SREENIVASAINSTITUTEOFTECHNOLOGYANDMANAGEMENTSTUDIES
(Autonomous)

Minor - INTERNET OF THINGS - Offered by CSE Department

S.No	Course Code	CourseTitle	Scheme of Instructions HoursperWeek				Scheme ofExaminationMaximumMarks		
			L	T	P	C	I	E	Total
1	23MRIOT1	Introduction to IoT	3	-	-	3	30	70	100
2	23MRIOT2	Wireless Sensor Networks	3	-	-	3	30	70	100
3	23MRIOT3	Communication Protocols for IoT	3	-	-	3	30	70	100
4	23MRIOT4	Industrial IoT	3	-	-	3	30	70	100
5	23MRIOT5	Cloud Computing	3	-	-	3	30	70	100
6	23MRIOT6	IoT Lab	-	-	3	1.5	30	70	100
7	23MRIOT7	Cloud Computing Lab	-	-	3	1.5	30	70	100

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CSE Department
INTERNET OF THINGS

23MRIOT1	INTRODUCTION TO IOT	L	T	P	C
		3	0	0	3

PRE-REQUISITES:

COURSE EDUCATIONAL OBJECTIVES:

- Understand the basics of Internet of Things and protocols.
- Discuss the requirement of IoTtechnology
- Introduce some of the application areas where IoT can be applied.
- UnderstandthevisionofIoTfromaglobalperspective,understanditsapplications, determine its market perspective using gateways, devices and data management

UNIT –1: Introduction to IoT: (9)

Definition and Characteristics of IoT, physical design of IoT, IoT protocols, IoTcommuna. Ceaser cipher b. Substitution cipher c. Hill Ciphericationmodels, IoT Communication APIs, Communication protocols, Embedded Systems, IoT Levels and Templates.

UNIT –2: Prototyping IoT Objects using Microprocessor / Microcontroller: (9)

principles of sensors and actuators, setting up the board – Programming for IoT, Readingfrom Sensors, Communication: communication through Bluetooth, Wi-Fi.

UNIT –3: IoT Architecture and Protocols: (9)

Architecture Reference Model Introduction, Reference Model and architecture, IoT reference Model, Protocols- 6LowPAN, RPL, CoAP, MQTT, IoT frameworks Thing Speak.

UNIT –4: Device Discovery and Cloud Services for IoT: (9)

Device discovery capabilities – Registering a device, Deregister a device, Introduction to Cloud Storage models and communication APIs Web-Server, Web server for IoT.

UNIT –5: UAV IoT: (9)

Introduction to Unmanned Aerial Vehicles/Drones, Drone Types, Applications: Defense, Civil, Environmental Monitoring; UAV elements and sensors- Arms, motors, Electronic Speed Controller (ESC), GPS, IMU, Ultra sonic sensors; UAV Software –Arudpilot, Mission Planner, Internet of Drones(IoD)- Case study FlytBase.

Total Hours: 45

COURSE OUTCOMES:

On successful completion of the course- students will be able to		Bloom's Level
CO1	• Understand general concepts of Internet of Things.	
CO2	• Apply design concept to IoTsolutions	
CO3	• AnalyzevariousM2MandIoTarchitectures	
CO4	• Evaluated e sign issues in IoTapplications	
CO5	• Create IoT solutions using sensors, actuators and Devices	

TEXT BOOKS:

1.VijayMadisettiandArshdeepBahga,"InternetofThings(AHands-on-Approach)",1st Edition, VPT, 2014.

2.Handbookofunmannedaerialvehicles,KValavanis;GeorgeJVachtsevanos,NewYork, Springer, Boston, Massachusetts : Credo Reference, 2014. 2016

REFERENCE BOOKS:

1.Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, DavidBoyle, "FromMachine-to-MachinetotheInternetofThings:Introductiontoa New Age of Intelligence", 1st Edition, Academic Press, 2014.

2.ArshdeepBahga,VijayMadisetti-InternetofThings:AHands-OnApproach,Universities Press,2014.

3.The Internet of Things, Enabling technologies and use cases – Pethuru Raj, Anupama C. Raman, CRC Press.

