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PROJECT 1

Company: Intel

Project title: MicroPython in Intel SGX Enclave

Project field: Intel Corporation, iSTARE Team

Supervisor: Dimitry Kloper

Project description: MicroPython is a non-standard implementation of Python interpreter that is used for embedded devices. It is designed to be used in memory restricted environments and can run on microprocessors with or without OS. Intel SGX (Software Guard Extensions) is an advanced code and data protection mechanism found on modern Intel processors (Skylake and above). Intel SGX makes the protection possible through the use of enclaves, which are protected areas of execution in memory. In this project you are going to create a MicroPython customization (porting) to be run inside SGX enclave.

Value to the company: specifically to iSTARE team: this project will be used as a base for a new generation of tools developed internally by iSTARE for SGX security evaluation.

Value to students: Hands-on experience with advanced Intel technology, SGX SDK, implementation of MicroPython and integration.

Prerequisites:
- C programming language
- Familiarity with Linux OS

PROJECT 2

Company: IBM Research – Haifa Lab

Project title: Trusted processing of sensitive data in the cloud

Project field: Deep learning, Reinforcement learning

Supervisors: Amir Kantor, Elad Shaked
Project Description: A Bandit model is a machine learning problem, where the computer must pick an action, repeatedly, and after each action a reward is returned. A contextual Bandit model extends this scenario, so that the reward now depends on a context, which is given to the computer before each action. Solving a (contextual) Bandit model involves designing a strategy that learns over time to collect the greatest accumulate reward. An example of a contextual Bandit model is that of web advertising: a context would be a user profile (a set of user features). In a given context, the computer must pick an action = an advertisement to be shown on the screen. The reward of such an action may be whether or not the user clicked on the ad (or more sophisticated metrics).

Bandit models are an important fragment of reinforcement learning. With the advent of deep learning, contextual Bandits strategies have become an effective and practical technology, especially for learning from user feedback in real-life scenarios such as the one described (advertisement selection), information retrieval, recommender systems, etc. One of the main obstacles to Bandit algorithms is huge context spaces (e.g., free text) and huge action spaces (e.g., the computer generating a customized response in free text). On the other hand, there is a structure to those spaces (in this case, via language models). In this project, we aim to form Bandit strategies that may solve previously-unattainable problems involving huge context and action spaces.

Value to the company: Deep learning huge Bandit models will allow learning from user feedback in various web/product scenarios, as well as improving other AI challenges that can be framed as Bandits such as information retrieval (search).

Value to the student: Obtaining experience in developing deep learning models in Tensorflow, as well as expertise in the important reinforcement learning model of contextual Bandits.

Recommended pre-requisite courses: 236756-Introduction to machine learning

Programming languages and development platforms: Python and particularly the Tensorflow package.
**Company:** IBM Research – Haifa Lab  

**Project title:** Basic video surveillance service using the Secure Reliable Transport Protocol  

**Project field:** Cloud, Computer Vision (OpenCV), Docker, Kubernetes, Video streaming, Networking  

**Supervisors:** Ophir Azulai, Yevgeni Burshtein  

**Project description:** The Secure Reliable Transport (SRT) is an Open-source software protocol and technology stack designed for live video streaming over the public internet. It uses the UDP protocol as an underlying transport layer. It supports packet recovery, while maintaining low latency (default: 120 ms).  

The OpenCV (Open Source Computer Vision Library) is designed for computational efficiency and with a strong focus on real-time applications. It has C++, Python and Java interfaces and supports Windows, Linux, Mac OS, iOS and Android.  

Kubernetes is an open-source container-orchestration system for automating deployment, scaling and management of containerized applications. It works with a range of container tools, including Docker.  

In this project, we will develop a basic video surveillance service. In the client side, we will use the gstreamer multimedia framework to capture the video and transmit it to the cloud. The service will receive the video stream using SRT, decode the video using the OpenH264 open source and detect motion using OpenCV. The first phase of the project is to develop a local system (not in the cloud) and the second phase will be to deploy it on Kubernetes in IBM cloud.  

