

Contents

RECPAD 2022	3
Conference Topics	5
Sponsors	7
Committees	9
Message from the General Chair	11
Program Sessions	13
Invited Speaker	15
Abstracts	17
Program Overview	61
Author Index	61

RECPAD 2022

RECPAD is the annual Portuguese Conference on Pattern Recognition, sponsored by APRP (Portuguese Association for Pattern Recognition). It is a one-day conference to promote the collaboration between the Portuguese scientific community in the fields of Pattern Recognition, Image Analysis and Processing, Soft Computing, and related areas.

This year, RECPAD2022 will be held and sponsored by ESTG (School of Technology and Management – Politécnico de Leiria), on October 28th, 2022. Please feel extremely welcome.

Conference Topics

Topics of interest include:

- | | |
|-----------------------------------------------------------|----------------------------------|
| Biometrics | Information theory |
| Character recognition | Intelligent systems |
| Classification clustering ensembles and multi-classifiers | Machine vision |
| Data mining and big data | Neural network architectures |
| Feature extraction, discretization and selection | Object recognition |
| Fuzzy logic and fuzzy image processing | Pattern recognition applications |
| Gesture recognition | Sensors and sensor fusion |
| Hybrid methods | Soft computing techniques |
| Image description and registration | Statistical methods |
| Image enhancement, restoration and segmentation | Syntactical methods |
| Image understanding | Deep learning |
| Image fusion | Transfer learning |
| | Natural language processing |

Sponsors



Committees

Organizing Committee

Joana Costa (Politécnico de Leiria/CISUC)

Carlos Grilo (Politécnico de Leiria/CIIC)

Filipe Pinto (Politécnico de Leiria)

Pedro Gago (Politécnico de Leiria/CIIC)

Nuno Miguel Rodrigues (Politécnico de Leiria/IT)

Sérgio Faria (Politécnico de Leiria/IT)

Telmo Fernandes (Politécnico de Leiria/IT)

Catarina Silva (Universidade de Coimbra/CISUC)

Bernardete Ribeiro (Universidade de Coimbra/CISUC)

The organizing committee would like to thank and acknowledge the contribution of César Teixeira from Universidade de Coimbra/CISUC for his valuable contribution for the realization of this book of abstracts.

Program Committee

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Ana Maria Tome	Francesco Renna	Luis Rato
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Fernando Monteiro	Jose Silvestre Silva	Teresa Goncalves
	Lio Goncalves	Thomas Gasche
		Verónica Vasconcelos

Message from the General Chair

Welcome to the 28th Portuguese Conference on Pattern Recognition (RecPad 2022), held at the Polytechnic of Leiria on October 24th, 2022.

RecPad is the annual Portuguese Conference on Pattern Recognition, sponsored by APRP (Portuguese Association for Pattern Recognition). It is a one-day conference to promote the collaboration between the Portuguese scientific community in the fields of Pattern Recognition, Image Analysis and Processing, Soft Computing, and related areas.

RecPad 2022 has a diversified program, including a plenary talk, oral sessions for the best papers, poster sessions, and technical visits, as well as social program activities. The Technical Program Committee peer reviewed the submitted contributions, resulting in 64 accepted articles for poster presentation and 4 for oral presentation for the best papers.

I would like to thank everyone who collaborated with the Organization. A special word of gratitude to the members of the Technical Program Committee for the thorough and timely review of submitted manuscripts, and also to the kind sponsors for their invaluable support. Recognition and special thanks must also go to the members of the Organizing Committee who worked hard for the success of this conference.

Please feel extremely welcome.

Joana Costa

Program Sessions

Friday October 28th 2022		
Registration	D Building	09:00-09:30
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Open - Opening Session		
- Inês Domingues, President Portuguese Association of Pattern Recognition	D Building,	09:30-
- Fernando Silva, Subdirector School of Technology and Management	auditorium D1	09:45
- Joana Costa, General Chair RecPad 2022		
<hr/>		
Plenary - Plenary Session	D Building,	09:45-
Keynote Speaker: Jochen Hemming	auditorium D1	10:45
“Deep learning and its application in horticulture and agriculture”		
<i>Chair: Catarina Silva</i>		
<hr/>		
Coffee Break	D Building	10:45-11:30
<hr/>		
Oral - Oral Presentations		
Oral Presentations	D Building,	11:30-
	auditorium D1	12:30
<i>Chair: Bernardete Ribeiro</i>		
<i>(Papers: 35, 27, 25, 13)</i>		
<hr/>		
Lunch Break	Campus restaurant	12:30-14:00
<hr/>		
P1 - Sessions		
Poster Session1	José Saramago Library	14:00-15:00
<i>Chair: Carlos Grilo</i>		

(Papers: 5, 8, 11, 16, 17, 18, 19, 21, 22, 28, 29, 38, 44, 45, 47, 51, 55, 56, 58, 59, 62, 63, 64, 69)

P2 - Sessions

Poster Session2	José Saramago Library	15:00- 16:00
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Chair:Nuno Rodrigues

(Papers: 1, 3, 4, 7, 14, 23, 26, 30, 31, 33, 36, 39, 49, 50, 52, 57, 61, 65, 66, 67, 68)

Coffee Break	José Saramago Library	16:00- 16:30
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P3 - Sessions

Poster Session3	José Saramago Library	16:30- 17:30
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Chair:Telmo Fernandes

(Papers: 2, 6, 9, 10, 12, 15, 20, 24, 32, 37, 40, 41, 42, 43, 46, 48, 53, 54, 60)

Awards and Closing Session	José Saramago Library	17:30- 18:00
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Invited Speakers

Jochen Hemming



Jochen Hemming, Wageningen University & Research (WUR), Netherlands

Plenary Session

09:45 - 10:45

(D Building, auditorium D1)

Chair: Catarina Silva

Speaker Bio: Jochen Hemming is holding a Ph.D. degree in horticultural science from the University of Hanover, Germany. Since 2000 he works with Wageningen University & Research (WUR) in the Netherlands. WUR is a world-renowned centre that combines fundamental and applied research in

the areas of food, agrotechnology, production systems, nature and the environment.

Jochen is currently appointed as senior researcher computer vision and robotics in horticulture. He is member of the Wageningen Agro Food Robotics program, a program that is specialized in robotics and computer vision projects (<https://www.wur.nl/en/research-results/projects-and-programmes/agro-food-robotics.htm>). He currently works as PI on large national and European projects on robotic harvesting and plant manipulation and is project leader of a number of national research projects with strong involvement of companies and industry. His research interests include computer vision, artificial intelligence, agro-robotics and automation in plant production.

“Deep learning and its application in horticulture and agriculture”

Due to the natural variation of the objects and of the environment the implementation of computer vision in horticulture and agriculture is more demanding than in traditional industries like the automotive or the semiconductor sector. The use of neural networks and deep learning algorithms for 2D and 3D image analysis has been proven to be very successful over the past years. Research is for example performed on the detection of insects with object detection methods. Insect populations are commonly monitored by greenhouse growers manually observing the type and number of insects. By automating the process of imaging and identification, this monitoring process can be eased and sped up. Semantic segmentation methods are used to quantify areas on leaves that show symptoms of specific pests or diseases. A research prototype for robotic harvesting of sweet peppers in greenhouses uses deep-learning methods to detect and localize ripe fruit. The network has also been trained to detect and avoid obstacles with the robotic arm, such as leaves and plant stems. Other harvesting robots target apples and pears in the orchard. In the open field, precision farming projects are using camera-controlled yield measurement systems during the harvest of seed potatoes. Continuous images are taken on the conveyor of the harvester to determine the size volume of every single potato. Autonomous moving vehicles with multiple layers of stereo-vision cameras that automatically count and classify tomatoes while they are still on the plant are under development. Together with forecasting software this results in valuable information on future crop development and harvest. F-RCNN and YOLO networks are also used to assess the number of flowers and flower buds of gerbera plants for yield prediction and autonomous harvesting. In plant manipulation applications typically 3D information is required from the vision system, often in combination with colour. The use of networks that can directly analyse point clouds, such as PointNet or PointPillars open new possibilities and have recently got a lot of attention.

Abstracts

Friday October 28th 2022

Oral Presentations

Papers: 35, 27, 25, 13,

Chair: Bernardete Ribeiro

35

Multi-Optimized Drug Design using Transformers

In recent years, computational methods employing deep learning have attracted increased interest in the de novo drug design field, leading to the discovery of small molecules with pharmacological potential in a reasonable amount of time. Despite the recent computational advances for generating compounds for biological targets, crucial physical-chemical characteristics, such as lipophilicity, molecular weight, and polar surface area, are typically individually optimized. Therefore, the new molecules are compromised since pharmacological efficacy is influenced by a variety of simultaneous factors. In this research, a transformer-based architecture is proposed to generate novel compounds with desirable pharmacological properties and relevant binding activity against a target with biological interest. The architecture combines a Transformer-Decoder Generator to produce valid new molecules, a Transformer-Encoder Predictor to estimate the binding activity, and a Feedback Loop based on a multi-objective optimization algorithm to optimize the generator according to the desired properties. The results obtained demonstrate the efficacy of the proposed framework to generate novel, synthesizable chemical compounds. The Transformer-based Generator outperformed state-of-the-art approaches in the novelty metric. The optimization of the unbiased model resulted in the generation of 99.79% valid molecules with 99.36% compliance with Lipinski's Rule of Five and a high binding affinity to the adenosine A2A receptor. Overall, the results revealed the model's ability to select crucial components in the chemical space to improve the biological interest and pharmacological properties of the molecules.

