PURDUE UNIVERSITY

DEPARTMENT OF COMPUTER SCIENCE

CS59000 – CGS - Generative Methods in Computer Graphics
Spring 2020, 3-credit course

Course number:	**CS 59000-CGS**
Instructor:	**Bedrich Benes**
Timeslot:	
Location:	
E-mail:	**bbenes@purdue.edu**
Discussions:	**Piazza**

Climbing plants generated as environmentally sensitive procedural model. The user places seeds to initiate the plant growth and draws attractors on the object surface (left). The plants grow on the surface and dynamically react to environmental changes (middle). The user interactively removes parts of the plant during the growth to make the windows and the lights of the car visible (right).

Course Syllabus
CS 59000-CGS - Generative Methods in Computer Graphic Class 3, Lab. 0, Credit Hours: 3.

Procedural modeling in computer graphics encompasses methods that generate geometry from a code or a set of rules. Procedural models are closely related to fractals, but recent advances have shown its relevance in simulations of natural phenomena such as vegetation, urban models, fluids, or terrains. Generative methods play an important role in a plethora of applications ranging from geometric modeling, game development, architecture, vegetation simulation and reconstruction, and geographic information systems.

This course will introduce the fundamentals of geometric modeling and the essential building blocks of procedural models. Then, procedural modeling methods will be introduced, in particular L-systems, split grammars, stochastic processes for geometry generation, fractional Brownian surfaces, and other stochastic fractals. The course will then focus on the applications of procedural models in vegetation and terrain simulations. The course will also apply deep learning methods, in particular generative adversarial networks and their applications in generative models in graphics.

Levels:	Graduate, Professional, Undergraduate
Schedule Types:	Lecture
Offered By:	College of Science
Department:	Computer Science
Course Attributes:	Upper Division
May be offered at any of the following campuses:	West Lafayette
Restrictions:	None
Prerequisites:	CS 58000 (or equivalent)

Environmentally sensitive procedural growth of wood.

Learning Objectives
This course provides in-depth working knowledge of procedural modeling, in particular curves and surfaces, fractals, L-systems, split grammars, stochastic

processes for geometry generation, fractional Brownian surfaces, and it will introduce recent progress in generative adversarial networks and their application in generative models.

Topics (*all items subject to revision*)

	Lesson Name	*Reading*	*Activities*
1	Course policies Introduction	Lesson Slides (1)	
2	3D modeling Introduction	Lesson Slides (2)	
3	Modeling Curves	Lesson Slides (3)	**Project 1 – curves (5%)**
4	Modeling Surfaces	Lesson Slides (4)	
5	Procedural Modeling – Introduction	Lesson Slides (5)	**Project 2 – surfaces (5%)**
6	Procedural Modeling – Fractals	Lesson Slides (6)	
7	Procedural Modeling – Fractional Brownian Motion	Lesson Slides (7)	**Project 3 – fractals (5%)**
8	Procedural Modeling - L-systems and vegetation	Lesson Slides (8)	**Midterm Exam (30%)**
9	Procedural Modeling – Split Grammars, urban models	Lesson Slides (9)	**Project 4 – grammar-based procedural models (5%)**
10	Terrain Modeling	Lesson Slides (10)	Final Project - **Checkpoint 1 (10%)**
11	Procedural Fluid Simulation	Lesson Slides (11)	Final Project - **Checkpoint 2 (10%)**
12	Generative Adversarial Networks	Lesson Slides (12)	Final Project - **Checkpoint 3 (10%)**
13	Generative Adversarial Networks		Final Project - **Checkpoint 4 (10%)**
14	Final presentations		**Final presentations (10%)**
15	Final presentations		**Final presentations**
16	Final presentations		**Final presentations**

- **Texts and Supplies:**
  Suggested (not required)
  - Ebert, D., Musgrave, F., Peachey, D., Perlin, K., and Worley, S., (2002) Texturing and Modeling: A Procedural Approach (3rd ed.). Morgan Kaufmann Publishers Inc., San Francisco, CA, USA.
  - Marschner, S., and Shirley, P., (2016). *Fundamentals of Computer Graphics*, Fourth Edition (4th ed.). A. K. Peters, Ltd., Natick, MA, USA.
  - Foley, J. D., Van, F. D., Van Dam, A., Feiner, S. K., Hughes, J. F., Hughes, J., and Angel, E. (2014). *Computer graphics: principles and practice*, Addison-Wesley Professional.
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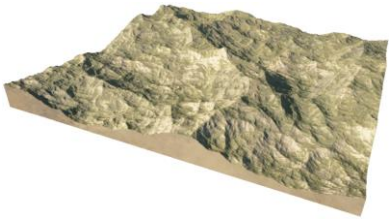
- **Evaluation and Assessment**

Task	Percentage
Mid-term Exam	30%
Four Labs	5%+5%+5%+5%=20%
Final Project	(50%)
Four Checkpoints	10%+10%+10%+10%=40%
Final Presentation	10%



A terrain model generated as ridged Perlin noise.