4.FrancisdaCosta, "Rethinking the Internet of Things: A Scalable Approach to Connecting Everything", 1st Edition, Apress Publications, 2013

5.CunoPfister, Getting Started with the Internet of Things, O"Reilly Media, 2011, ISBN: 978- 1-4493- 9357-1

6.DGCA RPAS Guidance Manual, Revision 3 – 2020

7.Building Your Own Drones: A Beginners' Guide to Drones, UAVs, and ROVs, John Baichtal

REFERENCE WEBSITE:

1. https://www.arduino.cc/
2. https://www.raspberrypi.org/
3. https://nptel.ac.in/courses/106105166/5
4. https://nptel.ac.in/courses/108108098/4

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23MRIOT2	WIRELESS SENSOR NETWORKS	L	T	P	C
		3	0	0	3

PRE-REQUISITES:

COURSE EDUCATIONAL OBJECTIVES:

- To acquire the knowledge about various architectures and applications of Sensor Networks
- To understand issues, challenges and emerging technologies for wireless sensor networks
- To learn about various routing protocols and MAC Protocols
- To understand various data gathering and data dissemination methods
- To Study about design principals, node architectures, hardware and software required for implementation of wireless sensor networks.

UNIT –1: Characteristics Of WSN: (9)

Characteristic requirementsfor WSN - Challenges for WSNs – WSN vsAdhoc Networks -Sensor node architecture – Commercially available sensor nodes –Imote, IRIS, MicaMote, EYES nodes, BTnodes, TelosB, Sunspot -Physicallayerandtransceiverdesign considerations in WSNs, Energy usage profile, Choice of modulation scheme,Dynamic modulation scaling, Antenna considerations.

UNIT –2: Medium Access Control Protocols: (9)

Fundamentals of MAC protocols - Low duty cycleprotocolsandwakeup concepts - Contention-basedprotocols-Schedule-basedprotocols-SMAC -BMAC -Traffic-adaptivemediumaccess protocol (TRAMA) - The IEEE 802.15.4 MAC protocol.

UNIT –3: Routing And Data Gathering Protocols (9)

Routing Challenges and Design Issues in Wireless Sensor Networks, Flooding and gossiping – Data centric Routing – SPIN – Directed Diffusion – Energy aware routing - Gradient-based routing - Rumor Routing – COUGAR – ACQUIRE – Hierarchical Routing - LEACH, PEGASIS – Location Based Routing – GF, GAF, GEAR, GPSR – Real Time routing Protocols – TEEN, APTEEN, SPEED, RAP - Data aggregation - data aggregation operations -Aggregate Queries in Sensor Networks - Aggregation Techniques – TAG, Tiny DB.

UNIT –4: Embedded Operating Systems: (9)

Operating Systems for Wireless Sensor Networks – Introduction - Operating System Design Issues - Examples of Operating Systems – TinyOS – Mate – MagnetOS – MANTIS- OSPM - EYES OS – SenOS – EMERALDS – PicOS – Introduction to Tiny OS – NesC – Interfaces and Modules-Configurations and Wiring - Generic Components -Programming in Tiny OS using NesC, Emulator TOSSIM.

UNIT –5: Applications Of WSN: (9)

WSN Applications - Home Control - Building Automation - Industrial Automation - Medical Applications - Reconfigurable Sensor Networks - Highway Monitoring - Military Applications - Civil and Environmental Engineering Applications-WildfireInstrumentation-HabitatMonitoring-NanoscopicSensorApplications –CaseStudy: IEEE802.15.4 LR-WPANs Standard - Target detection and tracking - Contour/edge detection - Field sampling.

Total Hours: 45

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COURSE OUTCOMES:

On successful completion of the course- students will be able to		**Bloom's Level**
CO1	• Analyze and compare various architectures of Wireless Sensor Networks	
CO2	• Understand Design issues and challenges in wireless sensor networks	
CO3	• Analyze and compare various data gathering and data dissemination methods.	
CO4	• Design, Simulate and Compare the performance of various routing and MAC protocol	
CO5		

TEXT BOOKS:

1. KazemSohraby, Daniel MinoliandTaiebZnati, " Wireless Sensor Networks Technology, Protocols, and Applications", John Wiley & Sons,2007.
2. Holger Karl and Andreas Willig, "Protocols and Architectures for Wireless Sensor Networks", John Wiley & Sons, Ltd, 2005.

