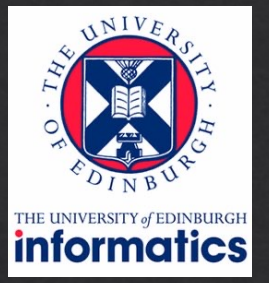
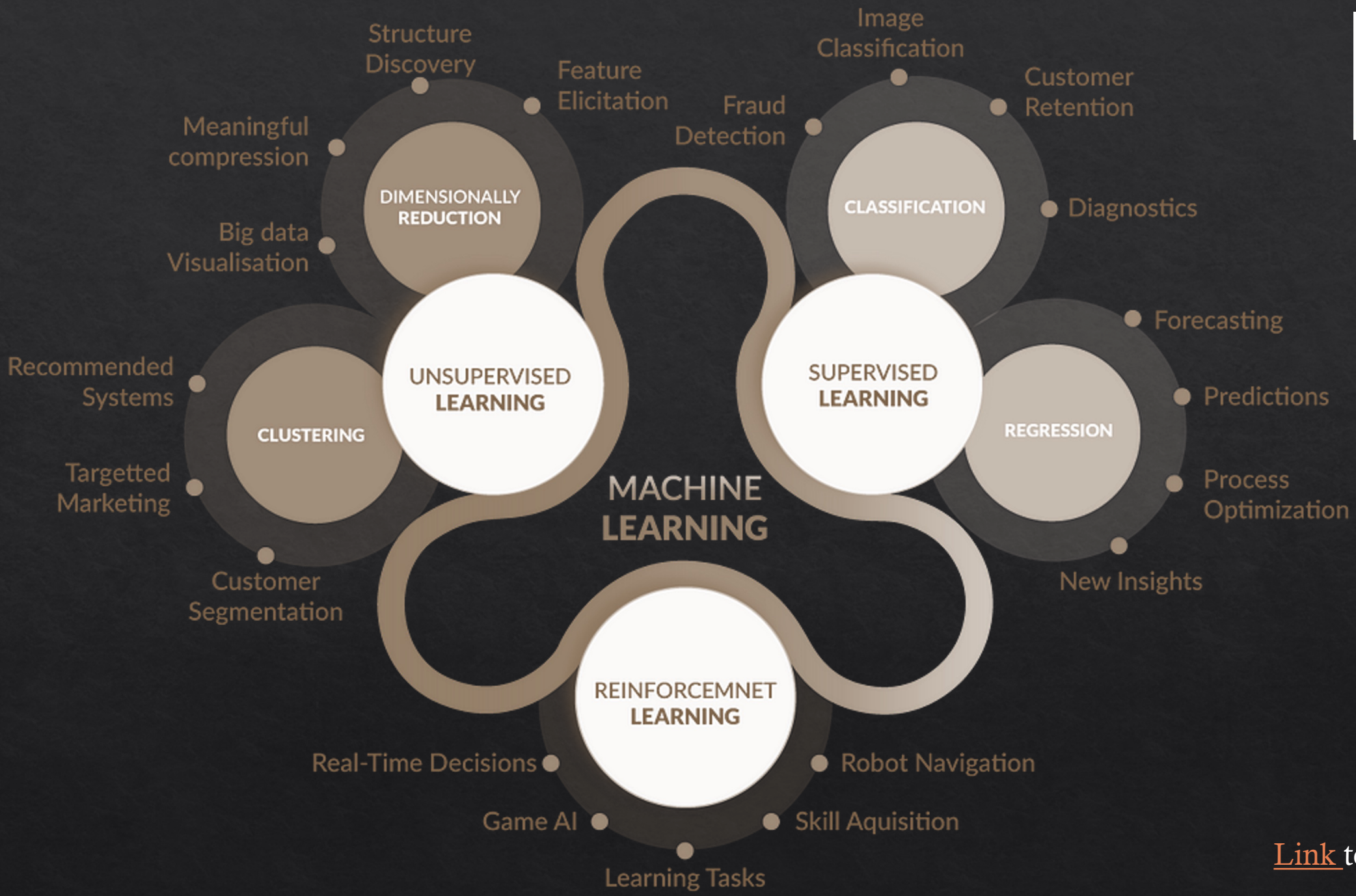


