

A Full-automatic Round, Oval or Rectangular Graveyards Feature Extraction Algorithm using Decision Tree Pattern Recognition

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Keywords: burial registers, graveyards parcels, cemetery, graveyards feature extraction, decision tree pattern recognition

SUMMARY

The officially registered area total in burial registers of all the graveyard parcels(264,917 parcels) among 37,530,183 land parcels in Republic of Korea(South Korea) is 283,443,098.7 m² and 85,891,848.1 pyoung(3.3m²) at the end of fiscal year 2009.

The 283,443,098.7 m² and 85,891,848.1 pyoung takes 0.28% point's portion to the homeland area of South Korea(99,897,411,054.6 km²).

Each graveyard parcel has the average area of 324.2 pyoung(1,069.9m²), while the others have the average of about 806.6 pyoung(2,661.8m²).

Including unregistered graves, cremation facilities, governmental or non-governmental cemeteries, reliquary facilities, churchyards and subsidiary roads, the graveyards portion to the homeland area is estimated to about 2%.

In order to physically manage the space within the cemetery (to avoid burials in existing graves) and to record locations in the burial register, most cemeteries have some systematic layout of graves in rows, generally grouped into larger sections as required.

Often the cemetery displays this information in the form of a map, which is used both by the cemetery administration in managing their land use and also by friends and family members seeking to locate a particular grave within the cemetery.

So, this study suggests an efficient full automatic graveyards feature extraction using decision tree pattern recognition into the estimation of the officially registered and unregistered area total in burial registers of all the graveyards parcels in South Korea.

Experiment results of proposed full automatic graveyards feature extraction using decision tree pattern recognition show about 70.71% of accuracy under RMSE 2 m of precision in comparison with conventional manual extraction.

의사결정나무 패턴인식을 이용한 전자등 원형, 타원형 또는 장방형 묘지객체추출 알고리즘

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주제어: 묘적대장, 묘지필지, 공동묘지, 묘지객체추출, 의사결정나무 패턴인식

요약

(Abstract)

이 연구는 대한민국의 모든 묘지필지중 묘적대장에 공식적으로 등록된 그리고 등록되지 않은 토지의 총면적과 그 위에 존재하는 분묘의 개수를 전수조사하기 위해 고해상도 영상을 입력데이터로 하는 의사결정나무 패턴인식을 사용한 효과적인 전자동화 원형, 타원형 또는 장방형 묘지객체추출 알고리즘을 제안한다.

제안한 자동화 묘지객체추출 알고리즘을 이용한 실험은 RMSE 2.0 m 정밀도 보다 양호한(엄격한) 조건 아래에서 70.71%의 자동추출 정확도를 보임으로써 기존 수동 육안추출에 비해 시간과 비용기준으로 월등히 개선된 결과를 얻었다.

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1. INTRODUCTION

A graveyard is any place set aside for long term burial of the dead, with or without monuments such as headstones. It is usually located near and administered by a church. Since the mid-1800s, the term cemetery has become a more popular label for most burying grounds. Graveyards were usually established at the same time as the building of the relevant place of worship (which can date back to the 8th to 14th centuries in European countries) and were often used by those families who could not afford to be buried inside or beneath the place of worship itself.

A tumulus (tumuli pl.) is a mound of earth and stones raised over a grave or graves. Tumuli are also known as barrows (Great Britain, Czech), burial mounds (United States, Canada, Scandinavia, Sweden, Norway, Denmark, Albania, Bulgaria, Croatia, Austria, Belgium), bunmyo (chong, the Koguryo tombs with well-preserved wall murals, shaped like Egyptian pyramids and half of the size of the Great Pyramid of Giza, South Korea, China), Hugel-Grab or kurgans (Germany), kenotaphions (Serbia), cairns(since Neolithic age surrounding stones, Ireland), mamoas (Portugal), mammulas (Latin), tombs (Italy, Greece), Maidams (India), Bin Tepeler, the pyramids of Anatolia, Maidas Mound, Mausoleum of Halicarnassus (Turkey), Rujm (Levant), kofun (includes keyhole shape kofun, Japan).

So in this paper, we denoted bunmyo in Korean as tumulus (tumuli, tombs, graves pl.) and myoji in Korean as graveyard (graveyards pl.) or burial ground(burying grounds pl.) including cemetery and necropolis.

