

2007

Analysis of the group A streptococcal surface protein, serum opacity factor as a vaccine antigen and virulence determinant

Christine Margaret Gillen
University of Wollongong

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KNOWLEDGE LIBRARIES AND INFORMATION SPACE

A thesis submitted in partial fulfilment of the requirements for the award of
the degree

DOCTOR OF PHILOSOPHY

from the

UNIVERSITY OF WOLLONGONG

by

ERIC RAYNER, BCompSc(Hons)

**SCHOOL OF COMPUTER SCIENCE AND
SOFTWARE ENGINEERING**

2009

Thesis Certification

I, Eric P. Rayner, declare that this thesis, submitted in partial fulfilment of the requirements for the award of Doctor of Philosophy, in the School of Information and Computer Science, University of Wollongong, is wholly my own work unless otherwise referenced or acknowledged. The document has not been submitted for qualifications at any other academic institution.

Eric Rayner
July 27, 2009

Contents

List of Figures	ix
List of Tables	xiii
Abbreviation, Notation and Typographical Conventions	xvii
Abstract	xix
Acknowledgements	xxi
1 Introduction	1
1.1 Thesis Overview	1
1.2 The Contribution of this Thesis	6
1.3 The Organisation of Information	7
1.4 Thesis Methodology	9
1.4.1 Gap in the literature	10
1.4.2 Research hypothesis	11
1.4.3 Experiment	11
1.5 How to Read this Thesis	12
1.6 Thesis Outline	13
1.7 The Nature of Information	14
1.8 Limitations of this Thesis	17
1.9 Knowledge Libraries	18
1.10 Information Space	19
1.11 Information Organisation Terms	23
2 The Organisation of Information	25
2.1 Overview	25
2.2 Introduction	26
2.3 Traditional Classification	27
2.3.1 Faceted classification	29
2.3.2 ISBN, ISSN, MARC and CIP	30

2.3.3	A critique of traditional classification	32
2.4	Computer File Systems	34
2.4.1	A critique of computer file systems	36
2.5	The Database	36
2.5.1	Critique of the database	38
2.6	Information Retrieval	38
2.6.1	Measuring the effectiveness of IR	40
2.6.2	A critique of IR	41
2.7	Data Warehousing	44
2.7.1	Critique	48
2.8	The Internet, World Wide Web and Semantic Web	48
2.8.1	The internet	48
2.8.2	The world wide web	49
2.8.3	The Semantic Web	50
2.9	Discussion and Summary	52
2.10	What this chapter achieved	52
3	Knowledge Libraries	53
3.1	Overview	53
3.2	Introduction	54
3.3	Knowledge Library User Scenarios	55
3.4	The Uses of Knowledge Libraries	69
3.4.1	Knowledge Libraries for Research	69
3.4.2	Knowledge Libraries for Education	71
3.4.3	Knowledge Libraries for Business	72
3.5	Core Knowledge Library Functionality	72
3.5.1	Core knowledge library administration functionality	73
3.5.2	Core knowledge library end use functionality	73
3.6	Knowledge Library Security	74
3.7	Extended Knowledge Library Functionality	74
3.7.1	Automatic dimensions	75
3.7.2	Dynamic dimensions	75
3.7.3	Automatic report generation	76
3.7.4	Automatic notification	77
3.7.5	Knowledge library graphical user interface	78
3.8	What this chapter achieved	78
4	Spaces for Information Organisation	79
4.1	Overview	79
4.2	Potential Mathematical Bases	80

