# Assignments

**Research papers**

In the second half of the course, there will be research papers presented by the students. You can think of this assignment similar to the peer-review process of conferences and journals. Each student will give a one A4 page review for each paper (individual assignment). In total, you should write reviews for 6 papers. It is mandatory to attend the sessions that you wrote a summary for and ask questions to the presenters. The one page review should include the following components:

- Summary: A short summary about what the paper is about, what is the method and results.

- Assessment: Critical analysis of the paper, advantages/disadvantages of the method, clarity, technical correctness, novelty

- Questions: Two questions about the paper (to be asked during the lecture)

The deadline for submitting these reviews is one day before the lecture the paper is presented (For example, if you write a review for paper 1, you should send your summary on 3 December until 23:59). Please email your reviews to z.yumak@uu.nl and k.i.haque@uu.nl.

Paper presentations will be done in teams of 2 students. The groups will be formed in the first two weeks of the course. There will be 2 presentations per session and each presentation will take around 30 mins + Q&A (no longer than one lecture hour). Presentation grades will be given to you in the next session. Although the presentations are done by teams, you might receive separate grades (in exceptional situations). The day you present, you do not need to hand in a paper review of the other paper(s). Below is the structure of the presentations:

- High-level overview and motivation of the paper

- Clear problem statement

- Related work and background information

- Technical details of the approach

- Critical analysis of the approach & evaluation

- Possible improvements of the paper (future work)

- Questions from the audience & discussion

The slides should be well-prepared with less text and clear images. A few mathematical formulas can be added but they should be explained very clearly. The complete package containing pdf versions of all papers will be sent to you by email.

**Project**

A practical assignment is given as part of the course. The assignment will be done in teams of 4 students. The groups will be formed in the first two weeks of the course. There are three project options based on the preferences of the students. The first option is about producing a movie using state-of-the-art 3D animation tools such as Maya, 3dsMax, Unity, Blender, Unreal Engine etc. The second option involves developing skeletal animation and skinning algorithm using a 3D graphics programming environment (e.g. Open GL/WebGL, Direct3D, Vulkan etc.). The third option is a small research project on speech-driven 3D facial animation synthesis using deep learning.

Assignment option 1 involves capturing motion in the Motion Capture and Virtual Reality Lab. You can also find existing animations and models freely available on the internet. For the other two assignments (Option 2 and 3), no need to collect data in the lab.

**Option 1: Animation movie assignment**

One of the goals of this course is to introduce you the latest animation techniques in industry standard animation tools. Therefore you will produce a short animation movie in small groups and gain hands-on experience with these tools. Movies made by the students in earlier years can be found on the course website in the External menu link. At the end of your movie, you should add a few seconds to mention the credits, similar to professional short films (who was in charge of what, sources of the assets you used etc.). You should also add a behind-the-scenes section at the end of your video. That gives an idea of how you used the lab and it is also fun to see.

You can do the project with your preferred 3D tools (3dsMax, Maya, Unity, Blender, Unreal Engine) and edit the motions using Motion Builder. You can also use Vicon Post for post-processing of mocap data and retargeting which is available in the lab. You can find a lot of 3D content on the Internet. Here are a few sites that have useful material (BlendSwap, Daz3D, Unity Asset Store, Unreal Engine Market Place, TurboSquid, TF3DM, Archieve3D, CGTrader, Mixamo). There are also motion capture datasets that are produced/used by research groups often mentioned in research papers or repositories including actions, dancing or playing instruments (CMU Mocap, Human3.6M, Talking with Hands, MoGaze etc). In addition to capturing motions, you can find other animations from the internet and modify them if necessary. Unreal Engine Meta-Human Editor is encouraged for realistic character animations. An iPhone is available in the lab for this purpose. Meta Human + Dynamixyz example can be used for combining them with facial motion capture and for non-Meta-Human characters. In the motion capture tutorial document, you will find more information. This will be sent to you by email after the mocap tutorial session. If you know any other useful websites, please send the link to the teachers so we can share it with other students.

