CURRICULUM VITAE

PERSONAL DETAILS

Name: **Aharon Bar Hillel**

Date & Place of Birth: July 5 1971, Beer-Sheva, Israel

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     Industrial Engineering and Management
     Ben Gurion University of the Negev
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EDUCATION

B.A.   1993-1996   Tel-Aviv University, *Mathematics and Philosophy (Double Major). Graduated magna cum laude.*

Ph.D.   1999-2006   The Hebrew University, *Neural computation,* at under Prof. Daphna Weinshall, the Interdisciplinary Center for Neural Computation (ICNC). Doctoral dissertation: "Learning from weak representation using distance function and generative models"

Thesis description: The research domains were Machine Learning and Computer Vision. In Machine learning, I developed theory and algorithms for distance function learning and semi-supervised clustering using equivalence constraints. In Computer Vision I developed part-based algorithms for object class and sub-class recognition and detection.

EMPLOYMENT HISTORY

2017 -	Senior lecturer in the Industrial Engineering and management department, Ben-Gurion University.

Research Interests: Computer vision, machine learning and its applications, deep learning.

2013 - 2016	Senior Researcher at Microsoft Research, Israel

Research and development in computer vision and machine learning: Development of very fast classifiers, based on table ensembles and convolutional neural networks. Specifically these classifiers are used in the Xbox-1 console. Face recognition in RGB, depth and IR images. Hand pose recognition and estimation.

2009 - 2013	Senior Research scientist at ATCI, GM research

Research and development in several areas: In pedestrian and children detection we developed a world-class system from both academic and product point of view, expected to be part of GMs rear camera in near years. Other projects include: Object class recognition in a 2D+3D camera, visual tracking of rigid and non-rigid objects, fast nearest neighbor finding in high dimensions, target classification from Radar signal, speaker recognition from audio signal, and validation tools for vision-based automotive features.

2006 - 2009	Research scientist and architect at Intel

2006-2008 - Work in the Intelligent Grid Management project, in which machine learning methods were applied to achieve performance optimization of large computer grids. Used primarily reinforcement learning techniques to increase the grid's throughput. The algorithm I developed was found preferable over competing alternatives and was chosen for deployment.
2008-2009 - Work in the architecture group on hardware planning for 2015/2016 CPUs.

2003 - 2004	Teaching Assistant in the ICNC program

Teaching the course "Neural Networks 2".

2000 - 2002	Algorithms designer at Meicom. (Now part of CEVA)

Design and implementation of algorithms for image compression and real time encoding/decoding of digital video (mpeg2). Specifically, I developed

algorithms for compression of .jpeg files (which are already compressed images), achieving further compression of 25%.

1998 - 2000   Computer science teacher at "Hacker software"

Teaching courses in a training program for the software industry. I taught the following courses: Data structures, Algorithms, Operating systems, Computer architecture, C++ and Java programming languages.

1996 - 1998   Teaching assistant at the Philosophy department, Tel-Aviv University

I taught the courses: Introduction to Logic, Advanced Logic, and Guided Reading 1.

PROFESSIONAL ACTIVITIES

Reviewed conference papers for the conferences:

- CVPR (Computer Vision and Pattern Recognition)
- ECCV (European Conference on Computer Vision)
- NIPS (Neural Information Processing Systems)
- ICML (International Conference of Machine Learning)
- ECML (European Conference of Machine Learning)
- ECPA (European Conference on Precision Agriculture)

Reviewed papers for the journals:

- JMLR (Journal of Machine Learning Research)
- PAMI (Pattern Analysis and Machine Intelligence)
- IJCV (International Journal of Computer Vision)
- TIP (Transactions on Image Processing)
- MVAP (Machine Vision Applications)
- CVIU (Computer Vision and Image Understanding)
- DAMI (Data Mining and Knowledge Discovery)
- Precision Agriculture
- PLOS Computational Biology

HONORS

2004 - 2006   Horowitz Fellowships – 2004-2006, Ph.D. excellence grant from the Horowitz Foundation.