Oral

D Building,
auditorium D1
11:30-12:30

Machado, A.
Monteiro, N.
Abbasi, M.
Arrais, J.

Approaches for Sentiment Analysis in Portuguese Dialogues

Sentiment Analysis in dialogue aims at detecting the sentiment expressed in the utterances of a conversation, which may improve human-computer interaction in natural language. In this paper, we explore different approaches for Sentiment Analysis in written Portuguese dialogues, mainly related to customer support in Telecommunications. We manually annotated two real-world datasets, Twitter-based and call-center-based, and experimented with different machine learning approaches. A Finetuned BERT achieved the highest F1 Scores in both datasets, 0.87 and 0.92. These interesting results suggest that automated customer support can benefit from sentiment detection.

OralD Building,
auditorium D1
11:30-12:30Carvalho, I.
Oliveira, H.
Silva, C.**Towards Safe Exploration using Demonstrations**

Reinforcement learning algorithms require large data sets to train a working policy. This is achieved by exploring the state space with trial and error interactions. However, such algorithms disregard any safety concerns. This can lead to many problems such as damage to the agent and surrounding objects or beings. Demonstrations of the task contain crucial information which the agent can use before interacting with the environment. We propose to train a safety model using demonstrations to evaluate the safety of each state. The output of this model can then be used to enhance the reward function to promote safety. We evaluate our model on four tasks and compare the safety of three baselines with and without our enhancement. Results show that our model increases the safety and performance of underlying RL models.

OralD Building,
auditorium D1
11:30-12:30Correia, A.
Alexandre, L.

Using Twitter Data and Natural Language Processing to Generate Wildfire Heat Maps**Oral**D Building,
auditorium D1
11:30-12:30Pinto, J.
Silva, C.
Oliveira, H.
Cardoso, A.

This paper proposes an information extraction pipeline capable of generating a wildfire heat map of Portugal from Twitter posts written in Portuguese. It uses a fine-tuned version of the state-of-the-art language model BERTimbau (Portuguese BERT) to extract fire reports from large batches of recent fire-related tweets as well as the spaCy NLP library to query the location of each recently reported fire. Wildfire locations are plotted to a colored map indicating the most probable fire locations, which could prove useful in the process of allocating firefighting resources for those region. The system should be easily adaptable to work with any other country or language, provided compatible BERT and spaCy models exist.

Friday October 28th 2022

Poster Session1

Papers: 5, 8, 11, 16, 17, 18, 19, 21, 28, 29, 38, 44, 45, 47, 51, 55, 56, 58, 59, 62, 63, 64, 69

Chair: Carlos Grilo

5

An evaluation of filter and wrapper methods for feature selection in chronotype profiles

Event related potential signals recorded during the performance of cognitive tasks may help differentiate between people with different chronotypes. In this study, two different approaches were tested, namely, filter methods that evaluate the most relevant characteristics based on statistical tests and wrapper methods, both based on machine learning algorithms. In particular, the Random Forest and XGBoost were used. The results showed that XGBoost proved to be much more efficient to distinguish a morning person from an evening person. In general, the applied methods show a greater importance of the peak amplitude values located in the occipital and parietal regions, whereas the latencies are more evident in the temporo-occipital region.

P1

José Saramago
Library
14:00-15:00

Ramos, M.
Silva, A.
Tomé, A.
Bem-Haja, P.
Santos, I.

Deep Learning for Segmentation of the Left Ventricle in Echocardiography

Two-dimensional echocardiography is the most widely used non-invasive imaging modality due to its fast acquisition time, low cost, and high temporal resolution. Accurate segmentation of the left ventricle in echocardiography is vital for ensuring the accuracy of subsequent diagnosis. Currently, numerous efforts have been made to automatize this task and various public datasets have been released in recent decades to further develop present research. However, medical datasets acquired at different institutions have inherent bias caused by various confounding factors, such as operation policies, machine protocols, treatment preference, etc. As a result, models trained on one dataset, regardless of volume, cannot be confidently utilized for the others. In this study, we investigated model robustness to dataset bias using two publicly available echocardiographic datasets. This work validates the efficacy of a supervised deep learning model for left ventricle segmentation, outside the dataset on which it was trained. The exposure of this model to unseen, but related samples without additional training maintained a good performance. However, a performance decrease from the original results can be observed, while the impact of quality is also noteworthy with lower quality data leading to decreased performance.

P1José Saramago
Library
14:00-15:00Ferraz, S.
Coimbra, M.
Pedrosa, J.**Evaluating mutual information between deep features and lung tumor semantics**

What knowledge is exactly extracted by pre-trained convolutional networks? We argue that, even though state-of-the-art feature extractors have gotten deeper over time, the abstraction level of the captured information is still lower than expected. Taking semantic characteristics from lung tumors as an application case, we explored the degree of mutual information (MI) that is found on deep features, with results reinforcing the idea that the perception power reached with these architectures is still far from real abstractions.

P1José Saramago
Library
14:00-15:00Silva, F.
Oliveira, H.
Pereira, T.

Automatic contrast generation from contrastless computed tomography

José Saramago
Library
14:00-15:00

Domingues, R.
Renna, F.
Pedrosa, J.

The use of Deep learning methods in the area of medicine is appearing as one of the most promising strategies to help detecting diseases that are hard to identify using only human intervention. The use of contrast-enhanced tomography for the detection of coronary artery disease brings not only high hospital costs, but it also exposes patients to significant radiation. The automatic generation of contrast from non-contrast tomography can avoid these problems.

The main contribution of this study is the comparison of the performance of two specific models of generative adversarial networks (GANs), the Pix2Pix-GAN and the Cycle-GAN, and the exploration of the trade-off of using 2D and 3D inputs. Using only the Structural Similarity Index Measure (SSIM) and the Peak Signal-to-Noise Ratio (PSNR), it could be concluded that the Pix2Pix-GAN using 2D data reached better results with 0,492 SSIM and 16,375 PSNR. However, visual analysis of the output shows significant blur in the generated images, which is not the case for the Cycle-GAN models. This behavior can be captured by the evaluation of the Fréchet Inception Distance (FID), that represents a fundamental performance metric that is usually not considered by related works in the literature. The non-alignment of non-contrast images with the contrast images and differences in the zoom is believed to induce error during the training, producing blur in the Pix2Pix-GAN. This observation suggests that image registration can have a fundamental impact in the performance of Pix2Pix-GAN approaches for this task.

COVID-19 Chest X-Ray classification and the impact of Data AugmentationJosé Saramago
Library
14:00-15:00Manso, C.
Domingues, I.
Vasconcelos, V.

Coronavirus disease 2019 (also known as COVID-19) is an infectious disease caused by SARS-CoV-2 whose symptoms commonly include fever, cough, dyspnoea, myalgia and fatigue. This pandemic that we are all so aware of, mainly because of confinement, has caused and is still causing serious problems, not only health, but also social and economic, to such an extent that the whole world has been changed by this disease. X-rays are a type of ionising radiation used to obtain images of the inside of body. This study attempts to analyze X-rays of the thorax in order to classify them as either healthy or COVID-19 infected as accurately as possible. For this purpose, the impact of different data augmentation methods, that consist of applying transformations in order to increase the size and performance of a small dataset, are studied. The neural networks used in this study are a sequential and DenseNet201. The best results achieved were using DenseNet201 and a 5% rotation, reaching a 99.54% accuracy.

Impact of Class Balancing Techniques in the Classification of Skin LesionsJosé Saramago
Library
14:00-15:00Loureiro, C.
GonÇalves, L.
Filipe, V.

Classification of skin lesions with imbalanced class distribution typically leads to misleading results, which can be of special concern when we are doing the diagnosis of rare diseases. This paper studies the effect of class balancing techniques for skin lesion classification. We utilized an attention mechanism incorporated into a classical neural backbone. This mechanism is known as triplet attention, a lightweight method that allows to capture cross-domain interactions. The model was evaluated based on Recall, Precision, and Accuracy

Automatic Pericardial Segmentation in Computed Tomography Images

The pericardium is a thin membrane sac that covers the heart. As such, the segmentation of the pericardium in computed tomography (CT) can have several clinical applications, namely as a preprocessing step for extraction of different clinical parameters. However, manual segmentation of the pericardium can be challenging, time-consuming and subject to observer variability, which has motivated the development of automatic pericardial segmentation methods. In this study, a method to automatically segment the pericardium in CT using a U-Net framework is proposed. The Cardiac Fat database was used for training with two different input sizes-512x512 and 256x256. A superior performance was obtained with the 256x256 image size, with a mean Dice similarity coefficient (DSC) of 0.871 ± 0.01 and 0.807 ± 0.06 . Results show that reasonable performance can be achieved with a small number of patients for training and an off-the-shelf framework. Nevertheless, additional data will increase the robustness of this approach in outlier cases and future approaches must focus on the integration of 3D information for a more accurate segmentation of the lower pericardium.