We mentioned that graveyards include cemeteries and necropolises. A cemetery is a place in which dead bodies and cremated remains are buried. The term cemetery (from Greek *κοιμητήριον*: sleeping place) implies that the land is specifically designated as a burying ground. The Oxford English Dictionary states that a cemetery is "A burial-ground generally; now esp. a large public park or ground laid out expressly for the interment of the dead, and not being the 'yard' of any church. " and that it "... originally applied to the Roman underground cemeteries or CATACOMBS ".

However, in Korea, private companies are increasingly purchasing and operating formerly church or temple owned cemeteries. Some cemeteries are owned by independent non-profit cemetery organizations. The use of graveyards for burial of the dead was largely discontinued in towns from the 19th century onwards as they were replaced by cemeteries.

As we commented above, almost all countries in the world have tumuli and graveyards. In brief, a Korean and Chinese bunmyo (chong) or many of them are located on the myoji,

which is the graveyard in English language.

2. RELATED STUDIES AND METHODS

Prehistoric cemeteries are sometimes referred to by the term 'grave field'. They are one of the chief sources of information on ancient and prehistoric cultures, and numerous archaeological cultures are defined by their burial customs, such as the Urn-field culture of the European Bronze Age. From about the 7th century, European burial was under the control of the Church and could only take place on consecrated church ground. Practices varied, but in continental Europe, bodies were usually buried in a mass grave until they had decomposed. The bones were then exhumed and stored in ossuaries, either along the arcaded bounding walls of the cemetery, or within the church under floor slabs and behind walls.

The earliest of the spacious landscaped-style cemeteries is Père Lachaise in Paris. This embodied the idea of state- rather than church-controlled burial – a concept that spread through Europe with the Napoleonic invasions, and sometimes became adapted leading to the opening of cemeteries by private companies. The shift to municipal cemeteries or those established by private companies was usually accompanied by the establishing of spacious, landscaped, burial grounds outside of the city limits. Cemeteries are usually a respected or protected area, and often include a crematorium for the cremation of the dead. The violation of the graves or buildings is usually considered a very serious crime, and punishments are often severe. The style of cemeteries varies greatly internationally. For example, in the United States and many European countries, modern cemeteries usually have many tombstones placed on open spaces. In Russia, tombstones are usually placed in small fenced family lots. (This was once common practice in American cemeteries as well, and such fenced family plots are still visible in some older American cemeteries.)

Usually there is a legal requirement to maintain records regarding the burials (or interment of ashes) within a cemetery. These *burial registers* usually contain (at a minimum) the name of the person buried, the date of burial and the location of the burial within the cemetery; although some burial registers contain far more information about the deceased person. Burial registers are an important resource for genealogy. In order to physically manage the space within the cemetery (to avoid burials in existing graves) and to record locations in the burial register, most cemeteries have some systematic layout of graves in rows, generally grouped into larger sections as required. Often the cemetery displays this information in the form of a map, which is used both by the cemetery administration in managing their land use and also by friends and family members seeking to locate a particular grave within the cemetery.

Traditionally cemetery management only involves the allocation of land for burial, the digging and filling of graves, and the maintenance of the grounds and landscaping. The construction and maintenance of headstones and other grave monuments is usually the private responsibility of families of the deceased. However, increasingly, many people regard the resultant collection of individual headstones, concrete slabs and fences (some of which may be decayed or damaged) to be aesthetically unappealing, leading to new cemetery developments either standardizing the shape or design of headstones or plaques, sometimes by

providing a standard shaped marker as part of the service provided by the cemetery. This has led to the development of new styles of cemetery. There are a number of different styles of cemetery in use. Many cemeteries have areas based on different styles, reflecting the diversity of cultural practices around death and how it changes over time.

A natural cemetery or eco-cemetery or green cemetery is a new style of cemetery and is an area set aside for natural burials (with or without coffins). Natural burials are motivated by a desire to be environmentally conscious with the body rapidly decomposing and becoming part of the natural environment with incurring the environmental cost of traditional burials. Although in principle natural burial can be performed in any style of cemetery, typically the environmental motivations of those requesting natural burial tend to favor the use of a natural bush land or woodland setting for the natural burial. Because of the number of trees usually present in a natural cemetery, burials occur in whatever location and orientation best fits the natural environment as opposed to the more traditional rows or other orderly arrangements in traditional cemeteries. As a consequence, natural burial may actually be less efficient land-use than a traditional cemetery.

