Seminar Jaminan Kualiti Sistem Aplikasi Sektor Awam 2023

Artificial Intelligence <=> Software Quality

Ts. Dr. Mohd Hafeez Osman

31.10.2023

Emerging Technologies

Top 15 New Technology Trends 2023

AI and Automation
- AI in Healthcare
- Automation in Manufacturing
- AI in Customer Service
- AI and Cybersecurity

Blockchain
- Blockchain in Supply Chain Management
- Decentralized Finance (DeFi)
- NFTs and Digital Ownership

5G Networks
- Enhanced Mobile Broadband (eMBB)
- Massive Machine Type Communications (mMTC)
- Ultra-Reliable Low-Latency Communications (URLLC)

Quantum Computing
- Quantum Cryptography
- Quantum Machine Learning
- Quantum Simulation

Edge Computing
- Edge AI
- Edge Analytics
- Edge Security

Augmented Reality (AR)
- AR in Retail
- AR in Education
- AR in Gaming

Virtual Reality (VR)
- VR in Healthcare
- VR in Education
- VR in Gaming

The Metaverse
- Virtual Worlds
- Virtual Economies
- Social Metaverse

Space Technology
- Space Tourism
- Space Mining
- Space Debris Cleanup

Biometrics
- Facial Recognition
- Voice Recognition
- Fingerprint Recognition

Cybersecurity
- Zero Trust Security
- AI in Cybersecurity
- Cybersecurity Regulations

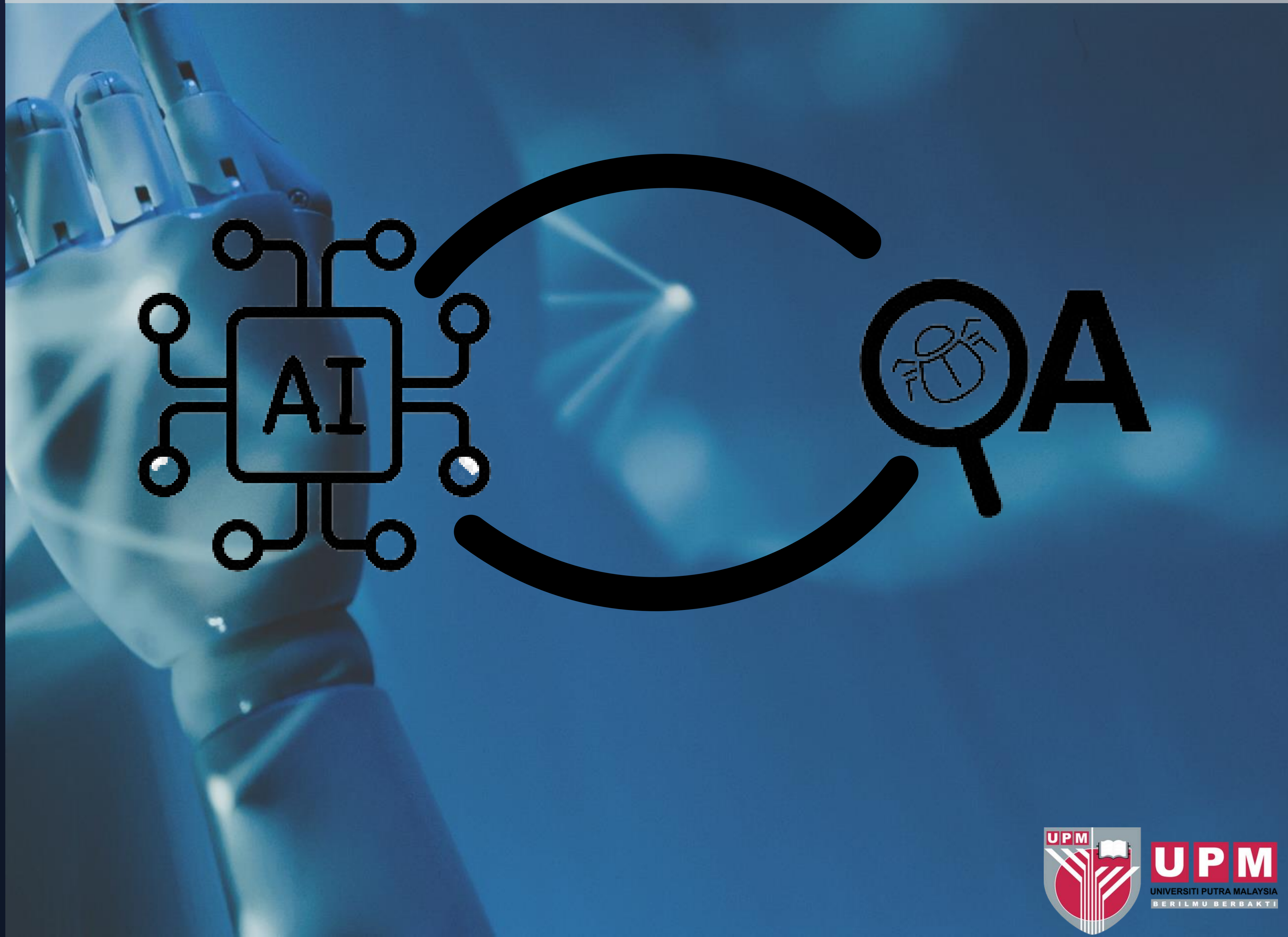
Cloud Computing
- Hybrid Cloud
- Edge Cloud
- Serverless Computing

Internet of Things (IoT)
- Smart Homes
- Smart Cities
- Industrial IoT

Extended Reality (XR)
- XR in Architecture and Design
- XR in Sports
- XR in Entertainment

Robotics
- Collaborative Robots (Cobots)
- Autonomous Robots
- Medical Robotics

WHIZLABS



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searching

KNOWLEDGE

LEARNING

AI

UNCERTAINTY

Optimization

NEURAL NETWORKS

LANGUAGE

source: CS50's Introductioin to Artificial Intelligence with Python, Harvard Univ.

Software Quality for Ai-based Software

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Source: ChatGPT :)

Software Quality for Ai-based Software

Data Quality:

- High-quality training data is essential for building accurate AI models. **Data should be clean, labeled correctly, and representative of the problem domain**. Data preprocessing and cleansing are critical to ensure the model's performance.