**Value to the company and value to student:** IBM can use it in IOT offerings for low delay streaming from video cameras. The students will learn video streaming and processing, basics of computer vision and will gain experience in various cloud technologies.  

**Required courses pre-requisites:** Software Engineering Methods (234321) or Object Oriented Programming (236703)
**Programming languages and development platforms:** C++, OpenCV, SRT, OpenH264, Linux, Docker, Kubernetes

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**PROJECT 4**

**Company:** IBM Research – Haifa Lab

**Project title:** Serverless for Big Data processing in the cloud

**Project field:** Serverless computing, big data processing frameworks

**Supervisors:** Gil Vernik

**Project description:** Serverless computing is an emerging technology that has the potential to radically change the way big data processing is done. Most big data analytic flows can benefit from the serverless platforms, starting with simple cases of processing object storage data, to more complex data preparations for AI frameworks, like TensorFlow.

To address the challenge of how to easily integrate serverless computing, without major disruptions to your system or code rewrites, the IBM Cloud Functions team and IBM Research developed the PyWren-IBM-Cloud framework. Based on the open source PyWren project, this new framework offers a brand new “push to the cloud” experience for the users. It allows them to focus strictly on writing their Python code, while PyWren deploys the code as a serverless action to IBM Cloud Functions, monitors its execution, and runs it with a large amount of parallelism.

As part of the industrial project, students will develop a unique extension to PyWren framework to run Monte Carlo Simulations. Students will enable PyWren with new capabilities for massively parallel big-data analytic computation on IBM Cloud. This involves writing Python code, contribute code to the open source, an leverage IBM Cloud for serverless big data processing in the cloud.

**Value to students:** Students will obtain skills in the serverless computing, which is one of the hottest topics in cloud computing. Students will also work with open source projects and contribute their code.

**The value for IBM:** students will work with PyWren and get familiar with IBM Cloud by using it for academic initiatives. In addition, PyWren is a strategic project that leverage
IBM Cloud for the serverless executions. Working on PyWren will improve our cloud offerings and perhaps attracts more potential customers

**Required course pre-requisites:** Data Structures, Algorithms

**Programming languages and development platforms:** Python

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**PROJECT 5**

**Company:** Qualcomm Israel

**Project title:** Dynamic camera and gyroscope calibration for improved Electronic Image Stabilization

**Project field:** image/video processing

**Supervisors:** Eran Pinhasov, Ron Gaizman

**Project description:** Mobile phone cameras, video and snapshot capabilities, are already considered as the second most important feature when customers come to purchase their next phone. Qualcomm as the leader in the mobile phone offers unique and advanced ISP (Image Signal Processor) hardware and complementary video stabilization solutions. The proposed assignment would be to develop an Android application that can guide the user on how to re-calibrate the various system components that relate to video stabilizing. Video / gyroscope offsets and latencies, rolling shutter timing and focal center may need adjustment over time. The fundamental idea is to implement the algorithm set in [https://users.isy.liu.se/cvl/perfo/papers/ovren_icra15.pdf](https://users.isy.liu.se/cvl/perfo/papers/ovren_icra15.pdf) and provide it to users via an Android application.

**Value to the company:** improved capabilities to maintain superior video stabilization performance after initial launch. In addition, if overtime there were some mechanical change related to un-intentional phone drop, users can re-calibrate their video stabilizer.

**Value to student:** exposure to one of the most growing technology segments in today’s market. Mobile image processing and video stabilization are important technologies which will provide the students with a unique learning opportunity.

**Programming languages and development platforms:**
- Android SDK
- Android OS based mobile device

**Required course pre-requisites:**
- 234122  Introduction to Systems Programming
- 234329  Project in Image Processing and Analysis

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**PROJECT 6**

**Company:** Qualcomm Israel

**Project title:** Cinematography sensor-based motion reconstruction using robotic arm

**Project field:** Signal/image processing

**Supervisors:** Nir Strauss, Eliad Tsairi

**Project description:** The development of new and attractive mobile camera features requires significant indoors and outdoors content collection. While capturing such content there are intentional and unintentional camera movements. Video recording scenes like walking, running, going up and down stair and even standing still contain motion of the camera. The proposed project contains two parts. 1) record translational and rotational movements, total of six degrees, on the mobile device while capturing content (use of device internal IMU). And 2) filter and simulate the camera movements, all 6 axes, and replay the motion on a Yaskawa robotic hand located in the camera image lab. The assignment will be composed of collecting data from the mobile device, can leverage existing Android applications and author a tool that parses the data, filters sampling noise and can be read by the robot programming API.

