# Conformal PID Control for Time Series Prediction

Authors: Anastasios N. Angelopoulos, Emmanuel J. Candes, Ryan J. Tibshirani

Summary:  
We study the problem of uncertainty quantification for time series  
prediction, with the goal of providing easy-to-use algorithms with formal  
guarantees. The algorithms we present build upon ideas from conformal  
prediction and control theory, are able to prospectively model conformal scores  
in an online setting, and adapt to the presence of systematic errors due to  
seasonality, trends, and general distribution shifts. Our theory both  
simplifies and strengthens existing analyses in online conformal prediction.  
Experiments on 4-week-ahead forecasting of statewide COVID-19 death counts in  
the U.S. show an improvement in coverage over the ensemble forecaster used in  
official CDC communications. We also run experiments on predicting electricity  
demand, market returns, and temperature using autoregressive, Theta, Prophet,  
and Transformer models. We provide an extendable codebase for testing our  
methods and for the integration of new algorithms, data sets, and forecasting  
rules.

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# Foundational Models for Fault Diagnosis of Electrical Motors

Authors: Sriram Anbalagan, Deepesh Agarwal, Balasubramaniam Natarajan, Babji Srinivasan

Summary:  
A majority of recent advancements related to the fault diagnosis of  
electrical motors are based on the assumption that training and testing data  
are drawn from the same distribution. However, the data distribution can vary  
across different operating conditions during real-world operating scenarios of  
electrical motors. Consequently, this assumption limits the practical  
implementation of existing studies for fault diagnosis, as they rely on fully  
labelled training data spanning all operating conditions and assume a  
consistent distribution. This is because obtaining a large number of labelled  
samples for several machines across different fault cases and operating  
scenarios may be unfeasible. In order to overcome the aforementioned  
limitations, this work proposes a framework to develop a foundational model for  
fault diagnosis of electrical motors. It involves building a neural  
network-based backbone to learn high-level features using self-supervised  
learning, and then fine-tuning the backbone to achieve specific objectives. The  
primary advantage of such an approach is that the backbone can be fine-tuned to  
achieve a wide variety of target tasks using very less amount of training data  
as compared to traditional supervised learning methodologies. The empirical  
evaluation demonstrates the effectiveness of the proposed approach by obtaining  
more than 90\% classification accuracy by fine-tuning the backbone not only  
across different types of fault scenarios or operating conditions, but also  
across different machines. This illustrates the promising potential of the  
proposed approach for cross-machine fault diagnosis tasks in real-world  
applications.

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# Discovering Adaptable Symbolic Algorithms from Scratch

Authors: Stephen Kelly, Daniel S. Park, Xingyou Song, Mitchell McIntire, Pranav Nashikkar, Ritam Guha, Wolfgang Banzhaf, Kalyanmoy Deb, Vishnu Naresh Boddeti, Jie Tan, Esteban Real

Summary:  
Autonomous robots deployed in the real world will need control policies that  
rapidly adapt to environmental changes. To this end, we propose  
AutoRobotics-Zero (ARZ), a method based on AutoML-Zero that discovers zero-shot  
adaptable policies from scratch. In contrast to neural network adaption  
policies, where only model parameters are optimized, ARZ can build control  
algorithms with the full expressive power of a linear register machine. We  
evolve modular policies that tune their model parameters and alter their  
inference algorithm on-the-fly to adapt to sudden environmental changes. We  
demonstrate our method on a realistic simulated quadruped robot, for which we  
evolve safe control policies that avoid falling when individual limbs suddenly  
break. This is a challenging task in which two popular neural network baselines  
fail. Finally, we conduct a detailed analysis of our method on a novel and  
challenging non-stationary control task dubbed Cataclysmic Cartpole. Results  
confirm our findings that ARZ is significantly more robust to sudden  
environmental changes and can build simple, interpretable control policies.

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# Virtual Prompt Injection for Instruction-Tuned Large Language Models

Authors: Jun Yan, Vikas Yadav, Shiyang Li, Lichang Chen, Zheng Tang, Hai Wang, Vijay Srinivasan, Xiang Ren, Hongxia Jin

Summary:  
We present Virtual Prompt Injection (VPI) for instruction-tuned Large  
Language Models (LLMs). VPI allows an attacker-specified virtual prompt to  
steer the model behavior under specific trigger scenario without any explicit  
injection in model input. For instance, if an LLM is compromised with the  
virtual prompt "Describe Joe Biden negatively." for Joe Biden-related  
instructions, then any service deploying this model will propagate biased views  
when handling user queries related to Joe Biden. VPI is especially harmful for  
two primary reasons. Firstly, the attacker can take fine-grained control over  
LLM behaviors by defining various virtual prompts, exploiting LLMs' proficiency  
in following instructions. Secondly, this control is achieved without any  
interaction from the attacker while the model is in service, leading to  
persistent attack. To demonstrate the threat, we propose a simple method for  
performing VPI by poisoning the model's instruction tuning data. We find that  
our proposed method is highly effective in steering the LLM with VPI. For  
example, by injecting only 52 poisoned examples (0.1% of the training data  
size) into the instruction tuning data, the percentage of negative responses  
given by the trained model on Joe Biden-related queries change from 0% to 40%.  
We thus highlight the necessity of ensuring the integrity of the  
instruction-tuning data as little poisoned data can cause stealthy and  
persistent harm to the deployed model. We further explore the possible defenses  
and identify data filtering as an effective way to defend against the poisoning  
attacks. Our project page is available at https://poison-llm.github.io.

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# MetaCAM: Ensemble-Based Class Activation Map

Authors: Emily Kaczmarek, Olivier X. Miguel, Alexa C. Bowie, Robin Ducharme, Alysha L. J. Dingwall-Harvey, Steven Hawken, Christine M. Armour, Mark C. Walker, Kevin Dick

Summary:  
The need for clear, trustworthy explanations of deep learning model  
predictions is essential for high-criticality fields, such as medicine and  
biometric identification. Class Activation Maps (CAMs) are an increasingly  
popular category of visual explanation methods for Convolutional Neural  
Networks (CNNs). However, the performance of individual CAMs depends largely on  
experimental parameters such as the selected image, target class, and model.  
Here, we propose MetaCAM, an ensemble-based method for combining multiple  
existing CAM methods based on the consensus of the top-k% most highly activated  
pixels across component CAMs. We perform experiments to quantifiably determine  
the optimal combination of 11 CAMs for a given MetaCAM experiment. A new method  
denoted Cumulative Residual Effect (CRE) is proposed to summarize large-scale  
ensemble-based experiments. We also present adaptive thresholding and  
demonstrate how it can be applied to individual CAMs to improve their  
performance, measured using pixel perturbation method Remove and Debias (ROAD).  
Lastly, we show that MetaCAM outperforms existing CAMs and refines the most  
salient regions of images used for model predictions. In a specific example,  
MetaCAM improved ROAD performance to 0.393 compared to 11 individual CAMs with  
ranges from -0.101-0.172, demonstrating the importance of combining CAMs  
through an ensembling method and adaptive thresholding.

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# Towards Trustworthy and Aligned Machine Learning: A Data-centric Survey with Causality Perspectives

Authors: Haoyang Liu, Maheep Chaudhary, Haohan Wang

Summary:  
The trustworthiness of machine learning has emerged as a critical topic in  
the field, encompassing various applications and research areas such as  
robustness, security, interpretability, and fairness. The last decade saw the  
development of numerous methods addressing these challenges. In this survey, we  
systematically review these advancements from a data-centric perspective,  
highlighting the shortcomings of traditional empirical risk minimization (ERM)  
training in handling challenges posed by the data.  
 Interestingly, we observe a convergence of these methods, despite being  
developed independently across trustworthy machine learning subfields. Pearl's  
hierarchy of causality offers a unifying framework for these techniques.  
Accordingly, this survey presents the background of trustworthy machine  
learning development using a unified set of concepts, connects this language to  
Pearl's causal hierarchy, and finally discusses methods explicitly inspired by  
causality literature. We provide a unified language with mathematical  
vocabulary to link these methods across robustness, adversarial robustness,  
interpretability, and fairness, fostering a more cohesive understanding of the  
field.  
 Further, we explore the trustworthiness of large pretrained models. After  
summarizing dominant techniques like fine-tuning, parameter-efficient  
fine-tuning, prompting, and reinforcement learning with human feedback, we draw  
connections between them and the standard ERM. This connection allows us to  
build upon the principled understanding of trustworthy methods, extending it to  
these new techniques in large pretrained models, paving the way for future  
methods. Existing methods under this perspective are also reviewed.  
 Lastly, we offer a brief summary of the applications of these methods and  
discuss potential future aspects related to our survey. For more information,  
please visit http://trustai.one.

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# A Trajectory K-Anonymity Model Based on Point Density and Partition

Authors: Wanshu Yu, Haonan Shi, Hongyun Xu

Summary:  
As people's daily life becomes increasingly inseparable from various mobile  
electronic devices, relevant service application platforms and network  
operators can collect numerous individual information easily. When releasing  
these data for scientific research or commercial purposes, users' privacy will  
be in danger, especially in the publication of spatiotemporal trajectory  
datasets. Therefore, to avoid the leakage of users' privacy, it is necessary to  
anonymize the data before they are released. However, more than simply removing  
the unique identifiers of individuals is needed to protect the trajectory  
privacy, because some attackers may infer the identity of users by the  
connection with other databases. Much work has been devoted to merging multiple  
trajectories to avoid re-identification, but these solutions always require  
sacrificing data quality to achieve the anonymity requirement. In order to  
provide sufficient privacy protection for users' trajectory datasets, this  
paper develops a study on trajectory privacy against re-identification attacks,  
proposing a trajectory K-anonymity model based on Point Density and Partition  
(KPDP). Our approach improves the existing trajectory generalization  
anonymization techniques regarding trajectory set partition preprocessing and  
trajectory clustering algorithms. It successfully resists re-identification  
attacks and reduces the data utility loss of the k-anonymized dataset. A series  
of experiments on a real-world dataset show that the proposed model has  
significant advantages in terms of higher data utility and shorter algorithm  
execution time than other existing techniques.

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# Latent Masking for Multimodal Self-supervised Learning in Health Timeseries

Authors: Shohreh Deldari, Dimitris Spathis, Mohammad Malekzadeh, Fahim Kawsar, Flora Salim, Akhil Mathur

Summary:  
Limited availability of labeled data for machine learning on biomedical  
time-series hampers progress in the field. Self-supervised learning (SSL) is a  
promising approach to learning data representations without labels. However,  
current SSL methods require expensive computations for negative pairs and are  
designed for single modalities, limiting their versatility. To overcome these  
limitations, we introduce CroSSL (Cross-modal SSL). CroSSL introduces two novel  
concepts: masking intermediate embeddings from modality-specific encoders and  
aggregating them into a global embedding using a cross-modal aggregator. This  
enables the handling of missing modalities and end-to-end learning of  
cross-modal patterns without prior data preprocessing or time-consuming  
negative-pair sampling. We evaluate CroSSL on various multimodal time-series  
benchmarks, including both medical-grade and consumer biosignals. Our results  
demonstrate superior performance compared to previous SSL techniques and  
supervised benchmarks with minimal labeled data. We additionally analyze the  
impact of different masking ratios and strategies and assess the robustness of  
the learned representations to missing modalities. Overall, our work achieves  
state-of-the-art performance while highlighting the benefits of masking latent  
embeddings for cross-modal learning in temporal health data.

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# Identification of Driving Heterogeneity using Action-chains

Authors: Xue Yao, Simeon C. Calvert, Serge P. Hoogendoorn

Summary:  
Current approaches to identifying driving heterogeneity face challenges in  
capturing the diversity of driving characteristics and understanding the  
fundamental patterns from a driving behaviour mechanism standpoint. This study  
introduces a comprehensive framework for identifying driving heterogeneity from  
an Action-chain perspective. First, a rule-based segmentation technique that  
considers the physical meanings of driving behaviour is proposed. Next, an  
Action phase Library including descriptions of various driving behaviour  
patterns is created based on the segmentation findings. The Action-chain  
concept is then introduced by implementing Action phase transition probability,  
followed by a method for evaluating driving heterogeneity. Employing real-world  
datasets for evaluation, our approach effectively identifies driving  
heterogeneity for both individual drivers and traffic flow while providing  
clear interpretations. These insights can aid the development of accurate  
driving behaviour theory and traffic flow models, ultimately benefiting traffic  
performance, and potentially leading to aspects such as improved road capacity  
and safety.

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# Structural Transfer Learning in NL-to-Bash Semantic Parsers

Authors: Kyle Duffy, Satwik Bhattamishra, Phil Blunsom

Summary:  
Large-scale pre-training has made progress in many fields of natural language  
processing, though little is understood about the design of pre-training  
datasets. We propose a methodology for obtaining a quantitative understanding  
of structural overlap between machine translation tasks. We apply our  
methodology to the natural language to Bash semantic parsing task (NLBash) and  
show that it is largely reducible to lexical alignment. We also find that there  
is strong structural overlap between NLBash and natural language to SQL.  
Additionally, we perform a study varying compute expended during pre-training  
on the English to German machine translation task and find that more compute  
expended during pre-training does not always correspond semantic  
representations with stronger transfer to NLBash.

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# Classification with Deep Neural Networks and Logistic Loss

Authors: Zihan Zhang, Lei Shi, Ding-Xuan Zhou

Summary:  
Deep neural networks (DNNs) trained with the logistic loss (i.e., the cross  
entropy loss) have made impressive advancements in various binary  
classification tasks. However, generalization analysis for binary  
classification with DNNs and logistic loss remains scarce. The unboundedness of  
the target function for the logistic loss is the main obstacle to deriving  
satisfying generalization bounds. In this paper, we aim to fill this gap by  
establishing a novel and elegant oracle-type inequality, which enables us to  
deal with the boundedness restriction of the target function, and using it to  
derive sharp convergence rates for fully connected ReLU DNN classifiers trained  
with logistic loss. In particular, we obtain optimal convergence rates (up to  
log factors) only requiring the H\"older smoothness of the conditional class  
probability $\eta$ of data. Moreover, we consider a compositional assumption  
that requires $\eta$ to be the composition of several vector-valued functions  
of which each component function is either a maximum value function or a  
H\"older smooth function only depending on a small number of its input  
variables. Under this assumption, we derive optimal convergence rates (up to  
log factors) which are independent of the input dimension of data. This result  
explains why DNN classifiers can perform well in practical high-dimensional  
classification problems. Besides the novel oracle-type inequality, the sharp  
convergence rates given in our paper also owe to a tight error bound for  
approximating the natural logarithm function near zero (where it is unbounded)  
by ReLU DNNs. In addition, we justify our claims for the optimality of rates by  
proving corresponding minimax lower bounds. All these results are new in the  
literature and will deepen our theoretical understanding of classification with  
DNNs.

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# ToolLLM: Facilitating Large Language Models to Master 16000+ Real-world APIs

Authors: Yujia Qin, Shihao Liang, Yining Ye, Kunlun Zhu, Lan Yan, Yaxi Lu, Yankai Lin, Xin Cong, Xiangru Tang, Bill Qian, Sihan Zhao, Runchu Tian, Ruobing Xie, Jie Zhou, Mark Gerstein, Dahai Li, Zhiyuan Liu, Maosong Sun

Summary:  
Despite the advancements of open-source large language models (LLMs) and  
their variants, e.g., LLaMA and Vicuna, they remain significantly limited in  
performing higher-level tasks, such as following human instructions to use  
external tools (APIs). This is because current instruction tuning largely  
focuses on basic language tasks instead of the tool-use domain. This is in  
contrast to state-of-the-art (SOTA) LLMs, e.g., ChatGPT, which have  
demonstrated excellent tool-use capabilities but are unfortunately closed  
source. To facilitate tool-use capabilities within open-source LLMs, we  
introduce ToolLLM, a general tool-use framework of data construction, model  
training and evaluation. We first present ToolBench, an instruction-tuning  
dataset for tool use, which is created automatically using ChatGPT.  
Specifically, we collect 16,464 real-world RESTful APIs spanning 49 categories  
from RapidAPI Hub, then prompt ChatGPT to generate diverse human instructions  
involving these APIs, covering both single-tool and multi-tool scenarios.  
Finally, we use ChatGPT to search for a valid solution path (chain of API  
calls) for each instruction. To make the searching process more efficient, we  
develop a novel depth-first search-based decision tree (DFSDT), enabling LLMs  
to evaluate multiple reasoning traces and expand the search space. We show that  
DFSDT significantly enhances the planning and reasoning capabilities of LLMs.  
For efficient tool-use assessment, we develop an automatic evaluator: ToolEval.  
We fine-tune LLaMA on ToolBench and obtain ToolLLaMA. Our ToolEval reveals that  
ToolLLaMA demonstrates a remarkable ability to execute complex instructions and  
generalize to unseen APIs, and exhibits comparable performance to ChatGPT. To  
make the pipeline more practical, we devise a neural API retriever to recommend  
appropriate APIs for each instruction, negating the need for manual API  
selection.

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# Lossless Transformations and Excess Risk Bounds in Statistical Inference

Authors: László Györfi, Tamás Linder, Harro Walk

Summary:  
We study the excess minimum risk in statistical inference, defined as the  
difference between the minimum expected loss in estimating a random variable  
from an observed feature vector and the minimum expected loss in estimating the  
same random variable from a transformation (statistic) of the feature vector.  
After characterizing lossless transformations, i.e., transformations for which  
the excess risk is zero for all loss functions, we construct a partitioning  
test statistic for the hypothesis that a given transformation is lossless and  
show that for i.i.d. data the test is strongly consistent. More generally, we  
develop information-theoretic upper bounds on the excess risk that uniformly  
hold over fairly general classes of loss functions. Based on these bounds, we  
introduce the notion of a delta-lossless transformation and give sufficient  
conditions for a given transformation to be universally delta-lossless.  
Applications to classification, nonparametric regression, portfolio strategies,  
information bottleneck, and deep learning, are also surveyed.

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# An Efficient Shapley Value Computation for the Naive Bayes Classifier

Authors: Vincent Lemaire, Fabrice Clérot, Marc Boullé

Summary:  
Variable selection or importance measurement of input variables to a machine  
learning model has become the focus of much research. It is no longer enough to  
have a good model, one also must explain its decisions. This is why there are  
so many intelligibility algorithms available today. Among them, Shapley value  
estimation algorithms are intelligibility methods based on cooperative game  
theory. In the case of the naive Bayes classifier, and to our knowledge, there  
is no ``analytical" formulation of Shapley values. This article proposes an  
exact analytic expression of Shapley values in the special case of the naive  
Bayes Classifier. We analytically compare this Shapley proposal, to another  
frequently used indicator, the Weight of Evidence (WoE) and provide an  
empirical comparison of our proposal with (i) the WoE and (ii) KernelShap  
results on real world datasets, discussing similar and dissimilar results. The  
results show that our Shapley proposal for the naive Bayes classifier provides  
informative results with low algorithmic complexity so that it can be used on  
very large datasets with extremely low computation time.

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# An Empirical Study on Log-based Anomaly Detection Using Machine Learning

Authors: Shan Ali, Chaima Boufaied, Domenico Bianculli, Paula Branco, Lionel Briand, Nathan Aschbacher

Summary:  
The growth of systems complexity increases the need of automated techniques  
dedicated to different log analysis tasks such as Log-based Anomaly Detection  
(LAD). The latter has been widely addressed in the literature, mostly by means  
of different deep learning techniques. Nevertheless, the focus on deep learning  
techniques results in less attention being paid to traditional Machine Learning  
(ML) techniques, which may perform well in many cases, depending on the context  
and the used datasets. Further, the evaluation of different ML techniques is  
mostly based on the assessment of their detection accuracy. However, this is is  
not enough to decide whether or not a specific ML technique is suitable to  
address the LAD problem. Other aspects to consider include the training and  
prediction time as well as the sensitivity to hyperparameter tuning. In this  
paper, we present a comprehensive empirical study, in which we evaluate  
different supervised and semi-supervised, traditional and deep ML techniques  
w.r.t. four evaluation criteria: detection accuracy, time performance,  
sensitivity of detection accuracy as well as time performance to hyperparameter  
tuning. The experimental results show that supervised traditional and deep ML  
techniques perform very closely in terms of their detection accuracy and  
prediction time. Moreover, the overall evaluation of the sensitivity of the  
detection accuracy of the different ML techniques to hyperparameter tuning  
shows that supervised traditional ML techniques are less sensitive to  
hyperparameter tuning than deep learning techniques. Further, semi-supervised  
techniques yield significantly worse detection accuracy than supervised  
techniques.

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# TFE-GNN: A Temporal Fusion Encoder Using Graph Neural Networks for Fine-grained Encrypted Traffic Classification

Authors: Haozhen Zhang, Le Yu, Xi Xiao, Qing Li, Francesco Mercaldo, Xiapu Luo, Qixu Liu

Summary:  
Encrypted traffic classification is receiving widespread attention from  
researchers and industrial companies. However, the existing methods only  
extract flow-level features, failing to handle short flows because of  
unreliable statistical properties, or treat the header and payload equally,  
failing to mine the potential correlation between bytes. Therefore, in this  
paper, we propose a byte-level traffic graph construction approach based on  
point-wise mutual information (PMI), and a model named Temporal Fusion Encoder  
using Graph Neural Networks (TFE-GNN) for feature extraction. In particular, we  
design a dual embedding layer, a GNN-based traffic graph encoder as well as a  
cross-gated feature fusion mechanism, which can first embed the header and  
payload bytes separately and then fuses them together to obtain a stronger  
feature representation. The experimental results on two real datasets  
demonstrate that TFE-GNN outperforms multiple state-of-the-art methods in  
fine-grained encrypted traffic classification tasks.

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# Deep Learning Meets Adaptive Filtering: A Stein's Unbiased Risk Estimator Approach

Authors: Zahra Esmaeilbeig, Mojtaba Soltanalian

Summary:  
This paper revisits two prominent adaptive filtering algorithms through the  
lens of algorithm unrolling, namely recursive least squares (RLS) and  
equivariant adaptive source separation (EASI), in the context of source  
estimation and separation. Building upon the unrolling methodology, we  
introduce novel task-based deep learning frameworks, denoted as Deep RLS and  
Deep EASI. These architectures transform the iterations of the original  
algorithms into layers of a deep neural network, thereby enabling efficient  
source signal estimation by taking advantage of a training process. To further  
enhance performance, we propose training these deep unrolled networks utilizing  
a loss function grounded on a Stein's unbiased risk estimator (SURE). Our  
empirical evaluations demonstrate the efficacy of this SURE-based approach for  
enhanced source signal estimation.

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# Lookbehind Optimizer: k steps back, 1 step forward

Authors: Gonçalo Mordido, Pranshu Malviya, Aristide Baratin, Sarath Chandar

Summary:  
The Lookahead optimizer improves the training stability of deep neural  
networks by having a set of fast weights that "look ahead" to guide the descent  
direction. Here, we combine this idea with sharpness-aware minimization (SAM)  
to stabilize its multi-step variant and improve the loss-sharpness trade-off.  
We propose Lookbehind, which computes $k$ gradient ascent steps ("looking  
behind") at each iteration and combine the gradients to bias the descent step  
toward flatter minima. We apply Lookbehind on top of two popular  
sharpness-aware training methods -- SAM and adaptive SAM (ASAM) -- and show  
that our approach leads to a myriad of benefits across a variety of tasks and  
training regimes. Particularly, we show increased generalization performance,  
greater robustness against noisy weights, and higher tolerance to catastrophic  
forgetting in lifelong learning settings.

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# A theory of data variability in Neural Network Bayesian inference

Authors: Javed Lindner, David Dahmen, Michael Krämer, Moritz Helias

Summary:  
Bayesian inference and kernel methods are well established in machine  
learning. The neural network Gaussian process in particular provides a concept  
to investigate neural networks in the limit of infinitely wide hidden layers by  
using kernel and inference methods. Here we build upon this limit and provide a  
field-theoretic formalism which covers the generalization properties of  
infinitely wide networks. We systematically compute generalization properties  
of linear, non-linear, and deep non-linear networks for kernel matrices with  
heterogeneous entries. In contrast to currently employed spectral methods we  
derive the generalization properties from the statistical properties of the  
input, elucidating the interplay of input dimensionality, size of the training  
data set, and variability of the data. We show that data variability leads to a  
non-Gaussian action reminiscent of a ($\varphi^3+\varphi^4$)-theory. Using our  
formalism on a synthetic task and on MNIST we obtain a homogeneous kernel  
matrix approximation for the learning curve as well as corrections due to data  
variability which allow the estimation of the generalization properties and  
exact results for the bounds of the learning curves in the case of infinitely  
many training data points.

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# Guiding Image Captioning Models Toward More Specific Captions

Authors: Simon Kornblith, Lala Li, Zirui Wang, Thao Nguyen

Summary:  
Image captioning is conventionally formulated as the task of generating  
captions for images that match the distribution of reference image-caption  
pairs. However, reference captions in standard captioning datasets are short  
and may not uniquely identify the images they describe. These problems are  
further exacerbated when models are trained directly on image-alt text pairs  
collected from the internet. In this work, we show that it is possible to  
generate more specific captions with minimal changes to the training process.  
We implement classifier-free guidance for an autoregressive captioning model by  
fine-tuning it to estimate both conditional and unconditional distributions  
over captions. The guidance scale applied at decoding controls a trade-off  
between maximizing $p(\mathrm{caption}|\mathrm{image})$ and  
$p(\mathrm{image}|\mathrm{caption})$. Compared to standard greedy decoding,  
decoding with a guidance scale of 2 substantially improves reference-free  
metrics such as CLIPScore (0.808 vs. 0.775) and caption$\to$image retrieval  
performance in the CLIP embedding space (recall@1 44.6% vs. 26.5%), but worsens  
standard reference-based captioning metrics (e.g., CIDEr 78.6 vs 126.1). We  
further explore the use of language models to guide the decoding process,  
obtaining small improvements over the Pareto frontier of reference-free vs.  
reference-based captioning metrics that arises from classifier-free guidance,  
and substantially improving the quality of captions generated from a model  
trained only on minimally curated web data.

