

Tervetuloa kurssille TIEA311 Tietokonegrafiikan perusteet!

Yritetään keskustella, piirrellä ja muuta päheetä.

Toimitaan sen vuoksi näin ennen luennon alkua:

- ▶ Ota pari tyhjää A4-paperia luokan edestä
- ▶ Jos ei ole kynää mukana, ota yksi lainaan luokan edestä (kokeile, että on toimiva yksilö)
- ▶ **Istutaan tiiviisti etuosassa auditoriota!**

Vapaa maailma toki: pakko ei ole toimia näin, mutta **olis niinku kiva**. . . :)

TIEA311

Tietokonegrafiikan perusteet

kevät 2019

(“Principles of Computer Graphics” – Spring 2019)

Copyright and Fair Use Notice:

The lecture videos of this course are made available for registered students only. Please, do not redistribute them for other purposes. Use of auxiliary copyrighted material (academic papers, industrial standards, web pages, videos, and other materials) as a part of this lecture is intended to happen under academic “fair use” to illustrate key points of the subject matter. The lecturer may be contacted for take-down requests or other copyright concerns (email: paavo.j.nieminen@jyu.fi).

TIEA311 Tietokonegrafiikan perusteet – kevät 2019 ("Principles of Computer Graphics" – Spring 2019)

Adapted from: *Wojciech Matusik*, and *Frédo Durand*: 6.837 Computer Graphics. Fall 2012. Massachusetts Institute of Technology: MIT OpenCourseWare, <https://ocw.mit.edu/>.

License: Creative Commons BY-NC-SA

Original license terms apply. Re-arrangement and new content copyright 2017-2019 by *Paavo Nieminen* and *Jarno Kansanaho*

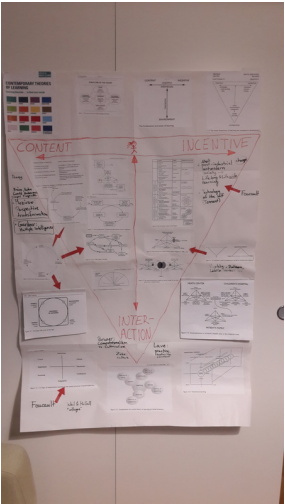
Frontpage of the local course version, held during Spring 2019 at the Faculty of Information technology, University of Jyväskylä:

<http://users.jyu.fi/~nieminen/tgp19/>

Slides are in English - OMG, why? How do I survive?

- ▶ Face it: Population of the world is 7.5 billion. 5.5 million Finns account for 0.07 percent.
- ▶ Most of science and technology is documented in English as of 2019.
- ▶ Very nice English course material available from MIT Open CourseWare with an open license!
- ▶ You just **need to survive**, now and in your future career!
- ▶ And... lectures and instruction happens in Finnish during the Spring 2019 course!

Inspired by (pretty much all) contemporary theories of learning...



We start by chatting and reflecting!

- ▶ Pair talk, 1 minute each, no interruptions: **Describe your feelings at the moment** to the one sitting next to you.
- ▶ Sum it up: let's gather some feelings and discuss.

Repeat:

- ▶ Pair talk, 1 minute each, no interruptions: Tell to your pair **why did you choose to take this course**
- ▶ Sum it up: let's gather some of the why's in the lecture hall.

Then we think (and chat):

- ▶ Silent thinking, 1 minute: What do you think Computer Graphics is.
- ▶ Make notes using a pen and paper, because next...
- ▶ We sum it up: What are our thoughts about what Computer Graphics is.

OK. Then the teacher will tell you what Computer Graphics is?

No.

We will all keep changing and updating our understanding of the topic throughout this Spring course.

What the teacher will do is show a web page that demonstrates some of the practical details you will be dealing with on this course. → "courselogo.js"

Then (highly likely) the teacher will show more of his "masterpieces", rant about the importance of having fun in computing, and **promise a way of getting an extra ECTS credit point**, don't tune out before that happens.

Cut from the lecture video for copyright reasons:

<https://www.youtube.com/watch?v=d0WZ9YWfIPc&t=2476s>

<https://youtu.be/Vt3ycfCMBkw?t=811>

Then the dull but inevitable part: Technicalities of the Spring 2019 course

What do we have?

