AN ABSTRACT OF THE DISSERTATION OF

Parisa Ataei for the degree of Doctor of Philosophy in Computer Science presented on June 20, 2021.

Title: Theory and Implementation of a Variational Database Management System

Abstract approved: _____

Eric Walkingshaw

In this thesis I present the variational database management system, a formal framework and its implementation for representing variation in relational databases and managing variational information needs. A variational database is intended to support any kind of variation in a database. Specific kinds of variation in databases have already been studied and are well-supported, for example, schema evolution systems address the variation of a database's schema over time and data integration systems address variation caused by accessing data from multiple data sources simultaneously. However, many other kinds of variation in databases arise in practice, and different kinds of variation often interact, but these scenarios are not well-supported by the existing work. For example, neither the schema evolution systems nor the database integration systems can address variation that arises when data sources combined in one database evolve over time.

This thesis collects a large amount of work: It defines the variational database framework and the syntax and [specific kind of] semantics of the variational relational algebra, a query language for variational databases. It also defines the requirements of a generic variational database framework that makes the framework expressive enough to encode any kind of variation in databases. Additionally, it [shows/proves] that the introduced framework satisfies all these needs. It presents two use cases of the variational database framework that are based on existing data sets and scenarios that are partially supported by existing techniques. It presents the variational database management system which is the implementation of variational databases and variational relational algebra as an abstract layer written in Haskell on top of a traditional RDBMS. It also presents several

theoretical results related to the framework and query language, such as syntax-based equivalence rules that preserve the semantics of a query, a type system for ensuring that a variational query is well formed with respect to the underlying variational schema, and a confluence property of the variational relational algebra type system and semantics with respect to the relational algebra type system and semantics.

Theory and Implementation of a Variational Database Management System

by

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APPROVED:

Major Professor, representing Computer Science

Director of the School of Electrical Engineering and Computer Science

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Dean of the Graduate School

I understand that my dissertation will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my dissertation to any reader upon request.

Parisa Ataei, Author

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[Eric. Committee. jeff. abu. parents. friends.]

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LIST OF ALGORITHMS

Algorithm Page

Chapter 1: Introduction

[points: - def variation in db and is everywhere - instances but context specific solution don't suffice - thus a generic framework that addresses problems]

[- dimension, behaviour - instances but context specific solution don't suffice - example of instances - well-studied: schema evolution - partial: SPL - new instance either out of combination of other or new - generic framework to instantiate for each instance and address all variational needs.]

1.1 Motivation and Impact

[motivation]

1.1.1 Motivating Example

[combination of instances, behaviours, and dimensions]

1.2 Contributions and Outline of this Thesis

[contribution]

I think this revision looks great. My only minor suggestion is to change the sentence about the case studies to something like "It presents two use cases of the variational database framework that are based on existing data sets and scenarios that are not well supported by existing techniques". Basically, make it clear that the use cases are based on prior work and that they demonstrate how we can solve problems that are not well supported otherwise.

Chapter 2: Background

[background]

2.1 Types

[types]

2.2 The Relational Database

[relational database]

2.3 Relational Algebra

[relational algebra]

2.4 Variational Set

[vset]

2.4.1 Variational Set Configuration

[vset configuration.]

2.5 The Formula Choice Calculus

[formula choice calculus]

Chapter 3: The Variational Database Framework

[needs. must have configuration.]

3.1 Variational Needs in a Relational Database

[needs and examples of them.]

3.2 Variation Space in a Variational Database Framework

[fexp. evaluation.]

3.3 Variational Schema

[vsch]

3.3.1 Variational Schema Configuration

[vsch configuration.]

3.4 Variational Table

[vtab]

3.4.1 Variational Table Configuration

[vtab configuration]

3.5 Variational Database

[vdb]

3.5.1 Variational Database Configuration

[vdb configuration]

3.6 Properties of a Variational Database Framework

[well-formed vdb properties.context-specific properties.]
[show that they hold for vdb.]

Chapter 4: The Variational Query Language

[vql]

4.1 Variational Relational Algebra

[vra]

4.1.1 VRA Configuration

[vra configuration]

4.1.2 VRA Semantics

[vra semantics]

4.1.3 VRA Type System

[type sys]

4.1.4 VRA Variation-Minimization Rules

[rules]

4.2 Variational Query Language Properties

[prop. show for vra.]

Chapter 5: Variational Database Management System (VDBMS)

[vdbms]

5.1 Implemented Approaches

[apps]

5.2 Experiments

[exp.]

Chapter 6: Related Work

[related work! have to work on this!]

6.1 Instances of Variation in Databases

[schema evolution. database versioning. data integration. data provenance.]

6.2 Instances of Database Variation Resulted from Software Development

[SPL. data model. query.]

6.3 Variational Research

[blah]

Chapter 7: Conclusion

[conclusion]

APPENDICES

Appendix A: Variational Database Usecases

A.1 Variation in Space

[enron email usecase]

A.2 Variation in Time

[employee evolution usecase]