Bibliography

[ABCK+90] W. Aspray, A.G. Bromley, M. Campbell-Kelly, P.E. Ceruzzi, and M.R. Williams. *Computing before Computers*. Iowa State University Press, 1990. (Cited on page 12.)

[ABCY98] J.A. Allderidge, W.M. Beynon, R.I. Cartwright, and Y.P. Yung. Enabling technologies for empirical modelling in graphics. In *Proc. Eurographics UK, 16th annual conference*, pages 199–213, 1998. (048). (Cited on pages 98, 124 and 156.)

[ABH02] Umut A. Acar, Guy E. Blelloch, and Robert Harper. Adaptive functional programming. In *Proceedings of the 29th ACM SIGPLAN-SIGACT symposium on Principles of programming languages*, pages 247–259. ACM Press, 2002. (Cited on page 40.)

[acm] ACM Digital Library. ACM, Inc. `http://portal.acm.org/` (accessed August 2004). (Cited on page 34.)

[aco88] *BBC BASIC guide*. The Archimedes Series. Acorn Computers Limited, first edition, 1988. (Cited on page 149.)

[aco92] *RISC OS 3 Programmer's Reference Manual*. Acorn Computers Limited, first edition, December 1992. (Cited on pages 110 and 111.)

[AEWJ+02] A. Allan, D. Edenfeld, Jr. W.H. Joyner, A.B. Kahng, M. Rodgers, and Y. Zorian. 2001 technology roadmap for semiconductors. *Computer*, 35(1):42–53, January 2002. (Cited on page 220.)

[age] AgentSheets, Inc. `http://agentsheets.com/` (accessed August 2004). (Cited on page 37.)

[All97] J.A. Allderidge. Applying the Definitive Assembler Maintainer (DAM) architecture to graphics. Final year undergraduate project report May, University of Warwick Department of Computer Science, 1997. (Cited on pages 98, 124, 129 and 137.)

[Ams86] Jonathan Amsterdam. Programming project: build a spreadsheet program. *BYTE*, 11(7):96–108, 1986. (Cited on page 33.)

[ant] Apache Ant `http://ant.apache.org/` (accessed August 2004). (Cited on page 39.)

[AO93] Gregory R. Andrews and Ronald A. Olsson. *The SR Programming Language*. Benjamin/Cummings, 309 Bridge Parkway, Redwood City, CA 94065, 1993. (Cited on page 289.)

[app87] *Human Interface Guidelines: The Apple Desktop Interface*. Addison-Wesley, 1987. (Cited on pages 11 and 247.)

[AS83] Gregory R. Andrews and Fred B. Schneider. Concepts and notations for concurrent programming. *ACM Comput. Surv.*, 15(1):3–43, 1983. (Cited on page 24.)

[Baa88] Erik H. Baalbergen. Design and implementation of parallel make. *Computing Systems*, 1(2):135–158, 1988. (Cited on page 39.)

[BABH86] W.M. Beynon, D. Angier, T. Bissell, and S. Hunt. DoNaLD: A line-drawing system based on definitive principles. Technical report, University of Warwick Department of Computer Science, 1986. (Cited on pages xiv, 127 and 209.)

[Bac78] John Backus. Can programming be liberated from the von Neumann style?: a functional style and its algebra of programs. *Commun. ACM*, 21(8):613–641, 1978. (Cited on pages 29 and 63.)

[BACY94a] W.M. Beynon, V.D. Adzhiev, A.J. Cartwright, and Y.P. Yung. An agent-oriented framework for concurrent engineering. In *Proc. IEE Colloquium: Issues of Cooperative working in Concurrent Engineering*, pages Digest 1994/177, 9/1–9/4, October 1994. (040). (Cited on pages 77, 78 and 89.)

[BACY94b] W.M. Beynon, V.D. Adzhiev, A.J. Cartwright, and Y.P. Yung. A computational model for multiagent interaction in concurrent engineering. In *Proc. CEEDA'94, Bournemouth University*, pages 227–232, 1994. (034). (Cited on pages 77, 78 and 89.)

[BACY94c] W.M. Beynon, V.D. Adzhiev, A.J. Cartwright, and Y.P. Yung. A new computer-based tool for conceptual design. In *Proc. Workshop Computer Tools for Conceptual Design*, pages 171–188, 1994. (035). (Cited on page 89.)

[BAD+01] M. Burnett, J. Atwood, R. Djang, H. Gottfried, J. Reichwein, and S. Yang. Forms/3: A first-order visual language to explore the boundaries of the spreadsheet paradigm. *Journal of Functional Programming*, 11(2):155–206, March 2001. (Cited on pages 37 and 249.)

[Bar00] Nicholas Barr. *A.W.H. Phillips: Collected Works in Contemporary Perspective*, chapter The History of the Phillips Machine, pages 89–114. Cambridge University Press, 2000. (Cited on page 8.)

[BBRW03] W.M. Beynon, A.H. Bhalerao, C.P. Roe, and A.T. Ward. A computer-based environment for the study of relational query languages. In *Proc. of the Teaching, Learning and Assessment in Databases Workshop*, pages 104–108, Coventry, UK, July 2003. (079). (Cited on pages xii, 1, 18 and 235.)

[BBY92] W.M. Beynon, I. Bridge, and Y.P. Yung. Agent-oriented modelling for a vehicle cruise controller. In *Proc. ESDA Conf., ASME PD-Vol. 47-4*, pages 159–165, 1992. (023). (Cited on pages 48 and 52.)

[BC93] W.M. Beynon and A.J. Cartwright. Agent-oriented modelling for engineering design. In *Proc. CAD '93, New Information Technologies in Science, Education and Business, Yalta*, pages 49–53, May 1993. (030). (Cited on page 89.)

[BC95] W.M. Beynon and R.I. Cartwright. Empirical modelling principles for cognitive artefacts. In *Proc. IEE Colloquium: Design Systems with Users in Mind: The Role of Cognitive Artefacts, Digest No 95/231, 8/1-8/8*, December 1995. (043). (Cited on page 89.)

[BCH+01] W.M. Beynon, Y-C. Ch'en, H-W. Hseu, S. Maad, S. Rasmequan, C.P. Roe, J. Rungrattanaubol, S.B. Russ, and A.T. Ward. The computer as instrument. In *Proc. Cognitive Technology '01: Instruments of Mind, LNAI 2117*, University of Warwick, August 2001. Springer-Verlag. (068). (Cited on pages xii, 1 and 14.)