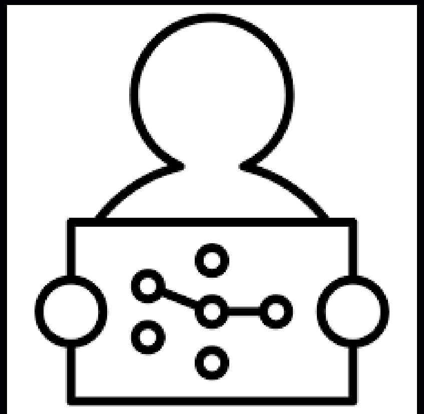
Model Accuracy:

- The primary measure of AI quality is its accuracy in making predictions or classifications. This requires **careful model selection, training, and evaluation to achieve desired performance levels.**

Software Quality for Ai-based Software

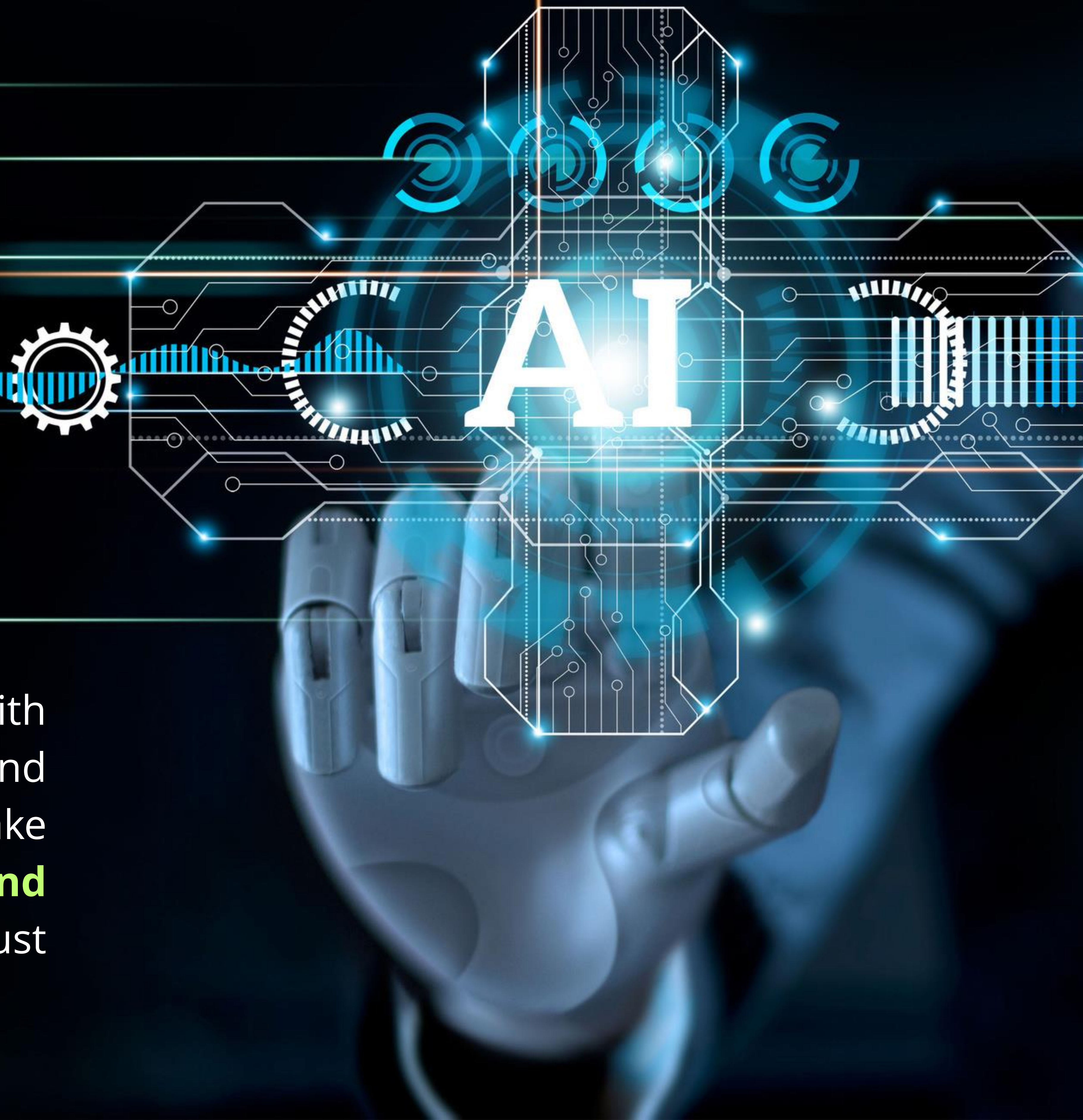
Model Robustness:

- AI systems should be tested for their ability to **handle a wide range of input data,** including edge cases and outliers. Robustness testing helps ensure the system's reliability in real-world scenarios.

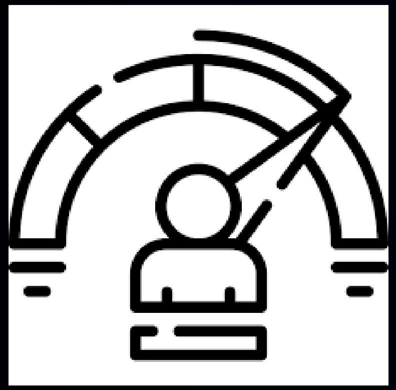


Explainability and Interpretability:

- For many AI applications, especially those with high stakes (e.g., healthcare, finance, and autonomous systems), it's essential to make **the model's decisions explainable and interpretable**. This can help gain user trust and satisfy regulatory requirements.



Software Quality for Ai-based Software



Performance and Scalability:

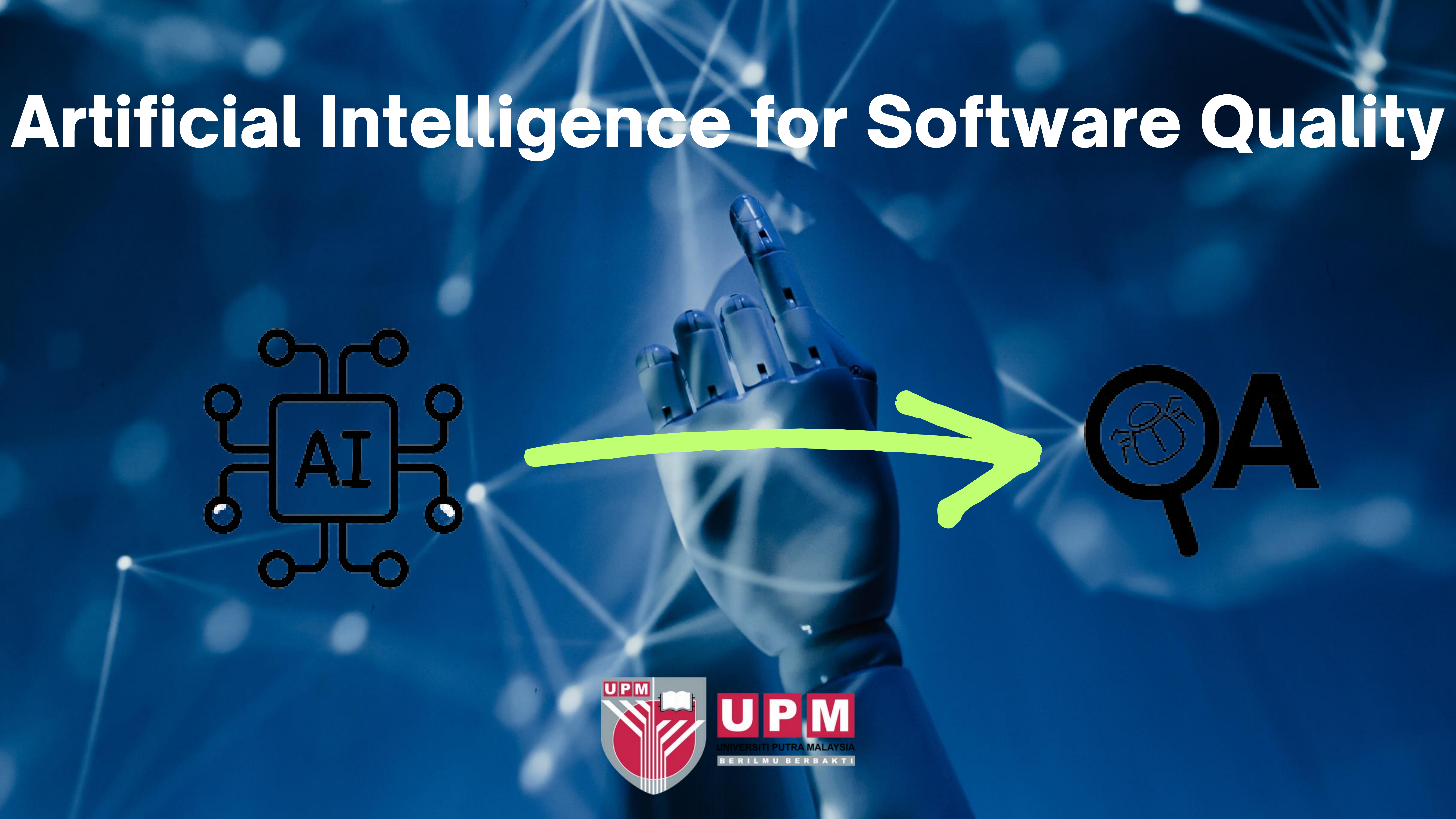
- AI models should be able to **perform efficiently and scale as needed** to handle real-world workloads. Performance optimization is often necessary to ensure that AI systems can meet user expectations.

