Revolutionizing Database Design through a Scalable, Formal, Learning-Powered Systematic Tradeoff Analysis

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ICANN 79 COMMUNITY FORUM

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San Juan, Puerto Rico

PRESENTED BY

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http://mdrashedulhasan.me/

Graduate Research Assistant at SquaRED Labs, SoC, UNL

Ph.D. Student studying Computer Science

Former CO Founder and Information Security Researcher at Cybertrendz Inc

Former Researcher at Zerocopter

OSINT Expert
Software Developer
Academic Researcher
Experienced working with govt. entities

Little Bit More About Me

Bachelor in Software Engineering from Daffodil International University

Recognition from Twitter for helping to find a bug in their web application

Recognition from Snapchat for a critical finding in their iOS mobile application

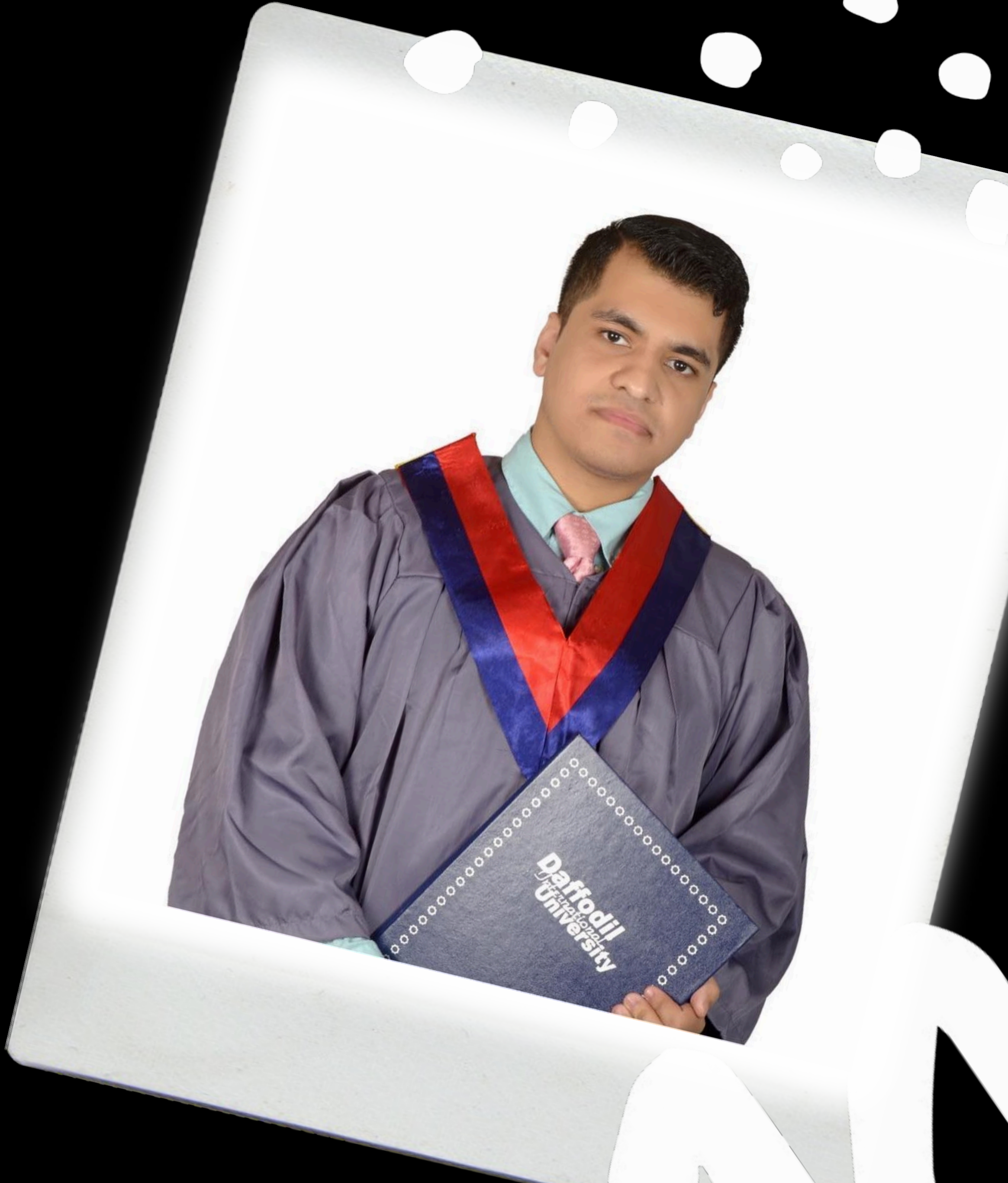
Recognition from US Department of Defense for identifying a bug in a particular web asset.

Recognition from T Mobile for identifying a bug in their web application

Former Assistant Maintenance Engineer
TIHDTCB Project, Ministry Of Defence, Bangladesh

Expertise in Open Source Intelligence, Information Security practices, Cyber forensics and different aspects of cyber crime investigation.

Current Research : Software Engineering centric systems , Software Security, Formal Specifications, Malware Analysis, LLM-DL-ML based problems analysis in SE field.



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Motivation

- Problem Area
- Significance of Tradeoff studies in ORM Selection
- Importance of ORM in DNS security
- Impact of this research

