## Elective Course Description Summer Term 2019

### Title
- **Machine Learning for Video Games**

### Cluster Title PO 07
- MEP9 Advanced Informatics

### Cluster Title PO 2012
- ME2_11 Advanced System Technology

### Cluster Title PO 2014
- Game Development

### Date of first course event / first organizational meeting with students****/ Room
- 8.4.19 **NN**
- 17/105 tbc.

### kind of room if not indicated above
- Hörsaal
- Seminarraum
- Labor

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### Course Data

<table>
<thead>
<tr>
<th>credit points</th>
<th>5 credit points</th>
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<tbody>
<tr>
<td>workload/semester</td>
<td>125-150 h</td>
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<tr>
<td>presence/week on average**</td>
<td>4 SWS</td>
</tr>
<tr>
<td>Group size according to cnw</td>
<td><strong>8 students</strong></td>
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<table>
<thead>
<tr>
<th>Min. size</th>
<th>8 students</th>
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<table>
<thead>
<tr>
<th>weekday of course</th>
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<tbody>
<tr>
<td>Monday</td>
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<table>
<thead>
<tr>
<th>frequency of course-events</th>
<th>weekly</th>
<th>bi-weekly</th>
<th>blocked</th>
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<tbody>
<tr>
<td>prospective timeframe****</td>
<td>Block 1</td>
<td>Block 2</td>
<td>Block 3</td>
</tr>
<tr>
<td>(Block = 90 min)</td>
<td>8:30</td>
<td>10:15</td>
<td>12:00</td>
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<tr>
<td></td>
<td>Block 4</td>
<td>Block 5</td>
<td>Block 6</td>
</tr>
<tr>
<td></td>
<td>14:15</td>
<td>16:00</td>
<td>17:45</td>
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<tr>
<th>course language</th>
<th>English</th>
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<tr>
<th>suitable for students of course/focus</th>
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<tbody>
<tr>
<td>DM</td>
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<tr>
<td>IMD</td>
</tr>
<tr>
<td>SMP</td>
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<tr>
<td>OJ/WJ/OK</td>
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### Content(s):

- Check one or more:
  - Design
  - Informatics / Technology
  - Economy / Business
  - Culture

### Time frame in case of blocked event

### Course Portrait

**Lecturer(s) Name(s)**

Prof. Dr.-Ing. Martin Leissler

**Lecturer(s) email**

martin.leissler@h-da.de

**Contact Prof. @ fbmd**

**Teaching Method**

- lecture
- lecture + seminar
- seminar
- project

**Course Contents**

In the past few years, advances in **Machine Learning (ML)** have triggered breakthroughs across several key areas, like detecting objects, translating text, recognizing speech, and playing games, to name a few. The connection between **ML and games** combined with breakthroughs in **Deep Learning** are already indicating a revolutionary change in how games are produced, changing everything from how textures and 3D-models are generated, to how non-playable characters (NPCs) are programmed, to how we think about animating characters or lighting scenes.

While intelligent behavior was coded by hand in the past, it is now increasingly taught to agents (e.g. robots or virtual entities) through interaction in a training
environment. Applying this method allows to learn behavior for everything from industrial robots, drones, and autonomous vehicles, to game characters and opponents.

The elective course therefore has the goal of exploring the relationship between ML and games. Most hand coded game AI consists of decision-trees with sometimes up to thousands of rules, which must be maintained by hand, and thoroughly tested. In contrast, ML relies on algorithms which can make sense of raw data, without the need of an expert to define how to interpret that data. A good example is the computer vision problem of classifying the content of an image. Until a few years ago, experts would write filters by hand that would extract useful features for classifying an image as containing certain objects. In contrast, ML - and in particular the newer Deep Learning approaches - only need the images and class labels and learn the useful features automatically.

The underlying hypothesis is that this automated learning approach can help simplify and speed up the process of creating games for all areas of game development. An example would be to apply automatic learning to game agent behavior a.k.a. NPCs, using Reinforcement Learning (RL) to train agents to estimate the value of taking actions within an environment. Once they have been trained, these agents can take actions to receive the most value, without ever having to be explicitly programmed how to act. Other examples could include (but are not limited to) auto-rigging of characters, adaptive gameplay, character-animation, level-generation, or even procedurally generated story arcs.

As the world’s most popular creation engine, Unity is at the crossroads between machine learning and gaming. Unity Technologies has recently released an open-source beta version of its Machine Learning Agents (ML-Agents), including an SDK, allowing researchers and developers to transform games and simulations into environments where intelligent agents can be trained using Deep Reinforcement Learning, Evolutionary Strategies, or other machine learning methods through a simple to use Python API and the Google Tensorflow framework.

Students in this course will:
- Learn to understand and apply the basic concepts of RL using the Unity game engine and Google Tensorflow
- Choose and research an area of game development and the potential benefit of applying ML to it.
- Create an experimental setup for applying ML/RL to a certain area of game development
- Present their results to the other members of the course in a scientific way
- Document their findings in a scientific publication

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<tr>
<th>Type of Exam</th>
<th>homework</th>
<th>work+presentation</th>
<th>x</th>
<th>paper</th>
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Milestones if known

End of Elective

Examination / Presentation

Suitability advanced course
Preconditions

Advanced understanding of (and experience with) computer science and programming concepts.

