

Contents

1	Background	1
1.1	Big Data	2
1.2	Omics	3
1.3	Human Neuroimaging	6
	References	7
2	Motivation and State of the Art	9
2.1	Data Management and Metadata	10
2.2	Data Sharing in Biomedical Research: An Open Issue	11
2.3	Metadata Standardisation	11
2.3.1	Approaches to Standardisation	12
2.3.2	Minimum Information Requirements and Metadata Checklists	13
2.3.3	Controlled Vocabularies: Taxonomies and Ontologies	15
2.3.4	Biomedical Metadata and the Semantic Web	16
2.3.5	Established Standards for Data Exchange in Clinical Research	17
2.3.6	The XCEDE Schema	18
2.4	The Shortcomings of Standards in Research Collaborations	19
2.5	Data Repositories: The State of the Art	21
2.5.1	XNAT	22
2.5.2	COINS	23
2.5.3	CARMEN	24
2.5.4	XTENS	25
2.5.5	SIMBioMS	26
2.5.6	openBIS	27
2.5.7	i2b2	30
2.6	Data Repositories Comparison	31
	References	34

3	The JSON-Based Data Model	39
3.1	Introduction	39
3.2	Why JSON?	39
3.3	The JSON Metadata Schema	41
3.4	A First Implementation: XTENS 1.5	43
	References	48
4	Results: The Integrated Biobanking Use Case	49
4.1	BIT Workflow	49
4.2	XTENS for BIT	51
4.2.1	Sample Management	54
4.2.2	ALK Management	56
4.3	BIT Installation Setup	57
	References	58
5	Results: XTENS 2, A JSON-Compliant Repository	61
5.1	XTENS 2 Back-End Architecture	63
5.2	XTENS 2 UML Class Diagram	65
5.2.1	XTENS 2 Metadata Management	66
5.3	The Query Builder	68
5.4	Performance Tests	72
5.4.1	1-Parameter Query	75
5.4.2	3-Parameter Query	77
5.4.3	Multi-datatype Query	82
5.5	Collaborative SEEG Project Use Case	84
	References	87
6	Discussion	89
6.1	XTENS 1.5–2 and the State of the Art	89
6.2	XTENS 1.5 for Integrated Biobanking	92
6.3	XTENS 2: Performance and Scalability	92
6.4	XTENS for Multidisciplinary Collaborations	94
	References	94
7	Conclusions	95
7.1	Future Developments	96
7.2	Implications and Predictions	96
	Reference	97
	Appendix: XTENS 2 Database Schemas	99
	Curriculum Vitae	103

Biomedical Research and Integrated Biobanking: An
Innovative Paradigm for Heterogeneous Data
Management

Izzo, M.

2016, XX, 104 p. 27 illus., 16 illus. in color., Hardcover

ISBN: 978-3-319-31240-8