Continuous Monitoring and Maintenance:

- **AI models can degrade over time as the data distribution shifts or the environment changes**. Regular monitoring and maintenance are essential to ensure that the AI system remains accurate and reliable.

Software Quality for Ai-based Software

Software quality for artificial intelligence applications is multifaceted and requires careful consideration of data, model, ethics, security, and more. Thorough testing, monitoring, and maintenance are crucial to ensure that AI systems remain effective and reliable in a rapidly evolving field.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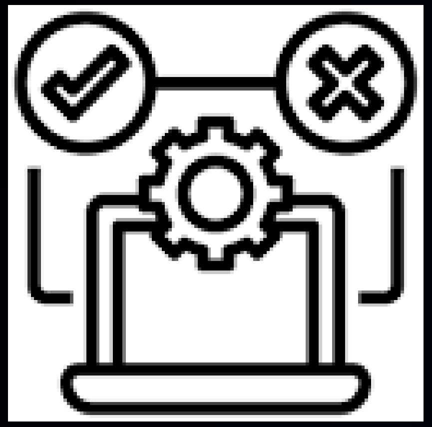
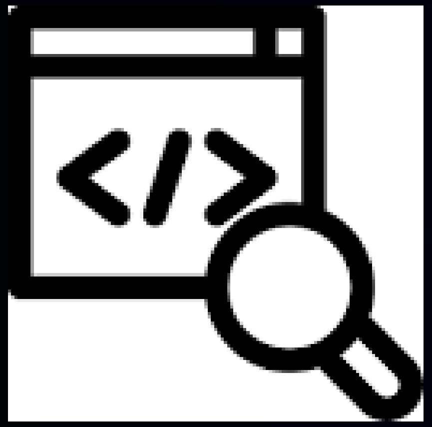
Artificial Intelligence for Software Quality



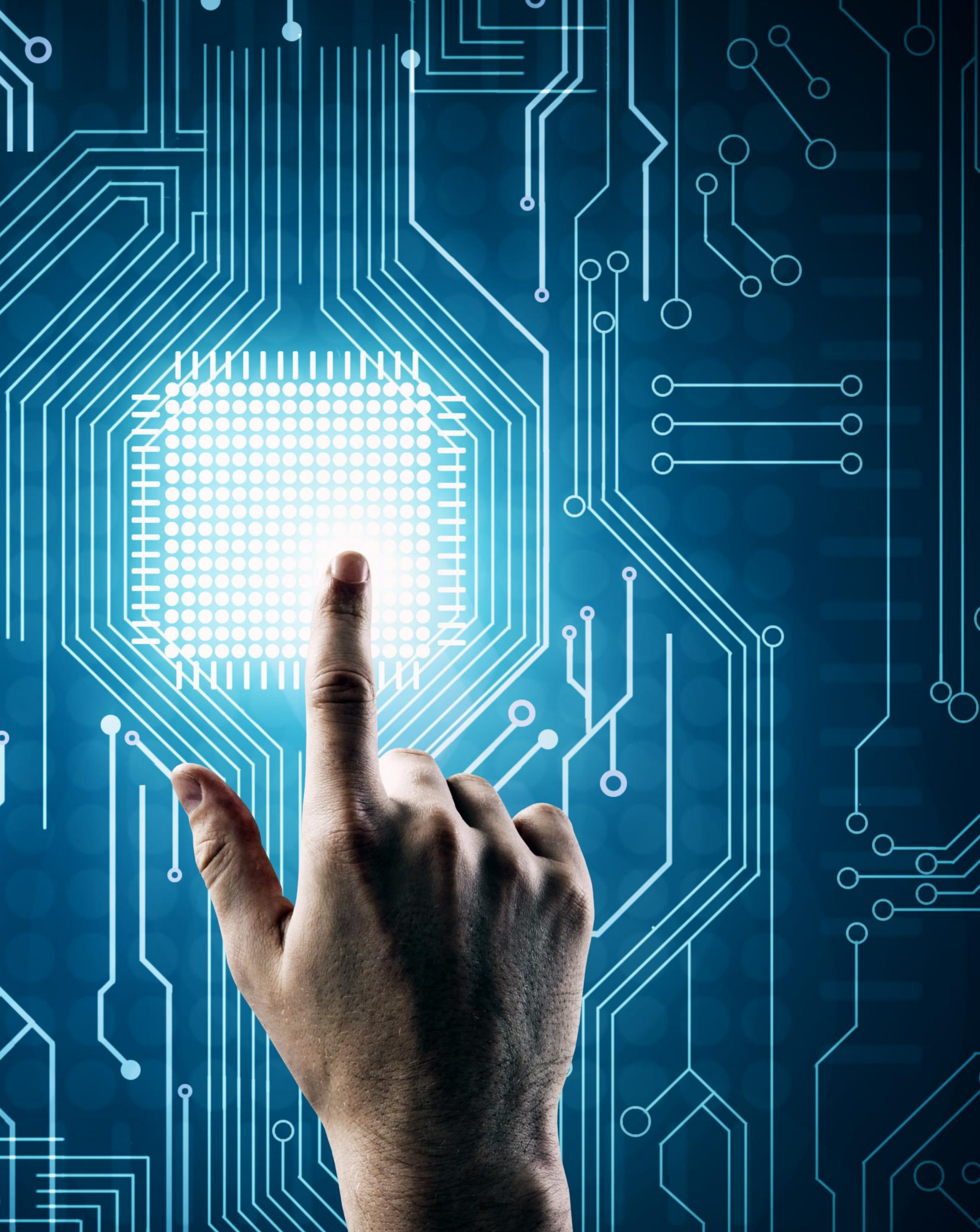
Automated Testing:

- AI-powered testing tools can **automate test case generation, execution, and analysis. These tools can identify defects, vulnerabilities**, and performance issues more efficiently and comprehensively than manual testing.



Code Analysis and Review:

- AI can assist in **code review by identifying coding standards violations, potential bugs, and code smells.** Tools like static code analyzers and linters can use AI to enhance code quality.



