

Presentation of Articles - Session 1.1

Industrial Applications - Industry 4.0 - Precision Agriculture

Session Chair: Edison Valencia

Date: August 10th Time: 10:30 to 12:00 Place: Building 34 – Room 303

ID	1
Title	Machine Learning based Plant Disease Detection using EfficientNet B7
Authors	Amit Kumar Bairwa, Sandeep Joshi and Shikha Choudhary
Abstract	Plant diseases have effects on growth and the production of the plant. Plant diseases can be figured out by using digital image processing, nowadays Deep learning has made a lot of progress in digital image processing to identify the disease efficiently. This paper finds the plant diseases using EfficientNet by focusing majorly on three data steps containing pre-processing, model selection, and detection network using a canny edge detection algorithm. The model is trained and tested on a plant disease data set. The model provides 97.2 % accuracy to detect the disease than existing CNN-based models.
Keywords	Plant diseases · Machine Learning · Classification · Segmentation · Detection

ID	3
Title	Land Cover Classification Using Remote Sensing and Supervised Convolutional Neural Networks
Authors	Jheison Manuel Perez Guerra, Veronica Herrera Ruiz, Juan David Martinez Vargas, Juan Carlos Gonzalez Velez and Maria Constanza Torres Madroñero
Abstract	The rapid and uncontrolled population growth and the development of various industrial sectors have accelerated the rate of changes in land use and land cover (LULC). The quantitative assessment of changes in LULC plays a fundamental role in understanding and managing these changes. Therefore, it is necessary to examine the accuracy of different algorithms for LULC mapping. We compared the performance of three deep learning architectures (PSPNet, U-Net, and U-Net++) with four different backbones, including ResNet-18, ResNet-34, ResNet- 50, and ResNext50_32x4d pre-trained on ImageNet. Besides, we compared the model's performance using the same scene but using: 1) a single date, 2) a time series, and 3) data augmentation. For this, we used Sentinel 2 images captured on Antioquia-Colombia and four main categories of the Corine Land Cover as ground truth. The mean Intersection-Over-Union (mIoU) metric and pixel accuracy was used like evaluation metrics. All models showed an increase in performance with data augmentation. The best models were U-Net with ResNet-50 encoder and U-Net with Resnext50-32x4d, with pixel accuracies of 88.6% and 89.2%, respectively, and mIoU 74.6% and 74.8%. Both models had similar computing times (244.07 min and 248.06 min). PSPNet was the lowest-performing architecture, with pixel accuracy between 83.2% and 84.1% and mIoU between 63.3% and 64.6%. In summary, our results show that semantic segmentation models are suitable for classifying the LC of optical images and provide benchmark accuracy for evaluating the integration of new techniques and sensors.
Keywords	Remote Sensing · Deep Learning · Sentinel2 · Semantic Segmentation · Land UseandLandCover

ID	40
Title	Fuzzy Model for Risk Characterization in Avocado Crops for Index Insurance Configuration
Authors	Juan Pablo Jiménez Benjumea, Laura Isabel López Giraldo, Juan Alejandro Peña Palacio and Tomas Enrique Ramirez Guerrero
Abstract	Climate change has caused strong variations in agro-climatic parameters such as precipitation, temperature, and relative humidity, accelerating the phytosanitary conditions associated with agricultural crops, mainly in insect pests, since these generate an alteration in their life cycle and an increase in their population. This causes significant economic damage to important crops such as the Hass avocado, which has had a growing development and demand in national and inter-national markets, which has generated significant income for small and medium-sized farmers and exporters of this fruit in the country. To mitigate the impacts of climate change on agricultural production, it is possible to implement digital agriculture technologies. These technologies allow estimating the incidence of climate variations on crops through the monitoring of agro-climatic and phytosanitary variables that affect fruit growth. Therefore, a variable dispersion model with fuzzy characterization is proposed that seeks to establish a correlation between rainfall and the aggregate distribution of losses in the Hass avocado crop. In order to analyze and validate the proposed model, the random variables related to phytosanitary risk were taken and characterized. Subsequently, the frequency and severity random variables were modeled as linguistic random variables using fuzzy logic concepts. The results indicate that rainfall is the key variable to correlate in the search for an index insurance model based on agricultural risk, as well as in the characterization of qualitative and quantitative risks, promoting the improvement of financial and environmental sustainability by reducing agricultural losses through better crop management.
Keywords	Phytosanitary · Agroclimatic · Fuzzy Logic · Productivity · Insurance · Indexing

ID	38
Title	Synthetic Hyperspectral Data for Avocado Maturity Classification
Authors	Froylan Jimenez, Jose Aguilar and Marta Tabares-Betancur
Abstract	The classification of avocado maturity is a challenging task due to the subtle changes in color and texture that occur during ripening and before that. Hyperspectral imaging is a promising technique for this task, as it can provide a more detailed analysis of the fruit's spectral signature compared with multi-spectral data. However, the acquisition of hyperspectral data can be time-consuming and expensive. In this study, we propose a method for generating synthetic hyperspectral data of avocados. The synthetic data is generated using a generative adversarial network (GAN), which is trained on a small dataset of real hyperspectral images. The generated data is then used to train a neural network for avocado maturity classification. The results show that the neural network trained on synthetic data achieves comparable accuracy to a neural network trained on real data. Additionally, synthetic data is much cheaper and faster to generate than get real data. This makes it a promising alternative for avocado maturity classification.
Keywords	Hyperspectral imaging · Classification models · Machine Learning · Avocado maturity

