Neural Networks in Arts

Course Administrative Details

Course Title	Neural Networks in Arts		
Instructor(s)	Helena Nikonole, Natalia Soboleva	**Instructor's e-mail**	helenanikonole@gmail.com, n.sob55@gmail.com
Course #	???	**Course Type**	Elective
Faculty	Computer Science and Engineering	**Major**	Computer science
Academic year	2019-2020	**Semester Offered**	Fall
No. of Credits	5 ECTS	**Total workload on average**	48 hrs. per month inc. 32 hrs. of self-study
Lecture Hours	12 per visit	**Lab Hours**	4 per visit
Language	English	**Frequency**	4 times per semester
Target Audience	Bachelors	**Anticipated Enrollment**	15 students
Studying year	4		
Grading Mode	A, B, C, D	**Keywords**	[Neural Networks, Digital Arts, Machine Learning, Art&Science, Technological Art]

Course outline

The curriculum is devoted to the historical, theoretical and technological aspects of digital art, particularly, machine learning as an art practice.
We will examine the interconnection between art and science, the historical conditions and implicit characteristics of emerging technological arts as well as strategies and approaches of new media artists.
One of the important parts of the course is the history of USSR early cyber arts and sound experiments which are strictly important as a link between contemporary technological art and its historical roots.
Curriculum is divided into 4 parts:
1) text arts;
2) sound;
3) visual arts (pictures, moving images, video);
4) original examples which were not included in previous parts (for instance, interactive arts, internet arts).
On the technological part of the curriculum we will analyze the differences in the structure of different types of neural networks: fullyconnected, convolutional, recurrent. Analyze applications in different areas and how the network structure varies depending on the type of data and the tasks to be solved. State-of-the-art models and approaches used in proposed fields (image, sound and and text processing) will be analyzed and partially implemented.
At the last stage of the curriculum students will prepare their own art projects: develop original ideas, choose the academic papers and prepare the implementations.

Course Delivery

The course will be given over 8 days, two days per 3-4 weeks from September to December 2019. There will be four 2-hour classes each day. There are four assignments. There is a mid-term presentation and a final presentation of projects. The best projects will be presented at the exhibition.

Prerequisite courses

It is recommended to pass "Introduction to Machine Learning" course before Neural Networks in Art course to be familiar with basic machine learning techniques and be familiar with python data processing libraries

Required background knowledge

Basic knowledge of mathematical statistics, machine learning algorithms. Ability to write and understand python code. Optional: awareness of deep learning and deep learning python libraries (tensorflow, keras, pytorch), git skills and interest in reading scientific articles.

Course structure

IA – Individual Assignment, R – reading, P – presentation, FP -final presentation

Week# / Date	***Topic***	***Assignments***
Sept 20-21.09	Introduction to Digital Arts. Generative Art and text generators. Introduction to Neural Networks in Pytorch. Word embeddings. Text Generation with Recurrent Neural Networks.	
Oct 11-12.10	Music and sound art. Music generators, synthesizers. Neural Networks for music and sound generaton. Deep Learning for Audio Signal Processing. Sound generation with Convolutional Neural Networks.	*IA* *R* *P*
Nov 1-2.11	Moving images in digital arts. Machine vision. Convolutional Neural Networks in Image Processing. Object detection and classification. Generative Adversarial Networks.	*IA* *R*
Nov 29-30.11	Hybrid examples (Interactive Art, Internet Art, Robotics). Introduction to Reinforcement Learning. Cartpole Problem. End-to-end project realization. How to implement article's materials.	*IA* *R* *FP*

Learning outcomes

The course will provide an opportunity for participants to:

- develop creative and critical approaches to technologies
- understand key principles of digital arts, strategies and approaches in art&science
- understand key principles involved in implementation of various deep learning techniques
- become familiar with deep learning tools in python, such as pytorch, tensorflow, etc.
- get hands-on experience of end-to-end art project development

Textbook(s)

