Syllabi for courses

Introduction to IoT

Course Purpose and Objectives

The Internet is evolving to connect people to physical things and also physical things to other physical things all in real time. It‟s becoming the Internet of Things (IoT). The course enables student to understand the basics of Internet of things and protocols. Itintroduces some of the application areas where Internet of Things can be applied. Students will learn about the middleware for Internet of Things. To understand the concepts of Web of Things

Course Content

1. IOT - What is the IoT and why is it important? Elements of an IoT ecosystem, Technology drivers, Business drivers, Trends and implications, Overview of Governance, Privacy and Security Issues.
2. IOT PROTOCOLS - Protocol Standardization for IoT – Efforts – M2M and WSN Protocols – SCADA and RFIDProtocols – Issues with IoT Standardization – Unified Data Standards – Protocols – IEEE802.15.4–BACNet Protocol– Modbus – KNX – Zigbee– Network layer – APS layer – Security
3. IOT ARCHITECTURE - IoT Open source architecture (OIC)- OIC Architecture & Design principles- IoT Devices and deployment models- IoTivity : An Open source IoT stack - Overview- IoTivity stack architecture- Resource model and Abstraction.
4. WEB OF THINGS - Web of Things versus Internet of Things – Two Pillars of the Web – Architecture StandardizationforWoT– Platform Middleware for WoT – Unified Multitier WoT Architecture – WoT Portals andBusiness Intelligence.
5. IOT APPLICATIONS - IoT applications for industry: Future Factory Concepts, Brownfield IoT, Smart Objects, Smart Applications. Study of existing IoT platforms /middleware, IoT- A, Hydra etc.

Big data analytics (incl. Artificial Intelligence and machine learning tools)

Course Purpose and Objectives

Big Data requires the storage, organization, and processing of data at a scale and efficiency -typically of heterogeneous nature and in streaming flow- that go well beyond the capabilities of conventional information technologies. Such requirements have been first introduced for processing the web, and they are today a common place in many industries. In modern enterprise systems, data lives in many different places (e.g., in relational databases, in `data lakes' on distributed file systems, behind REST APIs, or is constantly being scraped from web resources), and comes in many different formats. This reality calls for novel query and programming interfaces (e.g., Map/Reduce) and computing models (As_A_Service) in enterprise premises as well as on the Cloud. This course aims in a first step to introduce parallel/distributed data processing using the MapReduce (M/R) paradigm and provide insights for developing applications on top of popular Big Data platforms such as Spark. Big data raises also new challenges in data mining. Given the scale and speed of data that needs to be processed as well the variety of parameters to be taken into account, state of the art machine learning algorithms working offline and expecting homogeneous and clean data are also challenged. There is on ongoing effort to design Big Data Mining algorithms accommodating a parallel/distributed or even a streaming evaluation. Of course such kind of incremental, partial evaluation impacts the quality of obtained

statistical models and thus algorithms compromise between quality of the learning and computation time. This course aims to present Big Data Mining techniques used in real applications by adopting an algorithmic viewpoint: data mining is about applying algorithms to data, rather than using data to "train" a machinelearning engine of some sort.

Course Content

1. Introduction on Big Data Processing & Analytics and the challenges of Big Data Mining
2. Data Lakes and Warehouses Relational Query Processing Algorithms on MapReduce. NoSQL Database Systems MongoDB, Hive, etc.
3. Analysing Data Streams Sampling, Windows, Synopses and Sketches
4. Big Data Entity Resolution Indexing and Matching Semistructured Heterogeneous Entities, Big Data Analytics Accountability Fairness, Diversity, Transparency and Neutrality
5. Introduction to ML, supervised, unsupervised, reinforcement learning, hypothesis (models) spaces, examples of ML applications
6. Probability theory and concepts for ML, axioms of probability, conditional probability, Bayes theorem, maximum likelihood estimation, maximum a posteriori estimation
7. Hypothesis testing, and permutation-based hypothesis testing, Naïve Bayes and K-Nearest Neighbors
8. Decision Trees and Random Forests, Metrics of performance, Receiver Operating Characteristic Curves (ROC), and Area Under the ROC curve
9. Basics of optimization and constrained optimization, Support Vector Machines
10. Introduction to AI, definitions and history of AI. Intelligent Agents: Problem formulation, goals, constraints environment and actors/agents.
11. Search: Solving problems by uninformed search. Informed Search: Solving problems by searching using informed techniques involving heuristics. Beyond classical search: local search algorithms, nondeterministic actions, partial observations, online search.
12. Game theory: Selecting an optimal strategy in games using adversarial search techniques. Constraint Satisfaction Problems: Solving problems by finding acceptable solutions under constraints: Problem formulation and solving techniques.
13. Planning: Problem formulation construction of goal achieving plans: theory and practice. Planning and acting in the real world: schedules and resources, hierarchical planning, nondeterministic domains, multi-agent planning. Philosophical foundations of AI: Weak AI, strong AI, implications to dualism and consciousness.
14. Ethics and AI: Integrating ethics to AI systems, accountability and interpretability of AI systems. Regulatory Framework of AI: Existing regulatory frameworks and legal issues arising from AI applications.