B.TECH. III Semester-6	L	T	P	C
CS 601: Introduction to Machine Learning	3	0	2	4

Prerequisite
Linear Algebra, Matrix Calculus, Probability and Statistics

Unit - 1	14 Hours
Introduction Supervised Learning: Linear Regression (Gradient Descent, Normal Equations), Weighted Linear Regression (LWR), Logistic Regression, Perceptron, (cross-)Entropy, Natural Gradient, Exponential Family and Generalized Linear Models, Generative Models (Gaussian Discriminant Analysis, Naive Bayes), k-Nearest Neighbours, Kernel Method (SVM, Gaussian Processes), Tree Ensembles (Decision trees, Random Forests, Boosting and Gradient Boosting)	
Unit - 2	**8 Hours**
Learning Theory: Regularization, Bias-Variance Decomposition and Tradeoff, Concentration Inequalities, Generalization and Uniform Convergence, VC-dimension Deep Learning: Neural Networks, Backpropagation, Deep Architectures	
Unit - 3	**10 Hours**
Unsupervised Learning: K-means, Gaussian Mixture Model (GMM), Expectation Maximization (EM), Variational Auto-encoder (VAE), Factor Analysis, Principal Components Analysis (PCA), Independent Components Analysis (ICA)	
Unit - 4	**10 Hours**
Reinforcement Learning: Markov Decision Processes (MDP), Bellmans Equations, Value Iteration and Policy Iteration, Value Function Approximation, Q-Learning Applications: Advice on structuring an ML project, Evaluation Metrics, Recent Applications	
Total Contact Time: 42 Hours	

Recommended Books

1. Alpaydin, Introduction to Machine Learning , Third Edition, PHI
2. Haykin, Neural Networks and Learning Machines, PHI
3. Chris Bishop, Pattern Recognition and Machine Learning, Springer
4. Tom Mitchell, Machine Learning, McGraw-Hill.
5. Ethem Alpaydin, "Introduction to Machine Learning", MIT Press, 2004
6. Cathy O'Neil & Rachel Schutt, “Doing Data Science, Straight Talk From The Frontline”, O'Reilly, 2014.
7. Joel Grus, “Data Science from Scratch: First Principles with Python”, O’Reilly Media, 2015.
8. Wes McKinney, “Python for Data Analysis: Data Wrangling with Pandas, NumPy, and IPython”, O'Reilly Media, 2012.

B.TECH. III Semester-6	L	T	P	C
EC 602: Digital VLSI Design	3	0	2	4

The Wire, The CMOS Inverter	10 Hours
Introduction, A first Glance, Interconnect Parameters: Capacitance, Resistance, Inductance; Electrical Wire Models: The Ideal Wire, The Lumped Model, The Lumped RC Model, The Distributed RC Line, The Transmission Line; SPICE Wire Models: Distributed RC Lines in SPICE, Transmission Line Models in SPICE; Perspective: A look into the Future Introduction, The Static CMOS Inverter — An Intuitive Perspective, Evaluating the Robustness of the CMOS Inverter (The Static Behavior): Switching Threshold, Noise Margins, Robustness Revisited; Performance of CMOS Inverter (The Dynamic Behavior): Computing the Capacitances, Propagation; Delay: First-Order Analysis, Propagation Delay from a Design Perspective; Power, Energy, & Energy-Delay: Dynamic Power Consumption, Static Consumption, Putting It All Together, Analyzing Power Consumption Using SPICE; Perspective: Technology Scaling and its Impact on the Inverter Metrics	
Designing Combinational Logic Gates in CMOS	**10 Hours**
Introduction, Static CMOS Design: Complementary CMOS, Ratioed Logic, Pass-Transistor Logic; Dynamic CMOS Design: Dynamic Logic (Basic Principles), Speed and Power Dissipation of Dynamic Logic, Issues in Dynamic Design, Cascading Dynamic Gates; Perspectives: How to Choose a Logic Style, Designing Logic for Reduced Supply Voltages	
Designing Sequential Logic Circuits	**12 Hours**
Introduction: Timing Metrics for Sequential Circuits, Classification of Memory Elements; Static Latches and Registers: The Bistability Principle, Multiplexer-Based Latches, Master-Slave Edge-Triggered Register, Low-Voltage Static Latches, Static SR Flip-Flops—Writing Data by Pure Force; Dynamic Latches and Registers: Dynamic Transmission-Gate Edge-triggered Registers, C2MOS—A Clock-Skew Insensitive Approach, True Single-Phase Clocked Register (TSPCR); Alternative Register Styles: Pulse Registers, Sense-Amplifier Based Registers; Pipelining (An approach to optimize sequential circuits): Latch- vs. Register-Based Pipelines, NORA-CMOS—A Logic Style for Pipelined Structures; Non-Bistable Sequential Circuits: The Schmitt Trigger, Monostable Sequential Circuits, Astable Circuits; Perspective: Choosing a Clocking Strategy	
Implementation Strategies for Digital ICs	**8 Hours**
Introduction, From Custom to Semicustom and Structured Array Design Approaches, Custom Circuit Design, Cell-Based Design Methodology: Standard Cell, Compiled Cells, Macrocells, Megacells and Intellectual Property, Semi-Custom Design Flow; Array-Based Implementation Approaches: Pre-Diffused (or Mask-Programmable) Arrays, Pre-Wired Arrays; Perspective: The Implementation Platform of the Future	
Total Contact Time: 42 Hours	

