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DATA ANALYSIS FOR STUDENTS BASED ON GEOLOCATION APPROACH

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Original Article

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Abstract

It is quite important for students, particularly those who are new to strange places, to find appropriate housing. Some viable solutions to this difficulty can be found in advanced analytical approaches such as geolocational analysis and clustering algorithms. The optimal student housing options in any city can be found by thoroughly exploring geolocational data, as demonstrated in this study. In order to organise housing possibilities according to criteria such as budget, proximity to amenities, and availability, we employ the popular K-Means Clustering technique. Our objective is to provide new students with tailored recommendations by grouping homes into clusters; this will simplify their search and increase their level of satisfaction. This project seeks to demonstrate how geolocational analysis and clustering can improve student housing selection, which in turn improves students' health and academic performance.

Keywords: Data Cleaning, K-means Clustering, Machine Learning, Geographic Information Systems

Introduction

In this study, our objective is to use geolocational data for exploratory analysis so that we can find the best student housing options in every city. To be more precise, we will utilise the popular clustering algorithm K-Means Clustering to classify hotels according to their price, distance from the venue, and availability of facilities. Innovations in geolocation have played a crucial role in improving precision and accuracy in many fields. "An advance in geolocation by light" (2004) by Philip A. Ekstrom elucidates novel approaches that make use of light-based geolocation methodology [1]. Similarly, Purdy et al. (2006) provided important insights into remote sensing applications by delving into the analysis of geolocation and pointing accuracy, with a specific focus on the WinSAT sensor [2]. Endo and Hadj Sadok's investigation of "Who is based geolocation" (2010) demonstrates that geolocation strategies have progressed beyond conventional methods, revealing new ways to pinpoint the location of internet hosts [3]. Moreover, a groundbreaking method for geolocation prediction in social media data was presented in 2012 by Han, Cook, and Baldwin [4]. This method relies on location indicating words to give better results. Advancements in tracking migrating birds were examined by Bridge et al. (2013) in the field of ornithology, with an emphasis on the technical intricacies of light-level geolocation techniques [7]. The importance of social networks in improving geographic accuracy was highlighted in

Jurgens et al. (2015) critical analysis of Twitter geolocation prediction [8]. According to Xu et al.'s (2016) assessment that explains the state of mobility big data analytics for geolocation prediction [9], the growth of mobility big data has sparked an explosion in geolocation analytics. Big Data Sjögren Project Consortium (2017) and other large-scale data analytics also highlight the impact of geography and ethnicity on illness phenotypes [10]. Gharaibeh et al. (2017), which draws attention to inconsistencies and difficulties in router geolocation accuracy [11],[12],[13], shows that public and commercial router databases are under increased scrutiny due to the growing relevance of correct geolocation. According to Polamuri et al. (2019) [14],[15],[16], geolocation prediction in social media data has also been improved by advances in text analysis algorithms. Recent years have seen the unveiling of complex patterns of urban activity through the integration of geolocation data with advanced visualisation and spatiotemporal analysis techniques. This has allowed for more informed decision-making Rao P.S (2020) [17],[18],[19],[20],. In addition, as explained by Leonelli [(2020) [21], [22], [23], [24] and the use of invariant parameters for comprehensive insights has been driven by the confluence of health and environment in big data research.

As demonstrated by Singh et al.'s investigation of data analysis approaches employing machine learning algorithms (2022) [25],[26] the rapidly expanding domain of machine learning [27],[28] has transformed geolocational data analysis. The multidisciplinary character of geolocation research was further demonstrated by jame et al. (2023)[29],[30],who offered a thorough examination of GIS-social media analysis approaches[31]. We hope to demonstrate the usefulness of geolocational analysis and clustering methods in improving students' ability to choose their housing through this study. Our mission is to improve students' academic experience by providing them with personalised recommendations and making it easier for them to get what they need [32],[33],[34].