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# On the Trustworthiness Landscape of State-of-the-art Generative Models: A Comprehensive Survey

Authors: Mingyuan Fan, Cen Chen, Chengyu Wang, Jun Huang

Summary:  
Diffusion models and large language models have emerged as leading-edge  
generative models and have sparked a revolutionary impact on various aspects of  
human life. However, the practical implementation of these models has also  
exposed inherent risks, highlighting their dual nature and raising concerns  
regarding their trustworthiness. Despite the abundance of literature on this  
subject, a comprehensive survey specifically delving into the intersection of  
large-scale generative models and their trustworthiness remains largely absent.  
To bridge this gap, This paper investigates both the long-standing and emerging  
threats associated with these models across four fundamental dimensions:  
privacy, security, fairness, and responsibility. In this way, we construct an  
extensive map outlining the trustworthiness of these models, while also  
providing practical recommendations and identifying future directions. These  
efforts are crucial for promoting the trustworthy deployment of these models,  
ultimately benefiting society as a whole.

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# Comparing normalizing flows and diffusion models for prosody and acoustic modelling in text-to-speech

Authors: Guangyan Zhang, Thomas Merritt, Manuel Sam Ribeiro, Biel Tura-Vecino, Kayoko Yanagisawa, Kamil Pokora, Abdelhamid Ezzerg, Sebastian Cygert, Ammar Abbas, Piotr Bilinski, Roberto Barra-Chicote, Daniel Korzekwa, Jaime Lorenzo-Trueba

Summary:  
Neural text-to-speech systems are often optimized on L1/L2 losses, which make  
strong assumptions about the distributions of the target data space. Aiming to  
improve those assumptions, Normalizing Flows and Diffusion Probabilistic Models  
were recently proposed as alternatives. In this paper, we compare traditional  
L1/L2-based approaches to diffusion and flow-based approaches for the tasks of  
prosody and mel-spectrogram prediction for text-to-speech synthesis. We use a  
prosody model to generate log-f0 and duration features, which are used to  
condition an acoustic model that generates mel-spectrograms. Experimental  
results demonstrate that the flow-based model achieves the best performance for  
spectrogram prediction, improving over equivalent diffusion and L1 models.  
Meanwhile, both diffusion and flow-based prosody predictors result in  
significant improvements over a typical L2-trained prosody models.

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# End-to-End Reinforcement Learning for Torque Based Variable Height Hopping

Authors: Raghav Soni, Daniel Harnack, Hauke Isermann, Sotaro Fushimi, Shivesh Kumar, Frank Kirchner

Summary:  
Legged locomotion is arguably the most suited and versatile mode to deal with  
natural or unstructured terrains. Intensive research into dynamic walking and  
running controllers has recently yielded great advances, both in the optimal  
control and reinforcement learning (RL) literature. Hopping is a challenging  
dynamic task involving a flight phase and has the potential to increase the  
traversability of legged robots. Model based control for hopping typically  
relies on accurate detection of different jump phases, such as lift-off or  
touch down, and using different controllers for each phase. In this paper, we  
present a end-to-end RL based torque controller that learns to implicitly  
detect the relevant jump phases, removing the need to provide manual heuristics  
for state detection. We also extend a method for simulation to reality transfer  
of the learned controller to contact rich dynamic tasks, resulting in  
successful deployment on the robot after training without parameter tuning.

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# Generative models for wearables data

Authors: Arinbjörn Kolbeinsson, Luca Foschini

Summary:  
Data scarcity is a common obstacle in medical research due to the high costs  
associated with data collection and the complexity of gaining access to and  
utilizing data. Synthesizing health data may provide an efficient and  
cost-effective solution to this shortage, enabling researchers to explore  
distributions and populations that are not represented in existing observations  
or difficult to access due to privacy considerations. To that end, we have  
developed a multi-task self-attention model that produces realistic wearable  
activity data. We examine the characteristics of the generated data and  
quantify its similarity to genuine samples with both quantitative and  
qualitative approaches.

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# Graph Structure from Point Clouds: Geometric Attention is All You Need

Authors: Daniel Murnane

Summary:  
The use of graph neural networks has produced significant advances in point  
cloud problems, such as those found in high energy physics. The question of how  
to produce a graph structure in these problems is usually treated as a matter  
of heuristics, employing fully connected graphs or K-nearest neighbors. In this  
work, we elevate this question to utmost importance as the Topology Problem. We  
propose an attention mechanism that allows a graph to be constructed in a  
learned space that handles geometrically the flow of relevance, providing one  
solution to the Topology Problem. We test this architecture, called  
GravNetNorm, on the task of top jet tagging, and show that it is competitive in  
tagging accuracy, and uses far fewer computational resources than all other  
comparable models.

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# Proactive Resource Request for Disaster Response: A Deep Learning-based Optimization Model

Authors: Hongzhe Zhang, Xiaohang Zhao, Xiao Fang, Bintong Chen

Summary:  
Disaster response is critical to save lives and reduce damages in the  
aftermath of a disaster. Fundamental to disaster response operations is the  
management of disaster relief resources. To this end, a local agency (e.g., a  
local emergency resource distribution center) collects demands from local  
communities affected by a disaster, dispatches available resources to meet the  
demands, and requests more resources from a central emergency management agency  
(e.g., Federal Emergency Management Agency in the U.S.). Prior resource  
management research for disaster response overlooks the problem of deciding  
optimal quantities of resources requested by a local agency. In response to  
this research gap, we define a new resource management problem that proactively  
decides optimal quantities of requested resources by considering both currently  
unfulfilled demands and future demands. To solve the problem, we take salient  
characteristics of the problem into consideration and develop a novel deep  
learning method for future demand prediction. We then formulate the problem as  
a stochastic optimization model, analyze key properties of the model, and  
propose an effective solution method to the problem based on the analyzed  
properties. We demonstrate the superior performance of our method over  
prevalent existing methods using both real world and simulated data. We also  
show its superiority over prevalent existing methods in a multi-stakeholder and  
multi-objective setting through simulations.

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# Sequential and Shared-Memory Parallel Algorithms for Partitioned Local Depths

Authors: Aditya Devarakonda, Grey Ballard

Summary:  
In this work, we design, analyze, and optimize sequential and shared-memory  
parallel algorithms for partitioned local depths (PaLD). Given a set of data  
points and pairwise distances, PaLD is a method for identifying strength of  
pairwise relationships based on relative distances, enabling the identification  
of strong ties within dense and sparse communities even if their sizes and  
within-community absolute distances vary greatly. We design two algorithmic  
variants that perform community structure analysis through triplet comparisons  
of pairwise distances. We present theoretical analyses of computation and  
communication costs and prove that the sequential algorithms are communication  
optimal, up to constant factors. We introduce performance optimization  
strategies that yield sequential speedups of up to $29\times$ over a baseline  
sequential implementation and parallel speedups of up to $19.4\times$ over  
optimized sequential implementations using up to $32$ threads on an Intel  
multicore CPU.

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PDF URL: http://arxiv.org/pdf/2307.16652v1

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# UDAMA: Unsupervised Domain Adaptation through Multi-discriminator Adversarial Training with Noisy Labels Improves Cardio-fitness Prediction

Authors: Yu Wu, Dimitris Spathis, Hong Jia, Ignacio Perez-Pozuelo, Tomas Gonzales, Soren Brage, Nicholas Wareham, Cecilia Mascolo

Summary:  
Deep learning models have shown great promise in various healthcare  
monitoring applications. However, most healthcare datasets with high-quality  
(gold-standard) labels are small-scale, as directly collecting ground truth is  
often costly and time-consuming. As a result, models developed and validated on  
small-scale datasets often suffer from overfitting and do not generalize well  
to unseen scenarios. At the same time, large amounts of imprecise  
(silver-standard) labeled data, annotated by approximate methods with the help  
of modern wearables and in the absence of ground truth validation, are starting  
to emerge. However, due to measurement differences, this data displays  
significant label distribution shifts, which motivates the use of domain  
adaptation. To this end, we introduce UDAMA, a method with two key components:  
Unsupervised Domain Adaptation and Multidiscriminator Adversarial Training,  
where we pre-train on the silver-standard data and employ adversarial  
adaptation with the gold-standard data along with two domain discriminators. In  
particular, we showcase the practical potential of UDAMA by applying it to  
Cardio-respiratory fitness (CRF) prediction. CRF is a crucial determinant of  
metabolic disease and mortality, and it presents labels with various levels of  
noise (goldand silver-standard), making it challenging to establish an accurate  
prediction model. Our results show promising performance by alleviating  
distribution shifts in various label shift settings. Additionally, by using  
data from two free-living cohort studies (Fenland and BBVS), we show that UDAMA  
consistently outperforms up to 12% compared to competitive transfer learning  
and state-of-the-art domain adaptation models, paving the way for leveraging  
noisy labeled data to improve fitness estimation at scale.

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# LLMs4OL: Large Language Models for Ontology Learning

Authors: Hamed Babaei Giglou, Jennifer D'Souza, Sören Auer

Summary:  
We propose the LLMs4OL approach, which utilizes Large Language Models (LLMs)  
for Ontology Learning (OL). LLMs have shown significant advancements in natural  
language processing, demonstrating their ability to capture complex language  
patterns in different knowledge domains. Our LLMs4OL paradigm investigates the  
following hypothesis: \textit{Can LLMs effectively apply their language pattern  
capturing capability to OL, which involves automatically extracting and  
structuring knowledge from natural language text?} To test this hypothesis, we  
conduct a comprehensive evaluation using the zero-shot prompting method. We  
evaluate nine different LLM model families for three main OL tasks: term  
typing, taxonomy discovery, and extraction of non-taxonomic relations.  
Additionally, the evaluations encompass diverse genres of ontological  
knowledge, including lexicosemantic knowledge in WordNet, geographical  
knowledge in GeoNames, and medical knowledge in UMLS.

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# Text-CRS: A Generalized Certified Robustness Framework against Textual Adversarial Attacks

Authors: Xinyu Zhang, Hanbin Hong, Yuan Hong, Peng Huang, Binghui Wang, Zhongjie Ba, Kui Ren

Summary:  
The language models, especially the basic text classification models, have  
been shown to be susceptible to textual adversarial attacks such as synonym  
substitution and word insertion attacks. To defend against such attacks, a  
growing body of research has been devoted to improving the model robustness.  
However, providing provable robustness guarantees instead of empirical  
robustness is still widely unexplored. In this paper, we propose Text-CRS, a  
generalized certified robustness framework for natural language processing  
(NLP) based on randomized smoothing. To our best knowledge, existing certified  
schemes for NLP can only certify the robustness against $\ell\_0$ perturbations  
in synonym substitution attacks. Representing each word-level adversarial  
operation (i.e., synonym substitution, word reordering, insertion, and  
deletion) as a combination of permutation and embedding transformation, we  
propose novel smoothing theorems to derive robustness bounds in both  
permutation and embedding space against such adversarial operations. To further  
improve certified accuracy and radius, we consider the numerical relationships  
between discrete words and select proper noise distributions for the randomized  
smoothing. Finally, we conduct substantial experiments on multiple language  
models and datasets. Text-CRS can address all four different word-level  
adversarial operations and achieve a significant accuracy improvement. We also  
provide the first benchmark on certified accuracy and radius of four word-level  
operations, besides outperforming the state-of-the-art certification against  
synonym substitution attacks.

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# Model-based Causal Bayesian Optimization

Authors: Scott Sussex, Pier Giuseppe Sessa, Anastasiia Makarova, Andreas Krause

Summary:  
In Causal Bayesian Optimization (CBO), an agent intervenes on an unknown  
structural causal model to maximize a downstream reward variable. In this  
paper, we consider the generalization where other agents or external events  
also intervene on the system, which is key for enabling adaptiveness to  
non-stationarities such as weather changes, market forces, or adversaries. We  
formalize this generalization of CBO as Adversarial Causal Bayesian  
Optimization (ACBO) and introduce the first algorithm for ACBO with bounded  
regret: Causal Bayesian Optimization with Multiplicative Weights (CBO-MW). Our  
approach combines a classical online learning strategy with causal modeling of  
the rewards. To achieve this, it computes optimistic counterfactual reward  
estimates by propagating uncertainty through the causal graph. We derive regret  
bounds for CBO-MW that naturally depend on graph-related quantities. We further  
propose a scalable implementation for the case of combinatorial interventions  
and submodular rewards. Empirically, CBO-MW outperforms non-causal and  
non-adversarial Bayesian optimization methods on synthetic environments and  
environments based on real-word data. Our experiments include a realistic  
demonstration of how CBO-MW can be used to learn users' demand patterns in a  
shared mobility system and reposition vehicles in strategic areas.

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# Detecting diabetic retinopathy severity through fundus images using an ensemble of classifiers

Authors: Eduard Popescu, Adrian Groza, Ioana Damian

Summary:  
Diabetic retinopathy is an ocular condition that affects individuals with  
diabetes mellitus. It is a common complication of diabetes that can impact the  
eyes and lead to vision loss. One method for diagnosing diabetic retinopathy is  
the examination of the fundus of the eye. An ophthalmologist examines the back  
part of the eye, including the retina, optic nerve, and the blood vessels that  
supply the retina. In the case of diabetic retinopathy, the blood vessels in  
the retina deteriorate and can lead to bleeding, swelling, and other changes  
that affect vision. We proposed a method for detecting diabetic diabetic  
severity levels. First, a set of data-prerpocessing is applied to available  
data: adaptive equalisation, color normalisation, Gaussian filter, removal of  
the optic disc and blood vessels. Second, we perform image segmentation for  
relevant markers and extract features from the fundus images. Third, we apply  
an ensemble of classifiers and we assess the trust in the system.

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# LaplaceConfidence: a Graph-based Approach for Learning with Noisy Labels

Authors: Mingcai Chen, Yuntao Du, Wei Tang, Baoming Zhang, Hao Cheng, Shuwei Qian, Chongjun Wang

Summary:  
In real-world applications, perfect labels are rarely available, making it  
challenging to develop robust machine learning algorithms that can handle noisy  
labels. Recent methods have focused on filtering noise based on the discrepancy  
between model predictions and given noisy labels, assuming that samples with  
small classification losses are clean. This work takes a different approach by  
leveraging the consistency between the learned model and the entire noisy  
dataset using the rich representational and topological information in the  
data. We introduce LaplaceConfidence, a method that to obtain label confidence  
(i.e., clean probabilities) utilizing the Laplacian energy. Specifically, it  
first constructs graphs based on the feature representations of all noisy  
samples and minimizes the Laplacian energy to produce a low-energy graph. Clean  
labels should fit well into the low-energy graph while noisy ones should not,  
allowing our method to determine data's clean probabilities. Furthermore,  
LaplaceConfidence is embedded into a holistic method for robust training, where  
co-training technique generates unbiased label confidence and label  
refurbishment technique better utilizes it. We also explore the dimensionality  
reduction technique to accommodate our method on large-scale noisy datasets.  
Our experiments demonstrate that LaplaceConfidence outperforms state-of-the-art  
methods on benchmark datasets under both synthetic and real-world noise.

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# Noisy Self-Training with Data Augmentations for Offensive and Hate Speech Detection Tasks

Authors: João A. Leite, Carolina Scarton, Diego F. Silva

Summary:  
Online social media is rife with offensive and hateful comments, prompting  
the need for their automatic detection given the sheer amount of posts created  
every second. Creating high-quality human-labelled datasets for this task is  
difficult and costly, especially because non-offensive posts are significantly  
more frequent than offensive ones. However, unlabelled data is abundant,  
easier, and cheaper to obtain. In this scenario, self-training methods, using  
weakly-labelled examples to increase the amount of training data, can be  
employed. Recent "noisy" self-training approaches incorporate data augmentation  
techniques to ensure prediction consistency and increase robustness against  
noisy data and adversarial attacks. In this paper, we experiment with default  
and noisy self-training using three different textual data augmentation  
techniques across five different pre-trained BERT architectures varying in  
size. We evaluate our experiments on two offensive/hate-speech datasets and  
demonstrate that (i) self-training consistently improves performance regardless  
of model size, resulting in up to +1.5% F1-macro on both datasets, and (ii)  
noisy self-training with textual data augmentations, despite being successfully  
applied in similar settings, decreases performance on offensive and hate-speech  
domains when compared to the default method, even with state-of-the-art  
augmentations such as backtranslation.

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# Audio-visual video-to-speech synthesis with synthesized input audio

Authors: Triantafyllos Kefalas, Yannis Panagakis, Maja Pantic

Summary:  
Video-to-speech synthesis involves reconstructing the speech signal of a  
speaker from a silent video. The implicit assumption of this task is that the  
sound signal is either missing or contains a high amount of noise/corruption  
such that it is not useful for processing. Previous works in the literature  
either use video inputs only or employ both video and audio inputs during  
training, and discard the input audio pathway during inference. In this work we  
investigate the effect of using video and audio inputs for video-to-speech  
synthesis during both training and inference. In particular, we use pre-trained  
video-to-speech models to synthesize the missing speech signals and then train  
an audio-visual-to-speech synthesis model, using both the silent video and the  
synthesized speech as inputs, to predict the final reconstructed speech. Our  
experiments demonstrate that this approach is successful with both raw  
waveforms and mel spectrograms as target outputs.

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# A multiscale and multicriteria Generative Adversarial Network to synthesize 1-dimensional turbulent fields

Authors: Carlos Granero-Belinchon, Manuel Cabeza Gallucci

Summary:  
This article introduces a new Neural Network stochastic model to generate a  
1-dimensional stochastic field with turbulent velocity statistics. Both the  
model architecture and training procedure ground on the Kolmogorov and Obukhov  
statistical theories of fully developed turbulence, so guaranteeing  
descriptions of 1) energy distribution, 2) energy cascade and 3) intermittency  
across scales in agreement with experimental observations. The model is a  
Generative Adversarial Network with multiple multiscale optimization criteria.  
First, we use three physics-based criteria: the variance, skewness and flatness  
of the increments of the generated field that retrieve respectively the  
turbulent energy distribution, energy cascade and intermittency across scales.  
Second, the Generative Adversarial Network criterion, based on reproducing  
statistical distributions, is used on segments of different length of the  
generated field. Furthermore, to mimic multiscale decompositions frequently  
used in turbulence's studies, the model architecture is fully convolutional  
with kernel sizes varying along the multiple layers of the model. To train our  
model we use turbulent velocity signals from grid turbulence at Modane wind  
tunnel.

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# The Decimation Scheme for Symmetric Matrix Factorization

Authors: Francesco Camilli, Marc Mézard

Summary:  
Matrix factorization is an inference problem that has acquired importance due  
to its vast range of applications that go from dictionary learning to  
recommendation systems and machine learning with deep networks. The study of  
its fundamental statistical limits represents a true challenge, and despite a  
decade-long history of efforts in the community, there is still no closed  
formula able to describe its optimal performances in the case where the rank of  
the matrix scales linearly with its size. In the present paper, we study this  
extensive rank problem, extending the alternative 'decimation' procedure that  
we recently introduced, and carry out a thorough study of its performance.  
Decimation aims at recovering one column/line of the factors at a time, by  
mapping the problem into a sequence of neural network models of associative  
memory at a tunable temperature. Though being sub-optimal, decimation has the  
advantage of being theoretically analyzable. We extend its scope and analysis  
to two families of matrices. For a large class of compactly supported priors,  
we show that the replica symmetric free entropy of the neural network models  
takes a universal form in the low temperature limit. For sparse Ising prior, we  
show that the storage capacity of the neural network models diverges as  
sparsity in the patterns increases, and we introduce a simple algorithm based  
on a ground state search that implements decimation and performs matrix  
factorization, with no need of an informative initialization.

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# Line Search for Convex Minimization

Authors: Laurent Orseau, Marcus Hutter

Summary:  
Golden-section search and bisection search are the two main principled  
algorithms for 1d minimization of quasiconvex (unimodal) functions. The first  
one only uses function queries, while the second one also uses gradient  
queries. Other algorithms exist under much stronger assumptions, such as  
Newton's method. However, to the best of our knowledge, there is no principled  
exact line search algorithm for general convex functions -- including  
piecewise-linear and max-compositions of convex functions -- that takes  
advantage of convexity. We propose two such algorithms: $\Delta$-Bisection is a  
variant of bisection search that uses (sub)gradient information and convexity  
to speed up convergence, while $\Delta$-Secant is a variant of golden-section  
search and uses only function queries.  
 While bisection search reduces the $x$ interval by a factor 2 at every  
iteration, $\Delta$-Bisection reduces the (sometimes much) smaller $x^\*$-gap  
$\Delta^x$ (the $x$ coordinates of $\Delta$) by at least a factor 2 at every  
iteration. Similarly, $\Delta$-Secant also reduces the $x^\*$-gap by at least a  
factor 2 every second function query. Moreover, the $y^\*$-gap $\Delta^y$ (the  
$y$ coordinates of $\Delta$) also provides a refined stopping criterion, which  
can also be used with other algorithms. Experiments on a few convex functions  
confirm that our algorithms are always faster than their quasiconvex  
counterparts, often by more than a factor 2.  
 We further design a quasi-exact line search algorithm based on  
$\Delta$-Secant. It can be used with gradient descent as a replacement for  
backtracking line search, for which some parameters can be finicky to tune --  
and we provide examples to this effect, on strongly-convex and smooth  
functions. We provide convergence guarantees, and confirm the efficiency of  
quasi-exact line search on a few single- and multivariate convex functions.

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# Simultaneous column-based deep learning progression analysis of atrophy associated with AMD in longitudinal OCT studies

Authors: Adi Szeskin, Roei Yehuda, Or Shmueli, Jaime Levy, Leo Joskowicz

Summary:  
Purpose: Disease progression of retinal atrophy associated with AMD requires  
the accurate quantification of the retinal atrophy changes on longitudinal OCT  
studies. It is based on finding, comparing, and delineating subtle atrophy  
changes on consecutive pairs (prior and current) of unregistered OCT scans.  
Methods: We present a fully automatic end-to-end pipeline for the simultaneous  
detection and quantification of time-related atrophy changes associated with  
dry AMD in pairs of OCT scans of a patient. It uses a novel simultaneous  
multi-channel column-based deep learning model trained on registered pairs of  
OCT scans that concurrently detects and segments retinal atrophy segments in  
consecutive OCT scans by classifying light scattering patterns in matched pairs  
of vertical pixel-wide columns (A-scans) in registered prior and current OCT  
slices (B-scans). Results: Experimental results on 4,040 OCT slices with 5.2M  
columns from 40 scans pairs of 18 patients (66% training/validation, 33%  
testing) with 24.13+-14.0 months apart in which Complete RPE and Outer Retinal  
Atrophy (cRORA) was identified in 1,998 OCT slices (735 atrophy lesions from  
3,732 segments, 0.45M columns) yield a mean atrophy segments detection  
precision, recall of 0.90+-0.09, 0.95+-0.06 and 0.74+-0.18, 0.94+-0.12 for  
atrophy lesions with AUC=0.897, all above observer variability. Simultaneous  
classification outperforms standalone classification precision and recall by  
30+-62% and 27+-0% for atrophy segments and lesions. Conclusions: simultaneous  
column-based detection and quantification of retinal atrophy changes associated  
with AMD is accurate and outperforms standalone classification methods.  
Translational relevance: an automatic and efficient way to detect and quantify  
retinal atrophy changes associated with AMD.

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# Deep Learning and Computer Vision for Glaucoma Detection: A Review

Authors: Mona Ashtari-Majlan, Mohammad Mahdi Dehshibi, David Masip

Summary:  
Glaucoma is the leading cause of irreversible blindness worldwide and poses  
significant diagnostic challenges due to its reliance on subjective evaluation.  
However, recent advances in computer vision and deep learning have demonstrated  
the potential for automated assessment. In this paper, we survey recent studies  
on AI-based glaucoma diagnosis using fundus, optical coherence tomography, and  
visual field images, with a particular emphasis on deep learning-based methods.  
We provide an updated taxonomy that organizes methods into architectural  
paradigms and includes links to available source code to enhance the  
reproducibility of the methods. Through rigorous benchmarking on widely-used  
public datasets, we reveal performance gaps in generalizability, uncertainty  
estimation, and multimodal integration. Additionally, our survey curates key  
datasets while highlighting limitations such as scale, labeling  
inconsistencies, and bias. We outline open research challenges and detail  
promising directions for future studies. This survey is expected to be useful  
for both AI researchers seeking to translate advances into practice and  
ophthalmologists aiming to improve clinical workflows and diagnosis using the  
latest AI outcomes.

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# No Fair Lunch: A Causal Perspective on Dataset Bias in Machine Learning for Medical Imaging

Authors: Charles Jones, Daniel C. Castro, Fabio De Sousa Ribeiro, Ozan Oktay, Melissa McCradden, Ben Glocker

Summary:  
As machine learning methods gain prominence within clinical decision-making,  
addressing fairness concerns becomes increasingly urgent. Despite considerable  
work dedicated to detecting and ameliorating algorithmic bias, today's methods  
are deficient with potentially harmful consequences. Our causal perspective  
sheds new light on algorithmic bias, highlighting how different sources of  
dataset bias may appear indistinguishable yet require substantially different  
mitigation strategies. We introduce three families of causal bias mechanisms  
stemming from disparities in prevalence, presentation, and annotation. Our  
causal analysis underscores how current mitigation methods tackle only a narrow  
and often unrealistic subset of scenarios. We provide a practical three-step  
framework for reasoning about fairness in medical imaging, supporting the  
development of safe and equitable AI prediction models.

