

Visual Computing

2024/2025

Class 1

Introduction





Motivation

Objectives and Program

Course Details

Evaluation



Visual Comp... What? Why? HuM?

What have I done?!?!

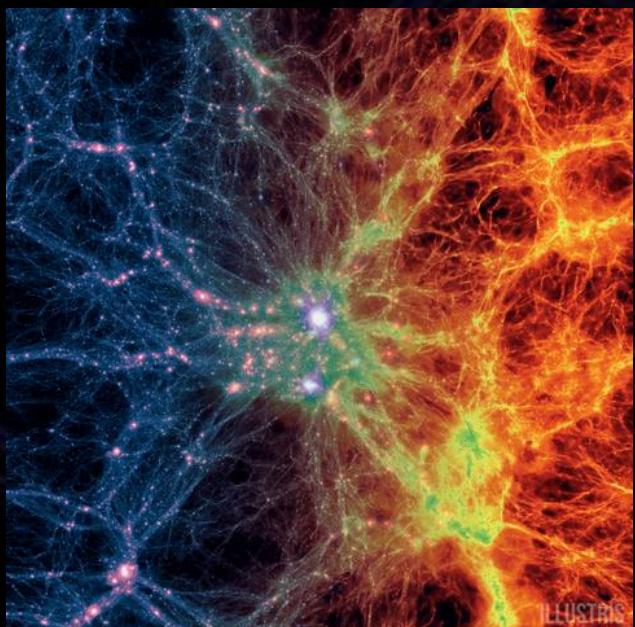
Can I still run away?

Perception and Visual Imagery

vision is a core element in our perception of the world

we use visual imagery to better grasp what is...