REFERENCE BOOKS:

1. K.AkkayaandM.Younis,"Asurveyofroutingprotocolsinwirelesssensornetworks", Elsevier Ad Hoc Network Journal, Vol. 3, no. 3, pp. 325--349
2. PhilipLevis,"TinyOSProgramming"
3. AnnaHa´c,"WirelessSensorNetworkDesigns",JohnWiley&SonsLtd,

REFERENCE WEBSITE:

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23MRIOT3	COMMUNICATION PROTOCOLS FOR IOT	L	T	P	C
		3	0	0	3

PRE-REQUISITES:

COURSE EDUCATIONAL OBJECTIVES:

In this course, learners will be going to learn about various protocols designed for the implementation of the Internet of Things (IoT) applications.

UNIT –1: Introduction: (9)

IoT architecture outline, standards - IoT Technology Fundamentals- Devices and gateways, Local and wide area networking, Data management, Business processes in IoT, Everything as a Service (XaaS), M2M and IoT Analytics.

UNIT –2: Iot Reference Architecture: (9)

Introduction, Functional View, Information View, Deployment and Operational View, Other Relevant Architectural views. Real-World Design Constraints- Introduction, Technical Design constraints.

UNIT –3: IoT Data Link Layer: (9)

PHY/MAC Layer (3GPP MTC, IEEE 802.11, IEEE 802.15), Wireless HART, ZWave, Bluetooth Low Energy, Zigbee Smart Energy, DASH7

UNIT –4: Network Layer Protocols: (9)

Network Layer-IPv4,IPv6, 6LoWPAN, 6TiSCH,ND, DHCP, ICMP, RPL, CORPL, CARP.

UNIT –5: IOT Transport & Session Layer Protocols: (9)

Transport Layer (TCP, MPTCP, UDP, DCCP, SCTP)- (TLS, DTLS) – Session Layer-HTTP, CoAP, XMPP, AMQP, MQTT.

Total Hours: 45

COURSE OUTCOMES:

On successful completion of the course- students will be able to		Bloom's Level
CO1	• Understand fundamentals of IoT architecture outline and standards.	
CO2	• Understand and analyze different architectural views.	
CO3	• Understand the importance of IoT Data Link Layer & Network Layer Protocols.	
CO4	• Understand the importance of Iot Transport & Session Layer Protocols.	
CO5		

TEXT BOOKS:

1. **Daniel Minoli, "Building the Internet of Things with IPv6 and MIPv6: The Evolving World of M2M Communications", ISBN: 978-1-118-47347-4, Willy Publications ,2016**
2. **Jan Holler, VlasiosTsiatsis, Catherine Mulligan, Stefan Avesand, StamatisKarnouskos, David Boyle, "From Machine-to-Machine to the Internet of Things: Introduction to a New Age of Intelligence",1st Edition, Academic Press, 2015.**

REFERENCE BOOKS:

1. **Bernd Scholz-Reiter, Florian Michahelles, "Architecting the Internet of Things", ISBN 978-3- 64219156-5 e-ISBN 978-3-642-19157-2, Springer, 2016.**
2. **N. Ida, Sensors, Actuators and Their Interfaces, Scitech Publishers, 2014.**

REFERENCE WEBSITE:

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23MRIOT4	INDUSTRIAL IoT	L	T	P	C
		3	0	0	3

PRE-REQUISITES:

COURSE EDUCATIONAL OBJECTIVES:

- Acquire theoretical knowledge on Industrial Internet of Things.
- Apply suitable machine learning techniques for data handling and to gain knowledge from it.
- Evaluate the performance of algorithms for sensors and data transmission.

UNIT –1: Overview of Internet of Things: (9)

Introduction, IOT Architecture, Application –based IOT protocols, Cloud Computing, Fog Computing, Sensor Cloud, Big Data.

Overview of Industry 4.0 and Industrial Internet of Things: IIoT- Prerequisites of IIOT, Basics of CPS, CPS and IIOT, Applications of IIoT.