Presentation of Articles - Session 1.2

Artificial Intelligence

Session Chair: Juan David Martinez

Date: August 10th Time: 10:30 to 12:00 Place: Building 38 – Room 303

ID	6
Title	Recent Advances in Machine Learning for Differential Cryptanalysis
Authors	Isabella Martínez, Valentina López, Daniel Rambaut, Germán Obando, Valérie Gauthier-Umaña and Juan F. Pérez
Abstract	Differential cryptanalysis has proven to be a powerful tool to identify weaknesses in symmetric-key cryptographic systems such as block ciphers. Recent advances have shown that machine learning methods are able to produce very strong distinguishers for certain cryptographic systems. This has generated a large interest in the topic of machine learning for differential cryptanalysis as evidenced by a growing body of work in the last few years. In this paper we aim to provide a guide to the current state of the art in this topic in the hope that a unified view can better highlight the challenges and opportunities for researchers joining the field.
Keywords	Differential cryptanalysis · Machine learning · Survey

ID	30
Title	Using Open Data for Training Deep Learning Models: A waste identification case study
Authors	Juan Carlos Arbeláez, Paola Vallejo Correa, Marta Silvia Tabares, José Aguilar, David Ríos, Elizabeth Rendón and Santiago Ruiz-Arenas
Abstract	One of the main challenges of building commercial solutions with Supervised Deep Learning is the acquisition of large custom-labeled datasets. These large datasets usually fit neither commercial industries' production times nor budgets. The case study presents how to use Open Data with different features, distributions, and incomplete labels for training a tailored Deep Learning multi-label model for identifying waste materials, type of packaging, and product brand. We propose an architecture with a CBAM attention module, and a focal loss, for integrating multiple labels with incomplete data and unknown labels, and a novel training pipeline for exploiting specific target-domain features that allows training with multiple source domains. As a result, the proposed approach reached an average F1-macro-score of 86% trained only with 13% tailored data, which is 15% higher than a traditional approach. In conclusion, using pre-trained models and highly available labeled datasets reduces model development costs. However, it is still required to have target data that allows the model to learn specific target domain features.
Keywords	Deep Learning · Transfer Learning · Waste Identification · Solid Waste Management

ID	11
Title	Evaluación de técnicas de IA para implementar estrategias proactivas de auto-escalado de contenedores
Authors	Bryan Figueredo and Mariela Curiel
Abstract	En este trabajo se evalúan técnicas para mejorar el uso de recursos informáticos en la nube mediante auto-escalado. El auto-escalado puede ser reactivo (respondiendo a las necesidades de recursos cuando éstas se presentan) o proactivo (anticipándose a las demandas futuras). El estudio propone modelos basados en técnicas de inteligencia artificial para prever la creación de nuevas entidades de cómputo bajo condiciones variables de carga. La metodología incluyó limpieza de datos, análisis de correlación para seleccionar características relevantes y la evaluación de varios modelos de aprendizaje automático supervisado y no supervisado. Los resultados mostraron que el aprendizaje automático puede utilizarse para anticipar y optimizar la capacidad de los sistemas informáticos, brindando una gestión proactiva de recursos en la computación moderna.
Keywords	Elasticidad · Auto-escalado proactivo · Machine Learning

ID	8
Title	Addressing the Diet Problem with Constraint Programming enhanced with Machine Learning
Authors	Sara Jazmín Maradiago Calderón, Juan José Dorado Muñoz, Juan Francisco Díaz Frías and Robinson Andrey Duque Agudelo
Abstract	In Colombia there is a problem related to eating habits that has its origin, mainly, in two causes: the lack of budget that allows access to a wider variety of food, and the lack of awareness among the population about their nutritional needs. To tackle this issue, a solution has been proposed using a Constraint Programming (CP) approach enhanced with Machine Learning (ML) for a version of the Diet Problem (DP). A CP model was developed to find a shopping list that meets a family's nutritional needs while minimizing costs; and a synthetic dataset was created to test the model, which was run multiple times to collect results. Since DP is an NPcomplete problem and computational time to find optimal solutions varies from one solver to another, a ML classifier was used to choose a solver that best performs in small cap time limits based on instance features (i.e., selection from an Algorithm Portfolio). After carrying out an extensive evaluation of the CP model, including our approach that implements a Classifier for algorithm selection, the model correctly selects the best solver over 68.07% of the time, for a sample of 1378 instances. By analyzing the performance of different solvers on a set of instances, it can be predicted which solver is likely to achieve the best results on new instances. This approach could be extended to tuning solver parameters, which would further improve their efficiency and effectiveness.
Keywords	Constraint Programming · Machine Learning · Classifier · Algorithm Selection · Diet Problem

Presentation of Articles - Session 1.3

Distributed systems and large-scale computing

Session Chair: Edwin Montoya

Date: August 10th **Time:** 10:30 to 12:00 **Place:** Building 35 – Room 102

ID	42
Title	Safety Verification of the Raft Leader Election Algorithm using Athena
Authors	Mateo Sanabria Ardila, Leonardo Angel Sanchez and Nicolás Cardozo
Abstract	<p>The Raft consensus algorithm is widely recognized for its practicality and comprehensibility in achieving consensus within distributed systems. This paper presents a comprehensive exploration of Raft, making clear key concepts and verifying critical properties. We delve into the fundamental components of Raft, encompassing leader election, log replication, and safety guarantees. Detailed explanations are shown in order to illustrate the interactions between actors during commit phases, leader selection, and other significant stages. The Athena proof system is employed to verify essential properties such as leader completeness, log consistency, and fault tolerance, ensuring the algorithm's resilience in the face of failures. Drawing upon the Athena programming language's actor model implementation, we simulate and validate the behavior of Raft, providing practical insights into its functionality.</p>
Keywords	Raft · Consensus algorithms · Athena · Formal verification