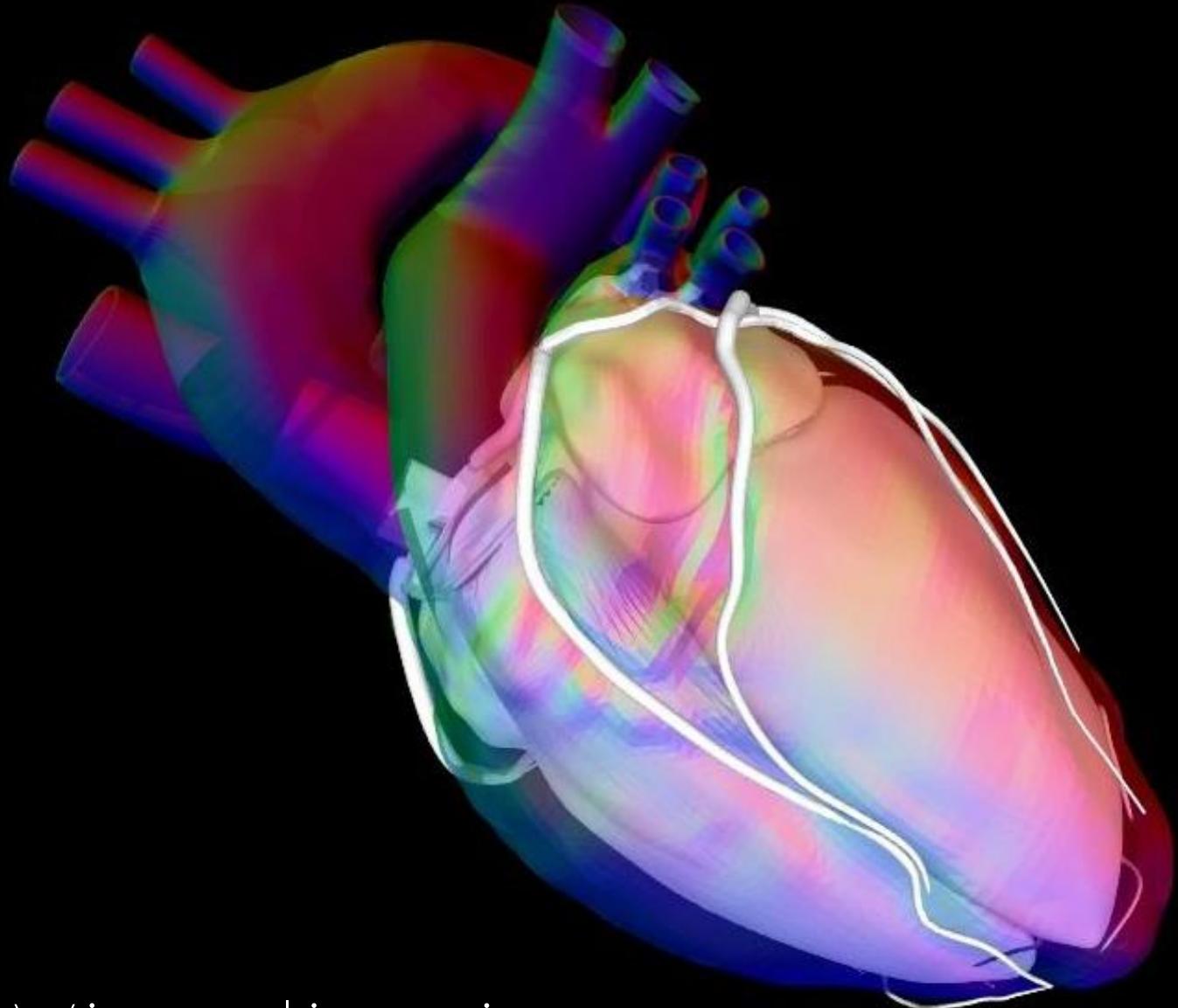
Data Visualization



Big bang



Medical Visualization



- Outer Heart
- Ventricles
- Atria
- Nerves
- Arteries
- Veins
- Aortic Valve
- Bicuspid Valve
- Pulmonary Valve
- Tricuspid Valve

[Close Controls](#)

... or, maybe, to preview what might be...

Realistic Image Synthesis



Credible effects



Global illumination



... and, sometimes,
one wants to preserve or recreate what was...

From real-world
to synthetic
models



Reconstructing Ancient Heritage



<https://spectrum.ieee.org/computing/software/ancient-sculptures-return-to-mosul-as-digitally-reconstructed-replicas>

Temple of Mars Ultor



<https://www.mdpi.com/2078-2489/12/4/167>

and one of the most prominent fields for graphical advances is....

TEEN
PRESENTS

Allergy Cat™

By
Bill Williams





Metro Exodus



The Hitman 2











all of this boosted by new “accessible” hardware...

