

COLLEGE OF INFORMATION SCIENCE & TECHNOLOGY

University of Nebraska at Omaha

Last Revised: August, 2008

ISQA 9020: Technical and Process Issues in IS/IT Research

Course Syllabus¹

Semester: Fall 2008. Classroom: PKI 277; **Meeting Time:** TR 10:00am-11:15am
Professor: Dr. Deepak Khazanchi; **Office:** PKI 172C. **Phone/Voice:** (402) 554-2029.
Consultation Hours: By appointment or walk-in. **E-mail:** khazanchi@unomaha.edu

COURSE DESCRIPTION

Overview of content and purpose of the course: This seminar is a survey course on the technical and process issues in Information Systems research. The course balances the acquisition of knowledge about the conduct of research in technical and process issues with the application of that knowledge to research on information systems. Major topics include: software engineering, programming, data base systems, decision support systems, data warehousing and mining systems, object-oriented systems, adaptive and expert systems, client-server systems, information filtering and multimedia systems, information agents, mobile computing, telecommunications, and electronic commerce.

For whom course is intended: The course is intended for doctoral students in Information Systems or Computer Science or related areas. Advanced master's students and students from other doctoral programs may find the course relevant.

Prerequisites of the course: Doctoral student standing in the information systems area or with the permission of the instructor. ISQA 9010 is recommended but not required.

Objectives: Upon completion of the seminar students should be able to:

- 13.1. Understand existing research relating to technical and process issues in Information Systems/Technology
- 13.2. Attain a critical perspective on past and current research
- 13.3. Understand appropriate methods for conducting technical and process research in Information Systems
- 13.4. Choose an appropriate method for researching specific technical and process issues
- 13.5. Identify and develop interesting research topics in technical and process issues

COURSE PEDAGOGY AND REQUIREMENTS

Pedagogical Method(s): The course uses a discussion-based learning approach and relies heavily on interaction between the student and professor as well as among students. The instructor plays a mentoring role.

¹ The syllabus is subject to change as announced in class.

Student role in the course: The student participates in class discussion, serves as a lead discussant when assigned, completes written assignments and papers, and writes a comprehensive final paper. Because this is a doctoral seminar focused on technical and process issues addressed in IS research, preparation for and participation in discussions for class meetings is absolutely essential.

Instructional Materials:

No specific textbooks will be used, although specific books may be made available on reserve or through the instructor for review by students. The course consists entirely of a list of required readings provided later in this syllabus. Readings will be updated, as appropriate, to reflect new developments in the field.

Course Assignments and Submission Guidelines:

Class Participation: All students are required to **read each article** for the meeting and prepare a brief outline or “**reading note**” of the articles assigned for a meeting session. A one or two paragraph synthesis of the topic and a brief summary of each reading should be sufficient (see guidelines below). These outlines should identify the strengths and weaknesses of the research method and its application to IS research. Based on these, a final report comparing and contrasting the various research methods covered in the seminar will be required (see guidelines below). In the first few weeks, you will be required to prepare a reading note for all articles assigned for each session. Subsequently, each student will continue to prepare reading notes, but the brunt of the effort will be that of the lead discussant assigned by the instructor to a reading(s). Please be prepared to share a copy of your assigned analysis with the other students.

Guidelines for Reading Notes: In general, your notes should be brief and address only the major points of an article or chapter. The idea is to convey the overall form and contribution of the material in one to two pages of single spaced text. Since this particular seminar is focused on different technical and process issues in IT research, your analysis should pay close attention to the issues raised and research approach used in the paper. Use the “miscellaneous” section to make any evaluative comments you feel need to be stated. If you do not have adequate background in a specific research approach, it is always useful to tie your analysis with readings from other sources. The following format is recommended:

