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Timothy James Becker

ACADEMIC AND PROFESSIONAL APPOINTMENTS

Connecticut College: John D. MacArthur Assistant Professor of Computer Science
New London, Connecticut (Fall 2023-present)
Taught core CS courses and data-focused course work. Informatics centered analysis, predictive modeling, algorithm development and interactive visualization. Exploring genomic landscapes in non-syndromic human defect phenotypes through second and third generation sequencing technologies.

University of Hartford, College of Arts and Sciences: Applied Assistant Professor of Computing Sciences
West Hartford, Connecticut (Fall 2017-Spring 2023)
Taught a variety of undergraduate CS and MWD/HCID courses as well as graduate QNT courses in the summer. Research and development of open-source computational tools in bioinformatics, transportation modeling, ecological informatics and data visualization.

University of Connecticut, Connecticut Transportation Institute: Graduate Research Assistant
Storrs, Connecticut (December 2016, August 2017)
Development of automated remote database synchronization mechanisms, data pre-processing and schema-bound importation. Development of automated Title VI reporting queries in TSQL.

The Jackson Laboratory for Genomic Medicine (JAXGM): Cooperative Associate
Farmington, Connecticut (April 2015-December 2016)
Development of a Linux based structural variation pipeline system (SVE) and open-source knowledge-based framework for comprehensive structural variation discovery (FusorSV project) under the direction of Dr. Charles Lee funded in part by NIH grant U41HG00749.

University of Hartford, College of Arts and Sciences: Visiting Instructor of Computer Science
West Hartford, Connecticut (Fall 2015-Spring 2016)
Taught a variety of undergraduate CS courses and supervised three student CS IT administrators.

University of Connecticut, Connecticut Transportation Institute: Graduate Research Assistant
Storrs, Connecticut (Fall 2012-Summer 2014, Spring 2016)
Creation of transit analytic tools and implementation of a directed graph data structure and TSQL generating scripts for mining and integration of large U.S. Census data sets with spatial transportation data.

University of Connecticut Health Center: Application Development Services Intern
Farmington, Connecticut (Summer 2011)
IIS system administration of Windows 2008 web servers, PowerShell scripting, development of an automated remote mirroring web service using multi-threaded C# workflow.

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PEER-REVIEWED PUBLICATIONS

Sean Congdon, John Guaglione, Omario Ricketts, Kyle V. Murphy, Megan Anderson, Darby Trowbridge, Yousuf Al-Abduladheem, Annabelle Phillips1, Allison Beausoleil, Alexus Stanley1, **Timothy Becker**, Adam C. Silver. "Prevalence and antibiotic resistance profiles of Staphylococus aureus associated with college-aged cohort: Life-style factors that contribute to nasal carriage", *Frontiers in Cellular and Infection Microbiology*, 13:1195758 (2023). https://doi.org/10.3389/fcimb.2023.1195758

Timothy Becker, Dashzeveg Bayarsaihan and Dong-Guk Shin. "A framework for associating structural variants with cell-specific transcription factors and histone modifications in defect phenotypes", *2022 IEEE International Conference on Bioinformatics and Biomedicine (BIBM),* Las Vegas, NV,December 6-8, (2022). https://doi.org/10.1109/BIBM55620.2022.9995130

Rossa Guzzo, Badam Enkhmandakh, **Timothy Becker**, Pujan Joshi, Paul Robson, Anushree VijayKumar, Mina Mina, Dong-Guk Shin, Dashzeveg Bayarsaihan. "Single-cell transcriptomics defines Dot1L interacting partners and downstream target genes in the mouse molar dental pulp" , *International Journal of Developmental Biology*, 66: 391-400*,* (2022). https://doi.org/10.1387/ijdb.220141db

Timothy Becker and Dong-Guk Shin. "Structural Variation Calling and Genotyping by Moment Based Deep Convolutional Neural Networks", *International Journal of Data Mining and Bioinformatics (IJDMB),* 25:1/2, 37-52, (2021). https://doi.org/10.1504/IJDMB.2021.10039922

Timothy Becker and Dong-Guk Shin. "TensorSV: structural variation inference using tensors and variable topology neural networks" *2020 IEEE International Conference on Bioinformatics and Biomedicine (BIBM)*, Seoul, Korea (South), December 16-19, (2020). https://doi.ieeecomputersociety.org/10.1109/BIBM49941.2020.9313154

Timothy Becker and Dong-Guk Shin. "Efficient methods for hierarchical multi-omic feature extraction and visualisation", *International Journal of Data Mining and Bioinformatics (IJDMB)*, 23, 4 (2020). https://doi.org/10.1504/IJDMB.2020.108699

Timothy Becker and Dong-Guk Shin. "HFM: Hierarchical Feature Moment Extraction for Multi-Omic Data Visualization," *2019 IEEE International Conference on Bioinformatics and Biomedicine (BIBM)*, San Diego, CA, USA, November 18-21, (2019). https://doi.ieeecomputersociety.org/10.1109/BIBM47256.2019.8983015.