4.2.1	Metric Space	81
4.2.2	Vector Space	82
4.2.3	The vector model for information retrieval	83
4.2.4	Lattices and Topological Space	89
4.2.5	Formal Concept Analysis	90
4.2.6	The Relational Model	93
4.2.7	Online Analytical Processing (OLAP)	95
4.3	Space	96
4.4	n -Dimensional Spaces	97
4.5	Nested Spaces	100
4.6	Span	101
4.7	Spans of Points in n -Dimensional Spaces	104
4.8	The Generalised Triangle Inequality and Set Space	105
4.9	Other Properties of Set Distance Functions	106
4.9.1	\subseteq -Reflexivity	106
4.9.2	$\not\subseteq$ -Strict Positiveness	107
4.9.3	$\not\subseteq^d$ -strict positiveness	108
4.10	Signed Distances	109
4.11	What this Chapter Achieved	109
5	Set Spaces	111
5.1	Overview	111
5.2	Manipulating Set Space	112
5.2.1	n -Dimensional Set Spaces	112
5.2.2	Other Properties of n -Dimensional Spaces	113
5.2.3	Dimension Nesting	114
5.2.4	Dilated and Translated Spaces	115
5.3	Set Distance Functions Based on Set Operations	116
5.4	The d_{ij}^M Set Distance function	118
5.4.1	The Triangle Inequality (ΔI)	122
5.4.2	Span	123
5.4.3	The Generalised Triangle Inequality ($G\Delta I$)	125
5.4.4	\subseteq -reflexivity	129
5.4.5	$\not\subseteq^d$ -strict positiveness	129
5.5	What this Chapter Achieved	130
6	L-Collections	133
6.1	Overview	133

6.2	Background	134
6.2.1	Sets	134
6.2.2	Multisets	135
6.2.3	Merges and Joins	136
6.2.4	Indexed Families	137
6.2.5	Rough Sets	138
6.2.6	Fuzzy sets	139
6.3	L -Collections	142
6.3.1	L -collection operators	143
6.4	Sets, Multisets, Fuzzy Sets, Rough Sets and L -Collections	147
6.4.1	Sets and L -Collections	147
6.4.2	Multisets and L -Collections	148
6.4.3	Fuzzy Sets and L -Collections	148
6.4.4	Rough Sets and L -Collections	148
6.5	Extending Proofs Over Sets and Multisets to $\{1\}$, \mathbb{N}_1 and $\mathbb{Q}^{>0}$ -Collections	148
6.6	What this Chapter Achieved	150
7	L-Collection Space	151
7.1	Overview	151
7.2	L -Collection Distance Functions	152
	An L -Collection Distance Function	152
7.2.1	ΔI for $ \mathcal{X} - \mathcal{X} \cap \mathcal{Y} $	153
7.2.2	$\not\subseteq^d$ -strict positiveness for $ \mathcal{X} - \mathcal{X} \cap \mathcal{Y} $	153
7.2.3	\subseteq -reflexivity for $ \mathcal{X} - \mathcal{X} \cap \mathcal{Y} $	154
7.3	The d_{ij}^M L -Collection Distance Function	154
7.4	The ${}_k^M d$ L -Collection Distance Function	156
7.4.1	Span and $G\Delta I$ for ${}_k^M d$	159
7.4.2	\subseteq -reflexivity for ${}_k^M d$ distance functions	162
7.4.3	$\not\subseteq^d$ -strict positiveness for ${}_k^M d$ distance functions	163
7.5	The ${}_{av}^M d$ L -Collection Distance Function	164
7.5.1	$G\Delta I$ for ${}_{av}^M d$	166
7.5.2	Other properties of ${}_{av}^M d$	174
7.6	What this Chapter Achieved	174
8	Information Space	177
8.1	Overview	177
8.2	Introduction	178
8.3	Networked Space	179
8.4	Classification Space	184

8.4.1	Classification spaces for uncertain and partial classifications	185
8.4.2	Many levelled classification spaces	187
8.4.3	Projected classification spaces	188
8.5	Working with Classification Space	190
8.5.1	Creation	190
8.5.2	Addition and subtraction	190
8.5.3	Point selection	191
8.5.4	Ordering	194
8.6	Attaching Information Units to Points in Classification Spaces	194
8.6.1	Distance	195
8.6.2	Indexing classification spaces	196
8.7	Information Space	198
8.8	Working with Information Space	199
8.8.1	Creation	199
8.8.2	Index Manipulation	199
8.8.3	Information unit selection	202
8.8.4	Selecting points in information space	204
8.9	What this Chapter Achieved	205
9	Basing Knowledge Libraries on Information Space	207
9.1	Overview	207
9.2	Information Space for Questionnaire Knowledge Libraries	208
9.2.1	Example Questionnaire Information Space	210
9.3	Information Space for Research Paper Knowledge Libraries	213
9.3.1	Selecting and Comparing Research Papers	214
9.3.2	Extended Dimensions	215
9.3.3	Further Dimensions	217
9.4	What this Chapter Achieved	218
10	The Efficient Implementation of Knowledge Libraries	219
10.1	Overview	219
10.2	Introduction	220
10.2.1	Distance query	220
10.2.2	Range query	221
10.2.3	k Nearest neighbour query	221
10.2.4	Ranked query	221
10.2.5	Sequential search range query algorithm	222

