## References

- [1] N. H. Lents, "The Poor Design of the Human Eye," 2015. [Online]. Available: https://thehumanevolutionblog.com/2015/01/12/the-poor-design-of-the-human-eye/. [Accessed: 10-May-2019].
- [2] H. Li and O. Chutatape, "Fundus image features extraction," *Annu. Int. Conf. IEEE Eng. Med. Biol. - Proc.*, vol. 4, pp. 3071–3073, 2000.
- [3] M. Garcia, R. Hornero, C. I. Sanchez, M. I. Lopez, and A. Diez, "Feature Extraction and Selection for the Automatic Detection of Hard Exudates in Retinal Images," in 29th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, 2007, pp. 4969–4972.
- [4] T. R. C. of Ophthalmologists, "The Royal College of Ophthalmologists Diabetic Retinopathy Guidelines," *Diabet. Retin. Guidel.*, 2013.
- [5] World Health Organization, *Global Report on Diabetes*. 2016.
- [6] A. Tamkin, I. Usiri, and C. Fufa, "Deep CNNs for Diabetic Retinopathy Detection," pp. 1–6, 2013.
- [7] G. M. Galshetwar, L. M. Waghmare, A. B. Gonde, and S. Murala, "Edgy salient local binary patterns in inter-plane relationship for image retrieval in Diabetic Retinopathy," *Procedia Comput. Sci.*, vol. 115, pp. 440–447, Jan. 2017.
- [8] C. G. Baby and D. A. Chandy, "Content-based retinal image retrieval using dual-tree complex wavelet transform," in 2013 International Conference on Signal Processing, Image Processing & Pattern Recognition, 2013, pp. 195– 199.
- [9] Sivakamasundari J., Kavitha G., Natarajan V., and Ramakrishnan S., "Proposal of a Content Based retinal Image Retrieval system using Kirsch template based edge detection," in 2014 International Conference on Informatics, Electronics & Vision (ICIEV), 2014, pp. 1–5.
- [10] U. T. V. Nguyen, A. Bhuiyan, L. A. F. Park, and K. Ramamohanarao, "An effective retinal blood vessel segmentation method using multi-scale line detection," *Pattern Recognit.*, vol. 46, no. 3, pp. 703–715, Mar. 2013.
- [11] G. Litjens *et al.*, "A survey on deep learning in medical image analysis," *Med. Image Anal.*, vol. 42, pp. 60–88, Dec. 2017.
- [12] M. Shakeri *et al.*, "Sub-cortical brain structure segmentation using F-CNN'S," in 2016 IEEE 13th International Symposium on Biomedical Imaging (ISBI), 2016, pp. 269–272.

- [13] D. Ciresan, U. Meier, and J. Schmidhuber, "Multi-column deep neural networks for image classification," in 2012 IEEE Conference on Computer Vision and Pattern Recognition, 2012, pp. 3642–3649.
- [14] A. Karpathy, G. Toderici, S. Shetty, T. Leung, R. Sukthankar, and L. Fei-Fei, "Large-Scale Video Classification with Convolutional Neural Networks," in 2014 IEEE Conference on Computer Vision and Pattern Recognition, 2014, pp. 1725–1732.
- [15] C. Szegedy, A. Toshev, and D. Erhan, "Deep Neural Networks for Object Detection," in *NIPS*, 2013, pp. 2553–2561.
- [16] J. Long, E. Shelhamer, and T. Darrell, "Fully convolutional networks for semantic segmentation," in 2015 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2015, pp. 3431–3440.
- [17] "All About Vision Complete Guide To Vision and Eye Care." [Online]. Available: https://www.allaboutvision.com/. [Accessed: 02-Dec-2018].
- [18] Y. LeCun *et al.*, "Handwritten Digit Recognition with a Back-Propagation Network," in *NIPS*, 1990, pp. 396–404.
- [19] A. Krizhevsky, I. Sutskever, and G. E. Hinton, "ImageNet Classification with Deep Convolutional Neural Networks," in *NIPS*, 2012, pp. 1097–1105.
- [20] K. Simonyan and A. Zisserman, "Very deep convolutional networks for large-scale image recognition," in *ICLR*, 2015.
- [21] C. Szegedy, V. Vanhoucke, S. Ioffe, J. Shlens, and Z. Wojna, "Rethinking the Inception Architecture for Computer Vision," in 2016 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2016, pp. 2818–2826.
- [22] F. Chollet, "Xception: Deep Learning with Depthwise Separable Convolutions," in 2017 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2017, pp. 1800–1807.
- [23] K. He, X. Zhang, S. Ren, and J. Sun, "Deep Residual Learning for Image Recognition," in 2016 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2016, pp. 770–778.
- [24] G. Huang, Z. Liu, L. van der Maaten, and K. Q. Weinberger, "Densely Connected Convolutional Networks," in 2017 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2017, pp. 2261–2269.
- [25] V. Nair and G. E. Hinton, "Rectified linear units improve restricted boltzmann machines," in *In the 27th International Conference on International Conference on Machine Learning*, 2010, pp. 807–814.
- [26] J. Gu et al., "Recent Advances in Convolutional Neural Networks," Dec.