1994 – 1996   Dean's list in Faculty of Exact Sciences – 1994-1996, Tel-Aviv University

EDUCATIONAL ACTIVITIES

(a) Courses taught in Ben-Gurion University

- 2017, 2020: Learning, Representation and Vision, 2nd degree, BGU
- 2017- 2020: Information systems infrastructure, 1st degree, BGU
- 2018 -2020: Learning and Neural Networks, 1st degree, BGU

(b) Research students at BGU

Note: IEM stands for Industrial Engineering and Management, EE for Electric Engineering, ISE for Information System Engineering

Ph.D students:

- Faina Khoroshevsky (IEM). 2017-
  "A deep modular approach for solving multi-stage computer vision tasks with real world data"
- Liel Cohen (IEM, with Dr. Tomer Hertz, the faculty of Health Sciences) 2017 –
  "Predicting interaction between T-Cell Receptors and pMHC recognition sites" (temporary title)
- Guy Fargon (IEM), 2018-
  "Efficient and Task Designated Networks Architectures"
- Alon Shpigler (IEM), 2018 –
  "Deep Neural Networks for Inverse problems in Non Destructive Testing"
- Stats Khoroshevsky (IEM), 2019 -
  Title TBD

M.Sc students
- Atalia Waissman (IEM). 2016-2017
  "Input dependent feature-map pruning"
- Yotam Itzhaky (IEM). 2016-2017
  "Improving the Accuracy of Deep Convolutional Neural Networks using Additional supervision"
- Alon Shpigler (IEM), 2016-2017
  "A generative model for regularization and analysis of deep neural networks activity"

- Guy Fargon (IEM), 2016-2017
  "Detection and Counting of Flowers on Apple Trees for Better Chemical Thinning Decisions"
- Yuval Litvak (IEM, with Dr. Amin Biess). 2017-2018
  "Learning Pose Estimation for High-Precision Robotic Assembly Using Simulated Depth Images"
- Yael Konforti (IEM with Prof. Boaz Lerner) 2017-
  "Probabilistic Interpretation and Visualization of Deep Neural Network"
- Avinoam Lichtenstadt (IEM with Dr. Yuval Bitan) 2017-
  "Medication Verification by a Visual Classifier"
- Felix Vilensky (EE with Prof. Stanley Rotman) 2017-
  "Visual object tracking using dense networks and multiple templates"
- Adar Vit (ISE, with Dr. Guy Shani) 2017-
  "Length and Width Phenotyping Using Low-Cos tRGB-D Sensors and Deep Networks"
- Omer Wosner (IEM) 2018-
  "Improving evaluation and performance of detection with deep neural network"
- Hadas Schlessinger (IEM) 2019-
  Title TBD

SCIENTIFIC PUBLICATIONS

ISI h-index = 12 (retrieved Jan. 2019), Number of articles with citation data = 26,

Number of citations=826, without self-citations = 824, Average citation per item 31.77

GS h-index = 21 (retrieved Nov. 2019), Number of articles in GS = 40, Number of

citations = 3729

(Google Scholar Profile:
http://scholar.google.com/citations?user=x4GlT3IAAAAJ&hl=iw&oi=ao)

Conference papers

1. Enhancing image and video retrieval : Learning via Equivalence Constraints
   Tomer Hertz (PI), Noam Shental (C), Aharon **Bar-Hillel** (C) ,Daphna Weinshall (C)
   In IEEE Conference on Computer Vision and Pattern Recognition (CVPR) 2003 (48 citations, 23% acceptance rate)

2. Learning distance functions using Equivalence Relations
   Aharon **Bar-Hillel** (PI), Tomer Hertz (C), Noam Shental(C), Daphna Weinshall (C),

In The Twentieth <u>International Conference on Machine Learning</u> (ICML) 2003 (387 citations, 32% acceptance rate)

3. Computing Gaussian Mixture Models with EM using Equivalence Constraints
    Noam Shental(PI), Aharon **Bar-Hillel**(C), Tomer Hertz(C) and Daphna Weinshall(C), In Conference on <u>Neural Information Processing Systems</u> (NIPS), 2003. (203 citations, 27% acceptance rate)