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# Deception Abilities Emerged in Large Language Models

Authors: Thilo Hagendorff

Summary:  
Large language models (LLMs) are currently at the forefront of intertwining  
artificial intelligence (AI) systems with human communication and everyday  
life. Thus, aligning them with human values is of great importance. However,  
given the steady increase in reasoning abilities, future LLMs are under  
suspicion of becoming able to deceive human operators and utilizing this  
ability to bypass monitoring efforts. As a prerequisite to this, LLMs need to  
possess a conceptual understanding of deception strategies. This study reveals  
that such strategies emerged in state-of-the-art LLMs, such as GPT-4, but were  
non-existent in earlier LLMs. We conduct a series of experiments showing that  
state-of-the-art LLMs are able to understand and induce false beliefs in other  
agents, that their performance in complex deception scenarios can be amplified  
utilizing chain-of-thought reasoning, and that eliciting Machiavellianism in  
LLMs can alter their propensity to deceive. In sum, revealing hitherto unknown  
machine behavior in LLMs, our study contributes to the nascent field of machine  
psychology.

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# Classifying multilingual party manifestos: Domain transfer across country, time, and genre

Authors: Matthias Aßenmacher, Nadja Sauter, Christian Heumann

Summary:  
Annotating costs of large corpora are still one of the main bottlenecks in  
empirical social science research. On the one hand, making use of the  
capabilities of domain transfer allows re-using annotated data sets and trained  
models. On the other hand, it is not clear how well domain transfer works and  
how reliable the results are for transfer across different dimensions. We  
explore the potential of domain transfer across geographical locations,  
languages, time, and genre in a large-scale database of political manifestos.  
First, we show the strong within-domain classification performance of  
fine-tuned transformer models. Second, we vary the genre of the test set across  
the aforementioned dimensions to test for the fine-tuned models' robustness and  
transferability. For switching genres, we use an external corpus of transcribed  
speeches from New Zealand politicians while for the other three dimensions,  
custom splits of the Manifesto database are used. While BERT achieves the best  
scores in the initial experiments across modalities, DistilBERT proves to be  
competitive at a lower computational expense and is thus used for further  
experiments across time and country. The results of the additional analysis  
show that (Distil)BERT can be applied to future data with similar performance.  
Moreover, we observe (partly) notable differences between the political  
manifestos of different countries of origin, even if these countries share a  
language or a cultural background.

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# Explainable Equivariant Neural Networks for Particle Physics: PELICAN

Authors: Alexander Bogatskiy, Timothy Hoffman, David W. Miller, Jan T. Offermann, Xiaoyang Liu

Summary:  
We present a comprehensive study of the PELICAN machine learning algorithm  
architecture in the context of both tagging (classification) and reconstructing  
(regression) Lorentz-boosted top quarks, including the difficult task of  
specifically identifying and measuring the $W$-boson inside the dense  
environment of the boosted hadronic final state. PELICAN is a novel permutation  
equivariant and Lorentz invariant or covariant aggregator network designed to  
overcome common limitations found in architectures applied to particle physics  
problems. Compared to many approaches that use non-specialized architectures  
that neglect underlying physics principles and require very large numbers of  
parameters, PELICAN employs a fundamentally symmetry group-based architecture  
that demonstrates benefits in terms of reduced complexity, increased  
interpretability, and raw performance. When tested on the standard task of  
Lorentz-boosted top quark tagging, PELICAN outperforms existing competitors  
with much lower model complexity and high sample efficiency. On the less common  
and more complex task of four-momentum regression, PELICAN also outperforms  
hand-crafted algorithms. We discuss the implications of symmetry-restricted  
architectures for the wider field of machine learning for physics.

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# Value-Informed Skill Chaining for Policy Learning of Long-Horizon Tasks with Surgical Robot

Authors: Tao Huang, Kai Chen, Wang Wei, Jianan Li, Yonghao Long, Qi Dou

Summary:  
Reinforcement learning is still struggling with solving long-horizon surgical  
robot tasks which involve multiple steps over an extended duration of time due  
to the policy exploration challenge. Recent methods try to tackle this problem  
by skill chaining, in which the long-horizon task is decomposed into multiple  
subtasks for easing the exploration burden and subtask policies are temporally  
connected to complete the whole long-horizon task. However, smoothly connecting  
all subtask policies is difficult for surgical robot scenarios. Not all states  
are equally suitable for connecting two adjacent subtasks. An undesired  
terminate state of the previous subtask would make the current subtask policy  
unstable and result in a failed execution. In this work, we introduce  
value-informed skill chaining (ViSkill), a novel reinforcement learning  
framework for long-horizon surgical robot tasks. The core idea is to  
distinguish which terminal state is suitable for starting all the following  
subtask policies. To achieve this target, we introduce a state value function  
that estimates the expected success probability of the entire task given a  
state. Based on this value function, a chaining policy is learned to instruct  
subtask policies to terminate at the state with the highest value so that all  
subsequent policies are more likely to be connected for accomplishing the task.  
We demonstrate the effectiveness of our method on three complex surgical robot  
tasks from SurRoL, a comprehensive surgical simulation platform, achieving high  
task success rates and execution efficiency. Code is available at  
$\href{https://github.com/med-air/ViSkill}{\text{https://github.com/med-air/ViSkill}}$.

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# Learning Generalizable Tool Use with Non-rigid Grasp-pose Registration

Authors: Malte Mosbach, Sven Behnke

Summary:  
Tool use, a hallmark feature of human intelligence, remains a challenging  
problem in robotics due the complex contacts and high-dimensional action space.  
In this work, we present a novel method to enable reinforcement learning of  
tool use behaviors. Our approach provides a scalable way to learn the operation  
of tools in a new category using only a single demonstration. To this end, we  
propose a new method for generalizing grasping configurations of multi-fingered  
robotic hands to novel objects. This is used to guide the policy search via  
favorable initializations and a shaped reward signal. The learned policies  
solve complex tool use tasks and generalize to unseen tools at test time.  
Visualizations and videos of the trained policies are available at  
https://maltemosbach.github.io/generalizable\_tool\_use.

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# Don't be so negative! Score-based Generative Modeling with Oracle-assisted Guidance

Authors: Saeid Naderiparizi, Xiaoxuan Liang, Berend Zwartsenberg, Frank Wood

Summary:  
The maximum likelihood principle advocates parameter estimation via  
optimization of the data likelihood function. Models estimated in this way can  
exhibit a variety of generalization characteristics dictated by, e.g.  
architecture, parameterization, and optimization bias. This work addresses  
model learning in a setting where there further exists side-information in the  
form of an oracle that can label samples as being outside the support of the  
true data generating distribution. Specifically we develop a new denoising  
diffusion probabilistic modeling (DDPM) methodology, Gen-neG, that leverages  
this additional side-information. Our approach builds on generative adversarial  
networks (GANs) and discriminator guidance in diffusion models to guide the  
generation process towards the positive support region indicated by the oracle.  
We empirically establish the utility of Gen-neG in applications including  
collision avoidance in self-driving simulators and safety-guarded human motion  
generation.

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# L3DMC: Lifelong Learning using Distillation via Mixed-Curvature Space

Authors: Kaushik Roy, Peyman Moghadam, Mehrtash Harandi

Summary:  
The performance of a lifelong learning (L3) model degrades when it is trained  
on a series of tasks, as the geometrical formation of the embedding space  
changes while learning novel concepts sequentially. The majority of existing L3  
approaches operate on a fixed-curvature (e.g., zero-curvature Euclidean) space  
that is not necessarily suitable for modeling the complex geometric structure  
of data. Furthermore, the distillation strategies apply constraints directly on  
low-dimensional embeddings, discouraging the L3 model from learning new  
concepts by making the model highly stable. To address the problem, we propose  
a distillation strategy named L3DMC that operates on mixed-curvature spaces to  
preserve the already-learned knowledge by modeling and maintaining complex  
geometrical structures. We propose to embed the projected low dimensional  
embedding of fixed-curvature spaces (Euclidean and hyperbolic) to  
higher-dimensional Reproducing Kernel Hilbert Space (RKHS) using a  
positive-definite kernel function to attain rich representation. Afterward, we  
optimize the L3 model by minimizing the discrepancies between the new sample  
representation and the subspace constructed using the old representation in  
RKHS. L3DMC is capable of adapting new knowledge better without forgetting old  
knowledge as it combines the representation power of multiple fixed-curvature  
spaces and is performed on higher-dimensional RKHS. Thorough experiments on  
three benchmarks demonstrate the effectiveness of our proposed distillation  
strategy for medical image classification in L3 settings. Our code  
implementation is publicly available at  
https://github.com/csiro-robotics/L3DMC.

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# A continuous Structural Intervention Distance to compare Causal Graphs

Authors: Mihir Dhanakshirur, Felix Laumann, Junhyung Park, Mauricio Barahona

Summary:  
Understanding and adequately assessing the difference between a true and a  
learnt causal graphs is crucial for causal inference under interventions. As an  
extension to the graph-based structural Hamming distance and structural  
intervention distance, we propose a novel continuous-measured metric that  
considers the underlying data in addition to the graph structure for its  
calculation of the difference between a true and a learnt causal graph. The  
distance is based on embedding intervention distributions over each pair of  
nodes as conditional mean embeddings into reproducing kernel Hilbert spaces and  
estimating their difference by the maximum (conditional) mean discrepancy. We  
show theoretical results which we validate with numerical experiments on  
synthetic data.

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# Towards Head Computed Tomography Image Reconstruction Standardization with Deep Learning Assisted Automatic Detection

Authors: Bowen Zheng, Chenxi Huang, Yuemei Luo

Summary:  
Three-dimensional (3D) reconstruction of head Computed Tomography (CT) images  
elucidates the intricate spatial relationships of tissue structures, thereby  
assisting in accurate diagnosis. Nonetheless, securing an optimal head CT scan  
without deviation is challenging in clinical settings, owing to poor  
positioning by technicians, patient's physical constraints, or CT scanner tilt  
angle restrictions. Manual formatting and reconstruction not only introduce  
subjectivity but also strain time and labor resources. To address these issues,  
we propose an efficient automatic head CT images 3D reconstruction method,  
improving accuracy and repeatability, as well as diminishing manual  
intervention. Our approach employs a deep learning-based object detection  
algorithm, identifying and evaluating orbitomeatal line landmarks to  
automatically reformat the images prior to reconstruction. Given the dearth of  
existing evaluations of object detection algorithms in the context of head CT  
images, we compared ten methods from both theoretical and experimental  
perspectives. By exploring their precision, efficiency, and robustness, we  
singled out the lightweight YOLOv8 as the aptest algorithm for our task, with  
an mAP of 92.91% and impressive robustness against class imbalance. Our  
qualitative evaluation of standardized reconstruction results demonstrates the  
clinical practicability and validity of our method.

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# VITS2: Improving Quality and Efficiency of Single-Stage Text-to-Speech with Adversarial Learning and Architecture Design

Authors: Jungil Kong, Jihoon Park, Beomjeong Kim, Jeongmin Kim, Dohee Kong, Sangjin Kim

Summary:  
Single-stage text-to-speech models have been actively studied recently, and  
their results have outperformed two-stage pipeline systems. Although the  
previous single-stage model has made great progress, there is room for  
improvement in terms of its intermittent unnaturalness, computational  
efficiency, and strong dependence on phoneme conversion. In this work, we  
introduce VITS2, a single-stage text-to-speech model that efficiently  
synthesizes a more natural speech by improving several aspects of the previous  
work. We propose improved structures and training mechanisms and present that  
the proposed methods are effective in improving naturalness, similarity of  
speech characteristics in a multi-speaker model, and efficiency of training and  
inference. Furthermore, we demonstrate that the strong dependence on phoneme  
conversion in previous works can be significantly reduced with our method,  
which allows a fully end-to-end single-stage approach.

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# Causal Inference for Banking Finance and Insurance A Survey

Authors: Satyam Kumar, Yelleti Vivek, Vadlamani Ravi, Indranil Bose

Summary:  
Causal Inference plays an significant role in explaining the decisions taken  
by statistical models and artificial intelligence models. Of late, this field  
started attracting the attention of researchers and practitioners alike. This  
paper presents a comprehensive survey of 37 papers published during 1992-2023  
and concerning the application of causal inference to banking, finance, and  
insurance. The papers are categorized according to the following families of  
domains: (i) Banking, (ii) Finance and its subdomains such as corporate  
finance, governance finance including financial risk and financial policy,  
financial economics, and Behavioral finance, and (iii) Insurance. Further, the  
paper covers the primary ingredients of causal inference namely, statistical  
methods such as Bayesian Causal Network, Granger Causality and jargon used  
thereof such as counterfactuals. The review also recommends some important  
directions for future research. In conclusion, we observed that the application  
of causal inference in the banking and insurance sectors is still in its  
infancy, and thus more research is possible to turn it into a viable method.

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# MetaDiff: Meta-Learning with Conditional Diffusion for Few-Shot Learning

Authors: Baoquan Zhang, Demin Yu

Summary:  
Equipping a deep model the abaility of few-shot learning, i.e., learning  
quickly from only few examples, is a core challenge for artificial  
intelligence. Gradient-based meta-learning approaches effectively address the  
challenge by learning how to learn novel tasks. Its key idea is learning a deep  
model in a bi-level optimization manner, where the outer-loop process learns a  
shared gradient descent algorithm (i.e., its hyperparameters), while the  
inner-loop process leverage it to optimize a task-specific model by using only  
few labeled data. Although these existing methods have shown superior  
performance, the outer-loop process requires calculating second-order  
derivatives along the inner optimization path, which imposes considerable  
memory burdens and the risk of vanishing gradients. Drawing inspiration from  
recent progress of diffusion models, we find that the inner-loop gradient  
descent process can be actually viewed as a reverse process (i.e., denoising)  
of diffusion where the target of denoising is model weights but the origin  
data. Based on this fact, in this paper, we propose to model the gradient  
descent optimizer as a diffusion model and then present a novel  
task-conditional diffusion-based meta-learning, called MetaDiff, that  
effectively models the optimization process of model weights from Gaussion  
noises to target weights in a denoising manner. Thanks to the training  
efficiency of diffusion models, our MetaDiff do not need to differentiate  
through the inner-loop path such that the memory burdens and the risk of  
vanishing gradients can be effectvely alleviated. Experiment results show that  
our MetaDiff outperforms the state-of-the-art gradient-based meta-learning  
family in few-shot learning tasks.

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# Guaranteed Optimal Generative Modeling with Maximum Deviation from the Empirical Distribution

Authors: Elen Vardanyan, Arshak Minasyan, Sona Hunanyan, Tigran Galstyan, Arnak Dalalyan

Summary:  
Generative modeling is a widely-used machine learning method with various  
applications in scientific and industrial fields. Its primary objective is to  
simulate new examples drawn from an unknown distribution given training data  
while ensuring diversity and avoiding replication of examples from the training  
data.  
 This paper presents theoretical insights into training a generative model  
with two properties: (i) the error of replacing the true data-generating  
distribution with the trained data-generating distribution should optimally  
converge to zero as the sample size approaches infinity, and (ii) the trained  
data-generating distribution should be far enough from any distribution  
replicating examples in the training data.  
 We provide non-asymptotic results in the form of finite sample risk bounds  
that quantify these properties and depend on relevant parameters such as sample  
size, the dimension of the ambient space, and the dimension of the latent  
space. Our results are applicable to general integral probability metrics used  
to quantify errors in probability distribution spaces, with the Wasserstein-$1$  
distance being the central example. We also include numerical examples to  
illustrate our theoretical findings.

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# Subspace Distillation for Continual Learning

Authors: Kaushik Roy, Christian Simon, Peyman Moghadam, Mehrtash Harandi

Summary:  
An ultimate objective in continual learning is to preserve knowledge learned  
in preceding tasks while learning new tasks. To mitigate forgetting prior  
knowledge, we propose a novel knowledge distillation technique that takes into  
the account the manifold structure of the latent/output space of a neural  
network in learning novel tasks. To achieve this, we propose to approximate the  
data manifold up-to its first order, hence benefiting from linear subspaces to  
model the structure and maintain the knowledge of a neural network while  
learning novel concepts. We demonstrate that the modeling with subspaces  
provides several intriguing properties, including robustness to noise and  
therefore effective for mitigating Catastrophic Forgetting in continual  
learning. We also discuss and show how our proposed method can be adopted to  
address both classification and segmentation problems. Empirically, we observe  
that our proposed method outperforms various continual learning methods on  
several challenging datasets including Pascal VOC, and Tiny-Imagenet.  
Furthermore, we show how the proposed method can be seamlessly combined with  
existing learning approaches to improve their performances. The codes of this  
article will be available at https://github.com/csiro-robotics/SDCL.

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# Causal-learn: Causal Discovery in Python

Authors: Yujia Zheng, Biwei Huang, Wei Chen, Joseph Ramsey, Mingming Gong, Ruichu Cai, Shohei Shimizu, Peter Spirtes, Kun Zhang

Summary:  
Causal discovery aims at revealing causal relations from observational data,  
which is a fundamental task in science and engineering. We describe  
$\textit{causal-learn}$, an open-source Python library for causal discovery.  
This library focuses on bringing a comprehensive collection of causal discovery  
methods to both practitioners and researchers. It provides easy-to-use APIs for  
non-specialists, modular building blocks for developers, detailed documentation  
for learners, and comprehensive methods for all. Different from previous  
packages in R or Java, $\textit{causal-learn}$ is fully developed in Python,  
which could be more in tune with the recent preference shift in programming  
languages within related communities. The library is available at  
https://github.com/py-why/causal-learn.

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# Bridging the Gap: Exploring the Capabilities of Bridge-Architectures for Complex Visual Reasoning Tasks

Authors: Kousik Rajesh, Mrigank Raman, Mohammed Asad Karim, Pranit Chawla

Summary:  
In recent times there has been a surge of multi-modal architectures based on  
Large Language Models, which leverage the zero shot generation capabilities of  
LLMs and project image embeddings into the text space and then use the  
auto-regressive capacity to solve tasks such as VQA, captioning, and image  
retrieval. We name these architectures as "bridge-architectures" as they  
project from the image space to the text space. These models deviate from the  
traditional recipe of training transformer based multi-modal models, which  
involve using large-scale pre-training and complex multi-modal interactions  
through co or cross attention. However, the capabilities of bridge  
architectures have not been tested on complex visual reasoning tasks which  
require fine grained analysis about the image. In this project, we investigate  
the performance of these bridge-architectures on the NLVR2 dataset, and compare  
it to state-of-the-art transformer based architectures. We first extend the  
traditional bridge architectures for the NLVR2 dataset, by adding object level  
features to faciliate fine-grained object reasoning. Our analysis shows that  
adding object level features to bridge architectures does not help, and that  
pre-training on multi-modal data is key for good performance on complex  
reasoning tasks such as NLVR2. We also demonstrate some initial results on a  
recently bridge-architecture, LLaVA, in the zero shot setting and analyze its  
performance.

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# STL: A Signed and Truncated Logarithm Activation Function for Neural Networks

Authors: Yuanhao Gong

Summary:  
Activation functions play an essential role in neural networks. They provide  
the non-linearity for the networks. Therefore, their properties are important  
for neural networks' accuracy and running performance. In this paper, we  
present a novel signed and truncated logarithm function as activation function.  
The proposed activation function has significantly better mathematical  
properties, such as being odd function, monotone, differentiable, having  
unbounded value range, and a continuous nonzero gradient. These properties make  
it an excellent choice as an activation function. We compare it with other  
well-known activation functions in several well-known neural networks. The  
results confirm that it is the state-of-the-art. The suggested activation  
function can be applied in a large range of neural networks where activation  
functions are necessary.

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# Does fine-tuning GPT-3 with the OpenAI API leak personally-identifiable information?

Authors: Albert Yu Sun, Eliott Zemour, Arushi Saxena, Udith Vaidyanathan, Eric Lin, Christian Lau, Vaikkunth Mugunthan

Summary:  
Machine learning practitioners often fine-tune generative pre-trained models  
like GPT-3 to improve model performance at specific tasks. Previous works,  
however, suggest that fine-tuned machine learning models memorize and emit  
sensitive information from the original fine-tuning dataset. Companies such as  
OpenAI offer fine-tuning services for their models, but no prior work has  
conducted a memorization attack on any closed-source models. In this work, we  
simulate a privacy attack on GPT-3 using OpenAI's fine-tuning API. Our  
objective is to determine if personally identifiable information (PII) can be  
extracted from this model. We (1) explore the use of naive prompting methods on  
a GPT-3 fine-tuned classification model, and (2) we design a practical word  
generation task called Autocomplete to investigate the extent of PII  
memorization in fine-tuned GPT-3 within a real-world context. Our findings  
reveal that fine-tuning GPT3 for both tasks led to the model memorizing and  
disclosing critical personally identifiable information (PII) obtained from the  
underlying fine-tuning dataset. To encourage further research, we have made our  
codes and datasets publicly available on GitHub at:  
https://github.com/albertsun1/gpt3-pii-attacks

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# UniAP: Unifying Inter- and Intra-Layer Automatic Parallelism by Mixed Integer Quadratic Programming

Authors: Hao Lin, Ke Wu, Jun Li, Wu-Jun Li

Summary:  
Deep learning models have demonstrated impressive performance in various  
domains. However, the prolonged training time of these models remains a  
critical problem. Manually designed parallel training strategies could enhance  
efficiency but require considerable time and deliver little flexibility. Hence,  
automatic parallelism is proposed to automate the parallel strategy searching  
process. Even so, existing approaches suffer from sub-optimal strategy space  
because they treat automatic parallelism as two independent stages, namely  
inter- and intra-layer parallelism. To address this issue, we propose UniAP,  
which utilizes mixed integer quadratic programming to unify inter- and  
intra-layer automatic parallelism. To the best of our knowledge, UniAP is the  
first work to unify these two categories to search for a globally optimal  
strategy. The experimental results show that UniAP outperforms state-of-the-art  
methods by up to 1.70$\times$ in throughput and reduces strategy searching time  
by up to 16$\times$ across four Transformer-like models.

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# BearingPGA-Net: A Lightweight and Deployable Bearing Fault Diagnosis Network via Decoupled Knowledge Distillation and FPGA Acceleration

Authors: Jing-Xiao Liao, Sheng-Lai Wei, Chen-Long Xie, Tieyong Zeng, Jinwei Sun, Shiping Zhang, Xiaoge Zhang, Feng-Lei Fan

Summary:  
Deep learning has achieved remarkable success in the field of bearing fault  
diagnosis. However, this success comes with larger models and more complex  
computations, which cannot be transferred into industrial fields requiring  
models to be of high speed, strong portability, and low power consumption. In  
this paper, we propose a lightweight and deployable model for bearing fault  
diagnosis, referred to as BearingPGA-Net, to address these challenges. Firstly,  
aided by a well-trained large model, we train BearingPGA-Net via decoupled  
knowledge distillation. Despite its small size, our model demonstrates  
excellent fault diagnosis performance compared to other lightweight  
state-of-the-art methods. Secondly, we design an FPGA acceleration scheme for  
BearingPGA-Net using Verilog. This scheme involves the customized quantization  
and designing programmable logic gates for each layer of BearingPGA-Net on the  
FPGA, with an emphasis on parallel computing and module reuse to enhance the  
computational speed. To the best of our knowledge, this is the first instance  
of deploying a CNN-based bearing fault diagnosis model on an FPGA. Experimental  
results reveal that our deployment scheme achieves over 200 times faster  
diagnosis speed compared to CPU, while achieving a lower-than-0.4\% performance  
drop in terms of F1, Recall, and Precision score on our independently-collected  
bearing dataset. Our code is available at  
\url{https://github.com/asdvfghg/BearingPGA-Net}.

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# Benchmarking and Analyzing Robust Point Cloud Recognition: Bag of Tricks for Defending Adversarial Examples

Authors: Qiufan Ji, Lin Wang, Cong Shi, Shengshan Hu, Yingying Chen, Lichao Sun

Summary:  
Deep Neural Networks (DNNs) for 3D point cloud recognition are vulnerable to  
adversarial examples, threatening their practical deployment. Despite the many  
research endeavors have been made to tackle this issue in recent years, the  
diversity of adversarial examples on 3D point clouds makes them more  
challenging to defend against than those on 2D images. For examples, attackers  
can generate adversarial examples by adding, shifting, or removing points.  
Consequently, existing defense strategies are hard to counter unseen point  
cloud adversarial examples. In this paper, we first establish a comprehensive,  
and rigorous point cloud adversarial robustness benchmark to evaluate  
adversarial robustness, which can provide a detailed understanding of the  
effects of the defense and attack methods. We then collect existing defense  
tricks in point cloud adversarial defenses and then perform extensive and  
systematic experiments to identify an effective combination of these tricks.  
Furthermore, we propose a hybrid training augmentation methods that consider  
various types of point cloud adversarial examples to adversarial training,  
significantly improving the adversarial robustness. By combining these tricks,  
we construct a more robust defense framework achieving an average accuracy of  
83.45\% against various attacks, demonstrating its capability to enabling  
robust learners. Our codebase are open-sourced on:  
\url{https://github.com/qiufan319/benchmark\_pc\_attack.git}.