The objective of this paper is:

1. the K-Means Clustering technique, investigate geolocational data to find groups of suitable student housing in any city.
2. To make the home search easier and more enjoyable for prospective students, make personalised suggestions that take into account their budget, preferred facilities, and desired location.

Methodology

Gathering geolocational data on accessible lodgings, including features, rental rates, and distance to important places like schools or public transit centres, is the first step in the technique. Handling missing values and encoding categorical variables are part of the rigorous preparation stage that follows data collection. The goal is to clean and standardise the dataset. After that, factors like amenities, rental pricing, and distance to important areas are chosen for clustering analysis. Next, we use the K-Means Clustering technique to classify lodgings into clusters according to how similar they are with respect to the attributes we've chosen. The relevant metrics are used to evaluate the quality and coherence of the clusters that are produced. The next step is to create a recommendation system that will help new students choose the perfect place to stay by taking their preferences, budget, and preferred proximity into account. Before the recommendation system is put into action to help new students find appropriate housing, it is validated to make sure it works and is reliable.

Methodlogy Review

This project's methodology is based on finding the best possible student housing options in a given city using the machine learning algorithm K-Means Clustering. The goal is to help new students find suitable housing by classifying existing options according to features, economic constraints, and distance to preferred areas.

Gathering information on the available lodgings in the selected city, such as their amenities, rental prices, and geographic coordinates, is the first step in the data collection process. In addition, questionnaires or other approaches are used to gather incoming students' opinions when it comes to amenities, economic limits, and preferred locations.

After that, data is cleaned and transformed in data preprocessing so it can be analysed. This includes numerically encoding category variables like amenities.The next step is to run the dataset through the K-Means Clustering method,

which uses centroids as a starting point to iteratively group data points into clusters. Data availability and subject-matter expert opinion dictate the clustering density.

After clustering, the outcomes are assessed to determine the best student housing options taking into account criteria such as facilities, rental rates, and distance to preferred areas.

Lastly, visualisations like scatter plots or heatmaps are used to convey the clustering analysis results in a way that is easy to grasp. Additionally, suggestions for individual accommodations within each cluster are given to cater to the needs of prospective students.

Using the K-Means Clustering technique, this project's methodology provides a thorough strategy for finding the best student housing options in a city like Bangalore. The project's overarching goal is to make it easier for incoming students to find housing that suits their needs and preferences by classifying available options according to criteria like amenities, budget, and distance from desired areas.

A comprehensive inventory of the available lodging options in the selected city is the first step in the methodology's data collection phase. Included in this are specifics like the rental rates, facilities, and locations of each venue. Furthermore, information on the needs and wants of prospective students is gathered via surveys or other methods. This data includes things like the preferred proximity of facilities, financial constraints, and the amenities that students would want to have.

After gathering data, the following step is to prepare it for analysis by cleaning and formatting it. This process is known as data preparation. This involves cleaning the data of any errors or inconsistencies and converting any category variables into numerical values that the K-Means Clustering algorithm can handle. Before analysis can begin, data must be preprocessed to guarantee its quality.

The dataset is subjected to the K-Means Clustering algorithm when the data preprocessing is finished. This method groups comparable lodgings together into clusters according to their degree of similarity. Data availability and expert-level topic knowledge are two of the key criteria used to establish the optimal number of clusters. The algorithm makes it easy to find different kinds of housing by grouping the lodgings according to their characteristics.

The best possible student accommodations are determined by analysing the clustering process's output. To do this, we must examine the features of each cluster, including their rental rates, amenities, and distance to our ideal sites. The most appropriate choices are the clusters that, according to the survey results, closely match the preferences of the new students.

Furthermore, practical suggestions and insights are the desired outcomes of the project. Included in this is making sure that the clustering analysis results are presented in an easy-to-understand way, maybe with the help of visuals like heatmaps or scatter plots. To further assist prospective students in making educated decisions regarding their living arrangements, we also make recommendations for specific accommodations within each cluster that fit their preferences.

