1) Graph Based image segmentation(基於圖論的超像素分割方法)
- Def：Graph based image segmentation is modeled in terms of partitioning a graph into several sub-graphs such that each of them represents a meaningful object of interest in the image.
- Problems：ill-posed nature
- Techniques
  - MST(minimum spanning tree)
    - Given vertices which need to be connected, it is the tree that have min sum of weight.
  - Mini-Cut
    - Minimizing cut(A,B) makes vertices in different sets dissimilar.
    - Problems：Tends to cut small sets of isolated nodes in the graph since its cost function increases with the number of edges going across the two partitioned parts.
  - Normalized-cut
  - Max-Flow

2) Clustering Based Image Segmentation
-

	Time Complexity	Cluster number	initialization	Outliers
K-means	O(NKI)	pre-determined	sensitive	sensitive
SLIC	O(N)	pre-determined	sensitive	sensitive
Mean-Shift	O(N^2)	o.w.	non-sensitive	non-sensitive

- Clustering
  - intro.(process)
    - pattern
    - representation
    - feature extraction
    - pattern proximity
  - Supervise
  - Unsupervise
    - K-means
    - FCM(Fuzzy C-Means)
      - Allows one piece of data to belong to two or more clusters.
  - Superpixel Segmentation(基於梯度上升的超像素分割方法)
    - Superpixel(超像素)
      - 具有相似紋理、顏色、亮度等特徵的相鄰像素構成的圖像塊。
      - 帶有更多的資訊

- SLIC(Simple Linear Iterative Clustering)
  - adaption of k-means
  - clusters pixels in a 5 dim Euclidean space combining colors and images.
- Mean-shift

3) Image Inpainting
- reconstructing damaged or missing parts of an image or a video clip.

4) Image Watermarking(水印 -> 防偽)
- Application
  - Visible
  - Invisible
  - Medical image、Copyright
- Property
  - Intelligibility(可理解性): 對於最終收到該訊號的人來說，浮水印應該是可以被擷取出且確認的
  - Protection: 透過加密的方法，只有被允許的人可以更動浮水印的內容
  - Sturdiness: 浮水印需要有抵抗攻擊的能力，即使訊號被破壞，隱藏在其中的浮水印也應該盡可能的保持原貌
- Approach
  - Spatial
    - LSB
      - 相對簡單的隱藏浮水方法，雖然可以對於剪裁或者加入一些雜訊還可以抵抗，但像是破壞性的壓縮就可能導致浮水印也間接被破壞。或者我們甚至就簡單地把 least significant bit 都設成1就可以破壞掉浮水印。
  - Frequency
    - 浮水印技術在隱藏性和堅固性上比較優秀，將圖片轉換到頻率域，嵌入浮水印。
    - 如果嵌在高頻區，則浮水印更加看不見。如果嵌在低頻區，浮水印會更加穩定。
    - 講述影像嵌入的流程，先經過三階的小波分解，並在低頻區嵌入浮水印，放回低頻區，之後透過小波合成重建影像，則生成含浮水印的影像
    - DFT、DWT、DCT、DWT+DCT

5) Image stitching and mosaicking
- Intro
  - Stitching = alignment(Geometrical registration) + blending(Photometric registration)
  - Can not work when the scene with depth variations and the camera has movement.
- Method
  - Image stitching Alg
    - Keypoint detection

- - - Registration
    - Alignment
    - Blending
  - Application
    - Video stabilization、summarization、compression、matting
    - Panorama creation
    - Sports broadcasting

6) Image Quality Assessment
- Intro
  - IQA(圖像質量評估)
  - Subjective and Objective Methods
- Methods
  - Subjective
    - Give the score by human eyes
  - Objective
    - FR(Full reference)
      - MSE、PSNR、SSIM、VIF(visual information fidelity)
    - RR(Reduced reference)
      - RR-IQA
    - NR(Non reference)
      - CNN -IQA

7) CNN for image denoising
- Methods
  - Adaptive Thresholding
  - Edge Detection、Dilation、Erosion
  - Median Filtering
  - CNN Autoencoder & Ensemble Learning
    - Encoder：compress data to feature map
    - Decoder：reconstruct the representation
  - Cycle GAN

8) Texture Descriptors(紋理描述)
- Concept
  - one of image features provides spatial arrangement information about colors and intensities.
- Approaches
  - structural
    - Geometry-based texture descriptor
  - statistic
    - LBP(Local Binary Pattern)
    - co-occurence matrix
  - spectral
    - gabor filter

9) Visual Saliency
- Visual saliency
  - 目標就是分析人的視覺注意機制，並設計算法模擬之。
- Saliency map(顯著圖)
  - Def:
    https://zh.wikipedia.org/wiki/%E9%A1%AF%E8%91%97%E5%9C%96
- Method:
  - Ltti Method
  - FOA(Focus of attention)
  - DL Method
- Applications x 3
  - Visualizing image classification CNN Models by Saliency Maps
  - Task-driven Webpage saliency
  - Salient Object Detection Driven by Fixation Prediction(Based on DL)

10) Super resolution
- Intro
  - The goal of Super Resolution (SR) methods is to recover a High Resolution (HR) image from one or more Low Resolution (LR) input images
  - Motion compensation、Interpolation、Blur-noise removal
- Application
  - 衛星影像、顯微鏡影像、太空影像、醫學影像、深度圖、臉部影像
- Main approach
  - Traditional methods
    - Non-uniform Interpolation
  - ML methods
    - SR-CNN
    - FSR-CNN

11) HDR(high dynamic range) imaging
- 動態範圍 Dynamic 是指一個拍攝場合下「最亮與最暗明度的比值」比值越大也代表明暗反差越大，則動態範圍也越高。
- HDR Photography is best used when the contrast of the scene exceeds your camera's range
- It preserves the details in highlights and shadows
- Don't use HDR for every scene

12) Computed Tomography
- App
  - radiology
  - introduce in X-ray and CT that how to reconstruction the image
    - CT (photo by X-ray machine)
  - Industrial tomography