# Curriculum Vita

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## Research and Technical Interests

*Computer Graphics, Geometric Modeling, Rasterization, GPU programming, Mobile Application Development.* My career in computer graphics started by implementing rasterization firmware for industrial graphics boards based on TI's TMS34010 line of graphics processors. Later I developed a 3D rendering system that used the TMS34082 floating point coprocessor. Essentially I was programming GPU's long before the current wave of GPU coding become popular. Later, during graduate school, I developed an interest in a class of fractal models that were used for compressing images at unusually high bit rates. I extended these algorithms (along with methods based on the DCT) to compress 3-D volumetric data produced by CT and MRI machines. Following this, I developed a variety of methods based on fractal interpolation functions to model and render intricate curves and surfaces. I remain interested in modeling complex surfaces and textures with fractals and I am investigating techniques inspired by Wang Tiles to generate infinitely detailed structures. Due to the availability of cheap video hardware, GPU programming has now extended beyond the realm of computer graphics. General Purpose GPU (GPGPU) techniques are also an interest of mine. I enjoy programming Apple's mobile devices, the iPad and iPhone, which utilize embedded GPU's.

## Teaching Interest and Goals

I have taught 17 different computer science courses at WSU from 1998 to the present that cover a wide range of topics from the sophomore to graduate level. The topics include computability and complexity theory and algorithm analysis, scientific and numerical computing, programming language design and translation, application programming, computer graphics, and mobile application design. Many of these subjects involve rapidly changing technology which are both exciting and challenging to keep pace with. For example the constant evolution of graphics hardware and API's and the variety of GPU platforms requires yearly redesigns of several of my courses. The current explosion of web and mobile frameworks, database and cloud storage techniques, and embedded devices requires continual learning. It is important that I provide students with current state-of-the-art material and that I create interesting and relevant programming projects to prepare them for their careers. At the same time, its crucial that I do not focus on specific technologies due to their transient nature, but provide the student with a foundation that will allow them to quickly absorb and even create new technology.

Predominantly I enjoy teaching upper division courses with students that have already began to form a foundation in computer science and software design. With a background and love for mathematics I enjoy the epiphanies that students experience when they see the power and usefulness of the math and theoretical knowledge they have been previously armed with. Every year I have students who flourish and genuinely enjoy computer science and it is these students who make what I do worthwhile.

## Courses Taught at WSU Vancouver EECS/ENCS 1999-2014

**CS 223 Advanced Data Structures** (2007, 2012-2015) Abstract data types, balanced binary trees (splay trees, AVL trees, red-black trees), hash-tables, heaps, graph traversal algorithms (Dijkstra's algorithm) (2007 C++, 2012-2014 Java).

**CS 330 Numerical Computing** (2008-2015) Power and limitation of numerical solutions; design, analysis and implementation of numerical algorithms.

**CS 452/542 Computer Graphics** (2001-2015) OpenGL graphics pipeline, geometric modeling and transformations, visibility, shading, texturing (conjoint grad course).

**CS 224 Programming Tools** (2008-2014) Unix file system, shell scripting, debugging, version control, graphical user interface programming, model-view-controller (2008-2009 wxWidgets, 2010-2014 Cocoa/Xcode).

**CS 483,458 Mobile Application Development** (2012-2016) Model-view-controller (MVC), event driven programming, mobile application user interfaces and frameworks, data persistence, front-end and back-end design, RESTful network API's, sensors (iOS, Xcode, Cocoa Touch).

**CS 421 Software Engineering in Practice** (2015-2016) New Senior Capstone course, implementation of industry sponsored senior projects, software management tools, version control.

**CS 452 Compiler Design** (2007, 2009, 2011, 2013, 2014) Lexical and syntax analysis, parsing tools (lex/yacc/bison), abstract syntax trees, symbol tables, intermediate representation (IR) code generation, static single assignment (LLVM), register allocation.

**CS 317 Automata and Formal Languages** (1999-2006, 2008, 2010) Formal languages and models of computation; finite automata, pushdown automata, Turing machines, regular languages, context free languages, parsing algorithms, computability (Halting Problem).