Overview

- Concept of ER – OM and ORM
- Current pareto optimal solution selection process

Proposed Approach

- Discussing proposed solution
- Assessment of Results

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Contribution

- Key potential contributions
- How it is related to ICANNs vision

Future Work

- Future Work and research agenda

Motivation, Significance and Impact to work on this research problem

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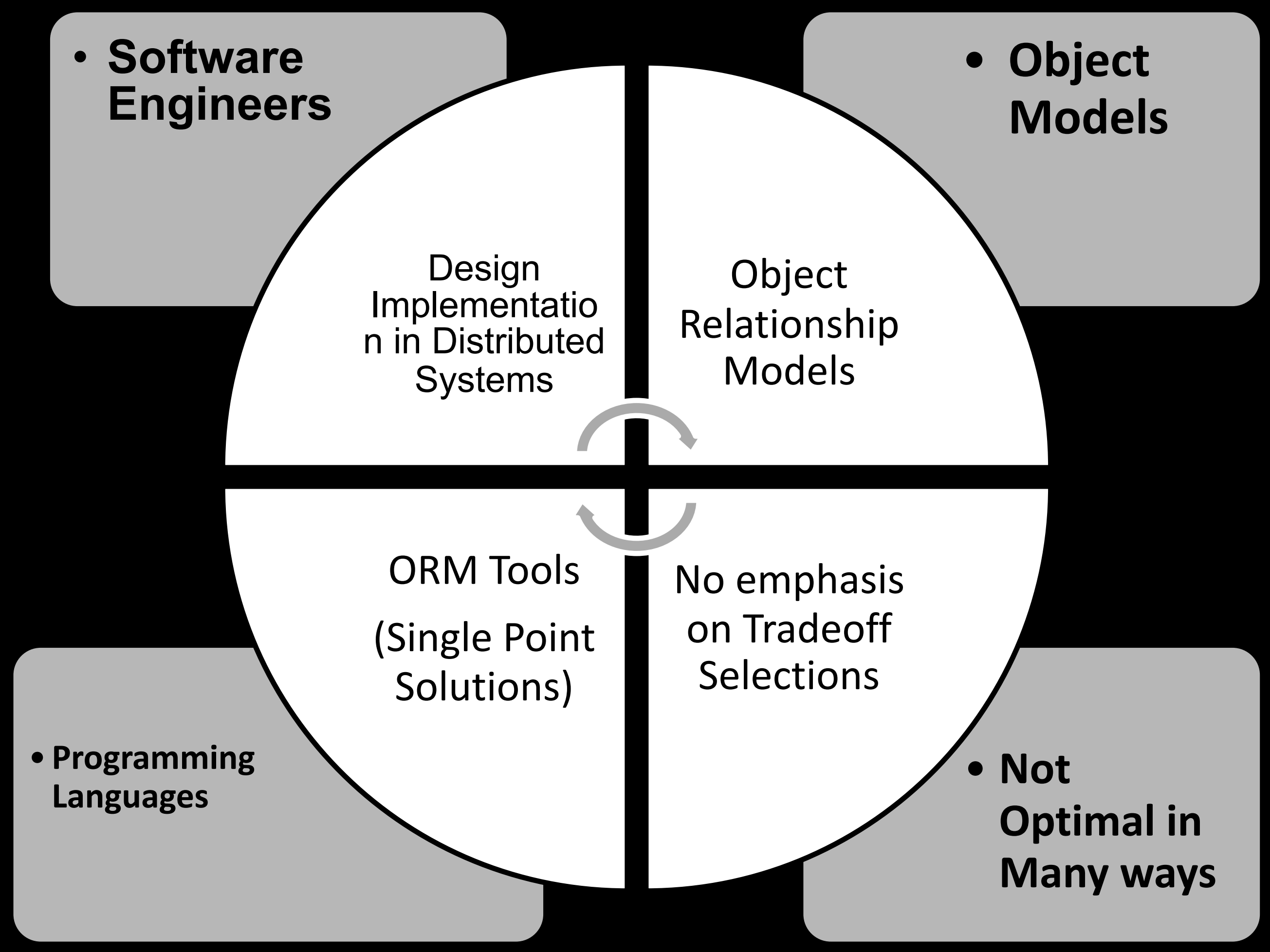
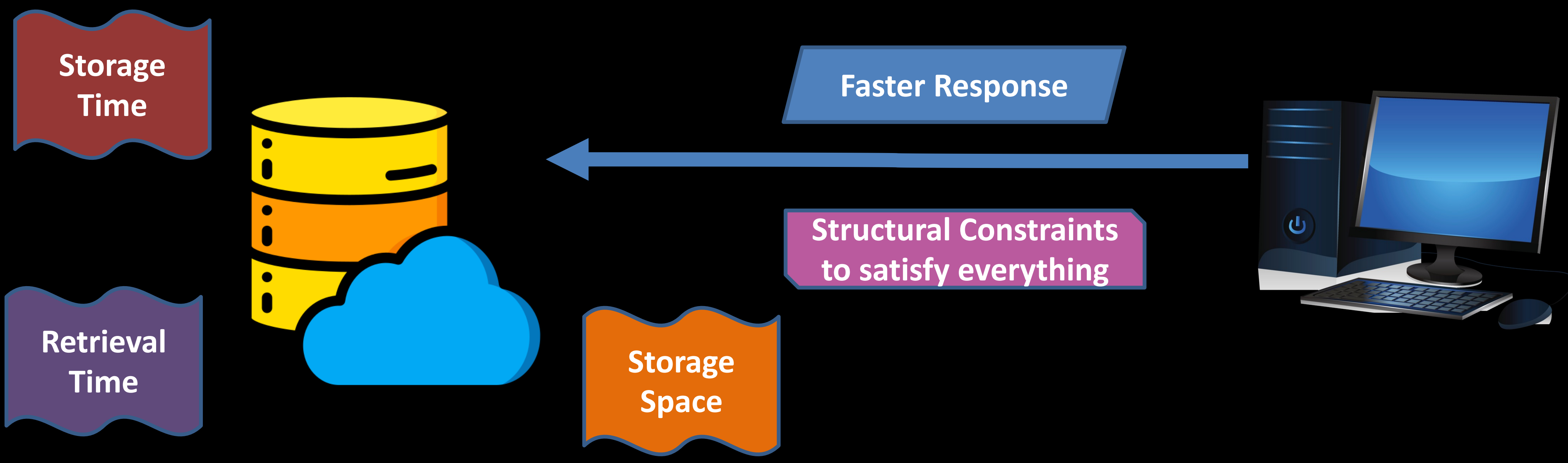


Tradeoff analysis in ORM refers to the process of evaluating and **choosing between different strategies** for mapping between objects in an **object-oriented programming language** and the relational database tables that store the data



1.ORM selection tradeoffs impact **application security** by balancing performance and robust security features.