Timothy Becker, Wan-Ping Lee, Joseph Leone, Qihui Zhu, Chengsheng Zhang, Silvia Liu, Jack Sargent, Kritika Shanker, Adam Mil-homens, Eliza Cerveira, Mallory Ryan, Jane Cha, Fabio C. P. Navarro, Timur Galeev, Mark Gerstein, Ryan E. Mills, Dong-Guk Shin, Charles Lee, Ankit Malhotra. "FusorSV: an algorithm for optimally combining data from multiple structural variation detection methods", *Genome Biology 19, 38* (2018). https://doi.org/10.1186/s13059-018-1404-6

Mary Becker, **Timothy Becker**, Christopher Bellucci. "Diatom tolerance metrics to identify total phosphorus as candidate cause of aquatic life impairment in Connecticut, USA freshwater streams", *Ecological Indicators*, 93, 638-646 (2018). https://doi.org/10.1016/j.ecolind.2018.05.046

Timothy Becker. "A General Perceptual Model for Eldercare Robots", *Association for the Advancement of Artificial Intelligence Conference Workshops* (*AAAI)*, San Francisco, August 7-11, (2011). https://dl.acm.org/doi/10.5555/2908724.2908726

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SELECT POSTERS AND PRESENTATIONS

Timothy Becker and Dashzeveg Bayarsaihan, "Associating Intergenic Genomic Variation with Locally Integrated scATAC and scRNA", *Single Cell Analysis Meeting*. Cold Spring Harbor, NY, November 8-11, (2023)

Timothy Becker and Mary Becker, "Computational Methods for Image Based Stream Connectivity Classification", *Northeast Aquatic Biologist Conference (NAB)*. Portland ME, March 2-4, (2022)

Timothy Becker and Dong-Guk Shin, "Structural Variation Genotyping by Feature Moment Based Convolutional Neural Networks", *Biology of Genomes Conference (BIOG),* Online/Virtual (COVID-19), May 11-14, (2021)

Timothy Becker, "Machine Learning Strategies for Image based Instream Water Flow Classification", *Northeast Aquatic Biologist Conference (NAB)*. Newport RI, March 4-6, (2020)

Timothy Becker, Andrew Koob and Dong-Guk Shin. "somaCX: a pathway based somatic genome generation framework", *Research in Computational Molecular Biology Conference (RECOMB)*, Washington D.C., May 5-8 (2019).

Timothy Becker and Mary Becker "Phylogenetic Indicator Species Visualizer", *Northeast Aquatic Biologist Conference (NAB)*. Saratoga Springs NY, February 27-March 1, (2019)

Timothy Becker et al. "FusorSV: A unified knowledge-based framework for comprehensive Structural Variant discovery", *American Society of Human Genetics (ASHG) Annual Meeting*, Vancouver, Canada, October 18-22 (2016)

INVITED PEER REVIEWER

Genomics, ISSN: 1089-8646. A forum for describing the development of genome-scale technologies and their application to all areas of biological investigation.

BMC Bioinformatics, ISSN: 1471-2105. An open access, peer-reviewed journal that considers articles describing novel computational algorithms and software, models and tools, including statistical methods, machine learning and artificial intelligence, as well as systems biology.

GRANTS AND AWARDS

National Institute of Health (NIH) Grant R03DE033083: CO-PI sub-award
Connecticut College, New London, CT (July 2023-August 2025)
Comprehensive SV ensemble calling with Orofacial Cleft specific integration of transcription factor binding sites and cell-specific Histone modifications. Candidates are generated across the human trio datasets and then will be further examined across interaction networks to examine potential regulatory mechanisms.

University of Hartford, College of Arts and Sciences: Innovative Remote/Hybrid Pedagogy Grant
West Hartford, Connecticut (Spring 2021)
Contextually relevant reinforcement learning in synchronous remote Algorithms and Complexity: interactive visualization and algorithm implementation via python-based jupyter lab to accompany an undergraduate level introduction to algorithms and complexity theory course.