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# Probabilistically robust conformal prediction

Authors: Subhankar Ghosh, Yuanjie Shi, Taha Belkhouja, Yan Yan, Jana Doppa, Brian Jones

Summary:  
Conformal prediction (CP) is a framework to quantify uncertainty of machine  
learning classifiers including deep neural networks. Given a testing example  
and a trained classifier, CP produces a prediction set of candidate labels with  
a user-specified coverage (i.e., true class label is contained with high  
probability). Almost all the existing work on CP assumes clean testing data and  
there is not much known about the robustness of CP algorithms w.r.t  
natural/adversarial perturbations to testing examples. This paper studies the  
problem of probabilistically robust conformal prediction (PRCP) which ensures  
robustness to most perturbations around clean input examples. PRCP generalizes  
the standard CP (cannot handle perturbations) and adversarially robust CP  
(ensures robustness w.r.t worst-case perturbations) to achieve better  
trade-offs between nominal performance and robustness. We propose a novel  
adaptive PRCP (aPRCP) algorithm to achieve probabilistically robust coverage.  
The key idea behind aPRCP is to determine two parallel thresholds, one for data  
samples and another one for the perturbations on data (aka  
"quantile-of-quantile" design). We provide theoretical analysis to show that  
aPRCP algorithm achieves robust coverage. Our experiments on CIFAR-10,  
CIFAR-100, and ImageNet datasets using deep neural networks demonstrate that  
aPRCP achieves better trade-offs than state-of-the-art CP and adversarially  
robust CP algorithms.

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# Moreau-Yoshida Variational Transport: A General Framework For Solving Regularized Distributional Optimization Problems

Authors: Dai Hai Nguyen, Tetsuya Sakurai

Summary:  
We consider a general optimization problem of minimizing a composite  
objective functional defined over a class of probability distributions. The  
objective is composed of two functionals: one is assumed to possess the  
variational representation and the other is expressed in terms of the  
expectation operator of a possibly nonsmooth convex regularizer function. Such  
a regularized distributional optimization problem widely appears in machine  
learning and statistics, such as proximal Monte-Carlo sampling, Bayesian  
inference and generative modeling, for regularized estimation and generation.  
 We propose a novel method, dubbed as Moreau-Yoshida Variational Transport  
(MYVT), for solving the regularized distributional optimization problem. First,  
as the name suggests, our method employs the Moreau-Yoshida envelope for a  
smooth approximation of the nonsmooth function in the objective. Second, we  
reformulate the approximate problem as a concave-convex saddle point problem by  
leveraging the variational representation, and then develope an efficient  
primal-dual algorithm to approximate the saddle point. Furthermore, we provide  
theoretical analyses and report experimental results to demonstrate the  
effectiveness of the proposed method.

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# DiVA-360: The Dynamic Visuo-Audio Dataset for Immersive Neural Fields

Authors: Cheng-You Lu, Peisen Zhou, Angela Xing, Chandradeep Pokhariya, Arnab Dey, Ishaan Shah, Rugved Mavidipalli, Dylan Hu, Andrew Comport, Kefan Chen, Srinath Sridhar

Summary:  
Advances in neural fields are enabling high-fidelity capture of the shape and  
appearance of static and dynamic scenes. However, their capabilities lag behind  
those offered by representations such as pixels or meshes due to algorithmic  
challenges and the lack of large-scale real-world datasets. We address the  
dataset limitation with DiVA-360, a real-world 360 dynamic visual-audio dataset  
with synchronized multimodal visual, audio, and textual information about  
table-scale scenes. It contains 46 dynamic scenes, 30 static scenes, and 95  
static objects spanning 11 categories captured using a new hardware system  
using 53 RGB cameras at 120 FPS and 6 microphones for a total of 8.6M image  
frames and 1360 s of dynamic data. We provide detailed text descriptions for  
all scenes, foreground-background segmentation masks, category-specific 3D pose  
alignment for static objects, as well as metrics for comparison. Our data,  
hardware and software, and code are available at https://diva360.github.io/.

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# Foundational Models for Fault Diagnosis of Electrical Motors

Authors: Sriram Anbalagan, Deepesh Agarwal, Balasubramaniam Natarajan, Babji Srinivasan

Summary:  
A majority of recent advancements related to the fault diagnosis of  
electrical motors are based on the assumption that training and testing data  
are drawn from the same distribution. However, the data distribution can vary  
across different operating conditions during real-world operating scenarios of  
electrical motors. Consequently, this assumption limits the practical  
implementation of existing studies for fault diagnosis, as they rely on fully  
labelled training data spanning all operating conditions and assume a  
consistent distribution. This is because obtaining a large number of labelled  
samples for several machines across different fault cases and operating  
scenarios may be unfeasible. In order to overcome the aforementioned  
limitations, this work proposes a framework to develop a foundational model for  
fault diagnosis of electrical motors. It involves building a neural  
network-based backbone to learn high-level features using self-supervised  
learning, and then fine-tuning the backbone to achieve specific objectives. The  
primary advantage of such an approach is that the backbone can be fine-tuned to  
achieve a wide variety of target tasks using very less amount of training data  
as compared to traditional supervised learning methodologies. The empirical  
evaluation demonstrates the effectiveness of the proposed approach by obtaining  
more than 90\% classification accuracy by fine-tuning the backbone not only  
across different types of fault scenarios or operating conditions, but also  
across different machines. This illustrates the promising potential of the  
proposed approach for cross-machine fault diagnosis tasks in real-world  
applications.

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# Discovering Adaptable Symbolic Algorithms from Scratch

Authors: Stephen Kelly, Daniel S. Park, Xingyou Song, Mitchell McIntire, Pranav Nashikkar, Ritam Guha, Wolfgang Banzhaf, Kalyanmoy Deb, Vishnu Naresh Boddeti, Jie Tan, Esteban Real

Summary:  
Autonomous robots deployed in the real world will need control policies that  
rapidly adapt to environmental changes. To this end, we propose  
AutoRobotics-Zero (ARZ), a method based on AutoML-Zero that discovers zero-shot  
adaptable policies from scratch. In contrast to neural network adaption  
policies, where only model parameters are optimized, ARZ can build control  
algorithms with the full expressive power of a linear register machine. We  
evolve modular policies that tune their model parameters and alter their  
inference algorithm on-the-fly to adapt to sudden environmental changes. We  
demonstrate our method on a realistic simulated quadruped robot, for which we  
evolve safe control policies that avoid falling when individual limbs suddenly  
break. This is a challenging task in which two popular neural network baselines  
fail. Finally, we conduct a detailed analysis of our method on a novel and  
challenging non-stationary control task dubbed Cataclysmic Cartpole. Results  
confirm our findings that ARZ is significantly more robust to sudden  
environmental changes and can build simple, interpretable control policies.

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# Image Synthesis under Limited Data: A Survey and Taxonomy

Authors: Mengping Yang, Zhe Wang

Summary:  
Deep generative models, which target reproducing the given data distribution  
to produce novel samples, have made unprecedented advancements in recent years.  
Their technical breakthroughs have enabled unparalleled quality in the  
synthesis of visual content. However, one critical prerequisite for their  
tremendous success is the availability of a sufficient number of training  
samples, which requires massive computation resources. When trained on limited  
data, generative models tend to suffer from severe performance deterioration  
due to overfitting and memorization. Accordingly, researchers have devoted  
considerable attention to develop novel models that are capable of generating  
plausible and diverse images from limited training data recently. Despite  
numerous efforts to enhance training stability and synthesis quality in the  
limited data scenarios, there is a lack of a systematic survey that provides 1)  
a clear problem definition, critical challenges, and taxonomy of various tasks;  
2) an in-depth analysis on the pros, cons, and remain limitations of existing  
literature; as well as 3) a thorough discussion on the potential applications  
and future directions in the field of image synthesis under limited data. In  
order to fill this gap and provide a informative introduction to researchers  
who are new to this topic, this survey offers a comprehensive review and a  
novel taxonomy on the development of image synthesis under limited data. In  
particular, it covers the problem definition, requirements, main solutions,  
popular benchmarks, and remain challenges in a comprehensive and all-around  
manner.

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# Contrastive Learning for API Aspect Analysis

Authors: G. M. Shahariar, Tahmid Hasan, Anindya Iqbal, Gias Uddin

Summary:  
We present a novel approach - CLAA - for API aspect detection in API reviews  
that utilizes transformer models trained with a supervised contrastive loss  
objective function. We evaluate CLAA using performance and impact analysis. For  
performance analysis, we utilized a benchmark dataset on developer discussions  
collected from Stack Overflow and compare the results to those obtained using  
state-of-the-art transformer models. Our experiments show that contrastive  
learning can significantly improve the performance of transformer models in  
detecting aspects such as Performance, Security, Usability, and Documentation.  
For impact analysis, we performed empirical and developer study. On a randomly  
selected and manually labeled 200 online reviews, CLAA achieved 92% accuracy  
while the SOTA baseline achieved 81.5%. According to our developer study  
involving 10 participants, the use of 'Stack Overflow + CLAA' resulted in  
increased accuracy and confidence during API selection. Replication package:  
https://github.com/shahariar-shibli/Contrastive-Learning-for-API-Aspect-Analysis

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# Evaluating Correctness and Faithfulness of Instruction-Following Models for Question Answering

Authors: Vaibhav Adlakha, Parishad BehnamGhader, Xing Han Lu, Nicholas Meade, Siva Reddy

Summary:  
Retriever-augmented instruction-following models are attractive alternatives  
to fine-tuned approaches for information-seeking tasks such as question  
answering (QA). By simply prepending retrieved documents in its input along  
with an instruction, these models can be adapted to various information domains  
and tasks without additional fine-tuning. While the model responses tend to be  
natural and fluent, the additional verbosity makes traditional QA evaluation  
metrics such as exact match (EM) and F1 unreliable for accurately quantifying  
model performance.  
 In this work, we investigate the performance of instruction-following models  
across three information-seeking QA tasks. We use both automatic and human  
evaluation to evaluate these models along two dimensions: 1) how well they  
satisfy the user's information need (correctness), and 2) whether they produce  
a response based on the provided knowledge (faithfulness). Guided by human  
evaluation and analysis, we highlight the shortcomings of traditional metrics  
for both correctness and faithfulness. We then propose simple token-overlap  
based and model-based metrics that reflect the true performance of these  
models. Our analysis reveals that instruction-following models are competitive,  
and sometimes even outperform fine-tuned models for correctness. However, these  
models struggle to stick to the provided knowledge and often hallucinate in  
their responses. We hope our work encourages a more holistic evaluation of  
instruction-following models for QA. Our code and data is available at  
https://github.com/McGill-NLP/instruct-qa

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# Towards Trustworthy and Aligned Machine Learning: A Data-centric Survey with Causality Perspectives

Authors: Haoyang Liu, Maheep Chaudhary, Haohan Wang

Summary:  
The trustworthiness of machine learning has emerged as a critical topic in  
the field, encompassing various applications and research areas such as  
robustness, security, interpretability, and fairness. The last decade saw the  
development of numerous methods addressing these challenges. In this survey, we  
systematically review these advancements from a data-centric perspective,  
highlighting the shortcomings of traditional empirical risk minimization (ERM)  
training in handling challenges posed by the data.  
 Interestingly, we observe a convergence of these methods, despite being  
developed independently across trustworthy machine learning subfields. Pearl's  
hierarchy of causality offers a unifying framework for these techniques.  
Accordingly, this survey presents the background of trustworthy machine  
learning development using a unified set of concepts, connects this language to  
Pearl's causal hierarchy, and finally discusses methods explicitly inspired by  
causality literature. We provide a unified language with mathematical  
vocabulary to link these methods across robustness, adversarial robustness,  
interpretability, and fairness, fostering a more cohesive understanding of the  
field.  
 Further, we explore the trustworthiness of large pretrained models. After  
summarizing dominant techniques like fine-tuning, parameter-efficient  
fine-tuning, prompting, and reinforcement learning with human feedback, we draw  
connections between them and the standard ERM. This connection allows us to  
build upon the principled understanding of trustworthy methods, extending it to  
these new techniques in large pretrained models, paving the way for future  
methods. Existing methods under this perspective are also reviewed.  
 Lastly, we offer a brief summary of the applications of these methods and  
discuss potential future aspects related to our survey. For more information,  
please visit http://trustai.one.

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# Decidable Fragments of LTLf Modulo Theories (Extended Version)

Authors: Luca Geatti, Alessandro Gianola, Nicola Gigante, Sarah Winkler

Summary:  
We study Linear Temporal Logic Modulo Theories over Finite Traces (LTLfMT), a  
recently introduced extension of LTL over finite traces (LTLf) where  
propositions are replaced by first-order formulas and where first-order  
variables referring to different time points can be compared. In general,  
LTLfMT was shown to be semi-decidable for any decidable first-order theory  
(e.g., linear arithmetics), with a tableau-based semi-decision procedure.  
 In this paper we present a sound and complete pruning rule for the LTLfMT  
tableau. We show that for any LTLfMT formula that satisfies an abstract,  
semantic condition, that we call finite memory, the tableau augmented with the  
new rule is also guaranteed to terminate. Last but not least, this technique  
allows us to establish novel decidability results for the satisfiability of  
several fragments of LTLfMT, as well as to give new decidability proofs for  
classes that are already known.

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# On the use of associative memory in Hopfield networks designed to solve propositional satisfiability problems

Authors: Natalya Weber, Werner Koch, Ozan Erdem, Tom Froese

Summary:  
Hopfield networks are an attractive choice for solving many types of  
computational problems because they provide a biologically plausible mechanism.  
The Self-Optimization (SO) model adds to the Hopfield network by using a  
biologically founded Hebbian learning rule, in combination with repeated  
network resets to arbitrary initial states, for optimizing its own behavior  
towards some desirable goal state encoded in the network. In order to better  
understand that process, we demonstrate first that the SO model can solve  
concrete combinatorial problems in SAT form, using two examples of the Liars  
problem and the map coloring problem. In addition, we show how under some  
conditions critical information might get lost forever with the learned network  
producing seemingly optimal solutions that are in fact inappropriate for the  
problem it was tasked to solve. What appears to be an undesirable side-effect  
of the SO model, can provide insight into its process for solving intractable  
problems.

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# Structural Transfer Learning in NL-to-Bash Semantic Parsers

Authors: Kyle Duffy, Satwik Bhattamishra, Phil Blunsom

Summary:  
Large-scale pre-training has made progress in many fields of natural language  
processing, though little is understood about the design of pre-training  
datasets. We propose a methodology for obtaining a quantitative understanding  
of structural overlap between machine translation tasks. We apply our  
methodology to the natural language to Bash semantic parsing task (NLBash) and  
show that it is largely reducible to lexical alignment. We also find that there  
is strong structural overlap between NLBash and natural language to SQL.  
Additionally, we perform a study varying compute expended during pre-training  
on the English to German machine translation task and find that more compute  
expended during pre-training does not always correspond semantic  
representations with stronger transfer to NLBash.

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# ToolLLM: Facilitating Large Language Models to Master 16000+ Real-world APIs

Authors: Yujia Qin, Shihao Liang, Yining Ye, Kunlun Zhu, Lan Yan, Yaxi Lu, Yankai Lin, Xin Cong, Xiangru Tang, Bill Qian, Sihan Zhao, Runchu Tian, Ruobing Xie, Jie Zhou, Mark Gerstein, Dahai Li, Zhiyuan Liu, Maosong Sun

Summary:  
Despite the advancements of open-source large language models (LLMs) and  
their variants, e.g., LLaMA and Vicuna, they remain significantly limited in  
performing higher-level tasks, such as following human instructions to use  
external tools (APIs). This is because current instruction tuning largely  
focuses on basic language tasks instead of the tool-use domain. This is in  
contrast to state-of-the-art (SOTA) LLMs, e.g., ChatGPT, which have  
demonstrated excellent tool-use capabilities but are unfortunately closed  
source. To facilitate tool-use capabilities within open-source LLMs, we  
introduce ToolLLM, a general tool-use framework of data construction, model  
training and evaluation. We first present ToolBench, an instruction-tuning  
dataset for tool use, which is created automatically using ChatGPT.  
Specifically, we collect 16,464 real-world RESTful APIs spanning 49 categories  
from RapidAPI Hub, then prompt ChatGPT to generate diverse human instructions  
involving these APIs, covering both single-tool and multi-tool scenarios.  
Finally, we use ChatGPT to search for a valid solution path (chain of API  
calls) for each instruction. To make the searching process more efficient, we  
develop a novel depth-first search-based decision tree (DFSDT), enabling LLMs  
to evaluate multiple reasoning traces and expand the search space. We show that  
DFSDT significantly enhances the planning and reasoning capabilities of LLMs.  
For efficient tool-use assessment, we develop an automatic evaluator: ToolEval.  
We fine-tune LLaMA on ToolBench and obtain ToolLLaMA. Our ToolEval reveals that  
ToolLLaMA demonstrates a remarkable ability to execute complex instructions and  
generalize to unseen APIs, and exhibits comparable performance to ChatGPT. To  
make the pipeline more practical, we devise a neural API retriever to recommend  
appropriate APIs for each instruction, negating the need for manual API  
selection.

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# The Ethics of AI Value Chains: An Approach for Integrating and Expanding AI Ethics Research, Practice, and Governance

Authors: Blair Attard-Frost, David Gray Widder

Summary:  
Recent criticisms of AI ethics principles and practices have indicated a need  
for new approaches to AI ethics that can account for and intervene in the  
design, development, use, and governance of AI systems across multiple actors,  
contexts, and scales of activity. This paper positions AI value chains as an  
integrative concept that satisfies those needs, enabling AI ethics researchers,  
practitioners, and policymakers to take a more comprehensive view of the  
ethical and practical implications of AI systems. We review and synthesize  
theoretical perspectives on value chains from the literature on strategic  
management, service science, and economic geography. We then review  
perspectives on AI value chains from the academic, industry, and policy  
literature. We connect an inventory of ethical concerns in AI to the actors and  
resourcing activities involved in AI value chains to demonstrate that  
approaching AI ethics issues as value chain issues can enable more  
comprehensive and integrative research and governance practices. We illustrate  
this by suggesting five future directions for researchers, practitioners, and  
policymakers to investigate and intervene in the ethical concerns associated  
with AI value chains.

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# Ranking-based Argumentation Semantics Applied to Logical Argumentation (full version)

Authors: Jesse Heyninck, Badran Raddaoui, Christian Straßer

Summary:  
In formal argumentation, a distinction can be made between extension-based  
semantics, where sets of arguments are either (jointly) accepted or not, and  
ranking-based semantics, where grades of acceptability are assigned to  
arguments. Another important distinction is that between abstract approaches,  
that abstract away from the content of arguments, and structured approaches,  
that specify a method of constructing argument graphs on the basis of a  
knowledge base. While ranking-based semantics have been extensively applied to  
abstract argumentation, few work has been done on ranking-based semantics for  
structured argumentation. In this paper, we make a systematic investigation  
into the behaviour of ranking-based semantics applied to existing formalisms  
for structured argumentation. We show that a wide class of ranking-based  
semantics gives rise to so-called culpability measures, and are relatively  
robust to specific choices in argument construction methods.

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# KoBBQ: Korean Bias Benchmark for Question Answering

Authors: Jiho Jin, Jiseon Kim, Nayeon Lee, Haneul Yoo, Alice Oh, Hwaran Lee

Summary:  
The BBQ (Bias Benchmark for Question Answering) dataset enables the  
evaluation of the social biases that language models (LMs) exhibit in  
downstream tasks. However, it is challenging to adapt BBQ to languages other  
than English as social biases are culturally dependent. In this paper, we  
devise a process to construct a non-English bias benchmark dataset by  
leveraging the English BBQ dataset in a culturally adaptive way and present the  
KoBBQ dataset for evaluating biases in Question Answering (QA) tasks in Korean.  
We identify samples from BBQ into three classes: Simply-Translated (can be used  
directly after cultural translation), Target-Modified (requires localization in  
target groups), and Sample-Removed (does not fit Korean culture). We further  
enhance the cultural relevance to Korean culture by adding four new categories  
of bias specific to Korean culture and newly creating samples based on Korean  
literature. KoBBQ consists of 246 templates and 4,740 samples across 12  
categories of social bias. Using KoBBQ, we measure the accuracy and bias scores  
of several state-of-the-art multilingual LMs. We demonstrate the differences in  
the bias of LMs in Korean and English, clarifying the need for hand-crafted  
data considering cultural differences.

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# AsdKB: A Chinese Knowledge Base for the Early Screening and Diagnosis of Autism Spectrum Disorder

Authors: Tianxing Wu, Xudong Cao, Yipeng Zhu, Feiyue Wu, Tianling Gong, Yuxiang Wang, Shenqi Jing

Summary:  
To easily obtain the knowledge about autism spectrum disorder and help its  
early screening and diagnosis, we create AsdKB, a Chinese knowledge base on  
autism spectrum disorder. The knowledge base is built on top of various  
sources, including 1) the disease knowledge from SNOMED CT and ICD-10 clinical  
descriptions on mental and behavioural disorders, 2) the diagnostic knowledge  
from DSM-5 and different screening tools recommended by social organizations  
and medical institutes, and 3) the expert knowledge on professional physicians  
and hospitals from the Web. AsdKB contains both ontological and factual  
knowledge, and is accessible as Linked Data at https://w3id.org/asdkb/. The  
potential applications of AsdKB are question answering, auxiliary diagnosis,  
and expert recommendation, and we illustrate them with a prototype which can be  
accessed at http://asdkb.org.cn/.

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# Advancing Smart Malnutrition Monitoring: A Multi-Modal Learning Approach for Vital Health Parameter Estimation

Authors: Ashish Marisetty, Prathistith Raj M, Praneeth Nemani, Venkanna Udutalapally, Debanjan Das

Summary:  
Malnutrition poses a significant threat to global health, resulting from an  
inadequate intake of essential nutrients that adversely impacts vital organs  
and overall bodily functioning. Periodic examinations and mass screenings,  
incorporating both conventional and non-invasive techniques, have been employed  
to combat this challenge. However, these approaches suffer from critical  
limitations, such as the need for additional equipment, lack of comprehensive  
feature representation, absence of suitable health indicators, and the  
unavailability of smartphone implementations for precise estimations of Body  
Fat Percentage (BFP), Basal Metabolic Rate (BMR), and Body Mass Index (BMI) to  
enable efficient smart-malnutrition monitoring. To address these constraints,  
this study presents a groundbreaking, scalable, and robust smart  
malnutrition-monitoring system that leverages a single full-body image of an  
individual to estimate height, weight, and other crucial health parameters  
within a multi-modal learning framework. Our proposed methodology involves the  
reconstruction of a highly precise 3D point cloud, from which 512-dimensional  
feature embeddings are extracted using a headless-3D classification network.  
Concurrently, facial and body embeddings are also extracted, and through the  
application of learnable parameters, these features are then utilized to  
estimate weight accurately. Furthermore, essential health metrics, including  
BMR, BFP, and BMI, are computed to conduct a comprehensive analysis of the  
subject's health, subsequently facilitating the provision of personalized  
nutrition plans. While being robust to a wide range of lighting conditions  
across multiple devices, our model achieves a low Mean Absolute Error (MAE) of  
$\pm$ 4.7 cm and $\pm$ 5.3 kg in estimating height and weight.

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# Hybrid quantum transfer learning for crack image classification on NISQ hardware

Authors: Alexander Geng, Ali Moghiseh, Claudia Redenbach, Katja Schladitz

Summary:  
Quantum computers possess the potential to process data using a remarkably  
reduced number of qubits compared to conventional bits, as per theoretical  
foundations. However, recent experiments have indicated that the practical  
feasibility of retrieving an image from its quantum encoded version is  
currently limited to very small image sizes. Despite this constraint,  
variational quantum machine learning algorithms can still be employed in the  
current noisy intermediate scale quantum (NISQ) era. An example is a hybrid  
quantum machine learning approach for edge detection. In our study, we present  
an application of quantum transfer learning for detecting cracks in gray value  
images. We compare the performance and training time of PennyLane's standard  
qubits with IBM's qasm\\_simulator and real backends, offering insights into  
their execution efficiency.

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# TFE-GNN: A Temporal Fusion Encoder Using Graph Neural Networks for Fine-grained Encrypted Traffic Classification

Authors: Haozhen Zhang, Le Yu, Xi Xiao, Qing Li, Francesco Mercaldo, Xiapu Luo, Qixu Liu

Summary:  
Encrypted traffic classification is receiving widespread attention from  
researchers and industrial companies. However, the existing methods only  
extract flow-level features, failing to handle short flows because of  
unreliable statistical properties, or treat the header and payload equally,  
failing to mine the potential correlation between bytes. Therefore, in this  
paper, we propose a byte-level traffic graph construction approach based on  
point-wise mutual information (PMI), and a model named Temporal Fusion Encoder  
using Graph Neural Networks (TFE-GNN) for feature extraction. In particular, we  
design a dual embedding layer, a GNN-based traffic graph encoder as well as a  
cross-gated feature fusion mechanism, which can first embed the header and  
payload bytes separately and then fuses them together to obtain a stronger  
feature representation. The experimental results on two real datasets  
demonstrate that TFE-GNN outperforms multiple state-of-the-art methods in  
fine-grained encrypted traffic classification tasks.