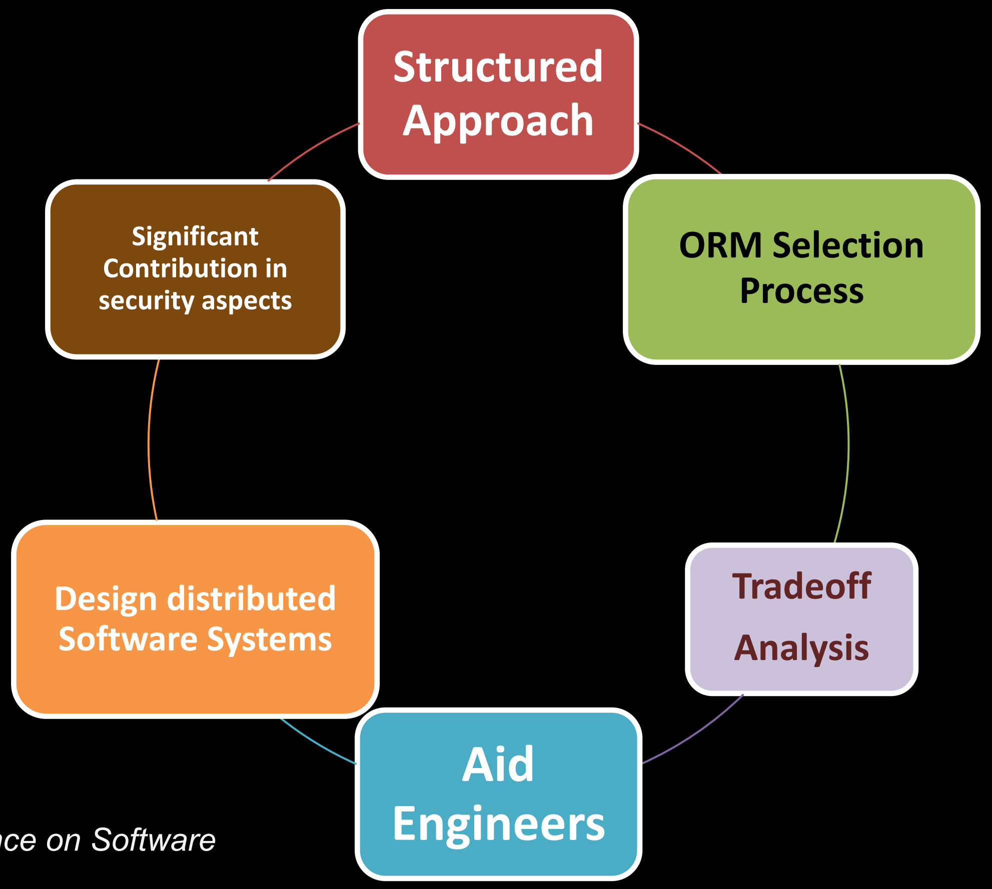
2.Compatibility with evolving security standards ensures ORM systems align with the latest requirements.

3.Encryption and access controls in ORM contribute to safeguarding sensitive data in both applications and DNS.

4.Effective error handling and logging within ORM systems are **crucial for rapid security incident detection.**

5.Choosing ORM systems from secure vendors **enhances overall application and DNS security**.

6.ORM's role in DNS services directly **influences the speed and efficiency** of DNS-related processes, impacting security.



Ref: Bagheri, H., Tang, C., & Sullivan, K. (2014, May). Trademaker: Automated dynamic analysis of synthesized tradespaces. In Proceedings of the 36th International Conference on Software Engineering (pp. 106-116).

Concept of ER, OM and ORM

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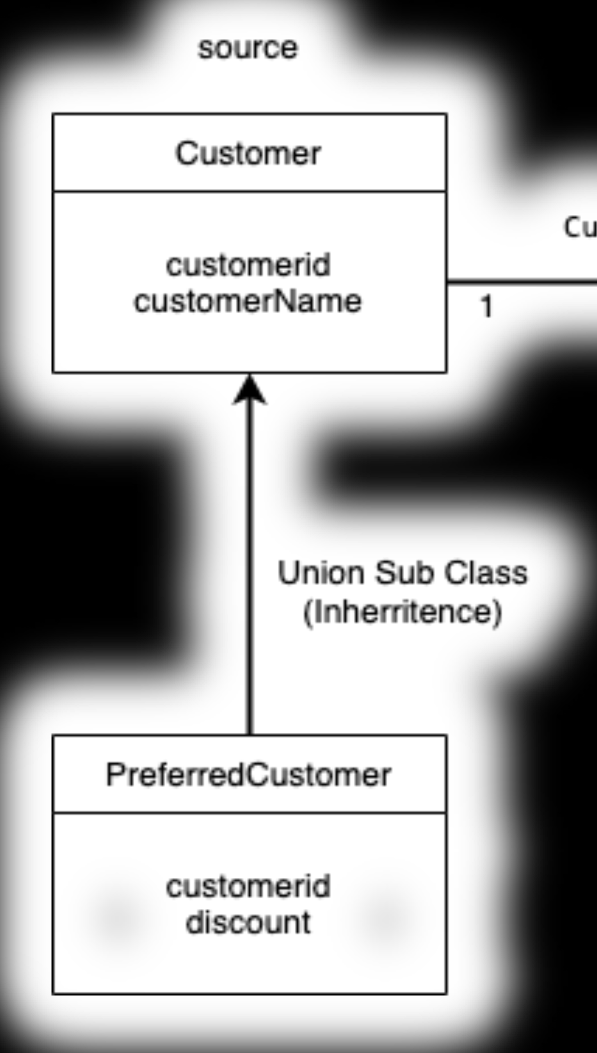