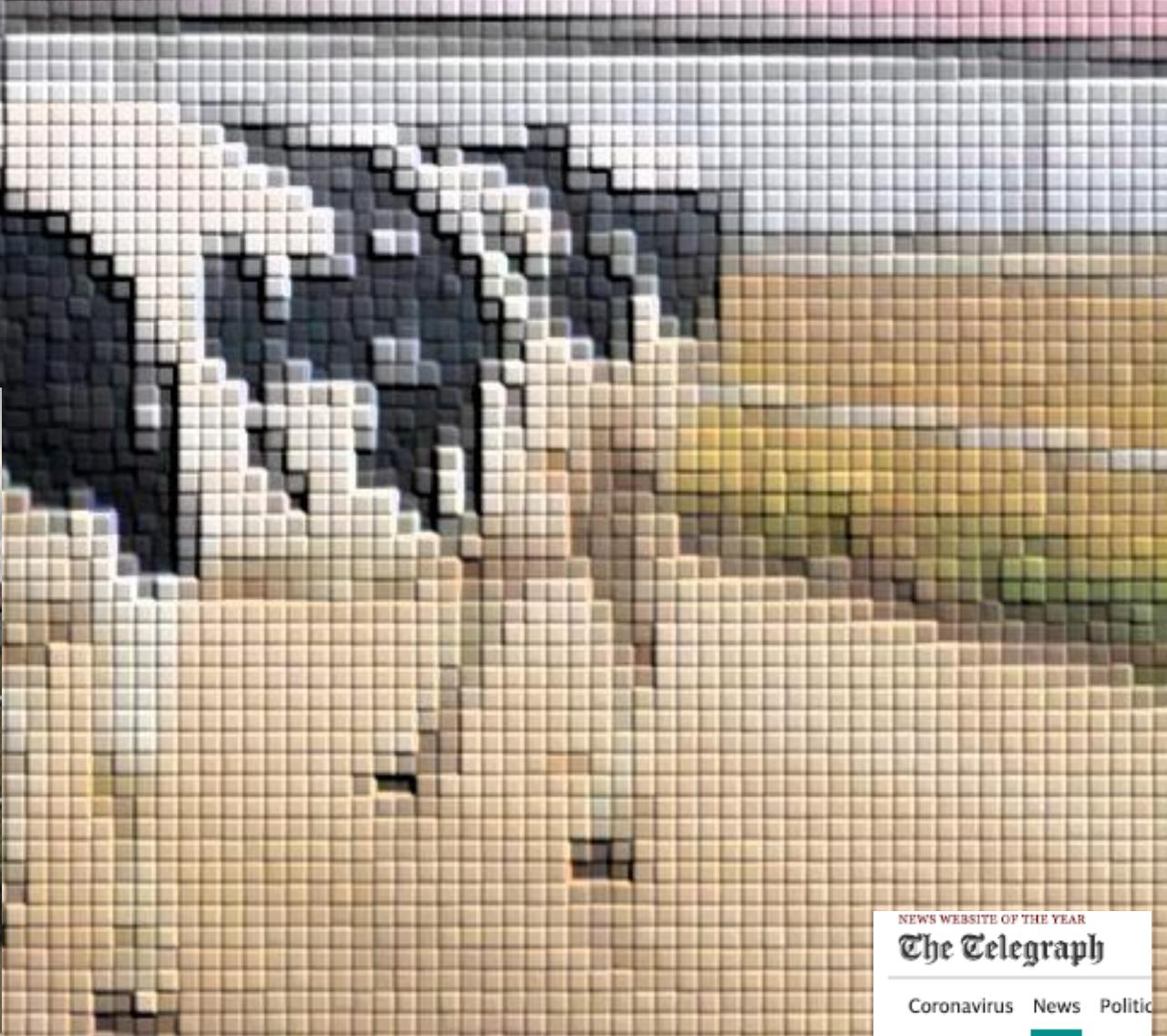


Graphics-able Hardware is Everywhere





VR / AR Visualization



NEWS WEBSITE OF THE YEAR

The Telegraph

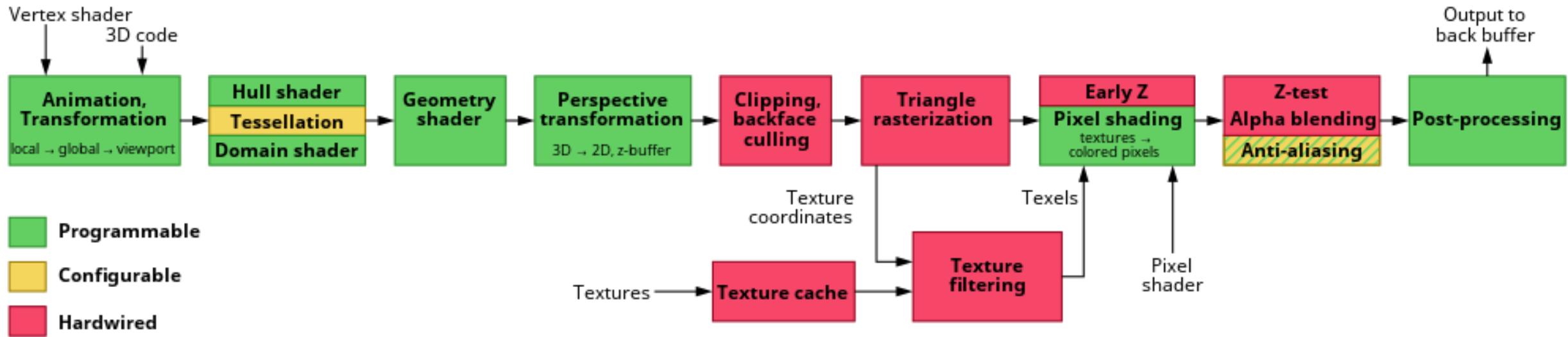
Coronavirus News Politics



The technology, which the US Army says is the first of its kind, works by letting a handler see everything the dog can see and then provide specific commands using visual cues that show up in the dog's line of vision.

Computer Graphics
is all about synthesizing (sequences of) images

... in one or two steps ...



Graphics Pipeline

But there are other ways of generating digital images...

A photograph of a person's hands holding a black digital camera, capturing a sunset over a body of water. The camera's LCD screen displays the scene being shot, showing a bright horizon with a few small boats. The background is a dramatic sky filled with orange and yellow clouds. The overall composition suggests a travel or photography theme.