**Value to the company:** improved image quality lab capabilities to mimic user movement while testing new de-noising and image stabilization algorithms.

**Value to student:** exposure to device-based accelerometer and gyroscope content capture. In addition, applying advance filters and other techniques to re-construct the movement in a space constraint environment.

**Programming languages and development platforms:** C++

**Required course pre-requisites:**
Introductory to Systems Programming

Signal, image and data processing

PROJECT 7

Company: Rafael

Project title: Auto verification

Project field: Machine Learning, Text recognition (NLP)

Supervisor: Alon Horesh

Project description:

In order to optimize the work and improve test procedures, we intend to examine automatic generation of test cases from software requirements, as part of a full solution for developing and verifying software.

Test cases are a set of conditions and outcomes (Test cases), and test coverage (Tests coverage), software development (Software STD), verification tools (Software STD). Further examination of these topics will be conducted.

The examination will include the methods and work processes, and the integration and adaptation of supporting tools.

The results of the activity will include a work method, starting from the definition of requirements, templates to which adherence is required, selection of appropriate tools, and so on, in accordance with additional insights that will emerge during the activity.

Value to the company and value to student:

Automatic generation of test cases will improve organizational productivity, and enable a more advanced and quality engineering product.

Required course pre-requisites: Machine Learning

Programming languages and development platforms: Python
Company: Medtronic

Project title: Anomaly detection in capsule endoscopy images using deep learning

Project field: deep learning, machine learning, pattern classification, computer vision, AI

Supervisor: Eyal Dekel

Project description: PillCam SB3 is a disposable capsule that uses a miniaturized camera to visualize the small bowel (SB). The data obtained from this procedure (capsule endoscopy) is widely used by doctors to detect and diagnose diseases such as Iron Deficiency Anemia, Crohn’s, Celiac and others.

The number of various pathologies in the SB is very high, and many of them are less common than others. The goal of this project is to develop a general anomaly detector, specifically for these hard-to-find pathologies, that will differentiate these images from healthy images. We propose to implement an unsupervised deep learning algorithm called Anomaly-GAN\(^1\) for this purpose.

Value to the company and value to student: a general anomaly detection for SB images will be very useful for detecting and identifying rare pathologies and anomalous events (such as foreign bodies). It will provide the physician the reassurance that even the less-common pathologies are captured by the capsule and in many cases will help in saving lives.

Required course pre-requisites: Introduction to machine learning (236756) OR computer vision (236873) OR equivalent courses (e.g., machine learning (046195))

Programming languages and development platforms: python, TensorFlow, MATLAB (advantage)
Company: Medtronic

Project title: Unsupervised transfer of deep learning pathology detector from one imager to another

Project field: image processing, deep learning, machine learning

Supervisor: Avishai Adler

Project description: PillCam is disposable capsule that uses a miniaturized camera to visualize the small bowels and the colon. The data obtained from this procedure (capsule endoscopy) is widely used by doctors to detect and monitor abnormalities such as polyps, lesions, bleeding and ulcers.

Deep learning requires large amounts of data to create a descent detector for such pathologies. This translates to large clinical experiment, which can take years and cost a lot of money. The purpose of this project is an attempt to use a detector that was trained on one imager, with lots of labeled data, and transfer it to a different type of imagers, while still achieving good performance.

Value to the company and value to student: Transferring deep learning networks across domains can enable Medtronic to incorporate new and better imagers without large-scale clinical experiment, thus providing better products that will retain all the features that were already developed.

The students will have opportunity to work on real medical image data and experiment with deep learning techniques, experimenting in domain transfer, which is currently an active research area at the front of ML.

