Integrating GIS Research into the Geography and Geospatial Undergraduate Student Experience

American Association of Geographers
April 5, 2019

Susan H. Kamei
Managing Director
USC Spatial Sciences Institute

Who we are

law

geology

industrial and systems engineering

physical geography

human geography

gerontology

history

sociology

political geography

soil science

architecture

landscape architecture

urban planning

public policy

preventive medicine

international relations

computer science

economics

oceanography

civil and environmental engineering

political science

evolutionary biology

global health

SSI's Undergraduate Geospatial Curriculum

Majors

- B.S. in GeoDesign
- B.S. in Global Geodesign
- B.S. in Human Security and Geospatial Intelligence

Minors

- GIS and Sustainability Science
- Human Security and Geospatial Intelligence
- Spatial Studies

GE Courses

- Maps in the Digital World
- Sustainability Science in the City
- Human Populations and Natural Hazard
- The Water Planet

Four-Course GIS Sequence

301L: Maps and Spatial Reasoning

381: Statistics for the Spatial Sciences

382L: Principles of GIS

383: Geospatial Modeling and Customization

SSI's Graduate Geospatial Curriculum

Graduate Certificates

- Geographic Information Science and Technology
- Geospatial Intelligence
- Geospatial Leadership
- Remote Sensing for Earth Observation (Fall 2019)

Specializations

- GeoHealth | Master of Public Health
- GIS | Transportation Systems Management

M.S. Degrees

- Geographic Information Science and Technology
- Human Security and Geospatial Intelligence
- Spatial Data Science
- Spatial Economics and Data Analysis

Doctoral

- Spatial Analytics Graduate Certificate
- Ph.D. in Population, Health and Place

SSI Computational Infrastructure

Dr. Laura Loyola
Dir of UG Studies

Dr. Robert Vos
Dir of Grad Studies

Susan Kamei
Managing Dir

Ken Watson
Academic Programs Dir

Beau MacDonald
GIS Project Specialist

Richard Tsung
IT Systems Administrator

Andrea Macko
Fiscal Administrator

Stephanie Tran
Operations Specialist

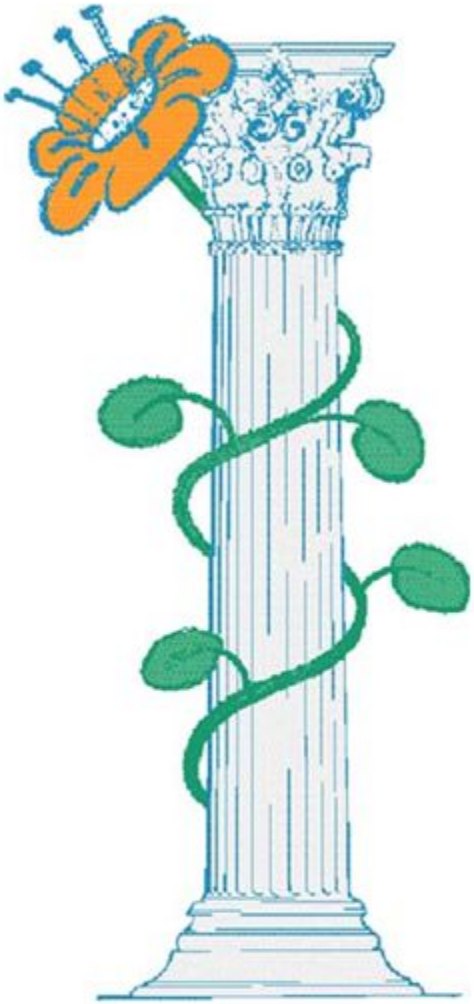
USC Dornsife
Dana and David Dornsife
College of Letters, Arts and Sciences

Spatial Sciences Institute

The Boyer Commission on Educating Undergraduates in the Research University

REINVENTING UNDERGRADUATE EDUCATION:

A Blueprint for America's Research Universities



http://notes.cc.sunysb.edu/Pres/boyer.nsf

Undergraduate Researchers
Critical Spatial Thinkers

+

USC Dornsife
Dana and David Dornsife
College of Letters, Arts and Sciences

Spatial Sciences Institute

Nature of faculty profiles

Lack of student awareness of research opportunities

Lack of faculty awareness of student interest and capabilities

Lack of funding for undergraduate student research

Lack of student awareness of benefits

Funding Sources: Research Grants

AEROSPACE

HUMAN RIGHTS WATCH

PHR
Physicians for Human Rights

Funding Sources: Gifts

esri

Eric Garcetti
@MayorOfLA

Funding Sources: University Programs

USC University of Southern California

Dr. Jennifer Swift and Dr. Darren Ruddell
Associate Professors (Teaching)

“The Catalogue” and “The Match”

2018 - 2019 Projects

“Automatic Generation of Long-term and Large Geospatial Data from Historical Maps”

“Impact of land use policy on urban development and human-environment systems change in Los Angeles County”

“Coast Light: Actionable Science to Manage Coastal Nightscapes”

“Los Angeles Regional Open Space and Affordable Housing Joint-Development – Site Identification and Analysis”

2018 - 2019 Projects, continued

“Smallsat Human Security Monitoring System”

“Urban Development and Inequality in India”

“’Superblocks’ for Los Angeles? — Sustainable Urban Alternatives Evaluated with GeoDesign”

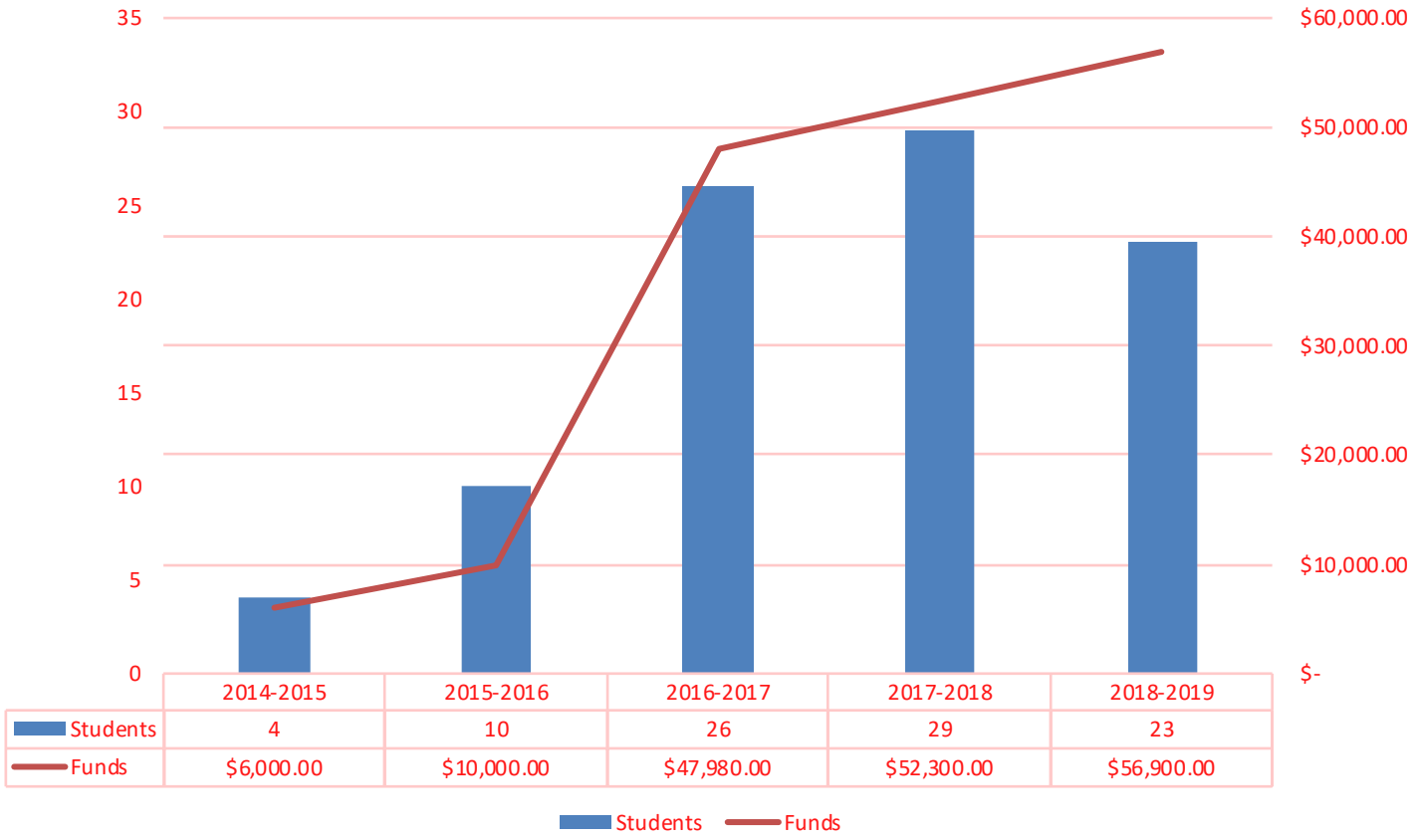
“City of Los Angeles Generation of Wealth and Business Growth”