4. Learning with Equivalence Constraints, and the relation to Multiclass Classification
    Aharon **Bar-Hillel**(PI) , Daphna Weinshall(C), In The Sixteenth Annual <u>Conference On Learning Theory</u> (COLT), 2003 (9 citations, 53% acceptance rate)

5. Learning Distance Functions for Image Retrieval
    Tomer Hertz(PI), Aharon **Bar-Hillel**(C) and Daphna Weinshall(C)
    In IEEE Conference on <u>Computer Vision and Pattern Recognition</u> (CVPR), 2004 (128 citations, 30% acceptance rate)

6. Boosting Margin Based Distance Functions for Clustering
    Tomer Hertz(PI), Aharon **Bar-Hillel**(C) and Daphna Weinshall(C)
    In the 21st <u>International Conference on Machine Learning</u> (ICML), 2004 (96 citations, 32% acceptance rate)

7. Spike sorting: Bayesian Clustering of non-stationary data
    Aharon **Bar-Hillel**(PI), Adam Spiro(S) and Eran Stark(C)
    In the Conference on <u>Neural Information Processing Systems</u> (NIPS), 2004 (30% acceptance rate)

8. Object class recognition by boosting a part based model
    Aharon **Bar-Hillel**(PI), Tomer Hertz(C) and Daphna Weinshall(C)
    In IEEE conference on <u>Computer Vision and Pattern Recognition</u> (CVPR), 2005 (53 citations, 28% acceptance rate)

9. Efficient learning of relational object class models
    Aharon **Bar-Hillel**(PI), Tomer Hertz(C) and Daphna Weinshall(C)
    <u>International Conference on Computer Vision</u> (ICCV), 2005. (20% acceptance rate)

10. Learning a kernel function for classification with small training samples
    Tomer Hertz(PI), Aharon **Bar-Hillel**(C), Daphna Weinshall(C)
    In the 23rd <u>International Conference on Machine Learning</u> (ICML), 2006 (63 citations, 20% acceptance rate)

11. Subordinate class recognition using relational object models
    Aharon **Bar-Hillel**(PI), Daphna Weinshall(C)
    In Conference on Neural Information Processing Systems (NIPS), 2006. (35 citations, 24% acceptance rate)

12. Learning distance functions by coding similarity
    Aharon **Bar-Hillel**(PI), Daphna Weinshall(C)
    In the 24rd International Conference on Machine Learning (ICML), 2007 (34 citations, 29% acceptance rate)

13. Reinforcement learning for capacity tuning of multi core servers
    Liat Ein-Dor(C), Yossi Ittach(T), Aharon **Bar-Hillel**(C), Amir Di-Nur(T), Ran Gilad-Bachrach(C), In workshop on machine learning for systems problems' in NIPS 2007

14. Workstation capacity tuning using reinforcement learning
    Aharon **Bar-Hillel**(C), Amir Di-Nur(T), Liat Ein-Dor(C), Ran Gilad-Bachrach(C), Yossi Ittach(T), In Super Computing (SC), 2007 (9 citations, 20% acceptance rate)

15. Efficient human computation: the distributed labeling problem
    Ran Gilad-Bachrach(C), Aharon **Bar-Hillel**(C), Liat Ein-Dor(C), In Workshop on human computation, KDD 2009 (1 citation)

16. Part-based feature synthesis for human detection
    Aharon **Bar-Hillel**(PI), Dan Levi(PI), Eyal Krupka(C), ChenGoldberg(S)
    In the European Conference on Computer Vision (ECCV), 2010 (63 citations, 27% acceptance rate)

17. Fusing visual and range imaging for object class
    Aharon **Bar-Hillel**(PI), Dmitry Hanukaev(S), Dan Levi(C)
    In the International Conference on Computer Vision (ICCV) 2011 (14 citations, 24% acceptance rate)

18. Off Vehicle Evaluation of camera based pedestrian detection
    Yaniv Alon(C), Aharon **Bar-Hillel**(PI)
    In IEEE Intelligent Vehicles Symposium (IV) 2012 (2 citations, 56% acceptance rate)