Recommended Books

Text-Book

1. Rabaey Jan, Chandrakasan Anantha Nikolic, "Digital Integrated Circuits: A Design Perspective", Pearson Education, 2nd Ed., 2nd Impression, 2008.

Reference-Books

2. Hodges D. A. and Jackson H. G. "Analysis And Design Of Digital Integrated Circuits", 3rd Ed., McGraw-Hill, 2004.
3. Sung-Mo Kang and Leblebici Y., "CMOS Digital Integrated Circuits: Analysis And Design", Tata McGraw-Hill, 3rd Ed., 2003.
4. Weste Neil H.E, Harris D. and Banerjee A., "CMOS VLSI Design: A Circuits And Systems Perspective", Pearson Education, 3rd Ed., 2002.

B.TECH. III Semester-6	L	T	P	C
CS 603: Web Engineering	3	0	2	4

HTML, Javascript, JQuery	10 Hours
Introduction to Web Engineering, Web Programming vs. Web Engineering, Introduction to Web: HTTP, URL, Web Browser, Web Server, SMTP Server, ISP, Hyperlink, DNS, XML, Parsers and Internet based services, Web Architecture, An Overview about HTML (Basic Tags), HTML5 forms, GET and POST data, Introduction to Cascading style sheets, CSS3 Properties (BOX model, Advance Selectors), Responsive Designs, Need of responsive designs (bootstrap), Introduction to Javascript and jquery, Angular JS (A Client Side MVC framework).	
PHP, Database Connectivity	**10 Hours**
Introduction to PHP, Associative arrays, Include, require, header, Developing Dynamic Content/Web page using PHP, Sessions and Cookies, Database Connectivity Using PHP and Insert Record into Database, Update, Delete and View Records from Database, Building a CRUD application, AJAX, How AJAX works, Case Study on Code Management Tool (Github), Secure Web Applications, Usability of web applications, Accessibility of web applications, Introduction to MVC, Model View Controller, Performance Optimization of Web Application.	
PHP Framework	**12 Hours**
Introduction to PHP Framework (LARAVEL), MVC Routing, Static and Dynamic Routing, Route Parameters, Named Routes, Route Groups, HTTP Middleware Introduction, Defining Middleware, Registering Middleware, Middleware Parameters, Blade Templates Introduction, Template Inheritance, Defining A Layout, Extending A Layout, Database: Migrations, How to Work on View Section in LARAVEL, Basic Usage, Passing Data To Views, Sharing Data With All Views, Introduction Generating Migrations, Migration Structure, Running Migrations, Rolling Back Migrations, Writing Migrations, Creating Tables, Renaming / Dropping Tables, Database Seeding in LARAVEL, Writing Seeder, Running Seeder.	
MVC in LARAVEL, Web Services	**10 Hours**
MVC Controller in LARAVEL, Introduction Basic Controllers, Controller Middleware, MVC Model and Eloquent ORM in LARAVEL, Getting Started, Relationships, Collections, Introduction to Web Services, Restful Services, Introduction to SOAP Services, SOAP Service Architecture, WSDL with SOAP Service, UDDI with SOAP, Web Application Testing, Test Driven Development(TDD), TDD and Traditional Testing, Introduction to CMS Systems (Wordpress/Magneto).	
Total Contact Time: 42 Hours	