UNIT –2: Industrial Internet of Things (9)

Introduction, Industrial Internet Systems, Industrial sensing, Industrial sensing, Industrial Processes.
Business Models and Reference Architecture of IIoT: Definition of a business model, Business models of IOT, Business models of IIOT.

UNIT –3: Key and On-site Technologies: (9)

Key Technologies:Off-site Technologies- Introduction, Cloud Computing- Necessity, Cloud Computing and IIot, Industrial Cloud Platform Providers, SLA, Requirements of Industry 4.0, Fog Computing.
On-site Technologies- Introduction, Augmented Reality- History, Categorization, Applications, Virtual Reality- History, Categorization, Applications.

UNIT –4: Sensors and Data Transmission Sensors: (9)

Introduction to Sensors, Characteristics-Sensor calibration, Sensor profile, Operating voltage, Sensor Categories. Actuators:Introduction, Thermal Actuators, Hydraulic Actuators, Pneumatic Actuators, Electromechanical Actuators.
Industrial Data Transmission: Foundation fieldbus, Profibus, HART, Interbus, Bitbus.

UNIT –5: Machine Learning and Data Science in Industries: (9)

Introduction, Machine Learning, Categorization on ML, Applications and Data Science of ML in industries, Deep Learning, Applications of Deep Learning in industries.

Applications of Healthcare in Industries: Smart Devices, Advanced Technologies using in Healthcare, Open Research Issues to be Addressed.

Total Hours: 45

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(Autonomous)

COURSE OUTCOMES:

On successful completion of the course- students will be able to		**Bloom's Level**
CO1	• Understand the characteristics of Internet of Things and its industry strategies.	
CO2	• Apply various Internet of Things models to appropriate problems.	
CO3	• Identify and integrate more than one technology to enhance the performance.	
CO4	• Understand the sensors and data transmission used in Internet of Things.	
CO5	• Analyse the co-occurrence of data to find interesting frequent patterns.	
	• Pre-process the data before applying to any real-world problem and can evaluate its performance.	

TEXT BOOKS:

1. S. Misra, C. Roy, and A. Mukherjee, 2020. Introduction to Industrial Internet of Things and Industry 4.0. CRC Press.

REFERENCE BOOKS:

1. Industrial IoT. Available online: https://medium.com/iotforall/whatproduct-managers-need-to-know-about-industrial-iot-8c92eec1d9d2
2. IIoT Cloud Platforms. Available online: https://fr.farnell.com/willthere-be-a-dominant-iiot-cloud-platform.

3. Kajima, T. and Kawamura, Y., 1995. Development of a high-speed solenoid valve: Investigation of solenoids. IEEE Transactions on industrial electronics, 42(1), pp.1-8.

REFERENCE WEBSITE:

1. https://www.coursera.org/learn/industrial-internet-of-things
2. https://www.coursera.org/specializations/developing-industrial-iot

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23MRIOT5	CLOUD COMPUTING	L	T	P	C
		3	0	0	3

PRE-REQUISITES:

COURSE EDUCATIONAL OBJECTIVES:

- To explain the evolving computer model called cloud computing.
- To introduce the various levels of services that can be achieved by cloud.
- To describe the security aspects in cloud.

UNIT –1: **(9)**

INTRODUCTION TO CLOUD COMPUTING: Introduction, Characteristics of cloud computing, Cloud Models, Cloud Services Examples, Cloud Based services and applications

Cloud concepts and Technologies: Virtualization, Load balancing, Scalability and Elasticity, Deployment, Replication, Monitoring, Software defined, Network function virtualization, Map Reduce, Identity and Access Management, services level Agreements, Billing.

Cloud Services and Platforms: Compute Services, Storage Services, Database Services, Application services, Content delivery services, Analytics Services, Deployment and Management Services, Identity and Access Management services, Open Source Private Cloud software.

UNIT –2: **(9)**

HadoopMapReduce: Apache Hadoop, Hadoop Map Reduce Job Execution, Hadoop Schedulers, Hadoop Cluster setup.

Cloud Application Design: Reference Architecture for Cloud Applications, Cloud Application Design Methodologies, Data Storage Approaches.

