CSCM77
Revision

Porf. Xianghua Xie

x.xie@swansea.ac.uk

http://csvision.swan.ac.uk

Kinect

- Depth estimation using structured light
  - Depth from focus
  - Depth from stereo
- Body part estimation
  - Emphasis is on the understanding of supervised learning
- Classification
  - Unsupervised learning: clustering
  - Supervised learning: classification
  - Overfitting vs. underfitting
- Random Forests
  - Ensemble of bagged decision tree learners with randomised feature selection: concept of weak classifier ensemblement
  - Randomisation techniques: data & feature selection
  - Performance & efficiency compared to conventional decision tree

Camera Model and Calibration

- Camera models
  - Perspective model (most important)
    - Diagram
  - Weak and orthographic
- Parameters
  - Extrinsic parameters
  - Intrinsic paramters
- Camera calibration
  - Understanding the concept
  - No need to recite the equations

Stereo

- Stereo camera problems:
  - Correspondence
  - Reconstruction
- Epipolar geometry
  - Diagram
  - Concept & why it is useful
- Parameters
  - Intrinsic parameters
  - Extrinsic parameters
- Essential matrix & fundamental matrix
  - Understand its concept and purposes
  - No need to recite the equations

Stereo

- Correspondence search
  - Challenges
  - Methods
    - Correlation based
    - Feature based
    - Epipolar constraint based
- 3D reconstruction
  - Understand the concept
  - Diagram
  - No need to recite the equations

Motion & Tracking

- Motion and stereo
  - Difference and similarity
- Motion estimation vs. motion tracking
- Apparent and true motion
- Motion tracking
  - Feature
  - Motion model
  - Estimate trajectory

- Mean shift
  - Concept & how it is used to estimate modes
  - Parameter
  - Challenges: perturbation and sensitivity to kernel parameter

Filtering

- Convolution
  - Concept & how it operates: able to expand the convolution equation for a given convolution kernel
  - Understand the difference to correlation
- Edge detection
  - Concept: 1st order and 2nd order & their differences
  - Methods
  - Performance towards noise & accuracy in localising edges
- Median filtering
  - Concept
  - Difference to Gaussian filtering

Haar

- Wavelet
  - Concept
  - Haar wavelets

- Boosting
  - Concept of classifier boosting
  - Assumption of AdaBoost

- Cascading
  - Concept and how this applied in face detection

HoG

- HoG human detection assumptions
- General procedure

- SVM
  - Concept & what is a support vector
  - The principle of selecting a better decision making in SVM

- KNN
  - Concept and how it determines class label in classification
  - Difference to SVM

NN & CNN

- Perceptron
  - Concept
  - How it is approximated in NN
- Multi-layer NN

- CNN intro
  - Concept & how it is different to NN
  - Convolution layer and its purpose
  - Pooling techniques

CNN

- Convolution
  - 1D, 2D, multichannel
  - Nonlinear transformation and its role
  - Convolution with multiple filters
  - Activation functions (types and their characteristics)
  - Softmax for multiclass classification
  - Cost function for classification and regression
  - Typical CNN architectures
  - Overfitting problems with CNN

RCNN

- Image classification and object localization
  - Concepts
  - Relationship between the two
- Region proposal
  - Concept
  - Its role in RCNN
- RCNN
  - Fundamental concept of RCNN
  - Architecture
  - Training process
- Fast-RCNN & Faster-RCNN
  - What are the differences to RCNN and improvements
- Mean average precision

RNN & LSTM

- The role of memory in deep neural network

- RNN
  - How memory is modelled
  - Graphical representations
  - Parameters associated with memory unit
  - Key RNN types to handle different applications, e.g. many to many
  - Back propagation concept in RNN
  - Challenges with conventional RNN
    - Vanishing/exploding gradients
    - Long term memory issue
    - State update and memory selection problems

RNN & LSTM

- LSTM
  - Fundamental concept of LSTM
  - The key functions of the memory cell in LSTM
  - Types of LSTM nonlinear function
  - LSTM graphical representation
  - LSTM gates
  - Unrolling LSTM
  - Understand examples of LSTM application, e.g. text captioning.