José Saramago
Library
14:00-15:00

Baeza, R.
Coimbra, M.
Renna, F.
Pedrosa, J.

Breast Cancer Detection in MRI using a Faster R-CNN model

This work aims to the development of machine (deep) learning algorithms and methods for detecting Breast Cancer (BC) pathological lesions on magnetic resonance imaging. For this purpose, we have used a TCIA public dataset [1,3] consisting of 922 biopsy proven BC patients' cases. Our work focused on assisting radiologists / physicians in the early detection of BC pathological lesions and the reduction of false negatives (Type II errors), which unfortunately can be a misleading factor of highest importance. Experimental results have demonstrated a patient maximum Intersection over Union (IoU) average of 0.66 for a corresponding pathological lesions prediction score of 85%.

José Saramago
Library
14:00-15:00

Raimundo, J.
Fontes, J.
Lopez, M.

From Easy to Hard: A Curriculum Learning Approach for Breast Lesion Classification

Radiologists are often requested to assess many screenings, which may lead to delays in diagnosis and the treatment of patients. Machine learning (ML) algorithms integrated in computer-aided diagnosis systems may work as a reliable solution to this problem. This study aims to evaluate the performance of a curriculum learning (CL) based algorithm in the breast lesion classification task. We ordered the training samples from the easiest to the hardest, considering the degree of confidence of radiologists in their ground-truth annotation. CL and baseline models achieved similar maximum validation accuracy values (74.42% versus 75.29%) and accuracy values of the best model in the test set (70.71% versus 70.08%). Results suggest that the CL approach was not performing better than the baseline in the lesion classification task.

P1José Saramago
Library
14:00-15:00Caldeira, E.
Castro, E.
Gonçalves, T.

A survey on computational tools for human viral genomes reconstruction

The increasing availability of large quantities of human viral sequenced samples from different contexts, including the Covid-19 pandemics, has led to the emergence of many optimized genome reconstruction tools. Although the number of new tools is steadily increasing, it is complex to identify optimized tools for improved human viral genome reconstruction. By optimized we mean an equilibrium point between accuracy and computational resources as well as the features that each tool provides. In this paper, we survey open-source computational tools used for human viral genome reconstruction, identifying specific characteristics, features, similarities, and dissimilarities between these tools. Moreover, we propose an open-source reconstruction benchmark based on synthetic data for future comparison of the existing tools that we make publicly available at <https://github.com/mirakaya/HVRS>.

P1José Saramago
Library
14:00-15:00Sousa, M.
Pratas, D.

Deep learning glaucoma detection models in retinal images capture by mobile devicesJosé Saramago
Library
14:00-15:00Rezende, R.
Coelho, A.
Fernandes, R.
Camara, J.
Neto, A.
Cunha, A.

Glaucoma is a disease that arises from increased intraocular pressure and leads to irreversible partial or total loss of vision. Due to the lack of symptoms, this disease often progresses to more advanced stages, not being detected in the early phase. The screening of glaucoma can be made through visualization of the retina, through retinal images captured by medical equipment or mobile devices with an attached lens to the camera. Deep learning can enhance and increase mass glaucoma screening. In this study, domain transfer learning is important to better weight initialization and for understanding features more related to the problem. For this, classic convolutional neural networks, such as ResNet50 will be compared with Vision Transformers, in high and low-resolution images. The high-resolution retinal image will be used to pre-train the network and use that knowledge for detecting glaucoma in retinal images captured by mobile devices. The ResNet50 model reached the highest values of AUC in the high-resolution dataset, being the more consistent model in all the experiments. However, the Vision Transformer proved to be a promising technique, especially in low-resolution retinal images.

Improving the compression of a complete Telomere-to-Telomere (T2T) human genome sequenceJosé Saramago
Library
14:00-15:00Sousa, M.
Ferreiro, R.
Fonseca, T.
Pinho, A.
Pratas, D.

The recent development of the Telomere-to-Telomere (T2T) sequencing technologies provided the reconstruction of the first full high-quality human genome sequence without gaps. This T2T sequence is enabling an increasing number of solutions to important applications, such as in haplotype characterization, epigenetic analysis, or viral integration, that were previously limited by the quality and completeness of the data. Another important matter is the efficient compression of this sequence to reduce the storage associated with its representability without loss and for understanding how redundant is a human genome sequence. In this article, we provide a data compression tool that substantially improves the compression of the T2T complete human genome sequence. Specifically, we describe an improvement path that reached a lossless storage reduction of 30%. Therefore, to the best of our knowledge, this is the best compression ratio achieved. The tool and benchmark are public available at <https://github.com/cobioders/HumanGenome>.

How Coherence of CT Annotations and Data Augmentation with Domain Knowledge Can Help Improve Lung SegmentationJosé Saramago
Library
14:00-15:00Sousa, J.
Pereira, T.
Neves, I.
Silva, F.
Oliveira, H.

Lung cancer screening and monitoring are crucial to prevent the disease from reaching advanced stages for which computed tomography scans play a key role. Nonetheless, the evaluation of these images is time consuming and dependent on the physicians' perspective. In this matter computer aided diagnosis systems are helpful tools as they enable a faster non-subjective evaluation. Because the lungs are seat of several diseases, encompassing numerous parenchymal patterns, its segmentation, a first step in many automatic systems, is hampered. In a previous work a combined model of ResNet34 and U-Net was developed for this task, and despite its good performance, it was unable to segment large cancer nodules. In addition, the datasets available for the development of such model followed different annotation guidelines, leading to incoherences and misleading the learning process. With that in mind, a correction protocol for the lung masks was created and data augmentation with domain knowledge was used to create lung masses. This study shows the importance of having consistent annotations in the learning process and how data augmentation could help overcome the lack of wide representative data.

Active Learning for Biomedical Image Segmentation: A case study

The time spent and resultant financial burden in the image annotation process for biomedical semantic segmentation continues to be a systematic challenge. In this article, an exploratory study of an Active Learning method's potentiality in optimising the annotation process is carried out. In greater detail, this method is based on the model's uncertainty and can reach state-of-the-art performance with an annotated data reduction of almost 19%. As such, our preliminary results demonstrate a possible significant reduction in the amount of annotated images and highlight the potential for further research in this area.

51

Semi-supervised learning for gastric landmark detection

The error rate of misdiagnosis caused by human error during the esophagogastroduodenoscopy (EGD) exam is significant - 9.0%. Avoiding blind spots during EGD exams is a fundamental prerequisite to detecting gastric cancer at an early stage. The aim of this work consisted in testing new automatic algorithms, specifically based on semi-supervised approaches, able to detect upper gastrointestinal landmarks (GIL), that can help to avoid the presence of blind spots during EGD exam. Unsupervised techniques were implemented to extract new information from unlabeled GIL images and then this new information was concatenated in a supervised model. We trained a convolutional autoencoder (AE), a variational autoencoder (VAE) and a generative adversarial network (GAN) with unlabeled GIL images to extract representative features. Then, such features were concatenated with those extracted by the pre-trained ResNet-50 architecture. The VAE + ResNet-50 approach achieved a Mathews Correlation Coefficient (MCC) of 65.10%.

P1

José Saramago
Library
14:00-15:00Silva, D.
GonÇalves, L.
GonÇalo, P.
Colaço, B.
Pimenta, S.
Ginja, M.
Ferreira, M.
Filipe, V.

P1

José Saramago
Library
14:00-15:00Lopes, I.
Coimbra, M.
Renna, F.

An Inherently Interpretable Classifier for Automatic Skin Lesion Diagnosis

AI-based Computer-Aided Diagnosis (CAD) systems are seldom adopted in clinical workflows partially due to the lack of transparency and interpretability in their decision process. This fact has raised the need for producing strategies capable of explaining the decision process of AI algorithms, leading to the creation of a novel research topic named eXplainable Artificial Intelligence (XAI). In this paper, we explore the capabilities of an inherently interpretable model (CCNN) to the problem of skin lesion classification. We demonstrate that providing multimodal concept-based explanations consisting of the high-level dermoscopic concepts with the respective contribution to the class prediction (textual) along with the spatial location of these concepts (visual), accounts for a more informative and interpretable model decision.

Automatic detection of calcifications in mammography images using Mask-RCNN

Technological advances in the field of Artificial Intelligence are a prominent phenomenon in recent decades and its application in the most diverse scientific areas has grown noticeably. The concept of computer-assisted detection and diagnosis using Deep Learning techniques is an increasingly popular reality in the field of medicine and, currently, high-precision detection systems for breast lesions already exist. These systems are highly effective and reach almost perfect precision values in the detection of masses, however, there is still room for progress in the automatic detection of calcifications which, due to their morphology, become more challenging and difficult to detect. This paper presents a method for simultaneous detection and segmentation of calcifications using Mask-RCNN. Experiments revealed a highest recall of 80.4% and precisions in a range of 70% to 97.6%, depending on the minimum confidence value in the detection.

José Saramago
Library
14:00-15:00

Patrício, C.
Pereira, N.
Neves, J.
Teixeira, L.