10.3	Metric Space Algorithms	222
10.3.1	Relative ordering	223
10.3.2	Radius partitioning	224
10.3.3	Hyperplane partitioning	226
10.3.4	Ranked query and k -NN query algorithms	227
10.3.5	A critique of the literature	228
10.4	Adapting Metric Space Algorithms for Set Space	229
10.4.1	Relative ordering for set spaces	230
10.4.2	Radius partitioning for set space	231
10.4.3	Hyperplane partitioning for set spaces	233
10.5	Searching hard spaces	234
10.5.1	Specialised algorithms for searching hard spaces	235
10.5.2	Specialised algorithms for searching n -dimensional spaces	236
10.6	What this Chapter Achieved	238
11	Experimental Results and Discussion	241
11.1	Overview	241
11.2	Introduction	242
11.3	Set Space Radius Partitioning Implementation: Non symmetric Experiments	243
11.3.1	Non Symmetric Experiment setup	244
11.3.2	Non Symmetric Experimental results	247
11.3.3	Discussion of non symmetric results	248
11.4	Variance Experiments	251
11.4.1	Variance experimental results	253
11.4.2	Random edge weight experimental results	253
11.4.3	Euclidean space experimental results	256
11.5	Center Selection and Multiple Tree Experiments	257
11.5.1	Greatest minimum center selection experiment	259
11.5.2	Standard deviation center selection experiment	259
11.5.3	Discussion of center selection experiments	261
11.5.4	Experiment with multiple search trees	261
11.6	Experiments with Multi-Dimensional Spaces	264
11.6.1	Multi-Dimensional experiment setup	264
11.6.2	Multi-Dimensional experimental results and discussion	265
11.6.3	Multiple tree experiments	265
11.7	Set Space Experiments	269
11.7.1	Discussion of set space results	270
11.8	Sequential search algorithms	270

11.8.1	Sequential search for n -dimensional spaces	272
11.8.2	Sequential search over set spaces with set distance functions	272
11.8.3	Discussion of sequential search results	273
11.9	Introducing the Sequential-Hybrid	
	Algorithm	274
11.9.1	Discussion of sequential-hybrid results	274
11.10	Summary, discussion and recommendations	275
11.11	What this Chapter Achieved	276
12	Summary, Discussion and Future Work	279
12.1	Chapter Overview	279
12.2	Thesis Summary	280
12.2.1	The importance of information systems	280
12.2.2	The significance of Knowledge Libraries	281
12.2.3	The mathematical basis for Knowledge Libraries	282
12.2.4	Implementing Knowledge Libraries	284
12.3	Discussion	284
12.3.1	The Contribution of this Thesis	285
12.3.2	The more formal development of Knowledge Libraries	286
12.3.3	The flexibility of information space	286
12.4	Future Work	287
12.4.1	The implementation of Knowledge Libraries	287
12.4.2	Graphical Interface	287
12.4.3	Improving existing systems	288
12.4.4	The dissemination of knowledge	289
	Appendix A: A Guide to the Accompanying CD	291
	Appendix B: Publications Relating to this Thesis	299
	Appendix C: Glossary of Information Organisation Terms	301

