## 33rd International Conference on Software Engineering & Knowledge Engineering (SEKE 2021)

Held online

Pittsburgh, Pennsylvania, USA 1-10 July 2021

ISBN: 978-1-7138-3081-8

## Printed from e-media with permission by:

Curran Associates, Inc. 57 Morehouse Lane Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

 $Copyright © (2021) \ by \ KSI \ Research \ Inc. \ and \ Knowledge \ Systems \ Institute \ Graduate \ School \ All \ rights \ reserved.$ 

Printed by Curran Associates, Inc. (2021)

For permission requests, please contact KSI Research Inc. at the address below.

KSI Research Inc. 156 Park Square Lane Pittsburgh, PA 15238 USA

Phone: 412-606-5022

office@ksiresearch.org

## Additional copies of this publication are available from:

Curran Associates, Inc. 57 Morehouse Lane Red Hook, NY 12571 USA Phone: 845-758-0400

Fax: 845-758-2633

Email: curran@proceedings.com Web: www.proceedings.com

## **Table of Contents**

Keynote: "Software Engineers Don't Care about Models, but They Want Automated Tests" by Dr. Jeff Offutt, George Mason University, USA	
	xvii
Plenary Talk: "Quantum Software Models: Instantiating Abstractions" by Dr. Iaakov Exman, Jerusalem College of Engineering, Israel	
	xviii
Keynote: "Declarative Debugging: Past, Present and Future" by Dr. Adrian Riesco, Universidad Complutense de Madrid, Spain	
	xix
Plenary Talk: "How Can Metaheuristics Help Software Engineers" by Dr. Enrique Alba, University of Malaga, Spain	
	XX
Session SAMS: Software Architecture Models and Systems	
Refactoring Java Code to MapReduce Framework (S)	1
Junfeng Zhao and Rui Feng	
ArchiNet: A Concept-token based Approach for Determining Architectural Change Categories	7
Amit Kumar Mondal, Banani Roy, Sristy Sumana Nath and Kevin Schneider	
Analyzing Open-Source Serverless Platforms: Characteristics and Performance (S)	15
Junfeng Li, Sameer Kulkarni, Ramakrishnan and Dan Li	
I-CMOMMT: A multiagent approach for patrolling and observation of mobile targets with a continuous environment representation (S)	21
Jamy Chahal, Assia Belbachir and Amal El Fallah Seghrouchni	
NVMSorting: Efficient Sorting on Non-Volatile Memory	25
Zhaole Chu, Yongping Luo, Peiquan Jin and Shouhong Wan	
HHML: A Hierarchical Hybrid Modeling Language for Mode-based Periodic Controllers	31
Zhiming Hu, Zheng Wang, Hongjian Jiang, Yuyuan Zhang and Yongxin Zhao	
Patterns for Reuse in Production Systems Engineering	37
Kristof Meixner, Arndt Lüder, Jan Herzog, Dietmar Winkler and Stefan Biffl	
Software Design Pattern Analysis for Micro-Service Architecture using Queuing Networks (S)	45
Shikuo Chang, Hanzhong Zheng and Justin Kramer	
Correctness Arguments for an SDN MAC Learning Algorithm (S)	51
Liang Hao, Xin Sun and Lan Lin	
Multiclass Classification of Four Types of UML Diagrams from Images Using Deep Learning	57
Sergei Shcherban, Peng Liang, Zengyang Li and Chen Yang	