ID	53
Title	Cloud-native architecture for distributed systems that facilitates integration with AIOps platforms
Authors	Juan Pablo Ospina Herrera and Diego José Luis Botia Valderrama
Abstract	DevOps has significantly enhanced application operations through the utilization of containers and CI/CD. It still relies on human intervention in the event of failures in any system component. Many existing solutions are limited to specific issues, such as reacting to server outages and scaling them up. As the complexity of distributed systems continues to grow due to the simultaneous operation of numerous components, even minor unavailability can substantially impact application reliability and result in significant economic consequences for businesses. Therefore, it is imperative that the solutions being developed minimize risks and increasingly automate these operations. In light of these challenges, the emergence of AIOps offers a promising solution using artificial intelligence techniques, including machine learning and big data, to operate and maintain application infrastructures, reduce operational complexity, and automate IT operations processes. Implementing such solutions has been shown to improve system quality and significantly reduce the time it takes to detect errors and recover from them. These advancements mark significant progress in the realm of operations. However, despite these benefits, widespread adoption of AIOps solutions by most companies remains limited due to the challenges associated with implementing them in large projects and the lack of clear integration pathways for emerging solutions. In this paper, we propose a holistic architecture that facilitates the integration of cloud-native distributed systems with these new solutions.
Keywords	Software Architecture · Distributed Systems · AIOps · Cloud-Native

Presentation of Articles - Session 2.1

Computational Statistics

Session Chair: Biviana Suárez

Date: August 10th Time: 15:00 to 16:00 Place: Building 27 – Room 204

ID	36
Title	Change Point Detection for time dependent counts using Extended MDL and Genetic Algorithms
Authors	Sergio Barajas-Oviedo, Biviana Marcela Suárez Sierra and Leticia Ramírez-Ramírez
Abstract	<p>This article introduces an extension for change point detection based on the Minimum Description Length (MDL) methodology. Unlike traditional approaches, this proposal accommodates observations that are not necessarily independent or identically distributed. Specifically, we consider a scenario where the counting process comprises observations from a Non-homogeneous Poisson process (NHPP) with a potentially non-linear time-dependent rate. The analysis can be applied to the counts for events such as the number of times that an environmental variable exceeded a threshold. The change point identification allows extracting relevant information on the trends for the observations within each segment and the events that may trigger the changes. The proposed MDL framework allows us to estimate the number and location of change points and incorporates a penalization mechanism to mitigate bias towards single regimen models. The methodology addressed the problem as a bilevel optimization problem. The first problem involves optimizing the parameters of NHPP given the change points and has continuous nature. The second one consists of optimizing the change points assignment from all possible options and is combinatorial. Due to the complexity of this parametric space, we use a genetic algorithm associated with a generational spread metric to ensure minimal change between iterations. We introduce a statistical hypothesis t-test as a stopping criterion. Experimental results using synthetic data demonstrate that the proposed method offers more precise estimates for both the number and localization of change points compared to more traditional approaches.</p>
Keywords	Change point detection · Evolutionary algorithm · Nonparametric Bayesian · Non-homogeneous Poisson Process · Bilevel Optimization

ID	37
Title	An Exploration of Genetic Algorithms Operators for the Detection of Multiple Change-points of Exceedances using Non-Homogeneous Poisson Processes and Bayesian Methods
Authors	Carlos A. Taimal, Biviana M. Suárez-Sierra and Juan Carlos Rivera
Abstract	In this paper it is presented an exploration of different strategies to generate solutions in a genetic algorithm for the detection of multiple change-points in univariate time series. The purpose is to find which combination of these is the optimal one while modeling times where there is an exceedance from a given threshold through Non Homogeneous Poisson Processes. Likewise, elements from information theory are taken to define a parsimonious model such that the explained phenomenon has a low memory usage and an optimal quantity of parameters, estimated through a Bayesian approach. These elements define the objective function. Thus and after evaluating different operators it is found that the optimal strategy to generate and to combine new solutions is through a random keys initialization, selection of the parents through the ranks and Boltzmann tournament method or through a roulette strategy and using a fixed low mutation rate.
Keywords	Genetic algorithm · Multiple Change-point detection · Non-homogeneous Poisson Process · Minimum Description Length · Bayesian Statistics

Presentation of Articles - Session 2.2

Digital Learning - E-learning

Session Chair: Daniel Correa

Date: August 10th **Time:** 15:00 to 16:00 **Place:** Building 27 – Room 202

ID	9
Title	Assessing ChatGPT's Proficiency in CS1-Level Problem Solving
Authors	Mario Sanchez and Andrea Herrera
Abstract	<p>ChatGPT is an advanced large language model (LLM) capable of generating code to solve specific problems when presented with carefully designed prompts, among other capabilities. The existence of ChatGPT raises significant questions regarding teaching practices and evaluations within the discipline. If ChatGPT can effectively solve exercises assigned to students, it prompts a reevaluation of the skills and knowledge that we teach and evaluate. The objective of this paper is to assess the proficiency of ChatGPT in solving exercises commonly encountered in a CS1 course. This serves as an initial step in exploring the implications of ChatGPT for computer science education. By examining ChatGPT's performance and comparing it with real students, we aim to gain insights into its capabilities and limitations. Our evaluation encompasses a comprehensive examination of 125 problems specifically designed for CS1-level learners. The experiment revealed that ChatGPT successfully solved approximately 60% of the provided problems. Subsequently, we conducted a detailed analysis of the characteristics of the problems that ChatGPT could not solve, aiming to gain a deeper understanding of the nuances that make them challenging for LLMs. This study contributes to the ongoing discourse surrounding the integration of AI-based tools, such as ChatGPT, in computer science education, and highlights the need for a reevaluation of educational objectives and methods employed in traditional educational institutions.</p>
Keywords	CS1 · Large language model · Computer science education · Generative AI