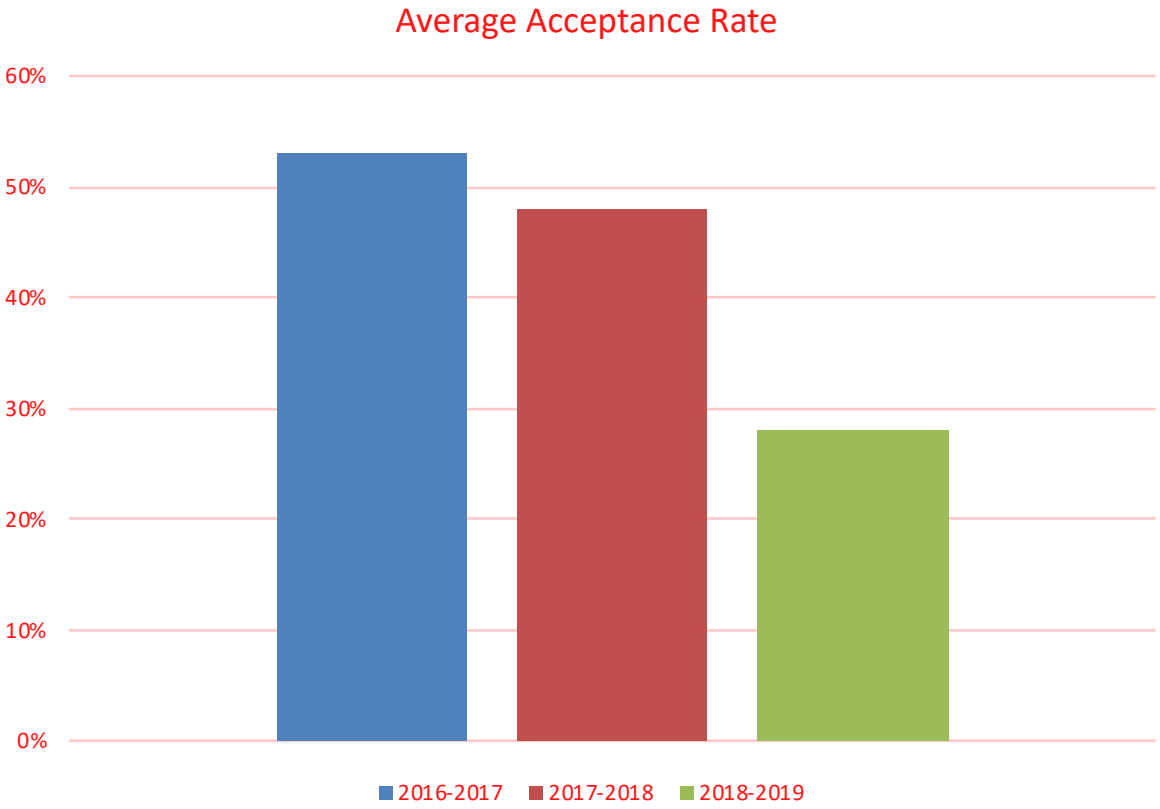
“Assessing residential soil lead contamination using geospatial analysis in Southeast Los Angeles County, California”