- 12.1. **Summary:** A concise summary of the research critique.
- 12.2. **Statement of the Research Problem and Purpose:** Describe the problem as visualized by the authors, the motivation for researching the problem, and the importance of the topic to the IS/T profession.
- 12.3. **Underlying theoretical model(s) used by the authors (if any):** Briefly summarize the conceptual basis of the research study (previously reported models, concepts, and research studies).
- 12.4. **Description of the Research Procedures (if applicable):** What is the overall research method used by the researchers? Is a research model proposed? How do the authors propose to test their model and/or hypothesis? Is the research design and/or experimental design sound? Are there any flaws in the research design? If the reviewed article or chapter is purely theoretical such as in the case of comprehensive literature review or conceptual development piece, describe the concepts/theories/frameworks and the process of arriving at conclusions.
- 12.5. **Data Analysis:** Provide a summary of the data analysis in your own words. Assess the soundness of the data analysis? Describe any flaws and deficiencies in the data analysis. Assess the soundness of the interpretation of data analysis. If the reviewed article or chapter is purely theoretical such as in the case of comprehensive literature review or conceptual development piece, be sure to analyze the validity of concepts/theories/frameworks and the logical coherence of the process used to arrive at conclusions.
- 12.6. **Conclusions:** Describe the major findings, implications, and conclusions. Are the conclusions justified given the research design adopted and research procedures followed? Have the limitations been correctly recognized and addressed? Assess the soundness of the implications (as described by the authors) of this research for research and practice.

- 12.7. **Researcher Reputation:** Assess the reputation of the researcher(s) given the information in the journal.
- 12.8. **Miscellaneous notes:** Are there any other thoughts or comments you have on this and related work you have read?

Leadership of class discussion: When leading a discussion, a student will be required to do a more in-depth analysis of the research articles in the specific section, particularly relating to a specific category of research methods in IS. Useful reference books and text books relating to a specific research method or approach are available in the library and through the instructor for use in preparing and leading a discussion. Specific readings will be assigned to students in the class.

Short Essays: Each student will write two to three short essays. These “think pieces” are to be no more than three (3) single-space pages in length and are intended to encourage you to critically evaluate the assigned readings. Your essay may analyze a single article, or preferably, several or even all of the articles assigned for a given meeting. In your readings, look for themes, problems, opportunities, and nuggets of wisdom. Feel free to draw on your educational background, your professional experience, and your intuition. In your writing, you may take any perspective you feel is appropriate. I want to know what you are thinking as you read and assimilate the material in the course. Your essays will be graded on their ability to communicate thoughtful and relevant ideas in a clear and cogent manner.

Book Report: Each student will write a book report. The book report will be no more than five (5) single-space pages in length. The goal of the report is to critically and thoughtfully summarize and integrate the ideas presented in the book of your choice with readings and ideas discussed in class. In addition, you will be asked to communicate your summary to the rest of the class. The time allotted for your presentation is a minimum of 20 and a maximum of 30 minutes.

Final Comprehensive Research Paper: A doctoral seminar also requires active participation in research. Therefore, each student will be required to develop a research paper that focuses on one or more critical research issues in the IS/T areas discussed in the class. Students will select topics in consultation with the instructor. Frequent progress reports throughout the semester and a completed manuscript at the end of the term will be required. The essential parts of the research paper for this class should follow the guidelines for a dissertation proposal and may include the following sections: (Please refer to detailed research paper guidelines provided separately)

- Problem, hypothesis, or question
- Significant prior research
- Theory, framework, hypotheses (why it is worthy of doctoral research)
- Possible research approach or methodology
- Potential outcomes of research and importance of each

To ensure that every student will submit a passing paper, students must seek feedback on their early draft from the professor at each stage of development. A one page overview using the previous sections and a two page outline of the research paper is due by the end of the 10th week of the seminar. First drafts of completed papers are due on November 30th. Early drafts will not be graded; however, feedback will be provided. An early draft is not an outline, rather it is a full paper. The research proposal should follow the research paper guidelines available separately from the instructor. With additional work after this semester (in the spring and summer) in collaboration with the instructor, it is expected that the paper would be of quality accepted in IS research conferences such as AMCIS, ECIS, ACM, ICIS, SIGCPR, WITS, SIGITPRJMT, SIGHCI, HICSS, etc.