2015.

- [27] G. E. Hinton, N. Srivastava, A. Krizhevsky, I. Sutskever, and R. R. Salakhutdinov, "Improving neural networks by preventing co-adaptation of feature detectors," Jul. 2012.
- [28] N. Srivastava, G. Hinton, A. Krizhevsky, I. Sutskever, and R. Salakhutdinov, "Dropout: A Simple Way to Prevent Neural Networks from Overfitting," J. Mach. Learn. Res., vol. 15, pp. 1929–1958, 2014.
- [29] M. Esnaashari, S. Amirhassan Monadjemi, and G. Naderian, "A Contentbased Retinal Image Retrieval Method for Diabetes-Related Eye Diseases Diagnosis," *Int. J. Res. Rev. Comput. Sci.*, vol. 2, no. 6, 2011.
- [30] J. Jun Wang, S. Kumar, and S.-F. Shih-Fu Chang, "Semi-Supervised Hashing for Large-Scale Search," *IEEE Trans. Pattern Anal. Mach. Intell.*, vol. 34, no. 12, pp. 2393–2406, Dec. 2012.
- [31] M. Datar, N. Immorlica, P. Indyk, and V. S. Mirrokni, "Locality-sensitive hashing scheme based on p-stable distributions," in *Proceedings of the twentieth annual symposium on Computational geometry SCG '04*, 2004, p. 253.
- [32] K. Lin, H.-F. Yang, J.-H. Hsiao, and C.-S. Chen, "Deep learning of binary hash codes for fast image retrieval," in 2015 IEEE Conference on Computer Vision and Pattern Recognition Workshops (CVPRW), 2015, pp. 27–35.
- [33] Wei Liu, Jun Wang, Rongrong Ji, Yu-Gang Jiang, and Shih-Fu Chang, "Supervised hashing with kernels," in 2012 IEEE Conference on Computer Vision and Pattern Recognition, 2012, pp. 2074–2081.
- [34] D. Ciresan, U. Meier, and J. Schmidhuber, "Multi-column deep neural networks for image classification," in 2012 IEEE Conference on Computer Vision and Pattern Recognition, 2012, pp. 3642–3649.
- [35] A. Karpathy, G. Toderici, S. Shetty, T. Leung, R. Sukthankar, and L. Fei-Fei, "Large-Scale Video Classification with Convolutional Neural Networks," in 2014 IEEE Conference on Computer Vision and Pattern Recognition, 2014, pp. 1725–1732.
- [36] C. Szegedy, A. Toshev, and D. Erhan, "Deep Neural Networks for Object Detection," in *NIPS*, 2013, pp. 2553–2561.
- [37] J. Long, E. Shelhamer, and T. Darrell, "Fully convolutional networks for semantic segmentation," in 2015 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2015, pp. 3431–3440.
- [38] A. Krizhevsky and G. E. Hinton, "Using Very Deep Autoencoders for Content-Based Image Retrieval," in 19th European Symposium on Artificial

Neural Networks, 2011.

