



UNIVERSIDADE D
COIMBRA

Nuno Pires

INTELLIGENT SYSTEM FOR LOCALISING AND
MONITORING FOREST FIRES

Dissertation in the context of the Master in Informatics Engineering, specialization in Information Systems, advised by Professor Alberto Cardoso and Professor Jacinto Estima and presented to the Department of Informatics Engineering of the Faculty of Sciences and Technology of the University of Coimbra.

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SISTEMA INTELIGENTE PARA LOCALIZAÇÃO E MONITORIZAÇÃO DE INCÊNDIOS FLORESTAIS

**Dissertação no âmbito do Mestrado em Engenharia Informática,
especialização em Sistemas de Informação, orientada pelo Professor Alberto
Cardoso e Professor Jacinto Estima e apresentada ao Departamento de
Engenharia Informática da Faculdade de Ciências e Tecnologia da
Universidade de Coimbra.**

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Abstract

Fire can have disastrous consequences. Decision-support systems play a central role in dealing with forest fires. Its early warning capacity and real-world impact help to protect forests, species, and communities from wildfire.

The presented work proposes a system for forecasting and monitoring forest fires using multiple data sources. Data fusion, aggregation, and enhancement techniques are also mentioned.

The main purpose of the system is to provide important information for emergency decision-making, such as the geolocation, severity, and temporal evolution of a wildfire. It will employ statistical and machine learning methodologies to predict and determine fire occurrence, susceptibility, and risk.

Finally, the system, with the help of data visualisation tools, will show findings and insights.

The document also presents current approaches and obstacles to forest fire prediction, as well as the suggested methodology and analysis of risk.

Keywords

Decision support system, Fire management, Fire forecasting, Machine learning, Spatial and temporal prediction

Resumo

Os incêndios podem ter consequências desastrosas. Os sistemas de apoio à decisão desempenham um papel central na luta contra os incêndios florestais. As suas capacidades de alerta e o seu impacto no mundo real ajudam a proteger as florestas, as espécies e as comunidades.

O trabalho apresentado propõe um sistema de previsão e monitorização de incêndios florestais que utiliza fontes diversas de dados. Onde são utilizadas técnicas de fusão, agregação e melhoramento de dados.

O principal objetivo do sistema é fornecer informações importantes para a tomada de decisões de emergência, tais como a geolocalização, a gravidade e a evolução temporal de um incêndio florestal. O sistema empregará metodologias estatísticas e de aprendizagem automática para prever e determinar a ocorrência, a suscetibilidade e o risco de incêndio.

Finalmente, com a ajuda de ferramentas de visualização de dados, o sistema será capaz de apresentar informações e resultados.

No documento também são analisadas as abordagens actuais e os obstáculos à previsão de incêndios florestais, bem como a metodologia sugerida e a análise de risco.

Palavras-Chave

Sistema de apoio à decisão, Gestão de incêndios, Previsão de incêndios, Aprendizagem automática, Previsão espacial e temporal