Digital Cameras

<https://shop.panasonic.com/collections/digital-cameras>

Medical Imaging



and there's a lot we need to do with these digital images

A blurry, overexposed photograph showing a person from the waist up, wearing a light-colored shirt and dark pants. The background is a dense forest with green trees and foliage. The image is very out of focus, making details difficult to discern.

Recovering or enhancing images

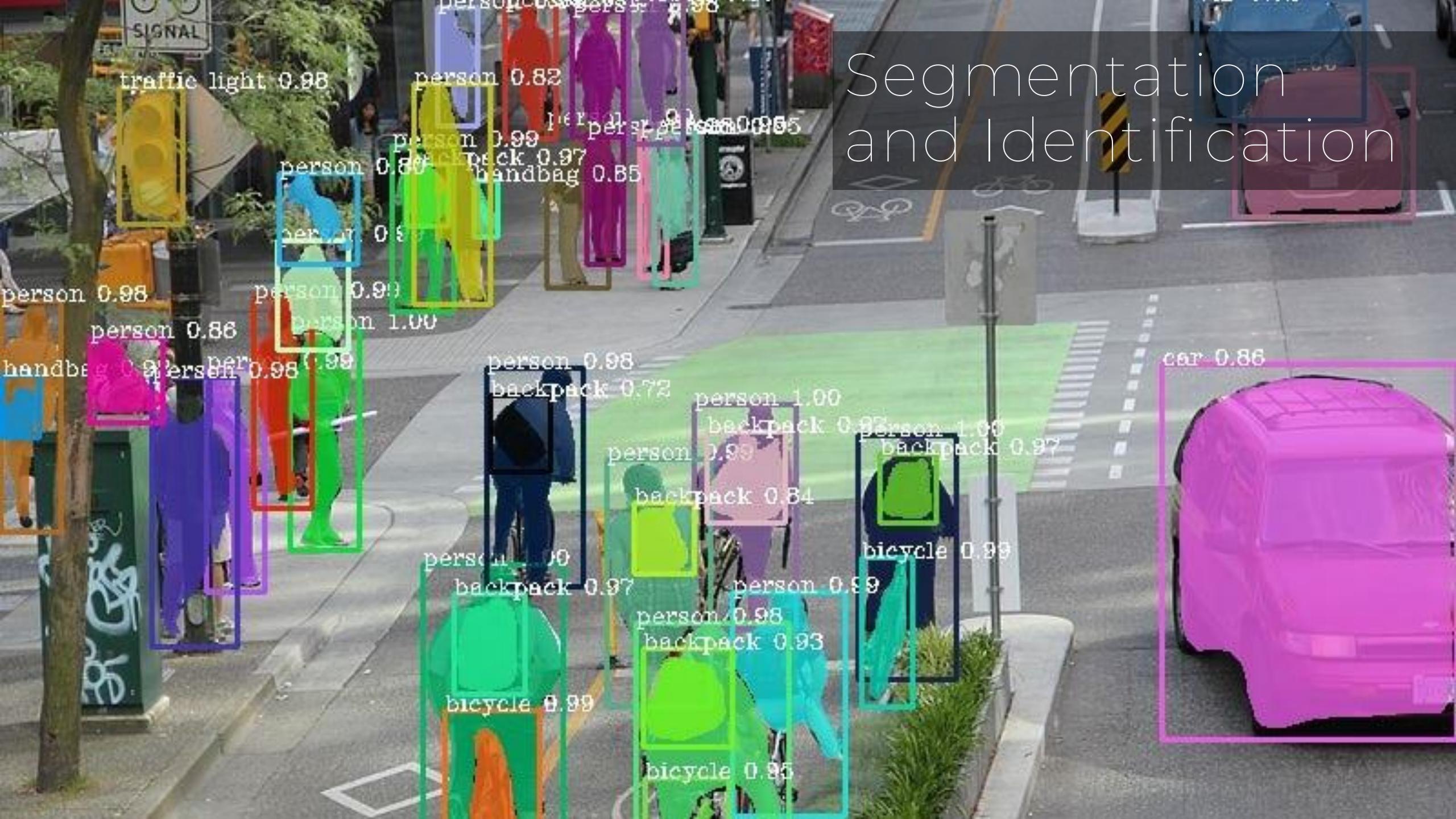
Revealing the invisible





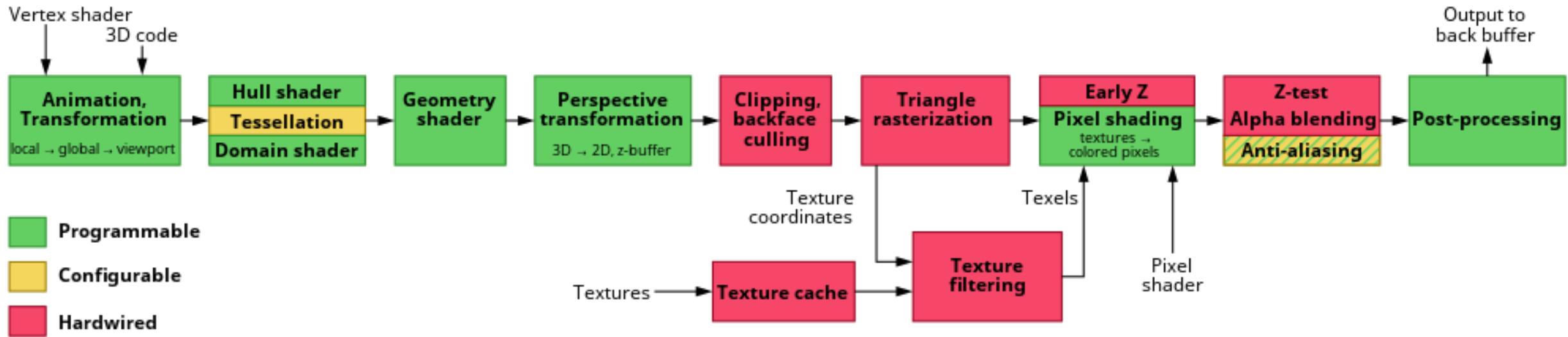
Making sense of specific content

Segmentation and Identification



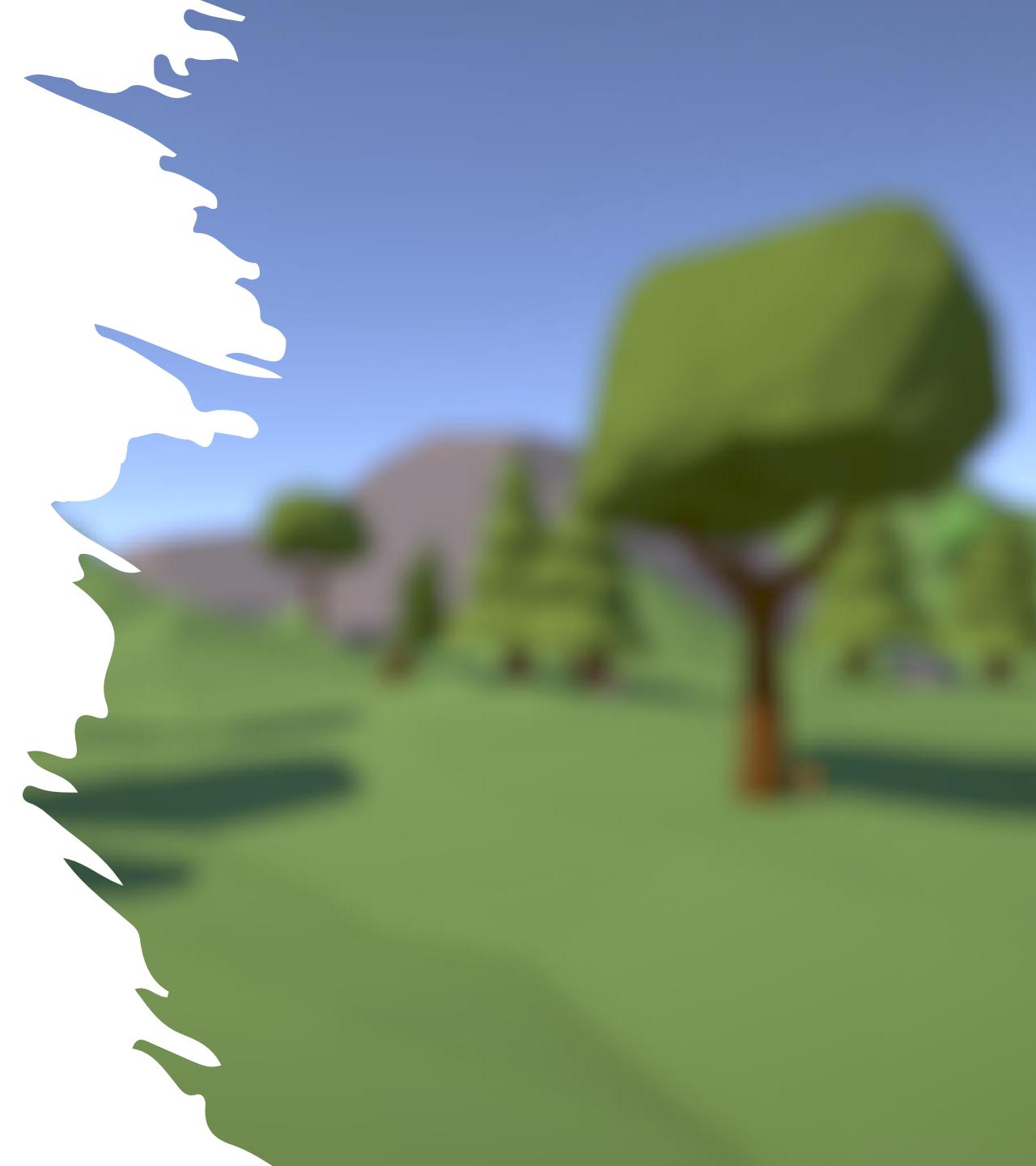
... and understanding about image processing also helps with computer graphics...