Computer Graphics

Lecture 17: Machine Learning for CG

Kartic Subr



Link to source

Machine Learning in CG

Content generation

Simulation

Rendering

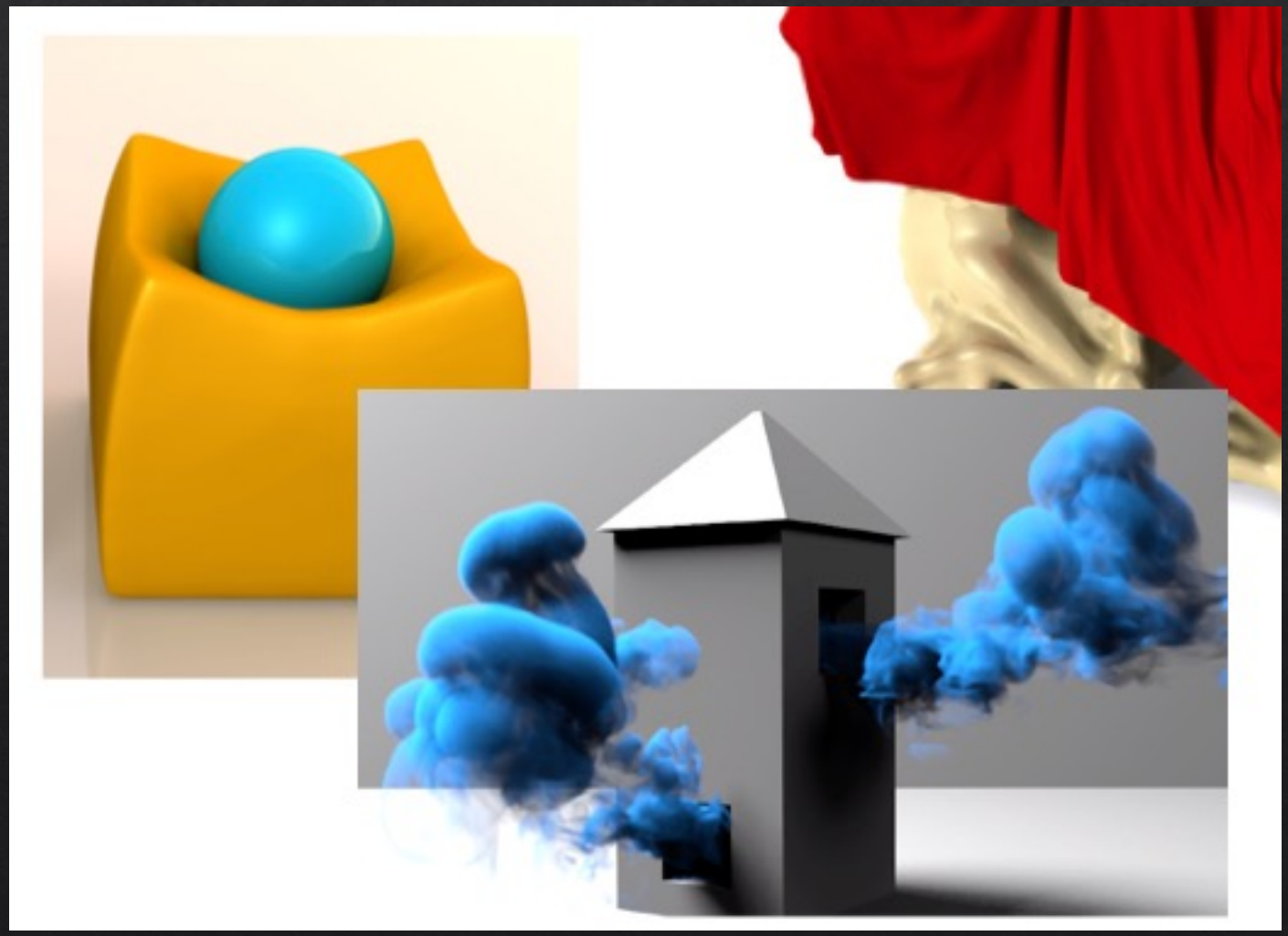
https://geometry.cs.ucl.ac.uk/workshops/creativeai/