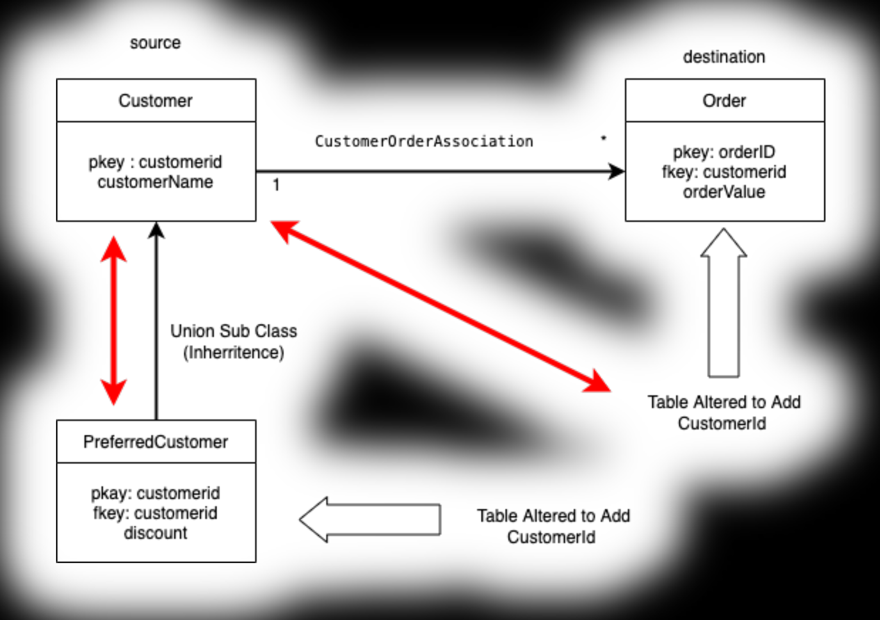

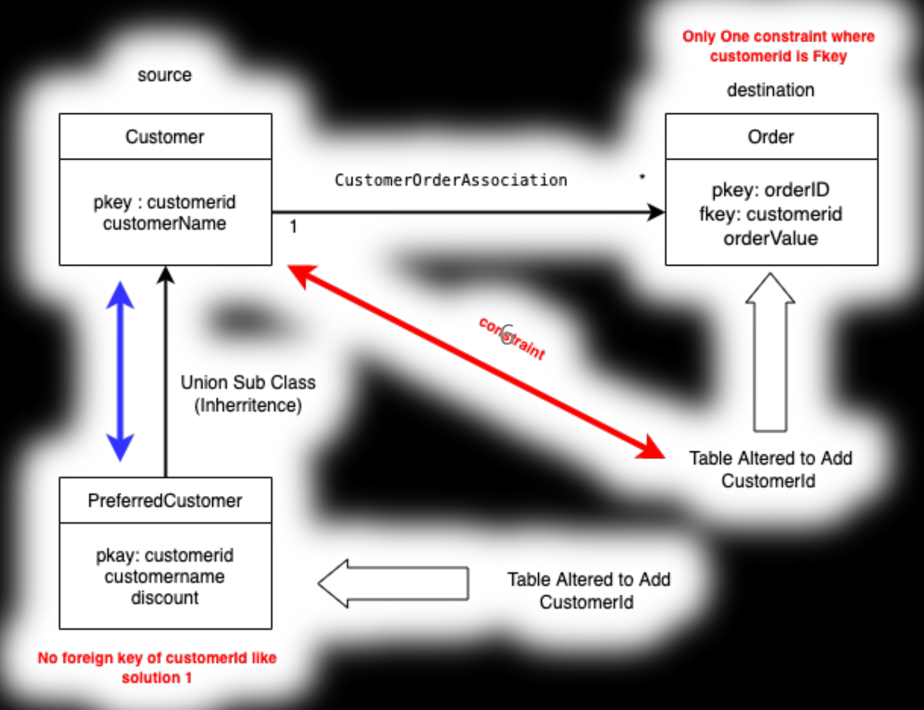

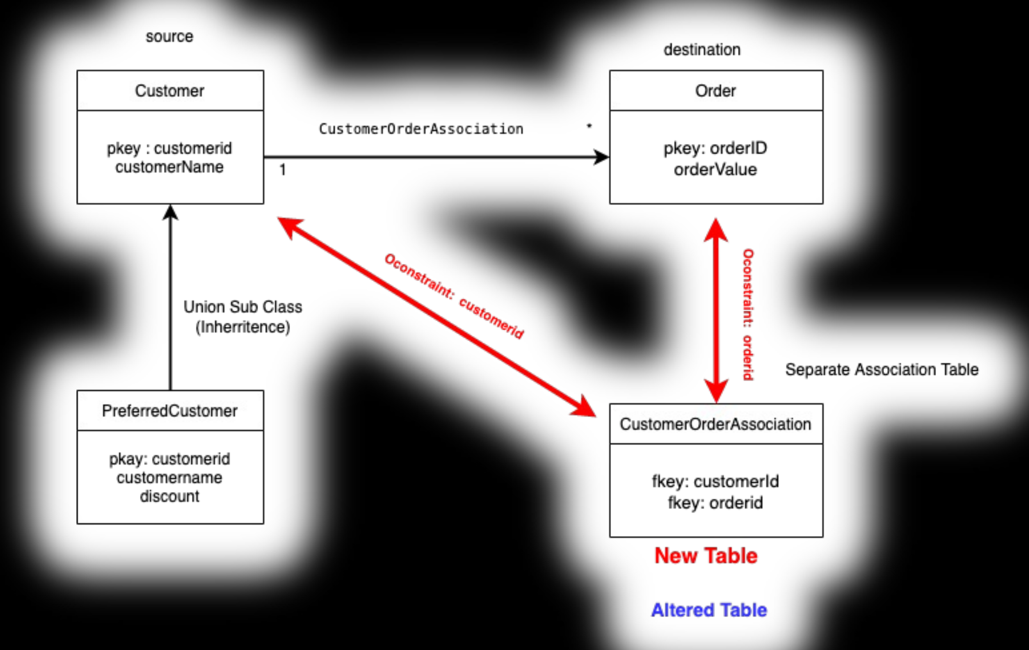

Ref: Bagheri, H., Tang, C., & Sullivan, K. (2014, May). Trademaker: Automated dynamic analysis of synthesized tradespaces. In Proceedings of the 36th International Conference on Software Engineering (pp. 106-116).

Current Procedure of Design Space generation, Optimal solution selection process.

