



DSCI 550: Data Science at Scale

Term-Day-Time

Summer 2023- Lecture: Tue, Thu, 3:00-7:10pm

First day of class: July 6th, 2023

Last day of class: August 8th, 2023

Instructor: Dr. Anna Farzindar

Email: farzinda@usc.edu

Location: OHE 100D or Virtual meeting (Please check the zoom link on D2L for DEN students)

Professor's Office Hours: Tuesday before class

Students are advised to make appointments with the professor ahead of time in any event and be specific with the subject matter to be discussed. Students should also be prepared for their appointment by bringing all applicable materials and information.

DSCI 550 Overview

This course is designed as an overview course to give students a broad understanding of Informatics topics for Big Data and to get practical experience with key Big Data informatics techniques. Topics include roadmap of informatics, the data lifecycle, the role of the data scientist, and analyzing and exploring Big Data with real world use cases in data analytics, and big data. Understanding Big Data involves understanding of digital file formats, their detection and data extraction from them. Emphasis areas include Document Type Detection; Parsing and extraction; Metadata understanding and analysis; Language Identification and detection from files and finally file formats and representation. The class also has a specific focus on Content Detection and Analysis from large data sets. Datasets used in the course are publicly collected by the instructor or his collaborators involved in national Big Data initiatives including DARPA, NASA and

other projects. The course is designed to be accessible to students with experience programming in Python and Java at an intermediate level. The course will introduce the students to topical software frameworks that deal with Big Data including Tika, Solr, ElasticSearch™, TensorFlow, Nutch and Apache Hadoop™. The course will be a combination of lecture, in-class discussion, readings, group-based assignments and a final exam.

The objective of this course is to train students to be able to understand Big Data and Large Data Environments, e.g., file formats, their representation, and how to automatically extract information from large datasets of files. Specifically, students successfully completing this course will achieve three main objectives:

1. Develop sufficient proficiency in Big Data frameworks to write software capable of automatically extracting information from data including its text and metadata and language.
2. Develop sufficient proficiency in techniques with Large Data sets collected from the Web and other places (Intranet, Science Data Sets, Public Data Sets).
3. Develop sufficient proficiency in Python and Java to write and execute software that is “File Aware” and that automatically extracts text and metadata from large data sets.

The primary teaching methods will be discussion, case studies, and lectures. Students are expected to perform directed self learning outside of class which encompasses, among other things, a considerable amount of literature review. Leadership training in open source is provided and encouraged, and students leave with an experience in open source that makes them more marketable to companies and institutions looking to hire in Big Data, and Data Science.

In addition to foundations, and practical experience with Big Data and Data Science, the class will also introduce the student to the state-of-the-art in content detection research, future trends and state-of-the-practice. Students are expected to attend class regularly, and participate (as directed) in all class discussions, and most importantly, have fun!

Textbooks

Chris A. Mattmann, and Jukka Zitting. Tika in Action, 256 pages. New York: Manning Publications, November 2011. ISBN: 9781935182856.

C. Mattmann. Machine Learning with TensorFlow: 2nd Edition. 456 pages. New York: Manning Publications, December 2020. ISBN 9781617297717

ASSIGNMENTS And EXAMINATIONS

Name	Description	Weight
Exam	An exam testing your understanding of the lecture materials	25%
Assignments	Assignments where you will build on the Big Data and Data Science topics in course and make a contribution to one of the existing open source frameworks (Tika, Solr, Nutch, TensorFlow, OODT, etc.).	45%
Individual Presentation	An individual presentation demonstrating the student's understanding of one of the required paper readings in the course.	10%
Quizzes	Participation in lectures, by asking questions and contributing to the conversation. Attending lectures (physically and remotely) and positively contributing to the class experience.	20%

Schedule

(subject to change; check regularly)

