

MIT3.1 Natural Language Processing

Course Objectives:

This course introduces the fundamental concepts and techniques of natural language processing (NLP). Students will gain an in-depth understanding of the computational properties of natural languages and the commonly used algorithms for processing linguistic information. The course examines NLP models and algorithms using both the traditional symbolic and the more recent statistical approaches.

Instructional objectives:

- How key concepts from NLP are used to describe and analyze language
- POS tagging and context free grammar for English language
- Understanding semantics and pragmatics of English language for processing
- Writing programs in Python to carry out natural language processing

Module I

Introduction: Knowledge in speech and language processing, Ambiguity, Models and Algorithms, Brief History

Regular Expressions and Automata: Regular Expressions, Finite-State Automata, Regular Languages and FSA

Morphology and Transducers: Inflectional and derivational morphology, finite state morphological parsing, Combining FST Lexicon and rules. Lexicon free FST: Porter Stemmer

N-grams: Counting Words in Corpora, SIMPLE (UNSMOOTHED) N-GRAMS, Smoothing, Entropy

HMM and Speech Recognition: Speech Recognition Architecture, Overview of HMM, A* decoding

Module II

Word Classes and Part-of-Speech Tagging: English word classes, Targets for English, Part of speech Tagging, Rule Based part of speech Tagging, Transformation Based Tagging.

Context Free Grammars for English: Constituency, Context Free rules and Trees, Sentence level construction, The Noun Phrase, Coordination, Agreement, The verb phrase and sub-categorization. Spoken Language Syntax, Grammar Equivalence and Normal form, Finite state context free grammars, Grammar and human processing.

Parsing with context free grammars: Parsing as Search, Basic Top down Parser, Problems with basic top-down-parsers, the early Algorithm, Finite state parsing method

Features and Unifications: Feature structures, Unification of Features Structures, Features Structures in the grammar, Implementing Unification.

Lexicalized and probabilistic parsing: Probabilistic context free grammars, problems with probabilistic context free grammars, probabilistic lexicalized GFG

Module III

Semantics

Representing Meaning: Computational Desiderata for representation, Meaning structure of language, First order predicate calculus, linguistically relevant concept, Related Re-presentational approaches, Alternative approaches to meaning.

Semantic Analysis: Syntax driven semantic analysis, Attachment of Fragment of English, Integrating semantic analysis with early parser. Robust Semantic Analysis.

Lexical Semantics: Relation among lexemes and their senses, Internal Structure of words.

Module IV

Pragmatics

Discourse: Reference resolution, Text Coherence, Discourse Structure, Psycholinguistics Studies of reference and coherence.

Natural Language generation: Introduction to language generation, Architecture for generation, Surface realization, Discourse planning, Macro planning, Lexical selection, evaluating generation systems, generating speech

Text books:

1. Speech and Language processing An introduction to Natural Language Processing, Computational Linguistics and speech Recognition by Daniel Jurafsky and James H. Martin (ISBN13: 978-0131873216)
2. Natural Language Processing with Python by Steven Bird, Ewan Klein, Edward Lopper (ISBN13:978-0596516499)

Reference book:

1. Handbook of Natural Language Processing, Second Edition—Nitin Indurkha, Fred J. Damerau, Fred J. Damerau (ISBN13: 978-1420085921)

MIT 3.2 Software Development Frameworks Using .NET

Course Objectives:

.NET is a widely used Framework in Software Development. The objective of the course is to enable the student to gain mastery in various advanced .NET features used in Software Industry.

Instructional Objectives:

To gain practical experience working with the major capabilities available in the .NET framework to meet demanding Software Engineering problems encountered in a variety of Industries.

Module I

Exception Handling in .NET: Role of .NET Exception Handling, the System. Exception Base Class, Configuring the State of an Exception, System Level Exceptions, Application Level Exceptions, Processing Multiple Exceptions.

.NET Interfaces: .NET Interfaces, Custom Interfaces, Implementation, Invoking Interfaces, Interfaces as parameters and return values.

Collections and Generics: Motivation, Problems associated with Non Generic Collections, the Role of Generic Type parameters.

Delegates Events and Lambda Expressions: .NET delegate Type, Delegate example, Sending Object State Notification, Generic Delegates, C# Events, C# Anonymous methods

Module II

Advanced C# Features: Indexer methods, Operator overloading, Custom Type Conversions, Extension Methods

Object Lifetimes: Classes, Objects and References, Basics of Object Lifetimes, Application Roots, Object Generation, Concurrent and Background garbage collection, Building Finalizable and Disposable objects

Programming with .NET Assemblies: Role of Assemblies, Format of a .NET Assembly, Building and Consuming a Custom Class Library, Private and Shared Assemblies.

