ARIN 5101
Advanced Python Programming for Artificial Intelligence

Course Project

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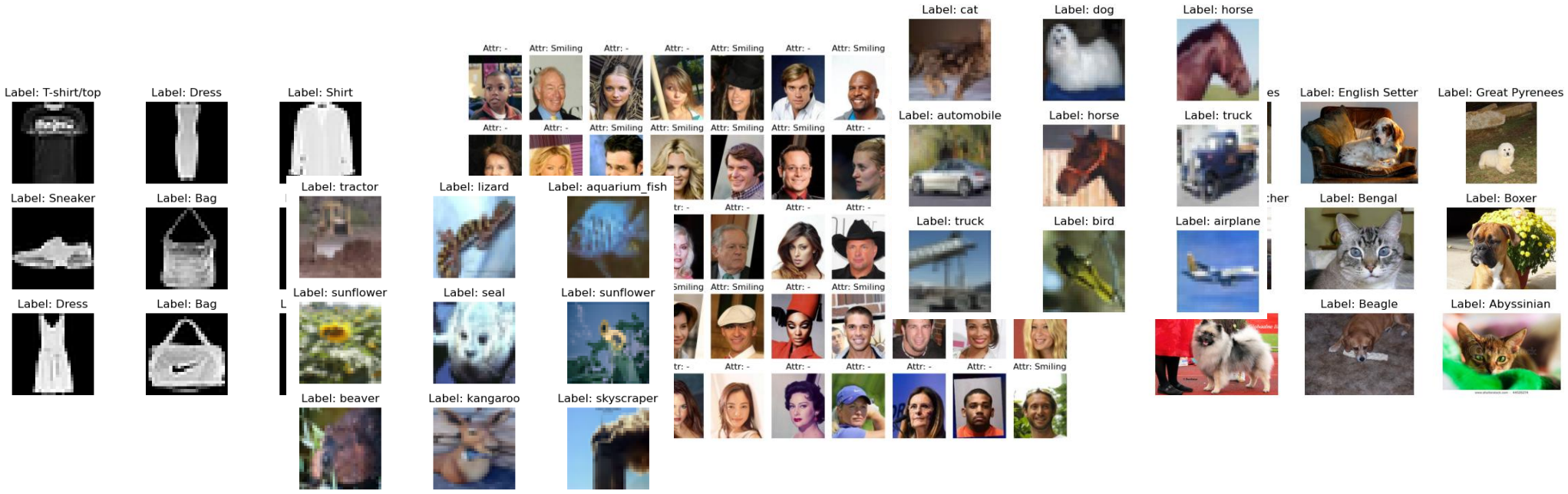
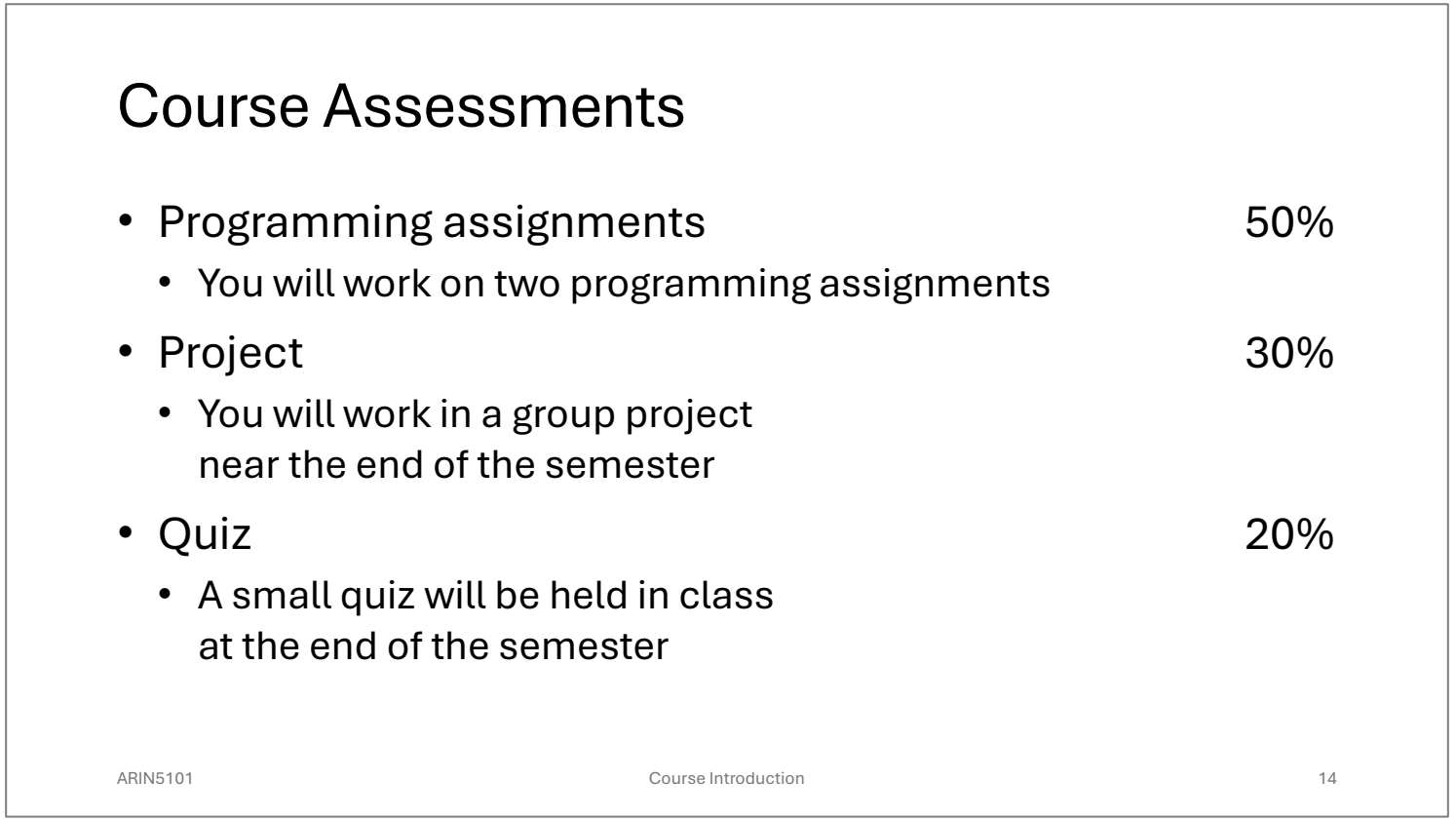
Group Project