- Lev Manovich, AI Aesthetics, Strelka press, 2018.
- Christiane Paul, A Companion to Digital Art, Wiley-Blackwell, 2016.
- David Foster, Generative Deep Learning. Teaching Machines to Paint, Write, Compose, and Play, O'Reilly Media, 2019.
- Hastie T., Tibshirani R, Friedman J. The Elements of Statistical Learning (2nd edition), Springer, 2009.
- Bishop C. M. Pattern Recognition and Machine Learning, Springer, 2006.
- Willi Richert, Luis Pedro Coelho. Building Machine Learning Systems with Python, Packt Publishing, 2013.
- Ian Goodfellow and Yoshua Bengio and Aaron Courville, Deep Learning, 2016.
- Jurafsky, D., Martin J. H. Speech and Language Processing, 3 edition, 2019.

Reference Materials

- Walter Benjamin, The Work of Art in the Age of Mechanical Reproduction, 1935 - https://www.marxists.org/reference/subject/philosophy/works/ge/benjamin.htm

- Marshall Mcluhan, Understanding Media: The Extensions of Man, 1964
- Smart Machines for Enhanced Arts, DIGIMAG Magazine, 2017
- Andrey Smirnov, Sound in Z: Experiments in Sound and Electronic Music in Early 20th Century Russia, FUNDACION PROA, 2013
- Ianina Prudenko, Cybernetics in the humanities arts and sciences, GARAGE, 2018
- João Correia, Vic Ciesielski, Antonios Liapis (eds.) - Computational Intelligence in Music, Sound, Art and Design, 6th International Conference, EvoMUSART 2017.
- Gene Kogan, Machine learning for artists, http://ml4a.github.io/classes/
- MOOC Advanced Machine Learning Course by HSE (Coursera) - https://www.coursera.org/specializations/aml?ranMID=40328&ranEAID=vedj0cWlu2Y&ranSiteID=vedj0cWlu2Y-1wxV9NjOcdnKVwPqBqMczA&siteID=vedj0cWlu2Y-1wxV9NjOcdnKVwPqBqMczA&utm_content=10&utm_medium=partners&utm_source=linkshare&utm_campaign=vedj0cWlu2Y
- CVPR 2018 Tutorial on GANs - https://sites.google.com/view/cvpr2018tutorialongans/
- CS224d: Deep Learning for Natural Language Processing - https://cs224d.stanford.edu/index.html
- MOOC Deep Learning in Computer Vision - https://www.coursera.org/learn/deep-learning-in-computer-vision
- MOOC Practical Reinforcement Learning - https://www.coursera.org/learn/practical-rl

Computer Resources

Students should have laptops with access to the internet (Google Collab). Optional: For long-term projects local environment with python, jupyter, pytorch, etc., or server instance.

Laboratory Exercises

1. Introduction to Neural Networks in Pytorch.
2. Word embeddings. Text Generation with Recurrent Neural Networks.
3. Deep Learning for Audio Signal Processing. Sound generation with Convolutional Neural Networks.
4. Convolutional Neural Networks in Image Processing. Object detection and classification.
5. Generative Adversarial Networks.
6. Introduction to Reinforcement Learning. Cartpole Problem.
7. End-to-end project realization. How to implement article's materials.

Laboratory Resources

Laptop with the access to the internet (Google Collab). GPU for long term student projects realization and individual assignments.

Grading criteria

Assignments (50%), Project: technology (30%) & art (20%)

Late Submission Policy

This policy will be strictly applied in this course. If a personal emergency should arise that affects your ability to turn in an assignment in a timely fashion, you must contact the course instructor BEFORE the deadline to get a "Special Late Submission Approval" from the course instructor. Without the "Special Late Submission Approval" submissions will be still accepted up to 48 hours late, but with a 50% penalty. No "Special Late Submission Approval" will be granted after the deadline. All late submissions should be submitted by email directly to the instructors.

Cooperation Policy and Quotations

We encourage vigorous discussion and cooperation in this class. You should feel free to discuss any aspects of the class with any classmates. However, we insist that any written material that is not specifically designated as a Team Deliverable be done by you alone. This includes answers to reading questions, individual reports associated with assignments, and labs. We also insist that if you include verbatim text from any source, you clearly indicate it using standard conventions of quotation or indentation and a note to indicate the source.