List of Figures

2.1	A 13-digit ISBN with EAN-13 bar code	31
4.1	A Hasse diagram of a concept lattice of objects = $\{1, \dots, 10\}$ and attributes = {composite, even, odd, prime, square}.	92
4.2	Three balls X, Z, Y in \mathbb{R}^2	102
5.1	Subset element counts for \subseteq -reflexive proofs. $a = X $, $b =$ $ Y - X $	116
5.2	Subset element counts for Δ I proofs. $a = Z - X - Y $, $b = Z \cap X - Y $, $c = Z \cap X \cap Y $	117
5.3	Subset element counts for $\not\subseteq^d$ -strict positive proofs. $a = X -$ $Y $, $b = X \cap Y $ and $c = Y - X $	117
7.1	Sub L -collection element counts for Δ I proofs. $a = \mathcal{Z} - \mathcal{X} -$ $\mathcal{Y} $, $b = \mathcal{Z} \cap \mathcal{X} - \mathcal{Y} $, $c = \mathcal{Z} \cap \mathcal{X} \cap \mathcal{Y} $, etc.	153
7.2	Sub L -collection element counts for $\not\subseteq$ -strict positive proofs. $a = \mathcal{X} - \mathcal{Y} $, $b = \mathcal{X} \cap \mathcal{Y} $ and $c = \mathcal{Y} - \mathcal{X} $	153
7.3	Sub L -collection element counts for \subseteq -reflexive proofs. $a =$ $ \mathcal{X} $, $b = \mathcal{Y} - \mathcal{X} $	154
11.1	Frequency of distances for typical 1000-point network spaces with $maxDist = 25$ and 1500, 2000, 2500 and 3000 directed, $weight = 1$ edges.	245
11.2	Frequency of distances for typical 1000-point network spaces with $maxDist = 25$. LHS: 1100 undirected, $weight = 1$ edges. RHS: 2200 directed, $weight = 1$ edges.	247

- 11.3 Data from a range query ($x = 999, t = 2$) on radius partitioning search trees ($branchFactor = 2, leafCapacity = 10$) over 1000 different, 1000-point, metric (network) spaces generated from networks with 1100 $weight = 1$ undirected edges and $maxDist = 25$. **LHS**: distribution of candidate point set size as a (truncated) percentage of space size. **RHS**: distribution of retrieved to candidate point set sizes (by truncated percentage). 251
- 11.4 Frequency of distances. **LHS**: a typical 1000-point network space with $maxDist = 255$ and $1.1n$ undirected edges with uniform random weights (integers 1 to 19) . Mean distance: 120.913, standard deviation: 39.2604. **RHS**: a 1-dimensional Euclidean space over integers 0–999. Mean distance: 333.333, standard deviation: 235.702. 255
- 11.5 Data from a range query ($x = 999, t = 50$) on radius partitioning search trees ($branchFactor = 2, leafCapacity = 10$) over 1000 different, 1000-point, metric (network) spaces (with 1100 randomly weighted undirected edges). **LHS**: distribution of candidate point set size as a (truncated) percentage of space size. **RHS**: distribution of retrieved to candidate point set sizes (by truncated percentage). Compare with figure 11.3. 255
- 11.6 Data from the range query $x = 999, t = 50$ on 1000 radius partitioning search trees (with randomly selected centers, $branchFactor = 2$ and $leafCapacity = 10$) over a 1000-point uniform Euclidean space. **LHS**: distribution of candidate point set size as a (truncated) percentage of space size. **RHS**: distribution of retrieved to candidate point set sizes (by truncated percentage). Compare with figure 11.3. 256