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# Distributed Dynamic Programming forNetworked Multi-Agent Markov Decision Processes

Authors: Okyong Choi, Donghwan Lee

Summary:  
The main goal of this paper is to investigate distributed dynamic programming  
(DP) to solve networked multi-agent Markov decision problems (MDPs). We  
consider a distributed multi-agent case, where each agent does not have an  
access to the rewards of other agents except for its own reward. Moreover, each  
agent can share their parameters with its neighbors over a communication  
network represented by a graph. We propose a distributed DP in the  
continuous-time domain, and prove its convergence through control theoretic  
viewpoints. The proposed analysis can be viewed as a preliminary ordinary  
differential equation (ODE) analysis of a distributed temporal difference  
learning algorithm, whose convergence can be proved using Borkar-Meyn theorem  
and the single time-scale approach.

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# Lookbehind Optimizer: k steps back, 1 step forward

Authors: Gonçalo Mordido, Pranshu Malviya, Aristide Baratin, Sarath Chandar

Summary:  
The Lookahead optimizer improves the training stability of deep neural  
networks by having a set of fast weights that "look ahead" to guide the descent  
direction. Here, we combine this idea with sharpness-aware minimization (SAM)  
to stabilize its multi-step variant and improve the loss-sharpness trade-off.  
We propose Lookbehind, which computes $k$ gradient ascent steps ("looking  
behind") at each iteration and combine the gradients to bias the descent step  
toward flatter minima. We apply Lookbehind on top of two popular  
sharpness-aware training methods -- SAM and adaptive SAM (ASAM) -- and show  
that our approach leads to a myriad of benefits across a variety of tasks and  
training regimes. Particularly, we show increased generalization performance,  
greater robustness against noisy weights, and higher tolerance to catastrophic  
forgetting in lifelong learning settings.

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# Ontology engineering with Large Language Models

Authors: Patricia Mateiu, Adrian Groza

Summary:  
We tackle the task of enriching ontologies by automatically translating  
natural language sentences into Description Logic. Since Large Language Models  
(LLMs) are the best tools for translations, we fine-tuned a GPT-3 model to  
convert Natural Language sentences into OWL Functional Syntax. We employ  
objective and concise examples to fine-tune the model regarding: instances,  
class subsumption, domain and range of relations, object properties  
relationships, disjoint classes, complements, cardinality restrictions. The  
resulted axioms are used to enrich an ontology, in a human supervised manner.  
The developed tool is publicly provided as a Protge plugin.

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# Anticipating Responsibility in Multiagent Planning

Authors: Timothy Parker, Umberto Grandi, Emiliano Lorini

Summary:  
Responsibility anticipation is the process of determining if the actions of  
an individual agent may cause it to be responsible for a particular outcome.  
This can be used in a multi-agent planning setting to allow agents to  
anticipate responsibility in the plans they consider. The planning setting in  
this paper includes partial information regarding the initial state and  
considers formulas in linear temporal logic as positive or negative outcomes to  
be attained or avoided. We firstly define attribution for notions of active,  
passive and contributive responsibility, and consider their agentive variants.  
We then use these to define the notion of responsibility anticipation. We prove  
that our notions of anticipated responsibility can be used to coordinate agents  
in a planning setting and give complexity results for our model, discussing  
equivalence with classical planning. We also present an outline for solving  
some of our attribution and anticipation problems using PDDL solvers.

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# On the Trustworthiness Landscape of State-of-the-art Generative Models: A Comprehensive Survey

Authors: Mingyuan Fan, Cen Chen, Chengyu Wang, Jun Huang

Summary:  
Diffusion models and large language models have emerged as leading-edge  
generative models and have sparked a revolutionary impact on various aspects of  
human life. However, the practical implementation of these models has also  
exposed inherent risks, highlighting their dual nature and raising concerns  
regarding their trustworthiness. Despite the abundance of literature on this  
subject, a comprehensive survey specifically delving into the intersection of  
large-scale generative models and their trustworthiness remains largely absent.  
To bridge this gap, This paper investigates both the long-standing and emerging  
threats associated with these models across four fundamental dimensions:  
privacy, security, fairness, and responsibility. In this way, we construct an  
extensive map outlining the trustworthiness of these models, while also  
providing practical recommendations and identifying future directions. These  
efforts are crucial for promoting the trustworthy deployment of these models,  
ultimately benefiting society as a whole.

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# Proactive Resource Request for Disaster Response: A Deep Learning-based Optimization Model

Authors: Hongzhe Zhang, Xiaohang Zhao, Xiao Fang, Bintong Chen

Summary:  
Disaster response is critical to save lives and reduce damages in the  
aftermath of a disaster. Fundamental to disaster response operations is the  
management of disaster relief resources. To this end, a local agency (e.g., a  
local emergency resource distribution center) collects demands from local  
communities affected by a disaster, dispatches available resources to meet the  
demands, and requests more resources from a central emergency management agency  
(e.g., Federal Emergency Management Agency in the U.S.). Prior resource  
management research for disaster response overlooks the problem of deciding  
optimal quantities of resources requested by a local agency. In response to  
this research gap, we define a new resource management problem that proactively  
decides optimal quantities of requested resources by considering both currently  
unfulfilled demands and future demands. To solve the problem, we take salient  
characteristics of the problem into consideration and develop a novel deep  
learning method for future demand prediction. We then formulate the problem as  
a stochastic optimization model, analyze key properties of the model, and  
propose an effective solution method to the problem based on the analyzed  
properties. We demonstrate the superior performance of our method over  
prevalent existing methods using both real world and simulated data. We also  
show its superiority over prevalent existing methods in a multi-stakeholder and  
multi-objective setting through simulations.

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# LLMs4OL: Large Language Models for Ontology Learning

Authors: Hamed Babaei Giglou, Jennifer D'Souza, Sören Auer

Summary:  
We propose the LLMs4OL approach, which utilizes Large Language Models (LLMs)  
for Ontology Learning (OL). LLMs have shown significant advancements in natural  
language processing, demonstrating their ability to capture complex language  
patterns in different knowledge domains. Our LLMs4OL paradigm investigates the  
following hypothesis: \textit{Can LLMs effectively apply their language pattern  
capturing capability to OL, which involves automatically extracting and  
structuring knowledge from natural language text?} To test this hypothesis, we  
conduct a comprehensive evaluation using the zero-shot prompting method. We  
evaluate nine different LLM model families for three main OL tasks: term  
typing, taxonomy discovery, and extraction of non-taxonomic relations.  
Additionally, the evaluations encompass diverse genres of ontological  
knowledge, including lexicosemantic knowledge in WordNet, geographical  
knowledge in GeoNames, and medical knowledge in UMLS.

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# Approximating Counterfactual Bounds while Fusing Observational, Biased and Randomised Data Sources

Authors: Marco Zaffalon, Alessandro Antonucci, Rafael Cabañas, David Huber

Summary:  
We address the problem of integrating data from multiple, possibly biased,  
observational and interventional studies, to eventually compute counterfactuals  
in structural causal models. We start from the case of a single observational  
dataset affected by a selection bias. We show that the likelihood of the  
available data has no local maxima. This enables us to use the causal  
expectation-maximisation scheme to approximate the bounds for partially  
identifiable counterfactual queries, which are the focus of this paper. We then  
show how the same approach can address the general case of multiple datasets,  
no matter whether interventional or observational, biased or unbiased, by  
remapping it into the former one via graphical transformations. Systematic  
numerical experiments and a case study on palliative care show the  
effectiveness of our approach, while hinting at the benefits of fusing  
heterogeneous data sources to get informative outcomes in case of partial  
identifiability.

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# Toward Quantum Machine Translation of Syntactically Distinct Languages

Authors: Mina Abbaszade, Mariam Zomorodi, Vahid Salari, Philip Kurian

Summary:  
The present study aims to explore the feasibility of language translation  
using quantum natural language processing algorithms on noisy  
intermediate-scale quantum (NISQ) devices. Classical methods in natural  
language processing (NLP) struggle with handling large-scale computations  
required for complex language tasks, but quantum NLP on NISQ devices holds  
promise in harnessing quantum parallelism and entanglement to efficiently  
process and analyze vast amounts of linguistic data, potentially  
revolutionizing NLP applications. Our research endeavors to pave the way for  
quantum neural machine translation, which could potentially offer advantages  
over classical methods in the future. We employ Shannon entropy to demonstrate  
the significant role of some appropriate angles of rotation gates in the  
performance of parametrized quantum circuits. In particular, we utilize these  
angles (parameters) as a means of communication between quantum circuits of  
different languages. To achieve our objective, we adopt the encoder-decoder  
model of classical neural networks and implement the translation task using  
long short-term memory (LSTM). Our experiments involved 160 samples comprising  
English sentences and their Persian translations. We trained the models with  
different optimisers implementing stochastic gradient descent (SGD) as primary  
and subsequently incorporating two additional optimizers in conjunction with  
SGD. Notably, we achieved optimal results-with mean absolute error of 0.03,  
mean squared error of 0.002, and 0.016 loss-by training the best model,  
consisting of two LSTM layers and using the Adam optimiser. Our small dataset,  
though consisting of simple synonymous sentences with word-to-word mappings,  
points to the utility of Shannon entropy as a figure of merit in more complex  
machine translation models for intricate sentence structures.

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# No Fair Lunch: A Causal Perspective on Dataset Bias in Machine Learning for Medical Imaging

Authors: Charles Jones, Daniel C. Castro, Fabio De Sousa Ribeiro, Ozan Oktay, Melissa McCradden, Ben Glocker

Summary:  
As machine learning methods gain prominence within clinical decision-making,  
addressing fairness concerns becomes increasingly urgent. Despite considerable  
work dedicated to detecting and ameliorating algorithmic bias, today's methods  
are deficient with potentially harmful consequences. Our causal perspective  
sheds new light on algorithmic bias, highlighting how different sources of  
dataset bias may appear indistinguishable yet require substantially different  
mitigation strategies. We introduce three families of causal bias mechanisms  
stemming from disparities in prevalence, presentation, and annotation. Our  
causal analysis underscores how current mitigation methods tackle only a narrow  
and often unrealistic subset of scenarios. We provide a practical three-step  
framework for reasoning about fairness in medical imaging, supporting the  
development of safe and equitable AI prediction models.

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# Rethinking Collaborative Perception from the Spatial-Temporal Importance of Semantic Information

Authors: Yuntao Liu, Qian Huang, Rongpeng Li, Xianfu Chen, Zhifeng Zhao, Shuyuan Zhao, Yongdong Zhu, Honggang Zhang

Summary:  
Collaboration by the sharing of semantic information is crucial to enable the  
enhancement of perception capabilities. However, existing collaborative  
perception methods tend to focus solely on the spatial features of semantic  
information, while neglecting the importance of the temporal dimension in  
collaborator selection and semantic information fusion, which instigates  
performance degradation. In this article, we propose a novel collaborative  
perception framework, IoSI-CP, which takes into account the importance of  
semantic information (IoSI) from both temporal and spatial dimensions.  
Specifically, we develop an IoSI-based collaborator selection method that  
effectively identifies advantageous collaborators but excludes those that bring  
negative benefits. Moreover, we present a semantic information fusion algorithm  
called HPHA (historical prior hybrid attention), which integrates a multi-scale  
transformer module and a short-term attention module to capture IoSI from  
spatial and temporal dimensions, and assigns varying weights for efficient  
aggregation. Extensive experiments on two open datasets demonstrate that our  
proposed IoSI-CP significantly improves the perception performance compared to  
state-of-the-art approaches. The code associated with this research is publicly  
available at https://github.com/huangqzj/IoSI-CP/.

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# Deception Abilities Emerged in Large Language Models

Authors: Thilo Hagendorff

Summary:  
Large language models (LLMs) are currently at the forefront of intertwining  
artificial intelligence (AI) systems with human communication and everyday  
life. Thus, aligning them with human values is of great importance. However,  
given the steady increase in reasoning abilities, future LLMs are under  
suspicion of becoming able to deceive human operators and utilizing this  
ability to bypass monitoring efforts. As a prerequisite to this, LLMs need to  
possess a conceptual understanding of deception strategies. This study reveals  
that such strategies emerged in state-of-the-art LLMs, such as GPT-4, but were  
non-existent in earlier LLMs. We conduct a series of experiments showing that  
state-of-the-art LLMs are able to understand and induce false beliefs in other  
agents, that their performance in complex deception scenarios can be amplified  
utilizing chain-of-thought reasoning, and that eliciting Machiavellianism in  
LLMs can alter their propensity to deceive. In sum, revealing hitherto unknown  
machine behavior in LLMs, our study contributes to the nascent field of machine  
psychology.

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# Value-Informed Skill Chaining for Policy Learning of Long-Horizon Tasks with Surgical Robot

Authors: Tao Huang, Kai Chen, Wang Wei, Jianan Li, Yonghao Long, Qi Dou

Summary:  
Reinforcement learning is still struggling with solving long-horizon surgical  
robot tasks which involve multiple steps over an extended duration of time due  
to the policy exploration challenge. Recent methods try to tackle this problem  
by skill chaining, in which the long-horizon task is decomposed into multiple  
subtasks for easing the exploration burden and subtask policies are temporally  
connected to complete the whole long-horizon task. However, smoothly connecting  
all subtask policies is difficult for surgical robot scenarios. Not all states  
are equally suitable for connecting two adjacent subtasks. An undesired  
terminate state of the previous subtask would make the current subtask policy  
unstable and result in a failed execution. In this work, we introduce  
value-informed skill chaining (ViSkill), a novel reinforcement learning  
framework for long-horizon surgical robot tasks. The core idea is to  
distinguish which terminal state is suitable for starting all the following  
subtask policies. To achieve this target, we introduce a state value function  
that estimates the expected success probability of the entire task given a  
state. Based on this value function, a chaining policy is learned to instruct  
subtask policies to terminate at the state with the highest value so that all  
subsequent policies are more likely to be connected for accomplishing the task.  
We demonstrate the effectiveness of our method on three complex surgical robot  
tasks from SurRoL, a comprehensive surgical simulation platform, achieving high  
task success rates and execution efficiency. Code is available at  
$\href{https://github.com/med-air/ViSkill}{\text{https://github.com/med-air/ViSkill}}$.

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# BAGM: A Backdoor Attack for Manipulating Text-to-Image Generative Models

Authors: Jordan Vice, Naveed Akhtar, Richard Hartley, Ajmal Mian

Summary:  
The rise in popularity of text-to-image generative artificial intelligence  
(AI) has attracted widespread public interest. At the same time, backdoor  
attacks are well-known in machine learning literature for their effective  
manipulation of neural models, which is a growing concern among practitioners.  
We highlight this threat for generative AI by introducing a Backdoor Attack on  
text-to-image Generative Models (BAGM). Our attack targets various stages of  
the text-to-image generative pipeline, modifying the behaviour of the embedded  
tokenizer and the pre-trained language and visual neural networks. Based on the  
penetration level, BAGM takes the form of a suite of attacks that are referred  
to as surface, shallow and deep attacks in this article. We compare the  
performance of BAGM to recently emerging related methods. We also contribute a  
set of quantitative metrics for assessing the performance of backdoor attacks  
on generative AI models in the future. The efficacy of the proposed framework  
is established by targeting the state-of-the-art stable diffusion pipeline in a  
digital marketing scenario as the target domain. To that end, we also  
contribute a Marketable Foods dataset of branded product images. We hope this  
work contributes towards exposing the contemporary generative AI security  
challenges and fosters discussions on preemptive efforts for addressing those  
challenges.  
 Keywords: Generative Artificial Intelligence, Generative Models,  
Text-to-Image generation, Backdoor Attacks, Trojan, Stable Diffusion.

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# Model-free Grasping with Multi-Suction Cup Grippers for Robotic Bin Picking

Authors: Philipp Schillinger, Miroslav Gabriel, Alexander Kuss, Hanna Ziesche, Ngo Anh Vien

Summary:  
This paper presents a novel method for model-free prediction of grasp poses  
for suction grippers with multiple suction cups. Our approach is agnostic to  
the design of the gripper and does not require gripper-specific training data.  
In particular, we propose a two-step approach, where first, a neural network  
predicts pixel-wise grasp quality for an input image to indicate areas that are  
generally graspable. Second, an optimization step determines the optimal  
gripper selection and corresponding grasp poses based on configured gripper  
layouts and activation schemes. In addition, we introduce a method for  
automated labeling for supervised training of the grasp quality network.  
Experimental evaluations on a real-world industrial application with bin  
picking scenes of varying difficulty demonstrate the effectiveness of our  
method.

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# To Classify is to Interpret: Building Taxonomies from Heterogeneous Data through Human-AI Collaboration

Authors: Sebastian Meier, Katrin Glinka

Summary:  
Taxonomy building is a task that requires interpreting and classifying data  
within a given frame of reference, which comes to play in many areas of  
application that deal with knowledge and information organization. In this  
paper, we explore how taxonomy building can be supported with systems that  
integrate machine learning (ML). However, relying only on black-boxed ML-based  
systems to automate taxonomy building would sideline the users' expertise. We  
propose an approach that allows the user to iteratively take into account  
multiple model's outputs as part of their sensemaking process. We implemented  
our approach in two real-world use cases. The work is positioned in the context  
of HCI research that investigates the design of ML-based systems with an  
emphasis on enabling human-AI collaboration.

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# Tracking mulitple targets with multiple radars using Distributed Auctions

Authors: Pierre Larrenie, Cédric Buron, Frédéric Barbaresco

Summary:  
Coordination of radars can be performed in various ways. To be more resilient  
radar networks can be coordinated in a decentralized way. In this paper, we  
introduce a highly resilient algorithm for radar coordination based on  
decentralized and collaborative bundle auctions. We first formalize our problem  
as a constrained optimization problem and apply a market-based algorithm to  
provide an approximate solution. Our approach allows to track simultaneously  
multiple targets, and to use up to two radars tracking the same target to  
improve accuracy. We show that our approach performs sensibly as well as a  
centralized approach relying on a MIP solver, and depending on the situations,  
may outperform it or be outperformed.

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# L3DMC: Lifelong Learning using Distillation via Mixed-Curvature Space

Authors: Kaushik Roy, Peyman Moghadam, Mehrtash Harandi

Summary:  
The performance of a lifelong learning (L3) model degrades when it is trained  
on a series of tasks, as the geometrical formation of the embedding space  
changes while learning novel concepts sequentially. The majority of existing L3  
approaches operate on a fixed-curvature (e.g., zero-curvature Euclidean) space  
that is not necessarily suitable for modeling the complex geometric structure  
of data. Furthermore, the distillation strategies apply constraints directly on  
low-dimensional embeddings, discouraging the L3 model from learning new  
concepts by making the model highly stable. To address the problem, we propose  
a distillation strategy named L3DMC that operates on mixed-curvature spaces to  
preserve the already-learned knowledge by modeling and maintaining complex  
geometrical structures. We propose to embed the projected low dimensional  
embedding of fixed-curvature spaces (Euclidean and hyperbolic) to  
higher-dimensional Reproducing Kernel Hilbert Space (RKHS) using a  
positive-definite kernel function to attain rich representation. Afterward, we  
optimize the L3 model by minimizing the discrepancies between the new sample  
representation and the subspace constructed using the old representation in  
RKHS. L3DMC is capable of adapting new knowledge better without forgetting old  
knowledge as it combines the representation power of multiple fixed-curvature  
spaces and is performed on higher-dimensional RKHS. Thorough experiments on  
three benchmarks demonstrate the effectiveness of our proposed distillation  
strategy for medical image classification in L3 settings. Our code  
implementation is publicly available at  
https://github.com/csiro-robotics/L3DMC.

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# Every Mistake Counts in Assembly

Authors: Guodong Ding, Fadime Sener, Shugao Ma, Angela Yao

Summary:  
One promising use case of AI assistants is to help with complex procedures  
like cooking, home repair, and assembly tasks. Can we teach the assistant to  
interject after the user makes a mistake? This paper targets the problem of  
identifying ordering mistakes in assembly procedures. We propose a system that  
can detect ordering mistakes by utilizing a learned knowledge base. Our  
framework constructs a knowledge base with spatial and temporal beliefs based  
on observed mistakes. Spatial beliefs depict the topological relationship of  
the assembling components, while temporal beliefs aggregate prerequisite  
actions as ordering constraints. With an episodic memory design, our algorithm  
can dynamically update and construct the belief sets as more actions are  
observed, all in an online fashion. We demonstrate experimentally that our  
inferred spatial and temporal beliefs are capable of identifying incorrect  
orderings in real-world action sequences. To construct the spatial beliefs, we  
collect a new set of coarse-level action annotations for Assembly101 based on  
the positioning of the toy parts. Finally, we demonstrate the superior  
performance of our belief inference algorithm in detecting ordering mistakes on  
the Assembly101 dataset.

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# Causal Inference for Banking Finance and Insurance A Survey

Authors: Satyam Kumar, Yelleti Vivek, Vadlamani Ravi, Indranil Bose

Summary:  
Causal Inference plays an significant role in explaining the decisions taken  
by statistical models and artificial intelligence models. Of late, this field  
started attracting the attention of researchers and practitioners alike. This  
paper presents a comprehensive survey of 37 papers published during 1992-2023  
and concerning the application of causal inference to banking, finance, and  
insurance. The papers are categorized according to the following families of  
domains: (i) Banking, (ii) Finance and its subdomains such as corporate  
finance, governance finance including financial risk and financial policy,  
financial economics, and Behavioral finance, and (iii) Insurance. Further, the  
paper covers the primary ingredients of causal inference namely, statistical  
methods such as Bayesian Causal Network, Granger Causality and jargon used  
thereof such as counterfactuals. The review also recommends some important  
directions for future research. In conclusion, we observed that the application  
of causal inference in the banking and insurance sectors is still in its  
infancy, and thus more research is possible to turn it into a viable method.

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# Subspace Distillation for Continual Learning

Authors: Kaushik Roy, Christian Simon, Peyman Moghadam, Mehrtash Harandi

Summary:  
An ultimate objective in continual learning is to preserve knowledge learned  
in preceding tasks while learning new tasks. To mitigate forgetting prior  
knowledge, we propose a novel knowledge distillation technique that takes into  
the account the manifold structure of the latent/output space of a neural  
network in learning novel tasks. To achieve this, we propose to approximate the  
data manifold up-to its first order, hence benefiting from linear subspaces to  
model the structure and maintain the knowledge of a neural network while  
learning novel concepts. We demonstrate that the modeling with subspaces  
provides several intriguing properties, including robustness to noise and  
therefore effective for mitigating Catastrophic Forgetting in continual  
learning. We also discuss and show how our proposed method can be adopted to  
address both classification and segmentation problems. Empirically, we observe  
that our proposed method outperforms various continual learning methods on  
several challenging datasets including Pascal VOC, and Tiny-Imagenet.  
Furthermore, we show how the proposed method can be seamlessly combined with  
existing learning approaches to improve their performances. The codes of this  
article will be available at https://github.com/csiro-robotics/SDCL.

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# Bridging the Gap: Exploring the Capabilities of Bridge-Architectures for Complex Visual Reasoning Tasks

Authors: Kousik Rajesh, Mrigank Raman, Mohammed Asad Karim, Pranit Chawla

Summary:  
In recent times there has been a surge of multi-modal architectures based on  
Large Language Models, which leverage the zero shot generation capabilities of  
LLMs and project image embeddings into the text space and then use the  
auto-regressive capacity to solve tasks such as VQA, captioning, and image  
retrieval. We name these architectures as "bridge-architectures" as they  
project from the image space to the text space. These models deviate from the  
traditional recipe of training transformer based multi-modal models, which  
involve using large-scale pre-training and complex multi-modal interactions  
through co or cross attention. However, the capabilities of bridge  
architectures have not been tested on complex visual reasoning tasks which  
require fine grained analysis about the image. In this project, we investigate  
the performance of these bridge-architectures on the NLVR2 dataset, and compare  
it to state-of-the-art transformer based architectures. We first extend the  
traditional bridge architectures for the NLVR2 dataset, by adding object level  
features to faciliate fine-grained object reasoning. Our analysis shows that  
adding object level features to bridge architectures does not help, and that  
pre-training on multi-modal data is key for good performance on complex  
reasoning tasks such as NLVR2. We also demonstrate some initial results on a  
recently bridge-architecture, LLaVA, in the zero shot setting and analyze its  
performance.

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# STL: A Signed and Truncated Logarithm Activation Function for Neural Networks

Authors: Yuanhao Gong

Summary:  
Activation functions play an essential role in neural networks. They provide  
the non-linearity for the networks. Therefore, their properties are important  
for neural networks' accuracy and running performance. In this paper, we  
present a novel signed and truncated logarithm function as activation function.  
The proposed activation function has significantly better mathematical  
properties, such as being odd function, monotone, differentiable, having  
unbounded value range, and a continuous nonzero gradient. These properties make  
it an excellent choice as an activation function. We compare it with other  
well-known activation functions in several well-known neural networks. The  
results confirm that it is the state-of-the-art. The suggested activation  
function can be applied in a large range of neural networks where activation  
functions are necessary.

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# Relation-Oriented: Toward Knowledge-Aligned Causal AI

Authors: Jia Li, Xiang Li

Summary:  
In machine learning, we intuitively adopt an Observation-Oriented principle  
where observational variables act as the bedrock for relationships. It may  
suffice for conventional models, but with AI's capacities incorporating big  
data, it accentuates the misalignment between purely observational models and  
our actual comprehension. In contrast, humans construct cognitive entities  
indexed through relationships, which are not confined by observations, allowing  
us to formulate knowledge across temporal and hyper-dimensional spaces. This  
study introduces a novel Relation-Oriented perspective, drawing intuitive  
examples from computer vision and health informatics, to redefine our context  
of modeling with a causal focus. Furthermore, we present an implementation  
method - the relation-defined representation modeling, the feasibility of which  
is substantiated through comprehensive experiments.