[BCHW95] Barry Boehm, Bradford Clark, Ellis Horowitz, and Chris Westland. Cost models for future software life cycle processes: COCOMO 2.0. *Annals of Software Engineering*, 1:57–94, 1995. (Cited on page 35.)

[BCSW99] W.M. Beynon, R.I. Cartwright, P-H. Sun, and A.T. Ward. Interactive Situation Models for Information Systems Development. In *Proc. SCI'99 and ISAS'99, Volume 2, Orlando, USA*, pages 9–16, July 1999. (052). (Cited on pages xii, 1, 5, 14, 22, 48, 50, 287, 292 and 319.)

[BDMN79] Graham M. Birtwistle, Ole-Johan Dahl, Bjorn Myhrhaug, and Kristen Nygaard. *SIMULA BEGIN*. Chartwell-Bratt, Old Orchard, Bickley Road, Bromley, Kent BR1 2NE, 1979. (Cited on page 53.)

[Bec99] Kent Beck. *Extreme Programming Explained: Embrace Change*. Addison-Wesley, first edition, 1999. (Cited on page 21.)

[Bey83] W.M. Beynon. A definition of the ARCA notation. Theory of Computation Report CS-RR-054, University of Warwick Department of Computer Science, 1983. (Cited on pages xiv, 229 and 301.)

[Bey85] W.M. Beynon. Definitive notations for interaction. In *Proceedings of HCI'85*, pages 23–34. Cambridge University Press, 1985. (001). (Cited on page 32.)

[Bey87a] W.M. Beynon. The LSD notation for communicating systems. Research Report CS-RR-087, University of Warwick Department of Computer Science, 1987. (Cited on pages xv, 47 and 50.)

[Bey87b] W.M. Beynon. The LSD notation for communicating systems. In *Proc. 3rd British Colloquium for Theoretical Computer Science, Leicester*, 1987. (003). (Cited on page 50.)

[Bey88] W.M. Beynon. Definitive programming for parallelism. Research Report CS-RR-132, University of Warwick Department of Computer Science, 1988. (Cited on pages 71 and 88.)

[Bey89a] W.M. Beynon. Definitions as a framework for design. In *Proc. 3rd Eurographics ICAD Workshop, CWI Amsterdam*, 1989. (015). (Cited on pages xiv and 89.)

[Bey89b] W.M. Beynon. A definitive programming approach to the implementation of CAD software. In *Intelligent CAD Systems II: Implementation Issues*, pages 126–45. Springer-Verlag, 1989. (013). (Cited on pages xiv, 227 and 229.)

[Bey89c] W.M. Beynon. Evaluating definitive principles for interactive graphics. In *New Advances in Computer Graphics*, pages 291–303. Springer-Verlag, 1989. (011). (Cited on page 88.)

[Bey90] W.M. Beynon. Parallelism in a definitive programming framework. In *Parallel Computing 89, North Holland: Advances in Parallel Computing Volume 2*, pages 425–430, 1990. (016). (Cited on pages 32, 71, 88 and 162.)

[Bey94] W.M. Beynon. Agent-oriented modelling and the explanation of behaviour. In *Proc. International W/S "Shape Modeling Parallelism, Interactivity and Applications", Dept. of Computer Software, TR 94-1-040*, pages 54–63, Univ. Aizu, Japan, September 1994. (037). (Cited on page 89.)

[Bey97] W.M. Beynon. Empirical Modelling for educational technology. In *Proc. Cognitive Technology '97, University of Aizu, Japan, IEEE*, pages 54–68, 1997. (047). (Cited on pages 50, 89 and 306.)

[Bey99] W.M. Beynon. Empirical Modelling and the foundations of Artificial Intelligence. *Lecture Notes in Artificial Intelligence*, 1562:322–364, 1999. (050). (Cited on pages 4, 89, 216 and 306.)

[Bey03] W.M. Beynon. Radical Empiricism, Empirical Modelling and the nature of knowing. In *Proceedings of the WM 2003 Workshop on Knowledge Management and Philosophy*, Luzern, April 3–4 2003. (078). (Cited on page 306.)

[BF] Dan Bricklin and Bob Frankston. VisiCalc: Information from its creators. `http://www.bricklin.com/visicalc.htm` (accessed April 2004). (Cited on page 10.)

[BH95] Krishna A. Bharat and Scott E. Hudson. Supporting distributed, concurrent, one-way constraints in user interface applications. In *Proceedings of the 8th annual ACM symposium on User interface and software technology*, pages 121–132. ACM Press, 1995. (Cited on page 39.)

[Bir91] Stuart Bird. An implementation of ARCA in EDEN. Final year undergraduate project report, University of Warwick Department of Computer Science, 1991. (Cited on page 301.)

[Bis86] Judy Bishop. *Data Abstraction in Programming Languages*. Addison-Wesley, 1986. (Cited on page 23.)

[Bla02] A. F. Blackwell. First steps in programming: a rationale for attention investment models. In *Proceedings of the IEEE 2002 Symposia on Human Centric Computing Languages and Environments*, pages 2–10, September 2002. (Cited on page 36.)

[BMR+96] Frank Buschmann, Regine Meunier, Hans Rohnert, Peter Sommerlad, and Michael Stal. *Pattern-Oriented Software Architecture: A system of patterns*. Wiley, 1996. (Cited on page 39.)

[BN87] W.M. Beynon and M.T. Norris. Comparison of SDL and LSD. In R. Saracco and P.A.J. Tilanus, editors, *Proc. SDL'87, North Holland*, pages 201–209, 1987. (004). (Cited on pages 50 and 65.)

[BNOS90] W.M. Beynon, M.T. Norris, R.A. Orr, and M.D. Slade. Definitive specification of concurrent systems. In *Proc. UKIT'90*, pages 52–57. IEE Conference Publications 316, 1990. (017). (Cited on pages 52, 59, 71 and 88.)

[BNR95] W.M. Beynon, P.E. Ness, and S.B. Russ. Worlds before and beyond words. In *Proc. VF '95*. University of Warwick, 1995. (041). (Cited on page 7.)