... and here we go again ...



Graphics Pipeline

Post Processing





Post Processing



Pix pix pixelate

22
FPS

164 ms

DLSS Off, RT On



96
FPS

62 ms

DLSS 3, RT On



Deep Learning Super Sampling (DLSS)⁴⁷

So, what is Visual Computing?

General term for computer science disciplines handling images and 3D models

Mixes algorithms and methods from CG, image and video processing, visualization, computer vision, MR

It deals with the acquisition, processing, analysis and rendering of visual information

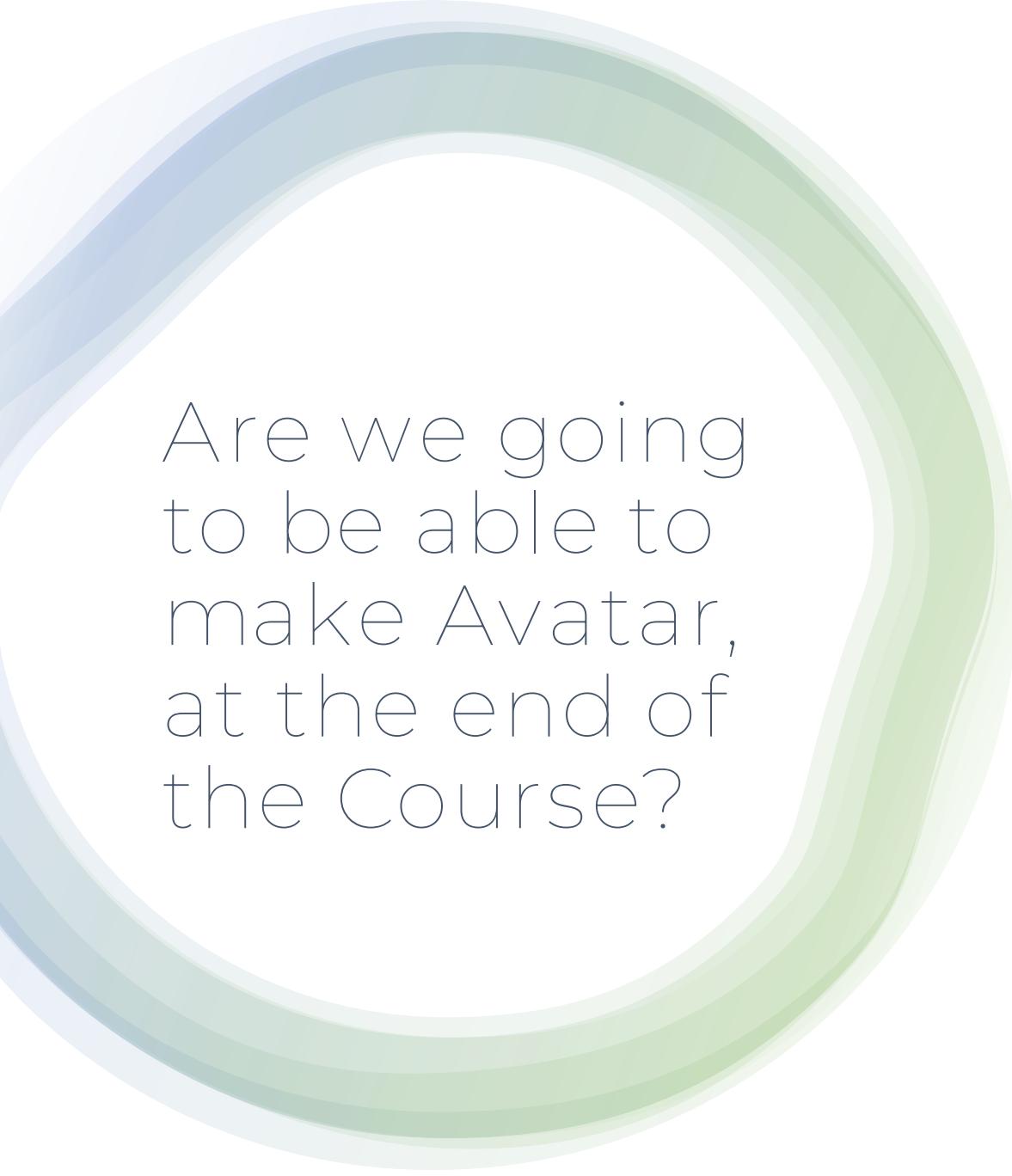
Course Details

So, what's the plan?

Objectives

At the end of the course, you should be able to:

- Understand the overall concepts and methods regarding CG enabling the pursuit of more advanced topics on this subject
- Design and implement systems displaying and animating graphic elements using off-the-shelf tools
- Master basic knowledge regarding image processing and computer vision
- Combine topics to propose Visual Computing solutions



Are we going
to be able to
make Avatar,
at the end of
the Course?

No! xD But:

- You will have learnt concepts and methods that will enable you to progress further, regardless of how the technology evolves
- It is important to be proficient in a few core tools to put things to practice, but it is even more important to be able to move into novel technologies, in the future
- This course will expose you to these concepts and show you what is under the wood, even if that is not what takes us faster to having a game working, but...



Faculty

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Program

- Visual Perception
- Fundamentals of Computer Graphics
- 2D and 3D Visualization and Transformation
- Projections
- Geometric Modelling
- Illumination and Shading
- Textures
- Image Processing basics
- Edge detection, segmentation, and morphological operations
- Introduction to computer vision