However because of the rapid decomposition of a natural burial, in principle the re-use of the grave site can occur earlier than in other conventional burials, which would improve the efficiency of land use. However, it remains to be seen if family members will accept the early re-use of natural burial sites, given the general community dislike of re-use of any kind of grave. Another consequence of the lack of orderly burials is the need for highly accurate surveying of the grave site for effective cemetery management, to prevent the accidental re-use of a grave site. In keeping with the intention of "returning to nature" and the early re-use potential; natural cemeteries do not normally have conventional grave markings such as headstones. Instead, the planting of a tree or bush or placement of a rock is regarded as the more appropriate way to commemorate the deceased. However, as with other types of cemetery, the intentions of the cemetery authorities may be in conflict with the grieving practices of family and friends, for whom being able to visit the precise location of a grave and see the name of the deceased is often important. In some natural cemeteries, names can be inscribed on naturally-shaped rocks (not carved headstones) but, unless the rock is particularly large and heavy, it can easily be knocked or kicked to another nearby location.

3. FULL-AUTOMATIC GRAVEYARDS FEATURE EXTRACTION USING DECISION TREE PATTERN RECOGNITION FOR MODERN CEMETERIES

Traditionally cemetery management only involves the allocation of land for burial, the digging and filling of graves, and the maintenance of the grounds and landscaping. The construction and maintenance of headstones and other grave monuments is usually the private responsibility of families of the deceased. However, increasingly, many people regard the resultant collection of individual headstones, concrete slabs and fences (some of which may

be decayed or damaged) to be aesthetically unappealing, leading to new cemetery developments either standardizing the shape or design of headstones or plaques, sometimes by providing a standard shaped marker as part of the service provided by the cemetery.

Usually cemetery authorities dig the grave, usually to ensure it is in the correct place and the correct depth, in order not to interfere with other burials in the cemetery. This is usually done before the mourners arrive for the burial. The cemetery authorities usually fill the grave after the burial, generally after the mourners have departed. Mechanical equipment, such as diggers, is used to reduce labour cost of digging and filling, but some hand shoveling may still be required.

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Cemetery authorities face a number of tensions in regard to the management of cemeteries. One issue relates to cost. Traditionally a single payment is made at the time of burial, but the cemetery authority incurs expenses in cemetery maintenance over many decades. Many cemetery authorities find that their accumulated funds are not sufficient for the costs of long-term maintenance. This shortfall in funds for maintenance results in three main options: charge much higher prices for new burials, obtain some other kind of public subsidy, or neglect maintenance. For cemeteries without space for new burials, the options are even more limited. Public attitudes towards subsidies are highly variable.

All of these issues tend to put pressure on the re-use of grave sites within cemeteries. The re-use of graves already used for burial can cause considerable upset to family members. Although the authorities might declare that the grave is sufficiently old that there will be no human remains still present, nonetheless many people regard the re-use of graves (particularly their family's graves) as a desecration. Also re-use of a used grave involves the removal of any monuments and headstones, which causes further distress to families (although families will typically be allowed to take away the monuments and headstones if they wish).

Cemetery authorities also face tension between the competing demands of efficient maintenance with the needs of mourners. Labour costs in particular have risen substantially and so finding low-cost maintenance methods (meaning low-labour maintenance methods) is increasingly important. However, as discussed above, the use of large mowers and string trimmers might be efficient but often cannot be used in cemeteries because they physically are

too large to fit between graves or because they can damage the monuments and headstones. In this regard, older cemeteries designed at a time of relatively low-cost labour and limited automation tend to present the greatest difficulties for maintenance. On the other hand, newer cemeteries might be designed to be more efficiently maintained with lower labour through the increased use of equipment, e.g. lawn cemeteries where the maintenance can be performed with a ride-on mower or lawn tractor. However, efficient maintenance of newer graves is often frustrated by the actions of mourners who often place flowers and other objects on graves. These objects often require manual intervention; in some cases objects will be picked up and returned after maintenance, in other cases (e.g. dead flowers) they will be disposed of.