11.7	Data from a range query ($x = 999, t = 2$) on radius partitioning search trees ($branchFactor = 2, leafCapacity = 10$) with specially selected centers over 1000 different, 1000-point, metric (network) spaces (with 1100 $weight = 1$ undirected edges). LHS: distribution of candidate point set size as a (truncated) percentage of space size. RHS: distribution of retrieved to candidate point set sizes (by truncated percentage). Compare with figure 11.3.	260
11.8	Data for the range query $x = 999, t = 2$ over 3 radius partitioning search trees (with random centers, $branchFactor = 2$ and $leafCapacity = 10$) for each of 1000 different, 1000-point, metric (network) spaces (with 1100 $weight = 1$ undirected edges). The intersection of the 3 resulting candidate point sets was taken as the candidate point set for this search method. LHS: distribution of candidate point set size as a (truncated) percentage of space size. RHS: distribution of retrieved to candidate point set sizes (by truncated percentage).	263
11.9	Distance frequencies for the “first” 1000 points in 2,3,4 and 5–dimensional uniform Euclidean spaces. Distances are truncated in the plot, but not when computing the mean and standard deviation. The 2–dimensional space has 32 coordinates each dimension. The others have 10, 6 and 4 (respectively).	266
11.10	Distribution of retrieved to candidate point set sizes (by truncated percentage) for the range query $x = 0, t = 2$ over 1000 radius partitioning search trees (with random centers, $branchFactor = 2$ and $leafCapacity = 10$) for uniform 1000-point, 2,3,4 and 5–dimensional Euclidean space.	267

11.11	Distribution of retrieved to candidate set sizes (by truncated percentage) for the range query $x = 0$, $t = 2$ over 1000 different groups of three radius partitioning search trees (with random centers, $branchFactor = 2$ and $leafCapacity = 10$) for a uniform 1000-point, 2,3,4 and 5-dimensional Euclidean space. The group candidate set is the intersection of the candidate sets corresponding to each of the three trees. . . .	268
11.12	Data from 1000 range queries ($0 \leq x \leq 999$, $t = 50$) on 1000 different radius partitioning search trees (with random centers, $branchFactor = 2$, $leafCapacity = 10$) over the space $\langle\{0, \dots, 999\}, x - y\rangle$. LHS : distribution of candidate point set size as a (truncated) percentage of space size. RHS : distribution of retrieved to candidate point set sizes (by truncated percentage).	269
11.13	Data from a range query ($x = 999$, $t = 2$) on radius partitioning search trees ($branchFactor = 2$, $leafCapacity = 10$) over 1000 different, 1000-point, (non symmetric) network spaces generated from networks with 2200 $weight = 1$ directed edges and $maxDist = 25$. LHS : distribution of candidate point set size as a (truncated) percentage of space size. RHS : distribution of retrieved to candidate point set sizes (by truncated percentage).	270

List of Tables

2.1	Simplified Star Schema for Nationwide Retail Chain	46
3.1	Dimension types	56
4.1	Eight relations illustrating operations defined in [24]	94
5.1	Distances for three distance functions over $X = \{1, 3\}$, $Y = \{5, 9\}$ and $Z = \{3, 5\}$	123
10.1	Ball to enclosing hypercube volume (4 s.f.) for different n in Euclidian space	237
11.1	Average, over 1000 distinct queries ($t = 2$, $0 \leq x < 1000$), radius partitioning tree search ($branchFactor = 2$, $leafCapacity = 10$) and sequential search range query times (milliseconds) for typical symmetric network spaces generated from (random) $n = 1000$, $e = 1100$; $n = 10000$, $e = 13000$; and $n = 100000$, $e = 150000$ (undirected) networks and non symmetric network spaces generated from (random) $n = 1000$, $e = 2200$; $n = 10000$, $e = 26000$; and $n = 100000$, $e = 300000$ (directed) networks.	248
11.2	Radius partitioning search tree ($branchFactor = 2$ and $leafCapacity = 10$) for a typical, random, 1000-point network space (with 1100 undirected $weight = 1$ edges).	254