Required course pre-requisites: Introduction to machine learning (236756), and preferably Signal and image processing by Computer (236327) OR equivalent courses (e.g., Image processing and analysis (046200), machine learning (046195))

Programming languages and development platforms: Python, TensorFlow
Company: Medtronic

Project title: Using deep learning to distinguish between multiple Ulcer events

Project field: Deep learning, machine learning, classification

Supervisors: Dorit Baras

Project description: PillCam is a disposable capsule that uses a miniaturized camera to visualize the small bowels and the colon. The data obtained from this procedure (capsule endoscopy) is widely used by doctors to detect and monitor abnormalities such as polyps, lesions, bleeding and ulcers.

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Required course pre-requisites: Introduction to machine learning (236756), and preferably Signal and image processing by Computer (236327) OR equivalent courses (e.g., Image processing and analysis (046200), machine learning (046195))

Programming languages and development platforms: Python, TensorFlow
Company: Shutterfly

Project title: Deep photo enhancement

Project field: Deep learning, Image processing

Supervisors: Omer Moussaffi, Nir Aides, Ron Maurer

Project description: Shutterfly as a business is constantly searching for ways to provide its users with the best photo-based products (e.g., Photobook, Poster, Coffee Mug, Pillow). The ultimate goal is to offer each user the right products with the right photos in the right context at the right timing.

A common problem in photo-product creation is the low quality of certain photos. Some photos were taken using low resolution cameras (e.g., mobile) or are a crop of a larger photo. These would have been a good fit to the product if only the image quality was higher.

In this project the students will:

- Explore options for deep-learning algorithms for image-enhancement.
- Given a super-resolution algorithm the students will evaluate the gain in quality using some perceptual metrics (e.g., SSIM).
- Develop an algorithm for automatic recommendation of which image-enhancement method(s) to apply if/any based on the improvement in the evaluation metrics.

Value to the company: Exploration of state-of-the-art image enhancement capabilities applicable to improving Shutterfly’s product quality.

**Value to students:** Hands on experience in developing modern deep-learning solutions for a predominant family of problems in the field of image processing. Experience in methodological improvement of image enhancement solutions through empirical evaluation.

**Pre-requisites:** Python. Advantage: knowledge in deep learning, image processing (or strong drive to learn through hands-on experience)

**Programming languages and development platforms:** Python, Deep learning frameworks (e.g., PyTorch), Image processing packages (e.g., opencv)

### PROJECT 12

**Company:** TSG IT Advanced Systems Ltd

**Project title:** **NLP using the semantic approach on Arabic**

**Project field:** NPL based on the Semantic network technology

**Supervisor:** Gilad Sharoni

**Project description:** TSG has developed NLP analytic using the semantic network technology ([https://en.wikipedia.org/wiki/Semantic_network](https://en.wikipedia.org/wiki/Semantic_network), [http://www.jfsowa.com/pubs/semnet.htm](http://www.jfsowa.com/pubs/semnet.htm)) to analyze text, identify entities (persons, places, and organization), key words, relations and links between entities, category of the text etc. Our product supports the usage of Hebrew, English and several more European languages. We would like to invite students to take part in adapting the product to short texts in Arabic by developing a parser for short Arabic text.

**Value to the company and value to student:** The student will gain knowledge in: NLP and semantic network usage in operational and deployed system, TSG will gain the development of required advance system components.

**Required course pre-requisites:** 236299 Intro. to Natural Language Processing.
Company: TSG IT Advanced Systems Ltd

Project title: Disaster area population assessment model

Project field: Smart City, Smart transportation, Disaster resilience

Supervisor: Gilad Sharoni

Project description: In a disaster event in urban environment, there is a need to have an updated ongoing assessment about the population status within the disaster area. The student will develop a population management module that can support rescue forces to get fast & best assessment of number of people that currently stay within the Technion area (as a use case), i.e.: What is there age distribution? How many are in good & how many casualties? How many people should be evacuated? How many people can evacuate themselves (driving or walking)? Are there people with in the area that can help, manage the evacuation? How many busses are needed for evacuation of the rest of the population? What first aid, food, etc. are needed to be supplied to the people inside? Since the whole operation is going to take between 10-24 hours it is a need to design the system as a continues monitor control & managements systems that can receive inputs from every relevant data source & can present an updated status with a short term (next 4 hours) forecast model.