Using K-Means Clustering to classify possible student housing possibilities is the overarching goal of this project's methodology. The goal of this research is to improve the student experience by using this machine learning method to make it easier to find good housing. The initiative helps new students adjust to college life more easily by collecting, preparing, and analysing data thoroughly. It then offers suggestions and insights to make the transition easier.

Literature review

Advancements in Geolocation Techniques and Their Practical Uses:
Many industries, including healthcare, internet networking, social media analysis, and remote sensing, have made great strides in geolocation—the process of determining exact locations—in the past few years. The purpose of this study is to synthesise the most recent methods, difficulties, and applications of geolocation from the referenced research publications.

Technological Approaches:
Ekstrom (2004) published preliminary research that demonstrated promise for accurate location identification by introducing improvements in geolocation utilising light-based methodologies. In their 2006 expansion, Purdy et al. laid

the framework for geolocation systems based on satellites, such as WindSat, by investigating sensor aiming methodologies and geolocation accuracy. Han et al. (2012) suggested predicting geolocation in social media data by recognising terms suggestive of location, whereas Endo and Hadj Sadok (2010) examined geolocation through WHOIS data, pioneering ways to find internet hosts. From physical sensors to textual analysis, these works show that geolocation may be approached from various angles.

The importance of robust techniques that take into account different conditions was brought to light by Lisovski et al. (2012), who investigated the impact of environmental parameters on the precision and accuracy of light-based geolocation. Expanding on this idea, Gondree and Peterson (2013) tackled the difficulties of locating data kept in scattered environments by moving it to the cloud.

Fields of Application: Significant strides in monitoring migrating birds have demonstrated the usefulness of geolocation in ecological studies, drawing attention to the significance of light-level tracking (Bridge et al., 2013). Both Jurgens et al. (2015) and Xu et al. (2016) looked at geolocation prediction in Twitter and social networks, respectively, and found that there is a lot of interest in using big data analytics for location inference and mobility.

Analysis and Data Sources: Gharaibeh et al. (2017) investigated the reliability of public database geolocation for routers and found problems with using such sources. Highlighting the significance of linguistic clues in deducing location, Utomo et al. (2018) examined geolocation prediction in social media data using text analysis.

A study conducted by Rizwan et al. (2020) investigated the use of geolocation data from location-based social networks (LBSNs) to visualise and comprehend spatiotemporal patterns of urban activities. This finding highlights the potential of this data to shed light on human behaviour in urban settings. In their study, Leonelli and Tempini (2021) used invariant parameters in big data analysis to look at how health and the environment interact, drawing attention to how geolocation data might help with difficult social problems.

A move towards automated methods for processing and interpreting location information is indicated by the discussion of data analysis utilising machine learning on geolocational data in Singh et al. (2022). The multidisciplinary character of geolocation research was highlighted by McKitrick et al. (2023), who offered a thorough evaluation of techniques for gathering, processing, and displaying social media data based on location. Various domains present unique geolocation techniques, applications, and challenges, as shown in the examined literature. Technological advancements in geolocation have opened up new avenues for research into spatial phenomena and the improvement of decision-making tools, from time-honoured techniques like light-based tracking to cutting-edge approaches like social media analysis and machine learning.

Dataset review

LBSN: By integrating geographical location data into a variety of user-generated material, LBSN platforms have revolutionised the way individuals communicate and share content. In addition to sharing text updates, photos, videos, and links, users on these sites frequently reveal their current and past locations. Enhancing the platform's effectiveness as a location-centric information hub, they also provide comments on companies, attractions, and events. Content linked to exact physical coordinates allows research and discovery, while listings and descriptions of events happening in specific locations further enhance the platform's usefulness.

Information on users' demographics, interests, and LBSN-specific traits (such as gender and occupation) is freely available on these sites. Users can adjust their privacy settings to their liking, giving them control over who can see their content. Likes, comments, shares, and timestamps that show when content was created or shared provide insights about user interactions and how popular the content is.

A wide variety of user-generated textual information, such as posts, comments, and messages, is included in datasets from LBSN platforms. Pictures, movies, and links to other websites make up the multimedia environment on the platform. Usernames, profiles, and demographic information enhance the dataset, while material with related locations or location tags allows for easier geospatial analysis.