General Evaluation Guidelines: Grades will conform to the degree to which each of the requirements stressed in class is met in the various assignments and final paper. To be eligible for a passing grade in the class, a student must complete all course requirements including, in-class assignments, homework, discussions, and research paper by their deadlines and to the satisfaction of the instructor. *Students are fully responsible for learning the content of this course and for material disseminated in the class. You are not released from this responsibility because of absences. Therefore, the instructor may lower a student's final grade because of excessive absences. Please adhere to deadlines.* All work is to be accomplished on an individual basis unless otherwise specified. In case of exigencies, students are advised to inform the instructor at least a week before a due date. Plagiarism and/or cheating (“a student who uses a dishonest or deceitful means to obtain a grade is guilty of cheating; a student who submits another’s work as one's own without adequate attribution is guilty of plagiarism”) will be penalized with a failing grade per policies established in the Student Handbook.

Grading: The final grade is determined by using the following weights.

- i. Class Participation – 20%
- ii. Leadership of class discussion (as assigned) – 10%
- iii. Short Essays (2 to 3) – 20%
- iv. Book report – 15%
- v. Final comprehensive paper (expected to be submitted to a conference or journal) – 35%

A word on evaluation of each category: A letter grade will be given for all submissions. In general, papers will be evaluated on the basis of currency of topic, application and integration of course concepts, organization of paper, thoroughness and quality of analysis, spelling and grammar, and originality of analysis. In addition, students will earn higher grades for successfully integrating information from additional sources and/or related articles. Grades for **class participation and discussion** will reflect the Instructor's perception of student **quality** and **quantity** of inputs to class learning (e.g., article preparation, research notes, read/discuss supplemental readings).

Grading scale and criteria:

The final grade is based on the percentage of points that the student receives out of the total possible points for the course. The guaranteed grade scale is shown in the following table.

GRADE	POINT VALUE
A	92% ≤ x % ≤ 100%
A-	89% ≤ x < 92%
B+	86% ≤ x < 89%
B	82% ≤ x < 86%
B-	79% ≤ x < 82%
C+	76% ≤ x < 79%
C	72% ≤ x < 76%
C-	69% ≤ x < 72%
D+	66% ≤ x < 69%
D	62% ≤ x < 66%
D-	59% ≤ x < 62%
F	Less than 59%

OVERVIEW OF SEMINAR AND TENTATIVE SCHEDULE

- Week 1. Technical and Process Issues in IS: Foundations (8/26-28)
- Week 2. Systems Development Methods (9/2-4)
- Week 3. Programming (9/9-9/11) – **1st short essay (9/11)**
- Week 4. Database Systems (9/16-21)
- Week 5. Decision Support Systems (9/23-25)
- Week 6. Data Warehousing and Mining Systems (9/30-10/2) – **2nd short essay (10/2)**
- Week 7. Workflow Systems (10/7-9)
- Week 8. Object Oriented Systems (10/14-10/16) – **Research paper one page topic analysis (10/16)**
- Week 9. Expert Systems and Adaptive Knowledge-Based Systems (10/21-23) – **3rd short essay (10/23)**
- Week 10. Client Server Systems (10/28-30) – **Research paper two page outline (10/30)**
- Week 11. Information-Filtering and Multimedia Systems (11/4-6)
- Week 12. Electronic Commerce and Internetworking Infrastructure (11/11-13)
- Week 13. Intelligent Agents (11/18-20)
- Week 14. Mobile and Ubiquitous Computing (11/25-12/2) -- **Draft research paper (11/30)**
- Week 15. Telecommunications Management (12/7-9)
- Week 16. **Book Reports & Presentation (12/12)**

READING LIST FOR SEMINAR ON TECHNICAL AND PROCESS ISSUES IN IS/IT RESEARCH

1. Technical and Process Issues: Foundations

- 1-1. Boulding, K. E. (1956). General systems theory – The skeleton of science. *Management Science*, 197-208.
- 1-2. Wirth, N. (1971). Program development by stepwise refinement. *Communications of the ACM*, 14(4), 221-227.
- 1-3. Dijkstra, E. W. (1972). The humble programmer. *Communications of the ACM*, 15(10), 859-866.

- 1-4. Boehm, B. W. (1973). Software and its impact: A quantitative assessment. *Datamation*, 19(5), 48-59.
- 1-5. Wing, Jeannette (2008). Five deep questions in computing. *Communications of the ACM*, 51(1), 58-60.
- 1-6. Kay, Alan (2004). "The computer revolution hasn't happened yet" *OOPSLA* (2003 ACM Turing Award Lecture). (Watch the talk at <http://awards.acm.org/images/awards/140/vstream/2003/AlanKay/AK768kFull.mov>).

