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Fast Abstracts and Student Forum Proceedings -- EDCC 2024 -- 19th European Dependable Computing Conference

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The goal of the Fast Abstracts track is to bring together researchers and practitioners working on dependable computing to discuss work in progress or opinion pieces. Contributions are welcome from academia and industry. Fast Abstracts aim to serve as a rapid and flexible mechanism to: (i) Report on current work that may or may not be complete; (ii) Introduce new ideas to the community; (iii) State positions on controversial issues or open problems; (iv) Share lessons learnt from real-word dependability engineering; and (v) Debunk or question results from other papers based on contra-indications. The Student Forum aims at creating a vibrant and friendly environment where students can present and discuss their work, and exchange ideas and experiences with other students, researchers and industry. One of the key goals of the Forum is to provide students with feedback on their preliminary results that might help with their future research directions.

link: http://arxiv.org/abs/2404.17465v1

MIMO in network simulators: Design, implementation and evaluation of single-user MIMO in ns-3 5G-LENA

Biljana Bojovic, Sandra Lagen

MIMO technology has been studied in textbooks for several decades, and it has been adopted in 4G and 5G systems. Due to the recent evolution in 5G and beyond networks, designed to cover a wide range of use cases with every time more complex applications, it is essential to have network simulation tools (such as ns-3) to evaluate MIMO performance from the network perspective, before real implementation. Up to date, the well-known ns-3 simulator has been missing the inclusion of single-user MIMO (SU-MIMO) models for 5G. In this paper, we detail the implementation models and provide an exhaustive evaluation of SU-MIMO in the 5G-LENA module of ns-3. As per 3GPP 5G, we adopt a hybrid beamforming architecture and a closed-loop MIMO mechanism and follow all 3GPP specifications for MIMO implementation, including channel state information feedback with precoding matrix indicator and rank indicator reports, and codebook-based precoding following Precoding Type-I (used for SU-MIMO). The simulation models are released in open-source and currently support up to 32 antenna ports and 4 streams per user. The simulation results presented in this paper help in testing and verifying the simulated models, for different multi-antenna array and antenna ports configurations.

link: http://arxiv.org/abs/2404.17472v1

CEval: A Benchmark for Evaluating Counterfactual Text Generation

Van Bach Nguyen, Jörg Schlötterer, Christin Seifert

Counterfactual text generation aims to minimally change a text, such that it is classified differently. Judging advancements in method development for counterfactual text generation is hindered by a non-uniform usage of data sets and metrics in related work. We propose CEval, a benchmark for comparing counterfactual text generation methods. CEval unifies counterfactual and text quality metrics, includes common counterfactual datasets with human annotations, standard baselines (MICE, GDBA, CREST) and the open-source language model LLAMA-2. Our experiments found no perfect method for generating counterfactual text. Methods that excel at counterfactual metrics often produce lower-quality text while LLMs with simple prompts generate high-quality text but struggle with counterfactual criteria. By making CEval available as an open-source Python library, we encourage the community to contribute more methods and maintain consistent evaluation in future work.

link: http://arxiv.org/abs/2404.17475v1

A multi-agent model of hierarchical decision dynamics

Paul Kinsler

Decision making can be difficult when there are many actors (or agents) who may be coordinating or competing to achieve their various ideas of the optimum outcome. Here I present a simple decision making model with an explicitly hierarchical binary-tree structure, and evaluate how this might cooperate to take actions that match its various evaluations of the uncertain state of the world. Key features of agent behaviour are (a) the separation of its decision making process into three distinct steps: observation, judgement, and action; and (b) the evolution of coordination by the sharing of judgements.

link: http://arxiv.org/abs/2404.17477v1

ReproHum #0087-01: Human Evaluation Reproduction Report for Generating Fact Checking Explanations