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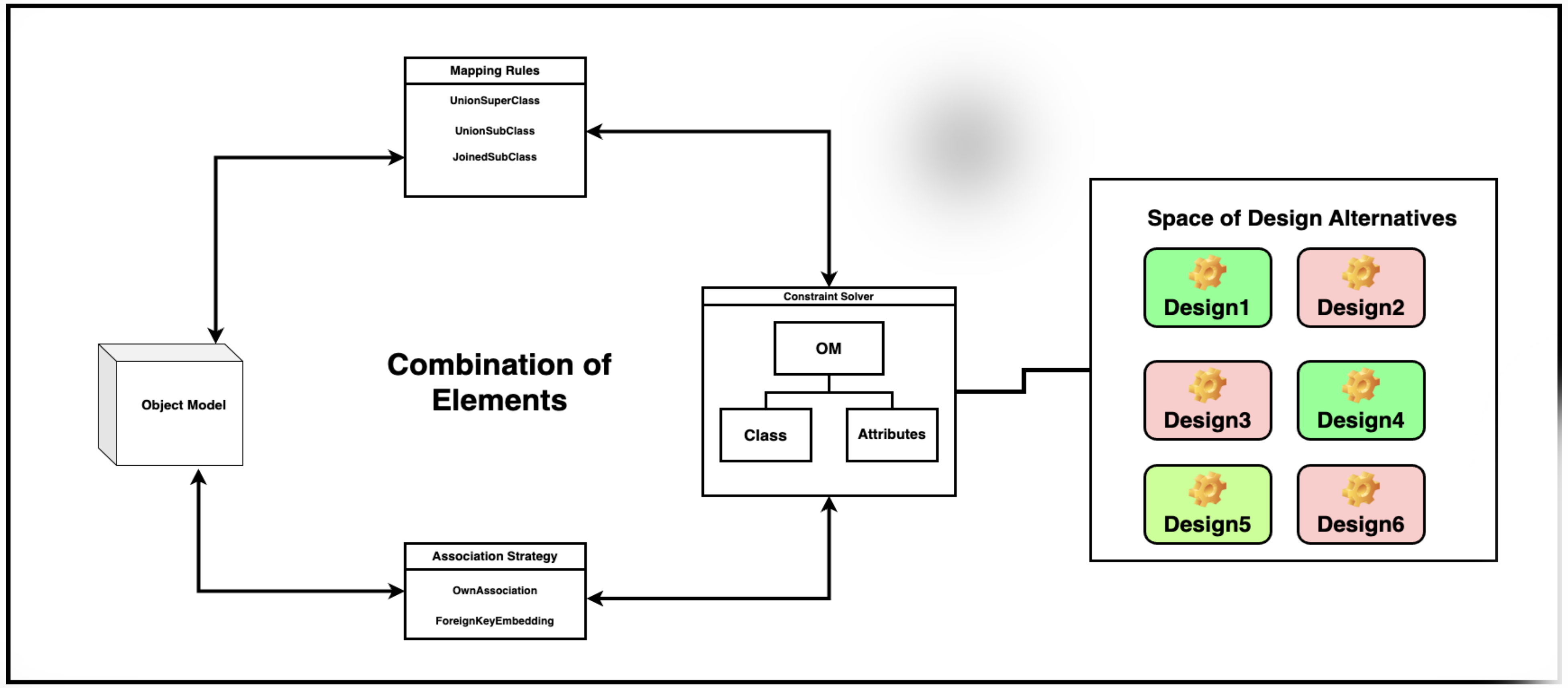