[BNS88] W.M. Beynon, M.T. Norris, and M.D. Slade. Definitions for modelling and simulating concurrent systems. In *Proc. IASTED conference ASM'88*. Acta Press, 1988. (007). (Cited on page 50.)

[Boo54] George Boole. *An Investigation of the laws of thought on which are founded the mathematical theories of logic and probabilities*. Macmillan, 1854. (Cited on page 26.)

[BR] W.M. Beynon and S.B. Russ. EM home page. `http://www.dcs.warwick.ac.uk/research/modelling/` (accessed April 2004). (Cited on page 2.)

[BR92] W.M. Beynon and S.B. Russ. The interpretation of states: a new foundation for computation. In *Proc. PPIG'92, Loughborough*, January 1992. (027). (Cited on page 55.)

[BR95] W.M. Beynon and S.B. Russ. Empirical Modelling of requirements. Research Report CS-RR-277, University of Warwick Department of Computer Science, 1995. (Cited on page 22.)

[BRJ99] Grady Booch, James Rumbaugh, and Ivar Jacobson. *The Unified Modeling Language User Guide*. Addison-Wesley, 1999. (Cited on page 22.)

[Bro87] Frederick P. Brooks, Jr. No silver bullet: essence and accidents of software engineering. *Computer*, 20(4):10–19, 1987. (Cited on pages 20, 21, 22 and 27.)

[Bro01] Chris Brown. An agent-based parsing system in EDEN. Final year undergraduate project report, University of Warwick Department of Computer Science, 2001. (Cited on page xiv.)

[BRWW01] W.M. Beynon, C.P. Roe, A.T. Ward, and A. Wong. Interactive Situation Models for cognitive aspects of user-artefact interaction. In *Proc. Cognitive Technology '01: Instruments of Mind, LNAI 2117*, pages 356–372, University of Warwick, August 2001. Springer-Verlag. (069). (Cited on pages xii, 1, 10, 43 and 352.)

[BRY90] W.M. Beynon, S.B. Russ, and Y.P. Yung. Programming as modelling: New concepts and techniques. In *Proc. ISLIP'90*. Computing and Information Science Dept, Queen's University, Canada, 1990. (019). (Cited on pages 65, 89 and 91.)

[BS99] W.M. Beynon and P-H. Sun. Computer-mediated communication: a distributed Empirical Modelling perspective. In *Proc. of CT'99*, San Francisco, 1999. (053). (Cited on pages 4 and 8.)

[BSY89] W.M. Beynon, M.D. Slade, and Y.W. Yung. Parallel computation in definitive models. In *CONPAR'88*, pages 359–367. British Computer Society Workshop Series CUP, 1989. (010). (Cited on pages 71 and 88.)

[BWM+00] W.M. Beynon, A.T. Ward, S. Maad, A. Wong, S. Rasmequan, and S.B. Russ. The Temposcope: A computer instrument for the idealist timetabler. In Edmund Burke and Wilhelm Erben, editors, *Proc. of the 3rd international conference on the Practice and Theory of Automated Timetabling*, pages 153–175, Fachhochscule Konstanz, University of Applied Sciences, Germany, August 2000. (058). (Cited on pages xii, 1 and 14.)

[BY90] W.M. Beynon and Y.P. Yung. Definitive interfaces as a visualisation mechanism. In *Proc. Graphics Interface '90*, pages 285–292. Canadian Information Processing Society, 1990. (018). (Cited on pages 89 and 243.)

[BY92] W.M. Beynon and Y.P. Yung. Agent-oriented modelling for discrete-event systems. In *Proc. IEE Coll. "Discrete-Event Dynamic Systems"*, page Digest 1992/138, 1992. (026). (Cited on page 89.)

[BY94] W.M. Beynon and Y.P. Yung. A computer-aided script generator for Computer Aided Design. In *Proc. Pacific Graphics '94 / CADDM'94, Vol 2*, pages 369–374, 1994. (039). (Cited on page 89.)

[BZ89] R. Bubenik and W. Zwaenepoel. Performance of optimistic make. In *Proceedings of the 1989 ACM SIGMETRICS international conference on Measurement and modeling of computer systems*, pages 39–48. ACM Press, 1989. (Cited on page 39.)

[Cao02] Charles Cao. A simple complexity — Rubik's cube. *illumin*, 0(3), 2002. `http://engrwp.usc.edu/illumin/article.php?articleID=11`. (Cited on page 227.)

[Car94] Alan Cartwright. *Application of Definitive Scripts to CACD*. PhD thesis, University of Warwick, July 1994. (Cited on page 18.)

[Car99] Richard Cartwright. *Geometric Aspects of Empirical Modelling: Issues in Design and Implementation*. PhD thesis, University of Warwick, May 1999. (Cited on pages xiii, xiv, xv, 18, 44, 89, 97, 98, 99, 100, 101, 102, 103, 105, 107, 108, 109, 113, 114, 117, 120, 122, 124, 127, 156, 157, 163, 164, 166, 185, 261, 294, 301, 344 and 345.)

[Car00] Ben Carter. Sasami project report: A 3D display engine for the EDEN modelling environment. Final year undergraduate project report, University of Warwick Department of Computer Science, 2000. (Cited on pages xv and 224.)

[Car04] Richard Cartwright. Personal communication. April 2004. (Cited on page 287.)

[Cas92] Rommert J. Casimir. Real programmers don't use spreadsheets. *SIGPLAN Not.*, 27(6):10–16, 1992. (Cited on page 34.)

[Ch'01] Yih-Chang Ch'en. *Empirical Modelling for Participative Business Process Reengineering*. PhD thesis, University of Warwick, December 2001. (Cited on pages 18 and 22.)

[Cha89] S. Chan. Enhancing the DoNaLD line drawing system. Final year undergraduate project report, University of Warwick Department of Computer Science, 1989. (Cited on page 211.)

[Che99] Peter Checkland. *Systems Thinking, Systems Practice: Includes a 30-year retrospective*. John Wiley and Sons, 1999. (Cited on pages 4 and 352.)

[CHP71] P. J. Courtois, F. Heymans, and D. L. Parnas. Concurrent control with "readers" and "writers". *Commun. ACM*, 14(10):667–668, 1971. (Cited on page 289.)