José Saramago
Library
14:00-15:00

Ferreira, C.
Vasconcelos, V.
Domingues, I.

Machine Learning models for the detection of ex vivo colorectal cancer in biophotonic data

In this study, we used machine learning techniques to reconstruct the wavelength dependence of the absorption coefficient of human normal and pathological colorectal mucosa tissues. Using only diffuse reflectance spectra from the ex vivo mucosa tissues as input to algorithms, several approaches were tried before obtaining good matching between the generated absorption coefficients and the ones previously calculated for the mucosa tissues from invasive experimental spectral measurements. From our results, it is possible to conclude that the most viable machine learning model for spectral reconstruction is the Random Forest Regressor, which was able to not only predict the absorption spectra with the most accuracy but was also able to reconstruct the desired blood ratios in both normal and pathological tissue. Considering such results good perspectives become available to develop minimally invasive spectroscopy methods for in vivo early detection and monitoring of colorectal cancer.

P1

José Saramago
Library
14:00-15:00Fernandes, L.
Carvalho, S.
Carneiro, I.
Henrique, R.
Tuchin, V.
Oliveira, L.
Oliveira, H.**Privacy-Preserving Case-Based Explanations for Medical Image Analysis**

Case-based explanations help clarify the reasoning of Deep Learning models in medical image analysis. Nonetheless, the medical cases provided as explanations must be anonymised to protect the privacy of patients. We propose a generative model that disentangles identity and medical features from images. We empirically show that this model can be used to anonymise medical images, by altering their identity features, and generate counterfactual explanations, by altering their medical features.

P1

José Saramago
Library
14:00-15:00Montenegro, H.
Silva, W.
Cardoso, J.

Novel Graph Neural Network architecture to predict HIV inhibitorsJosé Saramago
Library
14:00-15:00Santos, P.
Arrais, J.
Torres, L.
Abbasi, M.
Ribeiro, B.

Drug discovery is a process that may take as long as 15 years and may cost over one billion dollars and may still be unsuccessful using the traditional experimental methodologies. HIV was the cause of death of more than 30 million people. This project aims to improve the process of developing drugs that inhibits HIV replication by applying multiple graph based neural network techniques to predict whether a molecule has this specific property. After deploying and testing several architectures we demonstrate that by combining different graph neural network layers, our innovative model is able to achieve improved discriminative power in predicting HIV inhibiting molecules. The obtained results show that the optimal model reaches as high as 0.8166 ROCAUC score.

Deep Feature-Based Automated Chest Radiography Compliance AssessmentJosé Saramago
Library
14:00-15:00Costa, M.
Pereira, S.
Pedrosa, J.
Mendonça, A.
Campilho, A.

Chest radiography is one of the most common imaging exams, but its interpretation is often challenging and time-consuming, which has motivated the development of automated tools for pathology/abnormality detection. Deep learning models trained on large-scale chest X-ray datasets have shown promising results but are highly dependent on the quality of the data. However, these datasets often contain incorrect metadata and non-compliant or corrupted images. These inconsistencies are ultimately incorporated in the training process, impairing the validity of the results. In this study, a novel approach to detect non-compliant images based on deep features extracted from a patient pose classification model is proposed. This method is applied to CheXpert, a widely used public dataset. From a pool of 100 images, it is shown that the deep feature-based methods are able to retrieve a larger number of non-compliant images (up to 81% of non-compliant images), when compared to an uncertainty-based method (50%) and random selection (20%).

Augmented reality on campus

Augmented reality (AR) is a technology that can be used on mobile devices and that allows us to observe, in the real world, extra digital information. This technology has been used in different contexts, causing different types of applications to emerge, as well as promoting the appearance of different hardware that allows to expand the use of AR. Companies have been betting on this technology so that the work developed by their employees is more supported and facilitated. But it is not only in this context that applications arise. Academic institutions already make use of technology to facilitate the contact and collaboration with students, with quick responses. In order to develop an application to guide new students on the campus, the versatility of the AR was explored inside and outside the buildings. Research and experimentation of different solutions were performed, and the knowledge acquired in that process was used to develop the application "Descobre o Campus". This document summarizes the work that was carried out in the development of this application.

P1José Saramago
Library
14:00-15:00Rito, P.
Rocha, T.
Martins, N.**Towards Biometrically-Morphed Torsos for Improved Shared Decision-Making Process in Breast Cancer Patients**

Breast cancer conservative treatments are one of the most common procedures to treat breast cancer. The aesthetic results granted by this treatment are expected to be much better than the ones associated with other procedures but, unfortunately, a large number of women still get dissatisfied with their aesthetic results after a BCCT, which is often due to unrealistic expectations: before surgery, patients are usually shown photographs of past patients, which are often not representative. This problem fuelled the research on different methods, both synthetic and realistic, to introduce distortions in photographs in order to create images that portray probable surgery's outcomes realistically.

P1José Saramago
Library
14:00-15:00Nunes, M.
Carvalho, M.
Silva, W.
Cardoso, M.
Cardoso, J.

Friday October 28th 2022

Poster Session2

Papers: 1, 3, 4, 7, 14, 23, 26, 30, 31, 33, 36, 39, 49, 50, 52, 57, 61, 65, 66, 67, 68

Chair: Nuno Rodrigues

1

Crowd Counting with Conformalized Quantile Regression

Crowd counting is the process of counting the number of people in an image. It is key for automated public monitoring tasks such as surveillance and traffic control. In this article, we utilize the regression-based object counting approach. However, the point predictions yielded by the model have associated uncertainty, which can be amplified by different levels of brightness, weather conditions, etc. Consequently, we apply conformalized quantile regression (CQR) on top of a CNN (Convolutional neural network) to quantify the said uncertainty and deliver PIs (Prediction intervals) instead. All the code and data are made available.

P2

José Saramago
Library
15:00-16:00

Sousa, M.
Tomé, A.
Moreira, J.

3

Detection of vehicles and buildings in Drone aerial images

The need to develop software for aerial image analysis, captured by Unmanned Aerial Vehicles, has increased over the years because their use has become more prevalent in different day-to-day scenarios. Access to aerial images has enabled the growth of object detection tasks, which need to be performed accurately and quickly. In this work, the performance of the object detection algorithms, Faster R-CNN, YOLOv3 and YOLOv5l, in the detection of vehicles and buildings in aerial images obtained by UAV, was analyzed using the set of images provided by the Portuguese Military Academy. The dataset was annotated, pre-processed, and used for the training of each algorithm and to calculate the inference performance. The results showed that the YOLOv5l algorithm presented the best detection time and the best performance.

P2

José Saramago
Library
15:00-16:00

Amante, R.
Canedo, D.
Silva, J.
Neves, A.

Key Performance Indicators MOTA and HOTA for multi-object tracking

Multi-object detection and tracking is an essential component for Autonomous Driving Systems. Key Performance Indicators (KPI) are fundamental for the evaluation of tracking algorithms. This paper focuses on two different KPIs, Multi-object Tracking Accuracy (MOTA) and Higher Order Tracking Accuracy (HOTA). MOTA and HOTA are tested in a hypothetical situation corresponding to 3 simulated pedestrians walking trajectories. While MOTA evaluates the tracker performance as 0.907, HOTA classifies it as 0.289. The discrepancy of these values as well as the factors that lead to them are analyzed. It was concluded that HOTA penalizes the tracker for mismatched IDs continuously throughout the entire trajectory, balancing detection with association, whilst MOTA only penalizes and Identity Switch every time that happens, favoring detection over association.

P2José Saramago
Library
15:00-16:00Leite, P.
Marçal, A.**Clustering methods for the H3D LiDAR Dataset - Preliminary results**

An important aspect that ensures safe self-driving vehicles is their ability to detect the surrounding objects correctly. In this study, two clustering methods, DBSCAN and K-means, are used to recognize objects and group them into appropriate classes. The methods were evaluated in several traffic scenarios extracted from the Honda 3D LiDAR Dataset (H3D). The internal validation indexes Silhouette, Dunn, and Davies-Bouldin were applied to these scenarios. The preliminary results indicate that although the Silhouette Index presents a higher value for the K-means clustering, DBSCAN outperformed K-means on the other two indexes. Nevertheless, the results from the visualization of the clusters support the fact that density clustering is very suitable for LiDAR segmentation since it can detect arbitrary cluster shapes. DBSCAN was an effective method for clustering LiDAR point cloud data.

P2José Saramago
Library
15:00-16:00Oliveira, M.
Marçal, A.

Face Morphing Attack DetectionJosé Saramago
Library
15:00-16:00Isidoro, J.
Correia, P.

With the widespread usage of face recognition systems they are also targets of various types of attacks, including presentation attacks, where the reproduction of an image or video is presented to a camera, or morphing attacks, where facial images from more than one person are merged together so that the resulting image resembles all the morphed faces. This paper addresses the problem of detecting face morphing attacks, notably when two facial images are morphed together and the result is used to issue an identification document. The paper proposes a de-morphing solution, attempting to reconstruct the face of the person that is not facing the camera during the face verification process and whose image was used to create the morphed image included in the identification document, for instance in the context of an automated border control face verification system. The development of the system highlighted the need of having a representative set of images in the database used for training the system, and discusses solutions to improve the quality of the training data. The de-morphing system has shown an interesting performance, allowing to detect the occurrence of face morphing attacks, and the recovered face can be used to identify the accomplice that contributed to the morphed face included in the ID document.

