# Quality Quantity and Repellent Scent Aware Artificial Bee Colony Algorithm for Clustering

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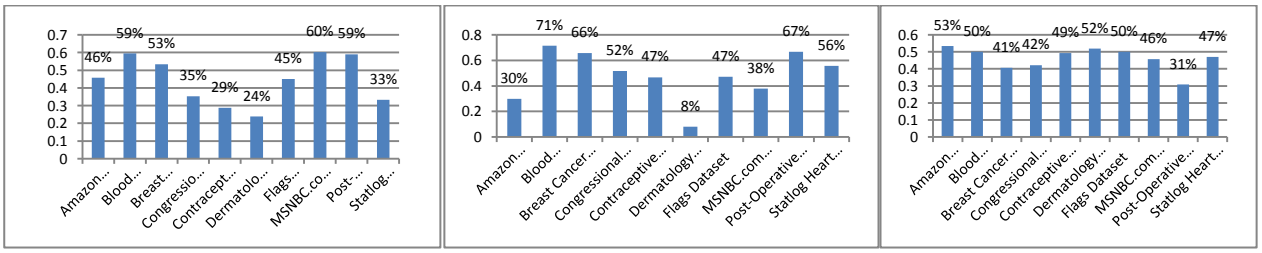
Cluster analysis, a process that aims to group observed sample of data or objects into homogeneous classes based on similarity of their observed attributes has found application in many areas such as computer sciences and engineering (security, web mining, spatial database analysis, textual document collection, image segmentation, machine learning, artificial intelligence, pattern recognition), life and medical sciences (genetics, microbiology, palaeontology, psychiatry, pathology), earth sciences (geography. geology, remote sensing), social sciences (sociology, psychology, archaeology, education) and economics (marketing segmentation, business strategy) [1, 2]. Cluster analysis has drawn the interests of researchers from various disciplines in the creation, use and modification of its underlying methods [3]. Artificial bee colony (ABC) algorithm is a relatively new swarm intelligence technique for clustering. It produces higher quality clusters compared to other population based algorithms but with poor energy efficiency, consistency and typically slower in convergence speed. Inspired by energy saving foraging behaviour of natural honey bees this paper presents a quality, quantity and repellent scent aware artificial bee colony (QRSABC) algorithm for clustering to improve quality of cluster identification, energy conservation and convergence speed of ABC. Three main foraging activities were modified: *Exploitation, Recruitment* and *Abandonment*. A structured approach using new equation relating to quality and quantity is introduced for recruitment to ensure lateral proportion based exploitation efforts. Also introduced is a repellent aware approach to avoid failed choices and, a quality and quantity abandonment approach to avoid false positive abandonments.

To evaluate the performance of QRSABC algorithm, experiments were conducted on a suite of ten randomly chosen benchmark UCI datasets popularly used by researchers in *machine learning*. The results Fig.1 demonstrate QRSABC algorithm performs better than the ABC algorithm in the quality of clusters delivered, speed and energy efficiency. Future work would be focused on investigating repellent scent life span influence on performance pattern.




(a) Quality (b) Energy Efficiency (c) Execution Time

Fig.1 Improvements achieved by QRSABC

## Reference

[1] E. Bonabeau and C. Meyer, 'Swarm intelligence', Harvard Business Review, vol. 79, no. 5, pp. 106-114, 2001.

[2] D. Pham et el., 'Data Clustering Using the Bee Algorithm', 40th CIRP International Manufacturing Systems Seminar, 2007.

[3] A. Jain, M. Murty and P. Flynn, 'Data clustering: a review', ACM computing surveys (CSUR), vol. 31, no. 3, pp. 264-323, 1999.