Week	Lecture Topic	Assigned Readings	Assignments & Deadlines
Week1 7/6	<ul style="list-style-type: none"> • Course Introduction • Introduction to Big Data • Breakout Groups on Big Data 	--	Resources: <ul style="list-style-type: none"> • DARPA I2O (DARPA Dan) Video • Square Kilometre Array Video • Kenneth Cukier: Big data is better data
Week2 7/11	<ul style="list-style-type: none"> • Report out from Big Data Breakouts 	<ul style="list-style-type: none"> • Tika in Action, Chapter 1 • Mattmann, Chris. A vision for data science. Nature, Vol. 	<ul style="list-style-type: none"> •

Week	Lecture Topic	Assigned Readings	Assignments & Deadlines
	<ul style="list-style-type: none"> • A Taxonomy of File Formats • Content Detection Libraries • Language Bindings for Apache Tika • Individual Student Presentations • Report outs from the in class discussion around 5 'Vs' 	<p>493, No. 7433, pp. 473-475, January 24, 2013.</p> <ul style="list-style-type: none"> • Lynch, Clifford. "Big data: How do your data grow?." Nature 455.7209 (2008): 28-29. 	
7/13	<ul style="list-style-type: none"> • Document Similarity and Deduplication • Individual Presentations • Introduction to Assignment 1 	<ul style="list-style-type: none"> • Tika in Action, Chapter 2 • Howe, Doug, et al. "Big data: The future of biocuration." Nature 455.7209 (2008): 47-50. • Wigan, Marcus R., and Roger Clarke. "Big data's big unintended consequences." Computer 46.6 (2013): 46-53. • Schwartz, J. A. N. A., et al. "Measuring the value of Big Data exploitation systems: Quantitative, non-subjective metrics with the user as a key component." Parsons Journal for Information Mapping 6 (2014): 1-12. • Sotera Defense Solutions. A Survey of Big Data Methods, Assessments, and 	<p>Resources:</p> <ul style="list-style-type: none"> • The MIME guys: How two Internet gurus changed e-mail forever • IEEE Computer Interview with Nathaniel Bornstein

Week	Lecture Topic	Assigned Readings	Assignments & Deadlines
		<p>Approaches. November 2012</p> <ul style="list-style-type: none"> • De Mauro, Andrea, Marco Greco, and Michele Grimaldi. "What is big data? A consensual definition and a review of key research topics." AIP conference proceedings. Vol. 1644. No. 1. AIP, 2015. • Crocker, David. RFC 822 "Standard for the format of ARPA Internet text messages." (1982). • Freed, Ned and Nathaniel Borenstein. RFC 1341. MIME (Multipurpose Internet Mail Extensions). Mechanisms for Specifying and Describing the Format of Internet Message Bodies. June 1992. • Freed, Ned, and Nathaniel Borenstein. RFC 2045. Multipurpose internet mail extensions (MIME) part one: Format of internet message bodies. 1996. 	
7/13	<ul style="list-style-type: none"> • Document Type Detection • Individual Presentations • Report outs from the in class 	<ul style="list-style-type: none"> • Tika in Action, Chapter 3 • Freed, Ned, and Nathaniel Borenstein. RFC 2046 Multipurpose internet mail extensions (MIME) part two: 	<p>Resources:</p> <ul style="list-style-type: none"> • The Economist - Digital Bit Rot • Bit Rot - on Digital Vellum (by Vint Cerf, Google) TEDx Talk

Week	Lecture Topic	Assigned Readings	Assignments & Deadlines
	<p>discussion around classifying files and the MIME taxonomy</p>	<p>Media types, November, 1996.</p> <ul style="list-style-type: none"> • Freed, Ned. RFC 2048 "Multipurpose internet mail extensions (MIME) part four: Registration procedures." ISI (1996). • Hicks, Ben J., et al. "Organizing and managing personal electronic files: A mechanical engineer's perspective." ACM Transactions on Information Systems (TOIS) 26.4 (2008): 23. • Shim, Jungwon Roy. "Arium: Beyond the Desktop Metaphor: A new way of navigating, searching, and organizing personal digital data." Masters Thesis, Carnegie Mellon University (2012). • Crowder, Jerome, Jonathan Marion, and Michele Reilly. "File Naming in Digital Media Research: Examples from the Humanities and Social Sciences." Journal of Librarianship and Scholarly Communication 3.3 (2015). • Jackson, Andrew N. "Formats over time: Exploring UK web history." arXiv preprint 	

