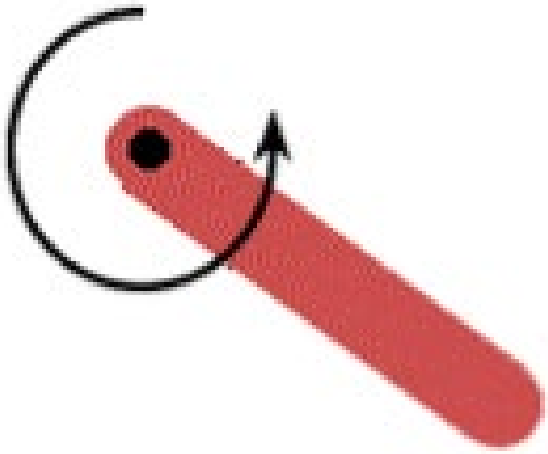
# ST1504 DEEP LEARNING ASSIGNMENT 2



From https://www.gymlibrary.dev/_images/pendulum.gif

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| School Name | School of Computing |
| Semester | AY2023/24 Semester 2 |
| Course Name | DAAA |
| Module Code | ST1504 |
| Module Name | Deep Learning |

# Assignment 2 (CA2: 40%)

The objective of the assignment is to help you gain a better understanding of applying Generative Adversarial Networks (GAN) and Reinforcement Learning (RL).

There are three parts in this assignment, Parts A, B, C.

## Guidelines

1. You are to work in groups of two for Parts A and B. For Part C, this is an individual task.

2. In this assignment, you will:

   A. Create a GAN model and evaluate the performance of the network.
   B. Create an RL model to solve the task at hand.
   C. Carry out some literature research and prepare a technical paper on GAN or RL.

3. For Parts A and B, you should prepare the following (one set of zipped files, for each part):

   a) Jupyter notebook including your code, comments and visualisations (.ipynb).
   b) In addition, please save a copy of the Jupyter notebook as a .html file.
   c) Include your best neural network weights (.h5 file).
   d) A deck of presentation slides (.pptx file) for your project.
   e) A statement indicating the contributions by each member of the group, including percentage of workload for specific contributions.

   Submit all materials in a zipped file.

4. For Part C, you should submit your file as a Word (.docx) or .pdf document.

5. The normal SP's academic policies on Copyright and Plagiarism applies. Please note that you are to cite all sources. You may refer to the citation guide available at: https://sp-sg.libguides.com/citation

6. You need to submit your declaration of academic integrity. You may access this document on Brightspace. Without this, your submission is deemed incomplete.

**Reminder: Please check that all files are valid, especially after zipping. If files cannot be opened, it would be considered as no submission. It is your responsibility as students to ensure this is properly carried out.**

## Submission Details

Deadline: 2 Feb 2024, 11:59 PM
Submit through: Brightspace

## Late Submission

50% of the marks will be deducted for assignments that are received within ONE (1) calendar day after the submission deadline. No marks will be given thereafter. Exceptions to this policy will be given to students with valid LOA on medical or compassionate grounds. Students in such cases will need to inform the lecturer as soon as reasonably possible. Students are not to assume on their own that their deadline has been extended.

## Neural network models

You must build your own neural network models, with explanations and justifications.

Your neural networks models can be improved upon with tweaks to your architectures.

If you wish to implement transfer learning, it is only acceptable after you have done the above (building your own models with justifications).

**Otherwise, transfer learning is rejected.**

Save the best weights of your neural networks. This is important for reproducibility without having to re-train over some extended duration.

# PART A: GAN (45 marks)

## Task

Apply some suitable GAN architectures to the problem of image generation.

## Dataset

Use the CIFAR10 dataset to create **1000** small colour images. There should be 10 classes of images for you to generate.

```
tf.keras.datasets.cifar10.load_data()
```

## Submission requirements for Part A

1. Submit a zip file containing all the project files (source code, Jupyter notebook .ipynb file, .html file, and best neural network weights .h5, slides).
2. Submit a .docx file containing the list of specific contributions by each team member in the deliverables for Part A.
3. Submit online via the Assignment link.

**Evaluation criteria:**

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|---|---|
| Background research, feature engineering | 9 marks |
| Application of GAN, explanation of architecture(s) | 9 marks |
| Evaluation and improvements of GAN performance | 9 marks |
| Presentation/Demo | 9 marks |
| Quality of report (Jupyter) | 9 marks |

# PART B: REINFORCEMENT LEARNING (45 marks)

## Task

Apply a suitable modification of deep Q-network (DQN) architecture to the problem. Your model should exert some appropriate torque on the pendulum to balance it.

**You must use DQN and satisfactorily demonstrate its viability.**

You may consider other reinforcement learning architectures, if you wish, but only after successfully implementing DQN. Otherwise, any other non-DQN architecture will be rejected.

## Dataset

Please use the following environment from OpenAI Gym.
https://www.gymlibrary.dev/environments/classic_control/pendulum/

## Submission requirements for Part B

1. Submit a zip file containing all the project files (source code, Jupyter notebook .ipynb file, .html file, and best neural network weights .h5, slides).
2. Submit a .docx file containing the list of specific contributions by each team member in the deliverables for Part B.
3. Submit online via the Assignment link.

**Evaluation criteria:**

| | |
|---|---|
| Background research, explanations of approach(es) taken | 9 marks |
| Application of RL with appropriate rationale and explanations | 9 marks |
| Evaluation and improvements of RL | 9 marks |
| Presentation/Demo | 9 marks |
| Quality of report (Jupyter) | 9 marks |

## PART C: Technical Paper (10 marks)

This part of the assignment is to be completed individually. This is a challenge task for students who wish to attempt it for higher marks.

Write a technical paper in single column format on any **ONE** of the following topics.

- GAN
- Reinforcement Learning

The paper should have the following component:

1. Abstract
2. Introduction
3. Related Works
4. Dataset/Methodology/Experiment
5. Discussion
6. Conclusions
7. References

Submit the paper in Word or PDF format (page limit of 10 pages).

Rubrics for technical paper:

| Marks | Requirements |
|---|---|
| 1 to 2 | (a) Review of one research article. Any citation must be properly documented and accurately attributed.<br><br>The review must be meaningful and complete to be considered. Otherwise, it is rejected.<br><br>(b) And/or attempt to build an original/advance model, but only sketchily.<br><br>The model must be original/advance, i.e. not something done in class so far. Otherwise, it is rejected. |
| 3 to 4 | (a) Review of several research articles.<br><br>(b) And/or attempt to build an original/advance model, with some interesting results. |
| 5 to 6 | (a) Attempt to build an original/advance model, with some substantial results.<br><br>This must be properly demonstrated, otherwise it is rejected.<br><br>(b) Review of relevant research articles must be included. |

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| 7 to 8 | (a) Extensive original/advance work on building an advance machine learning architecture, with training and evaluation to demonstrate good but not state-of-the-art results.<br><br>This must be properly demonstrated, otherwise it is rejected.<br><br>(b) Review of relevant research articles must be included. |
| 9 to 10 | (a) Extensive original/advance work on building an advance machine learning architecture, with training and evaluation to demonstrate near state-of-the-art results.<br><br>This must be properly demonstrated, otherwise it is rejected.<br><br>(b) Review of relevant research articles must be included. |

*— End of Assignment —*