Content Generation

1. https://visual.cs.brown.edu/workshops/aicc2021/
2. https://nvlabs.github.io/dl-for-content-creation/
3. https://www.youtube.com/watch?v=lkkFcg9k9ho
4. https://dl.acm.org/doi/10.1145/3587423.3595503

Simulation

https://dl.acm.org/doi/10.1145/3587423.3595518
https://geometry.cs.ucl.ac.uk/workshops/creativeai/slides/part6_physicsAnimation_nils.pdf

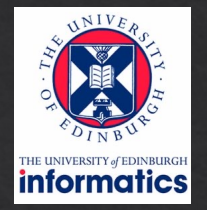


Rendering

1. Differentiable rendering
2. Neural rendering
3. Learning for faster MC rendering
    1. Denoising MC (also see this)
    2. DLSS
    3. Neural Radiance Fields

https://history.siggraph.org/learning/differentiable-signed-distance-function-rendering-by-vicini-speierer-and-jakob/

DLSS



- DLSS 1.0
  - upscale frames independently using DL
  - blurs on either side of an edge

- DLSS 2.0
  - Temporal Anti-Aliasing (TAA) problem with dynamic objects
  - Use DL to solve TAA history problem
  - Can oversharpen, causing ringing

- DLSS 3.0
  - Generates entire intermediate frames
  - could cause latency issues

NeRF (Neural Radiance Field)

1. https://www.matthewtancik.com/nerf
2. SIGGRAPH 2023 course

A Style-Based Generator Architecture for Generative Adversarial Networks

Tero Karras
NVIDIA
tkarras@nvidia.com

Samuli Laine
NVIDIA
slaine@nvidia.com

Timo Aila
NVIDIA
taila@nvidia.com

StyleGAN

2017

https://www.kaggle.com/dunky11/stylegan

VQGAN

Taming Transformers for High-Resolution Image Synthesis

Patrick Esser*, Robin Rombach*, Björn Ommer

CVPR 2021

https://github.com/CompVis/taming-transformers

VQGAN: Text to image

Input: “A bird drawn by a child”

VQGAN: Conditional image synthesis

VQGAN: Conditional image synthesis

DiffRF: Rendering-guided 3D Radiance Field Diffusion

CVPR 2023 Highlight

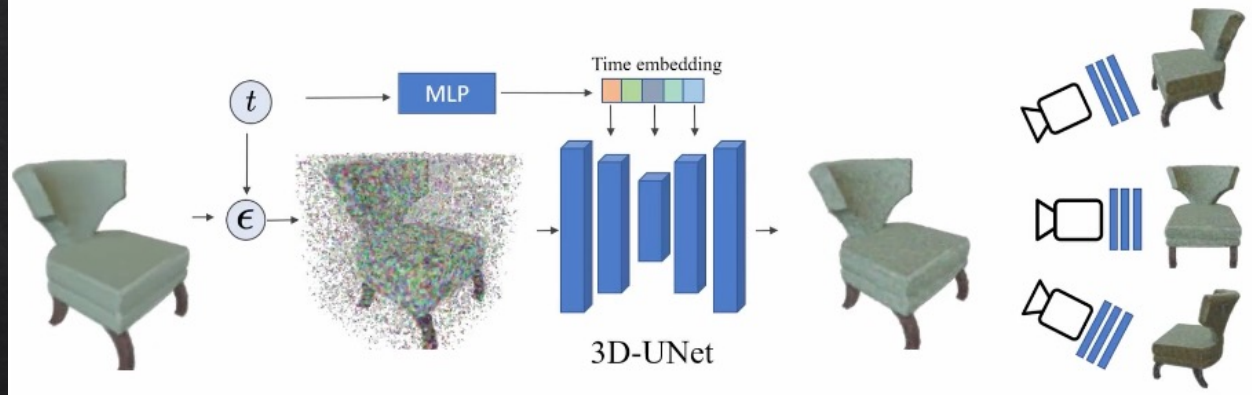
Norman Müller[1,2], Yawar Siddiqui[1,2], Lorenzo Porzi[2], Samuel Rota Bulò[2], Peter Kontschieder[2], Matthias Nießner[1]