Session ESR: Ethic Security and Reliability	
On Integrating Ethicality in User Stories (S)	63
Pankaj Kamthan and Nazlie Shahmir	
A Collaborative Forensic Framework for Detecting Advanced Persistent Threats	67
Weifeng Xu, Jie Yan and Daryl Stone	
An Empirical Study on the Impact of Class Overlapin Just-in-Time Software Defect Prediction (S)	75
Minyang Yi, Guisheng Fan, Huiqun Yu and Xingguang Yang	
FSSRE: Fusing Semantic Feature and Syntactic Dependencies Feature for threat intelligence Relation Extraction	79
Xuren Wang, Mengbo Xiong, Famei He, Peian Yang, Binghua Song, Jun Jiang, Zhengwei Jiang and Zihan Xiong	
AAMR: Automated Anomalous Microservice Ranking in Cloud-Native Environment	86
Zekun Zhang, Bing Li, Jian Wang and Yongqiang Liu	
Unsupervised Anomaly Detection Based on System Logs	92
Hao Chen, Ruizhi Xiao and Shuyuan Jin	
From Vulnerability Anti-Patterns to Secure Design Patterns (S)	98
Alok Ratnaparkhi, Onyeka Ezenwoye and Yi Liu	
Session FV: Formal Verification	
Formal Modeling and Verification of ICN-IoT Middleware Architecture (S)	102
Hongqin Zhang, Jiaqi Yin, Huibiao Zhu and Ningning Chen	
AnB2Murphi: A Translator for Converting Alice&Bob Specifications to Murphi	108
Yongxin Zhao, Hongjian Jiang, Jin Lv, Sijun Tan and Yongjian Li	
Formal verification of multitask hybrid systems by the OTS/CafeOBJ method	114
Masaki Nakamura, Kazutoshi Sakakibara, Yuki Okura and Kazuhiro Ogata	
Formal verification of IFF & NSLPK authentication protocols with CiMPG (S)	120
Thet Wai Mon, Shuho Fujii, Duong Dinh Tran and Kazuhiro Ogata	
$Formal\ verification\ of\ Anderson\ mutual\ exclusion\ protocol\ by\ introducing\ an\ auxiliary\ variable\ (S)$	126
Naoki Asae, Duong Dinh Tran and Kazuhiro Ogata	
Using LSTM to Predict Tactics in Coq	132
Xiaokun Luan, Xiyue Zhang and Meng Sun	
Formal specification and model checking of a recoverable wait-free version of MCS	138
Duong Dinh Tran, Kentaro Waki and Kazuhiro Ogata	
Fine-Grained Neural Network Abstraction for Efficient Formal Verification	144
Zhaosen Wen, Min Zhang and Weikai Miao	
Modeling and Verification of CKB Consensus Protocol in UPPAAL (S)	150
Yi-Chun Feng, Yuteng Lu and Meng Sun	
Formalization and Verification of Dubbo Using CSP	154
Zhiru Hou, Jiaqi Yin and Huibiao Zhu	
Conv-Reluplex : A Verification Framework For Convolution Neural Networks (S)	160
Jin Xu, Zishan Li, Miaomiao Zhang and Bowen Du	
Tree Ensemble Property Verification from A Testing Perspective	166

Bohao Wang, Zhe Hou, Gelin Zhang, Jianqi Shi and Yanhong Huang	
DeepAuto: A First Step Towards Formal Verification of Deep Learning Systems (S)	172
Yuteng Lu, Weidi Sun, Guangdong Bai and Meng Sun	
Evaluating the Impact of Vaccination on COVID-19 Using Model Checking <i>Xin Li</i>	177
A Novel Approach of CTL Model Checking Based on Probe Machine	183
Dong Wang, Jing Liu, Jin Xu, Haiying Sun and Jiexiang Kang	
Session SEPDSM: Software Education Project and Development and Software Maintenance	
How MOOC Videos Affect Dropout? A Lightweight Pipeline Making Student Dropout Interpretable From Several Levels	189
Deming Sheng, Jingling Yuan and Xin Zhang	
Development of an Automated Machine Learning Solution for Educational Data Mining (S)	195
Raniel Silva, Vitória Mendes, Rodrigo Rodrigues and Alexandre Maciel	
Towards the integration of the GDPR in the Unified Software Development Process (S)	199
Elena Gómez-Martínez, Miguel Marroyo and Silvia Acuña	
Remaining Activity Sequence Prediction for ongoing process instances	205
Xiaoxiao Sun, Yuke Ying, Siqing Yang and Hujun Shen	
Studying the Impact of the User Subscription Times in Different Cloud Configurations	211
Hernán-Indibil De la Cruz, María-Emilia Cambronero, Valentín Valero, Pablo Cañizares, Adrián Bernal and Alberto Núñez	
An Analysis of the State of the Art of Machine Learning for Risk Assessment in Software Projects (S)	217
André Sousa, João Faria and João Moreira	
Towards a Comprehensive Understanding of Agile Teamwork: A literature-based Thematic Network	223
Arthur Freire, Manuel Neto, Mirko Perkusich, Alexandre Costa, Kyller Gorgônio, Hyggo Almeida and Angelo Perkusich	
A Comparative Study of Psychometric Instrumentsin Software Engineering	229
Gleyser Guimarães, Mirko Perkusich, Danyllo Albuquerque, Everton Guimaraes, Danilo Santos, Hyggo Almeida and Angelo Perkusich	
Evaluating a Bayesian Network to Predict Customer Satisfaction in Scrum Software Development Projects: An Empirical Study with One Company	235
Mirko Perkusich, Gleyser Guimarães, Kyller Costa Gorgônio, Hyggo Almeida and Angelo Perkusich	
Towards Automatically Generating Release Notes using Extractive Summarization Technique	241
Sristy Sumana Nath and Banani Roy	
Understanding the Impact of COVID-19 on Github Developers: A Preliminary Study	249
Liu Wang, Ruiqing Li, Jiaxin Zhu, Guangdong Bai, Weihang Su and Haoyu Wang	
Analyzing Program Comprehensibility of Go Projects	255
Moumita Asad, Rafed Muhammad Yasir, Shihab Shahriar Khan, Nadia Nahar and Md Nurul Ahad Tawhid	