[CJS+02] J. Cao, S.A. Jarvis, D.P. Spooner, J.D. Turner, D.J. Kerbyson, and G.R. Nudd. Performance prediction technology for agent-based resource management in grid environments. In *Proc. 11th IEEE Heterogeneous Computing Workshop (HCW02), Marriott Marina, Fort Lauderdale, Florida*, April 2002. (Cited on page 104.)

[CK93] Paul B. Cragg and Malcolm King. Spreadsheet modelling abuse: An opportunity for OR? *The Journal of the Operational Research Society*, 44(8):743–752, August 1993. (Cited on page 36.)

[CK03] Martin Campbell-Kelly. *The History of Mathematical Tables: from Sumer to Spreadsheets*, chapter The rise and rise of the spreadsheet, pages 322–347. Oxford University Press, 2003. (Cited on page 33.)

[CKA96] Martin Campbell-Kelly and William Aspray. *Computer: A History of the Information Machine*. BasicBooks, first edition, 1996. (Cited on page 10.)

[CM88] K. Mani Chandy and Jayadev Misra. *Parallel Program Design*. Addison-Wesley, 1988. (Cited on pages xv, 81, 82, 83, 84, 85, 86 and 87.)

[Coo99] Alan Cooper. *The Inmates are Running the Asylum*. SAMS, A Division of Macmillan Computer Publishing, 201 West 103rd Street, Indianapolis, Indiana 46290, first edition, 1999. (Cited on page 21.)

[CP03] Steven Carroll and Constantine Polychronopoulos. A framework for incremental extensible compiler construction. In *Proceedings of the 17th annual international conference on Supercomputing*, pages 53–62. ACM Press, 2003. (Cited on page 39.)

[Cur96] David Curry. *UNIX systems programming for SVR4*. O'Reilly and Associates, 1996. (Cited on page 257.)

[cvs] Concurrent versions system. `http://www.cvshome.org/` (accessed April 2004). (Cited on page 250.)

[Dav95] Emma L. Davis. Modelling human interaction. Final year project report, University of Warwick Department of Computer Science, 1995. (Cited on page 76.)

[DCG+89] Peter J. Denning, D. E. Comer, David Gries, Michael C. Mulder, Allen Tucker, A. Joe Turner, and Paul R. Young. Computing as a discipline. *Commun. ACM*, 32(1):9–23, 1989. (Cited on page 352.)

[DDH72] O.-J. Dahl, E.W. Dijkstra, and C.A.R. Hoare. *Structured Programming*, chapter Notes on Structured Programming, pages 1–82. Academic Press Inc. (London) Ltd., 1972. (Cited on page 274.)

[dHRvE95] Walter A. C. A. J. de Hoon, Luc M. W. J. Rutten, and Marko C. J. D. van Eekelen. Implementing a functional spreadsheet in Clean. *Journal of Functional Programming*, 5(3):383–414, July 1995. (Cited on page 35.)

[Dij68] Edsger W. Dijkstra. Cooperating Sequential Processes. `http://www.cs.utexas.edu/users/EWD/ewd01xx/EWD123.PDF` (accessed April 2004), 1968. (Cited on pages 84 and 289.)

[Dij76] Edsger W. Dijkstra. *A discipline of programming*. Prentice-Hall, 1976. (Cited on pages 54, 81, 85, 165 and 352.)

[Dij01] Edsger W. Dijkstra. The end of computing science? *Commun. ACM*, 44(3):92, 2001. (Cited on page 22.)

[DW90] Weichang Du and William W. Wadge. The eductive implementation of a three-dimensional spreadsheet. *Softw. Pract. Exper.*, 20(11):1097–1114, November 1990. (Cited on page 35.)

[exc01] Excel X on-line help, 2001. Microsoft Corporation. (Cited on page 324.)

[FBY93] Monica Farkas, Meurig Beynon, and Yun Pui Yung. Agent-oriented modelling for a billiards simulation. Research Report CS-RR-260, University of Warwick Department of Computer Science, 1993. (Cited on page 220.)

[FCR+02] Marc Fisher, Mingming Cao, Gregg Rothermel, Curtis R. Cook, and Margaret M. Burnett. Automated test case generation for spreadsheets. In *Proceedings of the 24th international conference on Software engineering*, pages 141–153. ACM Press, 2002. (Cited on page 36.)

[Fel79] Stuart I. Feldman. Make — a computer program for maintaining computer programs. *Softw. Pract. Exper.*, 9(4):255–265, April 1979. (Cited on page 38.)

[FH89] C. J. Fleckenstein and D. Hemmendinger. A parallel 'make' utility based on Linda's tuple-space. In *Proceedings of the seventeenth annual ACM conference on Computer science : Computing trends in the 1990's*, pages 216–220. ACM Press, 1989. (Cited on page 39.)

[FPB95] Jr. Frederick P. Brooks. *The mythical man-month: essays on software engineering*. Addison Wesley Longman, Inc., 1995. (Cited on pages 21 and 352.)

[Fri97] Jeffrey E.F. Friedl. *Mastering Regular Expressions*. O'Reilly and Associates, Inc., 1997. (Cited on page 235.)

[Geh] Dominic Gehring. The MoDD API. `http://www.dcs.warwick.ac.uk/~gehring/modd/` (dated 1998). (Cited on pages 108 and 123.)

[Geh95] Dominic Gehring. Tables as definitive variables. Final year undergraduate project report, University of Warwick Department of Computer Science, 1995. (Cited on page 301.)

[GMR95] Ashish Gupta, Inderpal S. Mumick, and Kenneth A. Ross. Adapting materialized views after redefinitions. In *Proceedings of the 1995 ACM SIGMOD international conference on Management of data*, pages 211–222. ACM Press, 1995. (Cited on page 38.)

[GMT04] Deborah Gage, John McCormick, and Berta Ramona Thayer. Why software quality matters. *Baseline*, pages 34–59, March 2004. (Cited on page 20.)

[Gol] Jody Goldberg. The Gnumeric GNOME desktop environment spreadsheet. `http://www.gnome.org/projects/gnumeric/` (accessed August 2004). (Cited on page 34.)

[Goo01] David C. Gooding. Experiment as an instrument of innovation: Experience and embodied thought. In M. Beynon, C.L. Nehaniv, and K. Dautenhahan, editors, *Cognitive Technology: Instruments of Mind*, pages 130–140. Springer-Verlag, 2001. (Cited on page 6.)

