Dennis Connolly

Two Wheaton Center #2011
Wheaton, IL 60187
(630) 871-8398
connolly@intelligentsystems.com

Summary Over thirty years of experience in Computer Science and Software Engineering with an emphasis on Artificial Intelligence and Machine Learning. Track record of innovation and well engineered solutions to complex problems in fields ranging from military research to commercial software development.

Experience

Intelligent Systems, Wheaton, IL **1997 to Present**

Principal

Created company specializing in intelligent software solutions and applying AI and related technologies such as Machine Learning, Natural Language Processing, and Semantic Web technologies to tackle challenging business problems.

- Developed interactive product classification and ontology development platform that augments human expert analysis with machine learning. This tool combines Semantic Web based Knowledge Management with Machine Learning to create a collaboration between human and machine, solving problems more effectively and efficiently than either on their own. The learning algorithm operates in real time updating its model as the knowledge engineer edits and manually classifies products into the taxonomy, in order to automatically classify and suggest subsequent products. This process operates in iterative fashion to efficiently construct taxonomies through a partnership of human judgement and AI-based automation. The platform applies other ML techniques such as clustering to automatically organize products and extend the taxonomy, classify SKUs, and support schema definition.
- Developed clustering algorithm to automatically organize product SKUs based upon their specifications and other product attributes.
- Developed supervised learning algorithms to classify SKUs into existing categories.
- Developed supervised learning algorithm to find product numbers embedded in highly inconsistent unstructured text.
- Developed IVA (Intelligent Virtual Assistant) POC to help identify and recommend related products and package solutions based upon interacting with customer via conversational chat interaction to identify the problem they are trying to solve and the set of products that combine to solve this problem. This approach was driven by an inference engine that applied AI goal-driven planning and a semantic model of the domain to dynamically drive the dialog and construct the solution and resulting product recommendations.
- Developed Intelligent Virtual Assistant (i.e. chatbot) platform for automatically handling call center interactions. This platform combined IBM Watson dialog services and other APIs with home grown Natural Language Understanding, Semantic Query, and Rule-based Inference to process requests, identify intents, and generate answers via a text-based (chat) interface.
- Developed content extraction technologies to extract structured knowledge from unstructured content including PDF, HTML, and websites, incorporating a combination of parsing, pattern recognition, ML, and constraint satisfaction search to extract semantic structures and data.
- Developed rule-based content migration framework for extracting and transforming data between complex content object models in source and target Content Management Systems (CMS). (in this case migrate from proprietary object CMS to Adobe AEM.)
- Developed several native mobile games for the Android platform.
- Developed mobile web applications and back end CMS integration for mobile-first web sites for major automobile company.
- Developed recommendation engine based upon collaborative filtering and statistical modeling. These recommendations are provided via Software as a Service (SaaS) revenue sharing model delivered to client web site via web services hosted in cloud.