ID	12
Title	Teaching strategy for enabling technologies of Industry 4.0 to high school students
Authors	Duby Castellanos Cárdenas and María Clara Gómez Álvarez
Abstract	<p>Industry 4.0 enabling technologies are impacting several sectors of the economy by automating organizational processes. As a result, the demand for professionals with the necessary skills to face the challenges imposed by the new industrial trends has increased. This represents a challenge for technological and university institutions as they are at the forefront of the training and educational transformation processes. While there are various governmental strategies to provide training in technological topics, the most active stakeholders in implementing such strategies are higher education institutions, where the shortage of students in the foundational careers that support I4.0 technologies is particularly noticeable. For this reason, universities, as well as elementary and high schools, are consolidating strategies that could enhance the motivation of young people to choose technology-based careers.</p> <p>This paper presents an educational experience in Education 4.0 focused on enabling technologies for I4.0 oriented to high school students and led by The University of Medellín. Implementing this educational experience enabled the participants to devise solutions to problems real-world challenges using the Internet of Things. Among the benefits of this strategy, it does not require prior training in computational thinking or electronics fundamentals. Additionally, it integrates didactic strategies such as co-creation, gamification, and project-based learning, while allowing students to build a basic prototype within a relatively short period.</p>
Keywords	Educational Experience · Industry 4.0 · Enabling Technologies · Gamification · Co-Creation · High School

ID	34
Title	Instructional strategies for performance improvement in algebra: A systematic mapping
Authors	Laura Daniela Sepulveda Vega, Shirley Tatiana Garcia Carrascal and Dewar Rico-Bautista
Abstract	<p>Mathematics, specifically in the field of Algebra, becomes complicated for students to understand and this is reflected in their low academic grades. Additionally, in the results of reports of the international program for the evaluation of students in which Colombia is located with a lower score than the OECD average. This problem generates stress and anxiety, which can affect their ability to concentrate and retain information. The social and affective environment can also be an important factor in the learning of algebra. The methodology used for the selection of documents was systematic mapping. A total of 138 documents were found and, applying inclusion and exclusion criteria, 40 of these were selected. The most relevant current trends were found, which are the use of educational software and strategies such as gamification. It is important to find effective didactic tools that have the capacity to teach algebra in an effective way for students.</p>
Keywords	Algebra · Didactic strategies · Gamification · Systematic mapping · Performance

Presentation of Articles - Session 2.3

Software Engineering & Human Machine Interaction

Session Chair: Liliana González

Date: August 10th Time: 15:00 to 16:00 Place: Building 38 – Room 204

ID	10
Title	Clean Architecture: Impact on performance and maintainability of native Android projects
Authors	Javier Alfonso Santiago Salazar and Dewar Rico-Bautista
Abstract	<p>In software development, following an architecture is extremely essential for any project. Clean Architecture, since 2017, has become popular among the Native Android development community. It helps to improve the efficiency of the development process by establishing a clear separation of concerns, achieving modular, scalable, and maintainable code. Its advantages and how it can improve the efficiency of development projects in the Android eco-system are shown. It examined the challenges faced by Android developers and how Clean Architecture moving from its original version to a shorter version that revolves around native Android development can solve them. The main objective is to introduce the adaptation of the original Clean Architecture model to the current state of native Android development, all oriented towards an application called "InstaFlix", by creating a shorter and more coupled format. The developer will follow best practices and promote the use of presentation patterns such as Model-View-ViewModel (MVVM) or Model View Presenter (MVP), as well as encourage dependency injection. In short, it makes it easier for many developers to work simultaneously on different parts of the system. This separation also generated a noticeable improvement in the code base, as changes can be made to specific components without affecting the rest of the system; focusing on modularity and maintainability, making it clear that it is valuable for any Android developer who wants to create high quality software.</p>
Keywords	Clean Architecture · Android · Software development · Maintainability

ID	14
Title	Traducción automática de texto y audio a lengua de señas colombiana
Authors	Santiago Fernández Becerra, Fabián Andrés Olarte Vargas, Johan Mateo Rosero Quenguan, Andrés Felipe Vásquez Rendón and Andrea Rueda-Olarte
Abstract	La brecha comunicativa entre personas sordas y oyentes sigue siendo un gran problema en la actualidad, ya que la diferencia de lengua utilizada genera barreras que afectan diferentes ámbitos. Para solucionar esto, se propone un sistema de traducción de texto y audio a lengua de señas colombiana, mediante un aplicativo móvil accesible y fácil de usar, que permita dinamizar la comunicación entre ambas partes. Para este prototipo, se escogieron 76 frases o palabras que representarían las señas del sistema. Se utilizaron vídeos pregrabados de una intérprete de señas para realizar las traducciones con base en las palabras establecidas anteriormente. El servicio genera la concatenación de vídeos según la solicitud en texto o audio del cliente, haciendo uso del modelo Whisper para la transcripción del audio. De esta forma, en el marco de un trabajo de grado de pregrado, se logró desarrollar un prototipo de aplicación móvil que permite la traducción de texto y audio a lengua de señas colombiana, aportando en la reducción de la brecha comunicativa entre personas sordas y oyentes.
Keywords	Traducción automática · Lengua de señas colombiana · Transcripción de audio a texto · Intérprete de señas

ID	67
Title	Findby: An Application for Accessibility and Inclusive Exploration
Authors	Mariana Vásquez-Escobar, David Madrid-Restrepo, Salomón Vélez-Pérez, Diego Alejandro Vanegas-González and Liliana González-Palacio
Abstract	Inclusion and accessibility are essential human rights that should be upheld in all aspects of life, including access to both public and private spaces. Unfortunately, in Colombia, the rights of people with disabilities are often marginalized and neglected, with only 7 out of 100 Colombians having disabilities in 2022. Furthermore, despite 36.9% of people with disabilities in Colombia living with reduced mobility, the cities remain largely inaccessible to them. This paper introduces Findby, a web application designed for users with reduced mobility, aiming to provide information on the accessibility of places and promote inclusive exploration through challenges and a reward system. The app utilizes user-centered design and leverages technology to improve access to public and private spaces. Findby's key features include accessibility markers, user-generated content, review comments, ratings, and customized route-based challenges, making the application engaging and user-friendly. Findby has the potential to contribute significantly to improving accessibility and inclusion for individuals with reduced mobility. Future work includes expanding the user community, improving the accuracy of accessibility information, incorporating accessibility information for private spaces, integrating additional features, and expanding globally to promote inclusivity and accessibility worldwide.
Keywords	Accessibility · Reduced mobility · Web application · Inclusion · User community · Accessibility bookmarks · Personalized routes · Inclusive exploration · User-centered design · Citizen participation