2019 IEEE/ACM 27th International Conference on Program Comprehension (ICPC)

Learning a Classifier for Prediction of Maintainability based on Static Analysis Tools

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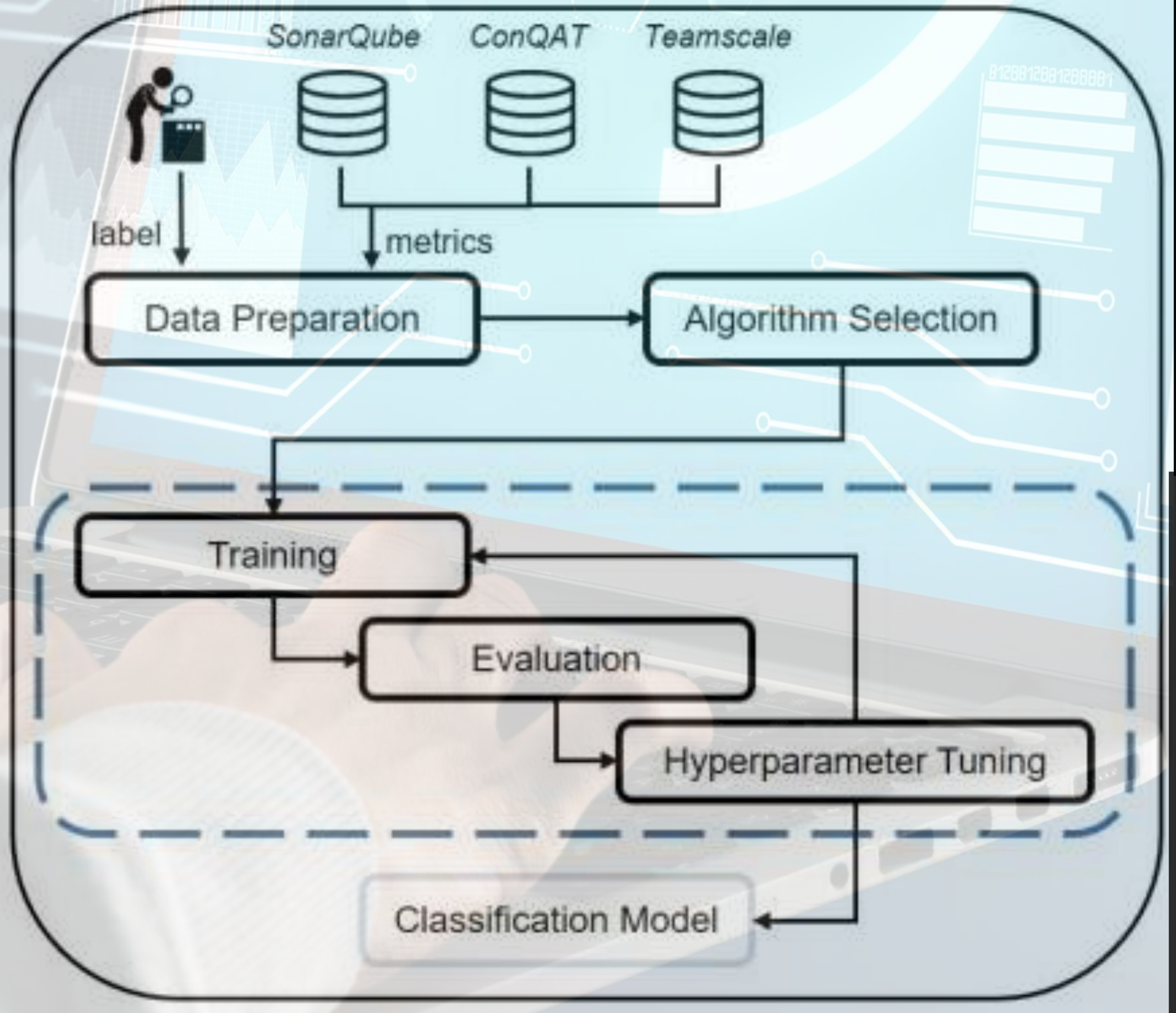


TABLE I
ANALYZED SOURCE CODE

	System A	JUnit 4 (4.11)	System C
Domain	*Insurance*	*Software Dev.*	*Insurance*
Purpose	*Offer Management System*	*Testing Framework*	*Damage Evaluation System*
First Release	*2000*	*2014*	*2014*
Development	*Outsourced*	*Open-source*	*In-house*
Size	*3.1M LOC*	*44.6k LOC*	*380k LOC*
Chosen Sample	*65k LOC* *160 Classes*	*10k LOC* *75 Classes*	*41k LOC* *110 Classes*

TABLE II
EXPERIMENT RESULTS

Classifier	Accuracy	Precision	Recall	F-Score
J48	0.8087	0.7967	0.8087	0.8009
LMT	0.7971	0.7693	0.7971	0.7757
SimpleLogistic	0.7971	0.7577	0.7971	0.7566
...	...	...	...	...
OneR	0.7102	0.6430	0.7101	0.6540
...	...	...	...	...
Multilayer Perceptron	0.6667	0.6667	0.6667	0.6667
ZeroR	0.5275	n/a	0.5275	n/a

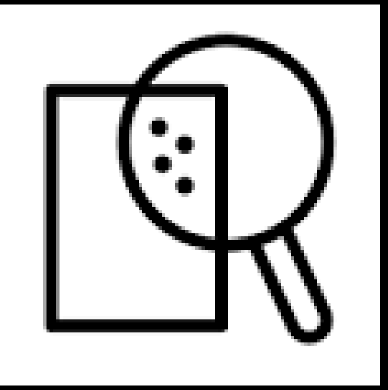
Artificial Intelligence for Software Quality

Bug Detection and Prediction:

- AI can **analyze historical data to predict potential software bugs**, enabling proactive bug fixing. It can also identify anomalies in code or system behavior that might indicate underlying issues.

Anomaly Detection:

- **AI can continuously monitor software systems to detect anomalies in real-time**, helping identify unexpected issues and potential security threats



2019 26th Asia-Pacific Software Engineering Conference (APSEC)

Run-time Safety Monitoring Framework for AI-based Systems: Automated Driving Cases