[GP96] T. R. G. Green and M. Petre. Usability analysis of visual programming environments: A 'cognitive dimensions' framework. *Journal of Visual Languages and Computing*, 7(2):131–174, June 1996. (Cited on page 36.)

[GS93] A. Gibbons and P. Spirakis, editors. *Lectures on Parallel Computation*. Cambridge International Series on Parallel Computation. Cambridge University Press, 1993. (Cited on page 108.)

[GYC+96] D.K. Gehring, Y.P. Yung, R.C. Cartwright, W.M. Beynon, and A.J. Cartwright. Higher-order constructs for interactive graphics in a definitive programming framework. In *Proc. 14th Eurographics UK Conference*, pages 179–192, 1996. (044). (Cited on pages 98 and 325.)

[Hal01] Alon Y. Halevy. Answering queries using views: a survey. *The VLDB Journal*, 10(4):270–294, 2001. (Cited on page 38.)

[Han02a] Keith Hanna. Interactive visual functional programming. In *Proceedings of the seventh ACM SIGPLAN international conference on Functional programming*, pages 145–156. ACM Press, 2002. (Cited on page 35.)

[Han02b] Per Brinch Hansen. *The origin of concurrent programming: from semaphores to remote procedure calls*, chapter The invention of concurrent programming, pages 3–61. Springer-Verlag New York, Inc., 2002. (Cited on pages 24 and 68.)

[Har87] David Harel. Statecharts: A visual formalism for complex systems. *Sci. Comput. Program.*, 8(3):231–274, 1987. (Cited on page 16.)

[Har88] David Harel. On visual formalisms. *Commun. ACM*, 31(5):514–530, 1988. (Cited on page 309.)

[Har02] Antony Harfield. Agent-oriented parsing with Empirical Modelling. Final year undergraduate project report, University of Warwick Department of Computer Science, 2002. (Cited on page xiv.)

[Haz] Philip Hazel. PCRE — Perl Compatible Regular Expressions library. `http://www.pcre.org/` (accessed February 2004). (Cited on page 235.)

[her00] The American Heritage dictionary of the English language, 2000. `http://dictionary.reference.com/` (accessed April 2004). (Cited on page 3.)

[Her02] Timothy Heron. Programming with dependency. Master's thesis, University of Warwick, September 2002. (Cited on pages 39, 89 and 261.)

[HNC65] Frank Harary, Robert Z. Norman, and Dorwin Cartwright. *Structural Models: An Introduction to the Theory of Directed Graphs*. John Wiley and Sons, 1965. (Cited on pages 106, 179 and 180.)

[Hoa78] C. A. R. Hoare. Communicating Sequential Processes. *Commun. ACM*, 21(8):666–677, 1978. (Cited on page 84.)

[HP03] John L. Hennessy and David A. Patterson. *Computer Architecture: A Quantitative Approach*. Morgan Kaufmann, third edition, 2003. (Cited on page 220.)

[Hud89] Paul Hudak. Conception, evolution, and application of functional programming languages. *ACM Comput. Surv.*, 21(3):359–411, 1989. (Cited on pages 30 and 40.)

[Hud94] Scott E. Hudson. User interface specification using an enhanced spreadsheet model. *ACM Trans. Graph.*, 13(3):209–239, 1994. (Cited on pages 36 and 37.)

[IEE] IEEE. IEEE Xplore. `http://ieeexplore.ieee.org/` (accessed August 2004). (Cited on page 34.)

[IL85] Kaoru Ishikawa and David J. Lu. *What is total quality control? : the Japanese way*. Prentice Hall, 1985. (Cited on page 4.)

[ISL95] Tomás Isakowitz, Shimon Schocken, and Henry C. Lucas, Jr. Toward a logical/physical theory of spreadsheet modeling. *ACM Trans. Inf. Syst.*, 13(1):1–37, 1995. (Cited on page 36.)

[itr] International Technology Roadmap for Semiconductors 2003 edition. `http://public.itrs.net/Files/2003ITRS/Home2003.htm` (accessed April 2004). (Cited on page 220.)

[Jam12] William James. *Essays in Radical Empiricism*. Longmans, Green and Co., 1912. (Cited on pages 3 and 306.)

[JBB03] Simon Peyton Jones, Alan Blackwell, and Margaret Burnett. A user-centred approach to functions in Excel. In *Proceedings of the eighth ACM SIGPLAN international conference on Functional programming*, pages 165–176. ACM Press, 2003. (Cited on page 36.)

[JC92] Ivar Jacobson and Magnus Christensen. *Object-oriented Software Engineering: A Use Case Driven Approach*. Addison-Wesley, 1992. (Cited on page 21.)

[Kay84] Alan Kay. Computer software. *Scientific American*, 251(3):52–59, September 1984. (Cited on page 34.)

[KB00] I. Kalas and A. Blaho. Imagine... new generation of Logo: Programmable pictures. In *Proc. of WCC2000, Beijing*, pages 427–430, 2000. (Cited on page 242.)

[Ken78] William Kent. *Data and Reality: basic assumptions in data processing reconsidered*. North-Holland Publishing Company, 1978. (Cited on page 11.)

[Kin04] Karl King. Timetabling with Empirical Modelling principles and tools. Final year undergraduate project report, University of Warwick Department of Computer Science, 2004. (Cited on page 249.)

[Knu73] Donald E. Knuth. *The Art of Computer Programming, Volume 1: Fundamental Algorithms*. Addison-Wesley, second edition, 1973. (Cited on pages 44, 106 and 108.)

[KP74] Brian W. Kernighan and P.J. Plauger. *The elements of programming style*. McGraw-Hill, 1974. (Cited on page 352.)

[KP84] Brian W. Kernighan and Rob Pike. *The UNIX programming environment*. Prentice Hall, 1984. (Cited on pages 196 and 197.)

[KP88] Glenn E. Krasner and Stephen T. Pope. A cookbook for using the model-view controller user interface paradigm in smalltalk-80. *J. Object Oriented Program.*, 1(3):26–49, 1988. (Cited on page 39.)