Tyler Loakman, Chenghua Lin

This paper presents a partial reproduction of Generating Fact Checking Explanations by Anatanasova et al (2020) as part of the ReproHum element of the ReproNLP shared task to reproduce the findings of NLP research regarding human evaluation. This shared task aims to investigate the extent to which NLP as a field is becoming more or less reproducible over time. Following the instructions provided by the task organisers and the original authors, we collect relative rankings of 3 fact-checking explanations (comprising a gold standard and the outputs of 2 models) for 40 inputs on the criteria of Coverage. The results of our reproduction and reanalysis of the original work's raw results lend support to the original findings, with similar patterns seen between the original work and our reproduction. Whilst we observe slight variation from the original results, our findings support the main conclusions drawn by the original authors pertaining to the efficacy of their proposed models.

link: http://arxiv.org/abs/2404.17481v1

Differentiable Pareto-Smoothed Weighting for High-Dimensional Heterogeneous Treatment Effect Estimation

Yoichi Chikahara, Kansei Ushiyama

There is a growing interest in estimating heterogeneous treatment effects across individuals using their high-dimensional feature attributes. Achieving high performance in such high-dimensional heterogeneous treatment effect estimation is challenging because in this setup, it is usual that some features induce sample selection bias while others do not but are predictive of potential outcomes. To avoid losing such predictive feature information, existing methods learn separate feature representations using the inverse of probability weighting (IPW). However, due to the numerically unstable IPW weights, they suffer from estimation bias under a finite sample setup. To develop a numerically robust estimator via weighted representation learning, we propose a differentiable Pareto-smoothed weighting framework that replaces extreme weight values in an end-to-end fashion. Experimental results show that by effectively correcting the weight values, our method outperforms the existing ones, including traditional weighting schemes.

link: http://arxiv.org/abs/2404.17483v1

Sparse Reconstruction of Optical Doppler Tomography Based on State Space Model

Zhenghong Li, Jiaxiang Ren, Wensheng Cheng, Congwu Du, Yingtian Pan, Haibin Ling

Optical Doppler Tomography (ODT) is a blood flow imaging technique popularly used in bioengineering applications. The fundamental unit of ODT is the 1D frequency response along the A-line (depth), named raw A-scan. A 2D ODT image (B-scan) is obtained by first sensing raw A-scans along the B-line (width), and then constructing the B-scan from these raw A-scans via magnitude-phase analysis and post-processing. To obtain a high-resolution B-scan with a precise flow map, densely sampled A-scans are required in current methods, causing both computational

and storage burdens. To address this issue, in this paper we propose a novel sparse reconstruction framework with four main sequential steps: 1) early magnitude-phase fusion that encourages rich interaction of the complementary information in magnitude and phase, 2) State Space Model (SSM)-based representation learning, inspired by recent successes in Mamba and VMamba, to naturally capture both the intra-A-scan sequential information and between-A-scan interactions, 3) an Inception-based Feedforward Network module (IncFFN) to further boost the SSM-module, and 4) a B-line Pixel Shuffle (BPS) layer to effectively reconstruct the final results. In the experiments on real-world animal data, our method shows clear effectiveness in reconstruction accuracy. As the first application of SSM for image reconstruction tasks, we expect our work to inspire related explorations in not only efficient ODT imaging techniques but also generic image enhancement.

link: http://arxiv.org/abs/2404.17484v1

A Survey on Industrial Internet of Things (IIoT) Testbeds for Connectivity Research

Tianyu Zhang, Chuanyu Xue, Jiachen Wang, Zelin Yun, Natong Lin, Song Han

Industrial Internet of Things (IIoT) technologies have revolutionized industrial processes, enabling smart automation, real-time data analytics, and improved operational efficiency across diverse industry sectors. IIoT testbeds play a critical role in advancing IIoT research and development (R&D;) to provide controlled environments for technology evaluation before their real-world deployment. In this article, we conduct a comprehensive literature review on existing IIoT testbeds, aiming to identify benchmark performance, research gaps and explore emerging trends in IIoT systems. We first review the state-of-the-art resource management solutions proposed for IIoT applications. We then categorize the reviewed testbeds according to their deployed communication protocols (including TSN, IEEE 802.15.4, IEEE 802.11 and 5G) and discuss the design and usage of each testbed. Driven by the knowledge gained during this study, we present suggestions and good practices for researchers and practitioners who are planning to design and develop IIoT testbeds for connectivity research.