Python Basics: Introduction, Installing Python, Python data Types & Data Structures, Control flow, Function, Modules, Packages, File handling, Date/Time Operations, Classes

UNIT –3: **(9)**

Python for Cloud: Python for Amazon web services, Python for Google Cloud Platform, Python for windows Azure, Python for MapReduce, Python packages of Interest, Python web Application Frame work, Designing a RESTful web API.

Cloud Application Development in Python : Design Approaches, Image Processing APP, Document Storage App, MapReduce App, Social Media Analytics App.

UNIT –4: **(9)**

Big Data Analytics: Introduction, Clustering Big Data, Classification of Bigdata Recommendation of Systems. Multimedia Cloud: Introduction, Case Study: Live video Streaming App, Streaming Protocols, case Study: Video Transcoding App.

Cloud Application Benchmarking and Tuning: Introduction, Workload Characteristics, Application Performance Metrics, Design Considerations for a Benchmarking Methodology, Benchmarking Tools, Deployment Prototyping, Load Testing & Bottleneck Detection case Study, Hadoop benchmarking case Study.

UNIT –5: **(9)**

Cloud Security: Introduction, CSA Cloud Security Architecture, Authentication, Authorization, Identity Access Management, Data Security, Key Management, Auditing.

Cloud for Industry, Healthcare & Education: Cloud Computing for Health care, Cloud computing for Energy Systems, Cloud Computing for Transportation Systems, Cloud Computing for Manufacturing Industry, Cloud computing for Education.

Migrating into a Cloud: Introduction, Broad Approaches to migrating into the cloud, the seven– step model of migration into a cloud.
Organizational readiness and Change Management in The Cloud Age: Introduction, Basic concepts of Organizational Readiness, Drivers for changes: A frame work to comprehend the competitive environment, common change management models, change management maturity models, Organizational readiness self – assessment.
Legal Issues in Cloud Computing: Introduction, Data Privacy and security Issues, cloud contracting models, Jurisdiction a issues raised by virtualization and data location, commercial and Business considerations, Special Topics.

Total Hours: 45

COURSE OUTCOMES:

On successful completion of the course- students will be able to		**Bloom's Level**
CO1	• Ability to create cloud computing environment	
CO2	• Ability to design applications for Cloud environment	
CO3	• Design & amp; develop backup strategies for cloud data base don features.	
CO4	• Use and Examine different cloud computing services.	
CO5	• Apply different cloud programming model asperneed.	

TEXT BOOKS:

1.Cloud computing A hands-on Approach‖ By ArshdeepBahga, Vijay Madisetti, Universities Press,
2016
2.Cloud Computing Principles and Paradigms: By Raj Kumar Buyya, James Broberg, Andrzej, **Goscinski, Wiley, 2016**

REFERENCE BOOKS:

1. Mastering Cloud Computing by RajkumarBuyya, Christian Vecchiola, SThamaraiSelvi, TMH
2. Cloud computing A Hands-On Approach by ArshdeepBahga and Vijay Madisetti.
3. Cloud Computing: A Practical Approach, Anthony T. Velte, Toby J. Velte, Robert Elsenpeter, Tata McGraw Hill, rp2011.
4. Enterprise Cloud Computing, GautamShroff, Cambridge University Press, 2010.
5. Cloud Application Architectures: Building Applications and Infrastructure in the Cloud, George Reese, O 'Reilly, SPD, rp2011.
6. Essentials of Cloud Computing by K. Chandrasekaran. CRC Press.

REFERENCE WEBSITE:

- Coursera: AI for Medicine Specialization (offered by DeepLearning.AI) **https://www.coursera.org/specializations/ai-for-medicine**
- HarvardX: Data Science in Healthcare (edX) **https://online-learning.harvard.edu/course/data-science-healthcare**

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23MRIOT6	IoT LAB	L	T	P	C
		-	-	3	1.5

PRE-REQUISITES: **Nil.**

COURSE EDUCATIONAL OBJECTIVES:

- To introduce components such as WiFi, Bluetooth, Temperature, Moisture sensors
- To know the Micro controller such as Arduino
- To know the System on Chip (SOC) / Single Board Computer such as Raspberry Pi
- To understand HTTP IoT protocols and perform Experiments for data transmission
- To understand UAV/Drones and Internet of Drones Experiments

Course Outcomes:

- Know the various IoT sensors and understand the functionality
- Design and analyzeIoT experiments and transfer the data to IoT Clouds
- Design the IoT systems for real time applications
- Understand Drones and Perform Internet of Drones Experiments

Experiments:

Experiments using ESP32
1. Serial Monitor, LED, Servo Motor - Controlling
Experiment1: Controlling actuators through Serial Monitor. Creating different ledpatterns and controlling them using push button switches. Controlling servo motor with the help of joystick.