Recommended Books

1. Web Engineering: A Practitioner's Approach by Roger Pressman and David Lowe, McGraw-Hill, 2009.
2. Web 2.0 Architectures: What Entrepreneurs and Information Architects Need to Know by James Governor, Dion Hinchcliffe, and Duane Nickull, O'Reilly, 2009.
3. Web Engineering: Modelling and Implementing Web Applications: Modelling and Implementing Web Applications.
4. Web Engineering - The Discipline of Systematic Development of Web Applications, GertiKappel, Birgit Proll, Siegfried Reich, Werner Retschitzegger.

B.TECH. III Semester-6	L	T	P	C
EC 604: Embedded Systems	3	0	2	4

Introduction to Embedded Systems	6 Hours
Embedded Systems: Introduction to Embedded Systems, Definition, Embedded Systems Vs General Computing Systems, ASICs, PLDs, Commercial off-the-shelf components (COTS), History of Embedded Systems, Classification, Major Application areas, Purpose of embedded systems, Characteristics and Quality attributes of embedded systems	
ARM: Architecture and Software Development	**16 Hours**
ARM Architecture Revision, Cortex Processor Architecture, Architecture of ARM Cortex M0/M0+, Registers, Current Program Status Register, Pipeline, Exception, Interrupt And Vector Table, Memory Map, ARM And Thumb Mode Memory Management Unit Arm & Thumb Instruction Set: Data Processing Instruction, Branch Instruction, Load Store Instruction, Program Status Resister Instruction, Loading Constant, Stack Instruction, Conditional Execution Peripheral Interfacing with ARM controller (GPIO, LED, Keypad, LCD display, ADC, DAC, I^2C, SPI), Device Drivers	
RTOS based Embedded System Design	**12 Hours**
Operating System Basics, Types of Operating Systems, Tasks, Process and Threads, Multiprocessing and Multitasking, Task Scheduling, Task Operations, Structure, Synchronization, Communication and Concurrency. Interrupts and Timers Exceptions, Interrupts, Applications, Processing of Exceptions and Spurious Interrupts, Real Time CLO scks, Programmable Timers, Timer Interrupt Service Routines (ISR), Soft Timers	
Task Communications	**8 Hours**
Defining Semaphores, Operations and Use, Exceptions, Shared Memory, Message Passing, Remote Procedure Call and Sockets, Task Synchronization: Task Communication/Synchronization issues, Task Synchronization, Techniques, How to Choose an RTOS	
Total Contact Time: 42 Hours	

Recommended Books

1. Shibu K. V, “Introduction to Embedded Systems”, McGraw Hill, 2nd Edition, 2017.
2. David E. Simon, “An Embedded Software Primer”, Pearson Education, 1st Edition, 12th Indian Reprint, 2005
3. Raj Kamal, “Embedded Systems”, Tata McGraw Hill, 2017.
4. Frank Vahid, Tony Givargis, “Embedded System Design”, John Wiley, 2006.
5. Sloss A. N., Symes D. and Wright C., "ARM System Developer's Guide", Morgan Kaufmann Publishers, 1st Ed., 3rd Reprint, 2006.

B.TECH. III Semester-6	L	T	P	C
CS 631: Mathematical Optimization	3	0	0	3

Linear Programming	10 Hours
Basic Problem, Graphical Solution, Simplex Method, Slack Variables, Simplex Method for Resource Requirements, General Constraints, Duality, Duality for Non-standard Linear Programs, Duality Theorems, Sensitivity Analysis, Changes in Objective Function Coefficients, Theory for Simplex Method.	
Unconstrained Extrema	**10 Hours**
Mathematical Background, Types of Subsets of R^n, Continuous Functions, Existence of Extrema, Differentiation in Multi-Dimensions, Second Derivative and Taylor's Theorem, Quadratic Forms, Derivative Conditions, First Derivative Conditions, Second Derivative Conditions.	
Constrained Extrema	**10 Hours**
Implicit Function Theorem, Extrema with Equality Constraints, Interpretation of Lagrange Multipliers, Extrema with Inequality Constraints: Necessary Conditions, Extrema with Inequality Constraints: Sufficient Conditions, Convex Structures, Karush-Kuhn-Tucker Theorem under Convexity, Rescaled Convex Functions, Global Extrema for Concave Functions, Proof of Karush-Kuhn-Tucker Theorem, Second-Order Conditions for Extrema of Constrained Functions.	
Dynamic Programming	**12 Hours**
Parametric Maximization and Correspondences, Budget Correspondence for Commodity Bundles, Existence of a Nash Equilibrium, Finite-Horizon Dynamic Programming, Supremum and Infimum, General Theorems, Infinite-Horizon Dynamic Program, Examples, Theorems for Bounded Reward Function, Theorems for One-Sector Economy, Continuity of Value Function.	
Total Contact Time: 42 Hours	