What Do Developers Reply To? An Empirical Study of the Top Unmanned Aerial Vehicles (UAVs) Apps (S)	261
Fatma Outay, David Dampier and Haroon Malik	
Quantifying Synergy between Software Projects using README Files Only (S)	265
Roxanne El Baff, Sivasurya Santhanam and Tobias Hecking	
Evaluating a Tool for Creating Bug Report Assignment Recommenders (S)	271
Disha Devaiya, John Anvik, Meher Bheree and Farjana Yeasmin Omee	
Session RPC: Requirements and Program Comprehension	
A family of experiments for evaluating the usability of a collaborative modelling chatbot	275
Ranci Ren, John Castro and Silvia Acuña	
Evaluation of Chatbots Usability Experimentation (S)	281
Ranci Ren, John Castro and Silvia Acuña	
From word embeddings to text similarities for improved semantic clustering of functional requirements (S)	285
Takwa Kochbati, Shuai Li, Sébastien Gerard and Mraidha Chokri	
Investigating Process Algebra Models to Represent Structured Requirements for Time-sensitive CPS	291
Mathilde Arnaud, Boutheina Bannour, Arnault Lapitre and Guillaume Giraud	
Risk Analysis for Collaborative Systems during Requirements Engineering (S)	297
Kirthy Kolluri, Robert Ahn, Tom Hill and Lawrence Chung	
Requirements Formality Levels Analysis and Transformation of Formal Notations into Semi-formal and Informal Notations (S)	303
Aya Zaki Ismail, Mohamed Osama, Mohamed Abdelrazek, John Grundy and Amani Ibrahim	
Session RC: Recommendation and Classification	
Spatial-Temporal Forecast of the probability distribution of Oceanic Nino Index for various lead times	309
Jahnavi Jonnalagadda and Mahdi Hashemi	
Recurrent Neural Graph Collaborative Filtering	315
Beichuan Zhang, Zhijiao Xiao and Shenghua Zhong	
Deep Self-Attention for Sequential Recommendation (S)	321
Beichuan Zhang, Zhijiao Xiao and Shenghua Zhong	
A recommender system to assist conceptual modeling with UML	327
Maxime Savary-Leblanc, Xavier Le Pallec and Sebastien Gerard	
Evaluating Visual Explanation of Bug Report Assignment Recommendations (S)	334
Shayla Bhuyan and John Anvik	
A Practical User Feedback Classifier for Software Quality Characteristics	340
Rubens dos Santos, Karina Villela, Diego Avila and Lucineia Heloisa Thom	
Improved Multiple Part Algorithm (IMPA) to extract multiple solutions for RNA sequence classification problem	346
Naoual Guannoni, Faouzi Mhamdi and Mourad Elloumi	
Attention Guided Filter for Jointly Extracting Entities and Classifying Relations	352
Shaoze Chen. Su Wang and Wenxin Hu	