Classes

Classes will typically have two parts:

- First part of a more theoretical presentation of the concepts (~1h15)
- Second part of practical application (hands on)

The support materials for both parts will be made available along the semester



Hands-on

Python + ...

OpenGL and GPU
programming (pyOpenGL)

Image processing will
consider (opencv-python)

An aerial photograph of a multi-level highway interchange in a city. The interchange is completely engulfed in intense orange and red flames, with thick black smoke billowing upwards from the burning structures. The surrounding area includes other roads, green spaces, and several tall residential buildings. The scene is captured from a high vantage point, showing the scale of the fire.

Evaluation

Why spoil the fun? Why?

Evaluation

The evaluation will be performed through continuous assessment:

- Report (45%) – This is a short individual report (about an advanced topic in Computer Graphics) and delivered in the form of a 4-page article + peer-review
- Project (55%) – This is a group project, carried out along the semester, and resulting in a software tool making use of computer graphics and image processing and/or computer vision based concepts and features.

Evaluation

Important (tentative) dates:

Task	Deadline	%
Choose topic for individual assig.	Class 04 – 10/11 Oct 2024	
Choose project	Class 06 – 24/25 Oct 2024	
Mid-term project review	Class 09 – 14/22 Nov 2024	10
Deliver indiv. assignment	Class 10 – 25 Nov 2024	35
Deliver Reviews	Class 13 – 12/13 Dec 2024	10
Project presentation	Class 14 – 19/20 Dec 2024	30
Deliver project	End of semester – ~5 Jan 2025	15

Objectives II



Researching and summarizing a new topic

High-level assessment of other's work

Presenting and defending your work

Properly planning and accomplishing a small group project



Bibliography

How is your latin?

<https://elearning.ua.pt/>