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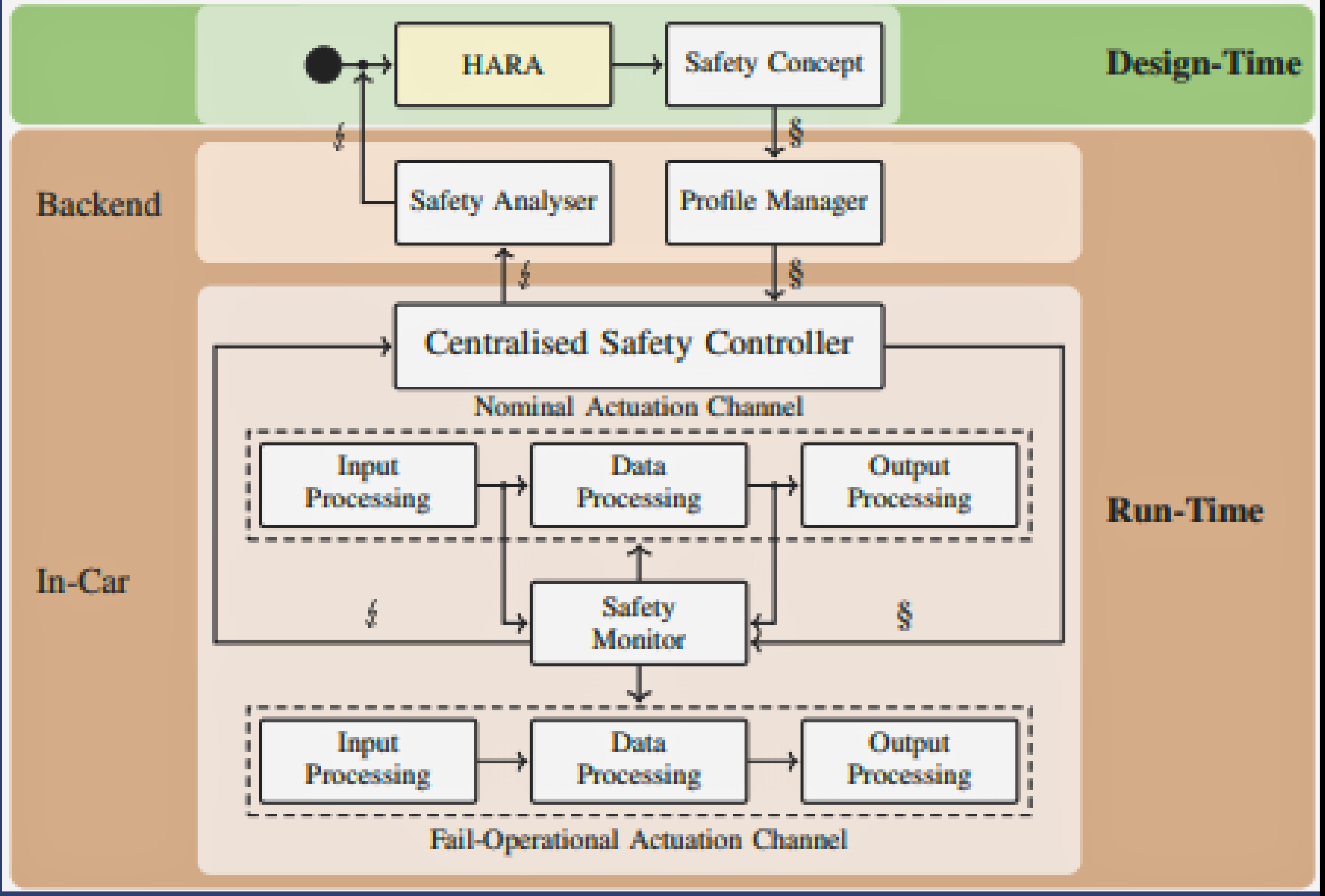
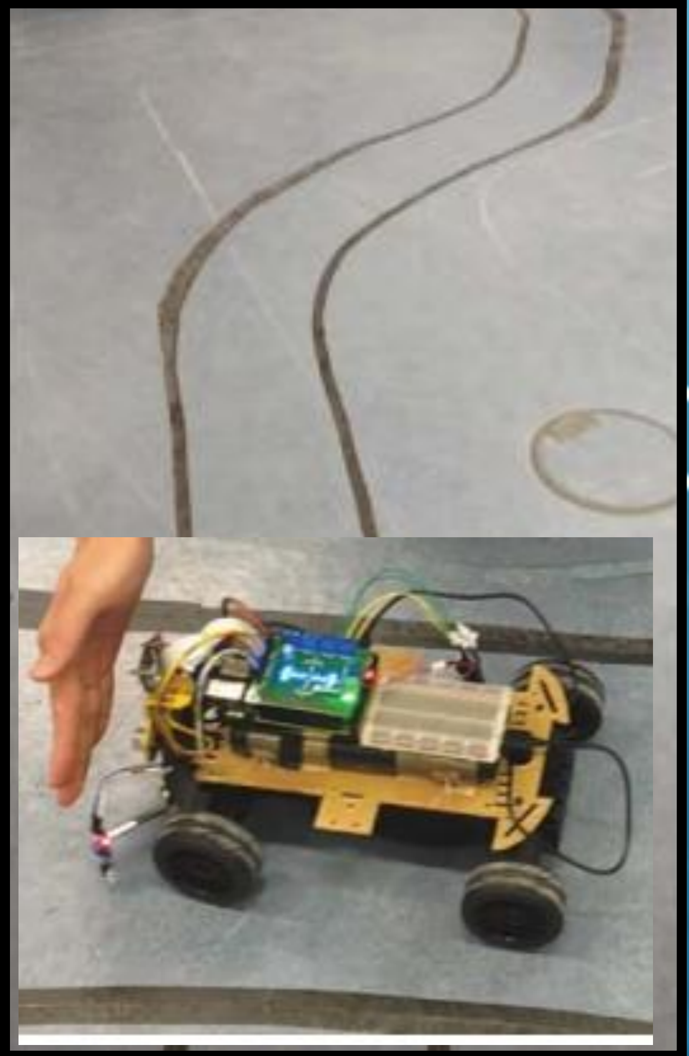
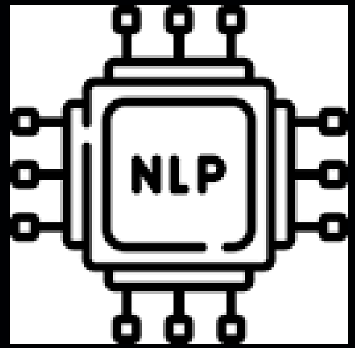




Artificial Intelligence for Software Quality

Requirements Analysis:

- AI can help **ensure that software requirements are clear, complete, and free from contradictions** by analyzing and validating the requirements documents.



Natural Language Processing (NLP):

- AI-powered **NLP tools can improve communication** among team members and stakeholders, making it easier to understand and document **software requirements, issues, and changes**