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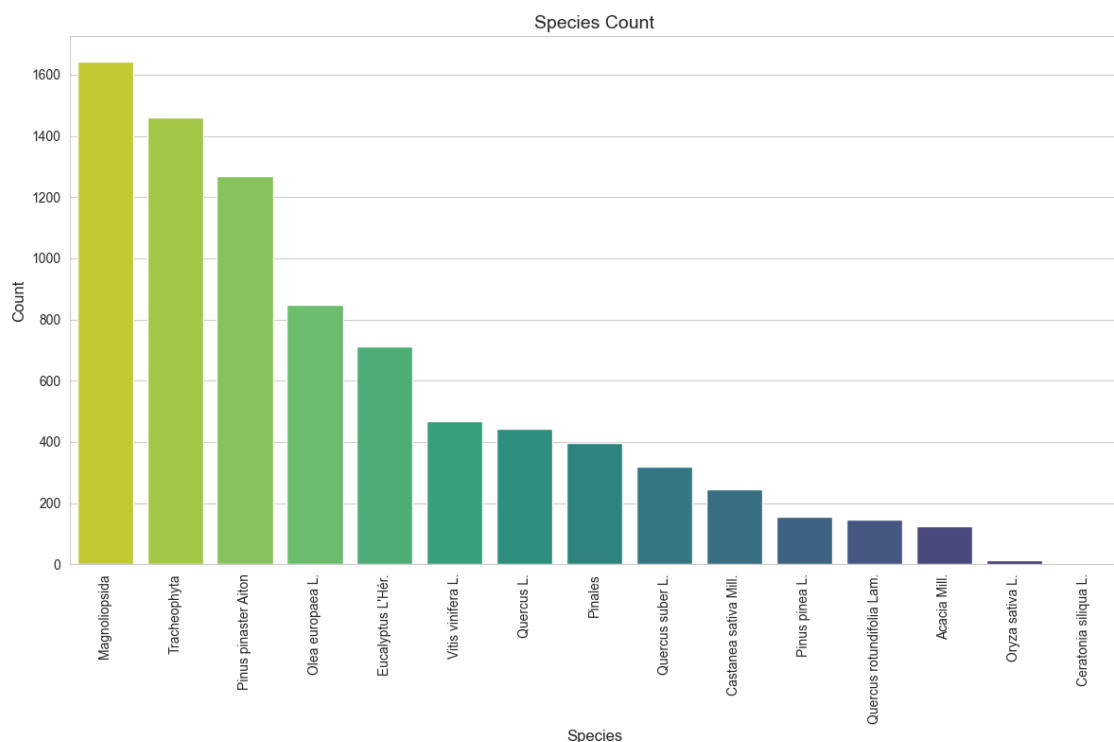
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Chapter 1

Exploratory Data Analysis

1.0.1 Introductory Data Exploration

Figure 1.1: The three created datasets



Portugal's vegetation is a blend of Atlantic, European, Mediterranean, and African species (Encyclopædia Britannica, Inc., 2024), and four tree species account for 80% of all the forest area: *Pinus pinaster*, *Eucalyptus globulus*, *Quercus suber*, and *Quercus rotundifolia* (Marques et al., 2011).

1.0.2 Weather variables distribution at the time of ignition

removed variables: 'hourly.weather_code' 'hourly.sunshine_duration' 'hourly.is_day'
'hourly.snowfall', 'hourly.snow_depth',