Culture


AHF B55


What We Need
- existing / proposed
- assumptions
- methods
↳ stakeholder charette (photo)
- typologies
- current conditions / issues
- stakeholders
- specific innovations
✓ - scenario maps - 1 km, 2.5 km
✓ - scenario summaries
↳ explanation for phasing
- scenario inn. / photos
✓ - data (housing units, mi. streets...)
wind mills, acres ag


Students and Funds
35
30
25
20
15
10
5
0
$60,000.00
$50,000.00
$40,000.00
$30,000.00
$20,000.00
$10,000.00
$-
2014-2015
2015-2016
2016-2017
2017-2018
2018-2019
Students
4
10
26
29
23
Funds
$6,000.00
$10,000.00
$47,980.00
$52,300.00
$56,900.00
Students
Funds


Average Acceptance Rate
60%
50%
40%
30%
20%
10%
0%
2016-2017
2017-2018
2018-2019

Outcomes: 2018 survey comments

"It definitely enhances my curriculum and it's a cool experience to be able to apply what you learn in class to the real world."

"It's been very interesting. . . . [We have been] allowed to develop our own framework which has been an amazing experience as well as a challenging one which has definitely shaped my college experience."

"Very very rewarding; comes with big results."

"Overall, I really enjoyed it. It helped me apply my class learning to solve real world problems, and develop close relationships with faculty and fellow students."

Outcomes: 2018 survey comments

" [The faculty and staff PIs] were phenomenal research leads, and I am grateful to have been able to work alongside them, learning from their various areas of expertise. I am proud of my work, and it is a great addition to any resume."

"It has been a great way to understand how to implement GIS and present data to people who are not familiar with GIS programs."

"Participating in research in SSI has been potentially the most meaningful opportunity I've had at USC. It has helped set me up for professional work and been one of my favorite uses of my time!"

"I am very happy that I took the chance to apply for a research position. I've learned so much and feel much more comfortable around GIS software. I am more confident about performing analysis on spatial data and figuring things out by myself."

Outcomes: presentations

Outcomes: awards

USC Price
Schwarzenegger Institute for State and Global Policy

Undergraduate Symposium for Scholarly and Creative Work

Outcomes: awards

BOREN AWARDS

FULBRIGHT

The PHI BETA KAPPA Society

THE NATION'S OLDEST ACADEMIC HONOR SOCIETY

Founded December 5, 1776

USGIF

Build the Community
Advance the Tradecraft
Accelerate Innovation

asprs THE IMAGING & GEOSPATIAL INFORMATION SOCIETY

Outcomes: student-authored publications

SRC: Automatic Extraction of Phrase-Level Map Labels from Historical Maps

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1. INTRODUCTION

Historical maps are important resources for various kinds of studies, providing insights for natural science and social science studies such as biology, landscape changes, and history [1]. However, text recognition on maps remains a challenging task because map usually has a complex background in which textual content appears in numerous colors, fonts, sizes, and orientations. Even if we were able to acquire perfectly recognized words and characters automatically, it is still difficult to generate useful information because individual words are not meaningful. For example, a typical result from OCR scanning or manual map digitization is that each recognized bounding box only contains a single word (Figure 1).

