# COMSM0160 - Advanced Visual AI Coursework Instructions (2025-2026)

## 1. General Information

### 1.1. Overview

This assignment is the summative piece of unit coursework for COMSM0160 for those who elected to do the CW version of COMSM0159. The assignment focusses on the classical problem of image super-resolution. It runs over 3 weeks and must be completed individually.

The report will be in the form of a research paper following the example structure and template provided on page 2. The report should be zipped together with the code that you will be using to produce all results. It should also include a link to the GitHub project that you will be creating.

### 1.2. The Image Super-Resolution Problem

Image super-resolution is a technique in computer vision used to enhance the resolution of an image. It takes a low-resolution image and applies from simple interpolation to learning-based methods to generate a high-resolution version of the same image. Super-resolution techniques are commonly used in applications like video services, medical imaging, image and video enhancement.

Within this assignment you are asked to select **two** of the methods you have been taught in lectures and have previously applied during lab sessions, to solve other inverse problems, such as deconvolution/deblurring or denoising. Bonus marks will be given for the implementation of a third method. A comparative analysis of the methods is required.

### 1.3. Dataset and Metrics

Use the NTIRE 2018 dataset and, particularly, the *Train and Validation Track 1 – bicubic x 8*: https://data.vision.ee.ethz.ch/cvl/DIV2K/

For the evaluation quality metrics including PSNR, SSIM, and LPIPS are required to be employed.

### 1.4. Assessment

You will be marked on both code and report. Please do not attempt to copy code or report text, etc. You are allowed to use any PyTorch libraries – but, in any case, you must understand the algorithmic workings of the functions used. If you do use code/text that is not your own, please declare this in your report with appropriate citation. Note, plagiarism is taken very seriously based on university plagiarism policies and processes and plagiarism detection software will be used. Please avoid it.

The distribution of marks can be found on page 2.

### 1.5. Submission

Each student is required to upload their full piece of work (incl all source code files, and your report in PDF) compressed into a ZIP file. Your report should be named as youruserid.pdf. There is no page limit, but a length of **at least 3 pages** is expected. The report should include a link to the GitHub repository created for the coursework.

Your zip file should be submitted on Blackboard under "Assessment, submission and feedback" on UNIT COMSM0160 before the deadline at **13:00 on Friday 5 December 2025**. Make sure you submit it an hour early or so (not last minute!) to avoid upload problems. Even if your upload is a single second late you will immediately have 10% deducted (per day) from your mark by the system (a universal BB imposition - out of our control).

### 1.6. Managing your assignment

There will be Coursework Support Sessions running in place of your lectures (on Thursdays from 10.00 to 11.00 - they are in your timetable), with TAs to answer your queries. Please do not ask "Does this look correct enough to get the marks?" Note, the TAs cannot provide academic solutions to the coursework, as per the School of Computer Science instructions.

## 2. Tasks to be Completed

### 2.1. Comparison of Methods (15 marks)

This first task requires you to pick two methods from the three groups taught, and compare their performances on the DIV2K dataset. You may choose to use the code provided to you for the labs.

The three classes of methods (with subcategories) studied as part of the lab sessions were:-

1. Model-Based and Data-Driven ML
   - Deep Image Prior
   - Deep Unfolding
2. Generative AI
   - Variational Autoencoders (VAEs)
   - Generative Adversarial Networks (GANs)
   - Diffusion Models
3. Implicit Neural Representations

### 2.2. Impact of Noise Degradation (5 marks)

Noise is a common degradation in computer vision and causes all sorts of problems. There are numerous reasons why noise can appear in images, e.g., shot noise, compression artifacts, transmission, etc.

This task requires you to synthetically add noise to the dataset and determine how it affects the performance of the chosen methods. You will need to describe how you implement this.

You should investigate the effect of various levels of noise so you can report on the influence of both low and high noise levels.

### 2.3. Impact of Downscaling (5 marks)

Generally, image super-resolution simulations consist in taking high-resolution images, applying some downscaling operation onto these images, and employ SR methodologies to upscale them back to the original resolution.

This task requires you to further downscale the downscaled $\times 8$ images by a factor of 2. Then modify your methods to upscale $\times 16$. Describe how this may have impacted the performance of the chosen methods.

### 2.4. Challenge (10 marks)

For achieving higher marks, you will need to perform all previously described experiments via a third method, that you would identify by surveying the relevant literature (*not* one that was taught in the curriculum). This third method should ideally achieve higher performances than the other chosen methods.

### 2.5. Report (5 marks)

These marks will be awarded based on the overall standard of presentation, analysis and evaluation of your report. The report should be structured according to the instructions in the next section.

## 3. Report Structure

### Abstract

*Here you will put a summary of experiments you performed. Include the link to your GitHub repository here.*

## 1. Introduction

Describe briefly the image super-resolution task

## 2. Selected Methods

Justification of the selected methodologies

### 2.1. Method 1

Basic description with references

### 2.2. Method 2

Basic description with references

### 2.3. Optional Method 3

Basic description with references

## 3. Experimental Design

- Dataset and Metrics of Evaluation
- Training
- Validation
- Qualitative and Quantitative Comparison of Methods

## 4. Conclusions

## References