**CS 355 Programming Language Design** (2001-2011,2015-2016) Language syntax, semantics, parsing strategies, translation and interpretation, memory layout and management, statements, expressions, control-flow, support for object-oriented programming, functional languages, logic programming.

**CS 516 Theory of Computation** (2006, 2009) Computability and complexity theory, decidability, Church-Turing Thesis, space and time complexity hierarchies (P, NP, co-NP, P-space), NP and P-space completeness.

**CS 548 Advanced Computer Graphics** (2003, 2005, 2006, 2008, 2010, 2012) Ray tracing, procedural texturing (Perlin noise), advanced mesh data structures, subdivision surfaces, GPU programming.

**CS 251 C Programming for Engineers** (2007) Computation and memory model, syntax, expressions, control flow, addressing and pointers, modularization, simple data structures, numerical methods for scientific and engineering applications.

**CptS 460 Operating Systems and Computer Architecture** (2000, 2001) Process management, pre-emptive multitasking, scheduling, concurrency issues, memory management, virtual memory, file system, inout/output, device drivers (Minix kernel).

**CptS 499 Professional Practice** (2000, 2001) Programming methods and practical exercises for "real world" problems using Java (2000) and C++ (2001) (co-taught with adjunct Roger Ray).

**Math 210 Introduction to Mathematics** (2007) General Education course on mathematics for non-technical students.

## Courses Taught at WSU Pullman EECS from 1998-1999

**CptS 252 Windows Programming** (1998) Win32 API for C. Windows environment, event-driven programming, event callbacks, user interface programming.

**CptS 251 C Programming** (1998) C programming for engineers. Computation and memory model, syntax, expressions, control flow, modularization, simple data structures, numerical methods.

**EE 305 Introduction to Microprocessors** (1998) Structured computer organization, simple digital circuits, memory, microprocessors (Z80), assembly language, operating systems, applications.

**CptS 253 Java Programming** (1999) Java programming language, object oriented programming, java applications and applets, abstract window toolkit (AWT).

**CptS 455 Computer Networks** (1999) OSI network layer model, TCP/IP, physical layer encoding, aloha, ethernet, network layer (IP, ICMP), transport layer (TCP, UDP), connection vs connectionless, streams vs datagrams, presentation layer, application layer (NFS, FTP, HTTP), Socket programming.

## Graduate Student Advising (Chair)

- Jason Neufeld (on hiatus, currently working at Google) MS Topic: *Tiling Techniques for Texture Maps.*
- Michael Persons, MS May 2010. *Texture Synthesis with Wang Tiles and Recurrent Iterated Function Systems.*
- Gunay Uyan, MS December 2005. *Efficient Wang-Tiling and Real Time Rendering of Lambertian Reflectance Maps.*
- Ryan Tindall, MS December 2005. *Graphics Hardware Acceleration of the Finite Difference Time Domain (FDTD) Algorithm.*

## Graduate Thesis Committee

- Rick Riensche, PhD May 2013, Advisor: Bob Lewis. *Modeling and Rendering of Fibrous Materials.*
- Travis Hall, MS May 2012, Advisor: David Chiu. *A Cost-Driven Replacement Policy for a Hierarchical Key-Value Store.*
- Farhana Kabir, MS July 2012, Advisor: David Chiu. *A self-managed cloud cache for accelerating data intensive applications.*
- Joseph Sturtevant, May 2011. Advisor: Orest Pilskalns. *Auto-Generating a Multi-Tiered Data Acquisition System.*
- Michael Heilmann, May 2011, Advisor: Orest Pilskalns. *Architectural analysis of generated UML documentation representing physical components.*
- Justin Morgan, May 2010. Advisor: George Fletcher, *Visual Language for Exploring Massive RFD Data Sets.*
- James Van Boxtel, May 2010. Advisor: Scott Wallace. *An Evaluation of Interactive Curriculum Using the Java Instructional Game Engine.*
- Paul Anthony Mancill Jr., December 2010. Advisor:Scott Wallace. *An Exploration of Naive Bayesian Classification Augmented with Confidence Intervals.*
- Hadresh Patel, December 2010. Advisor: Scott Wallace. *Machine Learning Approach to Barcode Detection and Stamp Identification.*
- Xiaogang Yang, August 2010. Advisor: Wen Zhan Song. *Liveweb: A Sensorweb Portal Sensing the World in Real Time.*
- Adam McDonald, Map 2010. Advisor: Orest Pilskalns. *An Integrated UML Based Model for Design Analysis.*
- Gang Lu, December 2010. Advisor: Wen Zhan Song. *Basic Components Design For Smart Grid.*
- Benjamin Eitzen, August 2007, Advisor: Bob Lewis. *GPUPY: Efficiently Using a GPU with Python.*