2018 ACM/IEEE 5th International Workshop on Requirements Engineering and Testing

Ambiguous Software Requirement Specification Detection: An Automated Approach

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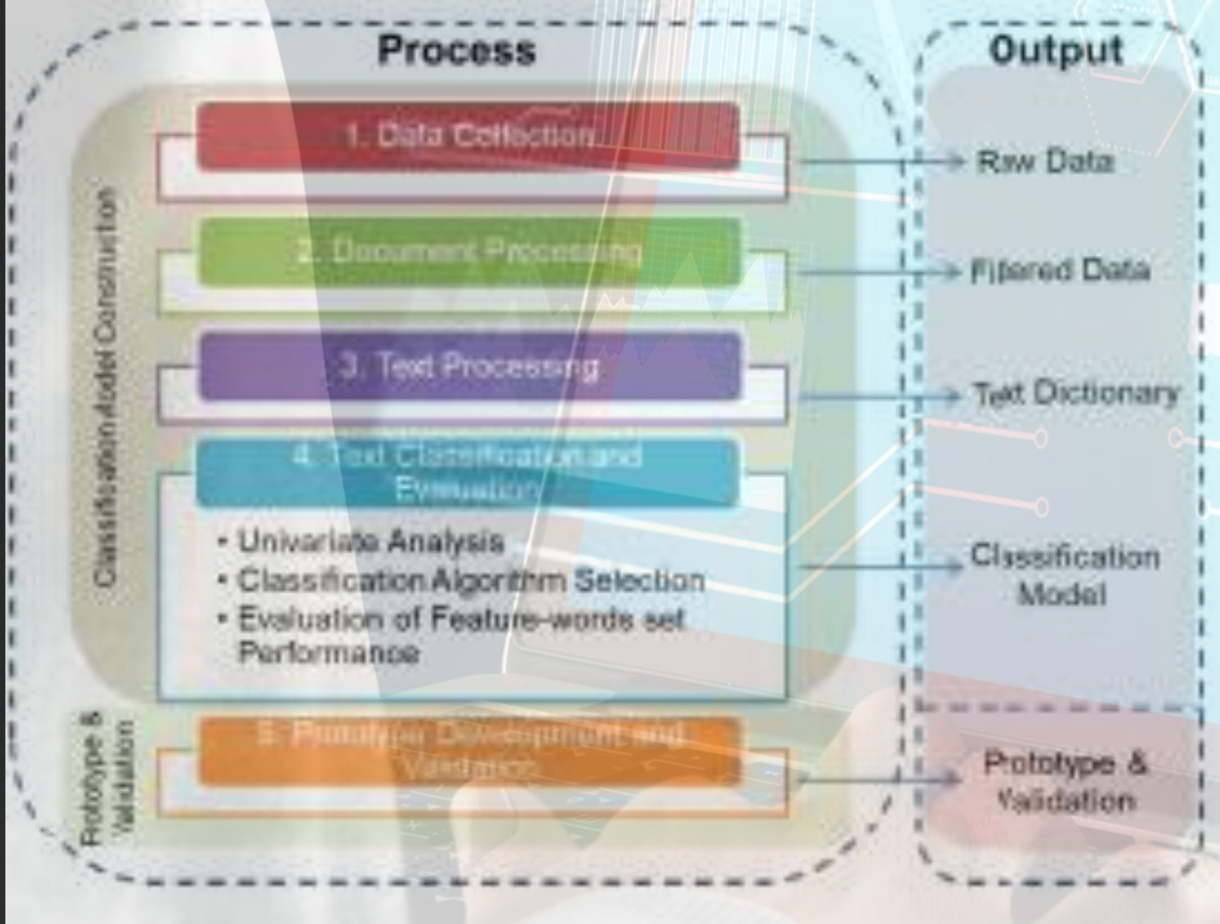


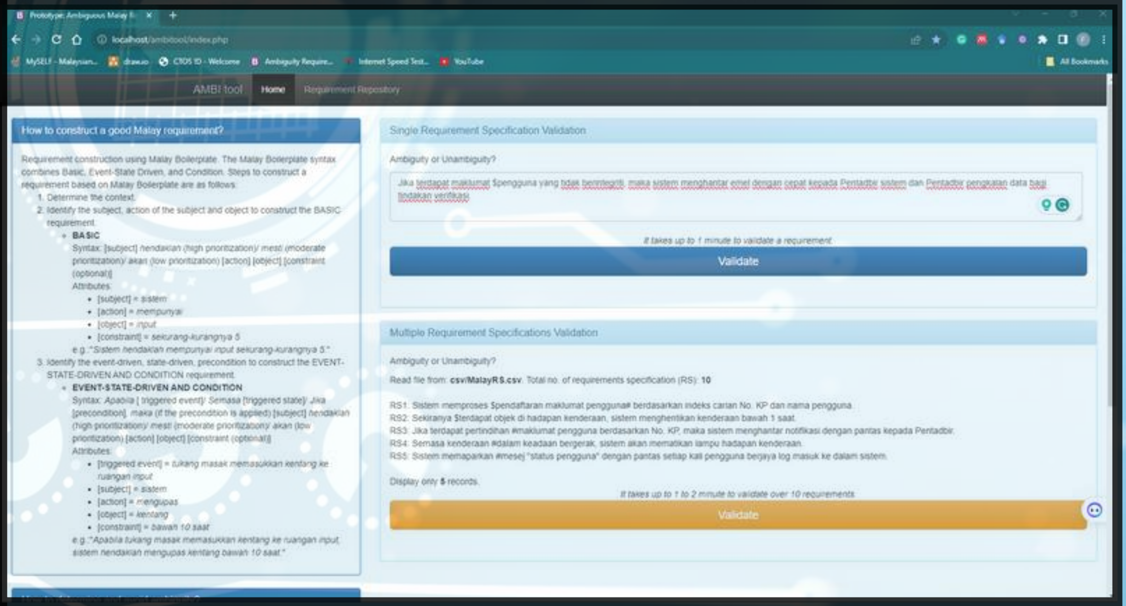
Figure 1: Overall Approach

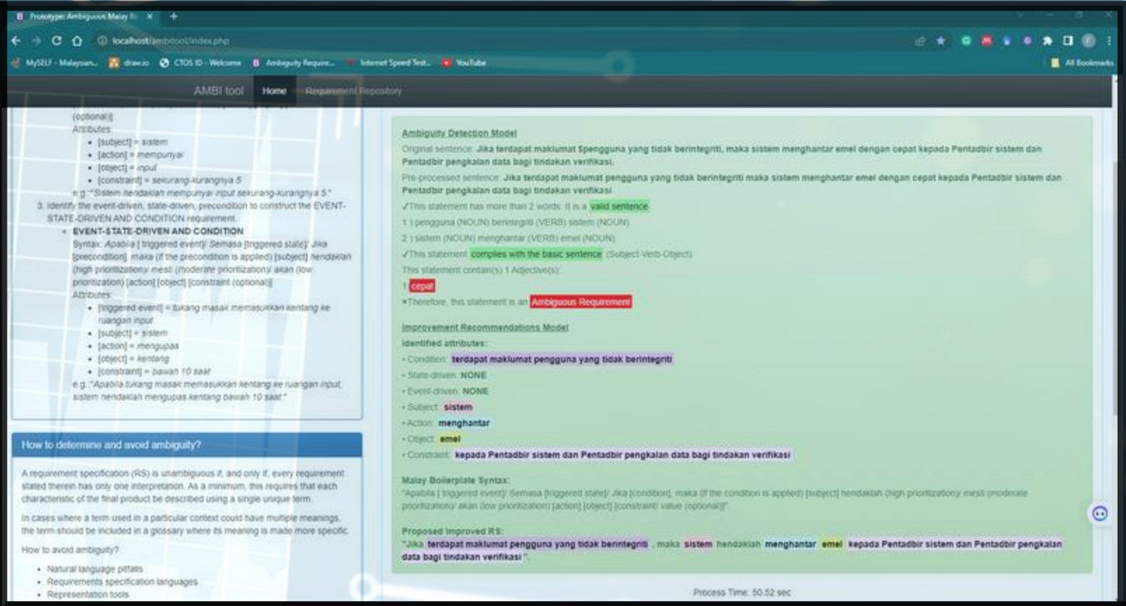
Table 6: Classification Performance Model (accuracy)

