Internship Projects

2022

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MRG: Biometrics for Smart human-Centred EmergiNg Technologies (BIO-SCENT)

Internship Title	Image Interpretation From Wearable Cameras
Description of Internship	Wearable cameras are small and light devices which can be fastened at human body covering the point of view of the wearer. They provide the capability to seamlessly record visual data in a passive way, in a first-person perspective, while the wearer is performing her/his activities.Visual lifelogging is the seamless collection of images and/or videos using wearable cameras and involves the continuous recording of the daily life of the wearer for a long period of time. The new field of the computer vision which deals with the content analysis of data collected by wearable cameras, is called Egocentric Vision or First-person Vision. The analysis of such visual data can be successfully used to study everyday life and draw useful conclusions about human behavior, aiming to improve the quality of life.
Required Skills	1. Basic knowledge in image processing or computer vision or deep learning 2. Computer programming skills
Level of required Skills	Good
Internship Objectives	The aim of the project is to develop advanced technologies for visual lifelog image analysis. Visual lifelog image analysis is concerned with the analysis of first-person images captured by wearable cameras or smart phones. The project will involve work in collecting and labelling data for supervised learning frameworks and/or the development of deep learning methods for interpreting visual lifelog images and/or experimental evaluation. Image interpretation algorithms will involve image enhancement, object detection and action classification. The work will focus on one of the following two ongoing projects: (1) automatic barriers detection in urban sidewalks for sustainable and safe public spaces, (2) tracking the visual view of museum visitors for enhancing the overall visiting experience and assisting curators and other museum professionals.

Internship Title	Developing Interactive Applications for Enhancing Visitor Experience in Cultural Heritage Sites
Description of Internship	The aim of the work is to develop interactive applications utilizing state of the art techniques in emerging technologies aiming to enhance the experience of visitors in Cultural Heritage Sites or other related sites such as museums and exhibitions. As part of this project interns will be expected to use techniques related to virtual/mixed reality, computer vision, and mobile applications.
Required Skills	Interns working in this project should have technical and/or creating skills that include 1. Computer Programming Skills 2. Basic knowledge in image processing or computer vision 3. Development of virtual/mixed reality applications 4. Mobile application development
Level of required Skills	Good
Internship Objectives	The objectives of the Internship are: 1) To review the literature in relation to the use of emerging technologies in Cultural heritage sites 2) To design, implement and evaluate s novel interactive application for enhancing the experience of cultural heritage site/museum visitors.

Internship Title	Image Analysis in Marine and Maritime domain using computer vision techniques
Description of Internship	Ocean imaging has become very popular nowadays, as an easy way to monitor the marine and maritime environment. Monitoring can be utilized for the protection of several threats that the Marine and Maritime industry faces or for the automation of everyday processes in the domains of border control, safety and security, fisheries control, customs, environment, defense, etc. The manual analysis of the large amounts of monitoring data is very time consuming and difficult task. Thus, the computer vision techniques have been extensively used to automate the process. Although computer vision has many advances the last years, the research for marine and maritime is at an early stage and several challenges remain open.
Required Skills	1. Computer Programming Skills
Level of required Skills	Good
Internship Objectives	Through the use of computer vision, the integrated ocean monitoring can be achieved offering ways to exchange and visualize information and data. Although some techniques for automated detection, identification, measurement, tracking, and counting objects (e.g. fishes, oil spills, etc.) in underwater or sea surface optical data streams have been proposed, very few automated systems are available which incorporate all appropriate techniques for highly successful and accurate results. The main objective of this project is to develop beyond the state-of-the-art technologies for analyzing ocean visual data. For this purpose, an extensively research review will be conducted to define the challenges of computer vision techniques in the domain, and then innovative techniques will be developed to tackle them which may include: pre-processing methods for enhancing the image quality, image segmentation to extract and locate the visual content, feature extraction and machine learning for modelling the object categories, and innovate image classification schemes using deep learning techniques.

MRG: Smart Networked Systems (SNS)

Internship Title	Topology Control Algorithms for Wireless Sensor Networks and the Internet of Things
Description of Internship	Wireless Sensor Networks are special types of networks with limited communication, processing and energy capabilities. This topic deals with the implementation of specific topology control algorithms. They mainly deal with network tree construction, maintenance and optimization. Many ideas are already defined, but additional development may be needed to match them to an overall concept. Students will have to get familiarized with the operating system (Contiki) and the accompanying sensor simulator (COOJA), which will not be difficult since they are both C/C++ based.
Internship Objectives	To create new algorithms for WSN and IoT topology control
Expected Deliverables	Final Report, Simulation Scripts

Internship Title	Protocols for Mobile Sensor Networks
Description of Internship	This topic deals with the implementation and evaluation of mobility management protocols for Wireless Sensor networks. Mobility is examined in the context of general 6LowPAN networks and specific performance-controlled implementation (GinMAC). The student involved will build a small testbed of TelosB or similar nodes and program them in Contiki. The Cooja simulator will also be used for proof of concept validation.
Required Skills	Basic knowledge of historical research (including oral history or art history)
Internship Objectives	To create new/test existing algorithms for WSN and IoT mobility
Expected Deliverables	Final Report, Simulation Scripts, Testbed

Internship Title	Use of Mobile Nodes for Congestion Control and Fault Tolerance
Description of Internship	This topic deals with the implementation of certain features and the evaluation of algorithms already developed at UCY, for the use ofmobile nodes for fixing congestion problems or other faults in WSNs and IoT networks
Required Skills	Computer Networks, Network protocols, Basic Programming
Internship Objectives	To create new algorithms for use of Mobile Nodes for network recovery
Expected Deliverables	Final Report, Simulation Scripts

Internship Title	Anomaly Detection Algorithms
Description of Internship	Every sensor and embedded device is prone to error failure which can be caused by natural causes such as environmental effects, battery discharging or by malicious invasion to the network. A fault in a node can decrease network performance and/or in the worst case scenario,dissolution of the network. Diagnosing faults in the network at an early stage can decrease the possibilities of tear down the network. Fault diagnosis can help identify the nature of the error; whether the error is a result of malicious intervention or of natural causes. The goal of the current project is to create faults so that to train a diagnosis tool. The tool will evaluate a set of data that will be considered crucial to identify the presence of fault or malicious intervention in the network. Data gathered in a controlled environment will be profiled as normalbehavior, that is, behavior with no faults present in the network. Data will also be taken in simulations where faults, or attacks are present. Both benign and malicious data will be used to establish boundaries that will identify the presence of malicious attack of failure. The recognition and classification of the activity will be based on one or more techniques from Statistical Analysis, Machine Learning and Computational Intelligence.
Required Skills	Computer Networks, Network protocols, Basic Programming, basic understanding of AI/ML
Internship Objectives	To create new intrusion detection techniques, or the extensive evaluation of existing techniques.
Expected Deliverables	Final Report, Simulation Scripts

Internship Title	Internet of Things Intrusion Detection
Description of Internship	Extension of the topic on anomaly detection by focusing more on the new types of topologies created in IoT settings. Implementation of monitoring at the gateway node and creation and evaluation of new types of attacks, related to the types of protocols most used in IoT (RPL, CoAP, MQTT etc).
Required Skills	Computer Networks, Network protocols, Basic Programming, basic understanding of AI/ML
Internship Objectives	To create new intrusion detection techniques, or the extensive evaluation of existing techniques.
Expected Deliverables	Final Report, Simulation Scripts

Internship Title	Implementation of direct communication between smartphones
Description of Internship	As part of ongoing work on Device-to-Device communication there is a need to implement and experiment with different types of technologies enabling direct communication. There are two modes of operation: interchanging files (ftp like) and sharing communication resources (one acts as a relay/router for the other). Work in this topics includes programming for Android phones (android studio or similar) to implement the two communication modes in WIFI-direct and LTE Direct.
Required Skills	Computer Networks, Network protocols, Basic Programming, Android programming
Internship Objectives	To implement a direct communication solutions between smartphones
Expected Deliverables	Final Report, Testbed

Internship Title	Design and Development of the User Equipment based Virtual Base Station (UE-VBS)
Description of Internship	Year by year, new Smartphones are released that are more capable and more powerful than the generation preceding it. Due to their advanced hardware, increased processing power and storage space, vastly improved networking capabilities and networking speeds, current market-based UEs have reached a stage of becoming powerful enough to fulfill almost all of our computing and communication demands. The aim of the UE-VBS concept is to exploit these unutilized resources for augmenting and supporting the Cellular Infrastructure to tackle the ambitious goals set for emerging 5G/6G Networks. More specifically, through a simple mobile application software, the Mobile Users will have the opportunity to: i) enhance their Smartphones into User Equipment based Virtual Base Stations1 (UE-VBSs); ii) embed them as an integral and compatible part of the Mobile Network Operators (MNOs) cellular infrastructure; and iii) get rewarded by offering networking services (i.e., deploy virtual small cells or relay traffic) for extending data rates, capacity and backhauling capabilities in a targeted and scalable manner, in areas where the Cellular Infrastructure is weak and demands in coverage, capacity and data rates are greater than it can provide.
Required Skills	Knowledge/Experience in the following aspects: • 5G Mobile Networks • State-of-the-art Mobile Network Architectures and 5G Technologies (i.e., SDN, NFV, D2D, SON, etc.); • 5G Network Equipment and Mobile/Portable Devices already in the market and their technical capabilities; • Android Programming
Level of required Skills	
Internship Objectives	1. Perform a comprehensive survey grounded on the latest 3GPP Technical Specification (TS) and Technical Reports (https://www.3gpp.org/), so as to identify aspects of the market-based Mobile Devices that should be evolved for allowing them to be enhanced into UE-VBSs (i.e., able to serve as a Virtual Small Cell or a Virtual Relay Node). 2. Provide the design (i.e., Software enhancements) that need to be made on the existing market-based Smartphones that will allow them to be enhanced into UE-VBs and operate in currently being deployed 5G Mobile Networks. 3. Develop the UE-VBS application. For the scope of this project, the UE-VBS application will developed for Android 10 and above compatible Mobile Devices using the latest android studio and SDK tools. In addition, the GUIs of the UE-VBS app allowing the Mobile Users to interact and control their Smartphones, might needed to be developed.