link: http://arxiv.org/abs/2404.17485v1

TextGaze: Gaze-Controllable Face Generation with Natural Language

Hengfei Wang, Zhongqun Zhang, Yihua Cheng, Hyung Jin Chang

Generating face image with specific gaze information has attracted considerable attention. Existing approaches typically input gaze values directly for face generation, which is unnatural and requires annotated gaze datasets for training, thereby limiting its application. In this paper, we present a novel gaze-controllable face generation task. Our approach inputs textual descriptions that describe human gaze and head behavior and generates corresponding face images. Our work first introduces a text-of-gaze dataset containing over 90k text descriptions spanning a dense distribution of gaze and head poses. We further propose a gaze-controllable text-to-face method. Our method contains a sketch-conditioned face diffusion module and a model-based sketch diffusion module. We define a face sketch based on facial landmarks and eye segmentation map. The face diffusion module generates face images from the face sketch, and the sketch diffusion module employs a 3D face model to generate face sketch from text description. Experiments on the FFHQ dataset show the effectiveness of our method. We will release our dataset and code for future research.

link: http://arxiv.org/abs/2404.17486v1

Conformal Prediction with Learned Features

Shayan Kiyani, George Pappas, Hamed Hassani

In this paper, we focus on the problem of conformal prediction with conditional guarantees. Prior work has shown that it is impossible to construct nontrivial prediction sets with full conditional coverage guarantees. A wealth of research has considered relaxations of full conditional guarantees, relying on some predefined uncertainty structures. Departing from this line of thinking, we propose Partition Learning Conformal Prediction (PLCP), a framework to improve conditional validity of prediction sets through learning uncertainty-guided features from the calibration data. We

implement PLCP efficiently with alternating gradient descent, utilizing off-the-shelf machine learning models. We further analyze PLCP theoretically and provide conditional guarantees for infinite and finite sample sizes. Finally, our experimental results over four real-world and synthetic datasets show the superior performance of PLCP compared to state-of-the-art methods in terms of coverage and length in both classification and regression scenarios.

link: http://arxiv.org/abs/2404.17487v1

Low Cost Machine Vision for Insect Classification

Danja Brandt, Martin Tschaikner, Teodor Chiaburu, Henning Schmidt, Ilona Schrimpf, Alexandra Stadel, Ingeborg E. Beckers, Frank Haußer

Preserving the number and diversity of insects is one of our society's most important goals in the area of environmental sustainability. A prerequisite for this is a systematic and up-scaled monitoring in order to detect correlations and identify countermeasures. Therefore, automatized monitoring using live traps is important, but so far there is no system that provides image data of sufficient detailed information for entomological classification. In this work, we present an imaging method as part of a multisensor system developed as a low-cost, scalable, open-source system that is adaptable to classical trap types. The image quality meets the requirements needed for classification in the taxonomic tree. Therefore, illumination and resolution have been optimized and motion artefacts have been suppressed. The system is evaluated exemplarily on a dataset consisting of 16 insect species of the same as well as different genus, family and order. We demonstrate that standard CNN-architectures like ResNet50 (pretrained on iNaturalist data) or MobileNet perform very well for the prediction task after re-training. Smaller custom made CNNs also lead to promising results. Classification accuracy of $>96\%$ has been achieved. Moreover, it was proved that image cropping of insects is necessary for classification of species with high inter-class similarity.

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Tabular Data Contrastive Learning via Class-Conditioned and Feature-Correlation Based Augmentation

Wei Cui, Rasa Hosseinzadeh, Junwei Ma, Tongzi Wu, Yi Sui, Keyvan Golestan

Contrastive learning is a model pre-training technique by first creating similar views of the original data, and then encouraging the data and its corresponding views to be close in the embedding space. Contrastive learning has witnessed success in image and natural language data, thanks to the domain-specific augmentation techniques that are both intuitive and effective. Nonetheless, in tabular domain, the predominant augmentation technique for creating views is through corrupting tabular entries via swapping values, which is not as sound or effective. We propose a simple yet powerful improvement to this augmentation technique: corrupting tabular data conditioned on class identity. Specifically, when corrupting a specific tabular entry from an anchor row, instead of randomly sampling a value in the same feature column from the entire table uniformly, we only sample from rows that are identified to be within the same class as the anchor row. We assume the semi-supervised learning setting, and adopt the pseudo labeling technique for obtaining class identities over all table rows. We also explore the novel idea of selecting features to be corrupted based on feature correlation structures. Extensive experiments show that the proposed approach consistently outperforms the conventional corruption method for tabular data classification tasks. Our code is available at https://github.com/willtop/Tabular-Class-Conditioned-SSL.

