# Image Processing and Analysis

# Term Project Topics

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# Topic 1: Image classification: cats vs. dogs

* **Goal:** to build a deep learning solution, i.e., a 2-class classifier (using MATLAB®), that is capable of predicting whether an input color image containing an animal represents a *cat* or a *dog*.
* **Dataset:** *cats and dogs* dataset from Kaggle   
  ( <https://www.kaggle.com/c/dogs-vs-cats/data> )
* **References:**
  1. <https://www.kaggle.com/c/dogs-vs-cats> (more details about the Kaggle challenge associated with the dataset)
  2. <https://www.mathworks.com/help/deeplearning/deep-learning-with-images.html> (deep learning with images using MATLAB)
  3. <https://www.mathworks.com/help/deeplearning/gs/get-started-with-transfer-learning.html> (transfer learning using MATLAB)
  4. <https://www.mathworks.com/help/deeplearning/ug/pretrained-convolutional-neural-networks.html> (pre-trained networks available in MATLAB)

# Topic 2: Skin lesion classification

* **Goal:** to build a deep learning solution (using MATLAB) that is capable of classifying an input color image containing a skin lesion into its type (7-class classifier) or (for simplicity) as *benign* or *malignant* (2-class classifier).
* **Dataset:** The HAM10000 dataset, available on Kaggle: <https://www.kaggle.com/kmader/skin-cancer-mnist-ham10000>
  + HAM10000 [5] is a large collection of multi-source dermatoscopic images. It is pre-classiﬁed into 7 diﬀerent classes: Melanocytic nevi, Melanoma, Benign keratosis-like lesions, Basal cell carcinoma, Actinic keratoses, Vascular lesions, and Dermatoﬁbroma.
* **References:**
  1. P. Tschandl, C. Rosendahl, H. Kittler, The HAM10000 dataset, a large collection of multi-source dermatoscopic images of common pigmented skin lesions, Scientiﬁc data 5 (2018) 180161. <https://www.nature.com/articles/sdata2018161>
  2. Alex Yu. Building a Skin Lesion Classification Web App. <https://towardsdatascience.com/building-a-skin-lesion-classification-web-app-16fd2c422b9d>
  3. Aryan Misra. Classifying Skin Lesions with Convolutional Neural Networks.  
     <https://towardsdatascience.com/classifying-skin-lesions-with-convolutional-neural-networks-fc1302c60d54>

# Topic 3: Single image super-resolution using deep learning

* **Goal:** to estimate a high-resolution image from a single low-resolution image using a Very-Deep Super-Resolution (VDSR) neural network.
* **Dataset:** IAPR TC-12 Benchmark, available free of charge and without any copyright restrictions: <http://www-i6.informatik.rwth-aachen.de/imageclef/resources/iaprtc12.tgz>
  + The dataset consists of 20,000 still natural images taken from locations around the world and comprising an assorted cross-section of still natural images. This includes pictures of different sports and actions, photographs of people, animals, cities, landscapes and many other aspects of contemporary life [8].
* **References:**
  1. IAPR TC-12 Benchmark (2020). <https://www.imageclef.org/photodata>
  2. Single Image Super-Resolution Using Deep Learning. MathWorks (2020). <https://www.mathworks.com/help/images/single-image-super-resolution-using-deep-learning.html>
  3. Grubinger, M., P. Clough, H. Müller, and T. Deselaers. "The IAPR TC-12 Benchmark: A New Evaluation Resource for Visual Information Systems." *Proceedings of the OntoImage 2006 Language Resources For Content-Based Image Retrieval*. Genoa, Italy. Vol. 5, May 2006, p. 10.
  4. Kim, J., J. K. Lee, and K. M. Lee. "Accurate Image Super-Resolution Using Very Deep Convolutional Networks." *Proceedings of the IEEE® Conference on Computer Vision and Pattern Recognition*. 2016, pp. 1646-1654.
  5. He, K., X. Zhang, S. Ren, and J. Sun. "Delving Deep into Rectifiers: Surpassing Human-Level Performance on ImageNet Classification." *Proceedings of the IEEE International Conference on Computer Vision*, 2015, pp. 1026-1034.