Additional References:

- Orlikowski, W.J. "The Duality of Technology: Rethinking the Concept of Technology in Organizations," *Organization Science*, Volume 3, Number 3, 1992, 398-427.
- Dewey, J. (1910). *How We Think*. Boston, New York, Chicago: D. C. Heath & Co.
- Mitroff, I. I. & Linstone, H.A. (1993). "The Unbounded Mind," Oxford University Press, New York.

2. Systems Development Methods

- 2-1. Colter, M. (1984). A comparative examination of systems analysis techniques. *MIS Quarterly*, 8(1), 51-66.
- 2-2. Caine, S. H., & Gordon, E. K. (1982). PDL – A tool for software design. In E. Yourdon (Ed.), *Writings of the revolution: Selected readings on software engineering* (pp. 176-186). New York: Yourdon Press.
- 2-3. Brooks Jr., F. P. (1995). No silver bullet – Essence and accidents of software engineering. In *The mythical man-month: Essays on software engineering Anniversary Edition* (pp. 179-203). Reading, Massachusetts: Addison-Wesley Longman, Inc.
- 2-4. Brooks Jr., F. P. (1995). No silver bullet' refired. In *The mythical man-month: Essays on software engineering Anniversary Edition* (pp. 207-226). Reading, Massachusetts: Addison-Wesley Longman, Inc.
- 2-5. Agarwal, R., Sinha, A. P., & Tanniru, M. (1996). Cognitive fit in requirements modeling: A study of object and process methodologies. *Journal of Management Information Systems*, 13(2), 137-162.
- 2-6. Henderson-Sellers, B. (2003). Method engineering for OO systems development. *Communication of the ACM*, 46(10), 73-78.
- 2-7. Wooldridge, M., Jennings, N. R., & Kinny, D. (1999). A methodology for agent-oriented analysis and design. In *Proceedings of the Third Annual Conference on Autonomous Agents* (Seattle, Washington, United States). O. Etzioni, J. P. Müller, and J. M. Bradshaw, Eds. AGENTS '99. ACM, New York, NY, 69-76. DOI= <http://doi.acm.org/10.1145/301136.301165>.
- 2-8. Zimmermann, Olaf; Schlimm, Pestel, & Waller (2005). "Analysis and Design Techniques for Service-Oriented Development and Integration." *INFORMATIK 2005 — Informatik LIVE! Band 2*, Beiträge der 35. Jahrestagung der Gesellschaft für Informatik e.V. (GI), Bonn, 19. bis 22. September 2005, [ISBN 3-88579-396-2](https://doi.org/10.1007/978-3-88579-396-2). [ALL TO REVIEW]

Additional References:

- Maiden, N.A.M. & Rugg, G. (1996, May). ACRE: Selecting Methods for Requirements Acquisition, *Software Engineering Journal*, 11(3).
- Bell, M. (2008). *Service-Oriented Modeling: Service Analysis, Design, and Architecture*, Wiley, [ISBN 978-0-470-14111-3](https://doi.org/10.1002/9780470141113).

- Yourdon, E. and Constantine, L.L. (1979). *Structured Design: Fundamentals of a Discipline of Computer Program and Systems Design*, Prentice-Hall, Englewood Cliffs NJ.

3. Programming

- 3-1. Parnas, D. L. (1972). A technique for software module specification with examples. *Communications of the ACM*, 15(5), 330-336.
- 3-2. Mills, H. D. (1982). Mathematical foundations for structured programming. In E. Yourdon (Ed.), *Writings of the revolution: Selected readings on software engineering* (pp. 220-262). New York: Yourdon Press.
- 3-3. Gamma, E., Helm, R., Johnson, R., & Vlissides, R. (1995). *Design patterns: Elements of reusable object-oriented software*: Addison-Wesley, Ch 1 (1-32) & Ch 2 (33-77).
- 3-4. Boyle, J. M., Resler, R. D., & Winter, V. L. (1999). Do you trust your compiler? *IEEE Communications Magazine*, 65-73.
- 3-5. Butler, R. W., & Finelli, G. B. (1993). The infeasibility of quantifying the reliability of life-critical real-time software. *IEEE Transactions on Software Engineering*, 19(1), 3-12.
- 3-6. Floyd, R. (1978). The paradigms of programming. *Communications of the ACM*, 22(8), 455-460. (1978 ACM Turing Lecture)
- 3-7. Landin, P. J. (1966). The next 700 programming languages. *Communications of the ACM*, 9(3), 157-166.