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		<p>arXiv:1210.1714 (2012).</p> <ul style="list-style-type: none"> Bik, Elisabeth M., Casadevall, Arturo, Fang, Ferrie C. The Prevalence of Inappropriate Image Duplication in Biomedical Research Publications. Manku, Gurmeet Singh, Arvind Jain, and Anish Das Sarma. "Detecting near-duplicates for web crawling." Proceedings of the 16th international conference on World Wide Web. ACM, 2007. 	
<p>Week 3 7/18</p>	<ul style="list-style-type: none"> Content Extraction Individual Presentations 	<ul style="list-style-type: none"> Tika in Action, Chapter 4 Henzinger, Monika. "Finding near-duplicate web pages: a large-scale evaluation of algorithms." Proceedings of the 29th annual international ACM SIGIR conference on Research and development in information retrieval. ACM, 2006. Cooper, Matthew, Jonathan Foote, and Andreas Girgensohn. "Automatically organizing digital photographs using time and content." Image Processing, 2003. ICIP 2003. Proceedings. 2003 	<p>Resources:</p> <ul style="list-style-type: none"> Introduction to Information Retrieval - Chris Mattmann

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		<p data-bbox="737 289 987 380">International Conference on. Vol. 3. IEEE, 2003.</p> <ul style="list-style-type: none"> <li data-bbox="691 390 1008 506">• Manber, Udi. "Finding similar files in a large file system." Usenix Winter. Vol. 94. 1994. <li data-bbox="691 516 1000 831">• Chim, Hung, and Xiaotie Deng. "Efficient phrase-based document similarity for clustering." IEEE Transactions on Knowledge and Data Engineering 20.9 (2008): 1217-1229. <li data-bbox="691 842 1008 1178">• Amirani, Mehdi Chehel, Mohsen Toorani, and A. Beheshti. A new approach to content-based file type detection. Computers and Communications, 2008. ISCC 2008. IEEE Symposium on. IEEE, 2008. <li data-bbox="691 1188 1008 1535">• McDaniel, Mason, and M. Hossain Heydari. Content based file type detection algorithms. System Sciences, 2003. Proceedings of the 36th Annual Hawaii International Conference on. IEEE, 2003. <li data-bbox="691 1545 1000 1787">• Alamri, Nasser S., and William H. Allen. "A comparative study of file-type identification techniques." SoutheastCon 2015. IEEE, 2015. <li data-bbox="691 1797 1000 1860">• Li, Wei-Jen, et al. "Fileprints: Identifying 	

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		<p>file types by n-gram analysis." Information Assurance Workshop, 2005. IAW'05. Proceedings from the Sixth Annual IEEE SMC. IEEE, 2005.</p> <ul style="list-style-type: none"> Shahi, Ashim. "Classifying the classifiers for file fragment classification." Masters Thesis, Universiteit van Amsterdam (2012). 	
7/20	<ul style="list-style-type: none"> Last Week Tonight: Robocalls RoboKiller Video Understanding Metadata Individual Presentations 	<ul style="list-style-type: none"> Tika in Action, Chapter 5 Ahmed, Irfan, et al. "Fast file-type identification." Proceedings of the 2010 ACM Symposium on Applied Computing. ACM, 2010. Pierris, Georgios, and Stilianos Vidalis. "Forensically classifying files using HSOM algorithms." Emerging Intelligent Data and Web Technologies (EIDWT), 2012 Third International Conference on. IEEE, 2012. Harris, Ryan M. "Using artificial neural networks for forensic file type identification." Master's Thesis, Purdue University (2007). 	<p>Resources:</p> <ul style="list-style-type: none"> Last Week Tonight - John Oliver (HBO) - Robocalls New App to stop Robocalls - RoboKiller