link: http://arxiv.org/abs/2404.17489v1

Causally Abstracted Multi-armed Bandits

Fabio Massimo Zennaro, Nicholas Bishop, Joel Dyer, Yorgos Felekis, Anisoara Calinescu, Michael Wooldridge, Theodoros Damoulas

Multi-armed bandits (MAB) and causal MABs (CMAB) are established frameworks for decision-making problems. The majority of prior work typically studies and solves individual MAB and CMAB in isolation for a given problem and associated data. However, decision-makers are

often faced with multiple related problems and multi-scale observations where joint formulations are needed in order to efficiently exploit the problem structures and data dependencies. Transfer learning for CMABs addresses the situation where models are defined on identical variables, although causal connections may differ. In this work, we extend transfer learning to setups involving CMABs defined on potentially different variables, with varying degrees of granularity, and related via an abstraction map. Formally, we introduce the problem of causally abstracted MABs (CAMABs) by relying on the theory of causal abstraction in order to express a rigorous abstraction map. We propose algorithms to learn in a CAMAB, and study their regret. We illustrate the limitations and the strengths of our algorithms on a real-world scenario related to online advertising.

link: http://arxiv.org/abs/2404.17493v1

Learning text-to-video retrieval from image captioning

Lucas Ventura, Cordelia Schmid, Gül Varol

We describe a protocol to study text-to-video retrieval training with unlabeled videos, where we assume (i) no access to labels for any videos, i.e., no access to the set of ground-truth captions, but (ii) access to labeled images in the form of text. Using image expert models is a realistic scenario given that annotating images is cheaper therefore scalable, in contrast to expensive video labeling schemes. Recently, zero-shot image experts such as CLIP have established a new strong baseline for video understanding tasks. In this paper, we make use of this progress and instantiate the image experts from two types of models: a text-to-image retrieval model to provide an initial backbone, and image captioning models to provide supervision signal into unlabeled videos. We show that automatically labeling video frames with image captioning allows text-to-video retrieval training. This process adapts the features to the target domain at no manual annotation cost, consequently outperforming the strong zero-shot CLIP baseline. During training, we sample captions from multiple video frames that best match the visual content, and perform a temporal pooling over frame representations by scoring frames according to their relevance to each caption. We conduct extensive ablations to provide insights and demonstrate the effectiveness of this simple framework by outperforming the CLIP zero-shot baselines on text-to-video retrieval on three standard datasets, namely ActivityNet, MSR-VTT, and MSVD.

link: http://arxiv.org/abs/2404.17498v1

HYPE: Hyperbolic Entailment Filtering for Underspecified Images and Texts

Wonjae Kim, Sanghyuk Chun, Taekyung Kim, Dongyoon Han, Sangdoo Yun

In an era where the volume of data drives the effectiveness of self-supervised learning, the specificity and clarity of data semantics play a crucial role in model training. Addressing this, we introduce HYPerbolic Entailment filtering (HYPE), a novel methodology designed to meticulously extract modality-wise meaningful and well-aligned data from extensive, noisy image-text pair datasets. Our approach leverages hyperbolic embeddings and the concept of entailment cones to evaluate and filter out samples with meaningless or underspecified semantics, focusing on enhancing the specificity of each data sample. HYPE not only demonstrates a significant improvement in filtering efficiency but also sets a new state-of-the-art in the DataComp benchmark when combined with existing filtering techniques. This breakthrough showcases the potential of HYPE to refine the data selection process, thereby contributing to the development of more accurate and efficient self-supervised learning models. Additionally, the image specificity ϵ_{i} can be independently applied to induce an image-only dataset from an image-text or image-only data pool for training image-only self-supervised models and showed superior performance when compared to the dataset induced by CLIP score.

link: http://arxiv.org/abs/2404.17507v1