3D object detection for self driving vehicles aided by object velocity

José Saramago
Library
15:00-16:00

Alexandrino, L.
Georgieva, P.
Drummond, M.
Zahir, H.

Road traffic accidents are ranked the 8th leading cause of death to all age groups. Furthermore, and although some road crashes can be caused by vehicle malfunctioning or poor maintenance, over 90% of road accidents can be assigned to human reasons. Self-driving vehicles are expected to significantly enhance road participants safety by enabling consistent driving and removing intrinsic risk factors associated to human drivers. Nowadays, Advanced Driver Assistance Systems (ADAS) are provided by automotive manufacturers to assist the vehicle drivers in driving or parking tasks. The automated features implemented in this technologies are paving the way to autonomous vehicles. Among the vision sensors commonly used to acquire vehicle surrounding data, the LiDAR sensor provides significant advantages over other sensors due to the direct acquisition of 3D point clouds with good resolution, which is optimal for object detection and classification tasks. The second generation of this sensor, Coherent LiDAR, brings reliability benefits and it is expected to significantly improve vehicle perception tasks due to its ability to directly acquire radial velocity as an additional feature per-point.

Image-based Fish Freshness Estimation

Fish is one of the healthiest foods in the world when consumed at its highest quality level of freshness. This work proposes a system to estimate the level of fish freshness by analysing an image of the fish's eye. The proposed system automatically detects and segments the eye region and extracts a set of features that correlated well with the level of freshness. These features are then used for classification purposes. A classification model, based on k-nearest neighbours (kNN), was trained using a dataset including images taken at regular intervals for a duration of 7 days, from 24 sea bream fish. The developed model achieved an accuracy of 92.5% using 5-fold cross-validation, which is a promising result, although still lacking in robustness; one of the limitations of the work was the limited number of samples available for model training.

José Saramago
Library
15:00-16:00

Rosário, T.
Correia, P.
Pacheco, O.

Mobile App using Object Detection for Car Driving

Car manufacturers have used object detection systems to provide driver assistance, ranging from simple warnings to limited self-driving, that require the use of dedicated hardware. We propose an Android application that, by analyzing the RGB camera input produced by the phone, is capable of aiding drivers by emitting sound warnings, with a visual grid representation of the inferred objects. Compared to previous systems used by car manufacturers, this project encompasses a broader audience, as it does not depend on the car's brand and has a simple interface. Our application utilizes a model that achieves a fast inference speed at the cost of accuracy, allowing it to be run on almost any Android phone.

José Saramago
Library
15:00-16:00

Campos, F.
Cerqueira, F.
Alves, V.
Cruz, R.

Detecting Archaeological Sites From Airborne LiDAR Data With YOLOv5

José Saramago
Library
15:00-16:00

Botelho, F.
Canedo, D.
Georgieva, P.
Neves, A.
Fonte, J.
Dias, R.
Pereiro, T.
Seco, L.
Vázquez, M.
Hipólito, J.
Machado, J.

The search on the Earth's surface for archaeological sites is a challenging and costly task conducted by expert archaeologists. Automating this entire process in whole or in part solves many problems associated with manpower, cost and frequently used intervention methods. Airborne LiDAR proved to be very effective in capturing the Earth's surface and since then it has been used for the detection of archaeological sites. In this work, 136 mamoas (burial mounds) identified in the Alto Minho region in northern Portugal were used to train a YOLOv5 model. A study was conducted to measure the ideal bounding box size in the annotations which lead to better results. Furthermore, an inference was made across the entire region of Arcos de Valdevez to discover possible mamoas not yet identified by expert archaeologists. The identifications are transmitted through geographic coordinates to pinpoint potential mamoas.

A Benford's Law Based method to Detect Manipulated Digital Photos

The automatic detection of manipulated digital images has challenged criminal investigation. There is a wide range of techniques for detecting manipulations in digital images, supported mainly by a set of machine learning methods. However, these techniques require substantial computational resources and make digital forensic analysis processes expensive.

This paper describes a statistical model based on Benford's Law and the results obtained with a dataset of 560 digital images, of which 280 were authentic, and the remaining were manipulated. The method was applied to a set of features (colours, textures) extracted from digital images. It extracts the first digits, that is the frequency with which they occurred in the set of features extracted for each photo. The detection method focus on the behaviour with which the frequency of each digit occurred in comparison with the frequency expected by Benford's law.

The proposed method integrates Pearson's and Spearman's correlations and Cramér-Von Mises (CVM) fitting model, applied to the first digit of a number consisting of several digits, obtained by extracting digital photos features through Fast Fourier Transform (FFT) method. The global results obtained are promising, but worst than those obtained with machine learning techniques. An F1 value of 64.74%, with a recall of 91.19% were obtained, using the CVM model.

José Saramago
Library
15:00-16:00

Fernandes, P.
Antunes, M.

3D Reconstruction using Images Acquired by Unmanned Aerial Vehicle

The technologies behind Unmanned Aerial Vehicles (UAVs) have suffered exponential growth in the past decade. For that reason, many Armed Forces (AF) worldwide started to increase the use of these aerial systems. UAVs offer a lot of good features, including the capability to be mounted with a wide variety of equipment, their size, usability, and mainly the ability to acquire data from a multi-view perspective while being remotely piloted, securing the person's safety when the study scene may be dangerous or inaccessible. From the characteristics mentioned, a UAV can add a significant substantial value in many military fields, including intelligence, target acquisition, reconnaissance, and surveillance.

José Saramago
Library
15:00-16:00

Jin, A.
Silva, J.
Bernardino, A.

An evaluation of Deep Learning Methods for Long-Term Forecasting Traffic Flow

The goal of forecasting is to provide accurate predictions of future events. Forecasting is essential for supporting decision-making since accurate forecasts can offer valuable knowledge. This work evaluated the performance of different deep learning methods for long-term forecasts, such as Long Short-Term Memory networks, Convolutional Neural Networks and hybrid architectures. We tested our algorithms in a real-world scenario by forecasting the values of traffic flow sensors deployed in a city. We conclude that Convolutional Neural Networks are adequate, efficient, robust and able to understand the seasonal patterns present in the data.

P2José Saramago
Library
15:00-16:00Almeida, A.
Brás, S.
Sargento, S.

Intrusion detection: Influence of dataset balancing methods

Intrusion detection is a problem of outmost importance nowadays because attacks are becoming more frequent and sophisticated. One of the characteristics of the datasets used with machine learning methods to generate attack detection models is that they are strongly unbalanced. In this work we present results regarding the influence of two dataset balancing methods: random undersampling and random oversampling using the CSE-CIC-IDS2018 dataset. The results of the tests carried out allow the following conclusions: 1) there is an improvement in the results up to a certain level of random undersampling but, beyond that limit, the reduction of the amount of data leads to a deterioration of the results; 2) the effect of the random oversampling operator is almost inexistent.

P2José Saramago
Library
15:00-16:00Almeida, H.
Grilo, C.

Facial Recognition in a non-cooperative environmentMenino, R.
Silva, J.
Neves, A.

Nowadays, facial recognition has become a very important milestone in the field of computing and over this time it has received a lot of attention by researchers in the area. Facial recognition can be used in many areas, but the one that has been growing a lot is security. Despite being an intense studied topic, there are still some limitations: the fact that the acquisition is in non-cooperative environment is one of the main factors. The objective of this work is to analyze several methods of detection and facial recognition. It presents a study of the most important algorithms, and pre-processing techniques such as frontalization and facial alignment to compare the performance of each algorithms. Before processing data, an image dataset was built at the University of Aveiro using multi-spectral cameras. It was possible to see that algorithms based on deep convolutional neural networks have a higher precision compared to several traditional methods. A first step was also taken towards proposing a model of facial detection in thermal images, where there was an improvement of about 30% compared to the original model.

Efficient Neuromorphic Architectures for Visual Perception in Autonomous Driving SystemsJosé Saramago
Library
15:00-16:00Carvalho, M.
Nunes, J.
Cardoso, J.

One of the many Deep Learning (DL) applications is Autonomous Driving (AD). But to allow in-vehicle inference, DL algorithms need to be fast and precise, while working under several hardware constraints. On the other hand, DL models' size and complexity have increased so much in the last years that DL may soon become unfeasible. Therefore, efficient DL is a growing concern within the DL community. Several approaches can be adopted to achieve efficient DL but Spiking Neural Networks (SNNs) combined with neuromorphic computing are a promising paradigm. Nonetheless, it is still not clear if the current state-of-the-art is suitable for real-world applications such as AD. In this work we explore a well known SNN learning strategy for AD applications. We suggest SNNs for classification on LiDAR data and propose a LiDAR spike-encoding scheme. Despite SNNs usually demonstrating worse performance when compared with conventional ANNs, we here demonstrate SNNs perform on par with conventional ANNs on LiDAR data. Although the proposed LiDAR spike encoding scheme can still be optimized, we argue the inherent sparseness of LiDAR point clouds is very suitable for SNNs making them very interesting candidates for in-vehicle efficient DL.

