UNIVERSITY OF TWENTE

FACULTY OF GEO-INFORMATION SCIENCE AND EARTH OBSERVATION

URBAN AND REGIONAL PLANNING AND GEO-INFORMATION MANAGEMENT

Urban dynamics - spider aided perspective

ROSA AGUILAR



3 JUNE 2024

SEMINARIO DE APLICACIONES SIG Y TELEDETECCION . UNIVERSIDAD NUEVA GRANADA. MAY 2021

OUTLINE





SDG 11.7 – Urban dynamics



Machine learning for Image Classification







3 June 2024

ABOUT ME

- Computer System Engineer
- Research and Development professional
- Master in Computer Science and Geoinformatics
- CTO at the Geographic Institute Venezuela
- Research in Machine Learning Crops and Cities QGIS contributor
- PhD Urban Planning
- Assistant Professor Machine learning/data Engineering





URBANIZATION – PROCESS.



URBANIZATION RATES

90.0

80.0

70.0

60.0

50.0

40.0

30.0 20.0

10.0

LEVEL OF URBANIZATION (%), 1950 - 2010) EUROPE, NORTH AMERICA, OCEANIA

ternEurope

1950

Europe

wern Europe

1970

ditem Europe

1990

stemEurope

2000

America

2010

Lealand

100.0

90.0

80.0

70.0

60.0

50.0

40.0

30.0

20.0 10.0

Norld

AFRICA, ASIA, LATIN AMERICA AND THE CARIBBEAN

LEVEL OF URBANIZATION (%), 1950 - 2020





WHAT ARE CITIES EXPANDING TOWARDS?



WHERE AND HOW MUCH?

• Planned expansion/growth? goods, services, spaces?



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SDG 11 - CITIES AND HUMAN SETTLEMENTS INCLUSIVE, SAFE, RESILIENT AND SUSTAINABLE

Target 11.7: By 2030, provide universal access to safe, inclusive and accessible, green and public spaces

 $Built_{Open} = \frac{\text{Total area open public space + Total area of streets}}{\text{Total built up area the urban agglomeration}}$



Differences between planned and well-serviced areas as compared to informal and deprived ones





MACHINE LEARNING



Artificial Intelligence

Any technique that enables computers to mimic human behavior.

Machine Learning

Ability to learn from data without being explicitly programmed

- AI as tiny minds in octopus, hawks and spiders. Matt Jones AI at Google.
- Image classification for land cover monitoring, crop identification, urban expansion

SUPERVISED IMAGE CLASSIFICATION

- A classifier is an algorithm that assigns objects to classes or categories.
- Supervised classifiers identify/predict, the class of a new instance, based on a training data set, of which the element memberships are known.
- Ensemble classification: combination of several classifiers



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Popular ML methods. Credits: Advanced Image Analyst - Claudio Persello



OUR CHALLENGE

 $Built_{Open} = \frac{\text{Total area open public space + Total area of streets}}{\text{Total built up area the urban agglomeration}}$

- Spatio temporal dynamic
- Machine learning methods \rightarrow ensemble



OUR STUDY AREA

- Training data: official datasets and OSM
- RapidEye images: 5m. Planet (planet.com) \bullet



CHALLENGES SUPERVISED IMAGE CLASSIFICATION

- Image classification is computationally demanding
- Large areas, high spatial resolution, large files
- Scalability
- Interpretability













Your Algorithms

AN ENSEMBLE CLASSIFIER

Combines several classifiers under certain rules to produce a more accurate classification.







RESULTS

| Year | 2010 | 2016 | 2018 |
|--|-----------|-----------|-----------|
| Built-up area | 9087.40 | 14,698.49 | 24,374.61 |
| Green space | 63,608.26 | 54,998.31 | 48,984.30 |
| Gray space | 18,263.67 | 21,230.23 | 17,600.43 |
| Built _{Open} | 9.00 | 5.19 | 2.73 |
| Built _{Open} per capita in m ² | 294.97 | 212.80 | 170.15 |

Land Cover statistics per year in ha, Built_{Open} indicator per capita/year in m²



Dynamics built-up in ha

IN SUMMARY





QUESTIONS









https://github.com/rosaguilar/geetutorial https://www.linkedin.com/in/rosamaguilar/?locale=en_US <u>r.aguilar@utwente.nl</u>

