Examinable Topics for Revision

ACTL3143 & ACTL5111 Deep Learning for Actuaries
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Exam details

- Exam is on Inspera
- Open book
- No handwritten answers, maybe have a calculator handy
- You'll have 1.5 hours to complete plus 15 mins reading
- Complete the IT preparation checklist (MFA, speed test, read policies)





Lecture 1: AI

- artificial intelligence
- artificial intelligence vs machine minimax algorithm learning
- classification problem
- Deep Blue
- labelled/unlabelled data

- machine learning
- pseudocode
- regression problem
- targets





Lecture 1: Python

- default arguments
- dictionaries
- f-strings
- function definitions
- Google Colaboratory
- help
- list

- pip install ...
- range
- slicing
- tuple
- type
- whitespace indentation
- zero-indexing





Lecture 2: Deep Learning

- activations, activation function
- artificial neural network
- biases (in neurons)
- callbacks
- cost/loss function
- deep/shallow network, network depth
- dense or fully-connected layer
- early stopping
- epoch
- feed-forward neural network

- Keras, Tensorflow, PyTorch
- matplotlib, seaborn
- neural network architecture
- overfitting
- perceptron
- ReLU activation
- representation learning
- training/validation/test split
- universal approximation theorem
- weights (in a neuron)





Tutorial 2: Forward Pass

- batches, batch size
- forward pass of network
- gradient-based learning

- learning rate
- stochastic (mini-batch) gradient descent





Lecture 3: Mixed Topics

Categorical Variables

- entity embeddings
- Input layer
- Keras functional API
- nominal variables
- ordinal variables
- Reshape layer
- skip connection
- wide & deep network

Classification

- accuracy
- confusion matrix
- cross-entropy loss
- metrics
- sigmoid activation
- sofmax activation





Lecture 4: Computer Vision

- channels
- computer vision
- convolutional layer & CNN
- error analysis
- filter/kernel

- flatten layer
- max pooling
- MNIST
- stride
- tensor (rank, dimension)





Tutorial 4: Backpropagation

- backpropagation
- partial derivatives





Lecture 5: Natural Language

- bag of words
- lemmatization
- one-hot embedding
- stop words

- vocabulary
- word embeddings/vectors
- word2vec





Week 6: Uncertainy Quantification

- aleatoric and epistemic uncertainty
- Bayesian neural network
- deep ensembles
- dropout
- ensemble model
- CANN
- GLM

- MDN
- mixture distribution
- Monte Carlo dropout
- posterior sampling
- proper scoring rule
- uncertainty quantification
- variational approximation





Lecture 7: Recurrent Networks

- GRU
- LSTM
- recurrent neural networks
- SimpleRNN





Lecture 8: Transfer Learning

- AlexNet, GoogLeNet, Inception fine-tuning

• ImageNet

• transfer learning





Lecture 8-9: Generative Networks

- autoencoder (variational)
- beam search
- bias
- ChatGPT (& RLHF)
- DeepDream
- generative adversarial networks stochastic sampling
- greedy sampling

- Hugging Face
- language model
- latent space
- neural style transfer
- softmax temperature





Lecture 9: Interpretability

- global interpretability
- Grad-CAM
- inherent interpretability
- LIME
- local interpretability
- permutation importance
- post-hoc interpretability
- SHAP values





StoryWalls

- 1. Go Al: Basic Python
- 2. Sydney Temperature Forecasting: Basic MLP
- 3. Victorian Crash Severity: Classification & entity-embedding
- 4. Hurricane damage: Convolutional neural networks and hyperparameter tuning
- 5. US Police reports: NLP with bag-of-words, TF-IDF, permutation importance
- 6. Health Insurance Premiums: Uncertainty Quantification
- 7. Generative networks experimenting