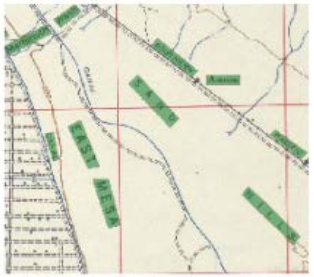

Figure 1: Example of recognized bounding boxes (green polygons)

Bounding boxes of the same phrases could be far away from each other, increasing the difficulty of linking them (e.g., SAND and HILLS, SOUTHERN and PACIFIC in Figure 1). This paper presents an automatic approach that combines single words extracted from historical maps into meaningful phrases, which represent complete location descriptions and can be used to link historical sites to other datasets. Our algorithm first combines textual and spatial features of individual map words to evaluate the potentiality of connecting two words. Then the algorithm trains a support vector machine to adjust the weight of each feature. This algorithm is potential to improve digital map processing by increasing the automation of text extraction on maps.

2. APPROACH

Table 1: Input Data and Output Data for Polygons in Figure 1

Input Data (Geo polygon)	Output Data
Mammoth	Linking with "Wash"
Wash	Linking with "Mammoth"
EAST	Linking with "MESA"
MESA	Linking with "EAST"
SAND	Linking with "HILLS"
HILLS	Linking with "SAND"
SOUTHERN	Linking with "PACIFIC"
Amos	No linkage
PACIFIC	Linking with "SOUTHERN"

The input data are the minimum bounding boxes for each word on maps. The output data is whether there exists a link for a pair of bounding boxes to constitute a phase. We assume all textual contents of the input data are perfectly transcribed. Table 1 presents the input data and ideal output data for bounding boxes in Figure 1.

2.1 Generating Feature Abstraction

Our algorithm uses four heuristic features to determine if two words should be linked to constitute a phrase. The features include boundary distances between two polygons, the text area for each character inside the bounding box, capitalization of the word and text contents.

2.1.1 *Boundary Distance*

Under most circumstances, bounding boxes with words in the same phrases are located nearby. Therefore, relative distances between two polygons can be a significant indicator for measuring word connection. We compute the distance between every line segment pairs on the boundary of every two bounding boxes and record the shortest one as the boundary distance. We use boundary distance instead of center-to-center distance because the polygons themselves could occupy a wide area and increase calculation errors. Boundary distances do not necessarily define whether the selected bounding boxes are in the same phrase or not, though.

2.1.2 *Text Area for Each Character*

Each map data consists of a varying number of text fonts. Words in the same phrases, even though separated, do not change their text fonts. However, identifying text font from maps with complicated layouts are challenging and time-consuming. Historical maps usually contain handwritten text also increase the difficulties for map label recognition [2]. To simplify the process and reduce errors, we use the area of each bounding boxes divided by the number of characters to distinguish text fonts.

2.1.3 *Capitalization*

There are three situations for case-sensitive textual contents on the map: 1) All letters are uppercase, 2) All letters are lowercase, and 3) Words are combinations of uppercase and lower letters. Having

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Detecting village burnings with high-cadence smallsats: A case-study in the Rakhine State of Myanmar

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ARTICLE INFO

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Human rights
Landcover change
Humanitarian
Conflict
Myanmar

ABSTRACT

Mass atrocities continue to occur in areas away from international observers and with poor information outflow, with the international community often learning days or weeks after the onset of violence. While organizations concerned with human rights are increasingly using remote sensing, high-resolution commercial satellites remain an expensive option for monitoring large areas at risk of human rights violations.In order to address the need for rapid alerting of possible human rights violations in remote areas, we present an algorithmic approach to leverage affordable, high-cadence, smallsat satellite imagery to detect the burning of villages within as little as two days of occurrence. This algorithm capitalizes on the constellation's systematic observations by detecting a potentially destroyed village if its near-infrared reflectance is less than 20% of its control pair for two sequential observations. The algorithm is based on Planet's Dove satellite's near-infrared band, which is a persistent indicator of the destruction of plant cell structure and is less affected by atmospheric scattering than a Dove satellite's visible bands.Comparison of this product with a database constructed from manual analysis of high-resolution satellite imagery shows high levels of accuracy among villages in the study area. We evaluated algorithm performance in the Republic of the Union of Myanmar, a sovereign state in Southeast Asia, from 1 August 2017 until 31 December 2017. In the study approximately 7000 images were downloaded and analyzed, producing algorithmic estimates that were within 82.5% of the ground-reference database, demonstrating a functioning system to alert human rights practitioners to a potential destruction of villages and to corroborate refugee eyewitness accounts of destruction. This information can also be used to validate refugee asylum claims or for the prosecution of the perpetrators in international courts.