Recommended Books

1. Russell C. Walker, Introduction to Mathematical Programming, 4th edition, Pearson Learning.
2. R. Clark Robinson, Introduction to Mathematical Optimization, 2013.
3. Wayne L. Winston, Operations Research - Applications and algorithms, Fourth edition.
4. Edwin K. P. Chong, Stanislaw H. Zak, An Introduction to optimization, Fourth Edition.

B.TECH. III Semester-6	L	T	P	C
CS 632: Cloud Computing & Big Data Infrastructure	3	0	0	3

Unit -1	8 Hours
Introduction to Cloud computing, Cloud computing: IaaS, PaaS, SaaS; Cloud computing: Current & future trends, Impact on scientific research Types of Cloud services providers: Google, Amazon, Microsoft Azure, IBM, Sales force	
Unit - 2	**8 Hours**
Virtualization for Cloud: Need for Virtualization, Pros and cons of virtualization, Types of virtualization; system VM, process VM, virtual machine monitor; Virtual machine properties, Interpretation and Binary translation, HLL VM – Hypervisors – Xen, VMWare, Hyper - V	
Unit - 3	**8 Hours**
Introduction to Big data. Big data and its importance, Drivers, Big data analytics, Big data applications. Algorithms, Matrix-Vector, Multiplication by Map Reduce. YARN, SQOOP, PIG	
Unit - 4	**8 Hours**
OpenStack – Cloud operating system, object storage (SWIFT). Introduction, distributed file system. Hadoop – Architecture, Hadoop distributed file system (HDFS) MapReduce – Programming model, Task scheduling algorithms, Data serialization	
Unit - 5	**10 Hours**
Apache Spark Java AWS SDK, S3 API, Relational Database Service, SimpleDB Service, NoSQL Databses, HIVE, MongoDB, HBase Elastic search, Qlik Sense, Superset. Building Interactive Visualization using Superset.	
Total Contact Time: 42 Hours	

Recommended Books

1. John Rittinghouse & James Ransome, Cloud Computing, Implementation, Management and Strategy, CRC Press, 2010.
2. Mastering Cloud Computing by Rajkumar Buyya, Christian Vecchiola, S. Thamarai Selvi, McGraw Hill Education (India) Private Limited, 2013.
2. Dr. Kumar Saurabh, “Cloud Computing 2nd Kindle Edition”, Wile India, 2012.
3. “Big Data, Black Book: Covers Hadoop, MapReduce, Hive, YARN, Pig, R and Data Visualization”, Dreamtech Press, 1st Edition, 2016.
4. Arvind Sathi, “Big Data Analytics: Disruptive Technologies for Changing the Game”, MC Press, 2012.
5. Tom White, “Hadoop: The Definitive Guide”, O’Reilly Media, Third Edition, 2012.