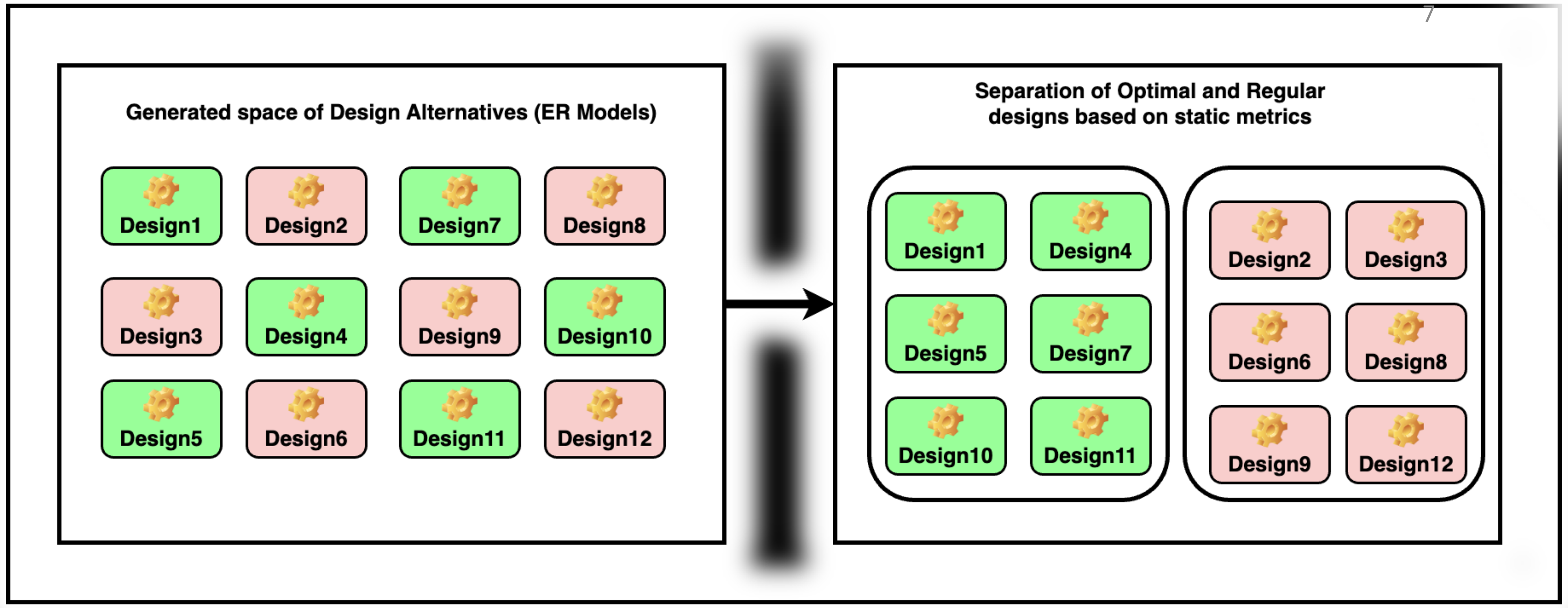

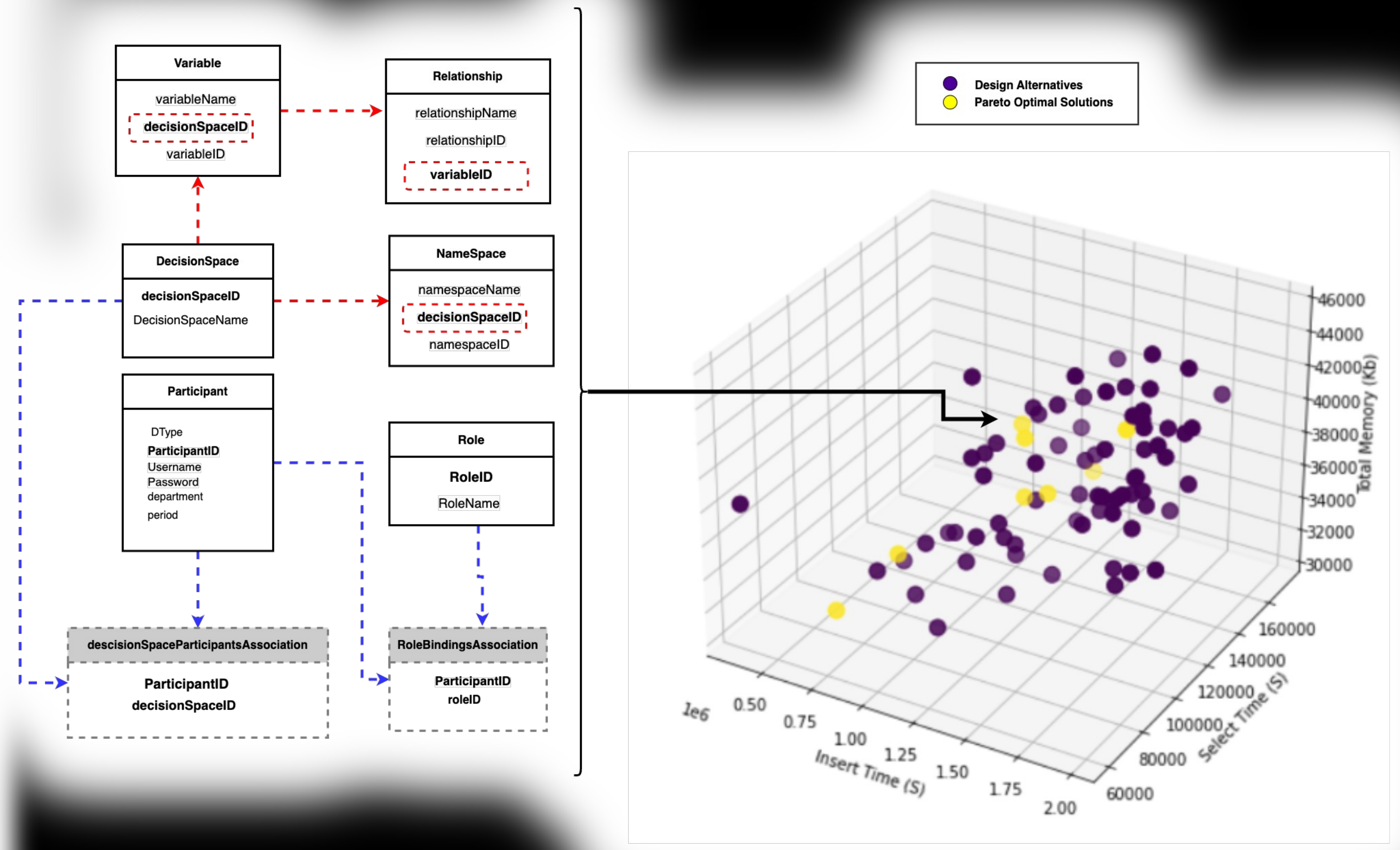

Ref: H. Bagheri, C. Tang and K. Sullivan, "**Automated Synthesis and Dynamic Analysis of Tradeoff Spaces for Object-Relational Mapping**," in *IEEE Transactions on Software Engineering*, vol. 43, no. 2, pp. 145-163, 1 Feb. 2017, doi: 10.1109/TSE.2016.2587646. keywords: {Data models;Load modeling;Object oriented modeling;Semantics;Relational databases;Measurement;Specification-driven synthesis;tradespace analysis;ORM;static analysis;dynamic analysis;relational logic},

Proposed Approach And How It Makes The Entire Process More Efficient And Resilient

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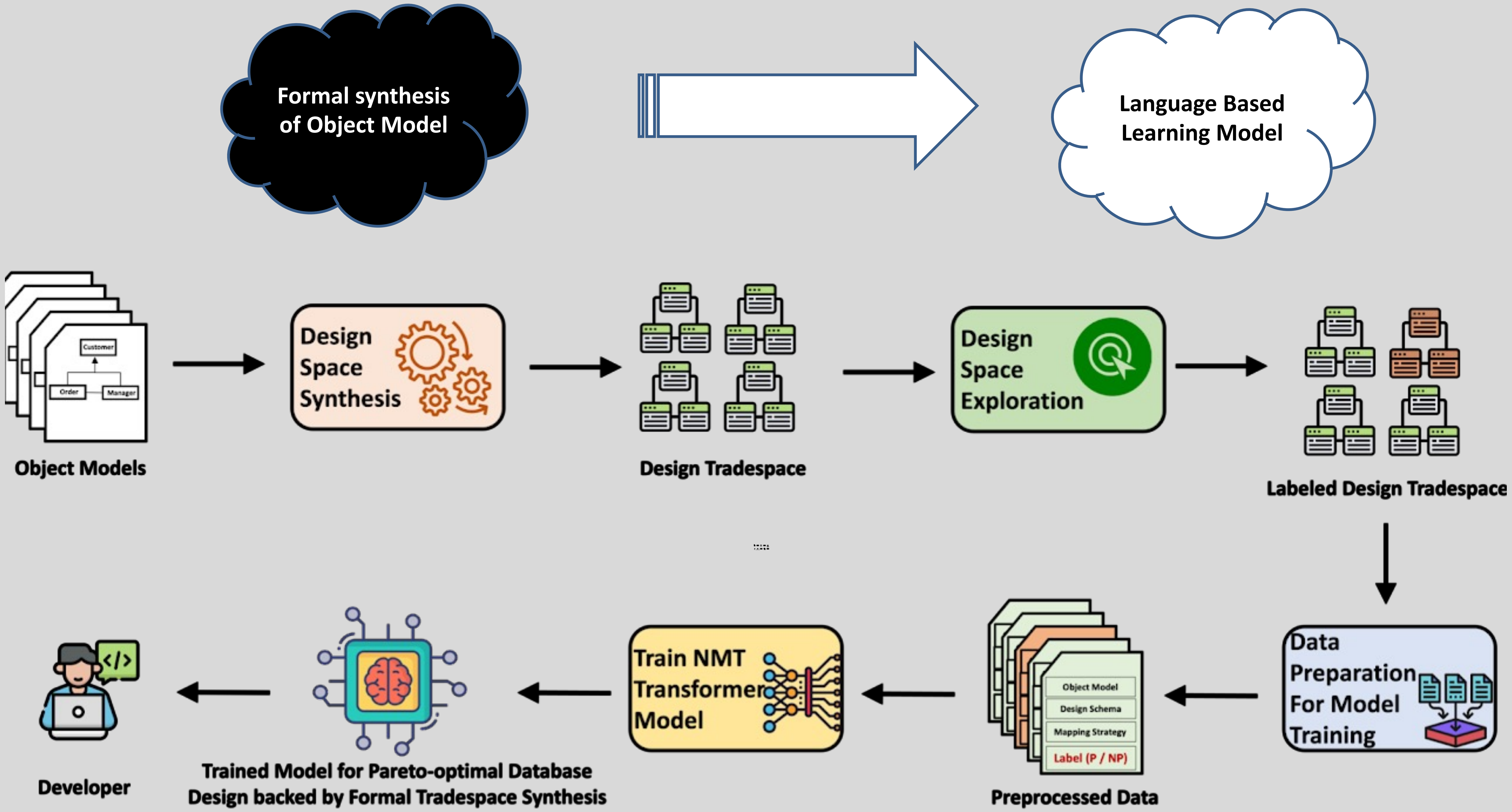