Info about lecturer (especially if guest)

Other information

* According to our examination law, the course titles have to be matched to a given catalogue with common course titles. This title will appear in the Transcript of Record and the Bachelor Certificate. Field has to be filed by Focus Managers, all clusters can be found below

** The official presence-time is 3 SWS for the whole semester. As the elective period is condensed to 12 weeks instead of 16 weeks, the presence time for the electives is 4 SWS.

*** Courses and focal points: dm = Digital Media, oj = Online Journalism; wj = Wissenschaftsjournalismus; blank field = please insert appropriate course. (check as many as apply)

**** Block 1 = 8.30 - 10.00 Uhr, Block 2 = 10.15 - 11.45 Uhr, Block 3 = 12.00 - 13.30 Uhr, Block 4 = 14.15 - 15.45 Uhr, Block 5 = 16.00 - 17.30 Uhr, Block 6 = 17.45 - 19.15 Uhr

***** In case that the course does not start in the first week 6.10.2014 there has to be a first organisational meeting to finalize the application process

Elective Start: 9.04.18
Free Days 1.5., 10.5., 21.5., 31.5.18
Electives End 23.6.18

Please upload in Moodle Course!

to be filed by lecturer

to be filed by focus manager

An die Schwerpunktleiter: Bitte auch die Folgeseite beachten.

Clustertitle DM PO 2007:

MEP1 Advanced Animation
MEP2 Advanced Video Production
MEP3 Graphic and Identity Design
MEP4 Sound Design and Production
MEP5 Interaction Design
MEP6 Media Experiments
MEP7 Media Events and Marketing
MEP8 Advanced Media Technology
MEP9 Advanced Informatics
MEP10 Media Theory

Clustertitle DM PO 2012:

ME2_01 Advanced Animation
ME2_02 Advanced Game Design
ME2_03 Advanced Video
ME2_04 Advanced Post Production
ME2_05 Interaction & Interface Design
ME2_06 Media Installation
ME2_07 Dramaturgy and Storytelling for Linear and Interactive Media
ME2_08 Media Experiments
ME2_09 E-Learning
ME2_10 Advanced Media Systems
ME2_11 Advanced System Technology
ME2_12 Interface Technology
ME2_13 Mobile/Web Application
ME2_14 3D Interactive Environment
ME2_15 Music & Technology

ME2_16 Media Events & Marketing
ME2_17 Media Producing in Different Fields of Media
SuK2_18 Media and Entertainment Law

ME2_19 Media Art History
ME2_20 Cultures and Creative Practice in Digital Media
ME2_21 Media Environments and Spaces
ME2_22 Media Ethics and Philosophy
ME2_23 Media and Communication Theories
ME2_24 Play, Game, Act, Use: Concepts, History and Practices

Clustertitle Studiengänge PO 2014

A&G:

Game Development
Technical Art for Animations and Games
Animation and Game Design
Animation and Game Methodology
Animation and Game Research and Development

IMD:

ME-D_01 – Design Management & Strategy
ME-D_02 – Design Concept & Dramaturgy
ME-D_03 – Audio/Visual Design
ME-D_04 – User Experience & Usability
ME-D_05 – Media Arts
ME-D_06 – Interaction & Interface Design
ME-D_07 – Interaction in Space
ME-IT_01 – Advanced Media Systems
ME_IT_02 – Advanced System Technology
ME-IT_03 – Interface Technology
ME-IT_04 – Mobile/Web Application
ME-IT_05 – 3D Interactive Environment
ME-M_01 – Media Events & Marketing
ME-M_02 – Media Producing
ME-M_03 – StartUp and Funding
ME-M_04 – Entertainment and Media Law
ME-PH_01 – Media Art History
ME-PH_02 – Cultures and Creative Practices in Digital Media
ME-PH_03 – Media Ethics and Philosophy
ME-PH_04 – Media and Communication Theories

MP:

ME_01 – Advanced Video Production
ME_02 – Advanced Post Production
ME_03 – Advanced Montage
ME_04 – Film-Sound
ME_05 – Media Installation
ME_06 – Creative Writing, Dramaturgy and Storytelling for Linear and Interactive Media
ME_07 – Media Experiments
ME_08 – Advanced Film, AV and studio technology
ME_09 – Transmedia Technology
ME_10 – Media Events & Marketing
ME_11 – Media Producing in Different Fields of Media
SuK_12 – Media and Entertainment Law *
ME_13 – Media Art History
ME_14 – Cultures and Creative Practices in Digital Media
ME_15 – Media Environments and Spaces
ME_16 – Media Ethics and Philosophy
ME_17 – Media and Communication Theories
ME_18 – Play, Game, Act, Use: Concepts, History and Practices

SMP:

ME1 - Computational Audio and Simulation
ME2 - Spatial Audio and Interaction
ME3 - Music and Media Production
ME4 - Post-Production
ME5 – Media Installation and PA
ME6 - Music and Media Theory
ME7 - Media Culture
ME8 – Film, Theatre, and Game
ME9 - Free multimedia elective
ME10 – Media Management