Internship Title	Design of an Evolved Mobile Network Architecture incorporating the UE-VBS Layer in E-UTRAN
Description of Internship	Year by year, new Smartphones are released that are more capable and more powerful than the generation preceding it. Due to their advanced hardware, increased processing power and storage space, vastly improved networking capabilities and networking speeds, current market-based UEs have reached a stage of becoming powerful enough to fulfill almost all of our computing and communication demands. Capitalizing on the dense and ubiquitous distribution of the Mobile users (expected to reach a total of 5.8 billion unique mobile subscribers by 2025) in our physical world, the vision is to form, through their Mobile Devices (i.e., Smartphones, Tablets, etc.), a new highly flexible, manageable and cost-effective (in terms of CAPEX and OPEX) multi-vendor, multi-spectrum and multi-RAT virtual cellular infrastructure (we refer to this as UE-VBS layer), at the bottom tier of E-UTRAN. On this virtual UE-VBS layer, the MNOs would be able to control and exploit on-demand, either as Virtual Small Cells (VSCs) or Virtual Relay Nodes (VRNs), the UE-VBSs comprising it. Such virtual layer can provide to MNOs a distributed pool of capacity from a well-balanced combination of different spectrum and air interfaces able to: i) Extend capacity and data rates in a target and scalable manner to meet the dynamic and high-bandwidth requirements of 5G use cases; ii) Automate the

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	real-time organization, reconfiguration and optimization of their Cellular Infrastructure and Operation to deliver assured service quality across the entire cell (always adapted to the Radio Access Network demands, stresses or failures and driven always by the current location trends and preferences of the users) and flexible enough to achieve the Enhanced Mobile Broadband (eMBB) and massive capacity defining characteristics of 5G.
Required Skills	Knowledge/Experience in the following aspects: • 5G Mobile Networks • State-of-the-art Mobile Network Architectures and 5G Technologies (i.e., SDN, NFV, D2D, SON, etc.); • 5G Network Equipment and Mobile/Portable Devices already in the market and their technical capabilities;
Level of required Skills	
Internship Objectives	1. Perform a comprehensive survey grounded on the latest 3GPP Technical Specification (TS) and Technical Reports (https://www.3gpp.org/), so as to identify aspects of the Mobile Network Architecture that should be evolved to allow the UE-VBS Layer to be embedded as an integral and compatible part of E-UTRAN in currently being deployed 5G Mobile Networks 2. Provide the design of the Evolved Mobile Network Architecture incorporating the UE-VBS Layer in E-UTRAN. With respect to the design of the overall architecture, the SDN and NFV technologies for 5G/6G, should be considered, as these technologies are expected to be a perfect match to the virtualised resource aspect of the UE-VBS Layer. The value of SDN, particularly in combination with NFV, is its ability to provide network virtualization, automation and create new services on top of virtualized resources offered by the UE-VBS layer. In this manner, a dynamic, highly manageable, and cost-effective architecture can be provided for 5G, making it ideal for the ever changing, dynamic, high-bandwidth nature of 5G use cases.

MRG: The Next Generation of Smart Cameras (DeepCamera)

Internship Title	AI based Encoding/Decoding Video Stream
Description of Internship	Video streaming technology is a pivotal tool for delivering high quality content over the network for providing a variety of services. On one hand, the network technology is upgrading to higher bandwidth but a slow pace. On the other hand, the entertainment industry is moving very fast in proposing higher quality content that can be streamed directly to your home. This of course create a bottleneck that can be solved providing efficient and resilient compression technology solutions. AI technology can help in this, accelerating the process of developing streaming technology efficient as the traditional one.
Required Skills	Python, Deep-learning, and deep-learning environments
Level of required Skills	Good level
Internship Objectives	The internship objectives are open of the followings: - Development of Datasets for different stages of the encoding system - Development of deep-learning based encoding technology

Internship Title	Modular Deeplearning tool
Description of Internship	Developing a deeplearning approach is tedious and it is requesting a large amount of time. In this project you will build an innovative framework which will allow to develop complex deeplearning approaches in a graphical fashion and then translate them in the corresponding code representation.
Required Skills	Python, Deep-learning, and deep-learning environments, JSON
Level of required Skills	Good level
Internship Objectives	The project aims are the followings: 1. Developing a graphical tool for developing deep-learning approaches (front-end) 2. Developing the back-end component

Internship Title	Color management system for HDR and WCG content
Description of Internship	Color management system allows to convey similar visual color experience when visualized the same digital content on different digital devices, e.g., displays with different capabilities. This is extremely important today where different digital contents are available, e.g., Standard dynamic Range (SDR), High Dynamic Range (HDR), Wide Color Gamut (WCG) etc.

Required Skills	Python, Deep-learning, and deep-learning environments.
Level of required Skills	Good level
Internship Objectives	The project aims are the followings: 1. Conduct research in deeplearning to advance the state-of-the-art color management system. 2. Collecting data, develop a deeplearning approach and training it with the scope of developing an efficient color management system for the HDR and WCG gamut.

Internship Title	Continuous Learning in image Processing/Computer Vision
Description of Internship	Continual learning techniques enable models to acquire specialized solutions without forgetting previous ones, potentially learning over a lifetime, as a human does. More fundamentally, continual learning methods could offer enormous advantages for deep neural networks even in stationary settings, by improving learning efficiency as well as by enabling knowledge transfer between related tasks. In this project you will investigate how continuous learning can be applied on the field of image processing/computer vision to solve one of the existing problems.
Required Skills	Python, Deep-learning, and deep-learning environments.
Level of required Skills	Good level
Internship Objectives	The project aims are the followings: 1. Conduct research in continuous learning to be applied to image processing/computer vision applications. 2. Collecting data, develop a continuous learning approach and training it to solve a specific image processing/computer vision problem.

Internship Title	Robotic Gstreamer node development
Description of Internship	Gstreamer is a prominent SDK for building imaging/video and computer vision pipeline. The concept of node is introduced to deploy a specific functionality of the developed pipeline. The Deepcamera group at CYENS as developed recently Dgistreamer a tool to develop and easily deploy any pipeline (see this video as result of our collaboration with the LEAR group from CYENS https://www.youtube.com/watch?v=VwwVzQpdIcc) In this project you will develop a node based on the gstreamer framework to read all the sensors available on the in-house unitree robot.
Required Skills	C/C++ and/or RUST.
Level of required Skills	Good level
Internship Objectives	The project aims are the followings: 1. Learn gstreamer framework syntax. 2. Develop a gstreamer based node to read all the robot sensors..

MRG: Interactive Media and Education/Edutainment (EdMedia)

The EdMedia Group of CYENS (https://www.cyens.org.cy/en-gb/) aims to conduct applied research and innovation in the field of Interactive Media for Education and Edutainment. EdMedia work is related to learning experience (LX) design, User Experience (UX), technology-enhanced learning, training and pedagogy, technology integration in formal, non-formal and informal education, assessment and evaluation.

EdMedia considers internships applicants with expertise and interests relevant to **EdMedia.**

MRG: Immersive Technologies for Intelligent and Creative Applications (ITICA)

Internship Title	Creative Industries with Emerging Technologies for Virtual and Augmented Reality applications
Description of Internship	We are looking for students interested to work with Augmented and Virtual reality technologies blended with elements from the culturaland creative industries. The work will focus on: a) developing modules such as facial/image/object recognition to be embedded on augmented reality glasses and b) on virtual reality integrated with haptic feedback to build applications and/or creative installations.
Required Skills	• Bachelor or master's degree in one of the following areas or a related area: computer science, graphic design, digital arts, cognitive systems and/or Mathematics • Programming skills in C++ or C#, and familiarity with game engines such as Unity3D and Unreal Engine. Experience with VR development. • Ability to create 3D models to be used in VR applications. Proficiency in 3DS Max, Maya or other 3D modeling software and Photoshop. Knowledge and ability to implement the full game asset pipeline, with experience in Substance Design a plus.
Level of required Skills	Good

MRG: Learning Agents and Robots (LEAR)

Internship Title	Fast Learning of Diverse Robotic Skills
Description of Internship	Quality diversity (QD) optimization [1] is an emerging field that has shown great promise in automatically producing a diversity of high-quality robotic skills. However, QD algorithms typically require millions of evaluations with a robotic simulator, often executed on CPU clusters for days, which limits their practicality. The recent introduction of simulators that can execute physics calculations directly on the GPU [3-6] opens up great potentials in accelerating QD by orders of magnitude. For instance, [6] reports the use of such a simulator for training a legged robot to walk in just 20 minutes on a single workstation. Project aims: 1) Accelerate the wall-clock time of QD algorithms for teaching legged robots a diversity of skills by implementing: - standard QD algorithms on Nvidia's IsaacGym simulator [3,6] OR - differentiable QD algorithms [2] on differentiable simulators [4,5] 2) Evaluate the resulting framework by comparing against the state-of-the-art.
Required Skills	Very good programming skills (C++ or Python). Experience with robotic simulation or physics engines. Interest in legged robots, reinforcement learning, or evolutionary computation.
Reading	[1] Chatzilygeroudis, K., Cully, A., Vassiliades, V., & Mouret, J. B. (2021). Quality-Diversity Optimization: a novel branch of stochastic optimization. In Black Box Optimization, Machine Learning, and No-Free Lunch Theorems (pp. 109-135). Springer, Cham. [2] Fontaine, M. C., & Nikolaidis, S. (2021). Differentiable Quality Diversity. To appear in NeurIPS 2021. Preprint: https://arxiv.org/abs/2106.03894 [3] Makoviychuk, V., Wawrzyniak, L., Guo, Y., Lu, M., Storey, K., Macklin, M., ... & State, G. (2021). Isaac Gym: High Performance GPU-Based Physics Simulation For Robot Learning. arXiv preprint arXiv:2108.10470. [4] Freeman, C. D., Frey, E., Raichuk, A., Girgin, S., Mordatch, I., & Bachem, O. (2021). Brax-A Differentiable Physics Engine for Large Scale Rigid Body Simulation. [5] Heiden, E., Millard, D., Coumans, E., Sheng, Y., & Sukhatme, G. S. (2020). NeuralSim: Augmenting differentiable simulators with neural networks. arXiv preprint arXiv:2011.04217. [6] Rudin, N., Hoeller, D., Reist, P., & Hutter, M. (2021). Learning to Walk in Minutes Using Massively Parallel Deep Reinforcement Learning. arXiv preprint arXiv:2109.11978.