Analysis on 3D Reconstruction in Traffic Accident Investigation

During the investigation of a road traffic accident, the collection of information is an important step. The main concerns when acquiring data are to gather as much information in the shortest time possible, whilst still allowing traffic to flow relatively unimpeded. In the last few years, digital 3D reconstruction of physical entities has become an established technique to reliably capture and analyse real-world data to later be transformed into 3D digital representations. Photogrammetry is a 3D reconstruction technique which obtains spatial information from photographic images. A recent application of photogrammetry uses drones to acquire these images. Drones can be used to quickly survey an area taking photos at a relatively reduced cost. This work aims to analyse the process of 3D reconstruction from a set of images of real traffic accidents acquired by drone, using commercial and other presently used software and algorithms. The various stages of generating 3D products, such as point clouds and triangular meshes are studied, to obtain a reliable representation of the accident scenes while analysing which factors and generation parameters have the greatest influence in the quality of the final products.

José Saramago
Library
15:00-16:00

Valério, P.
Silva, J.
Neves, A.

Finding Driver Styles on Driver Behavior Data with Unsupervised Learning

In most countries, insurance against civil liability for vehicles is mandatory. Usually, insurance companies set vehicle insurance rates according to static variables, such as the age of the driver, the number of years one holds a driving license, and the driving history. These variables may not reflect the everyday behavior of the driver on the road, thus ending up by penalizing young good drivers. Moreover, an automatic driver style identification has many useful applications such as fleet management or promoting good drivers. In this paper, we follow a pay-as-you-drive approach, to devise a driver style identification strategy, based on real-time driver behavior data. From data records with the trips from different drivers, we build a dataset. Then, we apply unsupervised machine learning techniques that are able to identify some distinct driver styles.

José Saramago
Library
15:00-16:00

Loureiro, L.
Ferreira, A.
Lourenço, A.

Eye-Tracking Data Reconstruction in Chest Radiography Screening

Chest radiography is increasingly used worldwide to diagnose a series of illnesses targeting the lungs and heart. The high amount of examinations leads to a severe burden on radiologists, which benefit from the introduction of deep learning tools in clinical practice. In this work, a UNet-based model was used to serve as a foundation for posterior design of medical applications. The proposed model is capable of performing eye-tracking data reconstruction, in the form of heatmaps, using only chest radiographs as input. The results obtained for two datasets, EGD and REFLACX, show that both original and reconstructed heatmaps highlight key areas of a chest x-ray with diagnostic relevance. Further improvements in the training process, preprocessing of the eye-tracking data and extensive collection of novel data will help the tuning of the current model, and aid its role in assisting pathology classification.

José Saramago
Library
15:00-16:00

Santos, R.
Pedrosa, J.
Mendonça, A.
Campilho, A.

Electric Vehicle Driving Range Prediction: an Approach with Machine Learning

The use of an electric vehicle (EV) as a reliable eco-friendly transportation has increased, over the past years. When choosing an EV, the vehicle's autonomy in terms of its driving range (DR) capability is a decisive factor, since it minimizes the drivers anxiety on a trip. On a given trip, the autonomy of the vehicle depends on many variables related to vehicle itself or related with external conditions. Thus, it is difficult to have an accurate estimation of the DR value. Machine learning (ML) techniques have become a widely used approach for many problems. In this paper, we explore the use of regression techniques, to the DR estimation problem. On publicly available datasets, our approach is able to perform accurate estimation of the DR, with standard metrics.

José Saramago
Library
15:00-16:00

Albuquerque, D.
Ferreira, A.
Coutinho, D.

Explainable deep learning for metaplasia detection in upper gastrointestinal endoscopyJosé Saramago
Library
15:00-16:00Neto, A.
Ferreira, S.
Libânio, D.
Ribeiro, M.
Coimbra, M.
Cunha, A.

Precancerous conditions such as intestinal metaplasia (IM) have a key role in gastric cancer development and can be detected during endoscopy. During upper gastrointestinal endoscopy (UGIE), misdiagnosis can occur due to technical and human factors or by the nature of the lesions. Deep learning systems show great potential in detecting precancerous gastric resulting in higher detection rates and fewer operation errors. This study aims to develop deep learning algorithms capable of detecting IM in UGIE images with a focus on model explainability and interpretability. In this work, standard models such as ResNet50, VGG16 and InceptionV3 were compared to more recent algorithms that rely on attention mechanisms, namely the Vision Transformer (ViT), trained in 818 UGIE images (409 normal and 409 IM). All the models were trained using a 5-fold cross-validation technique and for validation, an external dataset will be tested with 100 UGIE images (50 normal and 50 IM). In the end, explainability methods (Grad-CAM and attention rollout) were used for more clear and more interpretable results. The model which performed better was ResNet50 with a sensitivity of 0.75, an accuracy of 0.79, and a specificity of 0.82. The ViT model showed promising performance, reaching similar results compared to the remaining models.

On the Generalization of Masked Face Recognition Models to Occluded Face RecognitionJosé Saramago
Library
15:00-16:00Sequeira, A.
Neto, P.
Cardoso, J.

In recent years, the evolution of face recognition (FR) algorithms has been pushed forward by several factors. Motivated by the unexpected elements found in real-world scenarios, researchers have investigated and developed a number of methods for occluded face recognition (OFR). However, due to the SarS-Cov2 pandemic, masked face recognition (MFR) research branched from OFR and became a hot and urgent research challenge. Due to time and data constraints, these models followed different and novel approaches to handle lower face occlusions, i.e., face masks. This paper summarizes a study focusing on the evaluation of different approaches followed for both MFR and the more general scenario of OFR. Beyond the evaluation of state-of-the-art methods, this study aims at finding links between the two conceptually similar research directions and understand future directions for both topics. For this analysis, several occluded and face recognition algorithms from the literature are studied. These methods were picked accordingly to the novelty of their approach (proven state-of-the-art results, and publicly available source code) and were evaluated on 4 occluded datasets. The analysis presented, sustain the interoperable deployability of MFR methods on OFR datasets, when the occlusions are of a reasonable size. Thus, solutions proposed for MFR can be effectively deployed for general OFR.

Friday October 28th 2022

Poster Session3

Papers: 2, 6, 9, 10, 12, 15, 20, 24, 32, 37, 40, 41, 42, 43, 46, 48, 53, 54, 60

Chair: Telmo Fernandes

2

P3

Interpretability-Guided Human Feedback During Neural Network Training

José Saramago
Library
16:30-17:30

Silva, P.
Cruz, R.
Gonçalves, T.
Shihavuddin, A.

When a model makes a wrong prediction, a typical solution is to acquire more data related to the error – this is an expensive process known as active learning. Our proposal combines active learning with interpretability so that the user is able to correct such mistakes while the model is being trained. At the end of each epoch, our training pipeline shows the user cases of mistakes and uses interpretability to allow the user to visualize which regions of the images are receiving the attention of the model. The user is then able to guide the training through a regularization term in the loss function. Overall, in low-data regimens, the proposed method returned slight gains for the dataset used: 0.61 vs 0.63 loss, and 81.14% vs 78.41% for the proposal and the baseline, respectively.

Natural Language Processing in the Classification of Dialog ActJosé Saramago
Library
16:30-17:30Ferreira, P.
Martins, D.
Oliveira, H.
Silva, C.
Alves, A.

Dialog act (DA) classification is generally done on spontaneous utterances of dialog, and this paper aims to understand whether generalization through its annotations leads to improvements in DA classification. For this, Natural Language Processing (NLP) tasks were explored, such as, Part-of-Speech (PoS) Tagging, Named Entity Recognition (NER) and coreference resolution in the context of dialog. These tasks were implemented using the spaCy library and the result of them can be used as resources for the DA classification. Two datasets were used for these experiments: CamRest676 and Mastodon, presenting interesting insights into the possibility of using NLP in DA classification.

Intelligence Artificial approaches for credit scoring & coded biases ecosystem

José Saramago
Library
16:30-17:30

Silva, A.
Silva, C.
Graglia, M.

Credit scoring is a tool used by financial sector to classify customers as likely solvent or insolvent. Concerns exist about the use of these algorithms, especially on issues related their auditability, disability to explain their results or their evolution over time. Such concerns must be resolved through continuous learning and dialogue to overcome the feeling that these models are "black boxes" of unknown functions, eventually biased. Considering automated decisions, it is not possible to improve the behavior of the algorithm in certain situations, to avoid bias, to increase its adoption within companies by generating confidence; to provide a constructive personalized feedback and explanation to users. If these solutions were not better investigated disparity can arise, namely between the less privileged, the different genders, exacerbating structures in society. Explainable artificial intelligence models can explain the reasoning behind their decisions and might mitigate biases inside the algorithms, but it needed more, it required a complex approach involving technology, organization and human aspects, like ethics aspects to get progress. The science still trying to get progress isolated from many areas. It is possible to get AI faster, to process more data, maybe get smarter and with capacity to learn, but to solve human problems without cause other problems it is not easy. We need to start by enabling the people to develop and deploy AI systems with better tools for accountability. Even as the headwinds of society's existing race-, class- and gender-based inequities blow strong, as an industry, we can make it easier for marginalized populations to benefit from better technology.