Multi-Label Classification of Parrott's Emotions	359
Abhijit Mondal and Swapna Gokhale	
Special Session SEKEEO: Software Engineering and Knowledge Engineering Education	
On Conducting Tests in Software Engineering Courses during the COVID-19 Pandemic (S)	365
Pankaj Kamthan	
Revisiting UML Class Relationship Recovery for Online Education (S)	369
Dionysis Athanasopoulos	
Extracting Prerequisite Relations among Concepts from the Introduction of Online Courses (S)	375
Zesong Wang, Kui Xiao, Zeqing Qin and Shihui Wang	
A Technical Capability Evaluation Model Based Concept and Prerequisite Relation in Computer Education (S)	381
Jiwen Luo, Tao Wang, Junsheng Chang and Xiaoting Guo	
Session KO: Knowledge and Ontology	
Triangle Counting by Adaptively Resampling over Evolving Graph Streams	387
Wei Xuan, Huawei Cao, Mingyu Yan, Zhimin Tang, Xiaochun Ye and Dongrui Fan	
Influence Maximization with Consideration of PageRank Centrality and Propagation Probability	393
Qi Chen and Rong Yan	
Grasping or Forgetting? MAKT: A Dynamic Model via Multi-head Self-Attention for Knowledge Tracing	399
Deming Sheng, Jingling Yuan and Xin Zhang	
Deep Similarity Preserving and Attention-based Hashing for Cross-Modal Retrieval	405
Shubai Chen, Song Wu, Yu Chen and Yuan Yuan	
An Efficient ROS Package Searching Approach Powered By Knowledge Graph	411
Long Chen, Xinjun Mao, Yinyuan Zhang, Shuo Yang and Shuo Wang	
KatGCN: Knowledge-Aware Attention based Temporal Graph Convolutional Network for Multi- Event Prediction	417
Xin Song, Haiyang Wang, Kang Zeng, Yujia Liu and Bin Zhou	
SolDetector: Detect Defects Based on Knowledge Graph of Solidity Smart Contract	423
Tianyuan Hu, Zhenyu Pan and Bixin Li	
SMART: Towards Automated Mapping between Data Specifications	429
Safia Kalwar, Mersedeh Sadeghi, Alireza Javadian Sabet, Alexander Nemirovskiy and Matteo Giovanni Rossi	
Incorporating Presuppositions of Competency Questions into Test-Driven Development of Ontologies (S)	437
Jedrzej Potoniec, Dawid Wiśniewski and Agnieszka Ławrynowicz	
Session ML: Machine Learning	
Ride Hailing Service Demand Forecast by Integrating Convolutional and Recurrent Neural Networks	441
Zinat Ara and Mahdi Hashemi	
Transfer Learning-based City Similarity Measurement: A Case Study on Urban Hotel (S)	447

Ganghua Zhang and Xiaoping Che	
A hierarchical RNN-based model for learning recommendation with session intent detection	45
Jinyang Liu, Chuantao Yin, Xiaoyan Zhang, Kunyang Wang and Hong Zhou	
Intelligent Preprocessing Selection for Pavement Crack Detection based on Deep Reinforcement Learning	458
Yan Lin, Guosheng Xu, Guoai Xu, Siyi Li, Jie Deng and Jiankun Cao	
Inspect Defect of Power Equipment via Deep Learning Method	464
Qi Zhang, Qingsong Cai and Jianhui Zheng	
A method for generating various style Chinese fonts in the absence of training data (S)	470
Kang Shi and Tian-Ming Bu	
Multi-Fusion with Attention Mechanism for 3D Object Detection	475
Ning Wang and Ping Sun	
SADA: Improved Data Symbolization and Optimization Method on HAR from Microscopic Perspective	481
Men Huichao and Wang Botao	
HARP Pro: Hierarchical Representation Learning based on global and local features for social networks	487
Wei Zhang, Jing Yang and Fanshu Shang	
A Volume-Aware Positional Attention-Based Recurrent Neural Network for Stock Index Prediction Xinpeng Yu and Dagang Li	493
Session STPTA: Software Testing Program Test and Analysis	
DeepSCC: Source Code Classification Based on Fine-Tuned RoBERTa (S)	499
Guang Yang, Yanlin Zhou, Chi Yu and Xiang Chen	
Multi-Granularity Code Smell Detection using Deep Learning Method based on Abstract Syntax Tree	503
Weiwei Xu and Xiaofang Zhang	
FCEP: A Fast Concolic Execution for Reaching Software Patches	510
Meng Fan, Wenzhi Wang, Aimin Yu and Dan Meng	
Leveraging Compiler Optimization for Code Clone Detection	516
Shirish Singh, Harshit Singhal and Bharavi Mishra	
Which Factors Affect Q-Learning-based Automated Android Testing? – A Study Focusing on Algorithm, Learning Target, and Reward Function –	522
Yuki Moriguchi and Shingo Takada	
MACA: A Residual Network with Multi-Attention and Core Attributes for Code Search (S)	528
Lian Gu, Zihui Wang, Jiaxin Liu, Yating Zhang, Dong Yang and Wei Dong	
Dynamically Detecting Invariants for Automatic Testing PLC Programs (S)	532
Zeyu Lu, Xia Mao, Yanhong Huang, Jianqi Shi and Yang Yang	
Optimal Conjunctive Normal Form Encoding for Symbolic Execution	538
Weiyu Pan, Ziqi Shuai, Ke Ma and Luyao Liu	
Graph queries for analyzing the coverage of requirements by test cases	544
Shingo Ariwaka, Hiroyuki Nakagawa and Tatsuhiro Tsuchiya	