- Daniel Williams, August 2007, Advisor: Orest Pilskalns. *MS Design Analysis Techniques for Software Quality Enhancement.*
- Fengua Yuan, August 2007. Advisor: Wen Zhan Song. *Lightweight Network Management Design for Wireless Sensor Network.*
- James Edwards, MS December 2005. *A Hardware Implementation of a Multilevel B-Spline Shader.*
- Randolf Schwartz, MS May 2005. *MCNPVIZ: A Program for the Interactive Display of Monte Carlo N-Particle Geometry.*
- Shuangshuang Jin, MS 2003, *A Comparison of Algorithms for Vertex Normal Computation.*
- Masaki Kameya, PhD 2002, *A Smooth, Efficient Representation of Reflectance.*
- Cheng-Chih Fan-Chiang. MS 2002, *Star-Flower Subdivision.*
- Frank Taylor, MS 2001, *Enhancements to a Virtual Assembly Environment for Simulation of Heavy Machinery Assembly.*
- Nathan Carr, MS 2000, *Procedural Solid Texture Mapping Using Existing Computer Graphics API's.*
- Shuyang Li, MS 2000, *Computing Reflectance from Height Fields.*

## Committees

- Computer Science Curriculum Committee (annually).
- WSUV Scholarship Committee (2006 – 2013).
- WSUV Research Showcase judge (2010 – 2012)
- Consortium for Computing Sciences in Colleges (CCSC) NW Region, papers chair for 12th Annual Conference (2011).
- Chair of Computer Science Graduate Studies Committee (2005 – 2010).
- General Education Assessment Committee for WSUV (2006, 2007).
- WSUV IT Director Search (2007).
- WSUV Lower Division Planning Committee member (2005).

# Education

- **Ph.D.** Computer Science, 1998, Washington State University.
    Dissertation Title: "A Recurrent Modeling Toolset."
- **M.S.** Computer Science, 1994, Washington State University.
    Thesis title: "Fractal Volume Compression."
- **B.S.** Mathematics, cum laude, 1990. University of Washington.

## Awards

- Nominated for the Student Choice Award for Teaching Excellence by the Associated Students of WSU Vancouver (ASWSUV).
- Curtis Fellowship, 1994, Washington State University.
- Phi Beta Kappa, 1990, Alpha Chapter, University of Washington.
- Deans List, 1990, University of Washington.
- Golden Key National Honor Society, 1990, University of Washington.

# Professional Experience

- **Clinical Associate Professor**, 1999-present, Washington State University Vancouver. My original position was on a tenure track, but was later switched to a clinical position to match teaching interests. Promoted to the Associate Professor rank in 2015. I am heavily involved in program development for the computer science program which started in the fall of 1999. Any research performed as clinical professor involves intricate surface and texture modeling using recurrent models

and Wang Tiles. I also have high interest in OpenGL and GPU programming for both graphical applications and general purpose parallel computing.

- **Instructor**, 1998-1999, Washington State University. I performed research and taught five courses listed above.
- **Research Assistant**, 1994-1998, Washington State University. My research included volumetric compression using fractals, and other techniques using fractals to model complex geometry (*e.g.,* rough curves and surfaces). Research was part of the *Recurrent Modeling Project* funded by Intel and a grant from the NSF.
- **Research/Teaching Assistant**, 1992–1994, Washington State University. Contributed research for and implementation of knowledge based systems. Lab instructor for introductory computer programming courses.
- **Software Engineer**, 1990-1992, Raster Graphics Inc (assets acquired by Peritek Corporation in 2001) `http://www.rastergraf.com` 1804-P SE First St. Redmond, Oregon 97756 (541) 923-5530 Job Overview: Design and implementation of rasterization firmware for industrial graphics boards. Design and implementation of 3D rendering libraries.