Optimized European Portuguese Speech-To-Text using Deep Learning

We have developed an ASR system for European Portuguese implementing the QuartzNet architecture with the NeMo framework. Two approaches were used in this work: from scratch and using transfer learning. The experiments were data-driven focused instead of algorithm fine-tuning. Experiments confirm that models developed using transfer learning have shown better results (WER=0.0513) than developing models from scratch (WER=0.1945).

José Saramago
Library
16:30-17:30

Corado, L.
Medeiros, E.
Rato, L.
Quaresma, P.
Salgueiro, P.

Can we rely on clustering for approximating intents and dialog acts?

The classification of dialog acts and intents can play an important role in many natural language applications, notably in the conversation-based scenarios as chatbots. In this work the goal is to recognize and group dialog acts and/or intents using a clustering approach. The strategy is domain-independent, presenting the potential to enhance and support different application scenarios. Results show that clusters are closer to intents, presenting better results by external evaluation. Although more experiments should be carried out, the labels automatically chosen for intent clusters show clearer meaning than dialog act clusters labels, since the latter present greater entropy for different types of dialog acts.

José Saramago
Library
16:30-17:30

Martins, D.
Ferreira, P.
Oliveira, H.
Silva, C.
Alves, A.

Latent Noise Augmentation: On the applicability of noise as an augmentation in the latent space

This preliminary study proposes Gaussian noise as a way to augment data in the latent space. This method was evaluated in the specific task of extracting soft-biometric features from face templates obtained with ElasticFace on data from VGGFace2 dataset. Our results indicate that the use of such noise patterns in a learning stage leads to an increase of the reliability of the predictions of an ensemble of classifiers on unseen data.

José Saramago
Library
16:30-17:30

Mamede, R.
Oliveira, M.
Neto, P.
Sequeira, A.
Cardoso, J.

Ensembles and Wearable Sensors for Stroke Classification

Intelligent approaches in sports using IoT devices to gather data, attempting to optimise athlete's training and performance, are cutting edge research. Synergies between recent wearable hardware and wireless communication strategies, together with the advances in intelligent algorithms, which are able to perform online pattern recognition and classification with seamless results, are in the frontline of high-performance sports coaching. In this work, we propose an ensemble approach to stroke classification based on raw signals acquired by wearable sensors and biosensors. Experiments were carried out in a real training setup, including 10 athletes aged 15 to 17 years, and resulted in a set of circa 8000 samples. Experimental results show that the proposed approach with wearable sensors combined with an ensemble machine learning approach can effectively support coaches while monitoring the training of several swimmers.

José Saramago
Library
16:30-17:30

Santos, M.
Costa, J.
Silva, C.
Fernandes, T.
Faria, S.

Preliminary Study on Deep Iterative Semantic Segmentation

Semantic segmentation consists of classifying each pixel according to a set of classes. This process is particularly slow for high-resolution images, which are present in many applications, ranging from biomedicine to the automotive industry. In this work, we propose an algorithm targeted to segment high-resolution images based on two stages. During stage 1, a lower-resolution interpolation of the image is the input of a first neural network, whose low-resolution output is resized to the original resolution. Then, in stage 2, the probabilities resulting from stage 1 are divided into contiguous patches, with less confident ones being collected and refined by a second neural network. The main novelty of this algorithm is the aggregation of the low-resolution result from stage 1 with the high-resolution patches from stage 2. We used U-Net as the segmentation model and evaluated our proposal in three databases. Our method shows results similar to the baseline regarding the Dice coefficient, with fewer arithmetic operations.

José Saramago
Library
16:30-17:30

Silva, D.
Cruz, R.
Gonçalves, T.

Automatic Data Model Conversion

Source integration has been a problem for many organizations and products like Ubiwhere's Urban Platform, a platform which imports city data from different sensors and shows it in a web application. The goal was to create a system to map automatically the new sources' data models to the already existing database model. The conversion was approached as a schema matching problem. It explored relatively recent techniques, for instance, embeddings, besides the traditional ones, and formats like JSON, popular but not much explored by other works of this kind. The system obtained a f1-score of 61% on average, after being tuned. Although the solution is still far from its final form, it revealed important clues for future studies and improvements.

José Saramago
Library
16:30-17:30

Marques, J.
Silva, C.
Garcia, J.

Bitcoin Price Prediction using Natural Language Processing, Technical Analysis and Machine Learning Models

This paper focuses on the study of multiple fields related to Artificial Intelligence to predict the price of the popular cryptocurrency Bitcoin. To generate predictions, multiple regression models were created, based on Technical Analysis applied to past prices and Natural Language Processing applied to past Tweets. When using social based features in addition to the generic mathematical ones, the prediction results show clear improvements in comparison to the models based exclusively on Technical Analysis. A prototype was also developed to obtain real time data, using one of the created models to generate real time predictions.

José Saramago
Library
16:30-17:30Oliveira, V.
Alves, A.**IoT Forensic Framework: An Initial Approach**

Nowadays, police departments deal with different types of data from different sources during police investigations. One of these data sources derives from IoT (Internet of Things) devices, with their multiple formats and the amount of data produced. Therefore, we propose the IoT.EyeWitness framework, which aggregates the data gathered from IoT devices, and permits data visualization by a user-friendly interface. This framework offers a timeline view of the artifacts, allowing the user's activities to be contextualized in a specific time frame, as well as answering the "What", "When", "Who", and "Where" questions. Finally, the obtained results are an initial approach that tries to deal with different types of data from different IoT sources. Therefore, the proposal leads to the IoT.EyeWitness Framework consisting of a functional database (each table pertaining to a specific piece of artifact), in addition to a Graphical User Interface (GUI) for user-data interaction. Furthermore, the framework intends to answer, based on a heuristic method, the above questions that arise during the criminal investigation, based on a user timeline.

José Saramago
Library
16:30-17:30Wallberg, E.
Carnaz, G.
Domingues, I.

In recent years the great success of transformers-based models initially employed in NLP tasks has led to the development of several transformers variations to be employed in a wide range of domains such as vision. With the correct amount of training data and proper training, transformers can provide excellent performance when in comparison with CNN counterpart in the vision tasks. However, the main drawback of transformers concerns the know memory requirements that often exceed the available training platform, growing in a quadratic form regarding the input length. Several works address the problem of optimizing transformers to reduce their memory footprint, but mainly with a reduction in the prediction capabilities. In this work, we evaluate the use of random patch erasing to optimize the transformer model memory footprint while achieving competitive results on several image classification medical datasets. The evaluated ViT models allow being trained in a single GPU, reaching similar results than CNN, obtaining a accuracy 91.2%, 85.5%, 86.5% in three competitive image datasets, reducing the training time in average by 22% on the transformers models.

A deep learning approach for automatic counting of bedbugs and grape moth

The bedbug and the grape moth are the most significant pests affecting rice and vineyards, causing great damage. Insect traps are among the most appropriate solution for monitoring and counting, influencing the selection and dosage of the pesticide to be applied for pest control. However, the counting and monitoring operations are based on the frequent visit of technicians to the site and are supported by inefficient counting methods, which is a challenging and time-consuming task. This study proposes the automatic counting of bedbugs and grape moths in traps using deep learning algorithms. We use three different databases, Pest24, Bedbug and Grape moth. First, we trained the Pest24 dataset with YOLOv5 and got an mAP of 69.3%. Then, using the weights obtained from the Pest24 dataset, we trained the Bedbug and Grape moth datasets. The best results for the Bedbug dataset were obtained with the YOLOv5 with transfer learning with an AP of 96.5% and a counting error of 63.3%. The best result was obtained with YOLOv5 without transfer learning of Pest24 with an AP of 90.9% and a counting error of 6.7 for the Grape moth.

Startups' Twitter activity analysis: the case of Portuguese IT Startups

Due to its low costs and wider reach, Twitter is a relevant tool for small companies to be used as a promotion vehicle and can be used to understand what companies are interested. This paper presents a case study on the visualization of the activity of several known Portuguese startups in the Information Technology area of business. We performed a content categorization of their posts in order to understand what themes are addressed and concluded that companies share a similar content distribution. Moreover, a visualization of their Twitter followers and following communities have also been explored, showing that, as expected, their social communities overlap.

José Saramago
Library
16:30-17:30

Teixeira, A.
Morais, R.
Sousa, J.
Peres, E.
Cunha, A.

José Saramago
Library
16:30-17:30

Peixoto, A.
António, N.
Almeida, A.

Knowledge-based model for object recognition: The importance of linking archaeological knowledge with geoinformation

LiDARs have the unique capability of capturing a high-resolution point cloud, thus ranking as a key vision sensor for enabling autonomous driving. However, current LiDAR technology is still immature and expensive, which makes it unattractive to the automotive market. We therefore propose an alternative LiDAR sensor that resorts to mass-produced components, such as a dot pattern projector and a stereoscopic camera rig. This paper focuses on the calibration aspect of the stereo rig and aims to evaluate the systematic error introduced by non-ideal calibration in range estimation.

José Saramago
Library
16:30-17:30

Câmara, A.
Almeida, A.
Oliveira, J.