Using the Normalized Levenshtein Distance to Analyze Relationship between Faults and Local Variables with Confusing Names: A further Investigation (S)	550
Carmine Gravino, Alessandra Orsi and Michele Risi	
A Framework for Mutation Testing of Machine Learning Systems (S)	554
Raju Singh and Mukesh Kumar Rohil	
A Case Study of Testing an Image Recognition Application (S)	560
Chuanqi Tao, Dongyu Cao, Hongjing Guo and Jerry Gao	
Session NLTPDM: Natural Language and Text Processing and Data Mining	
A Novel Text Classification Approach based on Meta-path Similarities and Graph Neural Networks	564
Huan Wang, Jiang Li, Qing Zhou and Liang Ge	
Model-Agnostic Local Explanations with Genetic Algorithms for Text Classification	570
Qingfeng Du and Jincheng Xu	
Towards a Better Understanding of Gradient-Based Explanatory Methods in NLP	576
Qingfeng Du and Jincheng Xu	
Relation Extraction Model Based on Keywords Attention (S)	582
Yu Chen, Jianxia Chen, Chang Liu and Qi Liu	
Chinese Sentence Semantic Matching With Multi-Granularity Based on Siamese Neural Network	586
Xuan Wen, Jianxia Chen, Yu Chen and Shirui Sheng	
Complementary Representation of ALBERT for Text Summarization	592
Wenying Guo, Bin Wu, Bai Wang, Lianwei Li, Junwei Sun and Maham Nazir	
BEHIND: a 4W-oriented Method for Event Detection from Twitter	598
Kang Zeng, Yujia Liu, Xin Song and Bin Zhou	
ATFE: A Two-dimensional Feature Encoding-based Sentence-level Attention Model for Distant Supervised Relation Extraction	604
Shiyang Li and Qianqian Ren	
Extracting information from driving data using k-means clustering (S)	610
Nour Chetouane, Lorenz Klampfl and Franz Wotawa	
RoBF: An Auto-Tuning Bloom Filter for Mixed Queries on LSM-Tree	616
Ruicheng Liu, Peiquan Jin, Shouhong Wan and Bei Hua	
Using Surrounding Text of Formula towards More Accurate Mathematical Information Retrieval	622
Cheng Chen, Yifan Dai, Yuqi Shen, Jinfang Cai and Liangyu Chen	
Automatic Comprehension of Geometry Problems using AMR Parser (S)	628
Anca-Elena Iordan	
Special Session DEMO: Technial Demos	
AutoCom: Automatic Comment Generation for C Code (D)	632
Zhikang Tian and Yuekang Li	
Water-Wheel: Real-Time Storage with High Throughput and Scalability for Big Data Streams (D)	634
Yanqi Lv, Ruicheng Liu and Peiquan Jin	
MT4ImgRec:A Metamorphic Testing Tool for Image Recognition Software (D)	636
Dongyu Cao, Hongjing Guo and Chuanqi Tao	

Post2Event: Extracting Key Events from Microblogs (D)	637
Chongwei Wang, Xujian Zhao, Peiquan Jin, Hui Zhang, Chunming Yang and Bo Li	
CASTR: Assisting Bug Report Assignment Recommender Creation (D)	639
Disha Thakarshibhai Devaiya, John Anvik, Farjana Yeasmin Omee and Meher Bheree	

**Notes:** (S) denotes a short paper. (D) denotes a demo description.