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- Dijkstra, E. W. (1972). The Humble Programmer, *Communications of the ACM*, 15(10). **All must read.**
- Moore, G. E. (1965). Cramming more components onto integrated circuits. *Electronics*, 38(8).
- Larson, P.-A., Pachl, J., Slonim, J., Taylor, D. J., & Teorey, T. J. (1994). A distributed system architecture for a distributed application environment. *IBM Systems Journal*, 33(3), 399-425. URL: <http://search.ebscohost.com/login.aspx?direct=true&db=aph&AN=9608071144&site=ehost-live>".

4. Data Base Systems

- 4-1. Codd, E. F. (1982). Relational database: A practical foundation for productivity. *Communications of the ACM*, 25(2), 109-117. [1981 ACM Turing Award Lecture]
- 4-2. Letters on relational databases. (1992). *Communications of the ACM*, 35(4), 16-18.
- 4-3. More letters on relational databases. (1992). *Communications of the ACM*, 35(8), 13-15.
- 4-4. Adam, N. R., Gangopadhyay, A., & Clifford, J. (1994). A form-based approach to natural language query processing. *Journal of MIS*, 11(2), 109-135.
- 4-5. Apers, P. M. G. (1988). Data allocation in distributed data base systems. *ACM Transactions on Database Systems*, 13(3), 263-314.
- 4-6. Ahmed, R., De Smedt, P., Du, W., Kent, W., Ketabchi, M. A., Litwin, W. A., et al. (1991). The PEGASUS heterogeneous multi database system. *Computers*, 19-27.
- 4-7. Batory, D. S., Leung, T. Y., & Wise, T. E. (1988). Implementation concepts for an extensible data model and data language. *ACM Transactions on Database Systems*, 13(3), 231-262.
- 4-8. Silberschatz, A., Stonebraker, M., & Ullman, J. (1991). Database systems: Achievements and opportunities. *Communications of the ACM*, 110-120.

Additional References

- Ozsu, M. T., & Valdurieux, P. (1991). *Principles of distributed database systems*. Paris: Prentice Hall. Ch 4, 14 & 15.
- Hellerstein, J.M. & Stonebraker, M. "What Goes Around Comes Around". In: Hellerstein, J.M. & Stonebraker, M. (2005). *Readings in Database Systems*, 4th Edition.
- Hellerstein, J.M, Hamilton, J., & Stonebraker, M. (2007). "Architecture of a Database System." *Foundations and Trends in Databases* 1(2).
- <http://DSSResources.com>

5. Decision Support Systems

- 5-1. Sprague Jr., R. H. (1980). A Framework for the development of decision support systems. *MIS Quarterly*, 4(4), 1-25.
- 5-2. Moody, B., & Cheney, P. (1998). A theoretically grounded approach to assist memory recall during information requirements determination. *Journal of Management Information Systems*, 15(1), 79-98.
- 5-3. Todd, P., & Benbasat, I. (1999). Evaluating the impact of DSS, cognitive effort, and incentives on strategy selection. *Information Systems Research*, 19(4), 356-374.
- 5-4. Sridhar, S. (1998). Decision support using the internet. *Decision Support Systems*, 23, 19-28.
- 5-5. Singh, D. T. (1998). Incorporating cognitive aids into decision support systems: The case of the strategy execution process. *Decision Support Systems*, 24, 145-163.
- 5-6. Borenstein, D. (1998). Towards a practical method to validate decision support systems. *Decision Support Systems*, 23, 227-239.
- 5-7. Gregor, S., & Benbasat, I. (1999). Explanations from intelligent systems: Theoretical foundations and implications for practice. *MIS Quarterly*, 23(4), 497-530.