19. Real time pedestrian detection with deformable part models
    Hyunggi Cho(S), Paul E. Rybski(PI), Aharon **Bar-Hillel**(C), Wende Zhang(C)

In IEEE Intelligent Vehicles Symposium (IV) 2012 (31 citations, 56% acceptance rate)

20. Locally orderless tracking
Shaul Oron(S), Aharon **Bar-Hillel**(C), Dan Levi, Shai Avidan(PI)
In IEEE conference on Computer Vision and Pattern Recognition (CVPR) 2012 (26% acceptance rate)

21. Naive Bayes Nearest Neighbor classification of ground moving targets
Aharon **Bar-Hillel**(PI), Igal Bilik(C) and Ron Hecht(S)
IEEE Radar conference, 2013 (1 citation, 63% acceptance rate)

22. Fast multiple-part based object detection using KD-Ferns
Dan Levi(PI), Shai Silberstein(C), Aharon **Bar-Hillel**(C)
In IEEE conference on Computer Vision and Pattern Recognition (CVPR) 2013 (29 citations, 26% acceptance rate)

23. Discriminative Ferns Ensemble for Hand Pose Recognition
Eyal Krupka(PI), Alon Vinnikov(S), Ben Klein(S), Aharon **Bar-Hillel**(C), Daniel Freedman(C), Simon Stachniak(T)
In IEEE conference on Computer Vision and Pattern Recognition (CVPR) 2014 (6 citations, 30% acceptance rate)

24. Extended Luaks Kanade Tracking
Sahul Oron(S), Aharon **Bar-Hillel**(C), Shai Avidan(PI)
In the European Conference on Computer Vision (ECCV) 2014 (12 citations, 29% acceptance rate)

25. Cognitive workload and vocabulary sparseness: theory and practice
Ron M. Hecht(S), Aharon **Bar-Hillel**(C), Stas Tiomkin(S), Hadar Levi(S), Omer Thimhoni(PI), Naftali Tishby(PI), InterSpeech 2015 (52% acceptance rate)

26. * Toward Realistic hand gesture interface: keeping it simple for developers and machines.
Eyal Krupka, Kfir KArmon, Noam Bloom, Daniel Freedman, Ilya Gurvich, Aviv Hurvitz, Ido Leichter, Yoni Smolin, Yuval Tzairi, Alon Vinnikov, Aharon **Bar-Hillel** (PI). In CHI Conference on Human Factors in Computing Systems, 2017 (A* conference, 25% acceptance rate)

27. * Leaf counting: Multiple scale regression and detection using deep CNNs. Yotam Itzhaky, Guy Farjon, Faina Khoroshevsky, Alon Shpigler, Aharon **Bar-Hillel**(PI). In the British Machine Vision Conference (BMVC), CVPPP Workshop, 2018.

28. * Input-Dependent Feature-Map Pruning.
Atalya Waissman, Aharon **Bar-Hillel**(PI).
In the 27th International Conference on Artificial Neural Networks (ICANN), 2018.

29. * Learning Pose Estimation for High-Precision Robotic Assembly Using Simulated Depth Images. Yuval Litvak, Armin Biess, Aharon **Bar-Hillel**(PI). ICRA 2019 (B conference)

30. * Information constrained control for visual detection of important areas. Ron M Hecht, Ariel Telpaz, Gila Kamhi, Aharon **Bar-Hillel**(C), Naftali Tishby. ICASSP 2019 (B conference).

31. * Length phenotyping with interest point detection. Adar Vit, Guy Shani, Aharon **Bar-Hillel**(PI). CVPR CVPPP workshop 2019.