- ▶ Korppi page
- ▶ 1800+ slides and 6 programming assignments from MIT OpenCourseware (reduced to approx. 900 slides and 3.5 assignments in 2017-2018; we'll calibrate 2019 as we go)
- ▶ Open git repository for our local course adaptation
- ▶ Website for a static export version of the local course
- ▶ WWW full of tutorials :)

What we might build along the way?

- ▶ A local course version, adapted to University of Jyväskylä
- ▶ English-Finnish translations of terminology
- ▶ Some additional material about math and programming

Spring 2019 grading and passing the course

- ▶ All exercises must be done
- ▶ We aim at 5 ECTS credit points worth of workload, i.e., 135 hours of active studying. The course will be built along the way, so we can be “adaptive”.
- ▶ Grading will be based on the level achieved in the exercises (more information later)

What else?

Let's take a brief look at what our American professors thought when designing the "parent" of our present course . . .

(The following few slides are reproduced verbatim from "Lecture 0" of the MIT OCW course.)

What you will learn in 6.837

- Fundamentals of computer graphics algorithms
 - Will give a pretty good idea of how to implement lots of the things just shown
- We will concentrate on 3D, not 2D illustration or image processing
- Basics of real-time rendering and graphics hardware
- Basic OpenGL
 - Not the focus, though: Means, not the end.
- You will get C++ programming experience

What you will NOT learn in 6.837

- OpenGL and DirectX hacks
 - Most become obsolete every 18 months anyway!
 - Does not really matter either: Graphics is becoming all software again (OpenCL, Larrabee, etc.)
- Software packages
 - CAD-CAM, 3D Studio MAX, Maya
 - Photoshop and other painting tools
- Artistic skills
- Game design

How much Math?

- Lots of simple linear algebra
 - Get it right, it will help you a lot!
- Some more advanced concepts
 - Homogeneous coordinates
 - Ordinary differential equations (ODEs) and their numerical solution
 - Sampling, antialiasing (some gentle Fourier analysis)
 - Monte-Carlo integration
- Always in a concrete and visual context

Beyond computer graphics

- Many of the mathematical and algorithmic tools are useful in other engineering and scientific context
- Linear algebra
- Splines
- Differential equations
- Monte-Carlo integration
- ...

Textbooks

- No textbook is required
- Recommendations
 - 3D Computer Graphics (Watt)
 - 3D Computer Graphics: A Mathematical Introduction with OpenGL (Buss)
 - **There is a free online version** available from [Books24x7](#)
 - Real-Time Rendering, 3rd ed. (Akenine-Möller, Haines, Hoffman)
 - Fundamentals of Computer Graphics, 3rd ed. (Shirley, Marschner)

TIEA311

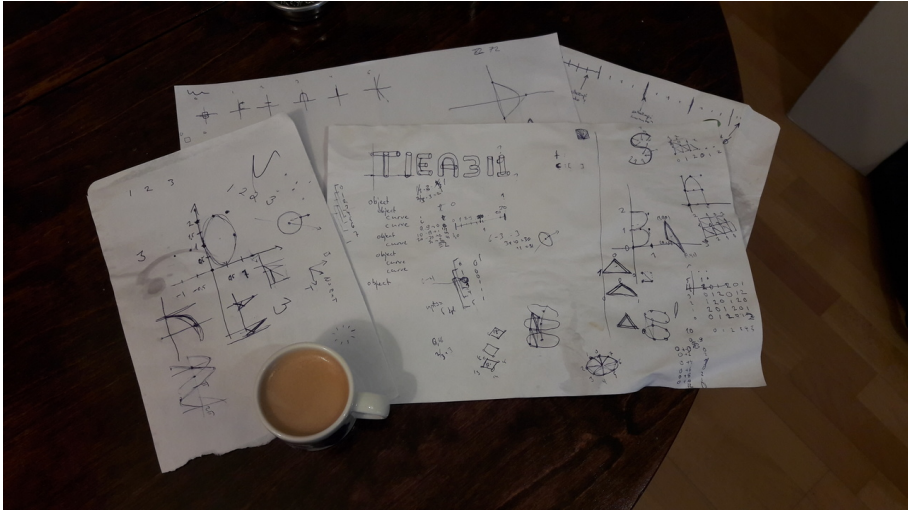
Now: **a thing you must never forget**

Practical introduction to your **Most Important Super Tools.**

What could these be?