B.TECH. III Semester-6	L	T	P	C
CS 633: Introduction to Game Design	3	0	0	3

Introduction	10 Hours
History of Video Games, Impact of Games on Society, Introduction to the Class, Role of the Game Designer, Game Design, Game types, Game genres, Game Writing, UI Layout, Asset Management, game state, gamer services and Interactive Storytelling Understanding Hardware, Input Devices, Output Devices, Network Requirements, Managing Game Performance, CPU vs GPU, and Graphics Networking Performance, Dramatic elements of games and Narrative Design, Narrative Game.	
Game design and Development	**12 Hours**
Concepts: Mathematical concepts, Collision Detection and resolution, Real-time game Physics, Graphics, System dynamics, Challenge, Skill and Chance, Character Animation, Animate basic characters, Transform objects, Artificial Intelligence Agents, Architecture, and Techniques, Overview of Path finding, Audio Programming, Conceptualization, Communication, Networking and Multiplayer.	
Audio visual design and production	**10 Hours**
Visual Design, 3D Modeling using 3D Studio Max, 3D Environments, 2D Textures and Texture mapping, Special Effects, Lighting, Animation, Cinematography, Audio design and production, Social play Games as culture, Introduction to Unity and 3D games.	
Working with unity and Scripting	**10 Hours**
Level design and properties of living things, Functionality, Completeness and Balance, Simple Playtesting and Quality Assurance, Design a board game, Game economies, Black Friday, the board game, Unity Demos, Courses Wiki, Lesson Files, Managing Project, Interface and Assets, Unity Interfaces, Prototyping and Scripting Basics, Collection, Inventory and HUD, Building Unity Game, Terrain, Unity Terrain Assets, Camera, Layer, GUI, Curves, Surfaces, Visible Surface.	
Total Contact Time: 42 Hours	

Recommended Books

1. Steve Rabin, Introduction to Game Development, Cengage Technology (2010).
2. Michael Dawson, Beginning C++ Through Game Programming, Cengage Learning (2010).
3. Kelly C., Programming 2D Games, A K Peters/CRC Press(2012).
4. A. Thorn, Learn Unity for 2D Game Development, Apress, (2013).

B.TECH. III Semester-6	L	T	P	C
EC 641: Information Theory and Coding	3	0	0	3

Information and Sources	10 Hours
Introduction, The Definition of Information, The Zero-memory Information Source, properties of Entropy, Extension of a Zero-memory Source, The Markov Information Source, The Adjoint Source.	
Source Coding, Channels and Mutual Information	**12 Hours**
Properties of Codes, Uniquely Decodable Codes, Instantaneous Codes, Construction of an Instantaneous Code, Kraft's Inequality. The Average Length of A Code, A method of Encoding for Special Sources, Shannon's First Theorem, Coding without Extensions, Huffman Codes, Code Efficiency And Redundancy. Introduction, Information Channels, Probability Relations in a Channel, A priori and A Posteriori Entropy, Mutual information, Properties of Mutual Information, Noiseless Channels and Deterministic Channels, Cascaded Channels, Additivity of Mutual Information.	
Linear Block Codes	**10 Hours**
Introduction and basic definitions, Encoding and Decoding of a linear block codes, Syndrome decoding, Perfect Codes, Hamming Codes, Minimum Distance, Error Correction And Error Detection Capabilities.	
Cyclic, BCH & Convolution Codes	**10 Hours**
Introduction to Cyclic Codes, Polynomials, Cyclic Code Generation, Quasi-cyclic and Shortened Cyclic Codes, Burst Error Correction, Fire Codes, Golay Codes, BCH Codes, Convolution Codes and Turbo Codes.	
Total Contact Time: 42 Hours	

Recommended Books

1. RanjanBose,"Information theory, coding and cryptography", Tata McGraw-Hill,2nd Edition,2008.
2. Giridhar K, "Information Theory & Coding", Pooja Publications, 2010.
3. Skalar, Digital Communications,
4. Carlson A., Communication Systems, 3rd Ed., McGraw Hill, 1986.
5. Proakis J.J., Digital Communications, 2nd Ed., McGraw Hill, 1989.
6. Blahut R.F., Digital transmission of Information, Addison Wesley 1990.