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- Power, D. J. and Sharda, R. 2007. Model-driven decision support systems: Concepts and research directions. *Decis. Support Syst.* 43, 3 (Apr. 2007), 1044-1061. DOI=<http://dx.doi.org/10.1016/j.dss.2005.05.030>

6. Data Warehousing and Mining Systems

- 6-1. Fayyad, Usama, Piatetsky-Shapiro, Gregory, and Smyth, Padhraic, "The KDD Process for Extracting Useful Knowledge From Volumes of Data," *Communications of the ACM*, Vol. 39, No. 11, November 1996, pp. 27-34.
- 6-2. Hearst, Marti A., "Untangling text data mining," *Proceedings of the 37th annual meeting of the Association for Computational Linguistics on Computational Linguistics*, 1999.
- 6-3. Risch, T., Reboh, R., Hart, P., and Duda, R., "A Functional Approach to Integrating Database and Expert Systems, *CACM*, (December 1988), Vol. 31, No. 12, pp. 1424-1437.
- 6-4. Howard, H. C., Rehak, D. R., "KADBASE - Interfacing Expert Systems with Databases", *IEEE Expert*, (Fall 1989), pp. 65-76.
- 6-5. Spangler, W.E., May, J.H., and Vargas, Luis, G., "Choosing Data-Mining Methods for Multiple Classification: Representational and Performance Measurement Implications for Decision Support, *Journal of Management Information Systems*, Vol. 16, No. 1, Summer 1999, pp. 37-62.

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- Hellerstein, J.M. (2007). “Bricolage: Data at Play.” Keynote, ICDM 2007. A largely non-technical discussion of the emerging Collaborative Data Analysis area, typified by Swivel (<http://www.swivel.com>) and IBM Many Eyes (<http://www.many-eyes.com>), with a tilt toward topics of interest to Data Mining Researchers [[.mov](#) at <http://db.cs.berkeley.edu/jmh/talks/icdm07-keynote.mov>] [PDF of slides in readings]. **No summary needed. All must watch movie and slides.**
- Mohan, C., Pirahesh, H., Tang, W. G., & Wang, Y. (1994). Parallelism in relational database management systems. *IBM Systems Journal*, 33(2).

7. Workflow Systems

- 7-1. Georgakopoulos, D., Hornick, M., & Sheth, A. (1995). An overview of workflow management: From process modeling to workflow automation infrastructure. *Distributed and Parallel Databases*, 3(2), 119-153.
- 7-2. Fox, M. S., & Gruninger, M. (1998). Enterprise modeling. *AI Magazine*, 109-121.
- 7-3. Tan, J. C., & Harker, P. (1999). Designing workflow coordination: Centralized versus market-based mechanisms. *Information Systems Research*.
- 7-4. Basu, A., & Blanning, R. (2000). A formal approach to workflow analysis. *Information Systems Research*, 11(1), 17-36

8. Object-Oriented Systems

- 8-1. Atkinson, M., Bancilhon, F., DeWitt, D., Dittrich, K., Maier, D., & Zdonik, S. (1992). The object-oriented database system manifesto. In F. Bancilhon (Ed.), *Building an Object-Oriented Database Systems*. San Mateo, CA: Morgan Kaufman Publishers.
- 8-2. Lindsey, A. H., & Hoffman, P. R. (1997). Bridging traditional and object technologies: Creating transitional applications. *IBM Systems Journal*, 36(1), 32-48.
- 8-3. Schlatter, M., Furegati, R., Jeger, F., Schneider, H., & Streckeisen, H. (1994). The business object management system. *IBM Systems Journal*, 33(2), 239-263.
- 8-4. Nerson, J.-M. (1992). Applying object-oriented analysis and design. *Communications of the ACM*, 63-74.
- 8-5. Jorgensen, P. C., & Erickson, C. (1994). Object-oriented integration testing. *Communications of the ACM*, 37(9), 30-38.
- 8-6. Zhao, L., & Roberts, S. A. (1988). An object-oriented data model for database modeling, implementation and access. *The Computer Journal*, 31(2), 116-124.
- 8-7. Higa, K., Morrison, M., Morrison, J., & Sheng, O. R. L. (1992). An object-oriented methodology for KB/DB coupling. *Communications of the ACM*, 99-113.
- 8-8. Hudson, S. E., & King, R. (1989). Cactis: A self-adaptive, concurrent implementation of an object-oriented database management system. *ACM Transactions on Database Systems*, 14(3), 291-321.