[1]Technical University of Munich, [2]Meta Reality Labs

(Work was done during Norman's and Yawar's internships at Meta Reality Labs Zurich as well as at TUM.)

Paper | arXiv | Video

(Version update, initial version contained a data mapping error causing all methods being trained/evaluated on a subset)



DiffRF is a denoising diffusion probabilistic model directly operating on 3D radiance fields and trained with an additional volumetric rendering loss. This enables learning strong radiance priors with high rendering quality and accurate geometry.

CGR 2023

- Theory (20h)
  - 17h lectures
  - 3h reading

- Practice (78h)
  - 4h tutorials
  - 32h CW1
  - about 42h CW2

In this course

- Overview of CG (10%)
- Fundamentals (20%)
- Raytracing (20%)
- Offline rendering (20%)
- Realtime rendering (15%)
- Advanced (15%)

CGR2023

- Overview of CG (10%)
- Fundamentals (25%)
- Raytracing (20%)
- Offline rendering (20%)
- Realtime rendering (10%)
- Advanced (5%)

Lectures

#	Lecture Title
1	Introduction
2	Graphics tools
3	Imaging: radiometry and photometry
4	Cameras
5	Basic Modelling
6	Raytracing: introduction
7	Raytracing: advanced
8	Numerical integration
9	Monte Carlo
	- - - - - - - - No Lecture - - - - - - - - -
10	C++ Programming with GPT and co-pilot
11	Presentations: CW1
12	Presentations: CW1
13	Light transport: path tracing
14	Sampling and reconstruction
15	Sampling II
16	Volume Scattering
17	Video lecture: Fast rendering pipelines I
18	Video lecture: Fast rendering pipelines II
19	Machine learning in rendering, conclusion and goodbyes

I would like your feedback on …

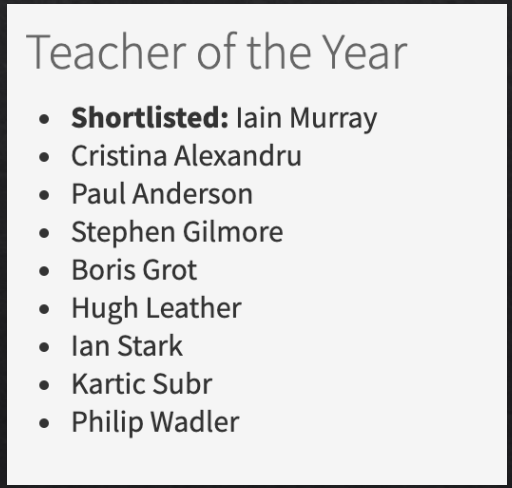
- Why was tutorials attendance poor?
- More details vs more topics in lectures (depth vs breadth)?
- Suggestions for changes to syllabus/CW?

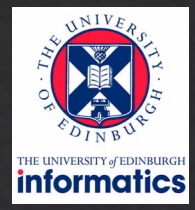
k.subr@ed.ac.uk

Feedback/nomination

1) course survey search for the link in your email or via learn

2) Nominate for award teaching.awards@eusa.ed.ac.uk Shortlisted in 2019/20 and 2021/22



https://www.eusa.ed.ac.uk/whatson/awards/teachingawards/nominate (cookies trouble? try it in an incognito window)

Come back as a speaker in this course!