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FTA (CAMMSE) Grant, 2020 Project 10: CO-PI sub-award
University of Hartford, West Hartford, CT (May 2020-September 2020)
Developed algorithms that improve the efficiency of public transit system modeling. Using several transportation network datasets, the team developed novel scoring methods that integrate sequence similarity into algorithmic path selection.

National Institute of Health (NIH) Grant U41HG007497: Coop Associate
JAXGM, Farmington, CT (April 2015-December 2016)
Structural variation (SV), involving deletions, duplications, insertions and inversions of DNA segments, accounts for a large proportion of human genetic diversity. Comprehensive identification and analysis of these genetic variants will help us more fully elucidate the biology of their functional effects on human health and demography.

University of Connecticut, School of Engineering: Graduate Fellowship in Areas of National Need (GAAN)
Storrs, Connecticut (Fall 2011-2015)
Full tuition and stipend awarded for pursuit of Doctor of Philosophy with Bioinformatics concentration.

University of Connecticut, School of Engineering: Graduate Pre-Doctoral Fellowship
Storrs, Connecticut (Spring 2014)
Stipend awarded for outstanding academic achievement.

EDUCATION

University of Connecticut, School of Engineering: PhD, Computer Science & Engineering
Concentration: Bioinformatics
Storrs, Connecticut (Summer 2021)

University of Hartford, College of Arts and Sciences: Bachelor of Science
Major: Computer Science, Minor: Mathematics
West Hartford, Connecticut (Spring 2011)

University of Hartford, Hartt School of Music: Bachelor of Music
Major: Music Production and Technology, Minor: Jazz Guitar
West Hartford, Connecticut (Fall 2002)

TEACHING EXPERIENCE

Graduate Courses Designed/Taught:
University of Hartford, Barney School of Business: Master of Science in Analytics Program
West Hartford, Connecticut (Summer 2019, Summer 2020, Summer 2021, Summer 2022)

QNT 745 Data Visualization **[3 credits]:** This project-oriented course introduces students to methods for visually exploring and communicating qualitative and quantitative data. Emphasis is placed on mapping the unique properties of emerging data sources to visual domains. Topics covered include introductory data analysis involving domain, range, and dimensionality. Students are exposed to a variety of publicly available data sources and learn to utilize human perception to visually represent data. Discussion topics include data and visual complexity and constraints, spatio-temporal relationships, and multiple visualization frameworks.

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***QNT 755 Coding-Programming for Data Science* [3 credits]:** This programming course extends prior student knowledge of problem solving to deal with complex but common domain challenges that arise with large data. Text processing, numeric computation, data association and data pre-processing will be discussed, as well as classic data structures for problem solving such as trees, maps, and lists. Open data sets will be used to introduce students to machine learning methods such as decision trees, k-means clustering and deep learning. The course will culminate in a collaborative programming project utilizing all course objectives.

QNT 735 Predictive Modeling [3 credits]: Predictive modeling is the process of developing mathematical tools or models that generate an accurate prediction. The topics covered in this course include: data pre-processing, over-fitting and model tuning, measuring performance in regression models, non-linear regression models like neural networks, adaptive regression splines, support vector machines, K-nearest neighbors, regression trees and rule-based models. These modeling techniques will be applied to large data sets from different business areas to support business decision making. This course will offer the basic concepts and techniques through a series of case studies. Either R or SAS software will be used in applications to arrive at the appropriate decision.

Undergraduate Courses Designed:

Connecticut College, Department of Computer Science, *New London, Connecticut*
(Fall 2023-present)

COM328: Predictive Data Modeling [4 credits]: An introduction to the computational modeling and critical assessment used for prediction problems. Topics in this course include data visualization, transformation, and imputation along with general linear models, randomized tree methods, maximum margin separators, and modern neural network forms (this includes deep learning). Unsupervised and supervised methods will be introduced along with semi-supervised methods. The course discusses normalization, regularization, validation, selection, and calibration (estimation of model performance on new unseen data). All examples and methods are demonstrated in the Python programming language and emphasis is placed on experimental Machine Learning application to analysis-ready heterogenous categorical, ordinal, and numerical multivariate data.

