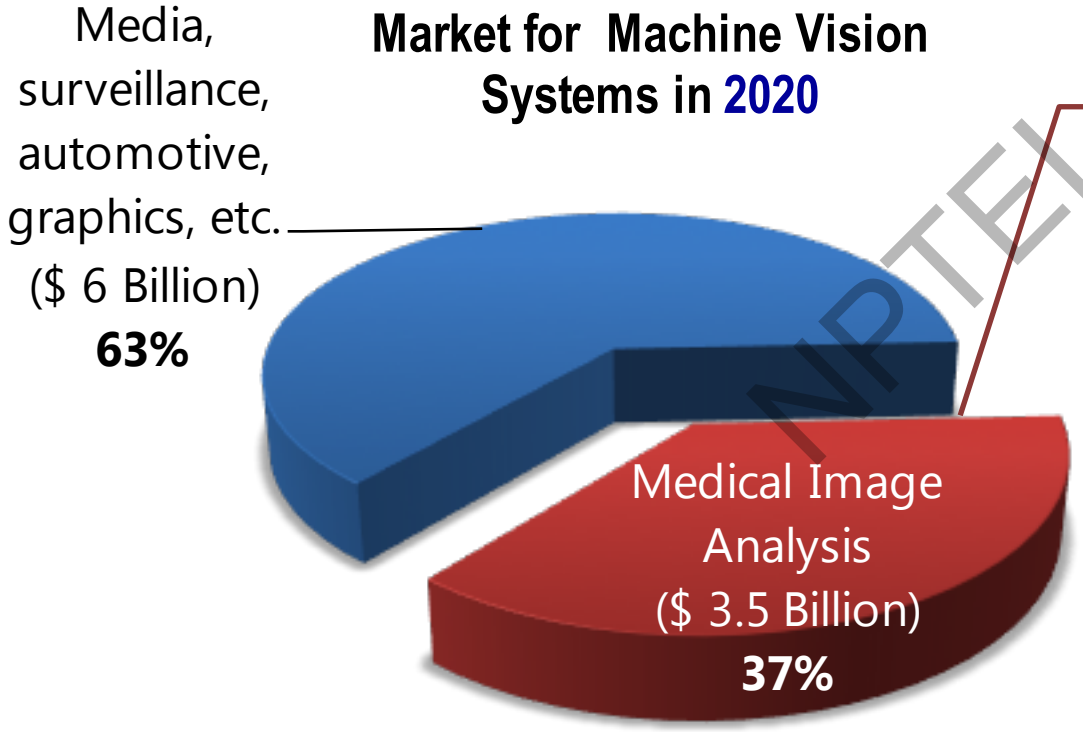
Deep Learning for Visual Computing

Dr. Debdoot Sheet
Assistant Professor
Department of Electrical Engineering
Indian Institute of Technology Kharagpur

www.facweb.iitkgp.ernet.in/~debdoot/

A GREAT PIECE OF CAREER ADVICE FOR EECS GRADUATES

Market Scenario and Career



Report code: HIT 1309 and SE 2701 from www.marketsandmarkets.com

Modality
- X-ray
- Ultrasound
- Computed Tomography (CT)
- Magnetic Resonance (MRI)
- Nuclear Imaging (PET & SPECT)

Clinical Indications
- Radiology
- Cardiology
- Oncology
- Neurology
- Obstetrics & gynecology
- Breast mammography

End Users
- Hospitals
- Diagnostic centers
- Research centers

Visual Computing in Medicine

Tong, S.; Sheet, D.; Bhuiyan, S.; Zequer Diaz, M.; Taberne, A., "BME Trends Around the World : From Baby X to frugal technologies, here's what biomedical engineers are excited about in 2015. [From the Editors]," *IEEE Pulse*, vol.6, no.1, pp.4-6, Jan.-Feb. 2015

Organization

- **Week 1**
  - Introduction to Visual Computing and Neural Networks
- **Week 2**
  - Multilayer perceptron to Deep Neural Networks
- **Week 3**
  - Autoencoders for Representation Learning
- **Week 4**
  - Stacked, Sparse, Denoising Autoencoders and Ladder Training
- **Week 5**
  - Cost functions, Learning Rate Dynamics and Optimization
- **Week 6**
  - Convolutional Neural Networks (CNN)
- **Week 7**
  - Convolutional Autoencoders and Deep CNN (AlexNet, VGGNet)
- **Week 8**
  - Very Deep CNN for Classification (GoogLeNet, ResNet, DenseNet)
- **Week 9**
  - Computational Complexity and Transfer Learning
- **Week 10**
  - Object Localization (RCNN) and Semantic Segmentation
- **Week 11**
  - Generative Models with Adversarial Learning
- **Week 12**
  - Recurrent Neural Networks (RNN) for Video Classification