- [39] L. Getoor, T. Scheffer, and International Machine Learning Society., "Minimal loss hashing for compact binary codes," in *Proceedings of the 28th International Conference on International Conference on Machine Learning*, 2011, p. 1216.
- [40] Y. Weiss, A. Torralba, and R. Fergus, "Spectral Hashing," in Advances in neural information processing systems, 2009, pp. 1753–1760.
- [41] H. Lai, Y. Pan, Y. Liu, and S. Yan, "Simultaneous Feature Learning and Hash Coding with Deep Neural Networks," Apr. 2015.
- [42] H. Zhu, M. Long, J. Wang, and Y. Cao, "Deep Hashing Network for Efficient Similarity Retrieval \*," in *Thirtieth AAAI Conference on Artificial Intelligence*, 2016.
- [43] H. Fujita *et al.*, "Computer-aided diagnosis: The emerging of three CAD systems induced by Japanese health care needs," *Comput. Methods Programs Biomed.*, 2008.
- [44] S. C. Lee, E. T. Lee, Y. Wang, R. Klein, R. M. Kingsley, and A. Warn, "Computer Classification of Nonproliferative Diabetic Retinopathy," Arch. Ophthalmol., vol. 123, no. 6, p. 759, Jun. 2005.
- [45] S. Roychowdhury, D. D. Koozekanani, and K. K. Parhi, "DREAM: Diabetic Retinopathy Analysis Using Machine Learning," *IEEE J. Biomed. Heal. Informatics*, vol. 18, no. 5, pp. 1717–1728, Sep. 2014.
- [46] U. R. Acharya, C. M. Lim, E. Y. K. Ng, C. Chee, and T. Tamura, "Computerbased detection of diabetes retinopathy stages using digital fundus images," *Proc. Inst. Mech. Eng. Part H J. Eng. Med.*, vol. 223, no. 5, pp. 545–553, Jul. 2009.
- [47] J. Nayak, P. S. Bhat, R. Acharya, C. M. Lim, and M. Kagathi, "Automated identification of diabetic retinopathy stages using digital fundus images.," J. Med. Syst., vol. 32, no. 2, pp. 107–15, Apr. 2008.
- [48] C. Sinthanayothin, V. Kongbunkiat, S. Phoojaruenchanachai, and A. Singalavanija, "Automated screening system for diabetic retinopathy," in 3rd International Symposium on Image and Signal Processing and Analysis, 2003. ISPA 2003. Proceedings of the, vol. 2, pp. 915–920.
- [49] N. Larsen, J. Godt, M. Grunkin, H. Lund-Andersen, and M. Larsen, "Automated Detection of Diabetic Retinopathy in a Fundus Photographic Screening Population," *Investig. Opthalmology Vis. Sci.*, vol. 44, no. 2, p. 767, Feb. 2003.
- [50] A. Singalavanija, J. Supokavej, P. Bamroongsuk, C. Sinthanayothin, S.

Phoojaruenchanachai, and V. Kongbunkiat, "Feasibility Study on Computer-Aided Screening for Diabetic Retinopathy," *Jpn. J. Ophthalmol.*, vol. 50, no. 4, pp. 361–366, Aug. 2006.

- [51] P. Kahai, K. R. Namuduri, and H. Thompson, "A Decision Support Framework for Automated Screening of Diabetic Retinopathy," Int. J. Biomed. Imaging, vol. 2006, pp. 1–8, Feb. 2006.
- [52] S. Giraddi, J. Pujari, and S. Seeri, "Identifying Abnormalities in the Retinal Images using SVM Classifiers," *Int. J. Comput. Appl.*, vol. 111, no. 6, pp. 5–8, Feb. 2015.
- [53] W. L. Yun, U. Rajendra Acharya, Y. V. Venkatesh, C. Chee, L. C. Min, and E. Y. K. Ng, "Identification of different stages of diabetic retinopathy using retinal optical images," *Inf. Sci.* (*Ny*)., vol. 178, no. 1, pp. 106–121, Jan. 2008.
- [54] Q. Li, X.-M. Jin, Q. Gao, J. You, and P. Bhattacharya, "Screening Diabetic Retinopathy Through Color Retinal Images," in *1st International Conference on Medical Biometrics*, 2008, pp. 176–183.
- [55] S. S. A. Hassan, D. B. L. Bong, and M. Premsenthil, "Detection of Neovascularization in Diabetic Retinopathy," *J. Digit. Imaging*, vol. 25, no. 3, pp. 437–444, Jun. 2012.
- [56] S. S. Rahim, V. Palade, J. Shuttleworth, and C. Jayne, "Automatic screening and classification of diabetic retinopathy and maculopathy using fuzzy image processing," *Brain Informatics*, vol. 3, no. 4, pp. 249–267, Dec. 2016.
- [57] M. Alban and T. Gilligan, "Automated Detection of Diabetic Retinopathy using Fluorescein Angiography Photographs," 2016.
- [58] A. Krizhevsky, I. Sutskever, and G. E. Hinton, "Imagenet classification with deep convolutional neural networks," *Adv. Neural Inf. Process. Syst.*, pp. 1097--1105, 2012.
- [59] C. Szegedy *et al.*, "Going deeper with convolutions," in 2015 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2015, pp. 1–9.
- [60] D. T. Butterworth, S. Mukherjee, and M. Sharma, "Ensemble Learning for Detection of Diabetic Retinopathy," in *NIPS*, 2016.
- [61] K. He, X. Zhang, S. Ren, and J. Sun, "Deep Residual Learning for Image Recognition," in 2016 IEEE Conference on Computer Vision and Pattern Recognition (CVPR), 2016, pp. 770–778.
- [62] V. Thambawita *et al.*, "The Medico-Task 2018: Disease Detection in the Gastrointestinal Tract using Global Features and Deep Learning," Oct. 2018.