COM428: Generative Data Modeling [4 credits]: Generative models have gained popularity and reached common use in the public space, being able to pass the bar exam and complete first-year programming assignments with ease. But underneath the hype and wonder, lies a carefully structured scientific methodology that has its foundation in probability distributions. In this course students will explore how data can be used to construct plausible generators along with careful discussions on limitations, bias, and the ethical issues that automated content-creation gives rise to. Open-source models will be used in the Python programming language to develop applications that make use of pre-trained models, while further exploration will be encouraged in a culminating course project.

University of Hartford, College of Arts and Sciences: Computing Sciences Department, *West Hartford, Connecticut*
(Fall 2017-Spring 2023)

DS330: Data Visualization [3 credits]: This course focuses on visualization of qualitative and quantitative data. Emphasis is placed on the mapping of multidimensional data to appropriate coordinate and color space. Introductory data visualization topics are explored in detail including domain, range, dimensionality, missing data and correlation, in additional to more advanced topics like unsupervised learning by visual clustering using linear and non-linear means, as ethics and artistry in concept and presentation. Students engage with a wide variety of publicly available data sources in the process of learning visual communication through manipulation and assembly of the scaled data features.

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CS290/CS291 ST: Bioinformatics [3 credits]: This course introduces students to the concepts and algorithms used to solve a variety of applied biological problems. DNA sequencing, motif finding, pairwise and multiple sequence alignment, gene prediction, and molecular evolution will be discussed. The algorithmic techniques covered in this course include exhaustive search, greedy algorithms, dynamic programming, combinatorial pattern matching, clustering, and probabilistic models.

CS390 ST: Machine Perception **[3 credits]**: Machine Perception is an introduction to the computational construction of visual and auditory models and frameworks. This course introduces students to common perceptual terminologies and the methods for solutions to these challenging machine learning problems in the real-time domain. This entails discussion and practice of signal processing, geometry, and probability. Open-source libraries will be utilized for hands on exploration of an instructor approved real-time machine perceptual group project working on either audio or video input streams.

CS375 Web Services **[3 credits]:** This course provides an in-depth exploration of Web Services in the context of modern web architecture. Students gain hands-on experience with HTML5, AJAX, JSON, and client-side Java Scripting frameworks. The course focuses on the server-side design and implementation of Web Services and web-enabled APIs using the REST paradigm with integrated persistence technologies like JPA. This course culminates in a fully functional group project utilizing introduced concepts and frameworks.

HCID/MWD220P Interactive Data Visualization **[4 credits]:** This course focuses on interactive visualization of qualitative and quantitative data. Emphasis is placed on mapping the unique properties of emerging data sources to animated or interactive environments. Topics covered include introductory data analysis involving domain, range and dimensionality. Additionally, students are exposed to a variety of publicly available data sets and learn to visually communicate through manipulation and assembly of scaled interactive environments. Discussion topics include data and visual complexity and constraints, spatio-temporal relationships, and ethics.

Undergraduate Courses Taught:

Connecticut College, Department of Computer Science, *New London, Connecticut*
(Fall 2023-present)

COM 110,110L introduction to Computer science and Problem solving **[4 credits]:** What is computer programming? How can computers be programmed to perform specific tasks such as playing music, displaying images, drawing graphics, and analyzing data for relevant information? Because they can be programmed to solve a wide variety of different problems, computers have become an essential part of every aspect of modern life. Students will learn the basic elements of programming with Python, exploring how these skills can be used to tackle a variety of real-world problems. They will have the opportunity to consider the role technology plays in everyday life and in a variety of disciplines, solving problems in areas such as visualization of text or data, political speech analysis, image processing, and sound manipulation. Students will also work with graphics and animation, simulation, object-oriented design, and text manipulation. Students will progress from writing simple programs to creating their own unique, self-designed final projects. These applications will enable students to connect acquired skills in programming and problem-solving to the wider perspectives of the liberal arts education and real-world problems.

COM 219 Computer Organization **[4 credits]:** Processors, primary memory, secondary memory and input/output mechanisms of computers are discussed. The computer structure is studied at a progression of levels: digital logic level, microarchitecture level, instruction set architecture level, operating system machine level and assembly language level.

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COM428: Generative Data Modeling [4 credits]: Generative models have gained popularity and reached common use in the public space, being able to pass the bar exam and complete first-year programming assignments with ease. But underneath the hype and wonder, lies a carefully structured scientific methodology that has its foundation in probability distributions. In this course students will explore how data can be used to construct plausible generators along with careful discussions on limitations, bias, and the ethical issues that automated content-creation gives rise to. Open-source models will be used in the Python programming language to develop applications that make use of pre-trained models, while further exploration will be encouraged in a culminating course project.