4. EXPERIMENTS AND RESULTS

We chose 5 pilot study areas among the whole 249 counties in Korea for the proposed full-automatic graveyards feature extraction using decision tree pattern recognition. One of our 5 study areas which is the part of Sangrok-Gu county, Ansan City, Gyeong-gi-Prefecture, Korea is shown in Following Figure 1..We used ITT's ENVI 4.7 software in image processing which is working on the HP Z800 workstation with 2 Intel Xeon E5530 CPU, expanded up to 8 virtual processors, each is running on Windows 7 professional K operating system.

The images in used are aerial photograph models, captured not only over the study area but also the entire south half of Korean peninsula in 2005-2009.

Camera is a UltraCam-x frame type sensor and has been manufactured by the Austrian Vexcel. The ground sampling distance is 0.5 m (50 cm) and 4 bands of a model are resampled with SOCET SET software to one layer stacking image.

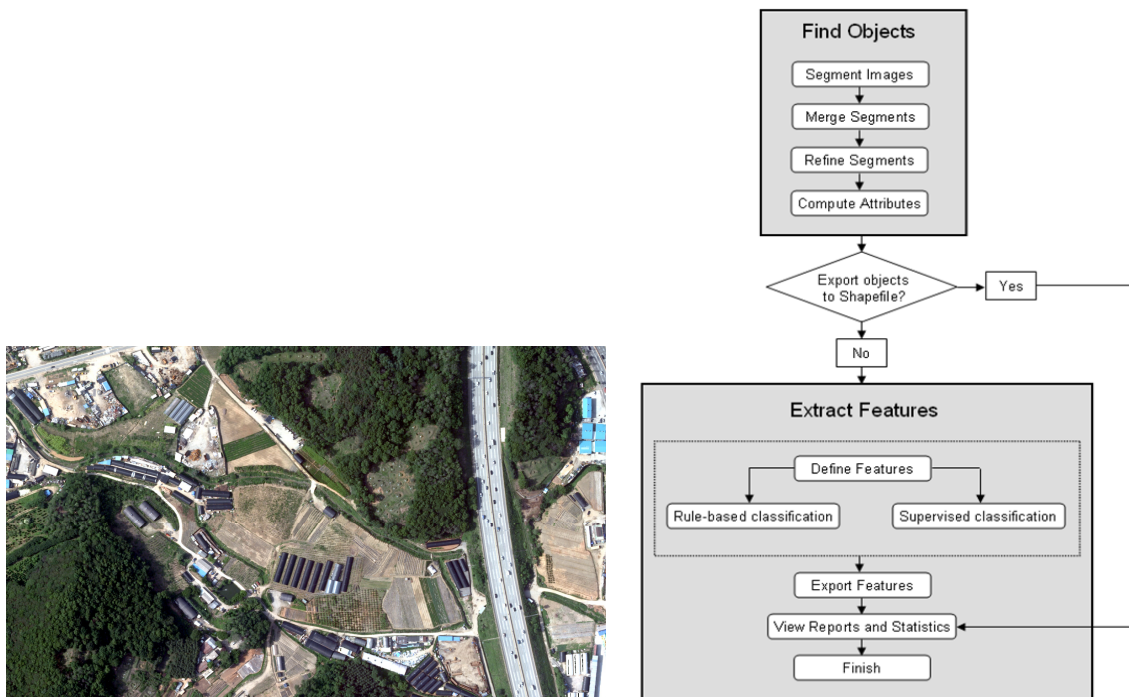


Figure 1. First step of the feature extraction: Source image ready

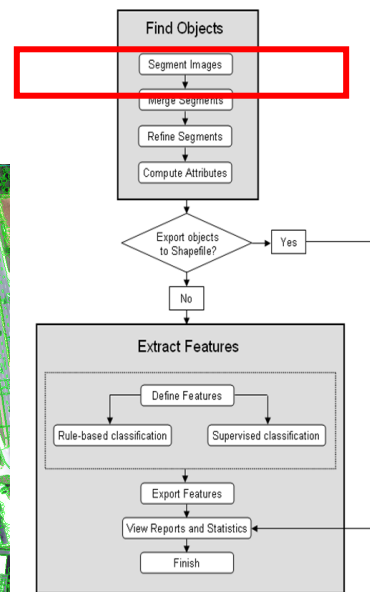


Figure 2. Second step of the feature extraction: Segment Images

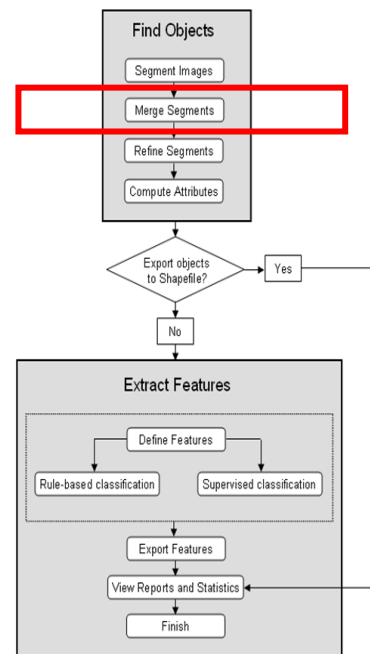


Figure 3. Third step of the feature extraction: Merge Segments

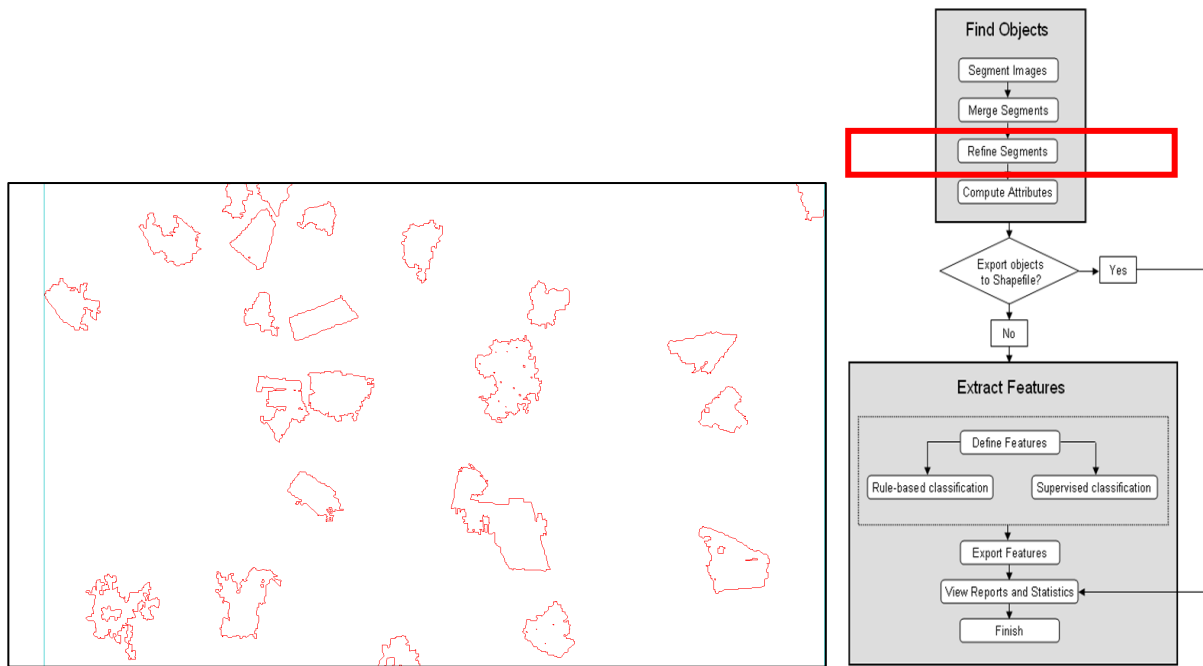


Figure 4. Forth step of the feature extraction: Refine Segments



Figure 5. Fifth step of the feature extraction: Rule-based or Supervised Classification