Figure 1.2: The three created datasets

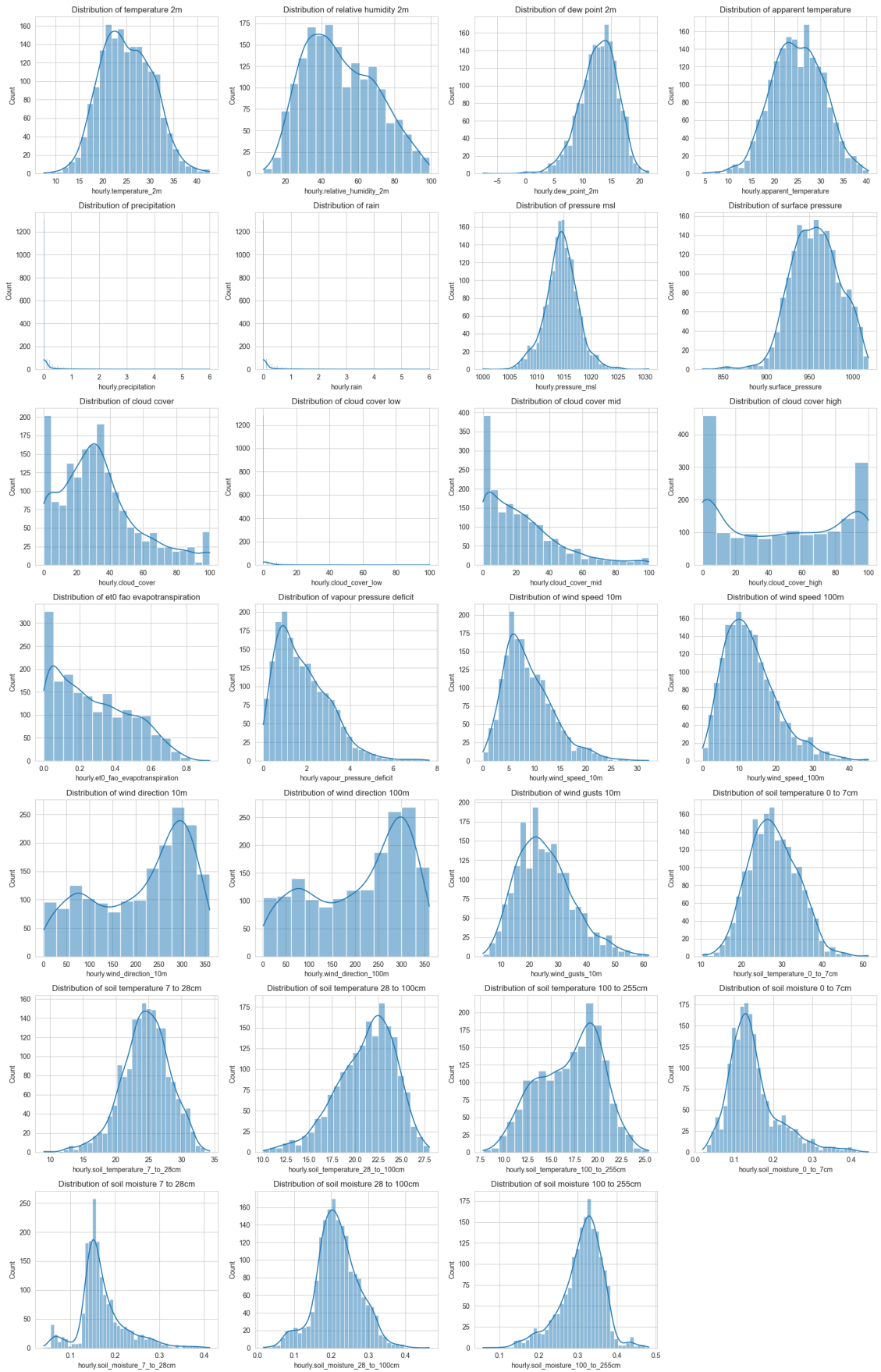


Figure 1.3: The three created datasets

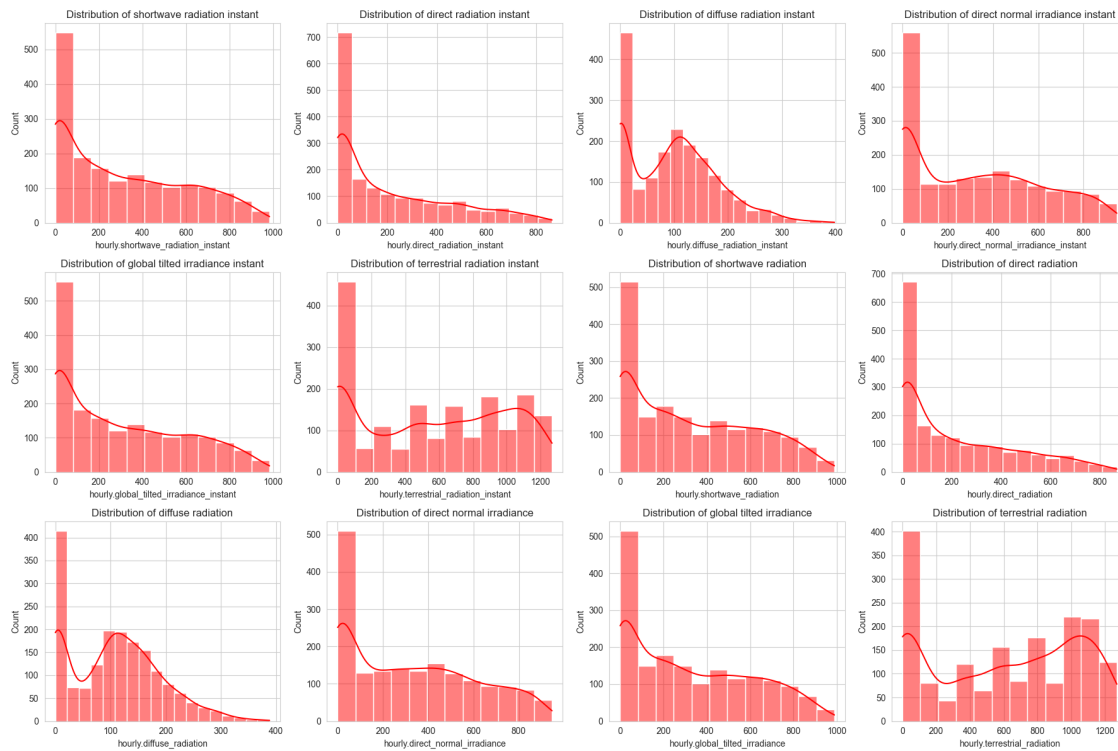