Ref. https://sites.google.com/view/designtradeoffsculptor/

Proposed Approach And How It Makes The Entire Process More Efficient And Resilient

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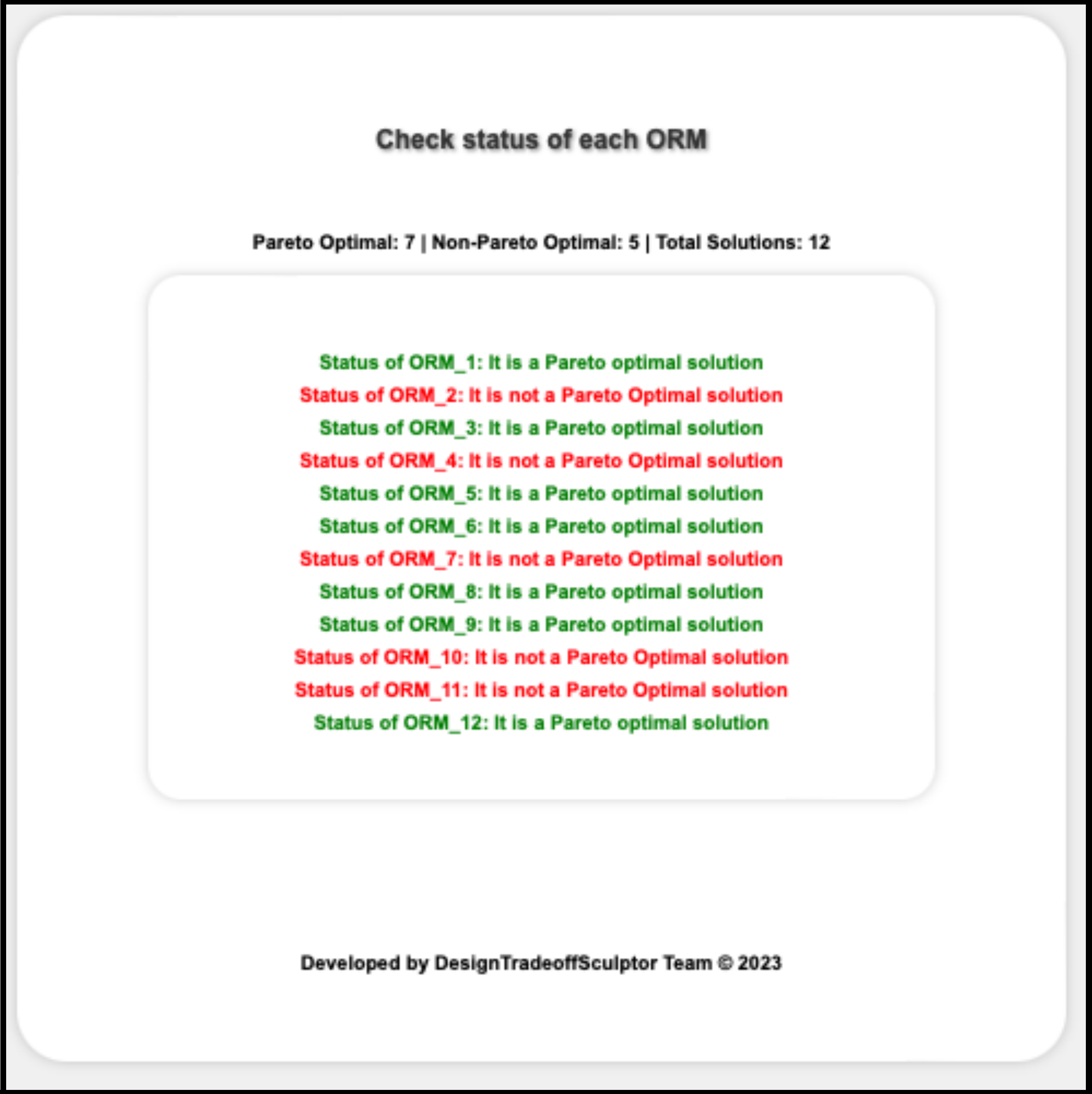
Time and Space Measurements

Object Model	Existing Solution Time (sec.)	Existing Solution Memory (Kb.)	Proposed Solution Time (sec.)	Proposed Solution Memory (Kb.)
Customer-Order	7,056	67,168	14	61
Online Store	1,004	10,589	24	31
Decider	63,465	601,680	20	134
Flagship	63,971	538,496	98	423
E-Commerce	5,697,328	156,952,992	6,054	40,800
CSOS	5,071,169	177,032,670	2,566	20,000
Bank	1,923	27,021	20	134
Library Management	915,642	1,600,742	1,055	13,700
Camping	1,808	30,208	24	118
Average	1,313,707	37,429,063	1,097	8,378