Presentation of Articles - Session 3.1

Image processing and Computer Vision

Session Chair: Óscar Ruiz

Date: August 11th Time: 09:00 to 10:00 Place: Building 29 – Room 202

ID	4
Title	Fusion of optical and radar data by aggregation into a single feature space for LULC classification
Authors	Veronica Herrera Ruiz, Jheison Manuel Perez Guerra, Juan David Martinez Vargas, Juan Carlos Gonzalez Velez and Maria Constanza Torres Madroñero
Abstract	Land use and land cover classification (LULC) is a fundamental input for ecological and socioeconomic models worldwide, generating a large volume of data from space-based platforms, mainly optical technologies. However, these can be affected by atmospheric conditions. Colombia has a high percentage of cloud cover due to its geographical location, which makes it challenging to map LULC changes. Studies have emerged that evaluate the integration of optical and radar images with algorithms that allow for good results despite the information gaps that affect these processes. Therefore, this work compares three supervised machine learning approaches, Support Vector Machines, Random Forest, and XGBoost, to classify land use and land cover from multispectral and radar images, contemplating four scenarios for data fusion. Optical, optical + SAR, optical + SAR ascending, and optical + SAR descending. The result for the Random Forest model using optical + ascending SAR has the best accuracy (76.02%), followed by Random Forest with optical + descending SAR data (75.97%) and with little difference for Random Forest using optical data (75.83%). In future studies, it is of great interest to explore feature extraction on both datasets to improve LULC representation and classification.
Keywords	Land Use Land Cover · Classification · Machine Learning · Remote sensing · Multispectral images · Fusion data

ID	26
Title	Oscar Ruiz-Salguero, Carolina Builes Roldan, Juan Lalinde-Pulido and Carlos Echeverri-Cartagena
Authors	Visual programming with invariant, pre- and post-conditions for approximation of a 3D model with assorted 1.5D and 2.5D lattice families
Abstract	In the context of Visual Programming for Product Design, the endowment of the Designer with programming tools to boost productivity is central. However, Product (and Architectural) Design are usually taught without programming courses. This manuscript reports the results of Lattice Design Visual Programming by a Product Designer with no previous exposure to programming but provided with the intuitive concepts of Pre-, Post-condition and Invariant logical first-order predicates for imperative programming. The scenario of application is the population of 3D domains (i.e. solid models) with lattice individuals of the type zero-curvature Truss (colloquially called 1.5D and 2.5D) structural elements. Results show that, although Pre-, Post-condition and Invariant are devised for imperative programming, they provide a solid and successful structure for declarative programming (e.g. Grasshopper) for Designers with no mathematical or programming background. Regarding the specific Additive Manufacturing scope, the manuscript depicts the population of the target domain with lattice individuals which, in this case, undergo a rigid transformation before docked in the target domain. The lattice design presented allows for the grading of the lattice geometry. Future work addresses the programming of non-rigid transformations (non-affine, non-conformal, etc.) which dock the lattice individual into the target solid domain. Regarding the endowment of non-programmer Product Designer with visual programming and pre-, post- and invariant conditions, the performance results are very positive. However, as with any work team, experts must be recruited to help with highly specialized topics (e.g. computational mechanics, differential geometry, discrete mathematics, etc.).
Keywords	Visual programming · Predicate-based programming · Lattice families · Truss · Frame

ID	50
Title	Hacia la construcción de un modelo de análisis de emociones en estudiantes universitarios usando imágenes tomadas en aulas de clase
Authors	Jader Daniel Atehortúa Zapata, Santiago Forero Hincapié, Santiago Cano Duque and Emilcy Juliana Hernández Leal
Abstract	Data mining is used in various fields, image processing is one of them, a particular application is the identification and classification of emotions expressed by students in the classroom. However, this creates challenges, such as the subjective interpretation of facial expressions and the need for extensive data sets to train and validate the models, for the former it is required to go to other allied research fields, and for the latter, a possibility is glimpsed in the transfer of learning. This work seeks to review and compare different classifiers for the construction of a model that allows the analysis of the emotions of university students from images extracted from recordings of face-to-face classes stored in an educational support platform. For this, the KDD (Knowledge Discovery in Databases) methodology was followed, and experiments were proposed with different configurations of hyperparameters and generation of models from classifiers such as Nearby Neighbors-KNN, Convolutional Neural Networks-CNN, and Random Forest. The performance of each one is contrasted based on precision, recall, F1, Accuracy, and ROC curve. Additionally, an approximation to a learning transfer process was carried out using an open-use data set (taken from the Kaggle repository) for the classification of emotions for the training of the models and validating with the data extracted from the source of the case study. The results support the utility and potential of applying these techniques in scenarios where image-based emotion analysis is required, with CNN being the classifier with the best accuracy and obtaining significant value from knowledge transfer that motivates further deepening of the approach for the treatment of this problem.
Keywords	Classification · Data mining · Educational data · Image analysis · Transfer learning