Figure 1.4: The three created datasets

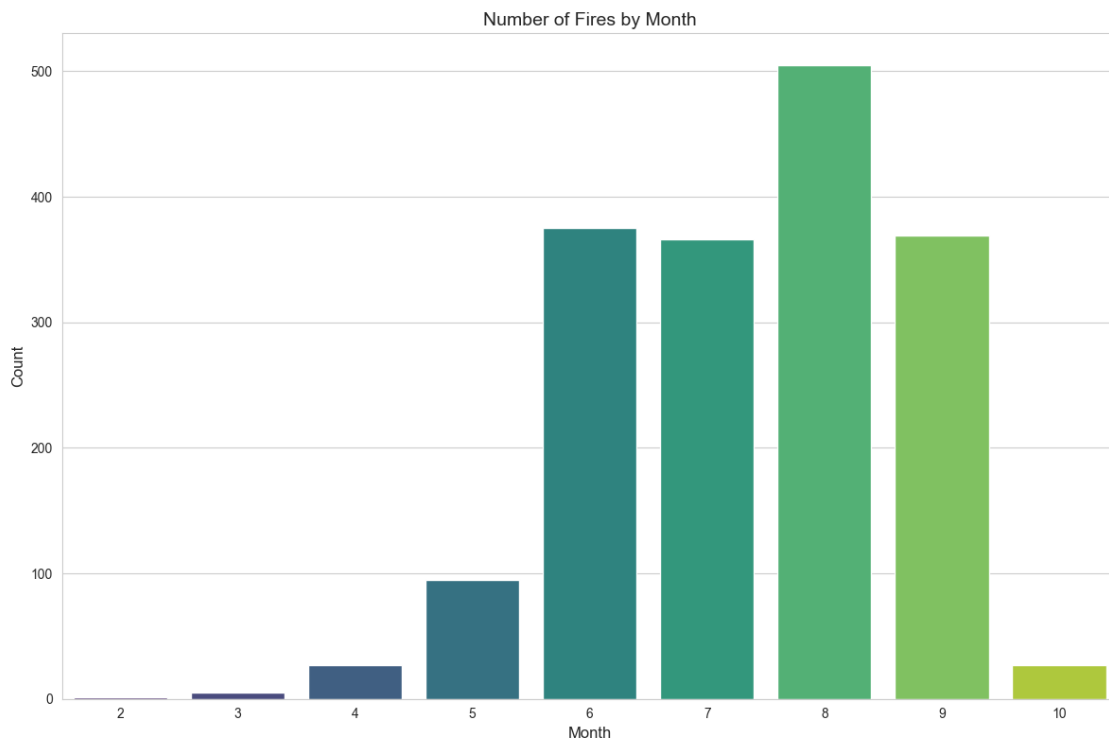


Figure 1.5: The three created datasets

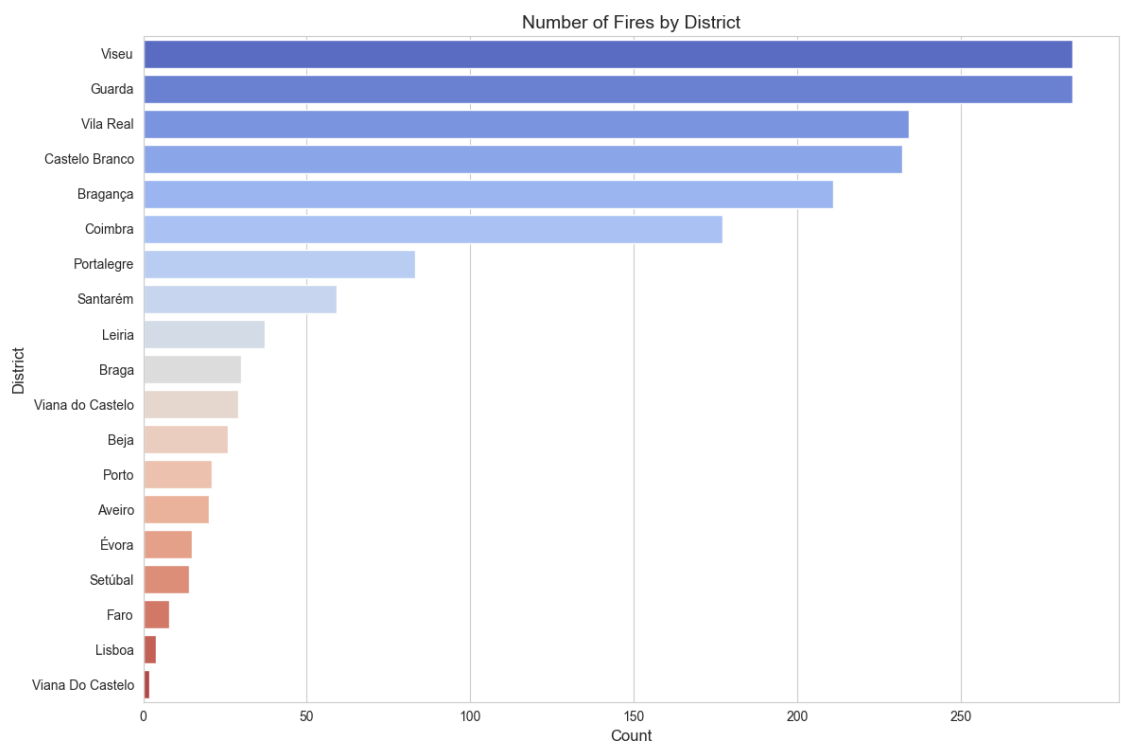