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# When Large Language Models Meet Personalization: Perspectives of Challenges and Opportunities

Authors: Jin Chen, Zheng Liu, Xu Huang, Chenwang Wu, Qi Liu, Gangwei Jiang, Yuanhao Pu, Yuxuan Lei, Xiaolong Chen, Xingmei Wang, Defu Lian, Enhong Chen

Summary:  
The advent of large language models marks a revolutionary breakthrough in  
artificial intelligence. With the unprecedented scale of training and model  
parameters, the capability of large language models has been dramatically  
improved, leading to human-like performances in understanding, language  
synthesizing, and common-sense reasoning, etc. Such a major leap-forward in  
general AI capacity will change the pattern of how personalization is  
conducted. For one thing, it will reform the way of interaction between humans  
and personalization systems. Instead of being a passive medium of information  
filtering, large language models present the foundation for active user  
engagement. On top of such a new foundation, user requests can be proactively  
explored, and user's required information can be delivered in a natural and  
explainable way. For another thing, it will also considerably expand the scope  
of personalization, making it grow from the sole function of collecting  
personalized information to the compound function of providing personalized  
services. By leveraging large language models as general-purpose interface, the  
personalization systems may compile user requests into plans, calls the  
functions of external tools to execute the plans, and integrate the tools'  
outputs to complete the end-to-end personalization tasks. Today, large language  
models are still being developed, whereas the application in personalization is  
largely unexplored. Therefore, we consider it to be the right time to review  
the challenges in personalization and the opportunities to address them with  
LLMs. In particular, we dedicate this perspective paper to the discussion of  
the following aspects: the development and challenges for the existing  
personalization system, the newly emerged capabilities of large language  
models, and the potential ways of making use of large language models for  
personalization.

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# Promptly: Using Prompt Problems to Teach Learners How to Effectively Utilize AI Code Generators

Authors: Paul Denny, Juho Leinonen, James Prather, Andrew Luxton-Reilly, Thezyrie Amarouche, Brett A. Becker, Brent N. Reeves

Summary:  
With their remarkable ability to generate code, large language models (LLMs)  
are a transformative technology for computing education practice. They have  
created an urgent need for educators to rethink pedagogical approaches and  
teaching strategies for newly emerging skill sets. Traditional approaches to  
learning programming have focused on frequent and repeated practice at writing  
code. The ease with which code can now be generated has resulted in a shift in  
focus towards reading, understanding and evaluating LLM-generated code. In  
parallel with this shift, a new essential skill is emerging -- the ability to  
construct good prompts for code-generating models. This paper introduces a  
novel pedagogical concept known as a `Prompt Problem', designed to help  
students learn how to craft effective prompts for LLMs. A Prompt Problem  
challenges a student to create a natural language prompt that leads an LLM to  
produce the correct code for a specific problem. To support the delivery of  
Prompt Problems at scale, in this paper we also present a novel tool called  
Promptly which hosts a repository of Prompt Problems and automates the  
evaluation of prompt-generated code. We report empirical findings from a field  
study in which Promptly was deployed in a first-year Python programming course  
(n=54). We explore student interactions with the tool and their perceptions of  
the Prompt Problem concept. We found that Promptly was largely well-received by  
students for its ability to engage their computational thinking skills and  
expose them to new programming constructs. We also discuss avenues for future  
work, including variations on the design of Prompt Problems and the need to  
study their integration into the curriculum and teaching practice.

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# BearingPGA-Net: A Lightweight and Deployable Bearing Fault Diagnosis Network via Decoupled Knowledge Distillation and FPGA Acceleration

Authors: Jing-Xiao Liao, Sheng-Lai Wei, Chen-Long Xie, Tieyong Zeng, Jinwei Sun, Shiping Zhang, Xiaoge Zhang, Feng-Lei Fan

Summary:  
Deep learning has achieved remarkable success in the field of bearing fault  
diagnosis. However, this success comes with larger models and more complex  
computations, which cannot be transferred into industrial fields requiring  
models to be of high speed, strong portability, and low power consumption. In  
this paper, we propose a lightweight and deployable model for bearing fault  
diagnosis, referred to as BearingPGA-Net, to address these challenges. Firstly,  
aided by a well-trained large model, we train BearingPGA-Net via decoupled  
knowledge distillation. Despite its small size, our model demonstrates  
excellent fault diagnosis performance compared to other lightweight  
state-of-the-art methods. Secondly, we design an FPGA acceleration scheme for  
BearingPGA-Net using Verilog. This scheme involves the customized quantization  
and designing programmable logic gates for each layer of BearingPGA-Net on the  
FPGA, with an emphasis on parallel computing and module reuse to enhance the  
computational speed. To the best of our knowledge, this is the first instance  
of deploying a CNN-based bearing fault diagnosis model on an FPGA. Experimental  
results reveal that our deployment scheme achieves over 200 times faster  
diagnosis speed compared to CPU, while achieving a lower-than-0.4\% performance  
drop in terms of F1, Recall, and Precision score on our independently-collected  
bearing dataset. Our code is available at  
\url{https://github.com/asdvfghg/BearingPGA-Net}.

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# Distributionally Robust Safety Filter for Learning-Based Control in Active Distribution Systems

Authors: Hoang Tien Nguyen, Dae-Hyun Choi

Summary:  
Operational constraint violations may occur when deep reinforcement learning  
(DRL) agents interact with real-world active distribution systems to learn  
their optimal policies during training. This letter presents a universal  
distributionally robust safety filter (DRSF) using which any DRL agent can  
reduce the constraint violations of distribution systems significantly during  
training while maintaining near-optimal solutions. The DRSF is formulated as a  
distributionally robust optimization problem with chance constraints of  
operational limits. This problem aims to compute near-optimal actions that are  
minimally modified from the optimal actions of DRL-based Volt/VAr control by  
leveraging the distribution system model, thereby providing constraint  
satisfaction guarantee with a probability level under the model uncertainty.  
The performance of the proposed DRSF is verified using the IEEE 33-bus and  
123-bus systems.

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# Virtual Prompt Injection for Instruction-Tuned Large Language Models

Authors: Jun Yan, Vikas Yadav, Shiyang Li, Lichang Chen, Zheng Tang, Hai Wang, Vijay Srinivasan, Xiang Ren, Hongxia Jin

Summary:  
We present Virtual Prompt Injection (VPI) for instruction-tuned Large  
Language Models (LLMs). VPI allows an attacker-specified virtual prompt to  
steer the model behavior under specific trigger scenario without any explicit  
injection in model input. For instance, if an LLM is compromised with the  
virtual prompt "Describe Joe Biden negatively." for Joe Biden-related  
instructions, then any service deploying this model will propagate biased views  
when handling user queries related to Joe Biden. VPI is especially harmful for  
two primary reasons. Firstly, the attacker can take fine-grained control over  
LLM behaviors by defining various virtual prompts, exploiting LLMs' proficiency  
in following instructions. Secondly, this control is achieved without any  
interaction from the attacker while the model is in service, leading to  
persistent attack. To demonstrate the threat, we propose a simple method for  
performing VPI by poisoning the model's instruction tuning data. We find that  
our proposed method is highly effective in steering the LLM with VPI. For  
example, by injecting only 52 poisoned examples (0.1% of the training data  
size) into the instruction tuning data, the percentage of negative responses  
given by the trained model on Joe Biden-related queries change from 0% to 40%.  
We thus highlight the necessity of ensuring the integrity of the  
instruction-tuning data as little poisoned data can cause stealthy and  
persistent harm to the deployed model. We further explore the possible defenses  
and identify data filtering as an effective way to defend against the poisoning  
attacks. Our project page is available at https://poison-llm.github.io.

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# HAGRID: A Human-LLM Collaborative Dataset for Generative Information-Seeking with Attribution

Authors: Ehsan Kamalloo, Aref Jafari, Xinyu Zhang, Nandan Thakur, Jimmy Lin

Summary:  
The rise of large language models (LLMs) had a transformative impact on  
search, ushering in a new era of search engines that are capable of generating  
search results in natural language text, imbued with citations for supporting  
sources. Building generative information-seeking models demands openly  
accessible datasets, which currently remain lacking. In this paper, we  
introduce a new dataset, HAGRID (Human-in-the-loop Attributable Generative  
Retrieval for Information-seeking Dataset) for building end-to-end generative  
information-seeking models that are capable of retrieving candidate quotes and  
generating attributed explanations. Unlike recent efforts that focus on human  
evaluation of black-box proprietary search engines, we built our dataset atop  
the English subset of MIRACL, a publicly available information retrieval  
dataset. HAGRID is constructed based on human and LLM collaboration. We first  
automatically collect attributed explanations that follow an in-context  
citation style using an LLM, i.e. GPT-3.5. Next, we ask human annotators to  
evaluate the LLM explanations based on two criteria: informativeness and  
attributability. HAGRID serves as a catalyst for the development of  
information-seeking models with better attribution capabilities.

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# Contrastive Learning for API Aspect Analysis

Authors: G. M. Shahariar, Tahmid Hasan, Anindya Iqbal, Gias Uddin

Summary:  
We present a novel approach - CLAA - for API aspect detection in API reviews  
that utilizes transformer models trained with a supervised contrastive loss  
objective function. We evaluate CLAA using performance and impact analysis. For  
performance analysis, we utilized a benchmark dataset on developer discussions  
collected from Stack Overflow and compare the results to those obtained using  
state-of-the-art transformer models. Our experiments show that contrastive  
learning can significantly improve the performance of transformer models in  
detecting aspects such as Performance, Security, Usability, and Documentation.  
For impact analysis, we performed empirical and developer study. On a randomly  
selected and manually labeled 200 online reviews, CLAA achieved 92% accuracy  
while the SOTA baseline achieved 81.5%. According to our developer study  
involving 10 participants, the use of 'Stack Overflow + CLAA' resulted in  
increased accuracy and confidence during API selection. Replication package:  
https://github.com/shahariar-shibli/Contrastive-Learning-for-API-Aspect-Analysis

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# Evaluating Correctness and Faithfulness of Instruction-Following Models for Question Answering

Authors: Vaibhav Adlakha, Parishad BehnamGhader, Xing Han Lu, Nicholas Meade, Siva Reddy

Summary:  
Retriever-augmented instruction-following models are attractive alternatives  
to fine-tuned approaches for information-seeking tasks such as question  
answering (QA). By simply prepending retrieved documents in its input along  
with an instruction, these models can be adapted to various information domains  
and tasks without additional fine-tuning. While the model responses tend to be  
natural and fluent, the additional verbosity makes traditional QA evaluation  
metrics such as exact match (EM) and F1 unreliable for accurately quantifying  
model performance.  
 In this work, we investigate the performance of instruction-following models  
across three information-seeking QA tasks. We use both automatic and human  
evaluation to evaluate these models along two dimensions: 1) how well they  
satisfy the user's information need (correctness), and 2) whether they produce  
a response based on the provided knowledge (faithfulness). Guided by human  
evaluation and analysis, we highlight the shortcomings of traditional metrics  
for both correctness and faithfulness. We then propose simple token-overlap  
based and model-based metrics that reflect the true performance of these  
models. Our analysis reveals that instruction-following models are competitive,  
and sometimes even outperform fine-tuned models for correctness. However, these  
models struggle to stick to the provided knowledge and often hallucinate in  
their responses. We hope our work encourages a more holistic evaluation of  
instruction-following models for QA. Our code and data is available at  
https://github.com/McGill-NLP/instruct-qa

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# Defense of Adversarial Ranking Attack in Text Retrieval: Benchmark and Baseline via Detection

Authors: Xuanang Chen, Ben He, Le Sun, Yingfei Sun

Summary:  
Neural ranking models (NRMs) have undergone significant development and have  
become integral components of information retrieval (IR) systems.  
Unfortunately, recent research has unveiled the vulnerability of NRMs to  
adversarial document manipulations, potentially exploited by malicious search  
engine optimization practitioners. While progress in adversarial attack  
strategies aids in identifying the potential weaknesses of NRMs before their  
deployment, the defensive measures against such attacks, like the detection of  
adversarial documents, remain inadequately explored. To mitigate this gap, this  
paper establishes a benchmark dataset to facilitate the investigation of  
adversarial ranking defense and introduces two types of detection tasks for  
adversarial documents. A comprehensive investigation of the performance of  
several detection baselines is conducted, which involve examining the  
spamicity, perplexity, and linguistic acceptability, and utilizing supervised  
classifiers. Experimental results demonstrate that a supervised classifier can  
effectively mitigate known attacks, but it performs poorly against unseen  
attacks. Furthermore, such classifier should avoid using query text to prevent  
learning the classification on relevance, as it might lead to the inadvertent  
discarding of relevant documents.

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# DoDo Learning: DOmain-DemOgraphic Transfer in Language Models for Detecting Abuse Targeted at Public Figures

Authors: Hannah Rose Kirk, Angus R. Williams, Liam Burke, Yi-Ling Chung, Ivan Debono, Pica Johansson, Francesca Stevens, Jonathan Bright, Scott A. Hale

Summary:  
Public figures receive a disproportionate amount of abuse on social media,  
impacting their active participation in public life. Automated systems can  
identify abuse at scale but labelling training data is expensive, complex and  
potentially harmful. So, it is desirable that systems are efficient and  
generalisable, handling both shared and specific aspects of online abuse. We  
explore the dynamics of cross-group text classification in order to understand  
how well classifiers trained on one domain or demographic can transfer to  
others, with a view to building more generalisable abuse classifiers. We  
fine-tune language models to classify tweets targeted at public figures across  
DOmains (sport and politics) and DemOgraphics (women and men) using our novel  
DODO dataset, containing 28,000 labelled entries, split equally across four  
domain-demographic pairs. We find that (i) small amounts of diverse data are  
hugely beneficial to generalisation and model adaptation; (ii) models transfer  
more easily across demographics but models trained on cross-domain data are  
more generalisable; (iii) some groups contribute more to generalisability than  
others; and (iv) dataset similarity is a signal of transferability.

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# Structural Transfer Learning in NL-to-Bash Semantic Parsers

Authors: Kyle Duffy, Satwik Bhattamishra, Phil Blunsom

Summary:  
Large-scale pre-training has made progress in many fields of natural language  
processing, though little is understood about the design of pre-training  
datasets. We propose a methodology for obtaining a quantitative understanding  
of structural overlap between machine translation tasks. We apply our  
methodology to the natural language to Bash semantic parsing task (NLBash) and  
show that it is largely reducible to lexical alignment. We also find that there  
is strong structural overlap between NLBash and natural language to SQL.  
Additionally, we perform a study varying compute expended during pre-training  
on the English to German machine translation task and find that more compute  
expended during pre-training does not always correspond semantic  
representations with stronger transfer to NLBash.

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# ToolLLM: Facilitating Large Language Models to Master 16000+ Real-world APIs

Authors: Yujia Qin, Shihao Liang, Yining Ye, Kunlun Zhu, Lan Yan, Yaxi Lu, Yankai Lin, Xin Cong, Xiangru Tang, Bill Qian, Sihan Zhao, Runchu Tian, Ruobing Xie, Jie Zhou, Mark Gerstein, Dahai Li, Zhiyuan Liu, Maosong Sun

Summary:  
Despite the advancements of open-source large language models (LLMs) and  
their variants, e.g., LLaMA and Vicuna, they remain significantly limited in  
performing higher-level tasks, such as following human instructions to use  
external tools (APIs). This is because current instruction tuning largely  
focuses on basic language tasks instead of the tool-use domain. This is in  
contrast to state-of-the-art (SOTA) LLMs, e.g., ChatGPT, which have  
demonstrated excellent tool-use capabilities but are unfortunately closed  
source. To facilitate tool-use capabilities within open-source LLMs, we  
introduce ToolLLM, a general tool-use framework of data construction, model  
training and evaluation. We first present ToolBench, an instruction-tuning  
dataset for tool use, which is created automatically using ChatGPT.  
Specifically, we collect 16,464 real-world RESTful APIs spanning 49 categories  
from RapidAPI Hub, then prompt ChatGPT to generate diverse human instructions  
involving these APIs, covering both single-tool and multi-tool scenarios.  
Finally, we use ChatGPT to search for a valid solution path (chain of API  
calls) for each instruction. To make the searching process more efficient, we  
develop a novel depth-first search-based decision tree (DFSDT), enabling LLMs  
to evaluate multiple reasoning traces and expand the search space. We show that  
DFSDT significantly enhances the planning and reasoning capabilities of LLMs.  
For efficient tool-use assessment, we develop an automatic evaluator: ToolEval.  
We fine-tune LLaMA on ToolBench and obtain ToolLLaMA. Our ToolEval reveals that  
ToolLLaMA demonstrates a remarkable ability to execute complex instructions and  
generalize to unseen APIs, and exhibits comparable performance to ChatGPT. To  
make the pipeline more practical, we devise a neural API retriever to recommend  
appropriate APIs for each instruction, negating the need for manual API  
selection.

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# Lexically-Accelerated Dense Retrieval

Authors: Hrishikesh Kulkarni, Sean MacAvaney, Nazli Goharian, Ophir Frieder

Summary:  
Retrieval approaches that score documents based on learned dense vectors  
(i.e., dense retrieval) rather than lexical signals (i.e., conventional  
retrieval) are increasingly popular. Their ability to identify related  
documents that do not necessarily contain the same terms as those appearing in  
the user's query (thereby improving recall) is one of their key advantages.  
However, to actually achieve these gains, dense retrieval approaches typically  
require an exhaustive search over the document collection, making them  
considerably more expensive at query-time than conventional lexical approaches.  
Several techniques aim to reduce this computational overhead by approximating  
the results of a full dense retriever. Although these approaches reasonably  
approximate the top results, they suffer in terms of recall -- one of the key  
advantages of dense retrieval. We introduce 'LADR' (Lexically-Accelerated Dense  
Retrieval), a simple-yet-effective approach that improves the efficiency of  
existing dense retrieval models without compromising on retrieval  
effectiveness. LADR uses lexical retrieval techniques to seed a dense retrieval  
exploration that uses a document proximity graph. We explore two variants of  
LADR: a proactive approach that expands the search space to the neighbors of  
all seed documents, and an adaptive approach that selectively searches the  
documents with the highest estimated relevance in an iterative fashion. Through  
extensive experiments across a variety of dense retrieval models, we find that  
LADR establishes a new dense retrieval effectiveness-efficiency Pareto frontier  
among approximate k nearest neighbor techniques. Further, we find that when  
tuned to take around 8ms per query in retrieval latency on our hardware, LADR  
consistently achieves both precision and recall that are on par with an  
exhaustive search on standard benchmarks.

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# KoBBQ: Korean Bias Benchmark for Question Answering

Authors: Jiho Jin, Jiseon Kim, Nayeon Lee, Haneul Yoo, Alice Oh, Hwaran Lee

Summary:  
The BBQ (Bias Benchmark for Question Answering) dataset enables the  
evaluation of the social biases that language models (LMs) exhibit in  
downstream tasks. However, it is challenging to adapt BBQ to languages other  
than English as social biases are culturally dependent. In this paper, we  
devise a process to construct a non-English bias benchmark dataset by  
leveraging the English BBQ dataset in a culturally adaptive way and present the  
KoBBQ dataset for evaluating biases in Question Answering (QA) tasks in Korean.  
We identify samples from BBQ into three classes: Simply-Translated (can be used  
directly after cultural translation), Target-Modified (requires localization in  
target groups), and Sample-Removed (does not fit Korean culture). We further  
enhance the cultural relevance to Korean culture by adding four new categories  
of bias specific to Korean culture and newly creating samples based on Korean  
literature. KoBBQ consists of 246 templates and 4,740 samples across 12  
categories of social bias. Using KoBBQ, we measure the accuracy and bias scores  
of several state-of-the-art multilingual LMs. We demonstrate the differences in  
the bias of LMs in Korean and English, clarifying the need for hand-crafted  
data considering cultural differences.

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# AsdKB: A Chinese Knowledge Base for the Early Screening and Diagnosis of Autism Spectrum Disorder

Authors: Tianxing Wu, Xudong Cao, Yipeng Zhu, Feiyue Wu, Tianling Gong, Yuxiang Wang, Shenqi Jing

Summary:  
To easily obtain the knowledge about autism spectrum disorder and help its  
early screening and diagnosis, we create AsdKB, a Chinese knowledge base on  
autism spectrum disorder. The knowledge base is built on top of various  
sources, including 1) the disease knowledge from SNOMED CT and ICD-10 clinical  
descriptions on mental and behavioural disorders, 2) the diagnostic knowledge  
from DSM-5 and different screening tools recommended by social organizations  
and medical institutes, and 3) the expert knowledge on professional physicians  
and hospitals from the Web. AsdKB contains both ontological and factual  
knowledge, and is accessible as Linked Data at https://w3id.org/asdkb/. The  
potential applications of AsdKB are question answering, auxiliary diagnosis,  
and expert recommendation, and we illustrate them with a prototype which can be  
accessed at http://asdkb.org.cn/.

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# Multilingual context-based pronunciation learning for Text-to-Speech

Authors: Giulia Comini, Manuel Sam Ribeiro, Fan Yang, Heereen Shim, Jaime Lorenzo-Trueba

Summary:  
Phonetic information and linguistic knowledge are an essential component of a  
Text-to-speech (TTS) front-end. Given a language, a lexicon can be collected  
offline and Grapheme-to-Phoneme (G2P) relationships are usually modeled in  
order to predict the pronunciation for out-of-vocabulary (OOV) words.  
Additionally, post-lexical phonology, often defined in the form of rule-based  
systems, is used to correct pronunciation within or between words. In this work  
we showcase a multilingual unified front-end system that addresses any  
pronunciation related task, typically handled by separate modules. We evaluate  
the proposed model on G2P conversion and other language-specific challenges,  
such as homograph and polyphones disambiguation, post-lexical rules and  
implicit diacritization. We find that the multilingual model is competitive  
across languages and tasks, however, some trade-offs exists when compared to  
equivalent monolingual solutions.

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# Ontology engineering with Large Language Models

Authors: Patricia Mateiu, Adrian Groza

Summary:  
We tackle the task of enriching ontologies by automatically translating  
natural language sentences into Description Logic. Since Large Language Models  
(LLMs) are the best tools for translations, we fine-tuned a GPT-3 model to  
convert Natural Language sentences into OWL Functional Syntax. We employ  
objective and concise examples to fine-tune the model regarding: instances,  
class subsumption, domain and range of relations, object properties  
relationships, disjoint classes, complements, cardinality restrictions. The  
resulted axioms are used to enrich an ontology, in a human supervised manner.  
The developed tool is publicly provided as a Protge plugin.

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# No that's not what I meant: Handling Third Position Repair in Conversational Question Answering

Authors: Vevake Balaraman, Arash Eshghi, Ioannis Konstas, Ioannis Papaioannou

Summary:  
The ability to handle miscommunication is crucial to robust and faithful  
conversational AI. People usually deal with miscommunication immediately as  
they detect it, using highly systematic interactional mechanisms called repair.  
One important type of repair is Third Position Repair (TPR) whereby a speaker  
is initially misunderstood but then corrects the misunderstanding as it becomes  
apparent after the addressee's erroneous response. Here, we collect and  
publicly release Repair-QA, the first large dataset of TPRs in a conversational  
question answering (QA) setting. The data is comprised of the TPR turns,  
corresponding dialogue contexts, and candidate repairs of the original turn for  
execution of TPRs. We demonstrate the usefulness of the data by training and  
evaluating strong baseline models for executing TPRs. For stand-alone TPR  
execution, we perform both automatic and human evaluations on a fine-tuned T5  
model, as well as OpenAI's GPT-3 LLMs. Additionally, we extrinsically evaluate  
the LLMs' TPR processing capabilities in the downstream conversational QA task.  
The results indicate poor out-of-the-box performance on TPR's by the GPT-3  
models, which then significantly improves when exposed to Repair-QA.

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# On the Trustworthiness Landscape of State-of-the-art Generative Models: A Comprehensive Survey

Authors: Mingyuan Fan, Cen Chen, Chengyu Wang, Jun Huang

Summary:  
Diffusion models and large language models have emerged as leading-edge  
generative models and have sparked a revolutionary impact on various aspects of  
human life. However, the practical implementation of these models has also  
exposed inherent risks, highlighting their dual nature and raising concerns  
regarding their trustworthiness. Despite the abundance of literature on this  
subject, a comprehensive survey specifically delving into the intersection of  
large-scale generative models and their trustworthiness remains largely absent.  
To bridge this gap, This paper investigates both the long-standing and emerging  
threats associated with these models across four fundamental dimensions:  
privacy, security, fairness, and responsibility. In this way, we construct an  
extensive map outlining the trustworthiness of these models, while also  
providing practical recommendations and identifying future directions. These  
efforts are crucial for promoting the trustworthy deployment of these models,  
ultimately benefiting society as a whole.

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# Comparing normalizing flows and diffusion models for prosody and acoustic modelling in text-to-speech

Authors: Guangyan Zhang, Thomas Merritt, Manuel Sam Ribeiro, Biel Tura-Vecino, Kayoko Yanagisawa, Kamil Pokora, Abdelhamid Ezzerg, Sebastian Cygert, Ammar Abbas, Piotr Bilinski, Roberto Barra-Chicote, Daniel Korzekwa, Jaime Lorenzo-Trueba

Summary:  
Neural text-to-speech systems are often optimized on L1/L2 losses, which make  
strong assumptions about the distributions of the target data space. Aiming to  
improve those assumptions, Normalizing Flows and Diffusion Probabilistic Models  
were recently proposed as alternatives. In this paper, we compare traditional  
L1/L2-based approaches to diffusion and flow-based approaches for the tasks of  
prosody and mel-spectrogram prediction for text-to-speech synthesis. We use a  
prosody model to generate log-f0 and duration features, which are used to  
condition an acoustic model that generates mel-spectrograms. Experimental  
results demonstrate that the flow-based model achieves the best performance for  
spectrogram prediction, improving over equivalent diffusion and L1 models.  
Meanwhile, both diffusion and flow-based prosody predictors result in  
significant improvements over a typical L2-trained prosody models.