Type Reflection, Late Binding: Necessity of Type Metadata, Understanding Reflection, Custom Metadata Viewer, Dynamically Loading Assemblies

Processes, App Domains and Object Contexts: Role of Window Processes, Interacting with Processes, .NET Application Domains, Default Application Domain

Module III

Common Intermediate Language (CIL): CL Directives, Attributes and Opcodes, The Stack based nature of CIL, Understanding Round Trip Engineering

Multithreaded, Parallel and Async Programming: The Process, AppDomain, Context and Thread Relationship, Asynchronous Nature of Delegates, Invoking Methods Asynchronously, Thread Class, Secondary Threads, Issue of Concurrency

File Input Output and object Serialization: System.IO Namespace, the Directory(Info) and File(Info) Types and operations, Abstract Stream Class, Stream Writers and Readers, String Writers and Readers, Watching Files Programmatically, Object Serialization using Binary Formatter, SOAP Formatter, XmlSerializer

ADO.NET:Connected Layer: Definition, ADO.NET Data Providers, System.Data Namespace, Connected Layer of ADO.NET, Data, Data Readers, Building a Reusable Data Access Library

Module IV

Introduction ASP.NET Web Forms: Role of HTTP, Web Applications and Servers, Client Side Scripting, Posting Back to the Web Server, Overview of ASP.NET API, Single File ASP.NET Web Page, Building ASP.NET Web Page using Code Files, Web Sites versus Web Applications, ASP.NET Web Directory Structure, Inheritance Chain, Incoming HTTP Request, Outgoing HTTP Response, web.config file

Web Controls, Master Pages, Themes: Nature of Web Controls, Control and WebControl base classes, Major Categories of ASP.NET Web Controls, Role of Validation Controls, Themes

ASP.NET State Management Techniques: ASP.NET View State, Global.asax file, Distinction between Application/Session, Application Cache, Maintaining Session Data, Cookies, session State Element, ASP.NET Profile API

TextBook:

1. C# 5.0 and NET 4.5 Framework, Andrew Troelson, Sixth Edition, ISBN-13: 978-1430242338

MIT3.3.a Advanced Image Processing

Course Objective:

To apply algorithms used in Image processing for day-to-day applications.

Instructional Objective:

Image processing is covered through analysis and programming. Student will learn varied facets of image processing from its fundamental concepts to different algorithms which find use in image processing at present scenario. Also the topics in FIR filtering and Wiener Filtering shall evolve a new way of statistical approach towards the subject.

Module I

Digital Image Processing fundamentals: Introduction, Topics of digital image processing and analysis, Digital image formation, Digital image representation, Elementary digital image processing operations, Digital image display, Fundamentals of color image processing, Noise generators for digital image processing

Digital image transform algorithms: Introduction, Two-dimensional discrete Fourier transform, Row-column FFT algorithm, Memory problems in 2-d DFT calculations, Vector-radix fast Fourier transform algorithm

Polynomial transform FFT: Two-dimensional power spectrum estimation, Discrete cosine transform, Two-dimensional discrete cosine transform, Discrete wavelet transform

Module II

Digital image filtering and enhancement: Introduction, Direct implementation of two-dimensional FIR digital filters, Fast Fourier transform implementation of FIR digital filters, Block methods in the linear convolution calculation, Inverse filter implementations, Wiener filters, Median filter algorithms, Digital filters based on order statistics, Signal Adaptive order statistic filters, Histogram and histogram equalization techniques, Pseudocoloring algorithms, Digital image halftoning, Image interpolation algorithms, Anisotropic Diffusion, Image Mosaicing, Image Watermarking.

Digital image compression: Introduction, Huffman coding, Run-length coding, Modified READ coding, LZW compression, Predictive coding, Transform image coding.

Module III

Edge detection algorithms: Introduction, Edge detection, Edge thresholding, Hough transform, Edge-following algorithms

Image segmentation algorithms: Introduction, Image segmentation by thresholding, Split/merge and region growing algorithms, Relaxation algorithms in region analysis, Connected component labeling, Texture description.

Module IV

Shape description: Introduction, Chain codes, Polygonal approximations, Fourier descriptors, Quadrees, Pyramids, Shape features, Moment descriptors, Thinning algorithms, Mathematical morphology, Grayscale morphology, Skeletons, Shape decomposition, Voronoi tessellation Watershed transform, Face detection and recognition.

Text Book:

1. Digital Image Processing – Algorithms & Applications by I. Pitas
Publisher: John Wiley & Sons, Inc, ISBN: 0-471-37739-2

Reference Books:

1. Digital Image Processing by Kenneth R. Castleman, Publisher: Prentice Hall, ISBN: 0-13-211467-4
2. Digital Image Processing by William K. Pratt, Publisher: John Wiley & Sons INC, ISBN: 9-814-12620-9

MIT 3.3.b Real Time Systems

Course Objective:

Real-Time system issues can be handled with the software and Hardware approach.