Week	Lecture Topic	Assigned Readings	Assignments & Deadlines
		<ul style="list-style-type: none"> <li data-bbox="690 289 982 573">• Douceur, John R., and William J. Bolosky. A large-scale study of file-system contents. ACM SIGMETRICS Performance Evaluation Review 27.1 (1999): 59-70. <li data-bbox="690 577 1003 955">• Kilicoglu, Halil, et al. "Semantic MEDLINE: a web application for managing the results of PubMed Searches." Proceedings of the third international symposium for semantic mining in biomedicine. Vol. 2008. 2008. <li data-bbox="690 959 993 1180">• Kobayashi, Mei, and Koichi Takeda. "Information retrieval on the web." ACM Computing Surveys (CSUR) 32.2 (2000): 144-173. <li data-bbox="690 1184 1008 1470">• Voorhees, Ellen M., and Donna Harman. "Overview of the sixth text retrieval conference (TREC-6)." Information Processing & Management 36.1 (2000): 3-35. <li data-bbox="690 1474 1003 1822">• Arasu, Arvind, and Hector Garcia-Molina. Extracting structured data from web pages. Proceedings of the 2003 ACM SIGMOD international conference on Management of data. ACM, 2003. 	

Week	Lecture Topic	Assigned Readings	Assignments & Deadlines
Week 4 7/25	<ul style="list-style-type: none"> • Video - Understanding Metadata TedX talk • Information Clustering • Example - Machine Learning with TensorFlow - Activity Clustering (Android) 	<ul style="list-style-type: none"> • Tika in Action, Chapter 6 • Lewandowski, Dirk. "Web searching, search engines and Information Retrieval." Information Services & Use 25.3, 4 (2005): 137-147. • Weninger, Tim, William H. Hsu, and Jiawei Han. "CETR: content extraction via tag ratios." Proceedings of the 19th international conference on World wide web. ACM, 2010. • Karpathy, Andrej, and Li Fei-Fei. "Deep visual-semantic alignments for generating image descriptions." Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition. 2015. • Gowda, Thamme, and Chris A. Mattmann. "Clustering Web Pages Based on Structure and Style Similarity (Application Paper)." Information Reuse and Integration (IRI), 2016 IEEE 17th International Conference on. IEEE, 2016. • Anquetil, Nicolas, and Timothy Lethbridge. File clustering using naming conventions 	Resources: <ul style="list-style-type: none"> • The Power of Metadata: Deepak Jagdish and Daniel Smilkov at TEDxCambridge 2013

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		<p>for legacy systems. Proceedings of the 1997 conference of the Centre for Advanced Studies on Collaborative research. IBM Press, 1997.</p> <ul style="list-style-type: none"> • Swierk, Edward, et al. "The Roma personal metadata service." Mobile Networks and Applications 7.5 (2002): 407-418. • Karypis, Michael Steinbach George, Vipin Kumar, and Michael Steinbach. "A comparison of document clustering techniques." KDD workshop on Text Mining. 2000. • Marchionini, Gary. "Exploratory search: from finding to understanding." Communications of the ACM 49.4 (2006): 41-46. 	
7/25	<ul style="list-style-type: none"> • Assignment 2 • Video - Linguistic Forensics • Language Identification • Individual Presentations 	<ul style="list-style-type: none"> • Tika in Action, Chapter 7 • Koehn, Philipp, et al. "Moses: Open source toolkit for statistical machine translation." Proceedings of the 45th annual meeting of the ACL on interactive poster and demonstration sessions. Association for Computational Linguistics, 2007. • Post, Matt, et al. "Joshua 5.0: Sparser, better, faster, server." 	<p>Resources:</p> <ul style="list-style-type: none"> • Forensic Linguistic Profiling & What Your Language Reveals About You Harry Bradford TEDxStoke • The Shallowness of Google Translate - The Atlantic - Douglas Hofstadter • Apache cTAKES • Apache UIMA • Apache OpenNLP • Stanford Core NER/NLP