[KPP+02] Barbara A. Kitchenham, Shari Lawrence Pfleeger, Lesley M. Pickard, Peter W. Jones, David C. Hoaglin, Khaled El Emam, and Jarrett Rosenberg. Preliminary guidelines for empirical research in software engineering. *IEEE Trans. Softw. Eng.*, 28(8):721–734, 2002. (Cited on page 352.)

[Lev95] Nancy G. Leveson. *Safeware: System safety and computers*. Addison-Wesley, September 1995. (Cited on pages 26 and 349.)

[Lew90] C. Lewis. *Visual Programming Environments: Paradigms and Systems*, chapter NoPumpG: Creating interactive graphics with spreadsheet machinery, pages 526–546. IEEE Computer Society Press, 1990. (Cited on page 37.)

[LM02] Björn Lisper and Johan Malmström. Haxcel: A spreadsheet interface to Haskell. In *Proceedings of the 14th International Workshop on the Implementation of Functional Languages*, pages 206–222, September 2002. (Cited on page 35.)

[LT77] Henry F. Ledgard and Robert W. Taylor. Two views of data abstraction. *Commun. ACM*, 20(6):382–384, 1977. (Cited on page 23.)

[Maa02] Soha Maad. *An Empirical Modelling Approach to Software System Development in Finance: Applications and Prospects*. PhD thesis, University of Warwick, March 2002. (Cited on page 18.)

[McC] G. Frank McCormick. When reach exceeds grasp. (Cited on pages 26 and 349.)

[Mez87] Samia Meziani. Denota - an interpreter for definitive notations. Master's thesis, University of Warwick, December 1987. (Cited on pages 45, 301, 303 and 347.)

[Mil93] Robin Milner. Elements of interaction: Turing award lecture. *Commun. ACM*, 36(1):78–89, 1993. (Cited on page 28.)

[Mil02] Joaquin Miller. What UML should be: introduction. *Commun. ACM*, 45(11):67–69, 2002. (Cited on page 22.)

[Moo65] Gordon E. Moore. Cramming more circuits onto integrated circuits. *Electronics*, 38(8), April 1965. (Cited on page 220.)

[Mor] MoreSteam.com. The Cause and Effect "Fishbone" diagram. `http://www.moresteam.com/toolbox/t406.cfm` (dated 2000). (Cited on pages 4 and 5.)

[mot] Digital Performer: Persistent unlimited multiple undo / redo with branching. MOTU, Inc `http://www.motu.com/english/software/dp/dp3/undo.html` (dated 2001). (Cited on page 250.)

[Nar93] Bonnie A. Nardi. *A small matter of Programming: Perspectives on End User Computing*. MIT Press, 1993. (Cited on pages 35 and 36.)

[Nes97] Paul Edward Ness. *Creative Software Development: An Empirical Modelling Framework*. PhD thesis, University of Warwick, October 1997. (Cited on page 18.)

[Neu] Peter G. Neumann. RISKS-LIST. `http://catless.ncl.ac.uk/Risks` (accessed March 2004). (Cited on page 12.)

[Neu95] Peter G. Neumann. *Computer Related Risks*. The ACM Press, 1995. (Cited on page 20.)

[NM90] Bonnie A. Nardi and James R. Miller. An ethnographic study of distributed problem solving in spreadsheet development. In *Proceedings of the 1990 ACM conference on Computer-supported cooperative work*, pages 197–208. ACM Press, 1990. (Cited on page 35.)

[Ope] OpenOffice.org. OpenOffice productivity suite. `http://www.openoffice.org/` (accessed August 2004). (Cited on page 34.)

[Oun04] Asma Ounnas. Development of the EDDI parser documentation of eddi.eden. Final year undergraduate project report, University of Warwick Department of Computer Science, 2004. (Cited on page 233.)

[Ous94] John K. Ousterhout. *Tcl and the Tk Toolkit*. Addison-Wesley, 1994. (Cited on pages xv and 214.)

[Par91] J. Parsons. Enhancement of the DoNaLD translator. Final year undergraduate project report, University of Warwick Department of Computer Science, 1991. (Cited on page 211.)

[PASS95] A.A. Pasko, V. Adzhiev, A. Sourin, and V. Savchenko. Function representation in geometric modelling: Concepts, implementation and application. *The Visual Computer*, 11(8):429–446, 1995. (Cited on page 98.)

[Per] Perforce Software, Inc. Jam. `http://www.perforce.com/jam/jam.html` (accessed August 2004). (Cited on page 39.)

[Per01] Michael L. Perry. Automate dependency tracking, 2001. `http://www.javaworld.com/javaworld/jw-08-2001/jw-0817-automatic_p.html` (dated 17 August 2001). (Cited on page 39.)

[PH98] David A. Patterson and John L. Hennessy. *Computer Organization and Design: The Hardware / Software Interface*. Morgan Kaufmann, second edition, 1998. (Cited on page 156.)

[Phi00] A.W. Phillips. *A.W.H. Phillips: Collected Works in Contemporary Perspective*, chapter Mechanical Models in Economic Dynamics, pages 68–88. Cambridge University Press, 2000. (Cited on pages xiii and 8.)

[Pie86] Kurt W. Piersol. Object-oriented spreadsheets: the analytic spreadsheet package. In *Conference proceedings on Object-oriented programming systems, languages and applications*, pages 385–390. ACM Press, 1986. (Cited on page 33.)

[PKNA95] E. Papaefstathiou, D.J. Kerbyson, G.R. Nudd, and T.J. Atherton. An overview of the CHIP^{3}S performance prediction toolset for parallel systems. In *Proc. of 8th IEEE International Conference on Parallel and Distributed Computing Systems, Orlando, Florida, USA*, September 1995. (Cited on page 104.)

[Puc87] Tom Puckett. Implementation of an APL-based spreadsheet manager. In *Proceedings of the international conference on APL*, pages 163–172. ACM Press, 1987. (Cited on page 33.)

[Ram] Chet Ramey. GNU Readline library. `http://www.gnu.org/directory/readline.html` (accessed April 2004). (Cited on page 249.)

[Ras01] Suwanna Rasmequan. *An Approach to Computer-based Knowledge Representation for the Business Environment using Empirical Modelling*. PhD thesis, University of Warwick, November 2001. (Cited on page 18.)

[Rau96] Martin Frank Rausch. The agent repository — supporting collaborative contextualized learning with a medium for indirect communication. Master's thesis, University of Colorado, Department of Computer Science, 1996. (Cited on page 37.)

