

# High Level Design Document

## AI Course

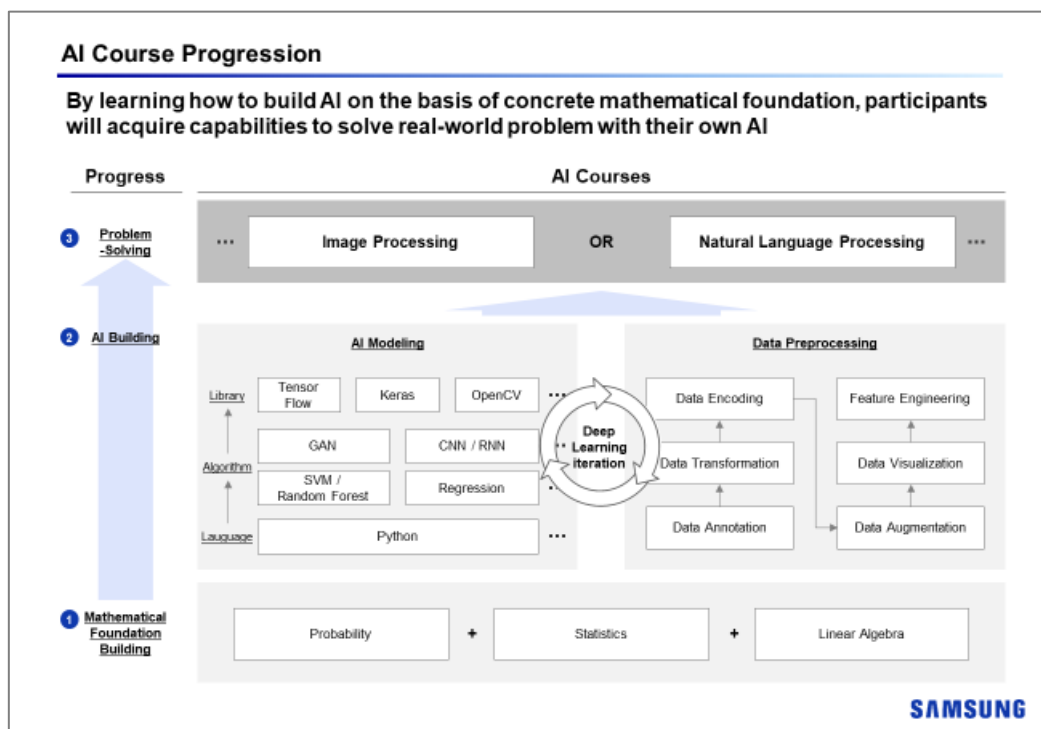
Version	Change Details	Date
1.0	Initial document (complete version)	12-18-2019
1.1	Chapter updated	1-06-2020

## Course Brief

Topic	AI (Artificial Intelligence) Course
Course Schedule	<ul style="list-style-type: none"> <li>▪ E-learning format: 12-13 weeks (total 240 hours total synchronous and asynchronous learning)               <ul style="list-style-type: none"> <li>- Online Lecture &amp; Exercise: 10 weeks</li> <li>- Capstone Project: 2 weeks (plus pitching week)</li> </ul> </li> </ul>
Learning Environment	<ul style="list-style-type: none"> <li>▪ Online Learning               <ul style="list-style-type: none"> <li>- e-learning platform for content delivery and virtual classroom,</li> <li>- slack for student support,</li> <li>- zoom for capstone pitching</li> </ul> </li> <li>▪ PC (students will have their own)               <ul style="list-style-type: none"> <li>- Minimum: Windows 8 + CPU i5 + RAM 8GB</li> <li>- Recommended: Windows 10 + CPU i7-8700 3.19 GHz + RAM 16GB + NVidia GPU 1660 Ti</li> </ul> </li> </ul>
Learning Objectives	<ul style="list-style-type: none"> <li>▪ Understand the basic concept of Probability, Statistics, and Linear Algebra that is fundamental to learn how to build AI</li> <li>▪ Understand the basic concept of Python and use Python to complete real-world coding exercises</li> <li>▪ Be able to implement AI (Machine Learning + Deep Learning) with related packages and learn its application to solve real-world problems</li> <li>▪ Understand the landscape of data science tools and their applications, and will be prepared to identify and dig into new technologies and algorithms needed for the job at hand</li> <li>▪ Have a fluid understanding of, and practical experience with, the process of designing, implementing, and communicating the results of an AI project</li> </ul>
Course Prerequisites	<ul style="list-style-type: none"> <li>▪ Coding Experience               <ul style="list-style-type: none"> <li>- Prior experiences in learning one of Object-oriented Language (e.g. Java, JavaScript, C++, etc.)</li> <li>- A basic level understanding of grammar in Object-oriented Language</li> </ul> </li> <li>▪ Basic Statistics               <ul style="list-style-type: none"> <li>- Understanding of probability and statistics fundamentals</li> <li>- A proper document certifies candidate's completion of relevant courses should be presented when a candidate submits an application form</li> </ul> </li> </ul>
Audience & Characteristics	<ul style="list-style-type: none"> <li>▪ Target               <ul style="list-style-type: none"> <li>- Youth (age 18~35), interested in pursuing a career in AI, who need the appropriate education for the career                   <ul style="list-style-type: none"> <li>■ Official Target for SIC program will follow the given characteristic.</li> </ul> </li> </ul> </li> </ul>