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		<p>Proceedings of the Eighth Workshop on Statistical Machine Translation. 2013.</p> <ul style="list-style-type: none"> • Lins, Rafael Dueire, and Paulo Gonçalves. Automatic language identification of written texts. Proceedings of the 2004 ACM symposium on Applied computing. ACM, 2004. • Papineni, Kishore, et al. "BLEU: a method for automatic evaluation of machine translation." Proceedings of the 40th annual meeting on association for computational linguistics. Association for Computational Linguistics, 2002. • Bahdanau, Dzmitry, Kyunghyun Cho, and Yoshua Bengio. "Neural machine translation by jointly learning to align and translate." arXiv preprint arXiv:1409.0473 (2014). • Tromp, Erik, and Mykola Pechenizkiy. "Graph-based n-gram language identification on short texts." Proc. 20th Machine Learning conference of Belgium and The Netherlands. 2011. 	<ul style="list-style-type: none"> • NLTK

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		<ul style="list-style-type: none"> • Lopez-Moreno, Ignacio, et al. "Automatic language identification using deep neural networks." Acoustics, Speech and Signal Processing (ICASSP), 2014 IEEE International Conference on. IEEE, 2014. • Bertoldi, Nicola, et al. "MMT: New open source MT for the translation industry." Proceedings of The 20th Annual Conference of the European Association for Machine Translation (EAMT). 2017. 	
7/27	<ul style="list-style-type: none"> • Individual Presentations • Discussion on Named Entity Recognition • Hadoop Spark and Tika: Large Scale Content Detection and Analysis 	<ul style="list-style-type: none"> • Tika in Action, Chapter 8 • Tjong Kim Sang, Erik F., and Fien De Meulder. "Introduction to the CoNLL-2003 shared task: Language-independent named entity recognition." Proceedings of the seventh conference on Natural language learning at HLT-NAACL 2003-Volume 4. Association for Computational Linguistics, 2003. • Nadeau, David, and Satoshi Sekine. "A survey of named entity recognition and classification." Lingvisticae 	<p>Resources:</p> <ul style="list-style-type: none"> • Apache Distributed Release Audit Tool (DRAT) • DRAT Video

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		<p>Investigationes 30.1 (2007): 3-26.</p> <ul style="list-style-type: none"> • Ritter, Alan, Sam Clark, and Oren Etzioni. "Named entity recognition in tweets: an experimental study." Proceedings of the Conference on Empirical Methods in Natural Language Processing. Association for Computational Linguistics, 2011. • Mattmann, Chris A., and Madhav Sharan. "An automatic approach for discovering and geocoding locations in domain-specific web data." Proceedings of the 2016 IEEE 17th International Conference on Information Reuse and Integration (IRI'16). 2016. • Khodak, Mikhail, Nikunj Saunshi, and Kiran Vodrahalli. "A Large Self-Annotated Corpus for Sarcasm." arXiv preprint arXiv:1704.05579 (2017). • Hutto, Clayton J., and Eric Gilbert. "Vader: A parsimonious rule-based model for sentiment analysis of social media text." Eighth international AAAI conference on weblogs and social media. 2014. 	

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		<ul style="list-style-type: none"> Geyer, Kelly, et al. "Named Entity Recognition in 140 Characters or Less." # Microposts. 2016. 	
7/27	<ul style="list-style-type: none"> Readout - Named Entity Recognition Group Presentations Open Source Content Detection Technologies Individual Presentations 	<ul style="list-style-type: none"> Tika in Action, Chapter 9 Dean, Jeffrey, and Sanjay Ghemawat. MapReduce: simplified data processing on large clusters. Communications of the ACM 51.1 (2008): 107-113. Zaharia, Matei, et al. Spark: cluster computing with working sets. Proceedings of the 2nd USENIX conference on Hot topics in cloud computing. Vol. 10. 2010. Elsayed, Tamer, Jimmy Lin, and Douglas W. Oard. "Pairwise document similarity in large collections with MapReduce." Proceedings of the 46th Annual Meeting of the Association for Computational Linguistics on Human Language Technologies: Short Papers. Association for Computational Linguistics, 2008. M. Bernaschi, M. Cianfriglia, A. Di Marco, A. Sabellico, G. Me, G. Carbone, 	<p>Resources:</p> <ul style="list-style-type: none"> TedXTalk Analyzing and modeling complex and big data Professor Maria Fasli TEDxUniversityofEssex Textract Scrapy Mattmann ApacheCon 2015 Content Talk