[Ray] Eric Steven Raymond. The cathedral and the bazaar. `http://www.catb.org/~esr/writings/cathedral-bazaar/cathedral-bazaar/index.html` (dated September 2000). (Cited on pages 21 and 223.)

[Rep93] A. Repenning. *Agentsheets: A Tool for Building Domain-Oriented Dynamic, Visual Environments*. PhD thesis, University of Colorado at Boulder, Department of Computer Science, December 1993. (Available as Technical Report CU-CS-693-93). (Cited on page 37.)

[Roe03] Chris Roe. *Computers for Learning: An Empirical Modelling Perspective*. PhD thesis, University of Warwick, November 2003. (Cited on pages 7, 18, 218 and 249.)

[Rol82] L.T.C. Rolt. *Red for Danger*. Pan Books, fourth edition, 1982. (Cited on pages 4 and 216.)

[RR93] G. Ramalingam and Thomas Reps. A categorized bibliography on incremental computation. In *Proceedings of the 20th ACM SIGPLAN-SIGACT symposium on Principles of programming languages*, pages 502–510. ACM Press, 1993. (Cited on page 40.)

[Run02] Jaratsri Rungrattanaubol. *A Treatise on Modelling with Definitive Scripts*. PhD thesis, University of Warwick, April 2002. (Cited on pages 19, 46, 56, 78, 88 and 89.)

[San] Georg Sander. VCG overview. `http://rw4.cs.uni-sb.de/users/sander/html/gsvcg1.html` (dated September 1995). (Cited on page 180.)

[San96] Georg Sander. *Visualisierungstechniken für den Compilerbau*. PhD thesis, Universität des Saarlandes, Technische Fakultät, 66125, 1996. (Cited on page 180.)

[Sed90] Robert Sedgewick. *Algorithms in C*. Addison-Wesley, 1990. (Cited on page 186.)

[Sha03] William Shakespeare. *The Tragedy of Hamlet*, chapter Scene I. A room in the castle. Folio edition, 1603. (Cited on page 152.)

[She81] B. A. Sheil. The psychological study of programming. *ACM Comput. Surv.*, 13(1):101–120, 1981. (Cited on page 352.)

[ŠilcRU01] Jurij Šilc, Borut Robič, and Theo Ungerer. *Progress in computer research*, chapter Asynchrony in parallel computing: from dataflow to multithreading, pages 1–33. Nova Science Publishers, Inc., 2001. (Cited on pages 30 and 40.)

[Sla90] Mike Slade. Definitive parallel programming. Master's thesis, University of Warwick, April 1990. (Cited on pages xiii, xiv, 43, 46, 47, 52, 53, 55, 56, 58, 59, 60, 62, 63, 64, 67, 68, 69, 70, 78, 80, 89, 310 and 344.)

[Slo] N. J. A. Sloane. The on-line encyclopedia of integer sequences. `http://www.research.att.com/~njas/sequences/` (accessed March 2004). (Cited on page 184.)

[sta] StarOffice office suite. Sun Microsystems, Inc. `http://wwws.sun.com/software/star/staroffice/` (accessed August 2004). (Cited on page 34.)

[Sun99] Patrick Pi-Hwa Sun. *Distributed Empirical Modelling and its Application to Software System Development*. PhD thesis, University of Warwick, July 1999. (Cited on pages xiv, xv, 4, 12, 18, 22, 62, 89, 216 and 326.)

[Tan99] Andrew S. Tanenbaum. *Structured Computer Organization*. Prentice Hall, fourth edition, 1999. (Cited on page 31.)

[TBH82] Philip C. Treleaven, David R. Brownbridge, and Richard P. Hopkins. Data-driven and demand-driven computer architecture. *ACM Comput. Surv.*, 14(1):93–143, 1982. (Cited on page 60.)

[TBT00] Duane Truex, Richard Baskerville, and Julie Travis. Amethodical systems development: the deferred meaning of systems development methods. *Accounting, Management and Information Technology*, 10:53–79, 2000. (Cited on page 352.)

[Tic85] Walter F. Tichy. RCS — a system for version control. *Softw. Pract. Exper.*, 15(7):637–654, 1985. (Cited on page 250.)

[Til43] E.M.W. Tillyard. *The Elizabethan world picture*. Chatto and Windus, London, 1943. (Cited on page 6.)

[Tod76] S.J.P. Todd. The Peterlee relational test vehicle — a system overview. *IBM Systems Journal*, 15(4):285–308, 1976. (Cited on page 229.)

[Tru96] S.V. Truong. Interfacing EDEN with ORACLE. Final year undergraduate project report, University of Warwick Department of Computer Science, 1996. (Cited on pages xiv and 229.)

[usb] Universal Serial Bus home. USB Implementers Forum, Inc. `http://www.usb.org` (accessed April 2004). (Cited on page 250.)

[Val90] Leslie G. Valiant. A bridging model for parallel computation. *Commun. ACM*, 33(8):103–111, 1990. (Cited on page 70.)

[VHM+01] Bradley T. Vander Zanden, Richard Halterman, Brad A. Myers, Rich McDaniel, Rob Miller, Pedro Szekely, Dario A. Giuse, and David Kosbie. Lessons learned about one-way, dataflow constraints in the Garnet and Amulet graphical toolkits. *ACM Trans. Program. Lang. Syst.*, 23(6):776–796, 2001. (Cited on page 39.)

[VL02] Lionel Villard and Nabil Layaïda. An incremental XSLT transformation processor for XML document manipulation. In *Proceedings of the eleventh international conference on World Wide Web*, pages 474–485. ACM Press, 2002. (Cited on page 40.)

[VMGS94] Brad Vander Zanden, Brad A. Myers, Dario A. Giuse, and Pedro Szekely. Integrating pointer variables into one-way constraint models. *ACM Trans. Comput.-Hum. Interact.*, 1(2):161–213, 1994. (Cited on pages 39 and 41.)

[VP95] Lawrence G. Votta and Adam Porter. Experimental software engineering: a report on the state of the art. In *Proceedings of the 17th international conference on Software engineering*, pages 277–279. ACM Press, 1995. (Cited on page 351.)

[WA85] William W. Wadge and Edward A. Ashcroft. *Lucid, the Dataflow Programming Language*, volume 22 of *A.P.I.C. Studies in Data Processing*. Academic Press Inc. (London) Ltd., 1985. (Cited on page 29.)