Internship Title	Unsupervised Robotic Skill Discovery using Quality-Diversity Optimization and Sequence Encoder-Decoder Models
Description of Internship	Quality diversity (QD) optimization [1] is an emerging field that has shown great promise in automatically producing a diversity of high-quality robotic skills. However, one of their limitations is the need to hard-code a low-dimensional skill descriptor which often requires domain knowledge and causes delays in experiments. A recent study [2] used simple dimensionality reduction techniques to automatically extract the skill descriptor from high-dimensional information. While promising, that study did not focus on the temporal nature of the data streams, suggesting that the use of recurrent neural networks [3] or more advanced models, such as Transformers [4], for encoding and decoding the data streams would offer greater benefits. Project aims: - Develop a QD optimization framework for the automatic discovery of robotic skills using sequence-to-sequence models [3] or Transformers [4]. - Evaluate the framework using hand-crafted skill descriptors, and simple dimensionality reduction techniques (Principal Components Analysis, Autoencoders).

Required Skills	Very good programming skills (C++ or Python). Knowledge of machine learning and deep learning (including frameworks such as Tensorflow or PyTorch). Interest in robot learning and evolutionary computation.
Reading	[1] Chatzilygeroudis, K., Cully, A., Vassiliades, V., & Mouret, J. B. (2021). Quality-Diversity Optimization: a novel branch of stochastic optimization. In Black Box Optimization, Machine Learning, and No-Free Lunch Theorems (pp. 109-135). Springer, Cham. [2] Grillotti, L., & Cully, A. (2021). Unsupervised Behaviour Discovery with Quality-Diversity Optimisation. arXiv preprint arXiv:2106.05648. [3] Sutskever, I., Vinyals, O., & Le, Q. V. (2014). Sequence to sequence learning with neural networks. In Advances in neural information processing systems (pp. 3104-3112). [4] Vaswani, A., Shazeer, N., Parmar, N., Uszkoreit, J., Jones, L., Gomez, A. N., ... & Polosukhin, I. (2017). Attention is all you need. In Advances in neural information processing systems (pp. 5998-6008).

Internship Title	Accelerated Quality Diversity Optimization using Improved Selection and Variation Operators
Description of Internship	Traditionally, the focus of evolutionary algorithms is to optimize black-box functions and return a single, globally optimal solution. However, many real-world cases demand for not just a single solution, but rather a diverse collection of high-quality ones. Quality diversity (QD) optimization [1-3] is a framework for solving such problems. QD algorithms have been successfully applied in domains such as robotics (e.g., creating behavioral repertoires), engineering (e.g., generating diverse aerodynamic designs) and video games (e.g., procedural level generation). However, they typically require a large number of evaluations to optimize both the coverage and the quality of the collection. In order to accelerate QD optimization, recent works proposed improved selection [2] and variation [4-6] operators, yet no systematic study has been conducted about their potentially complementary benefits. In addition, promising heuristics originated in the multimodal optimization literature (e.g., see [7,9]), have not yet been thoroughly investigated in the context of QD optimization. Project aims: - Develop a framework for experimentation with various selection and variation operators in QD algorithms (e.g., see [2] and [8]). - Investigate and analyze properties of the collections (over iterations) and the combination of various operators in terms of QD-related metrics (e.g., coverage, mean archive fitness, max archive fitness, QD-score, hypervolume). - Develop and evaluate novel heuristics and operators that aim to improve QD optimization. - The focus should be on simplicity (e.g., see [4]). In case a learning model is employed, its complexity should be kept at a minimum.
Required Skills	Very good programming skills (C++ or Python). Knowledge of evolutionary computation. Interest in machine learning.
Reading	[1] Chatzilygeroudis, K., Cully, A., Vassiliades, V., & Mouret, J. B. (2021). Quality-Diversity Optimization: a novel branch of stochastic optimization. In Black Box Optimization, Machine Learning, and No-Free Lunch Theorems (pp. 109-135). Springer, Cham. [2] Cully, A., & Demiris, Y. (2017). Quality and diversity optimization: A unifying modular framework. IEEE Transactions on Evolutionary Computation, 22(2), 245-259. [3] Vassiliades, V., Chatzilygeroudis, K., & Mouret, J. B. (2017). Using centroidal Voronoi tessellations to scale up the multidimensional archive of phenotypic elites algorithm. IEEE Transactions on Evolutionary Computation, 22(4), 623-630. [4] Vassiliades, V., & Mouret, J. B. (2018). Discovering the elite hypervolume by leveraging interspecies correlation. In Proceedings of the Genetic and Evolutionary Computation Conference (pp. 149-156). [5] Fontaine, M. C., Togelius, J., Nikolaidis, S., & Hoover, A. K. (2020). Covariance matrix adaptation for the rapid illumination of behavior space. In Proceedings of the 2020 genetic and evolutionary computation conference (pp. 94-102). [6] Choi, T. J., & Togelius, J. (2021). Self-referential quality diversity through differential MAP-Elites. In Proceedings of the Genetic and Evolutionary Computation Conference (pp. 502-509).

[7] Preuss, M. (2010). Niching the CMA-ES via nearest-better clustering. In Proceedings of the 12th annual conference companion on Genetic and evolutionary computation (pp. 1711-1718).
[8] https://pypi.org/project/qdpy/
[9] Harik, G. R. (1995). Finding Multimodal Solutions Using Restricted Tournament Selection. In ICGA (pp. 24-31).

Internship Title	Noisy Quality Diversity Optimization in Unbounded Domains
Description of Internship	Quality Diversity optimization algorithms [1] are capable of efficiently generating large collections of highly diverse and accurate solutions. MAP-Elites [2,3] is a popular and successful algorithm among this class. MAP-Elites assumes that diversity is maintained in a low-dimensional space, called the "behavior space", where the bounds of each dimension are known. This assumption enables the pre-tessellation of the behavior space into a number of bins which will be populated with the locally best solutions after the end of the optimization process. Approaches that either do not use bins [4] or adapt the tessellation based on data [5] can be used when this assumption does not hold. A second but important assumption shared by most QD algorithms is that each solution evaluation is deterministic, i.e., there is no uncertainty about the fitness of the solutions, nor their behavior descriptors (i.e., their coordinates in behavior space). This assumption is unrealistic, thus, mitigating it would allow QD algorithms to have a broader impact. A recent extension of MAP-Elites [6], i.e., a "binning approach", showed promising results, however, it is still an open problem how this can be accomplished efficiently in potentially high-dimensional behavior spaces where the bounds of each dimension are not known a priori. Project aims: - Develop new QD optimization algorithms robust to noise in a sample efficient manner, which do not require knowledge of the bounds of the behavior space. - Evaluate the algorithms by conducting experiments in various settings, against known algorithms, and analyse the results.
Required Skills	Very good programming skills (C++ or Python). Knowledge of evolutionary computation. Interest in machine learning or robot learning.
Reading	[1] Chatzilygeroudis, K., Cully, A., Vassiliades, V., & Mouret, J. B. (2021). Quality-Diversity Optimization: a novel branch of stochastic optimization. In Black Box Optimization, Machine Learning, and No-Free Lunch Theorems (pp. 109-135). Springer, Cham. [2] Mouret, J. B., & Clune, J. (2015). Illuminating search spaces by mapping elites. arXiv preprint arXiv:1504.04909. [3] Vassiliades, V., Chatzilygeroudis, K., & Mouret, J. B. (2017). Using centroidal Voronoi tessellations to scale up the multidimensional archive of phenotypic elites algorithm. IEEE Transactions on Evolutionary Computation, 22(4), 623-630. [4] Lehman, J., & Stanley, K. O. (2011). Evolving a diversity of virtual creatures through novelty search and local competition. In Proceedings of the 13th annual conference on Genetic and evolutionary computation (pp. 211-218). [5] Vassiliades, V., Chatzilygeroudis, K., & Mouret, J. B. (2017). A comparison of illumination algorithms in unbounded spaces. In Proceedings of the Genetic and Evolutionary Computation Conference Companion (pp. 1578-1581). [6] Flageat, M., & Cully, A. (2020). Fast and stable MAP-Elites in noisy domains using deep grids. In Artificial Life Conference Proceedings (pp. 273-282). One Rogers Street, Cambridge, MA 02142-1209 USA journals-info@ mit. edu: MIT Press.