Value to the company and value to student: TSG develops a command and control system for emergency management & currently involved in integration of ICMS with various urban systems that are relevant for rescues operations. Students will have a unique opportunity to learn about the challenges within large scale integrated systems projects.

Required course pre-requisites: 236501 Introduction to Artificial Intelligence
**Company:** TSG IT Advanced Systems Ltd.

**Project title:** Evacuation of civilians from a disaster area

**Project field:** Smart City, Smart transportation, Disaster resilience

**Supervisor:** Eran Reuveny

**Project description:** The project task is to develop an algorithm that optimizes the use of Buses for civilians’ evacuation in disasters such as a large scale fire or earthquake. The Project has two phases:

- **Phase I:** The Input for this algorithm is: Civilians (A set of coordinates – for each coordinate, number of persons to be evacuated) and Buses (A Set of Coordinates – for each coordinate representing a bus location and a number of passengers it can evacuate)

  The project task is to design, develop & demonstrate an algorithm that will optimize – in Time factor – the use of the buses, creating for each bus a route that will pick-up citizens from the designated locations.

  The algorithms should take in consideration the MAP of the area described.

  All coordinates will be in a 20Km * 20 Km square.

- **Phase II:** Adding to the same algorithm complexity based on a set of constraints regarding the routes such as: Blocked areas, busy routes etc.

**Value to the company and value to student:** TSG develops solutions for Emergency Evacuation of a disaster area. For an Optimal evacuation, the system needs to optimize in time factor the use of busses for evacuation.

Students will have a unique opportunity to deal with complex algorithms and learn how to implement appropriate adjusted software development methods.

**Required course pre-requisites:** at least one of the following: 234125 Numerical algorithms, 234247 Algorithms 1, 236374 Probabilistic methods and algorithms.
Company: Amdocs

Project title: Value rater

Project field: Optimization, analytic, advertisement

Supervisors: Netta Newman Sholev, Adi Lachman

Project description:

**Project objective:** The project aims to develop an application for measuring value (e.g. value of a customer such as social network influence rank) to enable better business decisions (e.g. churn management, segmentation, cross sell/upsell), based on different parameters and parameter types.

**Project scope**

- Students will develop an application that can use fixed and dynamic parameters to calculate a value to be associated with an object or action. The first use case that will be implemented is the ability to calculate the correct mix of subscription fee and ads shown in a service, based on a number of parameters (value of the customer, value of showing the ads to a specific customer, level of interest customer shows in ads and so on). If time permits, we will add additional use cases to the Value Rater application.

- The application will also include the following components:
  - A. Web UI for controlling the server side application as well as displaying the rating results
  - B. APIs for the following purposes:
    - Rating purposes - The API will provide value-based result, not necessarily money-based result
    - Setting rating rules
    - Maintaining rating rules
  - C. Usage reports – Usage queries for individual users as well as for companies
  - D. Engine for data analysis
  - E. DB for data management

Value Rater will manage the data to be used in calculating value. The data can be transactional data, application data, user data or user global data.

Value Rater will enable APIs which use the data to calculate value.
Value Rater SLA (Service Level Agreement) will be near real time (few seconds) to support TELCO transactions.

Steps:

- System will analyze customer data:
  - Customer service value (based on the value of the service the customer is requesting)
  - Customer advertising value (based on the value of the customer to an advertiser)
  - Customer advertising consumption habits
- System will use this data to determine:
  - What is the best frequency of ads that can be shown customer
  - What is the monetary value of that frequency of ads
  - What discount to offer customer on subscription fee

Value to the company: provide an engine for calculating value, which has multiple use cases

Value to student: experience working on systems that performs value optimization in real-time conditions, and building a full E2E system for production environment and will gain experience using state of the art web platform that will be selected during the project.