Presentation of Articles - Session 3.2

Industrial Applications - Industry 4.0 - Precision Agriculture

Session Chair: Mario César Vélez

Date: August 11th Time: 09:00 to 10:00 Place: Building 29 – Room 203

ID	35
Title	Model for Fruit Tree Classification through Aerial Images
Authors	Valentina Escobar Gómez, Diego Gustavo Guevara Bernal and Javier Francisco López Parra
Abstract	Manual measurements and visual inspection of trees are common practices among farmers, which incur labor costs and time-consuming operations to obtain information about the state of their crops at a specific moment. Considering that an approximately 1-hectare (ha) plot of land can have up to 1100 planted trees [1], this becomes a challenging task, and human error in such cases tends to be high. To address these issues, the emphasis is placed on the use of Convolutional Neural Networks (CNNs); however, CNNs alone are not robust enough to detect complex features in any given problem. Therefore, this article proposes a model that supports agricultural activities in organizing their tasks. The main procedure of the model is the classification of fruit trees (mango, citrus, and banana) using aerial images captured by a drone (UAV) in the Colombian context. The technique employed in this procedure is known as Mask R-CNN, which enables automatic segmentation of fruit trees.
Keywords	Artificial Intelligence · Fruit trees · Aerial images · Deep learning · Classification · Agriculture · Resources · Production · Investigation · Crop · Support · Monitoring · Features

ID	47
Title	Modeling Detecting Plant Diseases in Precision Agriculture: A NDVI Analysis for Early and Accurate Diagnosis
Authors	Manuela Larrea Gomez, Juan Alejandro Peña Palacio, Juan David Martinez Vargas, Tomas Enrique Ramirez Guerrero and Ivan Ochoa
Abstract	In precision agriculture, the accurate and timely plant disease identification is crucial. However, the lack of accuracy in current detection systems hampers reducing pesticide and fertilizer usage, causing significant productivity losses. The desired level of precision has not been achieved yet, hindering timely intervention and mitigation strategies. This research presents a novel approach that integrates a Lagrangian Gaussian Puff Dispersion Model (LGPTM) for assessing plant health, with Gaussian bell curve visualization, a tool for visualizing the distribution patterns of these indices in the field of precision agriculture. This integration ameliorates disease detection and monitoring in agricultural contexts, thereby improving disease management practices and enhancing crop health and productivity. The methodology leverages widely adopted libraries to process multispectral images and calculates vegetation index values based on the Normalized Difference Vegetation Index (NDVI). Additionally, the modeling approach employed modular programming. The code structure and execution encompass two main steps: the normalization of the Near-Infrared and Red bands of the multispectral images, and the construction of a three-dimensional Gaussian bell curve to visualize the distribution of vegetation indices using the meshgrid algorithmic technique. The results reveal a significant correlation between variations in the vegetation index and the vertical distribution of the Gaussian curve. Specifically, lower NDVI values indicate a diminished presence of vegetation or plant anomalies, resulting in an increase in the kurtosis of the Gaussian curve. To assess the effectiveness of the approach, Receiver Operating Characteristic analysis was employed, providing conclusive evidence regarding the reliability and performance of the implemented Python model.
Keywords	Precision agriculture · Lagrangian Gaussian Puff Dispersion Model · Plant disease early detection · Multispectral imaging · NDVI Analysis

ID	58
Title	Hacia un Modelo Predictivo que apoye el logro de KPI más asertivos Caso: Empresa Comercializadora de Madera
Authors	Jhon Walter Tavera Rodríguez
Abstract	<p>Este artículo presenta un modelo predictivo para determinar posibles causas de los resultados comerciales en una empresa de comercialización de productos y servicios para la industria del mueble y la madera en Colombia. Para lograrlo, se realizó una revisión de literatura para identificar estrategias de análisis y nuevas tecnologías que pudieran influir en el modelo propuesto. La metodología empleada fue CRISP-DM, donde se identificaron las principales variables e indicadores que componen el modelo comercial y los problemas asociados para lograr tomar decisiones asertivas. Asimismo, se identificaron los datos necesarios provenientes de los sistemas de información que podrían conducir a una predicción precisa. Se realizó un caso de estudio con un conjunto de datos de 99.972 registros recopilados entre 2020 y 2023, lo que facilitó la aplicación de técnicas de selección de variables para identificar las más influyentes en la predicción. El modelo fue desarrollado utilizando algoritmos como árboles de decisión, bosques aleatorios y regresión logística. Una vez realizado el entrenamiento del modelo, se determinó que el algoritmo de regresión de bosque aleatorio con el método de validación Out-of-Bag y un R2 del 94,1% proporcionó los mejores resultados y entregó la mayor predicción de ventas. En la evaluación, el modelo mostró que estaba influenciado por variables como el valor promedio de factura, la cantidad de facturas, el inventario disponible y el cumplimiento de los pedidos. Estos hallazgos amplían la capacidad de toma de decisiones al definir qué variables deben ser controladas para mejorar los resultados en los indicadores. En conclusión, el modelo predictivo basado en aprendizaje automático puede identificar posibles causas de los resultados comerciales y mejorar la precisión de las decisiones a nivel estratégico en el ámbito de la comercialización de productos y servicios del mueble y la madera. No obstante, se sugiere complementarlo con otras variables para obtener un diagnóstico aún más preciso.</p>
Keywords	

Presentation of Articles - Session 3.3

Robotics in Industry 4.0

Session Chair: David Velásquez

Date: August 11th Time: 09:00 to 10:00 Place: Building 27 – Room 204

ID	19
Title	Planning Navigation Routes in Unknown Environments
Authors	Laura Andrea Rodriguez Rodriguez, Fernando de la Rosa and Nicolás Cardozo
Abstract	<p>Self-driving robots have to fulfill many different operations, as coordinating the motors' traction, camera movement, or actuator arms mechanics, as well as more high-level operations like driving to different places. Autonomous navigation is of utmost importance for exploration robots, which must drive around exploring areas with unknown terrain conditions, as for example is the case of mars rovers and other space exploration vehicles. Given that the environment is unknown, planning a specific route and driving plan is challenging or even inappropriate due to blocking obstacles in the terrain. To overcome such problems we propose an adaptable plan for driving robots in different situations. Our solutions mixes both global and dynamic planning algorithms to take advantage of available information, if it exist beforehand, and to overcome unknown obstacles if they appear, while still moving towards the goal. In particular, we apply our algorithm to the movement of robots between posts in environments with partial information, as it is the case of space mission competitions. We evaluate our solution in a simulated environment taking into account the effectiveness in fulfilling a mission in the shortest time, using the shortest possible path. Our results show that of the A* algorithm with diagonals in combination with the ABEO algorithm offer the best combination reaching the goal in most cases, in optimal (planning + execution) time.</p>
Keywords	Mobile robotics · Autonomous driving · Dynamic planning