[Wara] A.T. Ward. The EDEN change.log file. `http://www.dcs.warwick.ac.uk/research/modelling/tools/eden-change.log.html` (accessed April 2004). (Cited on page 223.)

[Warb] A.T. Ward. EDEN SourceForge.net project. `http://sourceforge.net/projects/eden/` (dated December 2000). (Cited on page 1.)

[Warc] A.T. Ward. EM Tools home page. `http://www.dcs.warwick.ac.uk/research/modelling/tools/` (accessed April 2004). (Cited on page 1.)

[War98] A.T. Ward. EWE - the Empirical Wool Environment. Taught MSc project, University of Warwick Department of Computer Science, 1998. `http://www.dcs.warwick.ac.uk/~ashley/EWE/` (dated November 1998). (Cited on pages 18 and 123.)

[Wat] Gray Watson. Dmalloc - a debug malloc library. `http://dmalloc.com/` (accessed April 2004). (Cited on page 228.)

[Weg97] Peter Wegner. Why interaction is more powerful than algorithms. *Commun. ACM*, 40(5):80–91, 1997. (Cited on page 29.)

[Wil69] John Wild. *The Radical Empiricism of William James*. Greenwood Press, Westport, Connecticut, 1969. (Cited on pages 3, 4, 23 and 306.)

[Wil96] Robin J. Wilson. *Introduction to Graph Theory*. Longman, fourth edition, 1996. (Cited on pages 184 and 282.)

[Wil02] Maurice V. Wilkes. Moore's law and the future. `http://www.cl.cam.ac.uk/users/mvw1/lect-Moores-law-and-the-future.pdf` (accessed April 2004), October 2002. (Cited on page 220.)

[Wir76] Niklaus Wirth. *Algorithms + Data Structures = Programs*. Prentice Hall, 1976. (Cited on pages 36 and 235.)

[WL90] Nicholas Wilde and Clayton Lewis. Spreadsheet-based interactive graphics: from prototype to tool. In *Proceedings of the SIGCHI conference on Human factors in computing systems*, pages 153–160. ACM Press, 1990. (Cited on page 37.)

[Won03] Allan Kai Tung Wong. *Before and Beyond Systems: an Empirical Modelling approach*. PhD thesis, University of Warwick, January 2003. (Cited on pages 18, 89, 182 and 247.)

[WRB] A.T. Ward, C.P. Roe, and W.M. Beynon. empublic project archive. `http://empublic.dcs.warwick.ac.uk/projects/` (accessed April 2004). (Cited on pages xv, 1, 18, 20, 37, 108, 201 and 218.)

[WS97] Laura Wingerd and Christipher Seiwald. Constructing a large product with Jam. In *Proceedings of the SCM-7 Workshop on System Configuration Management*, pages 36–48. Springer-Verlag, 1997. (Cited on page 39.)

[WW90] Robin J. Wilson and John J. Watkins. *Graphs: An Introductory Approach*. John Wiley and Sons, 1990. (Cited on pages 184 and 185.)

[YC94] Alan G. Yoder and David L. Cohn. Real spreadsheets for real programmers. In *Proceedings of the 1994 IEEE International Conference on Computer Languages*, pages 20–30. IEEE Press, May 1994. (Cited on page 35.)

[YS91] Daniel M. Yellin and Robert E. Strom. INC: a language for incremental computations. *ACM Trans. Program. Lang. Syst.*, 13(2):211–236, 1991. (Cited on page 40.)

[Yun87] Edward Yung. EDEN - Evaluator of DEfinitive Notations. Final year undergraduate project report, University of Warwick Department of Computer Science, 1987. (Cited on pages 196, 199, 200, 201, 219 and 259.)

[Yun89] Edward Y.W. Yung. The EDEN handbook, 1989. (Cited on pages xiv, 32 and 194.)

[Yun90] Edward Yun Wai Yung. EDEN: An Engine for Definitive Notations. Master's thesis, University of Warwick, September 1990. (Cited on pages xiii, xiv, xv, 44, 102, 184, 194, 196, 199, 200, 210, 211, 243, 259, 260, 275, 284, 286, 287, 288 and 344.)

[Yun93] Simon Yun Pui Yung. *Definitive Programming - a Paradigm for Exploratory Programming*. PhD thesis, University of Warwick, January 1993. (Cited on pages xiii, xv, 18, 48, 50, 51, 52, 62, 64, 66, 89, 196, 210, 212, 260 and 275.)

[Yun96] Simon Yun Pui Yung. Agent-oriented modelling for interactive systems. Post-doctoral EPSRC project report, University of Warwick Department of Computer Science, July 1996. (Cited on pages 45, 62, 76, 77, 89, 196, 214, 274 and 275.)

Index

(Note: this index has not been constructed to a professional standard and should not be relied on for completeness — for example, the list of page numbers given after each entry may omit important references in some cases. It is hoped, however, that the index may help to find some information of interest.)

Symbols

A

B

C

D

E

J

K

L

M

N

O

P

R

S

T

U

V

X

Colophon

This thesis was produced using an Apple iBook laptop running Mac OS X. Most of the text for this thesis was originally written in Microsoft Word version 'X', then manually converted to the LaTeX text mark-up language. TeXShop was used as previewer and editor (along with TextEdit, `emacs` and SubEthaEdit). `pdftex` was the underlying typesetter. LaTeX packages by various authors were used (with many thanks), including `amssymb`, `array`, `backrefx`, `color`, `extramarks`, `fancyhdr`, `fancyvrb`, `fix2col`, `fnbreak`, `graphicx`, `hyperref`, `ifthen`, `makeidx`, `pdfsync`, `setspace`, `shortvrb`, `showkeys`, `stmaryrd`, `url`, `verbatim`, `xspace` and a much-modified version of the Warwick `wnewthesis` thesis LaTeX style file maintained by Mark Hadley. BibDesk was used to maintain bibliographic information that was later processed by BibTeX. `makeindex` was used to assist in typesetting the index. Most of the figures were produced using either OmniGraffle (for vector-based figures) or Adobe Photoshop Elements (for bitmaps). Donald Knuth's Computer Modern fonts are used throughout.

[document v1.103-SS]