

# COMP 4900/5900: Texture and Pattern Synthesis

## Contact

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## Nature of the course

This is a specialized course on creation of patterns and textures for use in computer graphics applications. Throughout the term, we will discuss various methods and algorithms, and implement some of them. The course will include a final project, which involves either a thorough implementation and minor extension of an existing algorithm, or an effort directed towards creating a novel algorithm.

One of the main approaches to the material will be reading the primary literature: several weeks will be spent discussing specific papers, with individual students from the class responsible for leading the discussion.

## Textbooks and Resources

There is no required textbook for the course. Some background on texture mapping can be found in any general computer graphics textbook. Early background for procedural texture synthesis is presented in this classic book: *Texturing and Modeling: A Procedural Approach* (3rd ed), D.S. Ebert et al.

Papers for the course will typically come from the ACM Digital Library. You have direct access to the ACM DL while on campus; off campus, you will need to go through the Carleton library.

For prototyping, I recommend Processing, a Java-based environment specialized for visualization and creative coding; visit [processing.org](http://processing.org) for the reference and download. We will also spend some time in Shadertoy, a standalone environment for real-time shaders.

## Topics

The course's main topics include the following, not necessarily in order.

- Procedural texture and noise
- Low-level image processing operators

- Pyramid-based image representations
- Texture mapping
- Simulation-based methods
- Non-parametric synthesis
- Patch-based techniques
- Point distributions
- Non-homogeneous texture
- Pattern synthesis
- Vector texture
- Frequency-based synthesis schemes
- Neural approaches

## Evaluation

- Assignments: 35%
- In-class presentations and discussions: 20%
- Course project: 35%
- Final exam: 10%

Many classes will involve discussing material read outside class time. Do the assigned reading and plan to attend every class to participate in the discussions. Naturally, things happen from time to time and you may wind up missing the occasional class, but you should not expect to be successful if you miss a significant fraction of the scheduled meetings.

## Course Project

Propose your own project. You will produce an implementation and a final writeup in the style of a scientific paper, including abstract, background, algorithm description, evaluation with sample results, and references. Your writeup should be 8-12 pages in length, single-spaced in two-column format. I recommend using LaTeX and the “acmsiggraph” LaTeX class; the free version of Overleaf provides a convenient LaTeX environment.

While this is not an exhaustive list, typically a project will be of one of three types:

1. A novel algorithm for some synthesis task, which might be

- an improvement on an existing synthesis method
- an interactive system for texture synthesis
- an interactive system for pattern synthesis
- a procedural method for novel aesthetic patterns
- a dedicated method for a certain texture type
- data fusion using multiple textures or video
- texture for some data visualization task
- applying texture synthesis to procedural geometry

2. A substantial implementation of an existing method, as described in a recent research paper (within the last ten years).

3. A hybridization of two or more existing synthesis methods, producing outcomes neither method would be capable of alone.

Select your topic by end of January. In late February, we will have in-class progress presentations. During the final week of class, you will present your final results.

COMP 5900 students will work individually and are expected to investigate their topic more thoroughly. COMP 4900 students can work individually or in a group of two, at your preference.

## Appendix: Academic Accommodation

### Requests for Academic Accommodation

You may need special arrangements to meet your academic obligations during the term. For an accommodation request, the processes are as follows:

#### Pregnancy obligation

Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, visit the Equity Services website:  
[carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf](http://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf)

#### Religious obligation

Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as

soon as possible after the need for accommodation is known to exist. For more details, visit the Equity Services website:  
[carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf](https://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf)

#### Academic Accommodations for Students with Disabilities

If you have a documented disability requiring academic accommodations in this course, please contact the Paul Menton Centre for Students with Disabilities (PMC) at 613-520-6608 or [pmc@carleton.ca](mailto:pmc@carleton.ca) for a formal evaluation or contact your PMC coordinator to send your instructor your Letter of Accommodation at the beginning of the term. You must also contact the PMC no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with your instructor as soon as possible to ensure accommodation arrangements are made. [carleton.ca/pmc](https://carleton.ca/pmc)

#### Survivors of Sexual Violence

As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and its survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit: [carleton.ca/sexual-violence-support](https://carleton.ca/sexual-violence-support)

#### Accommodation for Student Activities

Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist.

<https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf>

For more information on academic accommodation, please contact the departmental administrator or visit:  
[students.carleton.ca/course-outline](https://students.carleton.ca/course-outline)