- Objective:
  - Build a CNN model for a relatively small dataset
  - Compare a variety of design decisions



How Much Is It Worth?

- The group project is 30% of the course total:



Team Formation

- You form groups of 3 students
- You will collaborate on dataset selection, model design, training, and reporting
- A page has been set up to let you form your groups:

  https://canvas.ust.hk/courses/64868/groups

- The deadline to form a group is **Tue 4 Nov 11:59 PM**
  - If you are not in a group after the deadline, you will be randomly put in a group

Dataset Selection

- You can choose one small image dataset from:
  - FashionMNIST
  - CIFAR-10
- Or a medium image dataset from:
  - CIFAR-100
  - OxfordIIITPet
- Or any other dataset with labelled images, such as Kaggle datasets

For Medium/Large Datasets

- To ensure the training can be complete within a reasonable time, for example around 30 mins, you will tune down the size of any medium or large datasets
- For example, if you use CIFAR-100, you may need to use only a subset of the classes

Confirmation of Your Dataset

- Each group will choose to work on only one dataset
- Once you have decided on the dataset you will work on, you send an email to Muhammad (usman@ust.hk) with a brief description of your dataset
- The deadline to send this information is **Thu 6 Nov 11:59 PM**

Baseline CNN Architecture

- Based on your dataset, you will build a simple CNN with:
  - 2 convolution layers
    - For example, using `Conv2D`, `ReLU` and `MaxPool`
  - 1 dense layer with:
    - Input layer – flattened features from the convolution layers
    - Hidden layer – 128 units
    - Output layer – the number of classes in the dataset

Validation Setup

- During training, you will split your dataset into training and validation sets
- You will add the ability to track both loss and accuracy during training, for the training data and validation data
- You will show plots of loss and accuracy for comparisons

Model Improvements

- You will progressively enhance the baseline using:
  - Dropout – Prevent overfitting
  - Batch Normalization – Stabilize training
  - Data Augmentation – Improve generalization
- You only pick two of the above three improvements
- Your performance comparison will include using only one improvement, and using both improvements at the same time

Model Tuning

- You will experiment your baseline model with:
  - Convolution layer depth
    - For example, using values of 32, 64 and so on
  - Hidden layer size
    - For example, using different number of hidden layer units
  - Adding a third convolutional layer

Reporting 1/2

- Your report will include:
  - Your information – group number and your names
  - Dataset description
    - Basic description, distributions and samples
  - Training setup and validation strategy
    - Dataset splitting strategy and relevant code
  - Baseline model architecture
    - Basic illustration and relevant code
    - Performance analysis – loss, accuracy and other relevant metrics

Reporting 2/2

- Your report will include (cont.):
  - Improvement techniques and model tuning
    - Basic illustration and relevant code
    - Performance comparisons among the combinations using relevant metrics
  - Final model summary and reflections
    - Which one is the best performing model and why
- Everything should be illustrated with appropriate plots and visualizations

Project Video

- You will make a summary video for your project
  - **Duration:** 3 to 5 minutes
  - **Purpose:** Summarize your project clearly and concisely
  - **What to Include:**
    - Brief introduction of your dataset and objective
    - Overview of your baseline CNN and improvements
    - Key results such as accuracy, loss plots, comparisons
    - What you learned

Project Deliverables

1. A Jupyter notebook containing your report and all relevant code
   - The code should be runnable in a reasonable setup, for example, in Virtual Barn with all the latest libraries installed (Note that there is no GPU support in the Virtual Barn)
2. A 3 to 5 minute video for you to explain concisely what you have completed in the project

Grading Guideline

Component	Weight (%)	Description
Your Group	5	Group information at the top
Problem Definition	5	Description of your problem and objective
Data Handling	15	Dataset description, preprocessing, and justification
Model Design	20	Architecture design, training strategy, and innovation
Evaluation & Analysis	20	Use of metrics, interpretation of results, and comparison with baselines
Code Quality	10	Organization, readability, documentation, and reproducibility
Report Presentation	10	Structure, clarity, and visual effectiveness
Video Presentation	15	Concise and engaging summary demonstrating understanding

Submission Deadline

- The deadline for the project submission is:

Sat 29 Nov 2025 11:59 PM

- Only one member of each group need to submit the notebook (.ipynb) and the video (.mp4)
- The submission link is:

https://canvas.ust.hk/courses/64868/assignments/405829