1. Introduction

Historically there has been a conflict between the dominant Rakhine Buddhists and the Rohingya, an ethnic Muslim minority practicing a Sufi-inflected variation of Sunni Islam living in southern Myanmar. Modern violence began in late September and early October in 2013 when Buddhist extremists surrounded and attacked Muslim villages causing Muslims to flee (U.S. Department of State, 2016). More recently, the Government of Myanmar invalidated the legal identity document held by many Rohingya, which rescinded their temporary legal status, and, by extension, access to some social services and the right to vote (U.S. Department of State, 2016). These areas remain difficult for external observers to monitor because the government is staffed by the majority Rakhine people, prevents overflights by international organizations and limits the information outflow of the Rohingya through national laws enacted by the Myanmar Ministry of Information (Freedom House, 2017). This combination of factors has been identified as contributing to the risk of mass atrocities occurring without prompt knowledge of the international community (Marx and Goward, 2013).

On August 25, 2017, the Arakan Rohingya Salvation Army (ARSA) attacked Myanmar security force outposts. The Myanmar military then responded with deliberate and targeted burning of hundreds of Rohingya villages in northern Rakhine State (Amnesty International, 2018). Indications of violence became apparent over the next four days as several thousand Rohingya refugees arrived in Bangladesh, but the scale of the conflict was unknown. By November 17th of 2017, 620,000 Rohingya had fled. Human Rights Watch estimates that 354 villages were destroyed or partially destroyed between August and November (Human Rights Watch, 2017) with attacks continuing throughout early 2018. Because of the monsoon season in late August and early September encompassing and obscuring wide areas of the country with

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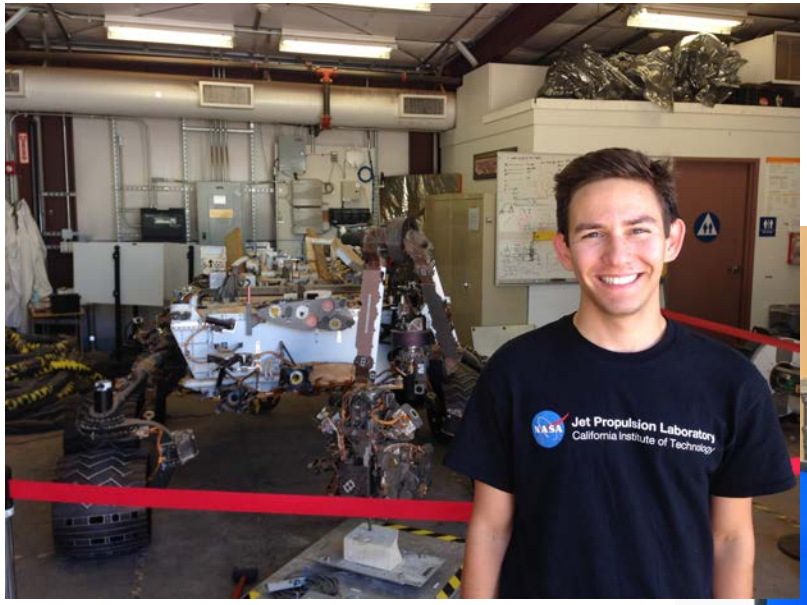
Outcomes: internships and jobs



Faculty limitations

Advancement limitations

Longitudinal assessments

Alumni engagement

Biofeedback to curriculum

"I have truly enjoyed my research experience, and therefore am very grateful that SSI provides opportunities for students to apply what they learned in class to the field and, in my case, see my work **make a tangible impact**."

Thank you!

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