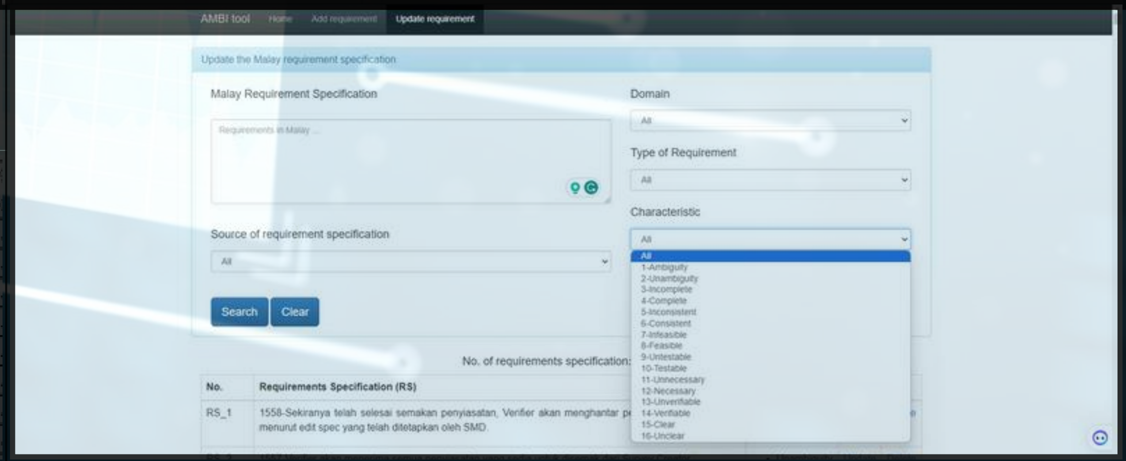
	AllData	*DataH	*DataB	*DataHB
OneR	78.06	65.78	60.78	65.78
Naive Bayes	80.22	65.33	58.11	67.22
Logistic Reg.	80.94	67.83	54.72	66.67
k-NN	71.89	67.89	58.22	69.83
Decision Table	78.06	62.00	56.72	63.28
Decision Stump	77.17	48.89	57.78	52.33
J48	82.67	71.17	57.83	70.89
Random Forest	89.67	70.44	59.06	76.56
Random Tree	80.89	68.22	59.00	71.39

* Data_H used feature-words suggested by Haron et. al [17];
*Data_B used feature-words mentioned in Berry et. al. [7] ; and
*DataHB is the combination of DataH and DataB

g ho)	sistem (system)	akan (will)	maklumat (information)	dan (and)	untuk (for)	telah (already)	mohon (apply)	guna (use)	boleh (can)	proses (process)	..(wo
	0	0	0	0	1	0	0	0	1	0	
	0	0	1	0	0	0	0	0	1	0	
	1	0	0	0	1	0	0	0	0	0	
	0	1	0	2	3	0	0	1	0	2	
	0	1	0	1	0	0	0	1	0	0	
	0	0	1	1	0	0	0	0	2	1	
	0	1	0	0	1	0	0	0	0	1	
	0	1	0	0	1	0	0	0	1	0	







Artificial Intelligence for Software Quality

Code Refactoring:

AI can assist in **refactoring code to improve maintainability, readability, and adherence** to best practices, ultimately enhancing software quality.

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From Monolith to Microservice: Measuring Architecture Maintainability

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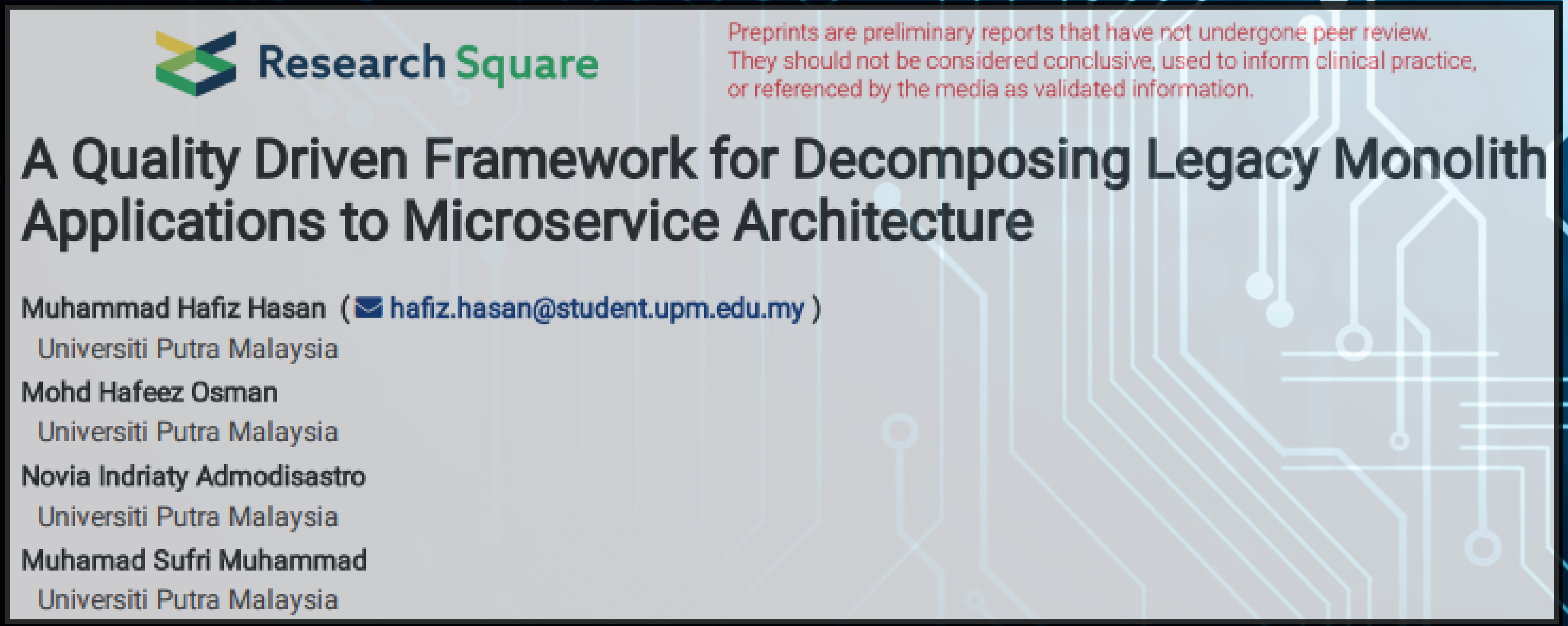

Research Square

A Quality Driven Framework for Decomposing Legacy Monolith Applications to Microservice Architecture