Internship Title	Deep Reinforcement Learning for Advanced Quadrupedal Locomotion from Vision
Description of Internship	Deep reinforcement learning has demonstrated great potential for learning robust quadrupedal robotic locomotion controllers [1,2]. These approaches typically rely on simulation, where privileged (ground truth) information (e.g., local terrain profile, friction coefficients etc.) is leveraged to train adaptive policies that do not use this information. The resulting controllers are then transferred on real robots making them capable of effectively handling certain real world environments. However, such controllers are "blind" - they do not use any

	information from the robot's camera. This disadvantage would make them fail in settings that require careful placement of their feet [3], or even simple obstacle avoidance. Enhancing simulation with such information [4-7] would make quadrupedal robots capable of autonomously handling an even greater diversity of environments, opening up new avenues for potential application. A recent impressive result along these research lines uses simulation to teach real autonomous drones to fly at high speeds (40km/h) in challenging environments (such as dense forests) without any crash [8]. Project aims: - Develop challenging simulated environments for training quadruped robots using camera depth information, in addition to other sensors. - Implement deep RL algorithms and conduct experiments for robot training. - Evaluate the ability of the simulated robots to use appropriate gaits in any given situation.
Required Skills	Very good programming skills (C++ or Python). Experience with robotic simulation. Knowledge of machine learning (including deep learning and reinforcement learning) and computer vision. Interest in legged robots.
Reading	[1] Lee, J., Hwangbo, J., Wellhausen, L., Koltun, V., & Hutter, M. (2020). Learning quadrupedal locomotion over challenging terrain. Science robotics, 5(47). [2] Kumar, A., Fu, Z., Pathak, D., & Malik, J. (2021). Rma: Rapid motor adaptation for legged robots. arXiv preprint arXiv:2107.04034. [3] Tsounis, V., Alge, M., Lee, J., Farshidian, F., & Hutter, M. (2020). Deepgait: Planning and control of quadrupedal gaits using deep reinforcement learning. IEEE Robotics and Automation Letters, 5(2), 3699-3706. [4] Choromanski, K., Jain, D., Parker-Holder, J., Song, X., Likhosherstov, V., Santara, A., ... & Weller, A. (2021). Unlocking Pixels for Reinforcement Learning via Implicit Attention. arXiv preprint arXiv:2102.04353. [5] Shi, H., Zhou, B., Zeng, H., Wang, F., Dong, Y., Li, J., ... & Meng, M. Q. H. (2021). Reinforcement Learning with Evolutionary Trajectory Generator: A General Approach for Quadrupedal Locomotion. arXiv preprint arXiv:2109.06409. [6] Imai, C. S., Zhang, M., Zhang, Y., Kierebinski, M., Yang, R., Qin, Y., & Wang, X. (2021). Vision-Guided Quadrupedal Locomotion in the Wild with Multi-Modal Delay Randomization. arXiv preprint arXiv:2109.14549. [7] Sorokin, M., Tan, J., Liu, C. K., & Ha, S. (2021). Learning to Navigate Sidewalks in Outdoor Environments. arXiv preprint arXiv:2109.05603. [8] Loquercio, A., Kaufmann, E., Ranftl, R., Müller, M., Koltun, V., & Scaramuzza, D. (2021). Learning high-speed flight in the wild. Science Robotics, 6(59), eabg5810.

Internship Title	Continual Unsupervised Learning on Edge Devices
Description of Internship	Deploying sophisticated machine learning models on edge devices (e.g., smart phones) is starting to become mainstream through frameworks such as TensorFlow Lite. Yet, the ability to continually adapt the model after deployment on-device without making it forget its previous knowledge is still a challenge. Doing so would enable to go beyond transfer learning scenarios (which simply fine-tune a model to the recent data), and build personalized systems that obey privacy, data and network limitations. This kind of personalization opens up the door to many innovations: from smart camera traps that monitor biodiversity in forests as a means to understand and mitigate climate change, to building the next generation of robotic systems that become more adaptive and accurate the longer they look at a video [5]. Recent research has demonstrated the ability to continually learn on smart phones in the supervised learning setting [1,2] where class labels are available. The more challenging continual unsupervised learning [3,4] setting on edge devices is still an open problem. Project aims: - Investigate continual unsupervised learning algorithms from visual data, as well as their proper evaluation metrics and protocols.

	- Develop a ML system that can be deployed and trained on a smart phone. - Conduct experiments that demonstrate the superior abilities of the system compared to traditional approaches in terms of the chosen evaluation protocol.
Required Skills	Very good programming skills (Python and mobile app development). Experience in computer vision or machine learning (including deep learning).
Reading	[1] Demosthenous, G., & Vassiliades, V. (2021). Continual Learning on the Edge with TensorFlow Lite. arXiv preprint arXiv:2105.01946. [2] Pellegrini, L., Lomonaco, V., Graffieti, G., & Maltoni, D. (2021). Continual Learning at the Edge: Real-Time Training on Smartphone Devices. arXiv preprint arXiv:2105.13127. [3] Smith, J., Taylor, C., Baer, S., & Dovrolis, C. (2019). Unsupervised progressive learning and the stam architecture. arXiv preprint arXiv:1904.02021. [4] Rao, D., Visin, F., Rusu, A. A., Teh, Y. W., Pascanu, R., & Hadsell, R. (2019). Continual unsupervised representation learning. arXiv preprint arXiv:1910.14481. [5] Pirk, S., Khansari, M., Bai, Y., Lynch, C., & Sermanet, P. (2019). Online object representations with contrastive learning. arXiv preprint arXiv:1906.04312.

Internship Title	Data-driven hierarchical reinforcement learning
Description of Internship	The availability of huge datasets has enabled the success of deep neural networks trained with supervised learning in problems spanning vision, speech and natural language processing. Reinforcement learning (RL), although it has seen a number of impressive applications (e.g., in games, animation and certain robotic tasks), has yet to be as successful and widespread as supervised learning. RL algorithms that effectively use offline data could enable the creation of better decision making systems in many domains, from autonomous robots to healthcare (e.g., see [3]). Moreover, identifying the hierarchical task decomposition from such data (e.g., see [1,2]) would offer better model interpretability, as well as more efficient learning and planning in an online setting. Project aims: - Investigate algorithms for extracting hierarchical policies from demonstrations in hierarchical tasks in game environments (such as [4]). - Evaluate the adaptation time of the extracted policies in unseen tasks that share the same hierarchical structure and against flat policies trained through imitation learning.
Required Skills	Very good programming skills (C++ or Python). Experience with reinforcement learning. Interest in deep learning and games.
Reading	[1] Hengst, B. (2012). Hierarchical approaches. In Reinforcement learning (pp. 293-323). Springer, Berlin, Heidelberg. [2] Pateria, S., Subagdja, B., Tan, A. H., & Quek, C. (2021). Hierarchical Reinforcement Learning: A Comprehensive Survey. ACM Computing Surveys (CSUR), 54(5), 1-35. [3] Levine, S., Kumar, A., Tucker, G., & Fu, J. (2020). Offline reinforcement learning: Tutorial, review, and perspectives on open problems. arXiv preprint arXiv:2005.01643. [4] https://minerl.io/

Internship Title	Projects related to switch-neuron networks
Description of Internship	Adaptation to changing environments is a hallmark of intelligence. Creating software agents capable of efficiently adapting their behavior to a variety of unpredictable environmental changes presents a challenge with modern artificial neural networks (ANNs). In this project, we will investigate how to tackle this challenge and create adaptive ANNs using "switch neurons" [1]. Switch neurons were proposed as a mechanism that enables flexible and adaptive behavior in ANNs through gating the flow of information. These models have shown to produce optimal exploration strategies in certain simple tasks, however, their full potential currently remains unexplored. We will be looking into projects related to 1) learning such ANN architectures through neuroevolution / neural architecture search; 2) extending such neurons to i) handle noisy signals, ii) become more adaptive; 3) using them in more complex environments; 4) training them using gradient-descent; 5) comparing them with other adaptive ANNs, such as Long Short-Term Memory [2] networks.
Required Skills	Very good programming skills (C++ or Python). Knowledge of machine learning, neural and evolutionary computation will be considered an advantage.
Reading	[1] Vassiliades, V. & Christodoulou, C. (2016). Behavioral Plasticity Through the Modulation of Switch Neurons. Neural Networks, 74: 35-51. [2] Hochreiter, S., & Schmidhuber, J. (1997). Long short-term memory. Neural Computation, 9(8), 1735-1780.

MRG: Socially-Competent Robotic and Agent Technologies (SCRAT)

Internship Title	Data Analysis and Visualization for Transparent User Profiling
Description of Internship	When a user provides consent for some of their personal data to be used towards creating their profile and customizing their experience, a natural question arises on whether the user is really informed of what data is being explicitly gathered and what inferences can be drawn from that data. If, for example, a user has chosen to share their geo-location with their smartphone, but has declined to share other demographic information, is the user aware of what stream of data is being gathered by their smartphone, and that this stream of data might reveal indirectly their gender, age, or marital status? How can we most transparently present to the user what data is being gathered, and what inferences can be drawn from that data. Depending on the internship type, the project can be adapted towards the visualization of the gathered data, towards the formal analysis of the inferences that can be drawn, or towards other aspects of the problem that can be discussed and identified with the intern.
Required Skills	data visualization OR formal analysis OR data analytics OR data modeling
Internship Objectives	The main objective of the internship is to provide an answer to the following question: How can we most transparently present to the user what data is being gathered, and what inferences can be drawn from that data. Depending on the background of the intern, the project can be adapted towards the visualization of the gathered data, towards the formal analysis of the inferences that can be drawn, or towards other aspects of the problem that can be discussed and identified with the intern.

Internship Title	Natural Language Interaction for Machine Coaching
Description of Internship	When a human interacts with their machine assistant, the scope and language of their interaction is typically fixed by the developers of the assistant. Even in those cases where the assistant is capable of adapting to the human, the feedback that the human provides to facilitate this process is typically very restricted, and comes in the form of categorizing objects into classes (in support of supervised learning) or reacting to the execution of policies (in support of reinforcement learning). Yet, in real life, the adaptation of a human assistant comes through a much richer form of interaction, where both the assistant and their counterpart engage in a natural language dialogue, with each interlocutor explaining why they chose to take an action and/or why they consider an action to be (in)appropriate. This process of coaching, rather than simple supervision, allows for the much more efficient and robust transfer of knowledge to the assistant. This project seeks to investigate how this process of coaching can be used when the assistant is a machine (see https://www.researchgate.net/publication/334989337_Machine_Coaching), focusing on how the machine will generate natural language explanations for its internal symbolically-represented knowledge and inferences, and how the natural language explanations received by the human counterpart will be turned into this internal representation. Depending on the internship type, the project can be adapted towards the natural language processing or generation part, towards the formal analysis of the coaching process, or towards the empirical investigation of the effectiveness of a natural language interaction for machine coaching.
Required Skills	natural language processing OR natural language generation OR formal analysis OR empirical cognitive psychology
Internship Objectives	The main objective of the internship is to investigate how the process of coaching can be used when the assistant is a machine, focusing on how the machine will generate natural language explanations for its internal symbolically-represented knowledge and inferences, and how the natural language explanations received by the human counterpart will be turned into this internal representation. Depending on the background of the intern, the project can be adapted towards the natural language processing or generation part, towards the formal analysis of the coaching process, or towards the empirical investigation of the effectiveness of a natural language interaction for machine coaching.