Instructional Objective:

A real time system (RTS) is a new era of subject domain where the students will learn about the scenarios of RTS; its usage, tools used. The communication scenarios along with the fault associated with some systems and reliability considerations will also be learnt.

Module I

Introduction: A Car-and-Driver Example, Issues in real time computing, Structure of a Real-Time system, Task classes

Characterizing Real-Time systems and Tasks: Introduction, Performance Measures for Real-Time Systems, Estimating Program Run Times

Module II

Task Assignment and Scheduling: Introduction, Classical Uniprocessor Scheduling Algorithms, Uniprocessor Scheduling of IRIS Tasks, Task Assignment, Mode changes, Fault-Tolerant Scheduling

Programming Languages and Tools: Introduction, Desired Language characteristics, Data Typing, Control Structures, Facilitating Hierarchical Decomposition, Packages, Run-Time Error Handling, Overloading and Generics, Multitasking, Low-Level Programming, Task Scheduling, Timing Specifications, Some Experimental Languages, Programming Environments, Run-Time Support

Module III

Real-Time Databases: Introduction, Basic Definitions, Real-Time vs. General-Purpose Databases, Main Memory Databases, Transaction Priorities, Transaction Aborts, Concurrency Control Issues, Disk Scheduling Algorithms, A Two-Phase Approach to Improve Predictability, Maintaining serialization Consistency, Databases for Hard Real-Time Systems

Real-Time Communication: Introduction, Network Topologies, Protocols

Module IV

Fault-Tolerance Techniques: Introduction, What causes Failures?, Fault types, Fault Detection, Fault and Error Containment, Redundancy, Data Diversity, Reversal Checks, Malicious or Byzantine Failures, Integrated Failure Handling

Reliability Evaluation Techniques: Introduction, Obtaining Parameter Values, Reliability Models for Hardware Redundancy, Software-Error Models, Taking Time into Account

Text Book :

1. Real-Time Systems by C.M.Krishna and Kang G. Shin Publication: The McGraw-Hill Companies, Inc. ISBN: 0-07-114243-6

Reference Books:

1. Real-Time Systems, by Jane W.S. Liu, Pearson Education Inc. 2000
2. Software Engineering for Real-time Systems by Jim Cooling, Addison Wesley, 1st edition (November 11, 2002)

MIT 3.3.c Mobile Application Development

Course Objective:

The aim of this course is to introduce students to the mobile application development environment and make them aware of the various technologies in the field. This course will help to develop the technical knowledge, specialized software development skills for developing mobile applications on various platforms.

Instructional Objective:

- Make students aware of various mobile development platforms
- Address various issue involved with mobile development
- Planning for effective mobile development
- Study of IOS and Android platforms

Module I

A Brief History of Mobile: In the Beginning, The Evolution of Devices

The Mobile Ecosystem: Operators, Networks, Devices, Platforms, Operating Systems, Application Frameworks, Applications, Services

Reasons for Mobile: Size and Scope of the Mobile Market, The Addressable Mobile Market, Mobile As a Medium, future, Ubiquity with the Mobile Web

Designing for Context: Thinking in Context, Taking the Next Steps,

Module II

Developing a Mobile Strategy: New Rules, Summary

Types of Mobile Applications: Mobile Application Medium Types, Mobile Information Architecture, Information Architecture, Mobile Information Architecture, The Design Myth

Mobile Design: Interpreting Design, The Mobile Design Tent-Pole, Designing for the Best Possible Experience, The Elements of Mobile Design, Mobile Design Tools, Designing for the Right Device, Designing for Different Screen Sizes

Mobile Web Apps Versus Native Applications: The Ubiquity Principle, When to Make a Native Application, When to Make a Mobile Web Application

Module III

Mobile 2.0: New things in mobile 2.0

Mobile Web Development: Web Standards, Designing for Multiple Mobile Browsers, Device Plans Markup, CSS: Cascading Style Sheets, Script

iPhone Web Apps: WebKit, Markup, CSS, JavaScript, Creating a Mobile Web App, Web Apps As Native Apps, PhoneGap, Tools and Libraries

Module IV

Basics of Android application Development:

Adapting to Devices: Necessity for Adaptation, Strategies for mobile adaptation, availability of domains, Future options

Making Money in Mobile: Working with Operators, Working with an App Store, Add Advertising, Invent a New Model

Supporting Devices: Having a Device Plan, Device Testing, Desktop Testing, Usability Testing, The Future of Mobile, The Opportunity for Change

Text Books:

1. Mobile Design and Development, Brian Fling, O'Reilly Media, ISBN10: 0-596-15544-1
2. Beginning Android 4 Application Development, Wei-Meng Lee, Wrox, ISBN10: 1118199545

Reference Book:

Mobile Development with C#: Building Native iOS, Android, and Windows Phone Applications: Greg Shackles, O'Reilly Media, ISBN13: 978-1449320232