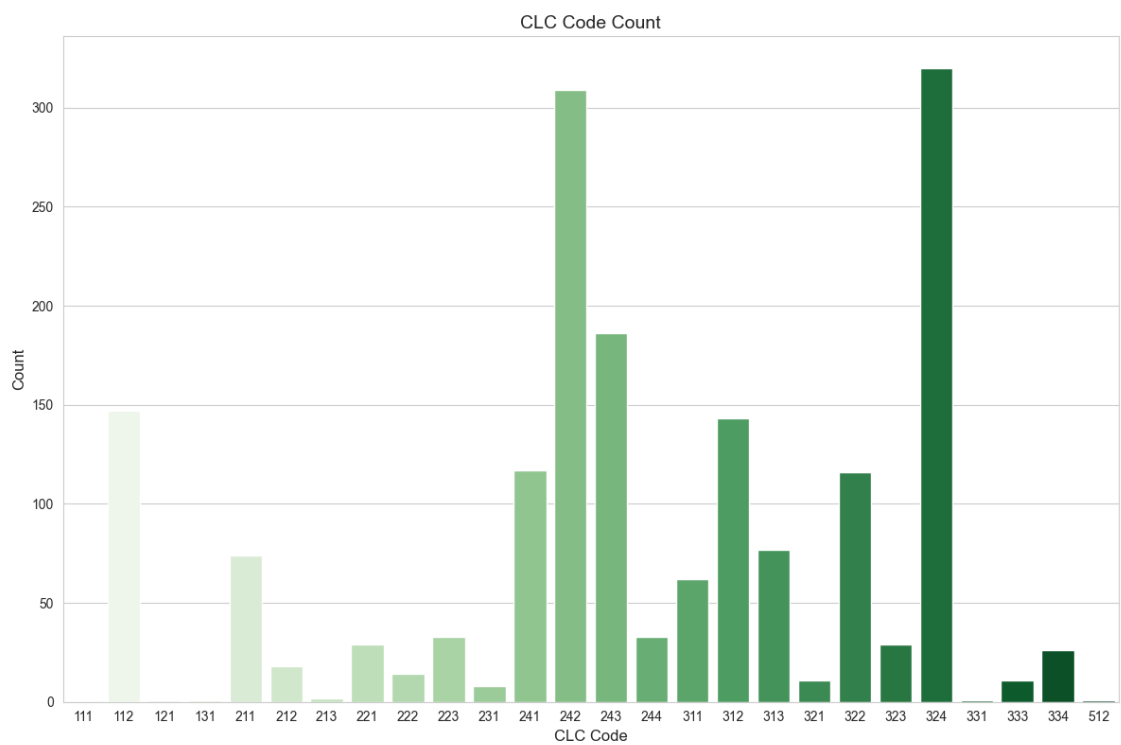


Figure 1.6: The three created datasets



1.1 Average conditions at ignition time

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