9. Expert Systems and Adaptive Knowledge-Based Systems

- 9-1. Hayes-Roth, B., Pflieger, K., Lalanda, P., Morignot, P., & Balabanovic, M. (1995). A domain-specific software architecture for adaptive intelligent systems. *IEEE Transactions on Software Engineering*, 21(4), 288-301.
- 9-2. Deng, P.-S., & Chaudhary, A. (1992). A conceptual model of adaptive knowledge-based systems. *Information Systems Research*, 3(2), 127-149.
- 9-3. Meseguer, P., & Preece, A. D. (1995). Verification and validation of knowledge-based systems with formal specifications. *The Knowledge Engineering Review*, 10(4), 331-343.

- 9-4. Weiss, S. M., & Kapouleas, I. (1989). *An empirical comparison of pattern recognition, neural nets, and machine learning classification methods*. Paper presented at the International Joint Conference on Artificial Intelligence (IJCAI).
- 9-5. Kirani, S. H., Zualkernan, I. A., & Tsai, W.-T. (1994). Evaluation of expert system testing methods. *Communications of the ACM*, 37, 71-81.
- 9-6. Tcheng, D., Lambert, B., Lu, S. C.-Y., & Rendell, L. (1989). *Building robust learning systems by combining induction and optimization*. Paper presented at the International Joint Conferences on Artificial Intelligence (IJCAI).
- 9-7. Trice, A., & Davis, R. (1993). Heuristics for reconciling independent knowledge bases. *Information Systems Research*, 4(3), 262-288.
- 9-8. Rapaport, W. J. (1986). Logical foundations for belief representation. *Cognitive Science*, 10, 371-422.
- 9-9. MacDonald, B. A., & Witter, I. H. (1989). A framework for knowledge acquisition through techniques of concept learning. *IEEE Transactions on Systems, Man and Cybernetics*, 19(3), 499-512.
- 9-10. Lehner, P. E. (1989). Toward an empirical approach to evaluating the knowledge base of an ES. *IEEE Transactions on Systems, Man and Cybernetics*, 19(3), 658-687.

Additional References:

- Alavi, M. and Leidner, D.E. (2001). "Knowledge Management and Knowledge Management Systems: Conceptual Foundations and Research Issues," *MIS Quarterly* 25:1 (2001), pp. 107-136.

10. Client-Server Systems

- 10-1. Sinha, A. (1992). Client-server computing: Current technology review. *Communications of the ACM*, 77-98.
- 10-2. Bauer, M. A., Finnigan, P. J., Hong, J. W., Rolia, J. A., Teorey, T. J., & Winters, G. A. (1994). A reference architecture for distributed systems management. *IBM Systems Journal*, 33(3), 426-444.
- 10-3. Bauer, M. A., Finnigan, P. J., Hong, J. W., Rolia, J. A., Teorey, T. J., & Winters, G. A. (1994). A reference architecture for distributed systems management. *IBM Systems Journal*, 33(3), 426-444.
- 10-4. Chau, P. Y. K., & Tam, K. Y. (1997). Factors affecting the adoption of open systems: An exploratory study. *MIS Quarterly*, 1-24.
- 10-5. Bernstein, P. A. (1996). Middleware: A model for distributed system services. *Communications of the ACM*, 39(2), 86-98.

11. Information Filtering and Multi-Media Systems

- 11-1. Bly, S. A., Harrison, S. R., & Irwin, S. (1993). Media spaces: Bringing people together in a video, audio, and computing environment. *Communications of the ACM*, 28-45.
- 11-2. Lucarella, D., & Zanzi, A. (1996). A visual retrieval environment for hypermedia information systems. *ACM Transactions on Information Systems*, 13(1), 3-29.
- 11-3. Aldred, B. K., & Bonsall, G. W. (1995). An architecture for multimedia communication and real-time collaboration. *IBM Systems Journal*, 34(3), 519-543.
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