*Intermediary report:* You will send a previz movie and a 1 page planning report in week 49. The planning document should include what tools you will use, the time planning and assignment of tasks to team members. The previz movie can be prepared using any tool you prefer (no restrictions here, the idea is you have a plan and communicate it among yourself and to us). Deadline: 4th December 23:59.

*Final deliverable:* At the end of the course, your video will be presented at the Project Festival and be put on the YouTube channel of the course. Please send the file to your teachers with CC to the teaching assistant. Send the movie file itself (not the YouTube link) as well as the source files. If the file size is too big, please send a cloud link to download. Deadline: 31st Jan 23:59.

**Option 2: Skeletal motion and skinning assignment**

The goal of this assignment is to practice animation techniques by developing them yourselves from scratch. The assignment will be composed of three parts:

- Skeletal animation: You will draw a skeleton in your preferred 3D graphics environment. You will write classes to represent the joints and skeleton hierarchy. You will also write an animation player class to play a keyframe animation.

- Motion capture: You will use mocap animations you found on the internet (e.g. walking, running, dancing, jumping etc.) and play these animations using your program (no need to collect data in the mocap lab).

- Skinning (bonus): You will add a mesh to your program and apply the linear blend skinning (or possibly dual-quaternion skinning) algorithm to animate the mesh together with the bones. The mesh should be attached to the bones in the binding phase. You can export the skinning weights from an animation package and use them in your program.

*Intermediary report:* You will send a 2 page specification & planning report in week 49. The report should contain a planning of what programming environment, programming language and libraries you will use. The animation classes should be developed by yourself however you can use external math libraries for matrix operations. You will also provide a timeline of tasks and a planning of who will do what. Deadline: 4th December 23:59.

*Final deliverable:* You will show a demo video of your project on Project festival day. The video should also include the original version of the motion capture animation to make a side-by-side comparison to the animation developed. An example from last year can be found here. You will submit a GitHub link of your code and an accompanying report as a user manual. The code should be well-written and documented. Send your deliverables in an email to your teachers with CC to the teaching assistant. Deadline: 31st Jan 23:59.

**Option 3: Small research project assignment on speech-driven 3D facial animation generation**
The goal of this assignment is to familiarize yourself with the research methodology of data-driven computer animation. More specifically, you will be looking into the task of generating 3D facial animation given speech signal using deep learning. You will be provided with appropriate reading materials and a baseline model implementation together with a dataset. Your objective would be to propose your own model, implement the model architecture, train the model and finally, evaluate the animation results against the baseline model. The assignment will be composed of the following aspects:

- Reading and understanding the baseline model paper. Related papers will be covered during the course and in lecture "Advanced Facial Animation".

- Propose, implement and train your own model.

- Evaluate your results against the provided baseline model. Three types of evaluations (the first two are mandatory):

  - Quantitative/Objective Evaluation (with objective metrics)

  - Qualitative/Subjective Evaluation (by producing video material showing the results, comparison to baseline)

  - Perceptual User Study (that will result into bonus grade)

*Intermediary report:* You will send a 2-page intermediary report in week 49. Discussion on related work along with some potential direction of the proposed model should be included in the report. The report should also contain a planning of the project including responsibilities of each teammate throughout the project timeline. Additionally, a discussion on the initial results, e.g. with the baseline model can be added. Deadline: 4th December 23:59.

*Final deliverable:* You will write and submit a short paper (3-4 pages, use this overleaf template - https://www.overleaf.com/latex/templates/association-for-computing-machinery-acm-sig-proceedings-template/bmvfhcdnxfty) along with a GitHub repository link containing your project code. Furthermore, you will present your work on Project festival day with accompanying slides (objective evaluation) and videos showing the results (subjective evaluation). The code should be well-written and should have proper documentation. Send your deliverables in an email to your teachers with CC to the teaching assistant. Deadline: 31st Jan 23:59.