Internship Title	Reconciling "Data for Learning" with "Data for Arguing"
Description of Internship	The data-driven view of Artificial Intelligence that is currently at the focus of research and industrial attention can be thought to treat a dataset through a collaborative prism, as a collection whose members have certain commonalities; one wishes to identify these commonalities by embracing the statistics of the collection over the views supported by any single member. Case-based reasoning, on the other hand, treats a dataset through a combative prism, as a loose grouping of individuals that support divergent views; one wishes to resolve the tension between these divergent views by identifying which individual makes a stronger case over the other members of the collection. The project seeks to reconcile these two views of data, by bringing together techniques from machine learning and formal argumentation. Depending on the internship type, the project can be adapted towards the development and analysis of a formal framework for this reconciliation, or towards the design and empirical evaluation of simple heuristics that acknowledge both the statistical and argumentative nature of data.
Required Skills	statistical analysis OR formal argumentation OR theoretical machine learning OR empirical cognitive psychology
Internship Objectives	The main objective of the internship is to reconcile the data-driven view and the case-based view of AI, by bringing together techniques from machine learning and formal argumentation. Depending on the background of the intern, the project can be adapted towards the development and analysis of a formal framework for this reconciliation, or towards the design and empirical evaluation of simple heuristics that acknowledge both the statistical and argumentative nature of data.

Internship Title	Teaching Computation through the Movement of Social Insects
Description of Internship	Insects like ants and bees are known to exhibit complex social behavior, not least of which in the way that they move, and this despite their limited and local sensing and decision-making capabilities. Research has shown, in fact, that under appropriate environmental conditions, the behavior of social insects can simulate arbitrary computations (see https://www.researchgate.net/publication/268590027_An_Ant- Based_Computer_Simulator). The aim of this project is to develop a visual simulator of the movement of social insects, to be used as an educational tool for introducing elementary-school students to the basic notions of computation. Depending on the internship type, the project can be adapted towards the development of the visual and user-experience parts of the simulator, or towards the implementation of a scalable simulation engine that supports the asynchronous movement of thousands of insects.
Required Skills	visual simulation OR user experience OR parallel programming
Internship Objectives	The main objective of the internship is to develop a visual simulator of the movement of social insects, to be used as an educational tool for introducing elementary-school students to the basic notions of computation. Depending on the background of the intern, the project can be adapted towards the development of the visual and user-experience parts of the simulator, or towards the implementation of a scalable simulation engine that supports the asynchronous movement of thousands of insects.

Internship Title	Predictive Visual Completion of Simple Sketched Figures
Description of Internship	Deep neural-based architectures have emerged in the last decade as a powerful general-purpose substrate for learning directly from raw data, and have been used, in particular, for the predictive completion of images and text. It remains an interesting prospect whether shallower architectures, which presumably require considerably less training data, might be sufficient for the predictive completion of

	simple sketched figures. The project aims to develop an application for a touch-based device that allows a user to hand-draw simple figures, while the application attempts in parallel to anticipate and visualize the remainder of the figure. Depending on the internship type, the project can be adapted towards investigating theoretically whether simple local learning mechanisms and relatively few training examples suffice for the particular task, or towards the actual development of the application and the empirical evaluation of the efficacy of heuristic learning techniques.
Required Skills	zero-shot learning OR local-to-global behavior OR smart-device programming OR empirical evaluation
Internship Objectives	The main objective of the internship is to develop an application for a touch-based device that allows a user to hand-draw simple figures, while the application attempts in parallel to anticipate and visualize the remainder of the figure. Depending on the background of the intern,the project can be adapted towards investigating theoretically whether simple local learning mechanisms and relatively few training examples suffice for the particular task, or towards the actual development of the application and the empirical evaluation of the efficacy of heuristic learning techniques.

Internship Title	Teaching Machines to Extract World Knowledge from Text
Description of Internship	A point made ad nauseam in the literature is that general-purpose AI systems will need to be able to utilize some form of world knowledge to comprehend the situations that they face. While raw text has been proposed as a potentially-useful source of such knowledge (see https://www.researchgate.net/publication/215991030_A_First_Experimental_Demonstration_of_Massive_Knowledge_Infusion), the completely autonomous choice of learning material risks derailing the learning process towards sifting through the massive haystack of irrelevant text found, for example, on the Web, while searching for the proverbial needle of useful training material. The project seeks to develop curriculum learning techniques for directing the learning process. Depending on the internship type, the project can be adapted towards empirically demonstrating the effectiveness of curriculum learning over completely autonomous learning, towards the investigation of whether knowledge for a particular domain of interest is, even in principle, learnable from Web text, or towards the identification of appropriate natural language processing techniques for parsing text and extracting knowledge.
Required Skills	curriculum learning OR natural language processing OR text mining OR knowledge extraction
Internship Objectives	The main objective of the internship is to The project seeks to develop curriculum learning techniques for directing the learning process. Depending on the background of the intern, the project can be adapted towards empirically demonstrating the effectiveness of curriculumlearning over completely autonomous learning, towards the investigation of whether knowledge for a particular domain of interest is, even in principle, learnable from Web text, or towards the identification of appropriate natural language processing techniques for parsing text and extracting knowledge.

Internship Title	Eliciting and Visualizing Actionable User Preferences
Description of Internship	A key feature of personalization is the elicitation and utilization of a user's preferences to anticipate their future choices. Any form of prompting during the elicitation process, however, might critically affect what information is divulged by the user, suggesting that a passive learning process might be appropriate. On the other hand, theoretical analysis (see https://www.researchgate.net/publication/316279661_Introspective_Forecasting) suggests that passive learning is inappropriate if one wishes to acquire actionable knowledge. The project seeks to reconcile these views by exploring the use of preference elicitation in a real-world setting. Depending on the internship type, the project can be adapted towards identifying a domain in which preference elicitation

	can be useful and empirically exploring the effectiveness of different learning strategies, or towards the development and analysis of formal elicitation processes that exhibit certain desirable properties.
Required Skills	empirical evaluation OR software development OR formal analysis OR theoretical machine learning
Internship Objectives	The main objective of the internship is to reconcile the two seemingly-conflicting requirements for the process of personalization by exploring the use of preference elicitation in a real-world setting. Depending on the background of the intern, the project can be adapted towards identifying a domain in which preference elicitation can be useful and empirically exploring the effectiveness of different learning strategies, or towards the development and analysis of formal elicitation processes that exhibit certain desirable properties.

Internship Title	Crowdsourced Event Reporting in a Smart City Setting
Description of Internship	The "wisdom of the crowd" has been used extensively to elicit reliable information from a collection of potentially unreliable sources, typically relying on the cognitive abilities of humans to compute an answer, recall information, or express an opinion. In the era of the Internet of Things, and with the widespread use of mobile smart devices (such as smartphones, smartwatches, etc.), humans in a crowdsourcing context can also be viewed as sensing devices with an admittedly powerful edge-computing ability to recognize events or situations. This project aims to develop a crowdsourcing application that runs on mobile smart devices and that offers a one-button solution to reporting events in a smart city setting, along with a back-end server application to collect, evaluate, aggregate, and visualize the reported events. Depending on the internship type, the project can be adapted towards the development of the applications and their empirical evaluation, or towards the design and analysis of appropriate incentive schemes and aggregation methods to guarantee the quality of the reporting.
Required Skills	smart-device programming OR empirical evaluation OR incentive design / game theory OR data aggregation
Internship Objectives	The main objective of the internship is to develop a crowdsourcing application that runs on mobile smart devices and that offers a one-button solution to reporting events in a smart city setting, along with a back-end server application to collect, evaluate, aggregate, and visualize the reported events. Depending on the background of the intern, the project can be adapted towards the development of the applications and their empirical evaluation, or towards the design and analysis of appropriate incentive schemes and aggregation methods to guarantee the quality of the reporting.

MRG: Smart, Ubiquitous, and Participatory Technologies for Healthcare Innovation

Internship Title	Dementia Project
Description of Internship	People with dementia residing in long-term care are usually facing numerous motor and cognitive impairments and go through therapeutic physical and cognitive training. In recent years, there have been a growing research interests towards designing non-pharmacological interventions aiming to improve the quality of life for people with dementia within long-term care. We are currently exploring the use of Virtual Reality for patients with mild, moderate, and severe dementia in collaboration with the Archangelos Michael Elderly People NursingHome / Rehabilitation Centre for Patients with Alzheimer. We are exploring the appeal of using VR for people with dementia, and the observed impact such interaction has on their physical and cognitive trainings. Moreover, we are investigating the design opportunities, pitfalls, and recommendations for future deployment in healthcare services. Using a user-centred design approach, we are carrying out multisite trials to evaluate the effectiveness of the virtual reality system that will be developed and to improve its usability.
Required Skills	• Bachelor or master's degree in one of the following areas or a related area: computer science, graphic design, digital arts, cognitive systems. • Programming skills in C++ or C#, and familiarity with game engines such as Unity3D and Unreal Engine. Experience with VR development. • Ability to create 3D models to be used in VR applications. Proficiency in 3DS Max, Maya or other 3D modeling software and Photoshop.Knowledge and ability to implement the full game asset pipeline, with experience in Substance Design a plus. • Bio-signals Analysis skills, preferably in Electrocardiography (ECG), Photoplethysmogram (PPG), Electromyography (EMG), Electrodermal Activity (EDA).
Internship Objectives	The successful candidate will be: (1) designing and developing Virtual Reality environments; (2) programming tracking devices (such as Arduinos), and or bio-signal devices (such as myo armband) suitable to the needs of a people with dementia and cancer patients; and (3) analysing bio-signals.