University of Hartford, College of Arts and Sciences: Computing Sciences Department, *West Hartford, Connecticut (Fall 2017-Spring 2023)*

CPLX 465 Readings in Complexity **[3 credits]:** Student-initiated independent study under the supervision of a faculty member. This course addresses two purposes: the in-depth study of a topic that is not represented in the minor's course offerings, or the completion of a minor requirement that cannot be satisfied due to scheduling conflicts.

University of Hartford, College of Arts and Sciences: Computing Sciences Department, *West Hartford, Connecticut (Fall 2017-Spring 2023)*

CPLX 465 Readings in Complexity **[3 credits]:** Student-initiated independent study under the supervision of a faculty member. This course addresses two purposes: the in-depth study of a topic that is not represented in the minor's course offerings, or the completion of a minor requirement that cannot be satisfied due to scheduling conflicts.

CS480 Independent Study in Computer Science **[3 credits]:** The study of more advanced computer science topics under the direction of a faculty member.

CSE471W Capstone Design **[3 credits]:** The capstone design project for Computer Science and Engineering majors is a group project that treats a single significant computer science and engineering problem. Students develop a proposal for a project which is based on the knowledge and skills acquired in earlier course work. Students analyze the project in terms of incorporating software and hardware standards and realistic constraints that include most of the following considerations: economic, environmental, sustainability, manufacturing, ethical, health and safety, social, and political.

CSE472P Senior Capstone **[3 credits]:** A project course for senior computer science and engineering majors in which a single significant computer science and engineering problem is treated, involving design and development, operation, and analysis. Students apply a software engineering process that includes the understanding of system requirements, evaluating engineering compromise, effective coding and testing, system validation and verification, and application of engineering tools.

CS451 Computer Operating Systems **[3 credits]:** Characteristics and design of objectives of operating systems. Serial and parallel processes. Deadlock detection, prevention, and avoidance. Scheduling, long and short term. Memory management. Executive multiprogramming and multiprocessor systems. A comparison of major operating systems.

CS371 Computer Graphics **[3 credits]:** An introduction to fundamental aspects of three-dimensional computer graphics, including the implementation of basic graphics algorithms, geometrical transformations and projections, representations of curves and surfaces, lighting models, and graphical interaction. Theory is applied via the development of programs using a graphics package, such as OpenGL.

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CS365 Principles of Database Systems **[3 credits]:** This course provides a solid background in the theory, design, and programming of database systems, with a focus on relational databases. The relational data model and entity relationship diagrams will be covered. Other data models, including the object-oriented model, will be presented. The course introduces database query languages, including an in-depth coverage of the Structured Query Language (SQL). Other database topics include storage and indexing techniques, transaction management, and database interface with application programs.

CS342 Algorithms and Complexity **[3 credits]:** This course is an introduction to the design and analysis of computer algorithms. Topics will include concepts of algorithm complexity; various algorithmic design patterns like divide and conquer, dynamic programming and greedy algorithms; worst-case and average-case analysis; and NP-complete problems.

CS211 Architecture and Assembly Language [3 credits]: Architecture topics to include CPU and ALU design and operation, instruction sets, microcode, cache memory, memory protection, arithmetic, instruction, and data formats. Architectural principles are illustrated with the study of a specific assembly language.

M368 Predictive Modeling for Data Science **[3 credits]:** An introduction to predictive modeling and modern machine learning in data science. The main topics for the course include: Data visualization and transformation, linear regression, classification and logistic regression, unsupervised learning and k-means clustering, techniques for learning from data, assessing and comparing models, cross-validation, model selection and regularization, communicating with data. Emphasis is placed on statistical computing in a high-level language.

Teaching Assistant for Undergraduate Courses:
University of Connecticut: Computer Science and Engineering Department,
Storrs, CT (Teaching Assistant Spring 2016)

CSE4701 Principles of Databases **[3 credits]:** Fundamentals of data base design and data indexing techniques. Hierarchical, network, and relational data models. Data base design theory. Query languages, their implementation and optimization. Data base security and concurrent data base operations.

PAST AFFILIATIONS

UCONN Bioinformatics & Biocomputing Institute
UCONN Connecticut Transportation Institute
The Jackson Laboratory for Genomic Medicine

MEMBERSHIPS

Institute of Electrical and Electronics Engineers
Intelligent Systems for Molecular Biology
Audio Engineering Society