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 learning
- classification problem
- ~~Deep Blue~~
- labelled/unlabelled data
- machine learning
- ~~minimax algorithm~~
- pseudocode
- regression problem
- targets

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Lecture 1: Python

- default arguments
- dictionaries
- f-strings
- function definitions
- ~~Google Colaboratory~~
- ~~`help`~~
- list
- ~~`pip install ...`~~
- `range`
- slicing
- tuple
- ~~`type`~~
- whitespace indentation
- zero-indexing

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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)

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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

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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~~

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Lecture 7: Recurrent Networks

- GRU
- LSTM
- recurrent neural networks
- SimpleRNN

Lecture 8: Transfer Learning

- ~~AlexNet, GoogLeNet, Inception~~
- ImageNet
- fine-tuning
- transfer learning

Lecture 8–9: Generative Networks

- autoencoder (~~variational~~)
- beam search
- bias
- ~~ChatGPT (& RLHF)~~
- ~~DeepDream~~
- ~~generative adversarial networks~~
- greedy sampling
- ~~Hugging Face~~
- language model
- latent space
- ~~neural style transfer~~
- softmax temperature
- stochastic sampling

Lecture 9: Interpretability

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

StoryWalls

1. ~~Go AI: 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~~

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