Internship Title	Cancer Project
Description of Internship	Cancer project proposes to design a low-cost mobile VR system to complement patients' physiotherapy and psychotherapy. The system willbe able to accurately monitor the physical training performed by the patent on a daily basis. In addition, the system will assess in real-time the patient's performance and will provide guidance to improve the training tasks accuracy. The system will also serve as a virtual platform to facilitate remote psychotherapy for the cancer patients and their psychotherapists. To do so, it leverages on a few state-of-the-art technologies: *(1) Virtual Reality,* through the use of low-cost Head-Mounted Display (HMD) systems, which will surround the user's vision completely. The VR-HMDs include head-tracking machinery to track the motion of the user's head and present a 360° Virtual Environment; and *(2) Interactivity Devices,* to enhance the user's engagement into the Virtual Environment and to monitor and correct the user's movement. These interactive devices will include Arduinos, which will facilitate more natural movements and navigations in the Virtual Environment.
Required Skills	• Bachelor or master's degree in one of the following areas or a related area: computer science, graphic design, digital arts, cognitive systems. • Programming skills in C++ or C#, and familiarity with game engines such as Unity3D and Unreal Engine. Experience with VR development. • Ability to create 3D models to be used in VR applications. Proficiency in 3DS Max, Maya or other 3D modeling software and Photoshop.Knowledge and ability to implement the full game asset pipeline, with experience in Substance Design a plus. • Bio-signals Analysis skills, preferably in Electrocardiography (ECG), Photoplethysmogram (PPG), Electromyography (EMG), Electrodermal Activity (EDA).
Internship Objectives	The successful candidate will be: (1) designing and developing Virtual Reality environments; (2) programming tracking devices (such as Arduinos), and or bio-signal devices (such as myo armband) suitable to the needs of a people with dementia and cancer patients; and (3) analysing bio-signals.

Internship Title	STTech Project
Description of Internship	Safe Transfer Techniques (STTech) is an Erasmus+ funded project. The overall goal of the project is to reduce transfer related works accidents as well as attrition among caregivers of Today´s Health Care Sector. The outputs of the project will be: Guidelines and toolkit Digital tools - e-learning and Virtual Reality Interactive Handbook. These will be free and accessible tools at the project's website, as we develop them.
Required Skills	• Bachelor or master's degree in one of the following areas or a related area: computer science, graphic design, digital arts, cognitive systems. • Programming skills in C++ or C#, and familiarity with game engines such as Unity3D and Unreal Engine. Experience with VR development. • Ability to create 3D models to be used in VR applications. Proficiency in 3DS Max, Maya or other 3D modeling software and Photoshop.Knowledge and ability to implement the full game asset pipeline, with experience in Substance Design a plus. • Bio-signals Analysis skills, preferably in Electrocardiography (ECG), Photoplethysmogram (PPG), Electromyography (EMG), Electrodermal Activity (EDA).

Internship Title	CoViRR Project
Description of Internship	CoViRR Project aims to co-create virtual reality reusable e-resources promoting innovative practices in the digital era, by supporting current curricula and fostering open education in the healthcare sector Simulation based training is identified as a valid teaching/learning strategy. Yet, little evidence exists for the design and use of virtual reality reusable e-resources, especially in healthcare education. To this extent, there is no development framework for the co-creation for virtual reality reusable e-resources utilising stakeholder participation. The successful candidate will be: (1) designing and developing Virtual Reality environments; (2) programming tracking devices (such as Arduinos), and or bio-signal devices (such as myo armband) suitable to the needs of a people with dementia and cancer patients; and (3) analysing bio-signals.
Required Skills	• Bachelor or master's degree in one of the following areas or a related area: computer science, graphic design, digital arts, cognitive systems. • Programming skills in C++ or C#, and familiarity with game engines such as Unity3D and Unreal Engine. Experience with VR development. • Ability to create 3D models to be used in VR applications. Proficiency in 3DS Max, Maya or other 3D modeling software and Photoshop. Knowledge and ability to implement the full game asset pipeline, with experience in Substance Design a plus. • Bio-signals Analysis skills, preferably in Electrocardiography (ECG), Photoplethysmogram (PPG), Electromyography (EMG), Electrodermal Activity (EDA).

Internship Title	Virtual Reality for Cognitive Training in People with Dementia
Description of Internship	People with dementia residing in long-term care are usually facing numerous cognitive impairments and go through several therapeutic cognitive trainings. In recent years, there have been a growing research interests towards designing non-pharmacological interventions aiming to improve the quality of life for people with dementia within long-term care. We are currently exploring the use of Virtual Reality for patients with mild, moderate, and severe dementia. With this project aims to explore the appeal of using Virtual Reality for people with dementia, and the observed impact such interaction has on their cognitive trainings.
Required Skills	The successful candidate will be responsible for the development of the Virtual Reality application. Therefore, the successful candidate should have a bachelor or master's degree in one of the following areas or a related area: computer science, computer graphics/graphic design, digital arts, cognitive systems. The successful candidate should have programming skills and familiarity with game engines such as unity3d and unreal engine.
Level of required Skills	Advanced.
Internship Objectives	The successful candidate will be responsible for the development of the Virtual Reality application.

Internship Title	Virtual Reality for Psychotherapy in Breast Cancer Patients
Description of Internship	In recent years there have been a growing research interest towards designing computer-assisted health interventions aiming to improve mental health services. Digital technologies are becoming common methods for diagnosis, therapy, education, and training. With the advent of lower-cost Virtual Reality Head-Mounted-Displays (HMDs) and high internet data transfer capacity, there is a new opportunity for applying immersive Virtual Reality tools to augment existing interventions. Covid19 has enhanced the need of developing tools that can aid recovery for the patient from their personal space. This project aims to explore the use of Virtual Reality as a therapeutic medium for breast cancer patients dealing with body image dissatisfaction due to lymphedema body shape concerns. The goal of the study is to examine the opportunities Virtual Reality could offer for interventions, capitalising on the success of past Virtual Reality-based therapies.
Required Skills	The successful candidate will be responsible for the development of the Virtual Reality application. Therefore, the successful candidate should have a bachelor or master's degree in one of the following areas or a related area: computer science, computer graphics/graphic design, digital arts, cognitive systems. The successful candidate should have programming skills and familiarity with game engines such as unity3d and unreal engine. The ability to create 3d models to be used in Virtual Reality applications, proficiency in 3ds max, maya or other 3d modelling software and photoshop, as well as knowledge to implement the full game asset pipeline, with experience in substance design will considered as a plus.
Level of required Skills	Advanced.
Internship Objectives	The successful candidate will be responsible for the development of the Virtual Reality application.

Internship Title	Chatbots Enhance personalised European Healthcare Curricula (CEPEH)
Description of Internship	Personalized Healthcare education is more than ever needed nowadays. There is growing evidence around chatbots, machine conversation systems, that these programs have the potential to change the way students learn and search for information. Chatbots can quiz existing knowledge, enable higher student engagement with a learning task or support higher-order cognitive activities. In large-scale learning scenarios with more than 100 students per lecturer, chatbots can solve the problem of individual student support and contribute to personalised learning. However, limited examples of chatbots in European Healthcare Curricula have been utilized to combine both the continuum of cognitive processes with the idea that some repetitive tasks can be done with a chatbot to provide greater access or to scale faculty time. Thus, CEPEH, an ERASMUS+ strategic partnership will co-create open access chatbots utilizing artificial intelligence promoting innovative practices in digital era, by supporting current curricula and fostering open education.
Required Skills	The successful candidate will be responsible for the development of the chatbot application. Therefore, the successful candidate should have a bachelor or master's degree in one of the following areas or a related area: computer science, computer graphics/graphic design, digital arts, cognitive systems. The successful candidate should have programming skills and familiarity with engines such as python and Rasa. The ability to create applications using Python.
Level of required Skills	Advanced.
Internship Objectives	The successful candidate will be responsible for the development of the chatbot application.

Internship Title	Augmented Reality in Medical Education
Description of Internship	Augmented reality seems to be ubiquitous recently and most associated with gaming technology, but when we zoom out, AR has the capacity to positively influence several industries, one being healthcare. AR applications enable medical professionals to recreate real-world images of anatomical structures virtually, an image they can then project onto the surgical site in real-time using the HMD technology. Essentially this is a form of data visualization—a high-resolution projection of patient vitals and other relevant information that the surgeon would normally have to divert attention to obtain. Medical students can undergo the stress of mid-surgery mishaps and experience the pressure of reacting logically in unfavorable scenarios without real-life implications. This project aims to explore the use of Augmented Reality as an application for medical student's practice.
Required Skills	The successful candidate will be responsible for the development of the Augmented Reality application. Therefore, the successful candidate should have a bachelor or master's degree in one of the following areas or a related area: computer science, computer graphics/graphic design, digital arts, cognitive systems. The successful candidate should have programming skills and familiarity with python.
Level of required Skills	Advanced.
Internship Objectives	The successful candidate will be responsible for the development of the Augmented Reality application.