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		<p>G. Totaro. Forensic Disk Image Indexing and Search in an HPC environment. IEEE International Conference on High Performance Computing & Simulation (HPCS), 2014.</p> <ul style="list-style-type: none"> • Meusel, Robert, Peter Mika, and Roi Blanco. "Focused crawling for structured data." Proceedings of the 23rd ACM International Conference on Conference on Information and Knowledge Management. ACM, 2014. • Niu, Feng, et al. "DeepDive: Web-scale Knowledge-base Construction using Statistical Learning and Inference." VLDS 12 (2012): 25-28. • Mattmann, C. A., Oh, J. H., Palsulich, T., McGibbney, L. J., Gil, Y., & Ratnakar, V. (2015, November). DRAT: An Unobtrusive, Scalable Approach to Large Scale Software License Analysis. In Automated Software Engineering Workshop (ASEW), 2015 30th IEEE/ACM International 	

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		<p>Conference on (pp. 97-101). IEEE.</p>	
<p>Week 5 8/1</p>	<ul style="list-style-type: none"> • Ted Talk (click link in resources) • Evaluating Content Detection • Walkthrough of Polar Deep Insights • Individual Presentations 	<ul style="list-style-type: none"> • Tika in Action, Chapter 10 • Bialecki, Andrzej, et al. "Apache lucene 4." SIGIR 2012 workshop on open source information retrieval. 2012. • Turtle, Howard, Yatish Hegde, and S. Rowe. "Yet another comparison of lucene and indri performance." SIGIR 2012 Workshop on Open Source Information Retrieval. 2012. • Bontcheva, Kalina, et al. "TwitIE: An Open-Source Information Extraction Pipeline for Microblog Text." RANLP. 2013. • Cunningham, Hamish. "GATE, a general architecture for text engineering." Computers and the Humanities 36.2 (2002): 223-254. • Atserias, Jordi, et al. "FreeLing 1.3: Syntactic and semantic services in an open-source NLP library." Proceedings of LREC. Vol. 6. 2006. • Manning, Christopher D., et al. "The stanford corenlp natural language processing toolkit." ACL (System 	<p>Resources:</p> <ul style="list-style-type: none"> • This is What happens when you reply to SPAM e-Mail. - James Veitch - Ted Talk • USC IRDS Polar Data Science website

Week	Lecture Topic	Assigned Readings	Assignments & Deadlines
		<p>Demonstrations). 2014.</p> <ul style="list-style-type: none"> Savova, Guergana K., et al. "Mayo clinical Text Analysis and Knowledge Extraction System (cTAKES): architecture, component evaluation and applications." Journal of the American Medical Informatics Association 17.5 (2010): 507-513. 	
8/1	<ul style="list-style-type: none"> Group Readouts on Evaluating Content Detection and Analysis Lecture on NoSQL Lecture on SciSpark Individual Presentations 	<ul style="list-style-type: none"> Tika in Action, Chapter 11 Nowell, Lucy Terry, et al. "Visualizing search results: some alternatives to query-document similarity." Proceedings of the 19th annual international ACM SIGIR conference on Research and development in information retrieval. ACM, 1996. Shneiderman, Ben. "The eyes have it: A task by data type taxonomy for information visualizations." Visual Languages, 1996. Proceedings., IEEE Symposium on. IEEE, 1996. Gottron, Thomas. "Evaluating content extraction on HTML documents." Proceedings of the 2nd International 	<p>Resources:</p> <ul style="list-style-type: none"> 2019 MIT Citi - 3 - Top Ten Big Data Blunders - Michael Stonebraker (Only watch first 15m) Data Manipulation at Scale - NoSQL rebuttal

