SYLLABUS — ECS 277 "ADVANCED VISUALIZATION" (Spring Quarter 2018)

Instructor:	Dr. Bernd Hamann; e-mail: hamann@cs.ucdavis.edu
Lectures:	Tuesday/Thursday, 6:10pm–7:30pm, 107 Cruess Hall
Office hours (Hamann):	Thursday, 11:15am–noon, 3035 Kemper Hall
Teaching Assistant:	Garrett Aldrich; e-mail: gaaldrich@ucdavis.edu
Discussion:	Wednesday, 4:10pm–5:00pm, 102 Hutchison Hall

Prerequisites: ECS 177 or consent of instructor (ECS 178 recommended)

Texts:

- Schroeder, Martin, Lorensen, "The Visualization Toolkit: An Object-Oriented Approach to 3D Graphics," 4^{th} ed., Kitware, 2006, ISBN 1-930934-19-X
- Recommended: Farin, "Curves and Surfaces for CAGD," 5^{th} ed., Morgan Kaufmann, 2002, ISBN 1-55860-737-4
- Proc. "IEEE Visualization" and "ACM SIGGRAPH," "IEEE Trans. on Visualization and Computer Graphics"
- **Data sets available at http://medvis.org/datasets/**

Objectives:

- Learn about data approximation and interpolation methods and their use in visualization
- Learn about higher-degree approximation methods and their relevance for visualization
- Learn about multi-resolution approximation methods and their use in hierarchical visualization
- Learn about advanced scalar and vector field visualization methods
- Learn about feature-based and topology-based data analysis and its use for more abstract visualization

Assignments:

- Four (4) programming projects: three (3) assigned by instructor, one (1) chosen by student ("student-chosen project" = project based on method in literature **or** own research idea; four (4) program demonstrations; final project: talk and demo given in class, plus paper).
- Programming can be done on workstations, PCs, or notebooks/laptop computers.
- Each program must be demonstrated to the instructor.
- Each student must choose his/her final programming project herself/himself, write a paper about it, give a presentation about it in class, and demo her/his implementation in class.

Grade:

- A: $\geq 90\%$; B: $\geq 80\%$; C: $\geq 70\%$; D: $\geq 60\%$; F: $< 60\%$
- A final exam, if given, contributes 30/100 to the overall grade.
- The projects contribute 70/100 (or 100/100) to the overall grade.
- Projects 1, 2 and 3 have a weight of one each, and project 4 (student-chosen project) has a weight of two.
- Each project is graded with respect to **completeness** (40%), **correctness** (40%), **interface quality** (15%), **simple manual** (5%), and whether it is **late** or not. **Late projects can be late by at most seven (7) days; for each late day four (4) points are deduced from the sum of points.**

Tentative course outline and course topics:

1 Review of some basic scalar and vector field visualization methods
2 Curve (1D), surface (2D), and volume (3D) schemes for approximation
3 Smooth rendering — tensor product splines for curvilinear meshes
4 Scattered data (and other gridless, point-cloud) approximation techniques
5 Approximation and interpolation methods for triangular and tetrahedral meshes
6 Tessellation-based methods — the Voronoi diagram and Sibson's method (including the dual of the Voronoi diagram, the Delaunay complex/triangulation)
7 Data reduction/decimation methods — surface (2D) and volume (3D) mesh reduction
8 Hierarchical methods for visualization (e.g., hierarchical B-splines)
9 Introduction to topology-based analysis and visualization of vector fields
10 Animation techniques for scientific visualization
11 Features, patterns, and discontinuities — extraction, tracking, and visualization

In the event of a campus emergency, this syllabus may be modified by the instructor.