Mark McDonald

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COURSE SUMMARY

Harvard University
Degree: Masters in Software Engineering – Studies in Extension
Certificate: Data Science
Final GPA: 4.0

Software Engineering Capstone (CSCI 599)
Final Grade: A
Final course of graduate work for degree including a large team project and including presentation of advanced topics in Software engineering

- Completed large project supporting European Union reporting for Green Deal initiatives focused on climate
- Team of 6 class members created web-based application that interfaced with real-time climate data providing EU leadership with current climate trends compared to EU climate targets.

Advanced Topics in Data Science (CSCI E109b)
Final Grade: A
Advanced Topics in Data Science / Machine Learning and Deep Learning

- Splines, Smoothers and Generalized Additive Models
- Unsupervised Learning/Clustering: K-Means / DBSCAN
- Bayesian Statics Models (PyGAM) / Markov Chain Monte Carlo
- Transfer Learning
- Convolutional Neural Networks (CNN)
- Recurrent Neural Networks (RNN)
- Long Short-Term Memory (LSTM)
- Autoencoders
- Generative Adversarial Networks (GAN)
- Basic Reinforcement Learning Concepts

Intro to Data Science (CSCI E109a)
Final Grade: A
Survey of current data science concepts

- ML and Data Management Libraries: Pandas, Keras, Numpy, Scikit-learn, Matplotlib, Seaborn, Beautiful Soup

- Linear Machine Learning Models
- k-NN Models, Non-Parametric Trees and Forests and Logistic Regression
- Principal Component Analysis
- Feed Forward Neural Networks
- Intro to Convolutional Neural Networks (CNN)

Image Processing and Computer Vision (CSCI E25)
Final Grade: A
Building deep learning models using computer vision

- Image Creation and Processing
- Fitting Algorithms
- Hough Transformation
- Multiple View Geometry
- Image Classification
- Deep CNNs
- Object Segmentation and Semantic Segmentation

Autonomous Vehicles and Robotics (DGMD 17)
Final Grade: A
Exploration of robotics and deep learning with autonomous model cars

- Autonomous robotic fundamentals (DuckieTown model)
- Raspberry Pi, Python, Docker
- Robotic Operating System – ROS
- ROS Networking
- Docker Networking
- Projects: RasPi Network

Micrososervices with Java / SpringBoot / Docker (CSCI E57a)
Final Grade: A
Implementation of a REST-based microservice system emphasizing and best-practices microservice design patterns

- Java, Spring and SpringBoot, Spring Cloud
- Amazon Web Services (AWS)
- Docker
- REST-based service design
- Patterns:
- Configuration Server (Spring Cloud)
- Service Discovery (Eureka)
- Resiliency (Netflix Hystrix)

- Service Routing (Zuul)
- Distributed Tracing (Papertrail, Logspout)

Deep Learning (CSCI E89)
Final Grade: A
Introduction to deep learning concepts with emphasis on computer vision and CNN's. Final project is an implementation of a CNN model that identifies navigable paths in an off-road landscape.

- Tensorflow, Keras
- Feedforward Neural Networks
- Back-Propagation
- Image Classification – Convolutional Neural Network (CNN)
- Regularization, Loss Functions
- Feature Map Visualization
- Recurrent Neural Networks (RNN) / Sequencing
- Natural Language Processing (NLP) – Word2Vec
- Autoencoders
- Reinforcement Learning
- Generative Adversarial Networks (GAN)
- Projects: Pathfinder (off-road path navigation)

Software Design: Principles, Models, and Patterns (CSCI E97)
Final Grade: A
Application of Agile methods for software design with an emphasis on the benefits of proper up-front design.

- Requirements analysis, Planning, Design, Documentation and Development
- Java-Based
- Agile Design First Development
- UML
- Scalability, Availability, Resilience
- Modularity, Loose Coupling, Abstraction and Separation of Concerns
- Service Oriented Architecture
- Programming to Interface
- Dependency Inversion
- Software Patterns (Singleton, Observer, Iterator, Composite, Factory, Command, Adapter, Bridge, Decorator, Façade, Proxy, Mediator, State, Strategy, Visitor)
- Microservices

- Projects: Automated Home

Hardware, Software, Networks, Security, and Management (CSCI E45a)
Final Grade: A
An exploration of the modern World of computing including not only, how the basic structures work and fit together, but also aspects of personal security, laws and governmental involvement.

- Fundamentals of Networking, Infrastructure and Computing Devices
- Fundamentals of Software Design
- History of the Internet
- Internet Protocols (IP, TCP, UDP)
- Routing
- Security
- Internet Regulation and Governance
- Data Privacy

Web Programming / Python / JavaScript / Flask / Django (CSCI E33a)
Final Grade: A
Broad focus on current web technologies and development strategies

- Git
- HTML, CSS
- JavaScript and Python Web Development
- Flask / Django Web Servers
- Web Page Templating
- Bootstrap
- Heroku
- Postgres
- SQL, SQLAlchemy
- Using APIs
- Continuous Integration Concepts (CI)
- Projects: Chatterbox Messaging App, Pizza Shop Ordering, GPS Route Sharing

Unix Systems Programming / C (CSCI E28)
Final Grade: A
Advanced concepts in Unix programming with a focus on the core structure of Unix and building custom Unix functionality

- Unix and C Programming
- Devices and I/O – Buffered I/O, Files, Devices and Drivers

- Multi-Tasking – Signals, Timers, Polling
- Shell Programming / Scripting
- Network Programming – Sockets, Servers, Clients
- Concurrent Programming
- Projects: Pong Video Game, Web Server, Shell, File Compression

Discrete Mathematics (CSCI E20)
Final Grade: A
Fundamentals in discrete mathematics for software engineering

- Sets and Functions
- Formal Logic
- Graphs and digraphs
- Probability and Counting
- Growth Rates and Order Notation

Java Distributed Programming / Maven /Hadoop (CSCI E55)
Final Grade: A
Intermediate Java Programming with introducing testing, logging, concise functions and distributed computing

- Java Programming
- Junit Testing and Log4J Logging
- Threads and Thread Management
- Maven Dependency Management, MapReduce and Hadoop
- Java Streams and Lambda Expressions

Into Quantitative Methods (STAT 100)
Final Grade: A
Introductory statistics with a focus on use of R

- R-based statistical analysis
- Sampling and Distribution
- Probability and Conditional Probability
- Expected Value
- Covariance and Correlation
- Binomial, Uniform and Normal Distributions
- Confidence Intervals
- P-value
- Hypothesis Testing
- Linear Regression