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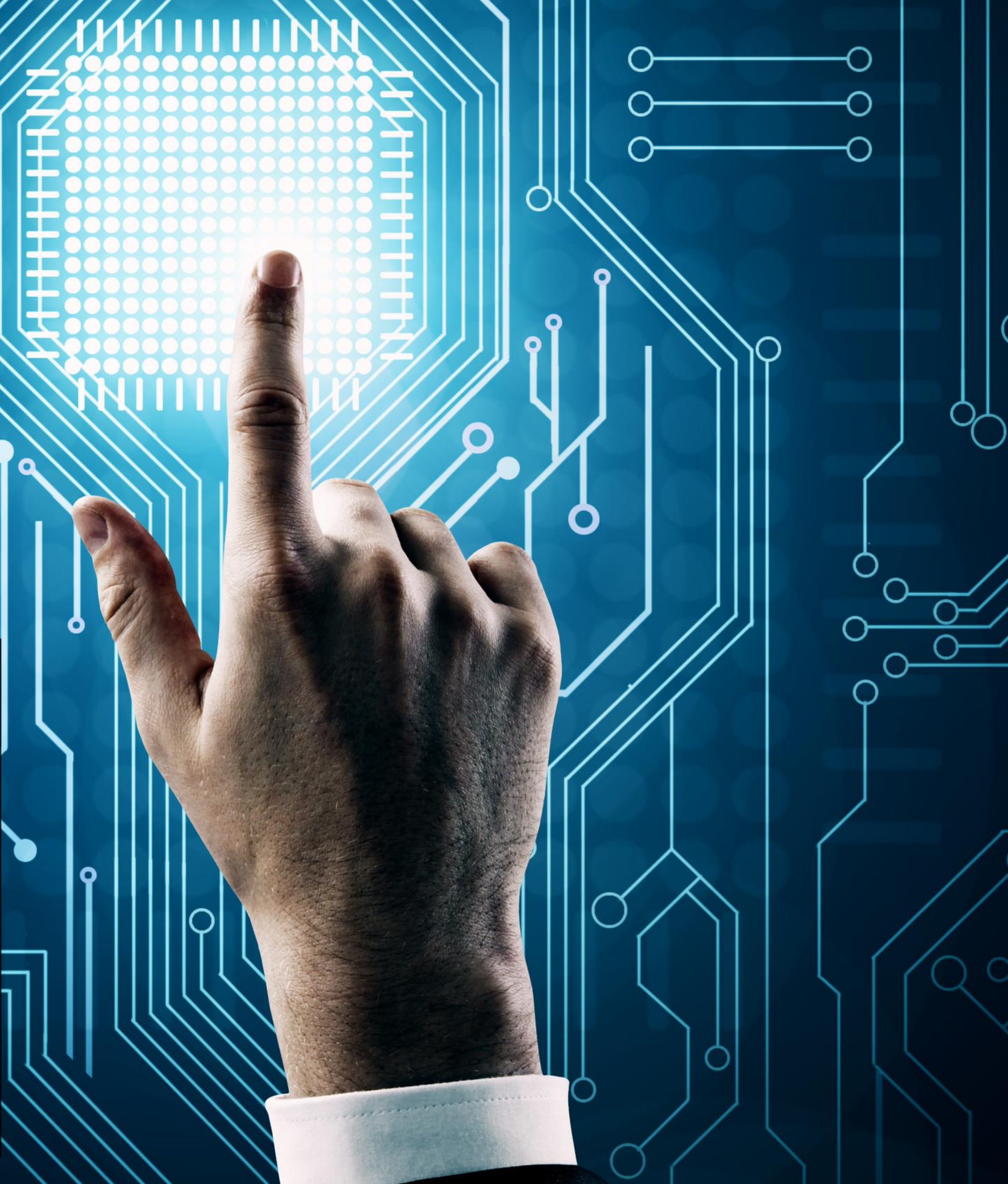

Artificial Intelligence for Software Quality

Predictive Maintenance:

- In the context of software-as-a-service (SaaS) applications, **AI can predict when software components or infrastructure might fail and require maintenance**, reducing downtime.

IET Collaborative Intelligent Manufacturing

Research Article

Journals
The Institution of Engineering and Technology

Classification model for predictive maintenance of small steam sterilisers

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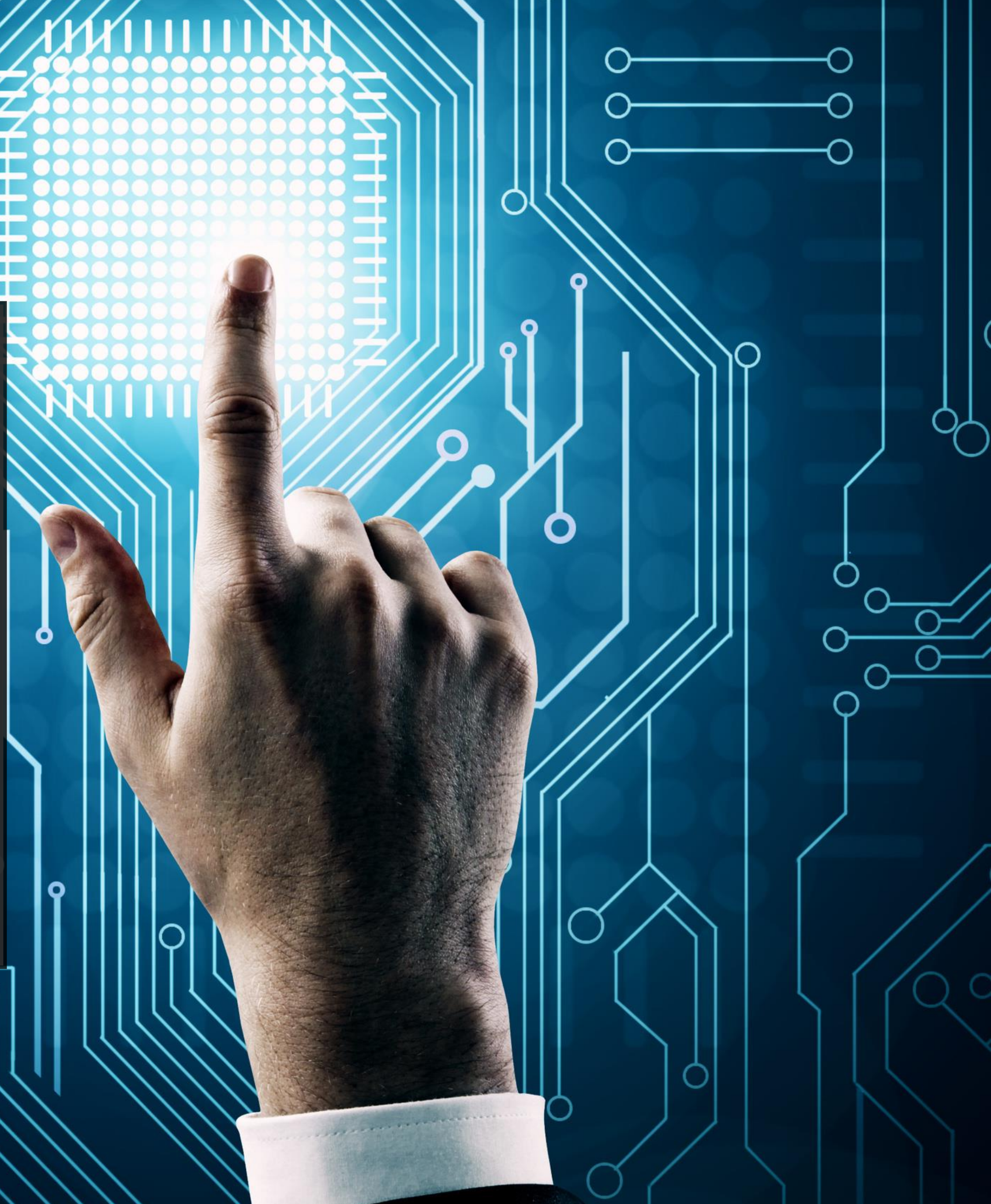

Artificial Intelligence for Software Quality

AI can enhance software quality by reducing human error, automating repetitive tasks, providing insights from vast data sets, and improving the overall development and testing process. However, it is **essential to use AI tools judiciously and in conjunction with human expertise to ensure the best results.**

Terima Kasih!

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