Book Chapters

1. Gaussian mixture models with equivalence constraints
Noam Shental(C), Aharon **Bar-Hillel**(C), Tomer Hertz(C), Daphna Weinshall(C).
In "Constrained Clustering: Advances in Algorithms, Theory, and Applications" by Sugatu Basu, Ian Davidson and Kiri Wagstaff (Eds.), 2008

2. Learning fast hand pose recognition
Eyal Krupka(PI), Alon Vinnikov(S), Ben Klein(S), Aharon **Bar-Hillel**(C), Daniel Freedman(C), Simon Stachniak(T), In "Computer Vision and Machine Learning with RGBD sensors", Springer, 2014

Refereed articles in scientific journals

1. Learning a Mahalanobis metric from equivalence constraints
Aharon **Bar-Hillel**(PI), Tomer Hertz(C), Noam Shental(C) and Daphna Weinshall(C), Journal of Machine Learning Research(JMLR) 6(Jun), pages 937-965, 2005 (457 citations, IF 2.473, 10/58, Q1)

2. Spike sorting: Bayesian clustering of non stationary data
   Aharon **Bar-Hillel**(PI), Adam Spiro(S), Eran Stark(C)
   Journal of Neuroscience Methods (JNM), Volume 157, Issue 2, October 2006,
   Pages 303–316 (61 citations, IF 2.025, 47/79, Q3)

3. Comparison Processes in Category Learning: From Theory to Behavior
   Rubi Hammer(PI), Aharon **Bar-Hillel**(C), Tomer Hertz(C), Daphna Weinshall(C)
   and Shaul Hochstein(C), Brain Research, Special issue on "Brain and Vision",
   Volume 1225, 15 August 2008, Pages 102–118 (21 Citations, IF 2.843, 122/252,
   Q2)

4. Efficient learning of relational object class models
   Aharon **Bar-Hillel**(PI), Daphna Weinshall(C)
   International Journal of Computer Vision (IJCV) 77, Pages 175-198, 2008 (75
   citations, IF 3.81, 8/123, Q1)

5. Recent progress in road and lane detection - a survey
   Aharon **Bar-Hillel**(C), Ronen Lerner(C), Dan Levi(C), Guy Raz(C)
   Machine Vision and Applications, April 2014, Volume 25, Issue 3, Pages 727-745
   (116 Citations, IF 1.351, 64/124, Q3)

6. Effective model representation by information bottleneck principle
   Ron Hecht(S), Elad Noor(C), Gil Dobry(C), Yaniv Zigel(C), Aharon **Bar-Hillel**(C),
   Naftali Tishby(PI), IEEE transaction on Audio, Speech and Language processing,
   21, issue 8, pages 1755 – 1759, 2013 (IF 2.475, 4/31, Q1)

7. Locally orderless tracking
   Shaul Oron(S), Aharon **Bar-Hillel**(C), Dan Levi(C), Shai Avidan(PI)
   International Journal of Computer Vision, January 2015, Volume 111, Issue 2,
   pages 213-228 (152 citations, IF 3.81, 8/123, Q1)

8. Real-time tracking with detection for coping with viewpoint change
   Sahul Oron(S), Aharon **Bar-Hillel**(C), Shai Avidan(PI)
   Machine Vision and Applications, May 2015, Volume 26, Issue 4, pages 507-518
   (IF 1.351, 64/124, Q3)

9. * Real-time Information constrained control analysis of eye gazing distribution
   under cognitive load. Ron M. Hecht, Aharon **Bar-Hillel**(C), Ariel Telpaz, Omer
   Tsimhoni, and Naftali Tishby. August 2019, pages 1-11, IEEE Transactions On
   Human-Machine Systems.

10.   * Detection and Counting of Flowers on Apple Trees for Better Chemical Thinning Decisions. Guy Farjon, Omri Krikeb, Aharon **Bar-Hillel**(PI), Victor Alchanatis. August 2019, pages 1-19, Precision Agriculture.