	<p>However, actual participants will mainly consist of undergraduate students in STEM major and a few graduate students within the given age range because secondary school graduates will barely meet prerequisites given above</p> <ul style="list-style-type: none"> <li>▪ Characteristics             <ul style="list-style-type: none"> <li>- Educational background: successfully completed high school level STEM courses or higher education</li> <li>- Level for understanding: possess basic knowledge in programming and statistics</li> <li>- Expectations: expects to obtain necessary knowledge and skills for entry-level job placement in AI field</li> </ul> </li> </ul>
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## Course Information

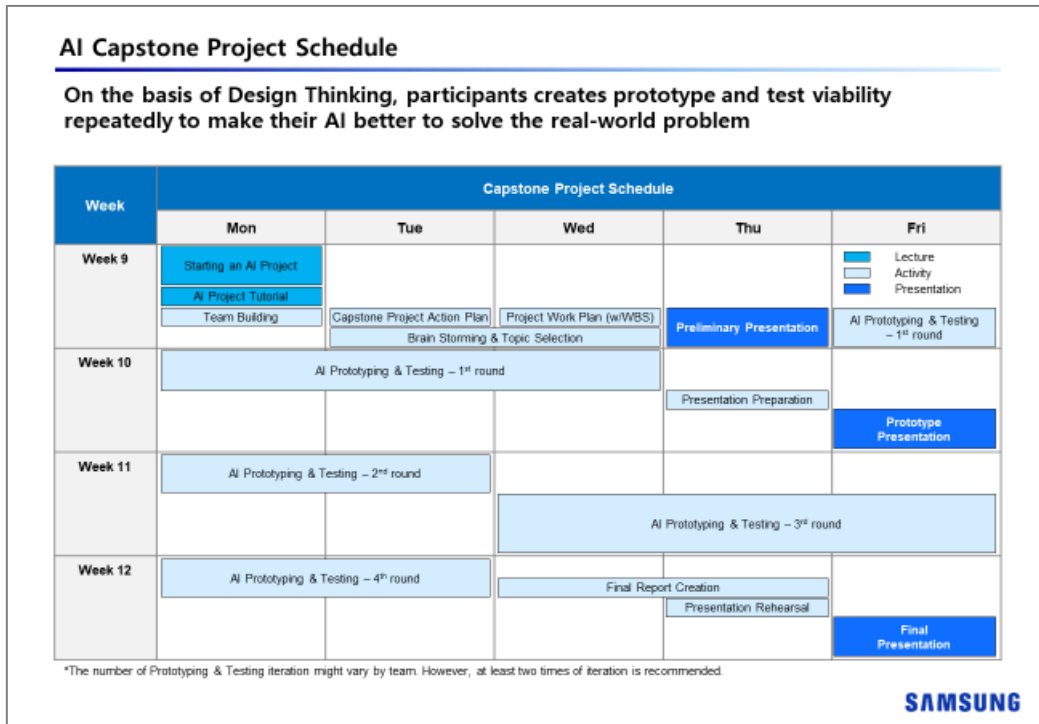


### ► Lecture and Exercise (2 months)

Course Contents	Duration
<b>Chapter 1. Introduction to Artificial Intelligence</b>	-
- Unit 1. The Concept of Artificial Intelligence	
- Unit 2. Applications of Artificial Intelligence	

- Unit 3. Trends in Artificial Intelligence	
- Unit 4. Course Roadmap	
<b>Chapter 2. Python Programming</b>	<b>24H (total)</b>
- Unit 1. Python I	3.5H
- Unit 2. Python II	4.5H
- Unit 3. Python III	4H
- Unit 4. Python IV	4H
- Unit 5. Python V	5.5H
- Quiz	2.5H
<b>Chapter 3. Python Libraries</b>	<b>22H (total)</b>
- Unit 1. NumPy Package	5.5H
- Unit 2. Pandas Package	8.5H
- Unit 3. Visualization	5.5H
- Quiz	2.5H
<b>Chapter 5. Machine Learning – Part I</b>	<b>16H (total)</b>
- Unit 1. Data Preprocessing	1.5H
- Unit 2. Unsupervised Learning	5H
- Unit 3. Regression	6.5H
- Quiz	3H
<b>Chapter 6. Machine Learning – Part II</b>	<b>17H (total)</b>
- Unit 4. Classification Prediction (Basic)	6H
- Unit 5. Classification Prediction (Advanced)	5.5H
- Quiz	5.5H
<b>Chapter 7. Machine Learning – Part III</b>	<b>21H (total)</b>
- Unit 6. Natural Language Processing	14H
- Unit 7. Image Processing	5.5H
- Quiz	1.5H
<b>Chapter 8. Deep Learning – Part I</b>	<b>18H (total)</b>