Generational Distance Measurement

Object Model	Proposed Solution	Hibernate	Django	SQL Alchemy	Entity Framework
Customer-Order	**0.02**	0.54	0.71	0.69	0.50
Online Store	**0.00**	0.73	0.15	**0.00**	0.03
Bank	**0.01**	0.18	0.09	0.09	0.13
Camping	0.06	**0.00**	0.07	0.11	0.24
Flagship	**0.01**	**0.01**	0.02	0.12	0.13
Decider	**0.00**	0.48	0.27	0.16	0.45
Library Management	**0.01**	**0.01**	0.03	0.08	0.04
CSOS	**0.03**	0.34	0.17	0.08	0.42
E-commerce	**0.06**	0.33	0.64	0.37	0.58
Average	**0.02**	0.29	0.24	0.19	0.28

Demo GUI tool for Developers



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Key Contributions, How it supports ICANN's vision and potential for Future Work

How this research supports ICANN's vision

Risk Mitigation
- Tradeoff studies enable to select ORM solutions that can effectively manage operational risks, and performance; supporting ICANNs vision of ensuring internet stability and security.

Resource Optimization
- Tradeoff studies can optimize resource allocation in ORM selection, contributing to efficient management and the overall health of the internet.

Adaptability and Innovation
- Tradeoff studies enable stakeholders to assess ORM solutions' adaptability to technological advancements and emerging threats, aligning with the ICANNs vision of fostering innovation

Stakeholder Engagement
- Involving stakeholders in tradeoff studies enhances decision-making, ensuring ORM solutions are acceptable to the community and promoting collaboration in line with ICANN's multi-stakeholder approach.

Resilience and Contingency Planning
- Tradeoff studies consider the resilience of ORM options, helping developers prepare for and respond to disruptions, supporting the ICANN's vision of maintaining stability in challenging circumstances.

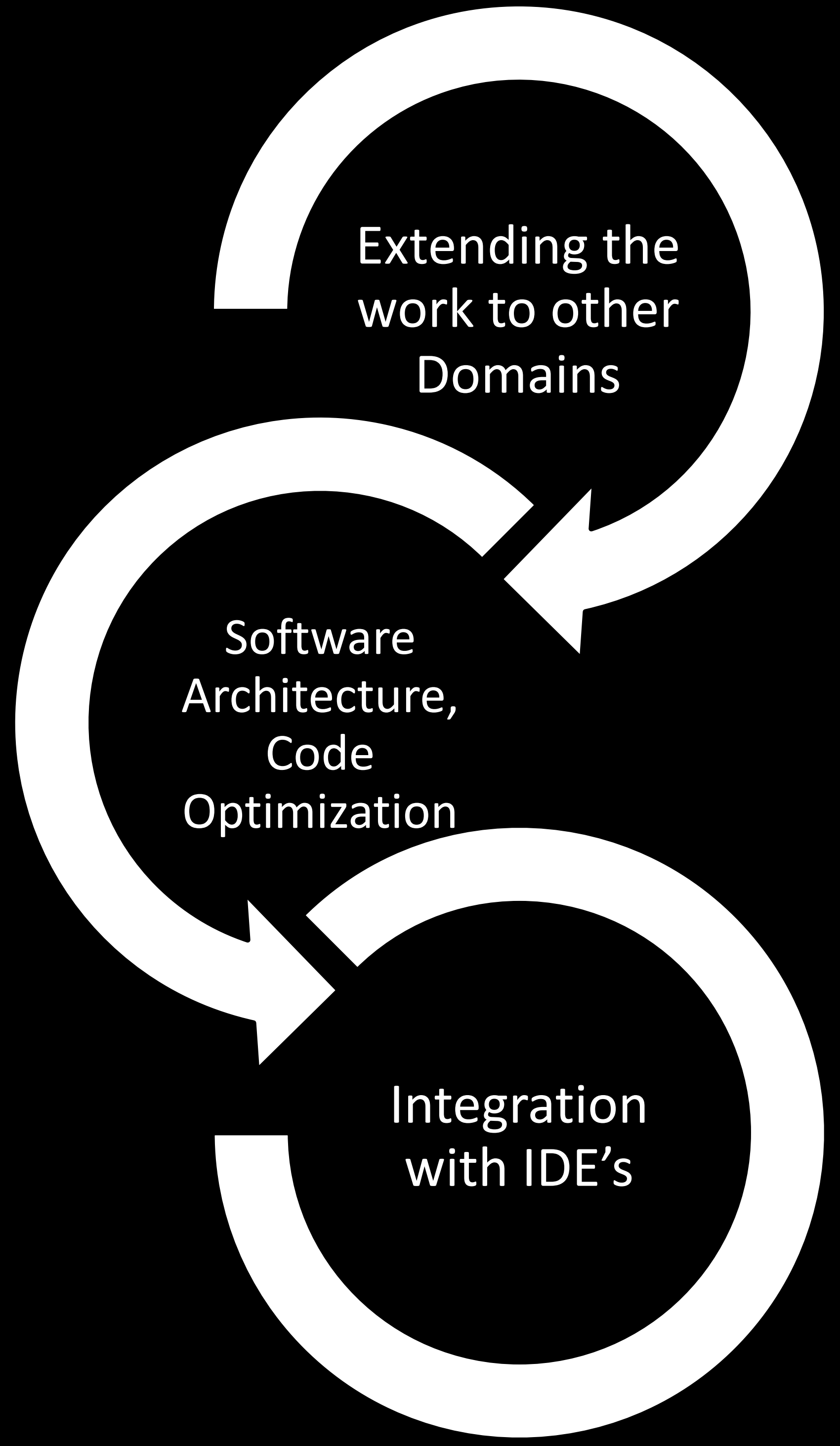
Key Contributions

Efficient Design Tradespace Analysis, Bridging Formal Methods and Machine Learning

Tool Implementation

Experimental Validation and Novelty definition

Future Work



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Thank You !

Let Me know if you have Questions

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