- [63] C. E. Baudoin, B. J. Lay, and J. C. Klein, "Automatic detection of microaneurysms in diabetic fluorescein angiography.," *Rev. Epidemiol. Sante Publique*, vol. 32, no. 3–4, pp. 254–61, 1984.
- [64] T. Spencer, J. A. Olson, K. C. McHardy, P. F. Sharp, and J. V Forrester, "An image-processing strategy for the segmentation and quantification of microaneurysms in fluorescein angiograms of the ocular fundus.," *Comput. Biomed. Res.*, vol. 29, no. 4, pp. 284–302, Aug. 1996.
- [65] Xiaohui Zhang and O. Chutatape, "A SVM approach for detection of hemorrhages in background diabetic retinopathy," in *Proceedings. 2005 IEEE International Joint Conference on Neural Networks, 2005.*, vol. 4, pp. 2435– 2440.
- [66] G. Quellec, M. Lamard, P. M. Josselin, G. Cazuguel, B. Cochener, and C. Roux, "Optimal Wavelet Transform for the Detection of Microaneurysms in Retina Photographs," *IEEE Trans. Med. Imaging*, vol. 27, no. 9, pp. 1230–1241, Sep. 2008.
- [67] G. B. Kande, T. S. Savithri, P. V. Subbaiah, and M. R. M. Tagore, "Detection of red lesions in digital fundus images," in 2009 IEEE International Symposium on Biomedical Imaging: From Nano to Macro, 2009, pp. 558– 561.
- [68] A. J. Frame *et al.*, "A comparison of computer based classification methods applied to the detection of microaneurysms in ophthalmic fluorescein angiograms.," *Comput. Biol. Med.*, vol. 28, no. 3, pp. 225–38, May 1998.
- [69] M. Niemeijer, B. van Ginneken, J. Staal, M. S. A. Suttorp-Schulten, and M. D. Abramoff, "Automatic detection of red lesions in digital color fundus photographs," *IEEE Trans. Med. Imaging*, vol. 24, no. 5, pp. 584–592, May 2005.
- [70] Huan Wang, Wynne Hsu, Kheng Guan Goh, and Mong Li Lee, "An effective approach to detect lesions in color retinal images," in *Proceedings IEEE Conference on Computer Vision and Pattern Recognition. CVPR 2000 (Cat. No.PR00662)*, vol. 2, pp. 181–186.
- [71] R. Phillips, J. Forrester, and P. Sharp, "Automated detection and quantification of retinal exudates.," *Graefes Arch. Clin. Exp. Ophthalmol.*, vol. 231, no. 2, pp. 90–4, Feb. 1993.
- [72] T. Walter, J. Klein, P. Massin, and A. Erginay, "A contribution of image processing to the diagnosis of diabetic retinopathy-detection of exudates in color fundus images of the human retina," *IEEE Trans. Med. Imaging*, vol. 21, no. 10, pp. 1236–1243, Oct. 2002.
- [73] C. I. Sánchez, M. García, A. Mayo, M. I. López, and R. Hornero, "Retinal

image analysis based on mixture models to detect hard exudates," *Med. Image Anal.*, vol. 13, no. 4, pp. 650–658, Aug. 2009.