Required course pre-requisites:
- Object Oriented Programming (236703) – Must
- Introduction to Computer Science (234111) – Must
- Algorithms 1 (234247) - Must
- Introduction to Optimization (236330) - Advantage

Programming languages and development platforms: Java or Python – Must.

PROJECT 16

Company: Amdocs

Project title: Business data optimization system

Project field: Decision support system, Optimization Algorithms, Software Development, Machine Learning (ML), Natural Language Processing (NLP)
Supervisors: Alex Gaitler, Amnon Ekshtein

Project description: Students will be solving large scale data optimization problem based on the real business case. The students will be required to develop a ML and NLP algorithms in order to solve this challenge. The goal is to develop a decision support system solution for products portfolio management. As part of the solution students are expected to develop Web based UI tool allowing analysis of the large set of data comprising of the products and their multiple characteristics. The system will execute the ML process to find the best match between the similar objects.

HL Scenario flow
- The tool is presenting the data on UI according to the .csv file received as an input
- User is choosing subset of products and selected list of parameters to be analyzed
- User will use the UI to configure rules for parameters similarity
- System engine will perform data pre-processing using NLP algorithms
- The tool is presenting in the UI the similarity results summary including the following information
  - NLP ranking similarity results
  - Initial Number of products
  - Number of Similar/Duplicated products
  - Total unique number of products
  - Detailed output of the analysis
- User is performing the corrections and re-runs the analysis process till the optimal results are received

Value to the company: allow more efficient execution of the data rationalization projects by improving quality and reducing analysis duration/effort; potential for new software product for Telco Product Managers

Value to student: practicing the software development knowledge and skills by solving a real life industry problem; gaining experience in the data analysis and BI field. Students will be building E2E system for production. Gain experience using Yii2 (or similar state of the art) web platform.

Recommended course pre-requisites:
- Data Structures (234218)
- Algorithms 1 (234247)
- Intro. to Natural Language Processing (236299)

Programming languages and development platforms:
- Java/Python programming experience - Must
- Background in algorithms development - Must
- Data Modeling/Architecture experience - Advantage

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**PROJECT 17**

**Company:** Amdocs

**Project title:** **Smart home: Distributed social security monitoring center**

**Project field:** IoT, Smart home, IOS, Android, Mobile, home land security, new social networks.

**Supervisor:** Moni Elnatan

**Project description:** Innovative concept of s/w based Home land & social security control center that is to replace physical Alarm Receiving Centers and dispatched guard personnel.

We target to create a social community based service with a mobile app that is to virtualize the Alarm Center and dispatched guard control and move the work force from hired to occasional community based force.

Students will develop a mobile application based service (client & Server side) with mechanism to intercept Homeland security events, filter false events, select, dispatch social intervention personnel if needed, and resolve the event.

**Steps:**

- Define and create specialized social community to function as distributed homeland security control center.
- System will intercept events from Amdocs Smart home system.
- System will filter events based on several rules.
  - System will respond to real even with analyzing its community of “security force members” based on location, speed of transport, availability.
  - System will take care to capture events from the dispatched security personnel in order to create documented event record up to resolution of the event.

The server side engine will be responsible for management of all processes of the system in order to result in efficient and timely filter/dispatch/follow-up/resolution of security event management in a virtual, fully distributed social control center.
The mobile UI/UX should be a Simple and comprehensive social community control panel to allow designated distributed control community members to get altered, accept, dispatched, treat the event to resolution, and get compensated

**Value to the company:** innovative distributed control center to allow new form of social economy.

**Value to student:** Experiences working on new innovative idea, working with infrastructure and development teams, get experience in Home Land Security, mobile development, building E2E system for production. Gain experience using Yii2 web platform.

**Required course pre-requisites:**
- Object Oriented Programming (236703) - Must
- Introduction to Computer Science (234111) – Must
- Introduction to Systems Programming (234122) – advantage

**Programming languages and development platforms:**
- Web (PHP, Html5) - Must
- SQL - Must
- JS, Yii2 - Advantage

UX examples:

![UX example 1](image1.png)

![UX example 2](image2.png)