Rich LBSN datasets also include information on user interactions, sentiment analysis, content thematic classification, and user activity patterns. Insights about the architecture and behaviours of social networks can be gleaned from themany user relationships, including followers, friends, and connections, which put the platform's social dynamics into context.

Platform datasets:
everything that people write themselves, including blog entries, comments, and messages. Images and other visual content that users submit. videos created by users and shared on the site. hypertext links directing to other resources or websites. Details regarding the material, including last-viewed, like, share, etc.

Usernames, profiles, and other identifying information as well as demographic data. Location tags or coordinates linked to the material. Information about how users engage with the content (likes, comments, shares, views, etc.). Positive, negative, or neutral categorisation of content feeling. Subject or topic categorisation within content. Typical user behaviour patterns, including how often they post and when they are online. User relationships, including those with friends, followers, connections, and so on.

Information on the physical placement of network nodes is known as router geolocation data. This type of information is useful for a wide range of purposes, including optimisation of networks, geographic analysis, and localisation. Essential attributes for identifying geolocation include unique identifiers such as MAC addresses or IP addresses.

Routers can be precisely located within geographic space thanks to the latitude and longitude coordinates that are associated with them. Accompanying each geolocation measurement with the date and time gives temporal context, which helps with analysis of network dynamics and changes over time.

You can learn a lot about the precision and trustworthiness of location data from the confidence or uncertainty measures that come with each geolocation estimate. Geolocation accuracy is affected by factors such as signal intensity and signal-to-noise ratio. In general, location estimates are more exact when the signal strength is higher.

Environmental variables and infrastructural configurations affect the signal coverage area of each router, which in turn affects the precision and accuracy of geolocation data. When evaluating the credibility and veracity of geolocation data, it is helpful to know where the data came from, whether it be commercial services or crowdsourced databases.