- [74] Lili Xu and Shuqian Luo, "Support vector machine based method for identifying hard exudates in retinal images," in 2009 IEEE Youth Conference on Information, Computing and Telecommunication, 2009, pp. 138–141.
- [75] R. Nekovei and Ying Sun, "Back-propagation network and its configuration for blood vessel detection in angiograms," *IEEE Trans. Neural Networks*, vol. 6, no. 1, pp. 64–72, 1995.
- [76] C. Sinthanayothin, J. Boyce, H. Cook, and T. Williamson, "Automated localisation of the optic disc, fovea, and retinal blood vessels from digital colour fundus images," *Br. J. Ophthalmol.*, vol. 83, no. 8, p. 902, Aug. 1999.
- [77] J. Staal, M. D. Abramoff, M. Niemeijer, M. A. Viergever, and B. van Ginneken, "Ridge-Based Vessel Segmentation in Color Images of the Retina," *IEEE Trans. Med. Imaging*, vol. 23, no. 4, pp. 501–509, Apr. 2004.
- [78] J. V. B. Soares, J. J. G. Leandro, R. M. Cesar, H. F. Jelinek, and M. J. Cree, "Retinal vessel segmentation using the 2-D Gabor wavelet and supervised classification," *IEEE Trans. Med. Imaging*, vol. 25, no. 9, pp. 1214–1222, Sep. 2006.
- [79] A. D. Hoover, V. Kouznetsova, and M. Goldbaum, "Locating blood vessels in retinal images by piecewise threshold probing of a matched filter response," *IEEE Trans. Med. Imaging*, vol. 19, no. 3, pp. 203–210, Mar. 2000.
- [80] C. A. Lupascu, D. Tegolo, and E. Trucco, "FABC: Retinal Vessel Segmentation Using AdaBoost," *IEEE Trans. Inf. Technol. Biomed.*, vol. 14, no. 5, pp. 1267–1274, Sep. 2010.
- [81] X. You, Q. Peng, Y. Yuan, Y. Cheung, and J. Lei, "Segmentation of retinal blood vessels using the radial projection and semi-supervised approach," *Pattern Recognit.*, vol. 44, no. 10–11, pp. 2314–2324, Oct. 2011.
- [82] S. Roychowdhury, D. Koozekanani, and K. Parhi, "Blood Vessel Segmentation of Fundus Images by Major Vessel Extraction and Sub-Image Classification," *IEEE J. Biomed. Heal. Informatics*, pp. 1–1, 2014.
- [83] S. Wang, Y. Yin, G. Cao, B. Wei, Y. Zheng, and G. Yang, "Hierarchical retinal blood vessel segmentation based on feature and ensemble learning," *Neurocomputing*, vol. 149, pp. 708–717, Feb. 2015.
- [84] S. A. Salem, N. M. Salem, and A. K. Nandi, "Segmentation of retinal blood vessels using a novel clustering algorithm (RACAL) with a partial supervision strategy," *Med. Biol. Eng. Comput.*, vol. 45, no. 3, pp. 261–273, Feb. 2007.
- [85] G. B. Kande, P. V. Subbaiah, and T. S. Savithri, "Unsupervised Fuzzy Based

Vessel Segmentation In Pathological Digital Fundus Images," J. Med. Syst., vol. 34, no. 5, pp. 849–858, Oct. 2010.

- [86] Y. Zhao, L. Rada, K. Chen, S. P. Harding, and Y. Zheng, "Automated Vessel Segmentation Using Infinite Perimeter Active Contour Model with Hybrid Region Information with Application to Retinal Images," *IEEE Trans. Med. Imaging*, vol. 34, no. 9, pp. 1797–1807, Sep. 2015.
- [87] "Diabetic Retinopathy Detection | Kaggle." [Online]. Available: https://www.kaggle.com/c/diabetic-retinopathy-detection. [Accessed: 03-Oct-2018].
- [88] K. Pogorelov et al., "KVASIR," in Proceedings of the 8th ACM on Multimedia Systems Conference - MMSys'17, 2017, pp. 164–169.
- [89] S. Ioffe and C. Szegedy, "Batch Normalization: Accelerating Deep Network Training by Reducing Internal Covariate Shift," in *ICLR*, 2015, pp. 448–456.
- [90] K. He, X. Zhang, S. Ren, and J. Sun, "Delving Deep into Rectifiers: Surpassing Human-Level Performance on ImageNet Classification," Feb. 2015.
- [91] C. Szegedy, S. Ioffe, V. Vanhoucke, and A. Alemi, "Inception-v4, Inception-ResNet and the Impact of Residual Connections on Learning," Feb. 2016.
- [92] V. Thambawita *et al.*, "The Medico-Task 2018: Disease Detection in the Gastrointestinal Tract using Global Features and Deep Learning," Oct. 2018.
- [93] A. H. Shahin, A. Kamal, and M. A. Elattar, "Deep Ensemble Learning for Skin Lesion Classification from Dermoscopic Images," in 2018 9th Cairo International Biomedical Engineering Conference (CIBEC), 2018, pp. 150– 153.
- [94] A. Kumar, J. Kim, D. Lyndon, M. Fulham, and D. Feng, "An Ensemble of Fine-Tuned Convolutional Neural Networks for Medical Image Classification," *IEEE J. Biomed. Heal. Informatics*, vol. 21, no. 1, pp. 31–40, Jan. 2017.
- [95] R. Xia, Y. Pan, H. Lai, C. Liu, and S. Yan, "Supervised hashing for image retrieval via image representation learning," in *Proceedings of the National Conference on Artificial Intelligence*, 2014.