ID	21
Title	Integration of Cyber-Physical System and Digital Twin for Controlling a Robotic Manipulator: An Industry 4.0 Approach
Authors	Oscar Loyola, Benjamín Suarez, César Sandoval and Eduardo Carrillo
Abstract	This paper considers the integration and application of a Cyber-Physical System (CPS) and a digital twin to control a three-degree-of-freedom (3DoF) robotic manipulator. Here, framed in Industry 4.0, we consider robots as interconnected components within a broader network. Supported by current literature, we contribute to advancing interlinked systems that mirror the physical dynamics of equipment and facilitate their remote visualization—a cornerstone in the architecture of Internet of Things (IoT) robotics. Our strategy is rooted in three core stages: modeling, simulation, and implementation, and aims to seamlessly integrate the constituent elements of a robotic agent within an Internet of Robotic Things (IoRT) environment. At this nascent stage, the system has undergone testing at the prototype level, with ambitions to scale it for deployment in industrial settings. Preliminary results demonstrate the efficacy of the system in simulating and controlling the robotic manipulator, highlighting the potential of this integrated approach in practical applications. Our findings are pivotal to these concepts' evolution and roll-out, bolstering understanding of the nexus between CPS, digital twins, and robotics within Industry 4.0.
Keywords	Cyber-Physical Systems, Industry 4.0, Robots, Robot Internet of Things

Presentation of Articles - Session 4.1

Image processing and Computer Vision

Session Chair: Edison Valencia

Date: August 11th Time: 13:30 to 14:30 Place: Building 27 – Room 204

ID	70
Title	Tracing the visual path: Gaze direction in the 360 video experience
Authors	Valentina Rozo Bernal and Pablo Figueroa Forero
Abstract	In traditional storytelling, a kind of predefined structure typically guides the narrative. However, when we move beyond the constraints of a rectangular screen, new possibilities emerge. 360-degree videos offer a unique opportunity to narrate with every element visible to the user in each frame. Nevertheless, some questions arise: What exactly are the end users seeing? Where is their attention directed? This paper deepens into an analysis of the data captured from the position and rotation of the headset worn by viewers while watching 360-degree videos. To accomplish this, two videos created by university students were examined, where gaze information was captured by testing it with a group of participants. Alongside viewing the videos, participants provide their feedback on what elements they focused during the video. The findings revealed that participants tended to focus on elements intended to draw their attention. Furthermore, when the camera was stationary, participants found it easier to explore their surroundings, highlighting the value of utilizing the 360-degree format.
Keywords	360 Videos · Narratives · Gaze Detection · Visual Attention · Focus · Context

ID	18
Title	Movement in video classification using structured data: Workout videos application
Authors	Jonathan Múnera
Abstract	Nowadays, several video movement classification methodologies are based on reading and processing each frame using image classification algorithms. However, it is rare to find approaches using angle distribution over time. This paper proposes video movement classification based on the exercise states calculated from each frame's angles. Different video classification approaches and their respective variables and models were analyzed to achieve this, using unstructured data: images. Besides, structure data as angles from critical joints Armpits, legs, elbows, hips, and torso inclination were calculated directly from workout videos, allowing the implementation of classification models such as the KNN and Decision Trees. The result shows these techniques can achieve similar accuracy, close to 95%, concerning Neural Networks algorithms, the primary model used in the previously mentioned approaches. Finally, it was possible to conclude that using structured data for movement classification models allows for lower performance costs and computing resources than using unstructured data without compromising the quality of the model.
Keywords	Machine Learning · Computer Vision · KNN · Mediapipe · Supervised classification · Video classification · Deep learning · Tensorflow · Neural network · Workout · Fitness · Exercise · Signal

Presentation of Articles - Session 4.2

Artificial Intelligence

Session Chair: Juan David Martinez

Date: August 11th Time: 13:30 to 14:30 Place: Building 27 – Room 202

ID	64
Title	Discovering Key Aspects to Reduce Employee Turnover using a Predictive Model
Authors	Paula Cardenas-Lopez and Marta S. Tabares
Abstract	<p>High employee turnover is a phenomenon that occurs in different types of companies and often leads to losses that could affect the organization's productive continuity. This situation leads to the understanding, with solid evidence, of the factors that influence employees to leave their jobs and, thus, develop talent retention strategies proactively. This article proposes a predictive model to identify the most relevant factors that could cause employee turnover, specifically in the logistics process of a food and beverage production company. To achieve the objective, the CRISP-DM methodology was applied. Initially, various types of variables were identified, such as demographic, contractual, and payroll-related factors (N=1517, period: 2017-2022). Then, five machine learning models, namely Logistic Regression, Random Forest, XGBoost, SVM, and AdaBoost, were trained, and optimal hyperparameters were used to improve the models' performance and generalization. The performance evaluation of these models was conducted using classification metrics and the construction of confidence intervals for the accuracy metric through non-parametric Bootstrap. The results obtained demonstrate that the XGBoost and Random Forest models show the highest AUC value, with a result of 99%. This indicates that variables such as work environment, years of service, salary, workplace location, and monthly salary deductions are the most significant factors influencing the evaluated human talent to leave their job. Therefore, it is possible to conclude that the aforementioned two models are accurate and reliable for predicting employee turnover in the logistics process of the analyzed company.</p>
Keywords	Employee turnover · Machine Learning · ROC curve · Non-parametric Bootstrap · Survival analysis