- Unit 1. Introduction to Deep Learning	9H
- Unit 2. Deep Learning Various Topics	7H
- Quiz	2H
<b>Chapter 9. Deep Learning – Part II</b>	<b>16H</b>
	<b>(total)</b>
- Unit 3. Deep Learning with Keras	14H
- Quiz	2H



► **Capstone Project (1 month)**

Course Contents	Duration
<b>Chapter 10. Starting an AI Project</b>	<b>3H (total)</b>
- Project Preparation	0.5H
- Design Thinking	2.5H
<b>Chapter 11. AI Capstone Project Tutorial</b>	<b>2H (total)</b>
- Using a Ready-Made CNN Model.	1H
- AI Application Cases.	1H
※ During the capstone project, student's project activities take more time than lecture itself. Please expect up to 80 hours to complete the whole project	<b>75H</b>

**Weekly Agenda**

Time	~ 2 months	1 month
1.5 hours	▪ Theory Lecture Weekly	▪ Theory
1.5 Hours	▪ Practice and Problem Solving Lecture weekly	▪ Practice

1.5 Hours	▪ Student Quiz	▪ Testing
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**Plus – take home weekly exercises which the students spend can spent 2+ hours per week doing depending on their personal learning.**

**When we begin Capstone – the students will be developing their projects and attending:**

1. Ideation sessions to discuss their capstone ideas
2. Practice sessions to practice their project pitches
3. Final Capstone Pitch

### Assessment

Criteria	Weight
<b>Quiz</b> <ul style="list-style-type: none"> <li>- Quiz will be placed at the end of each chapter</li> <li>- Approximately 5 ~ 10 questions per quiz</li> </ul>	40 %
<b>Capstone Project</b> <ul style="list-style-type: none"> <li>- Project is measured based on the quality of final product, presentation and teamwork</li> </ul>	60 %
<b>Participation</b> <ul style="list-style-type: none"> <li>- Participation is measured by the instructor throughout the course</li> </ul>	+α
<b>Total</b>	<b>100%</b>

### Certification

Qualification	Cut-off Rate
1. Attendance higher than	90 %
2. Total grade for assessment higher than	50 %
▶ Certified when both qualifications are met	-

## Course Details

Chapter	Details	Duration
1	<b>Chapter 1. Introduction to AI</b>	-
	<i>Objective: Get to know what AI is about, its concept, and trends. Then learn overall roadmap of the AI course</i>	
	Unit 1. The Concept of Artificial Intelligence	
	Unit 2. Applications of Artificial Intelligence	
	Unit 3. Trends in Artificial Intelligence	
	Unit 4. Course Roadmap	
2	<b>Chapter 2. Python Programming</b>	<b>24H (Total)</b>
	<i>Objective: Get familiar with Jupyter notebook environment, learn how to apply Python programming for practical use, and learn how to implement basic level of task automation</i>	
	Unit 1. Python I <ul style="list-style-type: none"> <li>About Python Programming Language</li> <li>Jupyter Notebook</li> </ul>	3.5H
	Unit 2. Python II <ul style="list-style-type: none"> <li>Basic Data Types (int, float, bool, str)</li> <li>Composite Data Types (list, tuple, dictionary, set)</li> <li>Mutable and Immutable Data Types</li> </ul>	4.5H
	Unit 3. Python III <ul style="list-style-type: none"> <li>Control Structures (if-else-elseif, for, while).</li> <li>File I/O, Object Oriented Programming,</li> <li>Modules, Exception Handling</li> </ul>	4H
	Unit 4. Python IV <ul style="list-style-type: none"> <li>Binary Search, Palindrome, Stack and Queue Data Structure, etc.</li> </ul>	4H
	Unit 5. Python V <ul style="list-style-type: none"> <li>Handling/Controlling/Extracting Data from Excel, Word, PDF documents</li> </ul>	5.5H
	Quiz	2.5H
	3	<b>Chapter 3. Python Libraries</b>
<i>Objective: Acquire detailed knowledge regarding application of Numpy and Pandas package that are essential for implementing AI. Be capable of generating insight through data wrangling and data visualization, and of conducting exploratory data analysis</i>		
Unit 1. NumPy Package <ul style="list-style-type: none"> <li>Array, Vector, Matrix, Simple Linear Algebra</li> </ul>		5.5H
Unit 2. Pandas Package		8.5H



