Contact Information

- Raimond Tunnel – jee7@ut.ee
Organizational Information

- 16 seminars:
  - 4 introductory lectures
  - 3 student presentations
  - 6 unknown
  - 1 project expo
  - 1 thesis defense practice

(info TBA)
Organization

• 16 seminars
  Attendance: ~24h = 0.85 credits

• 1 seminar
  Preparation: 56h = 2.1 credits
  Conducting: 1.5h = 0.05 credits
Organization

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Organization

• 16 seminars
  Attendance: ~24h = 0.85 credits

• 1 seminar
  Preparation: **56h** = 2.1 credits
    - Find suitable material (8h)
    - Read and understand the material (25h)
    - Synthesize a logical approach to the topic (10h)
    - Create a presentation (10h)
    - Practice the presentation (3h)
  Conducting: 1.5h = 0.05 credits
Organization

- **16 seminars**
  Attendance: \(~24h = 0.85\) credits

- **1 seminar**
  Preparation: **56h = 2.1** credits
    - Find suitable material (8h)
    - Read and understand the material (25h 10h)
    - Synthesize a logical approach to the topic (40h 2h)
    - Create a presentation (40h 5h)
    - Practice the presentation (3h)
    - Implement a demo (28h)

Conducting: **1.5h = 0.05** credits
What am I even doing here?
What do I see?
What about this one?
Or this one?
Or this one?
This one should be easy...
The Seminar

- Explore an interesting CG topic
The Seminar

- Tackle a difficult subject together
The Seminar

• Tell (teach) others about your discoveries
How do I choose a topic?
How do I choose a topic?

- What do you need to understand for your thesis?

*When they ask*

*How is your thesis going*
How do I choose a topic?

- What do you need to understand for your thesis?
- What knowledge will benefit you after the uni?

Ninja Theory developer talking about atmospheric VFX in Hellblade: [https://www.youtube.com/watch?v=jdZ1s3FHTFI](https://www.youtube.com/watch?v=jdZ1s3FHTFI)
How do I choose a topic?

- What do you need to understand for your thesis?
- What knowledge will benefit you after the uni?
- What did you come here to learn about CG?
How do I choose a topic?

- What do you need to understand for your thesis?
- What knowledge will benefit you after the uni?
- What did you come here to learn about CG?
- What do you find interesting in CG?

Fractal by Julius Horsthuis
http://www.julius-horsthuis.com/
How do I choose a topic?

- What do you need to understand for your thesis?
- What knowledge will benefit you after the uni?
- What did you come here to learn about CG?
- What do you find interesting in CG?
What is this?
Post-Processing: Bloom effect

Need for Speed: Most Wanted

Elephant's Dream

Hitman: Absolution

Warframe: https://www.youtube.com/watch?v=gYHxhlvEyHk
Post-Processing: Bloom effect

Elder Scrolls 3: Oblivion
Back to the main track
How to find materials?
How to find materials?

- The Interwebs.
  - Examples of some quality web articles:
    - GTA V Graphics Study by Adrian Courreges
      http://www.adriancourreges.com/blog/2015/11/02/gta-v-graphics-study/
    - Article lists by Jendrik Illner
      https://www.jendrikillner.com/post/
    - Volumetric Fog by Kostas Anagnostou
      https://interplayoflight.wordpress.com/2015/07/03/adventures-in-postprocessing-with-unity/
  - Just Google and be critical about what you find!
How to find materials?

- The Interwebs.
- UT library databases.
  - https://utlib.ut.ee/andmebaasid
  - ACM SIGGRAPH
  - IEEE Transactions on Visualization and CG
  - IEEE Transactions on Games

Be critical here as well...
How to find materials?

- The Interwebs.
- UT library databases.
- Books.
  - Fundamentals of Computer Graphics
  - GPU Pro 1-7, GPU Zen
  - Many-many others...
**Conditions**

<table>
<thead>
<tr>
<th>First time student</th>
<th>Choose any CG-related topic you want!</th>
</tr>
</thead>
<tbody>
<tr>
<td>BSc, MSc</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Returning student</th>
<th>Your topic should be related to several scientific articles or books.</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSc, PhD</td>
<td></td>
</tr>
</tbody>
</table>

- In either case, ensure you benefit from the topic!
- Can be the same that others have done before.
Previously...

PREVIOUSLY, ON SCRUBS...
Oh Wait, This Ain't Scrubs...
Post-Processing Effects
CPU vs GPU
Use Case Study: Coco
Motion Tracking
Reinforcement Learning in Games
## Modern GPU Architecture