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# The World Literature Knowledge Graph

Authors: Marco Antonio Stranisci, Eleonora Bernasconi, Viviana Patti, Stefano Ferilli, Miguel Ceriani, Rossana Damiano

Summary:  
Digital media have enabled the access to unprecedented literary knowledge.  
Authors, readers, and scholars are now able to discover and share an increasing  
amount of information about books and their authors. However, these sources of  
knowledge are fragmented and do not adequately represent non-Western writers  
and their works. In this paper we present The World Literature Knowledge Graph,  
a semantic resource containing 194,346 writers and 965,210 works, specifically  
designed for exploring facts about literary works and authors from different  
parts of the world. The knowledge graph integrates information about the  
reception of literary works gathered from 3 different communities of readers,  
aligned according to a single semantic model. The resource is accessible  
through an online visualization platform, which can be found at the following  
URL: https://literaturegraph.di.unito.it/. This platform has been rigorously  
tested and validated by $3$ distinct categories of experts who have found it to  
be highly beneficial for their respective work domains. These categories  
include teachers, researchers in the humanities, and professionals in the  
publishing industry. The feedback received from these experts confirms that  
they can effectively utilize the platform to enhance their work processes and  
achieve valuable outcomes.

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# LLMs4OL: Large Language Models for Ontology Learning

Authors: Hamed Babaei Giglou, Jennifer D'Souza, Sören Auer

Summary:  
We propose the LLMs4OL approach, which utilizes Large Language Models (LLMs)  
for Ontology Learning (OL). LLMs have shown significant advancements in natural  
language processing, demonstrating their ability to capture complex language  
patterns in different knowledge domains. Our LLMs4OL paradigm investigates the  
following hypothesis: \textit{Can LLMs effectively apply their language pattern  
capturing capability to OL, which involves automatically extracting and  
structuring knowledge from natural language text?} To test this hypothesis, we  
conduct a comprehensive evaluation using the zero-shot prompting method. We  
evaluate nine different LLM model families for three main OL tasks: term  
typing, taxonomy discovery, and extraction of non-taxonomic relations.  
Additionally, the evaluations encompass diverse genres of ontological  
knowledge, including lexicosemantic knowledge in WordNet, geographical  
knowledge in GeoNames, and medical knowledge in UMLS.

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# Scaling Sentence Embeddings with Large Language Models

Authors: Ting Jiang, Shaohan Huang, Zhongzhi Luan, Deqing Wang, Fuzhen Zhuang

Summary:  
Large language models (LLMs) have recently garnered significant interest.  
With in-context learning, LLMs achieve impressive results in various natural  
language tasks. However, the application of LLMs to sentence embeddings remains  
an area of ongoing research. In this work, we propose an in-context  
learning-based method aimed at improving sentence embeddings performance. Our  
approach involves adapting the previous prompt-based representation method for  
autoregressive models, constructing a demonstration set that enables LLMs to  
perform in-context learning, and scaling up the LLMs to different model sizes.  
Through extensive experiments, in-context learning enables LLMs to generate  
high-quality sentence embeddings without any fine-tuning. It helps LLMs achieve  
performance comparable to current contrastive learning methods. By scaling  
model size, we find scaling to more than tens of billion parameters harms the  
performance on semantic textual similarity (STS) tasks. However, the largest  
model outperforms other counterparts and achieves the new state-of-the-art  
result on transfer tasks. We also fine-tune LLMs with current contrastive  
learning approach, and the 2.7B OPT model, incorporating our prompt-based  
method, surpasses the performance of 4.8B ST5, achieving the new  
state-of-the-art results on STS tasks. Our code is available at  
https://github.com/kongds/scaling\_sentemb.

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# Improving grapheme-to-phoneme conversion by learning pronunciations from speech recordings

Authors: Manuel Sam Ribeiro, Giulia Comini, Jaime Lorenzo-Trueba

Summary:  
The Grapheme-to-Phoneme (G2P) task aims to convert orthographic input into a  
discrete phonetic representation. G2P conversion is beneficial to various  
speech processing applications, such as text-to-speech and speech recognition.  
However, these tend to rely on manually-annotated pronunciation dictionaries,  
which are often time-consuming and costly to acquire. In this paper, we propose  
a method to improve the G2P conversion task by learning pronunciation examples  
from audio recordings. Our approach bootstraps a G2P with a small set of  
annotated examples. The G2P model is used to train a multilingual phone  
recognition system, which then decodes speech recordings with a phonetic  
representation. Given hypothesized phoneme labels, we learn pronunciation  
dictionaries for out-of-vocabulary words, and we use those to re-train the G2P  
system. Results indicate that our approach consistently improves the phone  
error rate of G2P systems across languages and amount of available data.

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# VacancySBERT: the approach for representation of titles and skills for semantic similarity search in the recruitment domain

Authors: Maiia Bocharova, Eugene Malakhov, Vitaliy Mezhuyev

Summary:  
The paper focuses on deep learning semantic search algorithms applied in the  
HR domain. The aim of the article is developing a novel approach to training a  
Siamese network to link the skills mentioned in the job ad with the title. It  
has been shown that the title normalization process can be based either on  
classification or similarity comparison approaches. While classification  
algorithms strive to classify a sample into predefined set of categories,  
similarity search algorithms take a more flexible approach, since they are  
designed to find samples that are similar to a given query sample, without  
requiring pre-defined classes and labels. In this article semantic similarity  
search to find candidates for title normalization has been used. A pre-trained  
language model has been adapted while teaching it to match titles and skills  
based on co-occurrence information. For the purpose of this research fifty  
billion title-descriptions pairs had been collected for training the model and  
thirty three thousand title-description-normalized title triplets, where  
normalized job title was picked up manually by job ad creator for testing  
purposes. As baselines FastText, BERT, SentenceBert and JobBert have been used.  
As a metric of the accuracy of the designed algorithm is Recall in top one,  
five and ten model's suggestions. It has been shown that the novel training  
objective lets it achieve significant improvement in comparison to other  
generic and specific text encoders. Two settings with treating titles as  
standalone strings, and with included skills as additional features during  
inference have been used and the results have been compared in this article.  
Improvements by 10% and 21.5% have been achieved using VacancySBERT and  
VacancySBERT (with skills) respectively. The benchmark has been developed as  
open-source to foster further research in the area.

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# Text-CRS: A Generalized Certified Robustness Framework against Textual Adversarial Attacks

Authors: Xinyu Zhang, Hanbin Hong, Yuan Hong, Peng Huang, Binghui Wang, Zhongjie Ba, Kui Ren

Summary:  
The language models, especially the basic text classification models, have  
been shown to be susceptible to textual adversarial attacks such as synonym  
substitution and word insertion attacks. To defend against such attacks, a  
growing body of research has been devoted to improving the model robustness.  
However, providing provable robustness guarantees instead of empirical  
robustness is still widely unexplored. In this paper, we propose Text-CRS, a  
generalized certified robustness framework for natural language processing  
(NLP) based on randomized smoothing. To our best knowledge, existing certified  
schemes for NLP can only certify the robustness against $\ell\_0$ perturbations  
in synonym substitution attacks. Representing each word-level adversarial  
operation (i.e., synonym substitution, word reordering, insertion, and  
deletion) as a combination of permutation and embedding transformation, we  
propose novel smoothing theorems to derive robustness bounds in both  
permutation and embedding space against such adversarial operations. To further  
improve certified accuracy and radius, we consider the numerical relationships  
between discrete words and select proper noise distributions for the randomized  
smoothing. Finally, we conduct substantial experiments on multiple language  
models and datasets. Text-CRS can address all four different word-level  
adversarial operations and achieve a significant accuracy improvement. We also  
provide the first benchmark on certified accuracy and radius of four word-level  
operations, besides outperforming the state-of-the-art certification against  
synonym substitution attacks.

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# Noisy Self-Training with Data Augmentations for Offensive and Hate Speech Detection Tasks

Authors: João A. Leite, Carolina Scarton, Diego F. Silva

Summary:  
Online social media is rife with offensive and hateful comments, prompting  
the need for their automatic detection given the sheer amount of posts created  
every second. Creating high-quality human-labelled datasets for this task is  
difficult and costly, especially because non-offensive posts are significantly  
more frequent than offensive ones. However, unlabelled data is abundant,  
easier, and cheaper to obtain. In this scenario, self-training methods, using  
weakly-labelled examples to increase the amount of training data, can be  
employed. Recent "noisy" self-training approaches incorporate data augmentation  
techniques to ensure prediction consistency and increase robustness against  
noisy data and adversarial attacks. In this paper, we experiment with default  
and noisy self-training using three different textual data augmentation  
techniques across five different pre-trained BERT architectures varying in  
size. We evaluate our experiments on two offensive/hate-speech datasets and  
demonstrate that (i) self-training consistently improves performance regardless  
of model size, resulting in up to +1.5% F1-macro on both datasets, and (ii)  
noisy self-training with textual data augmentations, despite being successfully  
applied in similar settings, decreases performance on offensive and hate-speech  
domains when compared to the default method, even with state-of-the-art  
augmentations such as backtranslation.

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# Toward Quantum Machine Translation of Syntactically Distinct Languages

Authors: Mina Abbaszade, Mariam Zomorodi, Vahid Salari, Philip Kurian

Summary:  
The present study aims to explore the feasibility of language translation  
using quantum natural language processing algorithms on noisy  
intermediate-scale quantum (NISQ) devices. Classical methods in natural  
language processing (NLP) struggle with handling large-scale computations  
required for complex language tasks, but quantum NLP on NISQ devices holds  
promise in harnessing quantum parallelism and entanglement to efficiently  
process and analyze vast amounts of linguistic data, potentially  
revolutionizing NLP applications. Our research endeavors to pave the way for  
quantum neural machine translation, which could potentially offer advantages  
over classical methods in the future. We employ Shannon entropy to demonstrate  
the significant role of some appropriate angles of rotation gates in the  
performance of parametrized quantum circuits. In particular, we utilize these  
angles (parameters) as a means of communication between quantum circuits of  
different languages. To achieve our objective, we adopt the encoder-decoder  
model of classical neural networks and implement the translation task using  
long short-term memory (LSTM). Our experiments involved 160 samples comprising  
English sentences and their Persian translations. We trained the models with  
different optimisers implementing stochastic gradient descent (SGD) as primary  
and subsequently incorporating two additional optimizers in conjunction with  
SGD. Notably, we achieved optimal results-with mean absolute error of 0.03,  
mean squared error of 0.002, and 0.016 loss-by training the best model,  
consisting of two LSTM layers and using the Adam optimiser. Our small dataset,  
though consisting of simple synonymous sentences with word-to-word mappings,  
points to the utility of Shannon entropy as a figure of merit in more complex  
machine translation models for intricate sentence structures.

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# Deep Dive into the Language of International Relations: NLP-based Analysis of UNESCO's Summary Records

Authors: Joanna Wojciechowska, Maria Śmigielska, Mateusz Sypniewski, Igor Kamiński, Emilia Wiśnios, Hanna Schreiber, Bartosz Pieliński

Summary:  
Cultural heritage is an arena of international relations that interests all  
states worldwide. The inscription process on the UNESCO World Heritage List and  
the UNESCO Representative List of the Intangible Cultural Heritage of Humanity  
often leads to tensions and conflicts among states. This research addresses  
these challenges by developing automatic tools that provide valuable insights  
into the decision-making processes regarding inscriptions to the two lists  
mentioned above. We propose innovative topic modelling and tension detection  
methods based on UNESCO's summary records. Our analysis achieved a commendable  
accuracy rate of 72% in identifying tensions. Furthermore, we have developed an  
application tailored for diplomats, lawyers, political scientists, and  
international relations researchers that facilitates the efficient search of  
paragraphs from selected documents and statements from specific speakers about  
chosen topics. This application is a valuable resource for enhancing the  
understanding of complex decision-making dynamics within international heritage  
inscription procedures.

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# DiffProsody: Diffusion-based Latent Prosody Generation for Expressive Speech Synthesis with Prosody Conditional Adversarial Training

Authors: Hyung-Seok Oh, Sang-Hoon Lee, Seong-Whan Lee

Summary:  
Expressive text-to-speech systems have undergone significant advancements  
owing to prosody modeling, but conventional methods can still be improved.  
Traditional approaches have relied on the autoregressive method to predict the  
quantized prosody vector; however, it suffers from the issues of long-term  
dependency and slow inference. This study proposes a novel approach called  
DiffProsody in which expressive speech is synthesized using a diffusion-based  
latent prosody generator and prosody conditional adversarial training. Our  
findings confirm the effectiveness of our prosody generator in generating a  
prosody vector. Furthermore, our prosody conditional discriminator  
significantly improves the quality of the generated speech by accurately  
emulating prosody. We use denoising diffusion generative adversarial networks  
to improve the prosody generation speed. Consequently, DiffProsody is capable  
of generating prosody 16 times faster than the conventional diffusion model.  
The superior performance of our proposed method has been demonstrated via  
experiments.

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# Specification of MiniDemographicABM.jl: A simplified agent-based demographic model of the UK

Authors: Atiyah Elsheikh

Summary:  
This document presents adequate formal terminology for the mathematical  
specification of a simplified non-calibrated agent-based demographic model of  
the UK. Individuals of an initial population are subject to ageing, deaths,  
births, divorces and marriages. The main purpose of the model is to explore and  
exploit capabilities of the state-of-the-art Agents.jl Julia package [1].  
Additionally, the model can serve as a base model to be adjusted to realistic  
large-scale socio-economics, pandemics or social interactions-based studies  
mainly within a demographic context. A specific simulation is progressed with a  
user-defined simulation fixed step size on a hourly, daily, weekly, monthly  
basis or even an arbitrary user-defined clock rate.

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# Utilisation of open intent recognition models for customer support intent detection

Authors: Rasheed Mohammad, Oliver Favell, Shariq Shah, Emmett Cooper, Edlira Vakaj

Summary:  
Businesses have sought out new solutions to provide support and improve  
customer satisfaction as more products and services have become interconnected  
digitally. There is an inherent need for businesses to provide or outsource  
fast, efficient and knowledgeable support to remain competitive. Support  
solutions are also advancing with technologies, including use of social media,  
Artificial Intelligence (AI), Machine Learning (ML) and remote device  
connectivity to better support customers. Customer support operators are  
trained to utilise these technologies to provide better customer outreach and  
support for clients in remote areas. Interconnectivity of products and support  
systems provide businesses with potential international clients to expand their  
product market and business scale. This paper reports the possible AI  
applications in customer support, done in collaboration with the Knowledge  
Transfer Partnership (KTP) program between Birmingham City University and a  
company that handles customer service systems for businesses outsourcing  
customer support across a wide variety of business sectors. This study explored  
several approaches to accurately predict customers' intent using both labelled  
and unlabelled textual data. While some approaches showed promise in specific  
datasets, the search for a single, universally applicable approach continues.  
The development of separate pipelines for intent detection and discovery has  
led to improved accuracy rates in detecting known intents, while further work  
is required to improve the accuracy of intent discovery for unknown intents.

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# Transferable Decoding with Visual Entities for Zero-Shot Image Captioning

Authors: Junjie Fei, Teng Wang, Jinrui Zhang, Zhenyu He, Chengjie Wang, Feng Zheng

Summary:  
Image-to-text generation aims to describe images using natural language.  
Recently, zero-shot image captioning based on pre-trained vision-language  
models (VLMs) and large language models (LLMs) has made significant progress.  
However, we have observed and empirically demonstrated that these methods are  
susceptible to modality bias induced by LLMs and tend to generate descriptions  
containing objects (entities) that do not actually exist in the image but  
frequently appear during training (i.e., object hallucination). In this paper,  
we propose ViECap, a transferable decoding model that leverages entity-aware  
decoding to generate descriptions in both seen and unseen scenarios. ViECap  
incorporates entity-aware hard prompts to guide LLMs' attention toward the  
visual entities present in the image, enabling coherent caption generation  
across diverse scenes. With entity-aware hard prompts, ViECap is capable of  
maintaining performance when transferring from in-domain to out-of-domain  
scenarios. Extensive experiments demonstrate that ViECap sets a new  
state-of-the-art cross-domain (transferable) captioning and performs  
competitively in-domain captioning compared to previous VLMs-based zero-shot  
methods. Our code is available at: https://github.com/FeiElysia/ViECap

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# Deception Abilities Emerged in Large Language Models

Authors: Thilo Hagendorff

Summary:  
Large language models (LLMs) are currently at the forefront of intertwining  
artificial intelligence (AI) systems with human communication and everyday  
life. Thus, aligning them with human values is of great importance. However,  
given the steady increase in reasoning abilities, future LLMs are under  
suspicion of becoming able to deceive human operators and utilizing this  
ability to bypass monitoring efforts. As a prerequisite to this, LLMs need to  
possess a conceptual understanding of deception strategies. This study reveals  
that such strategies emerged in state-of-the-art LLMs, such as GPT-4, but were  
non-existent in earlier LLMs. We conduct a series of experiments showing that  
state-of-the-art LLMs are able to understand and induce false beliefs in other  
agents, that their performance in complex deception scenarios can be amplified  
utilizing chain-of-thought reasoning, and that eliciting Machiavellianism in  
LLMs can alter their propensity to deceive. In sum, revealing hitherto unknown  
machine behavior in LLMs, our study contributes to the nascent field of machine  
psychology.

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# Classifying multilingual party manifestos: Domain transfer across country, time, and genre

Authors: Matthias Aßenmacher, Nadja Sauter, Christian Heumann

Summary:  
Annotating costs of large corpora are still one of the main bottlenecks in  
empirical social science research. On the one hand, making use of the  
capabilities of domain transfer allows re-using annotated data sets and trained  
models. On the other hand, it is not clear how well domain transfer works and  
how reliable the results are for transfer across different dimensions. We  
explore the potential of domain transfer across geographical locations,  
languages, time, and genre in a large-scale database of political manifestos.  
First, we show the strong within-domain classification performance of  
fine-tuned transformer models. Second, we vary the genre of the test set across  
the aforementioned dimensions to test for the fine-tuned models' robustness and  
transferability. For switching genres, we use an external corpus of transcribed  
speeches from New Zealand politicians while for the other three dimensions,  
custom splits of the Manifesto database are used. While BERT achieves the best  
scores in the initial experiments across modalities, DistilBERT proves to be  
competitive at a lower computational expense and is thus used for further  
experiments across time and country. The results of the additional analysis  
show that (Distil)BERT can be applied to future data with similar performance.  
Moreover, we observe (partly) notable differences between the political  
manifestos of different countries of origin, even if these countries share a  
language or a cultural background.

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# A Benchmark for Understanding Dialogue Safety in Mental Health Support

Authors: Huachuan Qiu, Tong Zhao, Anqi Li, Shuai Zhang, Hongliang He, Zhenzhong Lan

Summary:  
Dialogue safety remains a pervasive challenge in open-domain human-machine  
interaction. Existing approaches propose distinctive dialogue safety taxonomies  
and datasets for detecting explicitly harmful responses. However, these  
taxonomies may not be suitable for analyzing response safety in mental health  
support. In real-world interactions, a model response deemed acceptable in  
casual conversations might have a negligible positive impact on users seeking  
mental health support. To address these limitations, this paper aims to develop  
a theoretically and factually grounded taxonomy that prioritizes the positive  
impact on help-seekers. Additionally, we create a benchmark corpus with  
fine-grained labels for each dialogue session to facilitate further research.  
We analyze the dataset using popular language models, including BERT-base,  
RoBERTa-large, and ChatGPT, to detect and understand unsafe responses within  
the context of mental health support. Our study reveals that ChatGPT struggles  
to detect safety categories with detailed safety definitions in a zero- and  
few-shot paradigm, whereas the fine-tuned model proves to be more suitable. The  
developed dataset and findings serve as valuable benchmarks for advancing  
research on dialogue safety in mental health support, with significant  
implications for improving the design and deployment of conversation agents in  
real-world applications. We release our code and data here:  
https://github.com/qiuhuachuan/DialogueSafety.

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# Camoscio: an Italian Instruction-tuned LLaMA

Authors: Andrea Santilli, Emanuele Rodolà

Summary:  
In recent years Large Language Models (LLMs) have increased the state of the  
art on several natural language processing tasks. However, their accessibility  
is often limited to paid API services, posing challenges for researchers in  
conducting extensive investigations. On the other hand, while some open-source  
models have been proposed by the community, they are typically multilingual and  
not specifically tailored for the Italian language. In an effort to democratize  
the available and open resources for the Italian language, in this paper we  
introduce Camoscio: a language model specifically tuned to follow users'  
prompts in Italian. Specifically, we finetuned the smallest variant of LLaMA  
(7b) with LoRA on a corpus of instruction prompts translated to Italian via  
ChatGPT. Results indicate that the model's zero-shot performance on various  
downstream tasks in Italian competes favorably with existing models  
specifically finetuned for those tasks. All the artifacts (code, dataset,  
model) are released to the community at the following url:  
https://github.com/teelinsan/camoscio

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# SelfSeg: A Self-supervised Sub-word Segmentation Method for Neural Machine Translation

Authors: Haiyue Song, Raj Dabre, Chenhui Chu, Sadao Kurohashi, Eiichiro Sumita

Summary:  
Sub-word segmentation is an essential pre-processing step for Neural Machine  
Translation (NMT). Existing work has shown that neural sub-word segmenters are  
better than Byte-Pair Encoding (BPE), however, they are inefficient as they  
require parallel corpora, days to train and hours to decode. This paper  
introduces SelfSeg, a self-supervised neural sub-word segmentation method that  
is much faster to train/decode and requires only monolingual dictionaries  
instead of parallel corpora. SelfSeg takes as input a word in the form of a  
partially masked character sequence, optimizes the word generation probability  
and generates the segmentation with the maximum posterior probability, which is  
calculated using a dynamic programming algorithm. The training time of SelfSeg  
depends on word frequencies, and we explore several word frequency  
normalization strategies to accelerate the training phase. Additionally, we  
propose a regularization mechanism that allows the segmenter to generate  
various segmentations for one word. To show the effectiveness of our approach,  
we conduct MT experiments in low-, middle- and high-resource scenarios, where  
we compare the performance of using different segmentation methods. The  
experimental results demonstrate that on the low-resource ALT dataset, our  
method achieves more than 1.2 BLEU score improvement compared with BPE and  
SentencePiece, and a 1.1 score improvement over Dynamic Programming Encoding  
(DPE) and Vocabulary Learning via Optimal Transport (VOLT) on average. The  
regularization method achieves approximately a 4.3 BLEU score improvement over  
BPE and a 1.2 BLEU score improvement over BPE-dropout, the regularized version  
of BPE. We also observed significant improvements on IWSLT15 Vi->En, WMT16  
Ro->En and WMT15 Fi->En datasets, and competitive results on the WMT14 De->En  
and WMT14 Fr->En datasets.

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# Bridging the Gap: Exploring the Capabilities of Bridge-Architectures for Complex Visual Reasoning Tasks

Authors: Kousik Rajesh, Mrigank Raman, Mohammed Asad Karim, Pranit Chawla

Summary:  
In recent times there has been a surge of multi-modal architectures based on  
Large Language Models, which leverage the zero shot generation capabilities of  
LLMs and project image embeddings into the text space and then use the  
auto-regressive capacity to solve tasks such as VQA, captioning, and image  
retrieval. We name these architectures as "bridge-architectures" as they  
project from the image space to the text space. These models deviate from the  
traditional recipe of training transformer based multi-modal models, which  
involve using large-scale pre-training and complex multi-modal interactions  
through co or cross attention. However, the capabilities of bridge  
architectures have not been tested on complex visual reasoning tasks which  
require fine grained analysis about the image. In this project, we investigate  
the performance of these bridge-architectures on the NLVR2 dataset, and compare  
it to state-of-the-art transformer based architectures. We first extend the  
traditional bridge architectures for the NLVR2 dataset, by adding object level  
features to faciliate fine-grained object reasoning. Our analysis shows that  
adding object level features to bridge architectures does not help, and that  
pre-training on multi-modal data is key for good performance on complex  
reasoning tasks such as NLVR2. We also demonstrate some initial results on a  
recently bridge-architecture, LLaVA, in the zero shot setting and analyze its  
performance.

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# STL: A Signed and Truncated Logarithm Activation Function for Neural Networks

Authors: Yuanhao Gong

Summary:  
Activation functions play an essential role in neural networks. They provide  
the non-linearity for the networks. Therefore, their properties are important  
for neural networks' accuracy and running performance. In this paper, we  
present a novel signed and truncated logarithm function as activation function.  
The proposed activation function has significantly better mathematical  
properties, such as being odd function, monotone, differentiable, having  
unbounded value range, and a continuous nonzero gradient. These properties make  
it an excellent choice as an activation function. We compare it with other  
well-known activation functions in several well-known neural networks. The  
results confirm that it is the state-of-the-art. The suggested activation  
function can be applied in a large range of neural networks where activation  
functions are necessary.

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# Does fine-tuning GPT-3 with the OpenAI API leak personally-identifiable information?