# Publications

1. Matthew J. Lambert, Wayne O. Cochran. Kyle G. Olsen, Cynthia D. Cooper, Subfunctionalization of splice forms in vertebrate genomes, *Genome Research.* Accepted, 2014.

2. Wayne O. Cochran, Recurrent Interpolation Surfaces, *Proceedings of the Western Computer Graphics Symposium,* March 2003, pp. 9–15.

3. Wayne. O. Cochran, R. R. Lewis, J. C. Hart, The Normal of a Fractal Surface, *The Visual Computer,* vol. 17, no. 4, April 2001, pp. 209–218.

4. Wayne O. Cochran, Fractal Interpolation Surfaces for Digital Elevation Maps, *Proceedings of the Western Computer Graphics Symposium,* March 2001, pp. 8–14.

5. Wayne O. Cochran, A Recurrent Modeling Toolset, Ph.D. dissertation. Washington State University, December 1998.

6. Wayne O. Cochran, John C. Hart, Patrick J. Flynn, On Approximating Rough Curves with Fractal Functions, *Proceedings of Graphics Interface,* June 1998.

7. J.C. Hart, P.J. Flynn, W.O. Cochran. Similarity Hashing: A Model-Based Vision Solution to the Inverse Problem of Recurrent Iterated Function Systems. *Fractals 5* April 1997, pp. 39-50.

8. Wayne O. Cochran, John C. Hart, Patrick J. Flynn, Hashing Fractal Functions *Proceedings of the Western Computer Graphics Symposium,* April 1997, pp. 69–78.

9. Wayne O. Cochran, John C. Hart, Patrick J. Flynn, Fractal Volume Compression, *IEEE Transactions on Visualization and Computer Graphics* 2 (4), December 1996, pp. 313–322.

10. Wayne O. Cochran, John C. Hart, Patrick J. Flynn, Similarity and Affinity Hashing, *Proceedings of the Western Computer Graphics Symposium,* March 1996, pp. 89–100.

11. Wayne O. Cochran, J.C. Hart and P.J. Flynn. Recurrent Modeling. *Intel Forum: Enabling Live Media in Cyberspace,* invited poster. January 1996.

12. Wayne O. Cochran, John C. Hart, Patrick J. Flynn, Principal Component Classification for Fractal Volume Compression, *Proceedings of the Western Computer Graphics Symposium,* March 1995, pp. 9–18.

## Consulting

- 3D-4U and Integrated Engineering Solutions (IES), 1610 NE Eastgate Blvd. Suite 440 Pullman, WA 99163, `www.3d-4u.com.`, `www.ie-sol.com.` Designed and implemented a video stitching algorithm for a stereo panorama camera system. The solution was implemented using NVidia's CUDA parallel computing platform for Telsa GPU-based systems.
- GeoMonkey, Inc, 5512 NE 109th Ct. Ste 101 Vancouver, WA 98662, (360) 718-8120, `www.geomonkey.com.` Converted large KML polygonal datasets into a form used for fast multiresolution viewing in Google Maps. Also helped implement the `MapWithUs GIS` iPhone app using Apple's core location technology and Google's map API.
- Smith-Root Inc, 14014 NE Salmon Creek Avenue, Vancouver, WA 98686.
  Helped design and port control software for an electronic fish barrier. The system is now web based, and uses a client/server protocol for remote control.

## Professional Service

- Paper Chair for Thirteen Annual *Consortium for Computing Sciences in Colleges* (CCSC) Northwestern Regional Conference 2011. Responsible for collecting all submitted papers, procuring referees, and organizing the paper acceptance committee.
- Paper Referee for the following Journals and Conferences:
  - ACM SIGGRAPH
  - ACM Transactions on Graphics
  - IEEE Transactions on Visualization and Computer Graphics
  - IEEE Transactions on Pattern Analysis and Machine Intelligence
  - Information Processing Letters
  - Graphics Interface
  - IEEE Visualization
  - Shape Modeling International
  - International Conference on Cyberworlds
  - Perspectives on Science and Christian Faith, The Journal of the American Scientific Affiliation.

## References

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