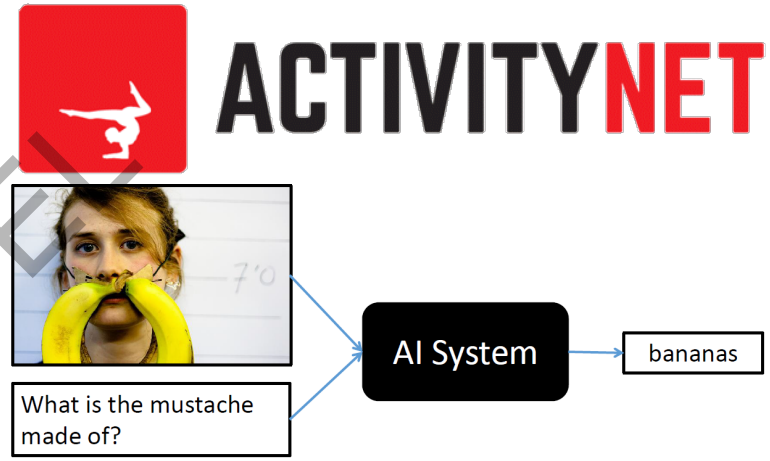
Last 35 years of Visual Computing

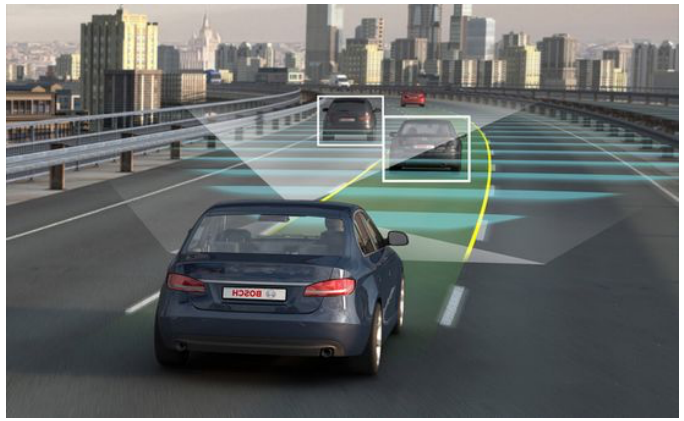
- Pre 1980 – 1984: Era of Pattern Recognition Analysis of 2D Images
- 1985 – 1991: Knowledge based Approaches
- 1992 – 1998: 3D Images and Towards Integrated Analysis
- 1999 – 2010: Machine Learning with Shallow Reasoning
- 2010 and Beyond: Machine Learning with Complex Reasoning

Duncan, J.S.; Ayache, N., "Medical image analysis: progress over two decades and the challenges ahead," *IEEE Trans. Pat. Anal., Mach. Intell.,* vol.22, no.1, pp.85,106, Jan. 2000

Visual Computing Challenges in 2018

- Activity classification in videos
- Computational Cameras and Displays
- Computer Vision in Sports
- Visual Question Answering
- Autonomous Driving





CAREER ADVICES FOR ASPIRANTS

Find a (Research) Challenge

- Kaggle
- Grand Challenges in Biomedical Image Analysis
  - www.grand-challenges.org
- CVPR
- ICCV
- ECCV
- BMVC
- ACCV

Tool(boxes) of the Trade

- Anaconda
  - Python 2.7 with scientific computing library for custom building tools
  - https://www.continuum.io/downloads/
- PyTorch
  - Used for Deep Learning
  - www.pytorch.org
- Matlab
  - Matrix laboratory scientific computing tool
  - https://www.mathworks.com/
- CUDA
  - Library for using NVIDIA GPUs

Where to Read for ML/DL?

Journal

- IEEE Trans. Pattern Analysis and Machine Intelligence
- Machine Learning
- J. Machine Learning Research
- IEEE Trans. Knowledge and Data Engineering
- IEEE Trans. Neural Networks
- IEEE Trans. Sys. Man. Cyber.

Conferences

- Computer Vision and Pattern Recognition (CVPR)
- Machine Learning confs.
  - International (ICML)
  - European (ECML)
  - Asian (ACML)
  - Neural Information Processing System (NIPS)
- Computer Vision conf.
  - International (ICCV)
  - European (ECCV)
  - Asian (ACCV)

Where to Listen and Socialize?

Workshops and Schools

- International Computer Vision Summer School (ICVSS)
- Machine Learning Summer School (MLSS)
- Deep Learning Summer School (DLSS)
  - MILA, Montreal

Conferences

- Indian Conference on Computer Vision, Graphics and Image Processing (ICVGIP)
- National Conference on Computer Vision, Pattern Recognition, Image Processing and Graphics (NCVPRIPG)