An High-Level View Of Pest Detection Using Computer Vision and IoT

Correct pest monitoring makes agricultural production more efficient and reduces costs with pesticides and workers. Currently, this monitoring is done in a traditional way and there is potential to introduce new technologies in order to make it more efficient. In this work we present a monitoring system based on Internet of Things (IoT) and Computer Vision (VC). First we train a CV model with a public dataset, then we use cameras placed in crops to obtain images in real conditions, these images are sent to the cloud where the CV model makes the detections and sends them to an application that displays the pests evolution. Results show that it is possible to use new technologies to make monitoring more autonomous, precise and cheaper.

José Saramago
Library
16:30-17:30

Cardoso, B.
Silva, C.
Costa, J.
Ribeiro, B.

Grapevine Varieties Identification Using Vision Transformers

The grape variety plays an important role in the wine production chain, thus identifying it is crucial for production control. In this work, we explore the benefit of using deep learning vision transformers architecture relative to the conventional Convolutional Neural Network (CNN) to identify 12 grapevine varieties using leaf-centred RGB images acquired in the field. We train an Xception model as a baseline and four different configurations of the ViT_B model. The best model achieved 0.96 of F1-score, outperforming the state-of-the-art convolutional-based model in the used dataset.

54

Engenhos.INFO Platform

Nowadays, people are concerned with the safety of their own and the people they love. As a result, they tend to act unpredictably in every possible danger and sometimes try to ward off potential threats, moving suspicious objects - when they should leave them to professionals. Our approach to the problem described above was to propose a platform, named Engenhos.Info, a mobile cross-platform application developed for iOS and Android that allows citizens and professionals to check whether or not an object or device is hazardous to them and those around them using a Convolution Neural Network (CNN) classifier to recognize dangerous objects, devices, or substances. Finally, a mobile application and server were delivered, with an initial machine learning classifier that enables the identification of the suspicious object. Regarding the classifier, obtained accuracy results between 0.35 and 0.54 against the validation set.

José Saramago
Library
16:30-17:30

Carneiro, G.
Pádua, L.
Peres, E.
Morais, R.
Sousa, J.
Cunha, A.

José Saramago
Library
16:30-17:30

Pintea, L.
Carnaz, G.
Domingues, I.

Machine Learning for the Identification of Material Constitutive Model ParametersJosé Saramago
Library
16:30-17:30Marques, A.
Ribeiro, B.
Prates, P.

This work aims to evaluate the predictive performance of various Machine Learning algorithms in the identification of material constitutive parameters, which describe the plastic behaviour of metal sheets. A dataset was generated, from the results of the numerical simulations of uniaxial tensile tests, and five different regression Machine Learning algorithms were considered: Gaussian Processes, Multi-layer Perceptron, Support Vector Regression, Decision Trees, and Random Forest. The algorithms were used to train models, considering different training set sizes. The results showed great potential for the application of Machine Learning for material parameter identification, with Gaussian Processes achieving the best performances overall.

Program Overview

Friday October 28th 2022		
Registration	D Building	09:00-09:30
Open - Opening Session	D Building, auditorium D1	09:30-09:45
Plenary - Plenary Session	D Building, auditorium D1	09:45-10:45
Coffee Break	D Building	10:45-11:30
Oral - Oral Presentations	D Building, auditorium D1	11:30-12:30
Lunch Break	Campus restaurant	12:30-14:00
P1 - Sessions	José Saramago Library	14:00-15:00
P2 - Sessions	José Saramago Library	15:00-16:00
Coffee Break	José Saramago Library	16:00-16:30
P3 - Sessions	José Saramago Library	16:30-17:30
Awards and Closing Session	José Saramago Library	17:30-18:00

Author Index

- Abbasi, M. , 17, 32
Albuquerque, D. , 46
Alexandre, L. , 18
Alexandrino, L. , 38
Almeida, A. , 42, 57, 58
Almeida, H. , 42
Alves, A. , 50, 52, 55
Alves, V. , 39
Amante, R. , 35
Antunes, M. , 41
António, N. , 57
Arrais, J. , 17, 32
- Baeza, R. , 24
Bem-Haja, P. , 20
Bernardino, A. , 41
Botelho, F. , 40
Brás, S. , 42
- Caldeira, E. , 25
Camara, J. , 26
Campilho, A. , 33, 46
Campos, F. , 39
Canedo, D. , 35, 40
Cardoso, A. , 19
Cardoso, B. , 58
Cardoso, J. , 31, 34, 44, 48, 53
Cardoso, M. , 34
Carnaz, G. , 55, 59
Carneiro, G. , 59
Carneiro, I. , 31
Carvalho, I. , 18
Carvalho, M. , 34, 44
Carvalho, S. , 31
Castro, E. , 25
Cerqueira, F. , 39
Coelho, A. , 26
Coimbra, M. , 21, 24, 29, 47
- Colaço, B. , 29
Corado, L. , 52
Correia, A. , 18
Correia, P. , 37, 39
Costa, J. , 53, 58
Costa, M. , 33
Coutinho, D. , 46
Cruz, R. , 39, 49, 54
Cunha, A. , 26, 47, 57, 59
Câmara, A. , 58
- Dias, R. , 40
Domingues, I. , 23, 30, 55, 59
Domingues, R. , 22
Drummond, M. , 38
- Faria, S. , 53
Fernandes, L. , 31
Fernandes, P. , 41
Fernandes, R. , 26
Fernandes, T. , 53
Ferraz, S. , 21
Ferreira, A. , 45, 46
Ferreira, C. , 30
Ferreira, M. , 29
Ferreira, P. , 50, 52
Ferreira, S. , 47
Ferrolo, R. , 27
Filipe, V. , 23, 29
Fonseca, T. , 27
Fonte, J. , 40
Fontes, J. , 24
- Garcia, J. , 54
Georgieva, P. , 38, 40
Ginja, M. , 29
Gonçalo, P. , 29
Gonçalves, L. , 23, 29

Gonçalves, T. , 25, 49, 54
 Graglia, M. , 51
 Grilo, C. , 42

 Henrique, R. , 31
 Hipólito, J. , 40

 Isidoro, J. , 37

 Jin, A. , 41

 Leite, P. , 36
 Libânio, D. , 47
 Lopes, I. , 29
 Lopez, M. , 24
 Loureiro, C. , 23
 Loureiro, L. , 45
 Lourenço, A. , 45

 Machado, A. , 17
 Machado, J. , 40
 Mamede, R. , 53
 Manso, C. , 23
 Marcal, A. , 36
 Marques, A. , 60
 Marques, J. , 54
 Martins, D. , 50, 52
 Martins, N. , 34
 Marçal, A. , 36
 Medeiros, E. , 52
 Mendonça, A. , 33, 46
 Menino, R. , 43
 Monteiro, N. , 17
 Montenegro, H. , 31
 Morais, R. , 57, 59
 Moreira, J. , 35

 Neto, A. , 26, 47
 Neto, P. , 48, 53
 Neves, A. , 35, 40, 43, 45
 Neves, I. , 28
 Neves, J. , 30
 Nunes, J. , 44
 Nunes, M. , 34

 Oliveira, H. , 18, 19, 21, 28, 31,
 50, 52, 56

 Oliveira, J. , 58
 Oliveira, L. , 31
 Oliveira, M. , 36, 53
 Oliveira, V. , 55

 Pacheco, O. , 39
 Patrício, C. , 30
 Pedrosa, J. , 21, 22, 24, 33, 46
 Peixoto, A. , 57
 Pereira, N. , 30
 Pereira, S. , 33
 Pereira, T. , 21, 28
 Pereiro, T. , 40
 Peres, E. , 57, 59
 Pimenta, S. , 29
 Pinho, A. , 27
 Pintea, L. , 59
 Pinto, J. , 19
 Pratas, D. , 25, 27
 Prates, P. , 60
 Pádua, L. , 59

 Quaresma, P. , 52

 Raimundo, J. , 24
 Ramos, M. , 20
 Rato, L. , 52
 Renna, F. , 22, 24, 29
 Rezende, R. , 26
 Ribeiro, B. , 32, 58, 60
 Ribeiro, M. , 47
 Rito, P. , 34
 Rocha, T. , 34
 Rosário, T. , 39

 Salgueiro, P. , 52
 Santos, I. , 20
 Santos, M. , 53
 Santos, P. , 32
 Santos, R. , 46
 Sargento, S. , 42
 Seco, L. , 40
 Sequeira, A. , 48, 53
 Shihavuddin, A. , 49
 Silva, A. , 20, 51
 Silva, C. , 18, 19, 50–54, 58

Silva, D. , 29, 54
Silva, F. , 21, 28
Silva, J. , 35, 41, 43, 45
Silva, P. , 49
Silva, W. , 31, 34
Sousa, J. , 28, 57, 59
Sousa, M. , 25, 27, 35

Teixeira, A. , 57
Teixeira, L. , 30
Tomé, A. , 20, 35
Torres, L. , 32
Tuchin, V. , 31

Valério, P. , 45
Vasconcelos, V. , 23, 30
Vázquez, M. , 40

Wallberg, E. , 55

Zahir, H. , 38