B.TECH. III Semester-6	L	T	P	C
EC 642: MEMS	3	0	0	3

Introduction to MEMS, Introduction to Microfabrication, Review of Essential Electrical and Mechanical Concepts	8 Hours
MEMS: The History of MEMS Development, The Intrinsic Characteristics of MEMS, Devices (Sensors and Actuators), Sensor Noise and Design Complexity Microfabrication: Overview of Microfabrication, Frequently used Microfabrication Processes, Microelectronics Fabrication Process Flow, Silicon-Based MEMS processes, Packaging and Integration, New Materials and Fabrication Processes, Process Selection & Design Review of Concepts: Conductivity of Semiconductors, Crystal Planes and Orientations, Stress and Strain, Flexural Beam Bending Analysis under Simple Loading Conditions, Torsional Deflections, Intrinsic Stress, Dynamic System, Resonant Frequency and Quality Factor, Active Tuning of Spring Constant and Resonant Frequency	
Sensors and Actuators	**18 Hours**
Electrostatic Sensing and Actuation: Introduction, Parallel-Plate Capacitor, Applications of Parallel-Plate Capacitors (Inertia Sensor, Pressure Sensor, Flow Sensor, Tactile Sensor, Parallel-Plate Actuators), Interdigitated Finger Capacitors, Applications of Comb-Drive Devices Thermal Sensing and Actuation: Introduction, Sensors and Actuators based on Thermal Expansion, Thermal Couples, Thermal Resistors, Applications Piezoresistive Sensors: Origin and Expression of Piezoresistivity, Piezoresistive Sensor Materials, Stress Analysis of Mechanical Elements, Application of Piezoresistive Sensors Piezoelectric Sensors: Introduction, Properties of Piezoelectric Materials, Applications Magnetic Actuation: Essential Concepts and Principles, Fabrication of Micro Magnetic Components, Case Studies	
Micromachining	**8 Hours**
Bulk Micromachining and Silicon Anisotropic Etching: Introduction, Anisotropic Wet Etching, Dry Etching and Deep Reactive Ion Etching, Isotropic Wet Etching, Gas Phase Etchants, Native Oxides, Special Wafers and Techniques Surface Micromachining: Basic Surface Micromachining Processes, Structural and Sacrificial Materials, Acceleration of Sacrificial Etch, Stiction and anti-Stiction Methods LIGA process	
MEMS Types	**8 Hours**
Polymer MEMS: Introduction, Polymers in MEMS, Representative Applications Optical MEMS, Bio MEMS, Chemical Sensors, Mechanical Sensors, MEMS Gyro Sensors, MEMS for Space application Interfacing Electronics for MEMS	
Total Contact Time: 42 Hours	

Recommended Books

1. Chang Liu, 'Foundations of MEMS', Pearson Education Inc., 2012.
2. Stephen D Senturia, 'Microsystem Design', Springer Publication, 2000.
3. Tai Ran Hsu, "MEMS & Micro systems Design and Manufacture" Tata McGraw Hill, New Delhi, 2002.

B.TECH. III Semester-6	L	T	P	C
CS 641: Augmented and Virtual Reality	3	0	0	3

Unit - 1	10 Hours
Introduction to Virtual Reality: Fundamental Concept and Components of Virtual Reality. Primary Features and Present Development on Virtual Reality. Multiple Models of Input and Output Interface in Virtual Reality: Input --Tracker, Sensor, Digital Glove, Movement Capture, Video-based Input, 3D Menus & 3DScanner etc. Output -- Visual /Auditory / Haptic Devices.	
Unit - 2	**14 Hours**
Visual Computation in Virtual Reality: Fundamentals of Computer Graphics. Software and Hardware Technology on Stereoscopic Display. Advanced Techniques in CG: Management of Large Scale Environments & Real Time Rendering. Interactive Techniques in Virtual Reality: Body Track, Hand Gesture, 3D Manus, Object Grasp. Augmented and Mixed Reality, Taxonomy, technology and features of augmented reality, difference between AR and VR, Challenges with AR	
Unit - 3	**18 Hours**
Development Tools and Frameworks in Virtual Reality: Frameworks of Software Development Tools in VR, Introduction and Overview of OpenGL and Unity Application of VR in Digital Entertainment: VR Technology in Film & TV Production, Demonstration of Digital Entertainment by VR, Technological Online-Education enhancement by AR and VR A short course project in OpenGL or Unity	
Total Contact Time: 42 Hours	

Recommended Books

1. Burdea, G. C. & P. Coffet. Virtual Reality Technology, Second Edition. Wiley-IEEE Press, 2003/2006.
2. Alan B. Craig, Understanding Augmented Reality, Concepts & Applications, Morgan Kaufmann, 2013.
3. Alan Craig, William Sherman and Jeffrey Will, Developing Virtual Reality Applications, Foundations of Effective Design, Morgan Kaufmann, 2009.
4. LaValle "Virtual Reality", Cambridge University Press, 2016.
5. John Vince, “Virtual Reality Systems “, Pearson Education Asia, 2007.
6. Anand R., “Augmented and Virtual Reality”, Khanna Publishing House, Delhi.
7. Stanford Course: Virtual Reality (https://stanford.edu/class/ee267/syllabus.html)