*Additional information:* The baseline model for this year is FaceXHuBERT and the dataset you will be using is Multiface. You will be given the implementation of FaceXHuBERT together with the pre-processed Multiface dataset. We strongly advise you to click and follow the named links above that will give you better insights of the project scope. For this project, previous knowledge and experience with machine learning, deep learning along with programming in python will greatly help, but not absolutely necessary. Furthermore, a computer with at least 4GB Nvidia GPU and 8GB RAM would be needed to work on this project for the model training. We will also provide a Google Colab notebook, however, because Colab compute resources are limited, we do not advise to solely rely on Google Colab.

*If you need help for the practical assignments, do not hesitate to reach out to the Teaching Team. Fabien will mainly be guiding you for the movie assignment in the lab (Option 1) and Kazi will be mainly guiding you for Option 3. Both Kazi and Fabian will be supporting you for Option 2 assignment. We will create channels per*

*project team in MS Teams for better communication and for your questions. If you have further questions that you cannot solve together with Fabian and Kazi, you can also send an email to Zerrin and ask for an appointment (optional). For the software assignments (Option 2 and 3), we will have a group meeting to go over the code and assignment with you in week 4 or 5.*

**Essay**

Last but not least is the essay writing assignment. The essay will be about a topic in computer animation, such as facial animation, motion synthesis, animating emotions, expressive animations (gaze, gestures), locomotion, hand animation and so on. That is an individual assignment (not team work). As a basis of the essay, use at least three research papers with different but related techniques. Describe these techniques in your essay, and compare them in terms of pros and cons, advantages and limitations. Make sure that you describe the techniques in enough depth but still give the overall big picture. The grade for the essay will be based on the following criteria:

- depth and completeness of the description of the techniques,
- completeness of the comparison between techniques, including strengths and drawbacks,
- showing how the techniques can be applied,
- writing the essay in your own words, instead of copying phrases from the original papers,
- correct layout, spelling and grammar.

You will use the ACM template at https://www.acm.org/publications/proceedings-template. Your essay should have 6 pages in double-column format including figures and references (if it has to be 7 pages, not a big problem). You will hand in the essay in pdf format by email to your teachers (z.yumak@uu.nl and k.i.haque@uu.nl). While writing your essay, look at the good examples of papers and surveys and improve your writing skills. The early you start writing your essay and have enough time to revise, the better it will be. Deadline: 2nd February 23:59.

**In addition to the research papers, following resources are recommended:**

- Rick Parent: Computer Animation: Algorithms and Techniques, Third Edition, Morgan-Kaufmann, 2012.
- Frederic Parke and Keith Waters: Computer Facial Animation, Second Edition, CRC press, 2008.
- A good source for computer animation is courses and tutorials in conferences (e.g. Siggraph and Eurographics)
- Some of the slides of this course are inspired by the Computer Animation course at the University of California San Diego.
- Related conferences are Siggraph, Eurographics, ACM/Eurographics Symposium on Computer Animation, Motion in Games, IEEE Virtual Reality and ACM Intelligent Virtual Agents. These are some major conferences on Computer Animation (including algorithms and perception of animations). The field of animation is also highly linked to the other communities on computer vision, multimedia, speech/music and language processing as well as to social sciences. Nowadays papers also appear on reporitories such as Arxiv.org, PapersWithCode or you can access to pdf versions of the papers on ResearchGate or you can use Google Scholar Alerts to get relevant paper notifications.
- There are also relevant journals such as: ACM Transactions on Graphics, IEEE Transactions on Visualization and Computer graphics, Computer Graphics Forum, Computers and Graphics, IEEE Computer Graphics and Applications, ACM Transactions on Applied Perception, Proceedings of the ACM on Computer Graphics and Interactive Techniques, Computer Animation and Virtual Worlds, Visual Computer. Journal papers provide more complete results on the research results in comparison to conference papers. For example, you can see the same research presented in a conference in 2021 and an extended journal version of it published in 2022. in that case, make sure you find the extended

version. Listings of highly cites graphics conferences:
https://scholar.google.nl/citations?view_op=top_venues&hl=en&vq=eng_computergraphics


**Note: In all your emails to the teachers (Zerrin and Kazi) or the TA (Fabien), you must include [INFOMCANIM 2023-24] in the subject line of your email. The grading criteria for each assignment is explained in the introduction lecture slides.**