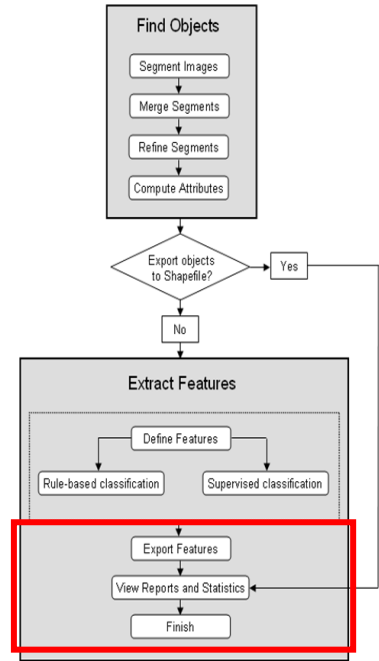


Figure 6. Sixth step of the feature extraction: Export Features and View Statistics



Figure 7. Study area's graveyards features on the source image

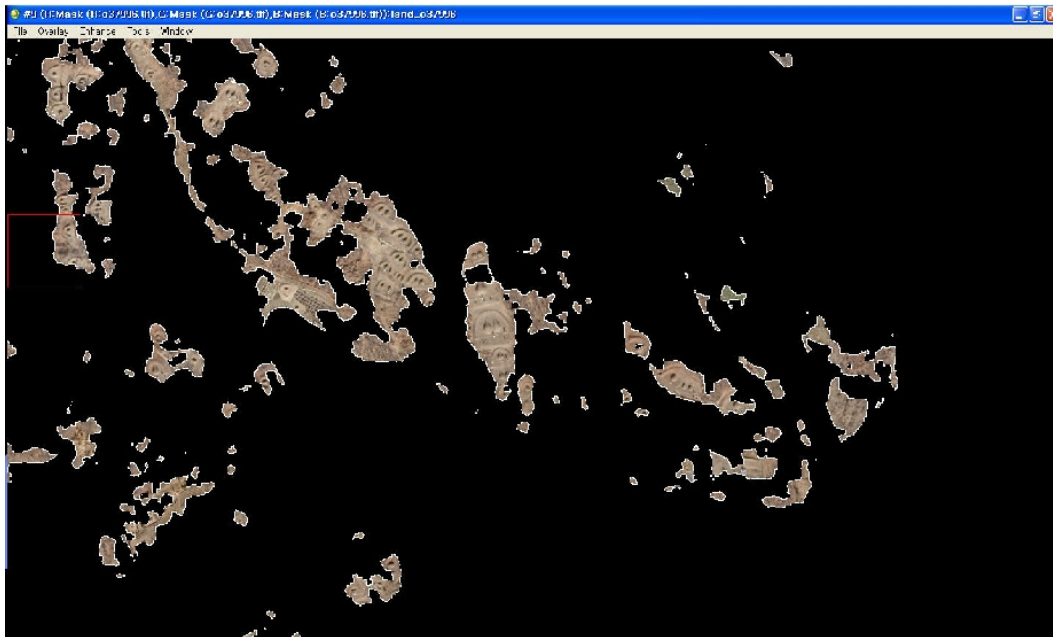


Figure 8. Segments extraction of the source image



Figure 9. Graveyards extraction experiments results over the source image

5. CONCLUDING REMARKS

Including unregistered graves, cremation facilities, governmental or non-governmental cemeteries, reliquary facilities, churchyards and subsidiary roads, the graveyards portion to the homeland area is estimated to about 2%.

In order to physically manage the space within the cemetery (to avoid burials in existing graves) and to record locations in the burial register, most cemeteries have some systematic layout of graves in rows, generally grouped into larger sections as required.

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BIOGRAPHICAL NOTES

Dr. Hyung Moo Kim, first author of this paper was born in Jeonju city, Jeonbuk province, about 180 km south west of Seoul, South Korea.

He has three older brothers and four elder sisters.

His father, Sang Young Kim is the Landlord of a large fruit plantation.

However his mother, Bok Lim Yang is a housewife but is a daughter of famous scholar.

He attended Seoul National University for a Bachelor of Arts degree, graduate school of Seoul National University for a Master of Education degree, majored in National Ethics Education in Korea and graduate school of Long Island University, Brookville, Nassau county, New York, USA for a Master of Science degree, majored in Computer Science Education, graduate center of The City University of New York, 365 Fifth Avenue, New York, New York for a Ph.D degree, majored in Computer Science.

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