**Moore’s Law at work**

<table>
<thead>
<tr>
<th>GPU</th>
<th>GT200 (Tesla)</th>
<th>GF110 (Fermi)</th>
<th>GK104 (Kepler)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transistors</td>
<td>1.4 billion</td>
<td>3.0 billion</td>
<td>3.54 billion</td>
</tr>
<tr>
<td>CUDA Cores</td>
<td>240</td>
<td>512</td>
<td>1536</td>
</tr>
<tr>
<td>Graphics Core Clock</td>
<td>648MHz</td>
<td>772MHz</td>
<td>1006MHz</td>
</tr>
<tr>
<td>Shader Core Clock</td>
<td>1476MHz</td>
<td>1544MHz</td>
<td>n/a</td>
</tr>
<tr>
<td>GFLOPs</td>
<td>1063</td>
<td>1581</td>
<td>3090</td>
</tr>
<tr>
<td>Texture Units</td>
<td>80</td>
<td>64</td>
<td>128</td>
</tr>
<tr>
<td>Texel fill-rate</td>
<td>51.8 Gigatexels/sec</td>
<td>49.4 Gigatexels/sec</td>
<td>128.8 Gigatexels/sec</td>
</tr>
<tr>
<td>Memory Clock</td>
<td>2484 MHz</td>
<td>4008 MHz</td>
<td>6008MHz</td>
</tr>
<tr>
<td>Memory Bandwidth</td>
<td>159 GB/sec</td>
<td>192.4 GB/sec</td>
<td>192.26 GB/sec</td>
</tr>
<tr>
<td>Max # of Active Displays</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>TDP</td>
<td>183W</td>
<td>244W</td>
<td>195W</td>
</tr>
</tbody>
</table>
Guest: Jaanus Jaggo
Guest: Ats Kurvet
Guest: Hendrik Proosa
Still confused?
World is a vast and mysterious place!

When you have a topic...

- Look for materials
- Investigate, research
- Find examples
- Try it out yourself
- Present your findings
- Engage others
  - Discussion
  - Interactive demo
  - Workshop
Creating a Presentation
Creating a Presentation

Ensure you understand what you put on the slide!

\[ L_o = L_e + \int_{\Omega} L_i \cdot f_r \cdot \cos \theta \cdot d\omega \]
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Try to implement what you share.
Creating a Presentation

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Put drawings, diagrams etc o
Try to implement what you s"

The quality should be on par with a thesis level.
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The quality should be on par with a...

You are the master of your topic!
Creating a Presentation

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- Try to make the drawings, diagrams etc yourself.
- Put drawings, diagrams etc on the slides!
- Try to implement what you share.
- The quality should be on par with a thesis level.
- You are the master of your topic!
Want to do projects?

- **Computer Graphics Project** (MTAT.03.328)
  - 3 credits course
  - Consists entirely of a project
  - Work on your own idea throughout the semester
  - Roughly 7h per every 2 weeks
I don't even know where to start!? 

- There will be 3 introductory lectures about the basics.
- Check out the topics from Computer Graphics:
  
  https://courses.cs.ut.ee/2017/cg/fall

- Check out the topics from the previous seminar:
  
  https://courses.cs.ut.ee/2018/cg-sem/spring/Main/Seminars
  https://courses.cs.ut.ee/2018/cg-sem/fall/Main/Seminars

- Find some online tutorial and try it out.
Computer Science
MSc Seminar Module

Goal:

The goal of the module is to give students the opportunity to deepen their understanding of the field most interesting for them and to develop their communication skills.

Learning outcomes:

After completing the module the student:
- is capable of independent work with modern research literature and other field-related material;
- can effectively communicate his knowledge of the field to others.
Questions?
List of some arbitrary topics

1. **Color blending** – What happens when there are transparent objects in your scene?

2. **Lighting models** – What are the common models? Where and when are they used?

3. **Texturing** – How can one sample from a texture? What kinds of artefacts may appear?

4. **Curves** – Why are they important in CG? What about curved surfaces?

5. **Global illumination** – Pick one or compare different methods: Radiosity, path tracing, photon mapping.

6. **Realtime realistic rendering** – Provide an overview of the common methods or pick some effect (light, wetness, fog, fur / hair) and find out how it's rendered realistically in real time.

7. **Non-photorealistic rendering** – Where is it used and how is it achieved? Realtime vs prerendered?

8. **Tessellation** – How can this be done in OpenGL 4?

9. **Post-processing effects** – What effects are there? When and how are they used?

10. **Procedural generation** – Where and how is it used? How to apply procedural textures to procedurally generated meshes?
List of some other topics

11. Physically-Based Shading – What is it? Why is it important to understand physical properties of materials for shading? What games / game engines use it?

12. Rendering in VR – What extra considerations are in VR? How do different technologies overcome them?

13. Vulkan / WebGL 2.0 – What is it for? Why is it useful? How to Vulkan / WebGL 2.0?

14. Subsurface scattering – What is it? How it is implemented? What does it solve?

15. Reflections and caustics – What are the modern techniques, which do those?

16. GLSL vs HLSL – What are the differences? How are both used?

17. Use case study – Find out in detail how graphics are done in one game or movie.

18. Motion capture – What are the difficulties today? Best budget setup for it?

19. Modern GPU architecture – How are GPU-s built today? What are they optimized for?

20. Graphics on consoles / smartphones – What limitations are there in consoles or embedded systems vs the PC? How to overcome them compared to the PC approach?
List of some other topics

21. Tileable Textures – What methods are there for creating those?
22. Ray Tracing with RTX – What can be done with Nvidia's RTX cards?
23. Occlusion Culling – How is this achieved? What data structures are used?
24. Volumetric Rendering – How to simulate volumetric light transport? Fog, fire?
25. Facial Animations – What are the modern, cheapest, professional solutions?

Full list: https://courses.cs.ut.ee/2019/cg-sem/spring/Main/Seminars#topics
(with links)