11.3	Candidate nodes, collisions, pruned nodes and points, considered and retrieved points by level from a range query ($x = 999$, $t = 2$) on the radius partitioning search tree in table 11.2. The retrieved point set contained 7 points, while the candidate point set contained 198 points, giving a retrieved to considered ratio of approximately 3%.	254
11.4	Typical radius partitioning search tree (with random centers, $branchFactor = 2$ and $leafCapacity = 1$) for a 1-dimensional Euclidean space over integers 0–999. Compare with table 11.2.	258
11.5	Collisions, pruned nodes and points, considered and retrieved points by level from the range query $x = 999$, $t = 50$ on the radius partitioning search tree in table 11.4. Both retrieved and candidate point sets contained 51 points, giving a retrieved to considered ratio of 100%. Compare with table 11.3.	258
11.6	Candidate set sizes for the range query $x = 999$, $t = 2$ over 3 radius partitioning search trees (with random centers, $branchFactor = 2$ and $leafCapacity = 10$) for each of 10 different, 1000-point, metric (network) spaces (with 1100 $weight = 1$ undirected edges). The size of the intersection of these 3 sets, and the size of the retrieved set is also displayed.	262
11.7	Space size and query time for the sequential search algorithm (for a C++ implementation, using the <code>cmath sqrt()</code> and <code>pow()</code> functions, on a 1.8GHz machine with 265k memory running Linux) for various n -dimensional spaces with 1000 points in each dimension and 10^6 information elements. “Dimensional distances” d_1, \dots, d_n are combined using $\sqrt{(\sum_{i=1}^n d_i^2)}$	272

11.8	Space size and query time for the sequential search algorithm (for a C++ implementation, using the <code>cmath sqrt()</code> and <code>pow()</code> functions, on a 1.8GHz machine with 265k memory running Linux) for a 3–dimensional space. Each dimension is a set space, based on an underlying space with 1000 points. The algorithm determines distances for 10^6 information units, attached to random points in the space. “Dimensional distances” d_1, d_2, d_3 are combined using $\sqrt{d_1^2 + d_2^2 + d_3^2}$	273
11.9	Retrieved to candidate set sizes (by truncated percentage) for a sequential search range queries over 3,5,7 and 9–dimensional spaces (with 10^6 randomly attached information elements). Each dimension consists of 1000 points. Distances are uniform random integers between 1 and 1000. In each n –dimensional space, the first $n - 1$ dimensions were used to determine the candidate set.	275

Abbreviation, Notation and Typographical Conventions

The set of real numbers is denoted by \mathbb{R} , the set of rational numbers by \mathbb{Q} and the set of natural numbers (integers, strictly larger than 0) by \mathbb{N}_1 . Note that $\mathbb{R}^{\geq 0}$ is the set of real numbers greater than or equal to 0, while $\mathbb{R}^{>0}$ is the set of real numbers strictly greater than 0. Interval notation is used to denote real intervals, so $(0, 1]$ is the set of real numbers less than or equal to 1 and strictly larger than 0. More generally, capital letters, such as L, M, X, Y , are used to denote sets. The power set of any set M (the set of all subsets of M) is denoted $\mathcal{P}(M)$.

Lowercase “math bold font” letters denote vectors, so \mathbf{x} and \mathbf{y} are vectors.

L -collections (introduced in chapter 6) are distinguished from sets by using “math calligraphy font”, so $\mathcal{M}, \mathcal{X}, \mathcal{Y}$ are L -collections.

Enclosing vertical bars are used to denote the cardinality of a set ($|M|$), the cardinality of an L -collection ($|\mathcal{M}|$), the absolute value of a real number ($|d(x, y)|$) and the magnitude of a vector ($|\mathbf{x}|$).

Bold text is used to denote key terms that are defined (or at least described), both within, and (optionally) prior to, the definition. “Double quotes” are used for short quotations (which are also referenced) and when introducing key terms that are not defined.

Finally, *iff* is used as shorthand for “if and only if”.

Abbreviations in this thesis are preceded and introduced by the corresponding, non abbreviated, full term.

Abstract

This research describes and develops **Knowledge Libraries**, idealised systems for organising and presenting information. By providing a mathematical basis, the definition of **information space** establishes a formal foundation for Knowledge Libraries. The definition of information space builds on the new definitions of *L*-**collections**, which generalise sets by allowing a real valued grade to be associated with each element, and **set space**, which generalises metric space to better model the relationships between **information units**.

The **multiple search tree** method improves existing metric space range query algorithms. These algorithms are also generalised to work over set space. The **sequential-hybrid algorithm** enables efficient range queries over multi-dimensional spaces.

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