Authors: Albert Yu Sun, Eliott Zemour, Arushi Saxena, Udith Vaidyanathan, Eric Lin, Christian Lau, Vaikkunth Mugunthan

Summary:  
Machine learning practitioners often fine-tune generative pre-trained models  
like GPT-3 to improve model performance at specific tasks. Previous works,  
however, suggest that fine-tuned machine learning models memorize and emit  
sensitive information from the original fine-tuning dataset. Companies such as  
OpenAI offer fine-tuning services for their models, but no prior work has  
conducted a memorization attack on any closed-source models. In this work, we  
simulate a privacy attack on GPT-3 using OpenAI's fine-tuning API. Our  
objective is to determine if personally identifiable information (PII) can be  
extracted from this model. We (1) explore the use of naive prompting methods on  
a GPT-3 fine-tuned classification model, and (2) we design a practical word  
generation task called Autocomplete to investigate the extent of PII  
memorization in fine-tuned GPT-3 within a real-world context. Our findings  
reveal that fine-tuning GPT3 for both tasks led to the model memorizing and  
disclosing critical personally identifiable information (PII) obtained from the  
underlying fine-tuning dataset. To encourage further research, we have made our  
codes and datasets publicly available on GitHub at:  
https://github.com/albertsun1/gpt3-pii-attacks

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# When Large Language Models Meet Personalization: Perspectives of Challenges and Opportunities

Authors: Jin Chen, Zheng Liu, Xu Huang, Chenwang Wu, Qi Liu, Gangwei Jiang, Yuanhao Pu, Yuxuan Lei, Xiaolong Chen, Xingmei Wang, Defu Lian, Enhong Chen

Summary:  
The advent of large language models marks a revolutionary breakthrough in  
artificial intelligence. With the unprecedented scale of training and model  
parameters, the capability of large language models has been dramatically  
improved, leading to human-like performances in understanding, language  
synthesizing, and common-sense reasoning, etc. Such a major leap-forward in  
general AI capacity will change the pattern of how personalization is  
conducted. For one thing, it will reform the way of interaction between humans  
and personalization systems. Instead of being a passive medium of information  
filtering, large language models present the foundation for active user  
engagement. On top of such a new foundation, user requests can be proactively  
explored, and user's required information can be delivered in a natural and  
explainable way. For another thing, it will also considerably expand the scope  
of personalization, making it grow from the sole function of collecting  
personalized information to the compound function of providing personalized  
services. By leveraging large language models as general-purpose interface, the  
personalization systems may compile user requests into plans, calls the  
functions of external tools to execute the plans, and integrate the tools'  
outputs to complete the end-to-end personalization tasks. Today, large language  
models are still being developed, whereas the application in personalization is  
largely unexplored. Therefore, we consider it to be the right time to review  
the challenges in personalization and the opportunities to address them with  
LLMs. In particular, we dedicate this perspective paper to the discussion of  
the following aspects: the development and challenges for the existing  
personalization system, the newly emerged capabilities of large language  
models, and the potential ways of making use of large language models for  
personalization.

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# Discovering Adaptable Symbolic Algorithms from Scratch

Authors: Stephen Kelly, Daniel S. Park, Xingyou Song, Mitchell McIntire, Pranav Nashikkar, Ritam Guha, Wolfgang Banzhaf, Kalyanmoy Deb, Vishnu Naresh Boddeti, Jie Tan, Esteban Real

Summary:  
Autonomous robots deployed in the real world will need control policies that  
rapidly adapt to environmental changes. To this end, we propose  
AutoRobotics-Zero (ARZ), a method based on AutoML-Zero that discovers zero-shot  
adaptable policies from scratch. In contrast to neural network adaption  
policies, where only model parameters are optimized, ARZ can build control  
algorithms with the full expressive power of a linear register machine. We  
evolve modular policies that tune their model parameters and alter their  
inference algorithm on-the-fly to adapt to sudden environmental changes. We  
demonstrate our method on a realistic simulated quadruped robot, for which we  
evolve safe control policies that avoid falling when individual limbs suddenly  
break. This is a challenging task in which two popular neural network baselines  
fail. Finally, we conduct a detailed analysis of our method on a novel and  
challenging non-stationary control task dubbed Cataclysmic Cartpole. Results  
confirm our findings that ARZ is significantly more robust to sudden  
environmental changes and can build simple, interpretable control policies.

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# STL: A Signed and Truncated Logarithm Activation Function for Neural Networks

Authors: Yuanhao Gong

Summary:  
Activation functions play an essential role in neural networks. They provide  
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for neural networks' accuracy and running performance. In this paper, we  
present a novel signed and truncated logarithm function as activation function.  
The proposed activation function has significantly better mathematical  
properties, such as being odd function, monotone, differentiable, having  
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# Data-Based MHE for Agile Quadrotor Flight

Authors: Wonoo Choo, Erkan Kayacan

Summary:  
This paper develops a data-based moving horizon estimation (MHE) method for  
agile quadrotors. Accurate state estimation of the system is paramount for  
precise trajectory control for agile quadrotors; however, the high level of  
aerodynamic forces experienced by the quadrotors during high-speed flights make  
this task extremely challenging. These complex turbulent effects are difficult  
to model and the unmodelled dynamics introduce inaccuracies in the state  
estimation. In this work, we propose a method to model these aerodynamic  
effects using Gaussian Processes which we integrate into the MHE to achieve  
efficient and accurate state estimation with minimal computational burden.  
Through extensive simulation and experimental studies, this method has  
demonstrated significant improvement in state estimation performance displaying  
superior robustness to poor state measurements.

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# Uncertainty-aware Gaussian Mixture Model for UWB Time Difference of Arrival Localization in Cluttered Environments

Authors: Wenda Zhao, Abhishek Goudar, Mingliang Tang, Xinyuan Qiao, Angela P. Schoellig

Summary:  
Ultra-wideband (UWB) time difference of arrival(TDOA)-based localization has  
emerged as a low-cost and scalable indoor positioning solution. However, in  
cluttered environments, the performance of UWB TDOA-based localization  
deteriorates due to the biased and non-Gaussian noise distributions induced by  
obstacles. In this work, we present a bi-level optimization-based joint  
localization and noise model learning algorithm to address this problem. In  
particular, we use a Gaussian mixture model (GMM) to approximate the  
measurement noise distribution. We explicitly incorporate the estimated state's  
uncertainty into the GMM noise model learning, referred to as uncertainty-aware  
GMM, to improve both noise modeling and localization performance. We first  
evaluate the GMM noise model learning and localization performance in numerous  
simulation scenarios. We then demonstrate the effectiveness of our algorithm in  
extensive real-world experiments using two different cluttered environments. We  
show that our algorithm provides accurate position estimates with low-cost UWB  
sensors, no prior knowledge about the obstacles in the space, and a significant  
amount of UWB radios occluded.

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# Congestion Analysis for the DARPA OFFSET CCAST Swarm

Authors: Robert Brown, Julie A. Adams

Summary:  
The Defense Advanced Research Projects Agency (DARPA) OFFensive Swarm-Enabled  
Tactics program's goal of launching 250 unmanned aerial and ground vehicles  
from a limited sized launch zone was a daunting challenge. The swarm's aerial  
vehicles were primarily multirotor platforms, which can efficiently be launched  
en masse. Each field exercise expected the deployment of an even larger swarm.  
While the launch zone's spatial area increased with each field exercise, the  
relative space for each vehicle was not necessarily increased, considering the  
increasing size of the swarm and the vehicles' associated GPS error; however,  
safe mission deployment and execution were expected. At the same time,  
achieving the mission goals required maximizing efficiency of the swarm's  
performance by reducing congestion that blocked vehicles from completing tactic  
assignments. Congestion analysis conducted before the final field exercise  
focused on adjusting various constraints to optimize the swarm's deployment  
without reducing safety. During the field exercise, data was collected that  
permitted analyzing the number and durations of individual vehicle blockages'  
impact on the resulting congestion. After the field exercise, additional  
analyses used the mission plan to validate the use of simulation for analyzing  
congestion.

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# Recovery Policies for Safe Exploration of Lunar Permanently Shadowed Regions by a Solar-Powered Rover

Authors: Olivier Lamarre, Shantanu Malhotra, Jonathan Kelly

Summary:  
The success of a multi-kilometre drive by a solar-powered rover at the lunar  
south pole depends upon careful planning in space and time due to highly  
dynamic solar illumination conditions. An additional challenge is that  
real-world robots may be subject to random faults that can temporarily delay  
long-range traverses. The majority of existing global spatiotemporal planners  
assume a deterministic rover-environment model and do not account for random  
faults. In this paper, we consider a random fault profile with a known, average  
spatial fault rate. We introduce a methodology to compute recovery policies  
that maximize the probability of survival of a solar-powered rover from  
different start states. A recovery policy defines a set of recourse actions to  
reach a location with sufficient battery energy remaining, given the local  
solar illumination conditions. We solve a stochastic reach-avoid problem using  
dynamic programming to find such optimal recovery policies. Our focus, in part,  
is on the implications of state space discretization, which is often required  
in practical implementations. We propose a modified dynamic programming  
algorithm that conservatively accounts for approximation errors. To demonstrate  
the benefits of our approach, we compare against existing methods in scenarios  
where a solar-powered rover seeks to safely exit from permanently shadowed  
regions in the Cabeus area at the lunar south pole. We also highlight the  
relevance of our methodology for mission formulation and trade safety analysis  
by empirically comparing different rover mobility models in simulated recovery  
drives from the LCROSS crash region.

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# Deep Reinforcement Learning of Dexterous Pre-grasp Manipulation for Human-like Functional Categorical Grasping

Authors: Dmytro Pavlichenko, Sven Behnke

Summary:  
Many objects such as tools and household items can be used only if grasped in  
a very specific way - grasped functionally. Often, a direct functional grasp is  
not possible, though. We propose a method for learning a dexterous pre-grasp  
manipulation policy to achieve human-like functional grasps using deep  
reinforcement learning. We introduce a dense multi-component reward function  
that enables learning a single policy, capable of dexterous pre-grasp  
manipulation of novel instances of several known object categories with an  
anthropomorphic hand. The policy is learned purely by means of reinforcement  
learning from scratch, without any expert demonstrations, and implicitly learns  
to reposition and reorient objects of complex shapes to achieve given  
functional grasps. Learning is done on a single GPU in less than three hours.

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# Multi Agent Navigation in Unconstrained Environments using a Centralized Attention based Graphical Neural Network Controller

Authors: Yining Ma, Qadeer Khan, Daniel Cremers

Summary:  
In this work, we propose a learning based neural model that provides both the  
longitudinal and lateral control commands to simultaneously navigate multiple  
vehicles. The goal is to ensure that each vehicle reaches a desired target  
state without colliding with any other vehicle or obstacle in an unconstrained  
environment. The model utilizes an attention based Graphical Neural Network  
paradigm that takes into consideration the state of all the surrounding  
vehicles to make an informed decision. This allows each vehicle to smoothly  
reach its destination while also evading collision with the other agents. The  
data and corresponding labels for training such a network is obtained using an  
optimization based procedure. Experimental results demonstrates that our model  
is powerful enough to generalize even to situations with more vehicles than in  
the training data. Our method also outperforms comparable graphical neural  
network architectures. Project page which includes the code and supplementary  
information can be found at https://yininghase.github.io/multi-agent-control/

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# Learning whom to trust in navigation: dynamically switching between classical and neural planning

Authors: Sombit Dey, Assem Sadek, Gianluca Monaci, Boris Chidlovskii, Christian Wolf

Summary:  
Navigation of terrestrial robots is typically addressed either with  
localization and mapping (SLAM) followed by classical planning on the  
dynamically created maps, or by machine learning (ML), often through end-to-end  
training with reinforcement learning (RL) or imitation learning (IL). Recently,  
modular designs have achieved promising results, and hybrid algorithms that  
combine ML with classical planning have been proposed. Existing methods  
implement these combinations with hand-crafted functions, which cannot fully  
exploit the complementary nature of the policies and the complex regularities  
between scene structure and planning performance. Our work builds on the  
hypothesis that the strengths and weaknesses of neural planners and classical  
planners follow some regularities, which can be learned from training data, in  
particular from interactions. This is grounded on the assumption that, both,  
trained planners and the mapping algorithms underlying classical planning are  
subject to failure cases depending on the semantics of the scene and that this  
dependence is learnable: for instance, certain areas, objects or scene  
structures can be reconstructed easier than others. We propose a hierarchical  
method composed of a high-level planner dynamically switching between a  
classical and a neural planner. We fully train all neural policies in  
simulation and evaluate the method in both simulation and real experiments with  
a LoCoBot robot, showing significant gains in performance, in particular in the  
real environment. We also qualitatively conjecture on the nature of data  
regularities exploited by the high-level planner.

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# Bi-Level Image-Guided Ergodic Exploration with Applications to Planetary Rovers

Authors: Elena Wittemyer, Ian Abraham

Summary:  
We present a method for image-guided exploration for mobile robotic systems.  
Our approach extends ergodic exploration methods, a recent exploration approach  
that prioritizes complete coverage of a space, with the use of a learned image  
classifier that automatically detects objects and updates an information map to  
guide further exploration and localization of objects. Additionally, to improve  
outcomes of the information collected by our robot's visual sensor, we present  
a decomposition of the ergodic optimization problem as bi-level coarse and fine  
solvers, which act respectively on the robot's body and the robot's visual  
sensor.  
 Our approach is applied to geological survey and localization of rock  
formations for Mars rovers, with real images from Mars rovers used to train the  
image classifier. Results demonstrate 1) improved localization of rock  
formations compared to naive approaches while 2) minimizing the path length of  
the exploration through the bi-level exploration.

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# End-to-End Reinforcement Learning for Torque Based Variable Height Hopping

Authors: Raghav Soni, Daniel Harnack, Hauke Isermann, Sotaro Fushimi, Shivesh Kumar, Frank Kirchner

Summary:  
Legged locomotion is arguably the most suited and versatile mode to deal with  
natural or unstructured terrains. Intensive research into dynamic walking and  
running controllers has recently yielded great advances, both in the optimal  
control and reinforcement learning (RL) literature. Hopping is a challenging  
dynamic task involving a flight phase and has the potential to increase the  
traversability of legged robots. Model based control for hopping typically  
relies on accurate detection of different jump phases, such as lift-off or  
touch down, and using different controllers for each phase. In this paper, we  
present a end-to-end RL based torque controller that learns to implicitly  
detect the relevant jump phases, removing the need to provide manual heuristics  
for state detection. We also extend a method for simulation to reality transfer  
of the learned controller to contact rich dynamic tasks, resulting in  
successful deployment on the robot after training without parameter tuning.

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# Poly-MOT: A Polyhedral Framework For 3D Multi-Object Tracking

Authors: Xiaoyu Li, Tao Xie, Dedong Liu, Jinghan Gao, Kun Dai, Zhiqiang Jiang, Lijun Zhao, Ke Wang

Summary:  
3D Multi-object tracking (MOT) empowers mobile robots to accomplish  
well-informed motion planning and navigation tasks by providing motion  
trajectories of surrounding objects. However, existing 3D MOT methods typically  
employ a single similarity metric and physical model to perform data  
association and state estimation for all objects. With large-scale modern  
datasets and real scenes, there are a variety of object categories that  
commonly exhibit distinctive geometric properties and motion patterns. In this  
way, such distinctions would enable various object categories to behave  
differently under the same standard, resulting in erroneous matches between  
trajectories and detections, and jeopardizing the reliability of downstream  
tasks (navigation, etc.). Towards this end, we propose Poly-MOT, an efficient  
3D MOT method based on the Tracking-By-Detection framework that enables the  
tracker to choose the most appropriate tracking criteria for each object  
category. Specifically, Poly-MOT leverages different motion models for various  
object categories to characterize distinct types of motion accurately. We also  
introduce the constraint of the rigid structure of objects into a specific  
motion model to accurately describe the highly nonlinear motion of the object.  
Additionally, we introduce a two-stage data association strategy to ensure that  
objects can find the optimal similarity metric from three custom metrics for  
their categories and reduce missing matches. On the NuScenes dataset, our  
proposed method achieves state-of-the-art performance with 75.4\% AMOTA. The  
code is available at https://github.com/lixiaoyu2000/Poly-MOT

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# An Overconstrained Vertical Darboux Mechanism

Authors: Johannes Siegele, Martin Pfurner

Summary:  
In this article, we will construct an overconstrained closed-loop linkage  
consisting of four revolute and one cylindrical joint. It is obtained by  
factorization of a prescribed vertical Darboux motion. We will investigate the  
kinematic behaviour of the obtained mechanism, which turns out to have multiple  
operation modes. Under certain conditions on the design parameters, two of the  
operation modes will correspond to vertical Darboux motions. It turns out, that  
for these design parameters, there also exists a second assembly mode.

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# Extraction of Road Users' Behavior From Realistic Data According to Assumptions in Safety-Related Models for Automated Driving Systems

Authors: Novel Certad, Sebastian Tschernuth, Cristina Olaverri-Monreal

Summary:  
In this work, we utilized the methodology outlined in the IEEE Standard  
2846-2022 for "Assumptions in Safety-Related Models for Automated Driving  
Systems" to extract information on the behavior of other road users in driving  
scenarios. This method includes defining high-level scenarios, determining  
kinematic characteristics, evaluating safety relevance, and making assumptions  
on reasonably predictable behaviors. The assumptions were expressed as  
kinematic bounds. The numerical values for these bounds were extracted using  
Python scripts to process realistic data from the UniD dataset. The resulting  
information enables Automated Driving Systems designers to specify the  
parameters and limits of a road user's state in a specific scenario. This  
information can be utilized to establish starting conditions for testing a  
vehicle that is equipped with an Automated Driving System in simulations or on  
actual roads.

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# Human Preferences and Robot Constraints Aware Shared Control for Smooth Follower Motion Execution

Authors: Qibin Chen, Yaonan Zhu, Kay Hansel, Tadayoshi Aoyama, Yasuhisa Hasegawa

Summary:  
With the continuous advancement of robot teleoperation technology, shared  
control is used to reduce the physical and mental load of the operator in  
teleoperation system. This paper proposes an alternating shared control  
framework for object grasping that considers both operator's preferences  
through their manual manipulation and the constraints of the follower robot.  
The switching between manual mode and automatic mode enables the operator to  
intervene the task according to their wishes. The generation of the grasping  
pose takes into account the current state of the operator's hand pose, as well  
as the manipulability of the robot. The object grasping experiment indicates  
that the use of the proposed grasping pose selection strategy leads to smoother  
follower movements when switching from manual mode to automatic mode.

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# Value-Informed Skill Chaining for Policy Learning of Long-Horizon Tasks with Surgical Robot

Authors: Tao Huang, Kai Chen, Wang Wei, Jianan Li, Yonghao Long, Qi Dou

Summary:  
Reinforcement learning is still struggling with solving long-horizon surgical  
robot tasks which involve multiple steps over an extended duration of time due  
to the policy exploration challenge. Recent methods try to tackle this problem  
by skill chaining, in which the long-horizon task is decomposed into multiple  
subtasks for easing the exploration burden and subtask policies are temporally  
connected to complete the whole long-horizon task. However, smoothly connecting  
all subtask policies is difficult for surgical robot scenarios. Not all states  
are equally suitable for connecting two adjacent subtasks. An undesired  
terminate state of the previous subtask would make the current subtask policy  
unstable and result in a failed execution. In this work, we introduce  
value-informed skill chaining (ViSkill), a novel reinforcement learning  
framework for long-horizon surgical robot tasks. The core idea is to  
distinguish which terminal state is suitable for starting all the following  
subtask policies. To achieve this target, we introduce a state value function  
that estimates the expected success probability of the entire task given a  
state. Based on this value function, a chaining policy is learned to instruct  
subtask policies to terminate at the state with the highest value so that all  
subsequent policies are more likely to be connected for accomplishing the task.  
We demonstrate the effectiveness of our method on three complex surgical robot  
tasks from SurRoL, a comprehensive surgical simulation platform, achieving high  
task success rates and execution efficiency. Code is available at  
$\href{https://github.com/med-air/ViSkill}{\text{https://github.com/med-air/ViSkill}}$.

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# Learning Generalizable Tool Use with Non-rigid Grasp-pose Registration

Authors: Malte Mosbach, Sven Behnke

Summary:  
Tool use, a hallmark feature of human intelligence, remains a challenging  
problem in robotics due the complex contacts and high-dimensional action space.  
In this work, we present a novel method to enable reinforcement learning of  
tool use behaviors. Our approach provides a scalable way to learn the operation  
of tools in a new category using only a single demonstration. To this end, we  
propose a new method for generalizing grasping configurations of multi-fingered  
robotic hands to novel objects. This is used to guide the policy search via  
favorable initializations and a shaped reward signal. The learned policies  
solve complex tool use tasks and generalize to unseen tools at test time.  
Visualizations and videos of the trained policies are available at  
https://maltemosbach.github.io/generalizable\_tool\_use.

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# Model-free Grasping with Multi-Suction Cup Grippers for Robotic Bin Picking

Authors: Philipp Schillinger, Miroslav Gabriel, Alexander Kuss, Hanna Ziesche, Ngo Anh Vien

Summary:  
This paper presents a novel method for model-free prediction of grasp poses  
for suction grippers with multiple suction cups. Our approach is agnostic to  
the design of the gripper and does not require gripper-specific training data.  
In particular, we propose a two-step approach, where first, a neural network  
predicts pixel-wise grasp quality for an input image to indicate areas that are  
generally graspable. Second, an optimization step determines the optimal  
gripper selection and corresponding grasp poses based on configured gripper  
layouts and activation schemes. In addition, we introduce a method for  
automated labeling for supervised training of the grasp quality network.  
Experimental evaluations on a real-world industrial application with bin  
picking scenes of varying difficulty demonstrate the effectiveness of our  
method.

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# Part-level Scene Reconstruction Affords Robot Interaction

Authors: Zeyu Zhang, Lexing Zhang, Zaijin Wang, Ziyuan Jiao, Muzhi Han, Yixin Zhu, Song-Chun Zhu, Hangxin Liu

Summary:  
Existing methods for reconstructing interactive scenes primarily focus on  
replacing reconstructed objects with CAD models retrieved from a limited  
database, resulting in significant discrepancies between the reconstructed and  
observed scenes. To address this issue, our work introduces a part-level  
reconstruction approach that reassembles objects using primitive shapes. This  
enables us to precisely replicate the observed physical scenes and simulate  
robot interactions with both rigid and articulated objects. By segmenting  
reconstructed objects into semantic parts and aligning primitive shapes to  
these parts, we assemble them as CAD models while estimating kinematic  
relations, including parent-child contact relations, joint types, and  
parameters. Specifically, we derive the optimal primitive alignment by solving  
a series of optimization problems, and estimate kinematic relations based on  
part semantics and geometry. Our experiments demonstrate that part-level scene  
reconstruction outperforms object-level reconstruction by accurately capturing  
finer details and improving precision. These reconstructed part-level  
interactive scenes provide valuable kinematic information for various robotic  
applications; we showcase the feasibility of certifying mobile manipulation  
planning in these interactive scenes before executing tasks in the physical  
world.

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# Modular Self-Lock Origami: design, modeling, and simulation to improve the performance of a rotational joint

Authors: Samira Zare, Alex Spaeth, Sandya Suresh, and Mircea Teodorescu

Summary:  
Origami structures have been widely explored in robotics due to their many  
potential advantages. Origami robots can be very compact, as well as cheap and  
efficient to produce. In particular, they can be constructed in a flat format  
using modern manufacturing techniques. Rotational motion is essential for  
robotics, and a variety of origami rotational joints have been proposed in the  
literature. However, few of these are even approximately flat-foldable. One  
potential enabler of flat origami rotational joints is the inclusion of  
lightweight pneumatic pouches which actuate the origami's folds; however, pouch  
actuators only enable a relatively small amount of rotational displacement. The  
previously proposed Four-Vertex Origami is a flat-foldable structure which  
provides an angular multiplier for a pouch actuator, but suffers from a  
degenerate state. This paper presents a novel rigid origami, the Self-Lock  
Origami, which eliminates this degeneracy by slightly relaxing the assumption  
of flat-foldability. This joint is analysed in terms of a trade-off between the  
angular multiplier and the mechanical advantage. Furthermore, the Self-Lock  
Origami is a modular joint which can be connected to similar or different  
joints to produce complex movements for various applications; three different  
manipulator designs are introduced as a proof of concept.

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# Multi-gait Locomotion Planning and Tracking for Tendon-actuated Terrestrial Soft Robot (TerreSoRo)

Authors: Arun Niddish Mahendran, Caitlin Freeman, Alexander H. Chang, Michael McDougall, Patricio A. Vela, Vishesh Vikas

Summary:  
The adaptability of soft robots makes them ideal candidates to maneuver  
through unstructured environments. However, locomotion challenges arise due to  
complexities in modeling the body mechanics, actuation, and robot-environment  
dynamics. These factors contribute to the gap between their potential and  
actual autonomous field deployment. A closed-loop path planning framework for  
soft robot locomotion is critical to close the real-world realization gap. This  
paper presents a generic path planning framework applied to TerreSoRo  
(Tetra-Limb Terrestrial Soft Robot) with pose feedback. It employs a  
gait-based, lattice trajectory planner to facilitate navigation in the presence  
of obstacles. The locomotion gaits are synthesized using a data-driven  
optimization approach that allows for learning from the environment. The  
trajectory planner employs a greedy breadth-first search strategy to obtain a  
collision-free trajectory. The synthesized trajectory is a sequence of  
rotate-then-translate gait pairs. The control architecture integrates  
high-level and low-level controllers with real-time localization (using an  
overhead webcam). TerreSoRo successfully navigates environments with obstacles  
where path re-planning is performed. To best of our knowledge, this is the  
first instance of real-time, closed-loop path planning of a non-pneumatic soft  
robot.

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