MRG: Pervasive Real-World Computing for Sustainability (SuPerWorld)

Internship Title	How climate change affects agriculture in Cyprus
Description of Internship	The goal is to use satellite imagery and computer vision to classify agricultural fields around Cyprus during the last 10 years, identifying how farmers adapt their practices (crops, seasonality, operations), being affected by climate change (e.g. higher temperatures, droughts). More info about the group's research: http://superworld.cyens.org.cy
Required Skills	Satellite imagery, deep learning (tensorflow/keras), computer vision, GIS (basic)
Level of required Skills	Good/advanced
Internship Objectives	Observe the trends in farming practices in Cyprus during the last 10 years
Expected Deliverables	Classification model, GIS visualizations, graphs and stats

Internship Title	Identifying parcels suitable for forestation
Description of Internship	The goal is to use satellite imagery and computer vision to identify public parcels around Cyprus which are suitable for forestation. These parcels need to be both public and unused, i.e. without any developments/infrastructures inside. The selected parcels will be shared to the Government of Cyprus to facilitate its efforts in reforestation. More info about the group's research: http://superworld.cyens.org.cy
Required Skills	Satellite imagery, deep learning (tensorflow/keras), computer vision, GIS (basic)
Level of required Skills	Good/advanced
Internship Objectives	Identify public parcels which are suitable for forestation
Expected Deliverables	Classification model, GIS visualizations

Internship Title	Why are bees declining in Cyprus and globally?
Description of Internship	As bees constitute the main pollinators for local flora, it is important to keep the bee population steady and healthy. For bees, the biggest problems they face include parasites (e.g. the Varroa Destructor parasite), pesticides (i.e. bees cannot function on plants that have been sprayed with artificial pesticide), radio waves from telephones (i.e. distort their orientation) and land use change, which is responsible for reducing its potential space for settling its base (colony). To counteract the extinction of bees, we propose in this pilot the development of smart beehives. Via embedded sensors, placed inside our custom beehive boxes, we will monitor the micro-climate of the hive from the inside (i.e. temperature, humidity, noise), as well as count the number of bees that inhabit the "smart hive", keeping statistics about the daily in- and out-flux of the bees. Environmental and counting data would be transferred to a web/mobile app which would give to the owner valuable insignts, in

	order to maintain the wealth of the hive. More info about the group's research: http://superworld.cyens.org.cy
Required Skills	Sensor technologies, Arduino programming
Level of required Skills	Good/advanced
Internship Objectives	Develop the smart bee hives and deploy them in different areas around Cyprus for small pilots
Expected Deliverables	Graphs, statistics and reports

Internship Title	Real-time assistance of endangered people in forest fires
Description of Internship	In recent years several human and natural disasters have caused a significant number of fatalities, mainly due to the lack of preparation of populations. In recent years, Europe has experienced several natural disasters. In particular, large forest fires have been reported in several countries mainly due to climate change (drought and extreme high temperatures), combined with a poor spatial planning: Portugal, Spain, Greece, Norway. Nevertheless, the evacuation plans on the affected communities have not been completely implemented related to forest fires and other disasters. Therefore, these communities continue to be vulnerable to future forest fires. It is also expected that countries which never had serious risks of fire disasters (e.g. Scandinavian countries, Netherlands) start to become at risk due to the summer prolonged heat waves and high temperatures. In a previous semester, we have developed "Escape Wildfires", a system and mobile app which can be used by citizens in order to safely evacuate wildfires occurring nearby them: https://superworld.cyens.org.cy/project11.html https://github.com/rise-centre/Escape-Wildfires https://superworld.cyens.org.cy/papers/kamilaris_PerAwareCity_6pages.pdf This project will address the problem of providing real-time support to people in danger in case of forest fires happening in the surrounding area. A mobile application needs to be extended and enhanced with new features, which will better guide the user, based on his/her current location and the information received from a central server on which way to take in order to escape safely the fire. The application needs to consider whether users have access to car, bike, if people have mobility problems etc. If the life of the user is in danger, then the application needs to inform automatically/immediately rescue services. The most important part of the project would be to improve the mobile app's evacuation algorithm, by considering the case study of a recent massive wildfire in Troodos, Cyprus, testing the app and the algorithm in different evacuation scenarios: https://newseu.cgtn.com/news/2021-07-05/Massive-fatal-Cyprus-wildfire-under-full-control--11EpuKaIPwQ/index.htm l
Required Skills	Modeling Algorithm development Mobile phone programming
Level of required Skills	Modeling (good) Algorithm development (very good)

	Mobile phone programming (very good)
Internship Objectives	New algorithm for creating escape routes for evacuation from wildfires Evaluation and validation using historic wildfires Visualizations & Report

Internship Title	Automatic detection and estimation of the area of buildings & pools
Description of Internship	In the latest years, the availability of high-resolution satellite data allows us to observe and identify with high accuracy urban infrastructures and settlements. This is particularly useful for environmental policy making (e.g. to estimate quantity of water spent on swimming pools), applications of the land registry (e.g. to validate information provided by citizens) and tax offices (claims about house areas and swimming pools). In South Europe, many citizens, especially some living in sub-urban or rural areas, do not honestly communicate that information with the government. This creates large inequalities in tax distributions and (most importantly) creates environmental issues, such as potential disaster hazards (e.g. easier spread of wildfires and flooding). This project requires the use of high spatial-resolution satellite imagery, using data from the Pleiades satellite, provided by the European Space Agency (0.5m resolution). Based on this data, the goal is to detect with high precision and (most importantly) recall, the precise area of all houses, buildings and swimming pools at the region of interest. This region is the country of Cyprus, an island located at South Europe. Deep learning approaches are expected to be used, involving some manual annotation of training data in order to detect house/building areas and swimming pools.
Required Skills	Deep learning Satellite imagery Annotation tools
Level of required Skills	Deep learning (very good) Satellite imagery (basic) Annotation tools (basic)
Internship Objectives	Achieve detection of buildings and pools with more than 95% precision and 95% recall Develop a geographical map of detected buildings and swimming pools Visualizations & Report

MRG: Museum Lab

Internship Title	Developing Interactive Applications with Geolocation
Description of Internship	The aim of the work is to develop interactive applications utilizing state of the art techniques in emerging technologies aiming to engage users in the area of the city that they are exploring. As part of this project interns will be expected to use techniques related to geolocation, interactivity, and mobile applications.
Required Skills	Interns working in this project should have technical and/or creating skills that include: 1. Computer Programming Skills 2. Mobile or web-based application development
Level of required Skills	Good
Internship Objectives	The objectives of the Internship are: 1) To review the literature in relation to the use of geolocation techniques in interactive maps 2) To design, implement and evaluate a novel interactive map application with geolocation and layers of information

Internship Title	Application of Emerging Technologies in Cultural Heritage
Description of Internship	Emerging technologies are becoming an important part in the interpretation, education, and overall enhancement of the visitor experience in museums and heritage sites. At the same time, technologies such as 3D models, 3D printing, blockchain etc are currently being used by museums and heritage practitioners for documenting, protecting, conserving and interpreting cultural heritage. Thus, we are looking for interns interested to work on researching various aspects of the application of these technologies for the protection and interpretation of cultural artefacts.
Required Skills	•Knowledge of qualitative research methodologies such as interviews, surveys and overall familiarity with qualitative data analysis • Knowledge of quantitative data analysis • Familiarity with technologies such as 3D modelling, 3D printing, blockchain (considered an advantage)
Level of required Skills	• knowledge of qualitative research methodologies (Good knowledge) • qualitative data analysis (Good knowledge) • quantitative data analysis and SPSS (basic knowledge)
Internship Objectives	Explore the application of 3D technologies, blockchain etc for protecting and interpreting cultural heritage Explore the potential of such technologies and the possible perceptions of heritage practitioners and the public

MRG: Cognitive and Clinical Applications (CCAPPs)

Internship Title	Cognitive skills in sports
Description of Internship	The intern(s) will assist in the collection of data on a behavioral study aims to assess the role of cognitive skills in fast-paced sports.
Required Skills	A background in Psychology or Neuroscience and statistical skills.
Internship Objectives	To collect and analyze data from experiments with human participnants

Internship Title	Pain rehabiliation for musicians using virtual reality and eletromyography
Description of Internship	The intern(s) will work on a project that aims to build a virtual reality neurofeedback tool that helps musicians improve their postures during instrument playing.
Required Skills	Skills in mathematics and statistics, experience with physiological measures will be a plus.
Internship Objectives	To assist in the design of the prototype tool

MRG: Visual Computing Group (VCG)

Internship Title	Semantic 3D Segmentation for Scene Understanding
Description of Internship	Semantic 3D segmentation is a task essential to applications that require an understanding of real-world 3D scenes, such as robotics, artificial intelligence (AI), augmented or virtual reality (AR/VR), and autonomous navigation/driving. The successful candidate is expected to conduct research at the intersection of computer vision, computer graphics and machine learning, by integrating concepts and methods from these areas to advance the state of the art in 3D scene understanding.
Required Skills	Basic knowledge of computer vision and deep learning. Programming skills: python, TensorFlow (optional), PyTorch (optional)
Level of required Skills	Intermediate
Internship Objectives	The scientific objectives of the project span a range of topics from these research areas, including data collection, neural networks training, evaluation, and application development, with the final goal to develop a novel deep learning architecture for semantic 3D segmentation, composed of deep neural networks for segmenting and labelling real-world objects and scenes.

Expected Deliverables	Final report, trained networks, code base

Internship Title	**Urban Semantic Understanding**
Description of Internship	Semantic understanding of urban data (e.g. buildings, streets, neighborhoods) is critical for urban sensing as well as many commercial applications such as accurate antenna placement for cellular networks, flood planning, and architectural urban visualisations. Without knowing the surface properties of urban models it is impossible to calculate, for example the thermal properties of buildings or to simulate window-visibility. In this project the goal is to utilize deep neural network architectures to fuse and understand noisy urban data from multiple sources.
	It will study the space of urban sensors, their competencies, errors, and failure cases, resulting in a robust framework for semantic urban reconstruction. Unlike many rigid urban modeling pipelines the desired outcome is a system that is entirely modular in its selection of sensors, allowing the addition, or removal, of data sources to suit the many different situations facing real-world urban planners.
Required Skills	Basic knowledge of computer vision and deep learning. Programming skills: python, TensorFlow (optional), PyTorch (optional)
Level of required Skills	Intermediate
Internship Objectives	The successful candidate will design and train novel deep neural networks on novel synthetic datasets, to fuse disparate data sources andcreate a semantically labelled 3D model of urban scale.
Expected Deliverables	Final report, trained networks, code base