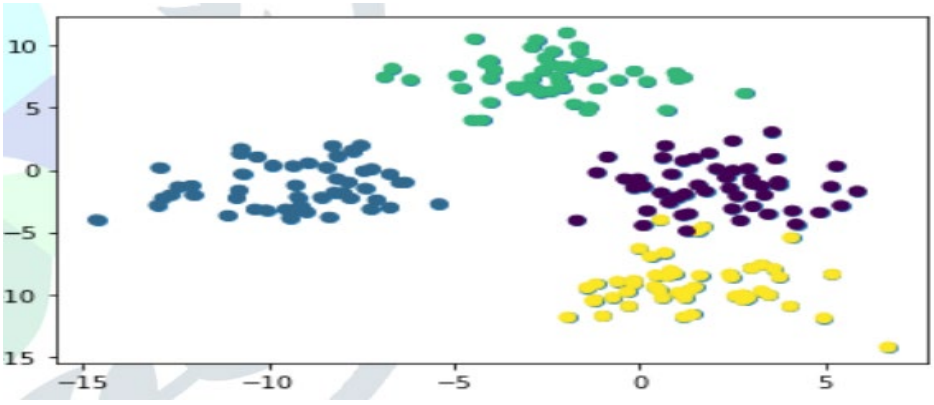


Fig1: Example of K-Means Clustering on Data Shown as a Scatter Plot

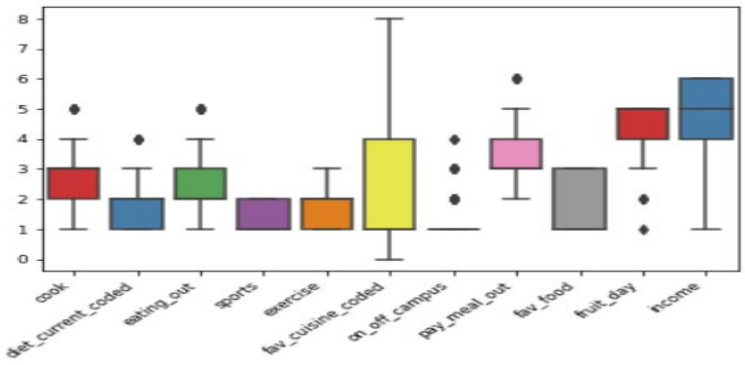


Fig2: Dataset Boxplot

Result and Conclusion

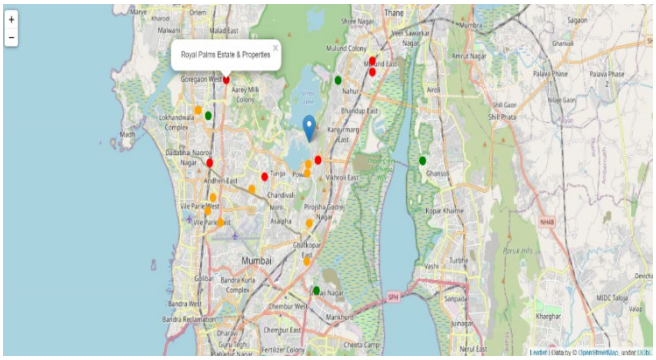
Result:
Based on the incoming students' budget, preferred facilities, and preferred location, the K-Means Clustering research into geolocational data produced multiple clusters of appropriate accommodations. In order to facilitate the categorisation of alternatives, these clusters were created by combining lodgings that shared comparable features.

The results showed that there were several groups of lodgings that fulfilled varied needs. There may be clusters that cater to more budget-conscious travellers by offering more basic amenities, while others may cater to those seeking more premium hotels near campus, offering a variety of services. Incoming students can simply choose options that fit their needs and preferences through this segmentation process.

A wealth of information regarding appropriate housing for new students has been uncovered through the analysis of geolocational data using K-Means Clustering. We found a lot of lodging clusters by looking at things like location, budget, and amenities. Accommodations with comparable features were grouped together to form these clusters, which made it easier to classify the possibilities.

The investigation revealed numerous groups of lodgings, all of which met unique requirements and catered to distinct tastes. There may be more budget-friendly options with fewer facilities in one cluster, and more luxurious ones with more facilities in another. Incoming students can improve their lodging search experience by rapidly identifying options that match their interests and requirements through this segmentation approach.

Result after implementation:



By Observation:

- There are fewer cafes and gyms in Cluster 0 (Green), but there are more eateries.
- There are more cafes, gyms, and restaurants in Cluster 1 (Orange).
- Less cafes may be found in Cluster 2 (Red), but there are more eateries and gyms.

Conclusion

K-Means Clustering, when applied to geolocational data, successfully finds appropriate student lodgings. Through the use of this clustering technique, students are able to expedite their search and make informed judgements according to their unique preferences and constraints.

Students looking for housing in different areas can benefit from this strategy because it can be adjusted to fit different cities or regions. Universities and housing companies can improve students' lodging search experience by employing geolocational data and clustering approaches. This will ultimately help students be more satisfied and well-off while they are in school.

It has been shown that using K-Means Clustering on geolocational data to find appropriate student lodgings works quite well. In order to help students make educated judgements, this clustering method offers a structured way to examine and classify lodging possibilities according to pertinent criteria.

In addition, this strategy is highly adaptable and may be used in other cities or locations, which increases its versatility and practicality. Whether students are looking for housing in busy city centres or peaceful suburbs, geolocational data and clustering approaches provide a useful foundation for improving the selection of housing.

Universities and housing organisations can greatly enhance students' accommodation search experiences by utilising geolocational data and clustering techniques. One way to help students thrive academically is to provide them with a categorised list of lodging possibilities that are specific to their needs and tastes.

To summarise, a strong framework for improving the accommodation selection process and the student experience as a whole can be obtained through the exploratory analysis of geolocational data for student lodgings using K-Means Clustering. This method allows for a more streamlined search for accommodations while still matching students with those that are the greatest fit for them, which boosts their chances of academic success and satisfaction.

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