→ the teacher has prepared a live, interactive coreography

Example of pen and paper: "The making of courselogo.js"



Outcome of the adventure: <https://yousource.it.jyu.fi/tiea311-kurssimateriaalikehitys/>

[tiea311-kurssimateriaali-avoin/blobs/master/instanssi17_4k_intro_webgl/courselogo.js](https://yousource.it.jyu.fi/tiea311-kurssimateriaali-avoin/blobs/master/instanssi17_4k_intro_webgl/courselogo.js)

Our Finnish students should revisit the material of our very first Programming course:

Vaikka ohjelmointia käytännössä tehdään suurelta osin tietokoneella, on silti kynä ja paperia syytä aina olla esillä. Ohjelmoinnin suurin vaikeus aloittelijalle onkin siinä, että ei malteta istua kynän ja paperin kanssa ja miettiä mitä ollaan tekemässä. Jos esimerkiksi pitää tehdä laivanupotuspeli, pitää ensin pelata useita kertoja peliä, jotta hahmottuu, mitä kaikkia asioita tulee aikanaan vastaan.

It is a little bit worrying to not see paper in the computer class rooms.

TIEA311

Extension:

Don't be confined to just staring the computer screen or a piece of code.

The screen will not make you understand what you need to do.

You are a physical, living, organism. Make full use of the fact.

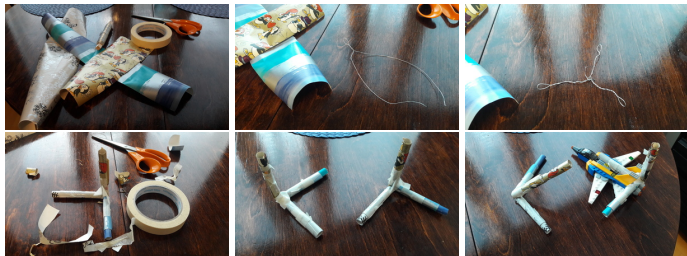
Your brain is very good, but it has its biological limitations!

So **help your brain** by drawings, equations, notes, mind-maps, real-world artefacts, . . .

On the next slides, a couple of examples from previous years.
(We'll return to these many times)

TIEA311 Hobby Crafts Corner presents:

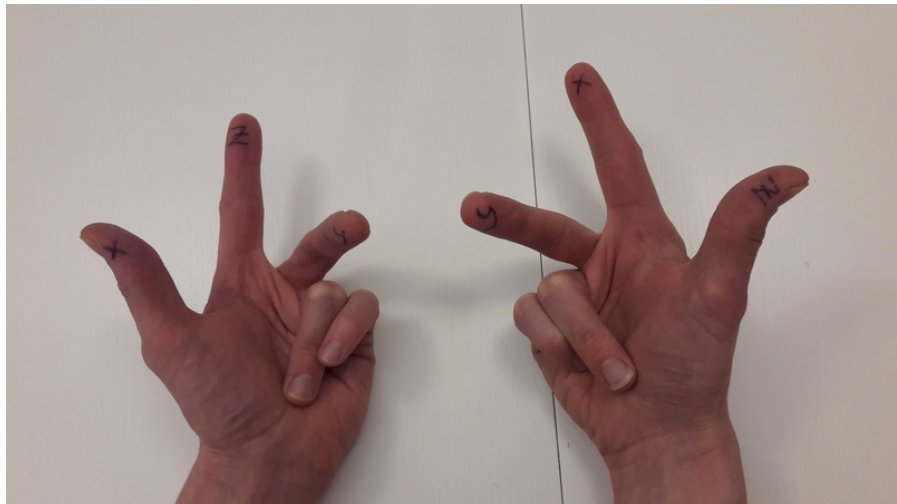
DIY Frame of Wire v0.1



The point being: Do whatever you need to do if you think it will help you understand things. . . Perhaps concrete and palpable artifacts (in "true 3D") work for you?

TIEA311

In February 2018, your nearly-qualified teacher observed he has **two right hands** – only a matter of symbols and level of abstraction.



TIEA311 - Today in Jyväskylä

The time allotted for our first lecture is now over.

Now: Break until tomorrow morning. Sleep if you have time.

You can start looking at the exercises and requirements, but we'll go to more detail about them gradually. This year's starter code packages are not yet ready, so be patient.

Tomorrow:

- ▶ We start thinking about programming, math.