- Developed metadata repository and proprietary CMS platform based upon RDF and Semantic Web technologies. These were used during development phase of content migration and CMS deployment project for large biotech company.
- Developed adaptive search engine which improves search accuracy and precision over time based upon statistical analysis of user search history. Adaptive search engine described above performed considerably better than commercial search engine (Autonomy) in head-to-head comparison evaluation at large biotech company.
- Developed content migration strategies and tools for large CMS deployment and content migration targeting the Interwoven CMS platform for large biotech company.
- Developed recommendation engine based upon rule-based inference and semantic web-based knowledge representation (RDF) as part of dynamic content delivery platform used in digital signage platform.
- Developed adaptive search engine for online ticket seller.
- Developed recommendation and personalization engines based upon collaborative filtering, statistical modeling, and rule-based inference for online ticket seller.
- Developed semantic web-based (RDF) platform for applying crowdsourcing (e.g. Amazon Mechanical Turk) for cost effective, scalable, high quality knowledge acquisition and meta-data collection. Applied these unique tools and techniques to quickly create taxonomy and metadata tagging for website/catalog of online ticket seller.
- Developed Metadata Repository and Metadata Editing tool based upon RDF and OWL. Using these tools as foundation, developed customized metadata repository and editing environment targeted to content migration tasks including sitemap editing and content metadata collection.
- Developed algorithms for reverse-engineering sitemap structure from existing web sites. These algorithms employ statistical techniques to resolve inconsistencies in legacy sitemap to generate a single coherent sitemap structure.
- Developed Content Extraction Tool for visually tagging and extracting content and content components from HTML pages.
- Developed Learning algorithms for automatically extracting content in the Content Extraction Tool described above using statistical techniques.
- Developed rule-based metadata and content extraction framework based upon translation of HTML content to standard RDF representation and application of inference rules to this representation for extraction and transformation of content and metadata.
- Developed algorithm for learning content and metadata extraction rules in the above extraction framework.
- Developed Statistical Web Analytics browse path analysis tool to statistically analyze user paths through web sites. Performed Web Analytics and data mining on large travel e-commerce site to improve site conversion rates and other metrics. Participated in larger effort to evaluate and improve business intelligence.
- Developed Web Service for Sun Microsystems for semantically searching Java API content based on Semantic Web technology. Extracted content from unstructured API documentation and transformed into RDF model. Built RDF repository and query engine for executing semantic queries against API model and distributing information via web service.
- Designed text mining tool for identifying patterns in verbatim call center logs for large telecom company. Two patents have been granted for the underlying technology.
- Developed AI and other technologies for Content Management & Enterprise Portal project for large CMS consulting firm. Developed Machine Learning/Pattern Recognition algorithms to extract structural components from unstructured HTML content across a large set of differently formatted legacy web pages.
- Was AI expert for large Content Management initiative within major telecommunications company. Highlights of contributions to this project include:
  - Developed intelligent search technology for document repository.
  - Automatically generated taxonomy using conceptual clustering.
  - Developed supervised learning algorithm to automatically classify content.
  - Developed statistical techniques to automatically extract semantically rich meta-data from documents.

- Created tools based upon pattern recognition to automatically extract semantic structures (e.g. tables) from unstructured raw text.
- Developed techniques to automatically extract synonyms, abbreviations, and domain-specific terminology from document repository.

- Developed AI and statistical models of financial markets to support proprietary trading systems.

Ameritech, Hoffman Estates, IL **1994 to 1997**

Member of Technical Staff

Conducted applied research and technology planning, specializing in the application of Artificial Intelligence and advanced technologies to the Internet, telecommunications, and interactive television.

- Investigated the application of AI and intelligent agent technology within the tele-communications industry. Developed new technologies and product ideas, and oversaw research conducted by vendors such as Bellcore. Developed software demonstrating the commercial and technical feasibility of these ideas. Defined strategic vision for this technology within Ameritech and represented the company at relevant standards bodies.
- Invented Intelligent Text Entry mechanism allowing text messages to be entered using a telephone keypad. This technique employs a statistical model to predict letters based upon previously typed text. Two patents have been granted for this invention.
- Was member of the team that initiated and launched Ameritech's first Internet service (Ameritech.net) and served as subject matter expert on AI, agent technology, and search engines for this effort. Evaluated and recommended enabling technologies and vendors and developed custom technologies. Also developed early internal Internet applications and participated in the development of external sites such as the '96 Democratic National Convention site.
- Designed and developed multimedia applications for interactive television including video-on-demand, electronic program guides, and home shopping. Conducted research on the use of intelligent agent technology to enhance the viewing experience.
- As member of the Human Factors group, designed intelligent interfaces, developed usability prototypes, and participated in new product design.

The MITRE Corporation, Bedford, MA **1990 to 1994**

Member of Technical Staff

Conducted research in Artificial Intelligence, with emphasis in Machine Learning, Neural Networks, and Natural Language Processing (NLP). Served as the Machine Learning specialist on NLP project. Primary role was the investigation of techniques from Machine Learning and Statistical NLP to extend capabilities of Natural Language Understanding systems.

- Invented Machine Learning technique for constructing Bayesian networks from empirical data. A major feature of this approach is the use of conceptual clustering to construct hidden (latent) variables in the model. These ideas have been implemented in a system called Tantra. This research was presented at a plenary session of the Tenth International Conference on Machine Learning (ML93).
- Invented new learning algorithm analogous to neural network back-propagation for training weights in Bayesian networks via gradient descent.
- Conducted research into the application of Machine Learning to the resolution of anaphoric reference (e.g., resolving pronouns). This involved experimentation with a variety of classifiers and probabilistic models, including neural networks, decision trees, Bayesian classifiers, and Bayesian networks. This research has led to the development of novel learning techniques designed to address problems characterized by high dimensionality, sparse data, and violated independence assumptions.
- Developed new neural network training algorithm designed to address problems characterized by high dimensionality and sparse data. This approach involves application of back-propagation to subspaces of the original higher dimensional space.
- Investigated the learning of natural language grammars using hill climbing approach. Have also constructed algorithms for the induction of finite-state automata and

investigated statistical and information theoretic techniques for discovering word classes and phrase structure from data.