ID	65
Title	Transfer Learning aplicado al análisis de Registros Médicos Electrónicos para el pronóstico de la Apnea del Sueño
Authors	Diego Alejandro Montoya Tovar, Yohann Montaña Reyes and Jehico Bladimir Bolivar Battle
Abstract	La polisomnografía también llamada estudio del sueño, es una prueba integral utilizada para diagnosticar trastornos del sueño y actualmente es el único examen que permite realizarlo con total certeza. Lograr pronosticar el trastorno a través de técnicas de machine learning y en especial las cubiertas por el transfer learning permitirán a los profesionales de la salud una alternativa para su detección temprana y apoyarlos en su diagnóstico antes del examen médico. En este estudio, se propone el uso de técnicas de transfer learning basadas en modelos de arquitecturas Transformers para el análisis de registros médicos electrónicos en español, con el fin de generar un pronóstico para la presencia de apnea del sueño en pacientes de la clínica San Ignacio, Bogotá.
Keywords	Transfer Learning · Deep Learning · BERT · Registros médicos electrónicos Apnea del sueño · Procesamiento de lenguaje natural

Presentation of Articles - Session 4.3

Scientific Applications

Session Chair: Nicolás Moreno

Date: August 11th Time: 13:30 to 14:30 Place: Building 38 – Room 204

ID	55
Title	Comparing Three Agent-Based Models Implementations of Vector-Borne Disease Transmission Dynamics
Authors	Luisa F. Londoño, Paula Escudero, Maria Sofia Uribe, Susana Alvarez, Mariajose Franco and Rafael Mateus
Abstract	<p>Aedes aegypti, the vector responsible for transmitting diseases such as dengue, zika, and chikungunya, poses a significant public health threat in many regions. Understanding the dynamics of Aedes aegypti propagation is crucial for designing effective control and prevention strategies.</p> <p>Agent-Based Models (ABMs) have emerged as valuable tools for studying complex systems like vector-borne disease dynamics. Hybrid Agent-Based Models (HABMs), a variation of these models that incorporates Ordinary Differential Equations to model mosquitoes and ABMs to model humans, have been proposed by several authors.</p> <p>This study presents a comparative analysis of three HABMs to model Aedes aegypti propagation dynamics, with a focus on the impact of different modeling frameworks. The first model was built using Repast Simphony, a widely used ABM framework. It incorporates key factors such as mosquito life cycle, environmental conditions, and human-mosquito interactions. To enhance computational performance, the second model is migrated to a high-performance environment using Repast HPC. This migration leverages parallel computing capabilities to simulate larger populations. The third model is migrated to Mesa-Geo, a Python library specifically designed for geospatial agent-based modeling. This migration facilitates the integration of geospatial data into the model.</p> <p>Preliminary results show that migrating the model to a high performance environment enables more comprehensive analyses and reduces simulation runtime. Moreover, migrating to Mesa-Geo provides enhanced geospatial capabilities, and allows us to analyze the results in a graphical interface, which facilitates communication with decision makers.</p> <p>The main contributions of this research are: 1) insights into the trade-offs and benefits of using Repast Simphony, Repast HPC, and Mesa-Geo for modeling the transmission of viruses, and 2) a guide to researchers and stakeholders in selecting the most suitable modeling framework based on their specific requirements and available computational resources.</p>
Keywords	Repast Simphony · Repast HPC · Mesa-Geo · HABMs · ABMs · Vector-Borne Diseases

ID	61
Title	BDI Peasants Model for the WellProdSim Agent-based Social Simulator
Authors	Jairo Enrique Serrano and Enrique González
Abstract	This article describes the design and implementation of BDI agents for the WellProdSim Social Simulator, a system that assesses the productivity and social wellbeing of Peasant Families. A first BDI emotional reasoning model was designed to incorporate personal and social wellbeing components in the agent that represents a Peasant Family. Furthermore, decision-making mechanisms based on variable modulation and fuzzy logic evaluation of human welfare were added. The evaluation aspects include health state, knowledge and skills, food consumption, emotional state and expected productivity. Preliminary results demonstrate a high quality in the proposed model; although, some elements with potential for improvement, in future work, were also identified.
Keywords	Social Simulation · Multi-agent systems · Emotional BDI · Multi-agent simulation · BDI agent · Fuzzy Logic

ID	5
Title	Sistema de reporte de fallas en las salas de cómputo de una Institución de Educación Superior
Authors	Johan Manuel Alvarez Pinta, Mateo Jesús Cadena Cabrera, Juan Diego Eraso Muñoz, Miguel Angel Llanten Llanten, Brayan Fabian Meza Pantoja, Nicolás Rodríguez Trujillo, Juan Manuel Quijano Quijano and Marta Cecilia Camacho Ojeda
Abstract	Para una institución de educación superior, las salas de cómputo desempeñan un papel esencial al ser espacios obligatorios para la realización de clases, laboratorios y prácticas relacionadas con los diversos programas académicos. Usualmente las salas son compartidas por los diferentes programas de una institución y su uso es constante y demandante, por lo cual es importante que los equipos se encuentren en perfecto estado para poder garantizar que los estudiantes podrán utilizarlos sin ningún inconveniente. No obstante, los equipos pueden experimentar fallos debido a un uso excesivo o incorrecto. Por esta razón, es necesario que estas fallas se detecten y sean comunicadas rápidamente para poder ser atendidas por las personas encargadas del mantenimiento de los equipos. El sistema será evaluado desde el enfoque de la experiencia de usuario, con la participación de estudiantes, docentes y el equipo de TIC de la Institución Universitaria Colegio Mayor del Cauca.
Keywords	Desarrollo Web · Reporte de Fallas · Experiencia de Usuario · Salas de Computo