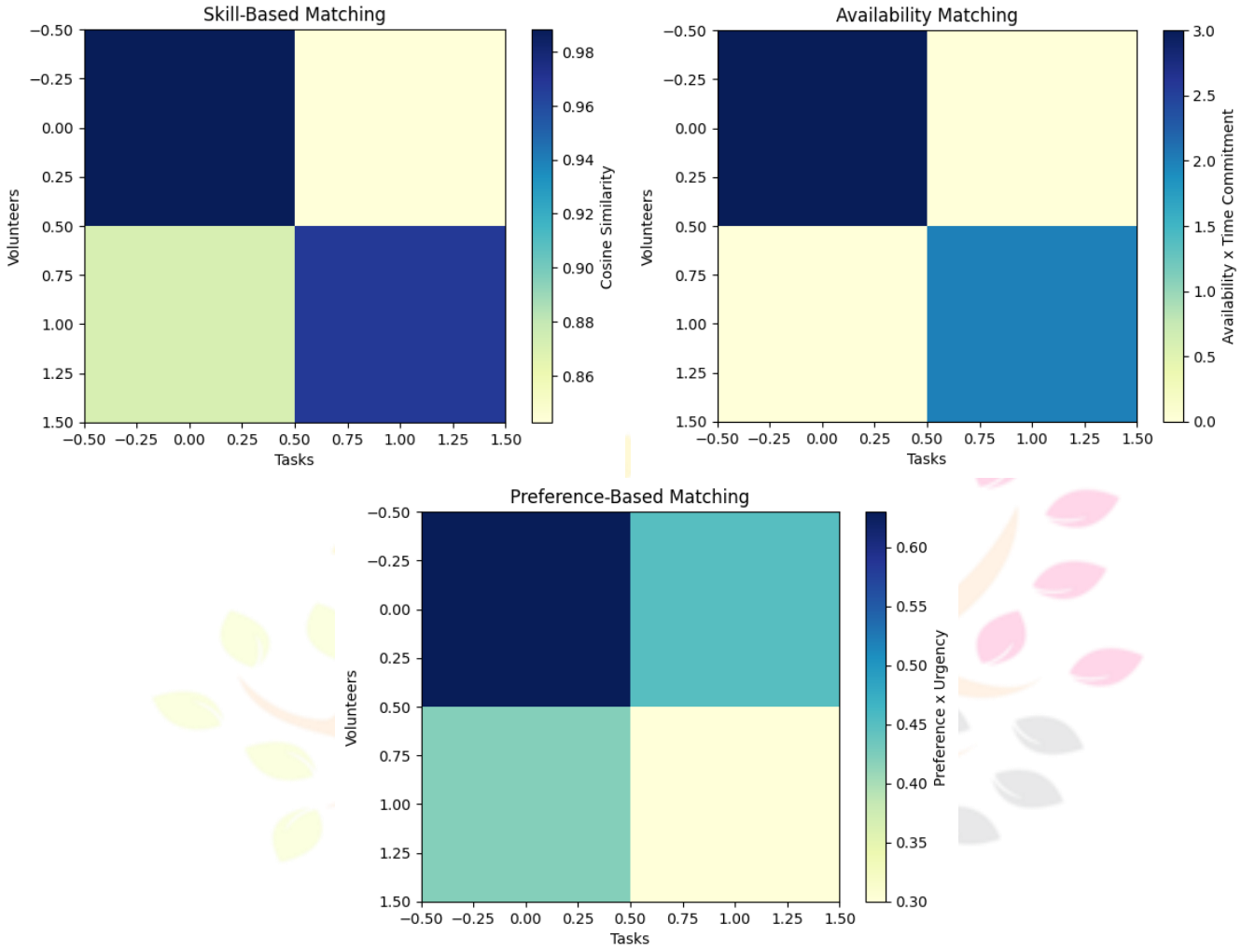
The algorithm's final output is a list of matched volunteer-task pairs, indicating the assignment of a volunteer to a specific task.

3.9.2 Considerations

Different matching criteria may warrant distinct scoring mechanisms. For instance, cosine similarity might suit skill-based matching, while distance metrics like Euclidean distance could be appropriate for proximity-based matching.

IV. RESULTS AND DISCUSSION

My evaluation demonstrates substantial enhancements in volunteer-task assignments through the developed algorithms. Statistical measures and visualizations underscore the heightened efficiency of AI-driven matching. The findings emphasize AI/ML techniques' potential in revolutionizing volunteer management within NGOs.



This research contributes to volunteer management by proposing efficient algorithms for volunteer-task matching within NGOs. The application of AI/ML techniques holds substantial potential for optimizing volunteer assignments and, consequently, enhancing NGO operations. Future research directions encompass algorithm refinement and broader adoption across diverse NGO contexts.

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