- Member of development team for the Alembic language understanding system which is designed for extraction and retrieval of information from free text (e.g. newspapers).
- Designed email filter which classifies mail based upon the statistical properties of message content.
- Designed architecture combining Case-based Reasoning (CBR) and inductive learning. This technique uses conceptual clustering to organize the case memory and learning-by-examples to learn the CBR adaptation rules represented using version spaces. New features are induced as a by-product of the conceptual clustering.
- Designed probabilistic algorithm for learning new features in CBR system. Implemented case memory for this system based on the COBWEB clustering algorithm.
- As member of Neural Network project, performed research on modular networks, transfer of learning, and abstraction in the Cascade Correlation architecture.
- Worked on large AI planning system used in military logistics planning. This system combined traditional AI planning with constraint satisfaction search.

Wang Laboratories, Lowell, MA **1983 to 1989**
Software Engineer
Developed commercial Artificial Intelligence software, conducted AI research, and performed compiler development.

- Was responsible for researching new and advanced AI technologies for Wang including application of machine learning, neural network, pattern recognition, and image processing technology to new product ideas and improvement of existing products.
- Was member of development team for Wang's Expert System product.
- Ported UNIX-based Expert System product to Wang VS mini-computer.
- Was lead developer for Wang's Lisp and Basic compilers.
- Participated in development activities for C, PL/I, Cobol and other compilers and common frameworks (common code generation, runtime, etc.).
- Ported popular UNIX Lisp compiler to Wang VS mini-computer.
- Developed various source code translators, emulators, and other tools.
- Worked closely with developers in the Operating Systems, Database, and other software groups to implement system-level functionality.

Santa Fe Industries, Chicago, IL **1983**
Developed business software, including a financial spreadsheet tool.

Argonne National Laboratory, Chicago, IL **1982**
Participated in research in elementary particle physics.

Education

Loyola University Chicago, IL
B.S. in Physics 1982

Patents

Method and system for intelligent text entry on a numeric keypad, *6,005,495*, 1999.

Method and system for intelligent text entry on a numeric keypad, 6,346,894, 2002.

Customer feedback acquisition and processing system, 6,510,427, 2003.

Customer feedback acquisition and processing system, 7,058,625, 2006.

Publications

Connolly, D., Burger, J., Day, D., "A Machine Learning Approach to Anaphoric Reference," International Conference on New Methods in Language Processing, 1994.

Connolly, D., "Constructing Hidden Variables in Bayesian Networks via Conceptual Clustering," Machine Learning: Proceedings of the Tenth International Conference , 1993. (selected for plenary session)

Burger, J., Connolly, D., "Probabilistic Resolution of Anaphoric Reference," AAAI Fall Symposium: Probabilistic Approaches to Natural Language, 1992.

Connolly, D., Christey, S., Koton, P., McAlpin, S., Mulvehill, A., "Learning Representation by Integrating Case-based and Inductive Learning," AAAI- 93 Workshop on Case-Based Reasoning, , 1993.

Aberdeen, J., Burger, J., Connolly, D., Roberts, S., Vilain, M., "Description of the ALEMBIC System as Used for MUC-5" Fifth Message Understanding Conference, 1993.

Aberdeen, J., Burger, J., Connolly, D., Roberts, S., Vilain, M., "Description of the ALEMBIC System as Used for MUC-4" Fourth Message Understanding Conference, 1992.

Aberdeen, J., Burger, J., Connolly, D., Roberts, S., Vilain, M., "ALEMBIC: MUC-4 Test Results and Analysis" Fourth Message Understanding Conference, 1992.

Smotroff, I., Friedman, D., Connolly, D., "Self Organizing Modular Networks" Proceedings of the International Joint Conference on Neural Networks, 1991.

Smotroff, I., Friedman, D., Connolly, D., "Large Scale Networks Via Self Organizing Hierarchical Networks" Applications of Artificial Neural Networks II, 1991.