Thesis

1. Learning from weak representation using distance functions and generative models Aharon **Bar-Hillel**(PI), Ph.D Thesis, 2007. (8 citations)

PATENTS

1. Forward feature selection for support vector machines
    Eyal Krupka and Aharon **Bar-Hillel**
    Filed for United Stated patent #8108324 on 15/8/2008

2. Vision-based object detection by part-based feature synthesis
    Dan Levi and Aharon **Bar-Hillel**
    Filed for United States patent #8724890 on 6/4/2011

3. System and method for fast object detection using parts to whole fragment detection
    Aharon **Bar-Hillel** and Dan Levi
    Filed for United States patent application 20130077873 on 23/9/2011

4. Complex-object detection using a cascade of classifiers
    Dan Levi and Aharon **Bar-Hillel**
    Filed for United States patent #8630483 on 12/6/2012

5. Statistical Data Learning Under Privacy Constraints
    Aharon **Bar-Hillel**, Ron M. Hecht, Nadav Lavi
    Filed for United States patent #9037520 on 1/5/2014

6. Structure and training for image classification
    Eyal Krupka, Aharon **Bar-Hillel**
    Filed for United States patent #9037520 on 31/12/2015. Pending.

7. Gesture recognition

Kfir Karmon, Eyal Krupka, Noam Bloom, Ilya Gurvich, Aviv Hurvitz, Ido Leichter, Yoni Smolin, Yuval Tzairi, Alon Vinnikov, Aharon **Bar-Hillel**
Filed for United States patent #15671118 on 20/4/2017. Pending.

RESEARCH GRANTS

* 2018-2020 Solving visual agriculture phenotyping problems using deep learning tools. The Phenomics consortium of the Israel innovation authority. 844,000NIS.

* **2018-2020** Development of a decision supporting system for apple tree thinning with precision agricultural tools. Israel Chief scientist - Ministry of Agriculture. With three researchers from Volkani, Technion and North R&D. 111,000NIS.

* **2019-2022** Deep Neural Networks for Inverse problems in Non Destructive Testing. Atomic Energy Commission (PAZY). With Dr. Itay Mor. 399,000NIS.

* **2019-2022** Solving multi-staged visual inference problems with a compositional neural framework. The Ministry of Science and Technology (MOST). 550,850NIS.

PRESENT ACADEMIC ACTIVITIES

Research in progress

- A deep modular approach for solving multi-stage computer vision tasks with real world data. Ph.D Student Faina Khoroshevsky. Expected to continue till 2021.
- Deep tables – a deep learning paradigm not based on linear products. Ph.D Student Guy Fargon. Expected to continue till 2022.
- Applying machine learning tools for prediction of the interaction between T-cell receptors and possible antigens. A joint Ph.D student Liel Cohen with Dr. Tomer Hertz from the Systems Immunology lab, BGU. Expected to continue till 2021.
- Deep Neural Networks for Inverse problems in Non Destructive Testing. A joint Ph.D student Alon Sphigler with Dr. Etai Mor from Soreq NRC. Expected to continue till 2022.
- Visualization of deep learning models using graphical models. M.sc student Yael Konforty. Expected to continue till 2019.

- Applying deep learning methods for fine visual classification problems in the domain of agriculture phenotyping. Working students are Faina Khoroshevsky, Guy Fargon, Alon Sphigler, Omer Wosner. Adar Vit (a joint student with Dr. Guy Shani). Expected to continue till 2021.
- Visual tracking using a segmentation network. With Prof. Stanly Rotman from Electric Enginering, BGU. The student is Felix Vilensky. Expected to end in 2019
- Verification of medication label. The student is Avinoam Lichtenstadt. With Dr. Yuval Bitan. Expected to continue till 2019.

Articles in preparation/submitted

Submitted:
- A deep learning based pipe for Ultra sound beam forming and image processing. Etai Mor and Aharon **Bar-Hillel**(C). Submitted to UltraSonics.
- Leaf counting: detection and regression in deep networks. Guy Fargon, Yotam Itzhaky, Faina Khoroshevsky, Aharon **Bar Hillel**(PI). Submitted to Computers and electronics in agriculture.
- Length Phenotyping with Interest Point Detection. Adat Vit, Guy Shani, Aharon **Bar-Hillel**(PI). Submitted to Computers and electronics in agriculture.
- Information constrained control for a Gaussian mixture model. Ron M. Hecht, Ariel Telpaz, Omer Tsimhoni, Gila Kamhi, Aharon **Bar Hillel**(C), Naftali Tishby. Submitted to ICASPP 2020 conference.