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		<p>Conference on Internet Technologies and Applications (ITA'07). 2007.</p> <ul style="list-style-type: none"> • Leuski, Anton. "Evaluating document clustering for interactive information retrieval." Proceedings of the tenth international conference on Information and knowledge management. ACM, 2001. • Bailey, Peter, et al. "Evaluating search systems using result page context." Proceedings of the third symposium on Information interaction in context. ACM, 2010. 	
8/3	<ul style="list-style-type: none"> • Take home Exam 		
Week 6 8/8	<ul style="list-style-type: none"> • Video - Scientific Data: Water and Snow in the Western US • Searching Scientific Datasets • Scientific Data Processing (Airborne Snow Observatory) • Individual Presentations • Big Data with an Eye Towards the 	<ul style="list-style-type: none"> • Tika in Action, Chapter 12 - 14 • Palamuttam, Rahul, et al. "SciSpark: Applying in-memory distributed computing to weather event detection and tracking." Big Data (Big Data), 2015 IEEE International Conference on. IEEE, 2015. • Leavitt, Neal. "Will NoSQL databases live up to their 	<p>Resources:</p> <ul style="list-style-type: none"> • Thomas Painter of NASA JPL speaks at TEDxIS on a thought provoking take

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	<p>Future: Discussion</p>	<p>promise?." Computer 43.2 (2010).</p> <ul style="list-style-type: none"> • Stonebraker, Michael. "SQL databases v. NoSQL databases." Communications of the ACM 53.4 (2010): 10-11. • Stonebraker, Michael. "Stonebraker on NoSQL and enterprises." Communications of the ACM 54.8 (2011): 10-11. • Rafique, Ansar, et al. "On the performance impact of data access middleware for nosql data stores." IEEE Transactions on Cloud Computing (2015). • Moniruzzaman, A. B. M., and Syed Akhter Hossain. "Nosql database: New era of databases for big data analytics-classification, characteristics and comparison." arXiv preprint arXiv:1307.0191 (2013). 	
<p>8/8</p>	<ul style="list-style-type: none"> • Group Presentations 	<ul style="list-style-type: none"> • C. Mattmann, D. Freeborn, D. Crichton, B. Foster, A. Hart, D. Woollard, S. Hardman, P. Ramirez, S. Kelly, A. Y. Chang, C. E. Miller. A Reusable Process Control System Framework 	<ul style="list-style-type: none"> •

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		<p>for the Orbiting Carbon Observatory and NPP Sounder PEATE missions. In Proceedings of the 3rd IEEE Intl Conference on Space Mission Challenges for Information Technology (SMC-IT 2009), pp. 165-172, July 19 - 23, 2009.</p> <ul style="list-style-type: none"> • Wilkinson, Mark D., et al. "The FAIR Guiding Principles for scientific data management and stewardship." Scientific data 3 (2016): 160018. • Buneman, Peter, et al. "Archiving scientific data." ACM Transactions on Database Systems (TODS) 29.1 (2004): 2-42. • Fox, Peter, and James Hendler. "Changing the equation on scientific data visualization." Science 331.6018 (2011): 705-708. • Plale, Beth, et al. "Active management of scientific data." IEEE Internet Computing 9.1 (2005): 27-34. • Gray, Jim, et al. "Scientific data management in the coming decade." ACM SIGMOD Record 34.4 (2005): 34-41. • Ailamaki, Anastasia, Verena Kantere, and 	

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		Debabrata Dash. "Managing scientific data." Communications of the ACM 53.6 (2010): 68-78.	

USC ACADEMIC INTEGRITY

Statement on Academic Conduct and Support Systems

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Support Systems

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Statement on Diversity

The diversity of the participants in this course is a valuable source of ideas, problem solving strategies, and engineering creativity. We encourage and support the efforts of all of our students to contribute freely and enthusiastically. We are members of an academic community where it is our shared responsibility to cultivate a climate where all students and individuals are valued and where both they and their ideas are treated with respect, regardless of their differences, visible or invisible.