Internship Title	**Object and Scene Synthesis via deep neural networks**
Description of Internship	Synthesizing 3D objects and 3D scenes has received a great deal of attention in recent years due to its applications in simulation, AI, robotics and 3D modelling. Recent work has taken advantage of deep generative networks such as variational autoencoders (VAEs) and generative adversarial networks (GANs) which have found great success in generating 2D images or mapping input to output images (e.g. for altering image style). Extending these ideas to work on 3D data is far from trivial, with very recent efforts focused on GANs operating on volumetric representations or latent-GANs operating on point cloud latent spaces learned by autoencoders.
Required Skills	Basic knowledge of computer vision and deep learning. Programming skills: python, TensorFlow (optional), PyTorch (optional)
Level of required Skills	Intermediate
Internship Objectives	This project proposes applying architectures such as latent-GANs to the problem of 3D object and scene synthesis, tackling challenges such as increasing the realism of the synthesized output as well as the scalability of the proposed methods.
Expected Deliverables	Final report, trained networks, code base

Internship Title	Supervised City Mesh texturing via deep neural networks
Description of Internship	Supervised deep learning approaches sometimes is limited due to the lack of data for specific tasks and researchers flee in unsupervised approaches as sometimes to create datasets that contain the target for each input is too time-consuming or even not possible. However, forreal scenarios, datasets as cityscapes and kitti were developed in order to provide the capability for the research community to work on various computer vision tasks as semantic scene segmentation, autonomous car navigation, pedestrian detection and so forth. In this project, we would like to investigate whether we can use transfer learning from real to virtual data. More precisely, we intend to use deep
	networks as Pix2Pix or Pix2PixHD to translate panoramic street-view data from semantic segmentation street view to a real street-viewimage
Required Skills	Basic knowledge of computer vision and deep learning. Programming skills: python, TensorFlow (optional), PyTorch (optional)
Level of required Skills	Intermediate
Internship Objectives	This project is separated into two phases, the first is the virtual data collection and the second phase is to experiment on whether a deepimage-to-image learning approach can generalize from real to virtual data.
Expected Deliverables	Final report, trained networks, code base, dataset

Internship Title	Real-time understanding of outdoor environments
Description of Internship	One of the main research challenges in the area of autonomous navigation (e.g. self-driving cars), is the real-time processing and understanding of 3D point clouds captured by LiDAR (Light Detection And Ranging) sensors in outdoor environments. As a consequence, many types of deep neural network architectures have been proposed for processing such data (e.g. PointNet++, PointCNN, FrustumNet etc.), which offer good accuracy on benchmarks but rarely offer real-time performance. The goal of this project is to develop architectures for real-time understanding of raw 3D point clouds of outdoor scenes, building upon existing top-performing neural network architectures.
Required Skills	Basic knowledge of computer vision and deep learning. Programming skills: python, TensorFlow (optional), PyTorch (optional)
Level of required Skills	Intermediate
Internship Objectives	The project involves evaluating existing methods on real-world autonomous vehicle benchmarks e.g. KITTI, collecting synthetic or real data for challenging scenarios, and developing novel architectures for real-time outdoor scene understanding.
Expected Deliverables	Final report, trained networks, code base

Internship Title	Reconstruction and texturing of humans using deep neural networks
Description of Internship	Capturing the shape and appearance of a human has been a significant first step for applications such as clothing fitting, avatar creation, andfitness, to name a few. With the release of powerful, relatively low-cost cameras on mobile devices, there are new opportunities for achieving this task. In this project the goal is to investigate recent deep neural network architectures for reconstruction of human shape and texture. Given a set of images (RGB or RGBD) of a human taken from multiple views, the objective is to reconstruct the geometry of the human body
	and a highly detailed texture for the mesh of the human body. Methods for segmenting the body into parts or detecting body landmarks willalso be investigated.
Required Skills	Basic knowledge of computer vision and deep learning. Programming skills: python, TensorFlow (optional), PyTorch (optional)
Level of required Skills	Intermediate
Internship Objectives	The project involves collecting the relevant literature on human body reconstruction, testing existing neural network architectures, comparing and reporting on their results, and considering how their performance can be improved.
Expected Deliverables	Final report, code base

Internship Title	Retail store dataset augmentation
Description of Internship	The need to incorporate artificial intelligence in real-life scenarios and essentially improve the quality of various industry business services rise the need to develop datasets that fit very specific different needs. In our case, we intend to develop an algorithm that augments an annotated dataset for retail stores. The tricky part is to augment a dataset that forces our detector to be robust and provide object detection high accuracy under different conditions.
Required Skills	Basic knowledge of computer vision and deep learning. Programming skills: python, TensorFlow (optional), PyTorch (optional)
Level of required Skills	Intermediate
Internship Objectives	The desired outcome is a network that is invariant to illumination, scale and rotation of the products on the shelf.
Expected Deliverables	Final report, code base, dataset

MRG: Living, Breathing Virtual Worlds(V-EUPNEA)

Internship Title	Artist friendly methods to populate virtual environments
Description of Internship	We aim to develop techniques to design, control and simulate multiple characters with different behaviors that can then be applied to different environments in various application domains (computer games, movies, urban studies, etc.). Designers should have maximum levelsof control of the generated simulation results with minimal user intervention. Characters should exhibit both high level behaviours such as reasoning and path planning and low-level ones such as navigation with collision avoidance and individual character animations. Additionally, animated characters can be of different types such as virtual humans, vehicles and animals. We aim to have easy and efficient multi-character design and control using notions known to animators from existing tools such as copy-pasting, painting with strokes, blending, etc. Since people are accustomed to using examples in order to describe desired requirements, we are interested in investigating novel methods that take as input exemplars of animated scenes (e.g., people behaving as one expects in a shopping street) and then given a new environment, output semantically correct behaviours for the animated characters.

Internship Title	Robust Photogrammetry
Description of Internship	Photogrammetry is the process by which one can reconstruct 3D scenes using a set of photographs. The quality of results is greatly affected by several factors; quality of photographs, lighting conditions, the presence of moving objects (Cars, pedestrians), the presence of reflective surfaces. Moreover, a very important limiting factor is the amount of data to be processed (photographs, point clouds). In this internship we will examine several techniques to tackle these issues including Deep Learning, Clustering and Anomaly Detection. Knowledge of Python and Deep Learning frameworks are recommended, but not mandatory.
Required Skills	Python Some tasks require Deep Learning in Python (PyTorch, Tensorflow, Keras) Some tasks require basic understanding of Machine Learning (Clustering, Anomaly Detection) and Image Handling
Level of required Skills	Very Good/Excellent
Internship Objectives	Development of Models and Tools
Expected Deliverables	Machine Learning Models and Tools

Internship Title	Real-time Performance Capture
Description of Internship	Performance capture is the process of capturing the performance of a human actor using several motion capture technologies. In the project we will combine several motion capture technologies (optical, inertia and markerless) to capture in real-time the body, facial and hand movement to animate in real-time virtual characters. The capturing process will also involve props such as chairs, swords, etc. Knowledge and experience with at least one game engine (preferably Unity or Unreal) or with Computer Graphics and Animation are required.
Required Skills	Experience with a Game Engine (Unity, Unreal prefered)
Level of required Skills	Very Good
Internship Objectives	Capture human performance
Expected Deliverables	Pipeline to capture human performance in real-time

MRG: Real-time Populated Virtual Environments

Internship Title	Simulation and animation of pedestrian-vehicle interactions
Description of Internship	This project aims to develop algorithms for crowd simulation in urban environments, in the presence of vehicles. It will built on our recent crowd simulation work and will use machine learning techniques.
Required Skills	Computer programming, mathematics and ideally computer graphics or machine learning
Level of required Skills	As a minimum, the intern needs to have completed 3 years of undergrad studies.
Internship Objectives	Develop and test algorithms for crowd simulation

Other Internship topics

Internship Title	Mobile Augmented Reality Recoloring Tool
Description of Internship	The focus of the internship is to develop a tool in augmented reality for recoloring virtual information (3D objects and text) according to the background. Different recoloring techniques will be investigated to enhance the quality of integration of virtual objects in different scenarios. Virtual content will be recolored according to specific logic to generate a more appealing and visual aesthetic view to the user. Efforts along these lines may therefore positively influence several application domains such as entertainment, creative industries and manufacturing.
Required Skills	1. Knowledge of augmented reality/virtual reality 2. Computer programming skills and Unity game Engine 3. Basic knowledge in image processing 4. Mobile application development
Level of required Skills	Good
Internship Objectives	1. Implement image processing algorithms for color harmonization 2. Develop an augmented reality application for recoloring 3. Design at least 3 different case-studies 4. Benchmark/evaluate the application
Supervisor	Dr Fotis Liarokapis

Internship Title	Mobile Augmented Reality Heritage Guide
Description of Internship	The focus of the internship is to develop an interactive augmented reality guide for Amathus ancient port. The ancient town of Amathous is located on the south coast of Cyprus, about 7 km east of the city of Limassol. A novel mobile augmented reality interface will be developed offering unique user experience. Tracking will be performed using sensors belonging to the mobile device (i.e. GPS and orientation sensors). Interaction will be based on the device and/or on the sensors of the device. The graphical user interface will be designed and optimised for offering different types of information (i.e. 3D objects, textual information, images).
Required Skills	1. Knowledge of augmented reality/virtual reality 2. Computer programming skills and Unity game Engine 3. Basic knowledge in 3D modeling 4. Mobile application development
Level of required Skills	Good

Internship Objectives	1. Generate the content that will be used for visualisation 2. Develop an augmented reality application for heritage guide 3. Design at least 3 different case-studies 4. Benchmark/evaluate the application
Supervisor	Dr Fotis Liarokapis

Internship Title	Immersive EEG Framework
Description of Internship	An electroencephalogram (EEG) is a test used to evaluate the electrical activity in the brain. Currently virtual reality provides an ideal medium to be combined with EEG technology and perform a variety of experiments. The aim of this internship is to design an immersive EEG framework based on virtual reality.
Required Skills	Excellent
Level of required Skills	1. Knowledge of augmented reality/virtual reality
	2. Good computer programming skills and Unity game Engine 3. Good knowledge of EEG and signal analysis 4. Good knowledge of experimental design
Internship Objectives	1. Develop a generic virtual reality framework based in Unity and OpenVibe 2. Design a generic experimental methodology for immersive EEG environments 3. Perform data analysis
Supervisor	Dr Fotis Liarokapis