In Preparation:
- Deep Convolutional tables for efficient visual classification. Shai Dekel, Yosi Keller, Aharon **Bar-Hillel**(PI). To be Submitted to CVPR 2020.
- A generative model for visualization and analysis of deep neural networks activity. Alon Shpigler, Aharon **Bar-Hillel**(PI), Boaz Lerner.

RESEARCH SYNOPSIS

General: My research interests are in machine learning, computer vision, and machine learning\computer vision applications. In machine learning, I am mostly interested in representation, i.e. choosing the feature space in which the model is trained. This includes distance function learning (conference papers [2,4,5,6,10,12], journal papers [1,6]), Feature selection and synthesis (conference [16]), and deep learning [28]). In computer vision I am handling problem as classification (conference [1,8,9,11,17,28], journal [4]), detection (conference [16,19,22,27], journal [5]), tracking (conference [20,24], journal [7,8]) and pose estimation (conference [23,26], book chapter [2]) using

machine learning and inference tools. I like areas in which machine learning can contribute to understanding of biological (conference [7], journal [2]) or psychological phenomena (conference [25,30], journal [3,9]). Finally, I am interested in machine learning and vision applications including computing grid optimization (conference [13,14]), Radar target classification (conference [21]), and recently agricultural (conference [27,31]), robotic (conference [29]) and ultra sound applications (in preparation))

Facilities: My recent is BGU is deep learning oriented and hence it relies on machines with strong computing power provided by GPU cards. I have a lab (joint with other faculty members) with such machines, and a two servers providing GPU and CPU power for larger scale learning tasks.

Collaborations: the applications of machine learning and computer vision, which are a larger portion of my activity, are far reaching and require natural partners. My current collaborations (meaning: having a joint student) include
- Prof. Boaz Lerner: We collaborate on the topic of deep networks visualization and understanding using graphical model tools
- Dr. Armin Biess: We collaborate in the robotics field, where we train robots for assembly and manipulation tasks using pose estimation and reinforcement learning techniques
- Dr. Tomer Hertz: Tomer is an Immunology researcher from the department of Microbiology, Immunology and Genetics. We jointly train predictors determining which T-cell receptors are likely to bind to known peptid+MHC complexes.
- Dr. Yuval Bitan: We jointly consider the development of a visual medication system for reducing medication errors in hospital environments
- Dr. Guy Shani: We cooperate in topics related to visual measurements of agricultural phenotypes
- Dr. Etai Mor: Etai is a researcher in Soreq NRC in the NDT (Non Destructive Testing) lab. We work together on network for ultra-sound imaging.

Research domains and concepts: My main domain (machine learning techniques in computer vision) was transformed in recent years by the penetration of deep learning techniques, currently providing the state of the art solutions to most of the traditional problems. My current research handles the following subjects
- **Deep network understanding and debugging**: Our current understanding of the empirical success of deep networks is lacking, from both an empiric and theoretical perspectives. I am developing models of the activity of hidden (intermediate) network layer with the goal of providing better understanding of the inference process in a specific network and in general. The motivation of this

research is to enable better understanding of the good generalization abilities of deep networks, and development of debugging tools which enable their improvement.

- **Novel deep architectures**: While currently deep networks are usually designed with a fixed architecture for a fixed task, we are exploring a more modular approach, in which pre-trained network modules are assembled ad-hoc for solving different multiple-stage tasks, expressed in a formal language. In another effort, we develop deep architectures which replace traditional convolutional layers with convolutionally-applied tables, with a potential for significant efficiency gains.

- **Deep learning and vision applications**: We use the set of tools brought up by deep networks in recent years to advance the scientific and engineering front in several domains, including: 1) Visual tasks in agricultural phenotyping and medication discrimination. 2) Robotic assembly and manipulation tasks. 3) Protein matching problems, specifically the alignment between T-Cell Receptors and peptide-MHCs, and 4) Image reconstruction problems in ultra sound and CT modalities.