2. Distance Measurement of an object
Experiment 2: Calculatethe distance to an object with the help of an ultrasonic sensor and display it on an LCD.

3, **LDR Sensor, Alarm and temperature, humidity measurement**
Experiment 3:

- Controlling relay state based on ambient light levels using LDR sensor.
- Basic Burglar alarm security system with the help of PIR sensor and buzzer.
- Displaying humidity and temperature values on LCD

4. Experiments using Raspberry Pi
Experiment 4:

- Controlling relay state based on input from IR sensors
- Interfacing stepper motor with R-Pi
- Advanced burglar alarm security system with the help of PIR sensor, buzzer and keypad. (Alarm gets disabled if correct keypad password is entered)
- Automated LED light control based on input from PIR (to detect if people are present) and LDR(ambient light level)

5. IOT Framework
Experiment 5: Upload humidity & temperature data to ThingSpeak, periodically logging ambient light level to ThingSpeak
Experiment 6: Controlling LEDs, relay & buzzer using Blynk app

6. HTTP Based
Experiment 7: Introduction to HTTP. Hosting a basic server from the ESP32 to control various digital based actuators (led, buzzer, relay) from a simple web page.

Experiment 8:Displaying various sensor readings on a simple web page hosted on the ESP32.

7. MQTT Based

Experiment 9:Controlling LEDs/Motors from an Android/Web app, Controlling AC Appliances from an android/web app with the help of relay.

Experiment 10:
Displaying humidity and temperature data on a web-based application

8. UAV/Drone:

Experiment 11:

- Demonstration of UAV elements, Flight Controller
- Mission Planner flight planning design

Experiment 12:

- Python program to read GPS coordinates from Flight Controller

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23MRIOT7	CLOUD COMPUTING LAB	L	T	P	C
		-	-	3	1.5

PRE-REQUISITES: Nil.

COURSE EDUCATIONAL OBJECTIVES:

- Demonstrate application development using Cloud
- Explain features of Hadoop

COURSE OUTCOMES (CO):

On completion of this course, the students will be able to:

- Configure various virtualization tools such as Virtual Box, VMware workstation.
- Design and deploy a web application in a PaaS environment.
- Learn how to simulate a cloud environment to implement new schedulers.
- Install and use a generic cloud environment that can be used as a private cloud.
- Manipulate large data sets in a parallel environment.

Experiments:

1. Install VirtualBox/VMware Workstation with different flavours of Linux or windows OS on top of windows operating systems.
2. Install a C compiler in the virtual machine created using virtual box and execute Simple Programs
3. Install Google App Engine. Create hello world app and other simple web applications using python/java.
4. Use GAE launcher to launch the web applications.
5. Simulate a cloud scenario using CloudSim and run a scheduling algorithm that is not present in CloudSim.
6. Find a procedure to transfer the files from one virtual machine to another virtual machine.
7. Find a procedure to launch virtual machine using try stack (Online Open stack Demo Version)
8. Install Hadoop single node cluster and run simple applications like wordcount
9. Establish an AWS account. Use the AWS Management Console to launch an EC2 instance and connect to it.
10. Develop a Guestbook Application using Google App Engine
11. Develop a Serverless Web App using AWS
12. Design a Content Recommendation system using AWS
13. Design a Cloud based smart traffic management system
14. Design Cloud based attendance management system
15. Design E-learning cloud-based system
16. Using Amazon Lexbuild a Chatbot

References:

- https://www.vmware.com/products/workstation-pro/workstation-pro evaluation.html.
- http://code.google.com/appengine/downloads.html
- http://code.google.com/appengine/downloads.html

Online Learning Resources/Virtual Labs:

Google Cloud Computing Foundations Cour