	<ul style="list-style-type: none"> <li>Series, DataFrame, Data Retrieval and Query</li> <li>Data Summarization, Aggregation, Pivoting</li> <li>Data Wrangling Methods</li> </ul>	
	Unit 3. Visualization <ul style="list-style-type: none"> <li>Visualization using Matplotlib and Pandas</li> <li>Visualization using Seaborn</li> </ul> Exploratory Data Analysis	5.5H
	Quiz	2.5H
5	<b>Chapter 5. Machine Learning – Part I</b>	<b>16H (Total)</b>
	<i>Objective: Be capable of conducting data analysis by using Cluster Analysis and Linear Regression</i>	
	Unit 1. Data Preprocessing <ul style="list-style-type: none"> <li>Machine learning with Scikit-Learn</li> <li>Pre-processing. Feature Engineering</li> </ul>	1.5H
	Unit 2. Unsupervised Learning <ul style="list-style-type: none"> <li>Unsupervised Learning with Scikit Learn, DBSCAN</li> <li>Clustering, PCA, Dimensional Reduction</li> </ul>	5H
	Unit 3. Regression <ul style="list-style-type: none"> <li>Linear Regression: Train, Predict and Evaluate</li> <li>Linear Regression: Modeling, Dummy Variables, Interactions</li> <li>Regularization methods: Lasso and Ridge</li> <li>Polynomial and Poisson Regression</li> </ul>	6.5H
	Quiz	3H
6	<b>Chapter 7. Machine Learning – Part II</b>	<b>17H (Total)</b>
	<i>Objective: Be capable of conductin data analysis by using Classification Prediction</i>	
	Unit 4. Classification Prediction (Basic) <ul style="list-style-type: none"> <li>Logistic Regression, Naïve Bayes, KNN, SVM, Statsmodels</li> </ul>	6H
	Unit 5. Classification Prediction (Advanced) <ul style="list-style-type: none"> <li>Ensemble Algorithms: Tree, Random Forest, Ada Boost, XGBoost (optional).</li> </ul>	5.5H
	Quiz	5.5H
7	<b>Chapter 7. Machine Learning – Part III</b>	<b>21H (Total)</b>
	<i>Objective: Understand basic Text mining and learn how to train machine to understand natural language via Supervised and Unsupervised learning and I earn how to conduct Image Processing with OpenCV package.</i>	
	Unit 6. Natural Language Processing <ul style="list-style-type: none"> <li>Pre-Processing Text Data. Extracting Insight from Text Data</li> <li>Stemming, Lemmatization, POS, Stopwords</li> </ul>	14H

	<ul style="list-style-type: none"> <li>N-Gram, BOW, TF-IDF, Word2Vec Models</li> <li>Matrix Decomposition. Topic Modeling: LSA, LDA</li> <li>Classification with Natural Language Models</li> </ul>	
	Unit 7. Image Processing <ul style="list-style-type: none"> <li>Pixel Manipulation, Filtering, Blurring, Dilation, Erosion</li> <li>Thresholding, Contour Detection, Edge Detection, Feature Detection</li> </ul>	5.5H
	Quiz	1.5H
8	<b>Chapter 8. Deep Learning – Part I</b>	<b>18H (Total)</b>
	<i>Objective: Be capable of implementing a variety of deep learning models by using TensorFlow deep learning package</i>	
	Unit 1. Introduction to Deep Learning <ul style="list-style-type: none"> <li>Manipulating Tensors with TensorFlow</li> <li>Single Layer Neural Networks for Regression and Classification</li> <li>Multilayer Neural Networks. Forward and Back Propagation.</li> <li>Batch Training. Weight Initialization</li> </ul>	9H
	Unit 2. Deep Learning Various Topics. <ul style="list-style-type: none"> <li>Convolution, Pooling, Dropout, Regularization</li> <li>Convolution Network Applied to Image Classification</li> <li>RNN/LSTM</li> <li>Explore GAN. AutoEncoder for Dimensional Reduction</li> </ul>	7H
	Quiz	2H
9	<b>Chapter 9. Deep Learning – Part II</b>	<b>16H (Total)</b>
	<i>Objective: Acquire essential skill sets to independently explore and implement deep learning with Keras package</i>	
	Unit 1. Deep Learning with Keras. <ul style="list-style-type: none"> <li>Sequential Model. Compilation. Training and Evaluation</li> <li>Keras Layers. Batch Training</li> </ul>	14H
	Quiz	2H