Module 4 - Building software applications using AI

FAAI:

The Future is In Applied Artificial Intelligence

UCM team

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Building software applications using AI

- **Identify the problem**: Begin by clearly defining the problem that the AI app aims to solve.
- **Language selection for AI**: Decide on the programming language that best supports the chosen algorithms and provides necessary libraries and frameworks for AI development
- **Platform selection**: Choose the appropriate platform or framework to build and deploy the AI app, considering factors such as scalability, performance, and compatibility.
- **Data preparation**: Collect and organize the relevant data required for training and testing the AI algorithms
- **Algorithm selection**: Choose the most suitable algorithm or a combination of algorithms based on the problem and available data.
- **Algorithm training**: Train the selected algorithms using the prepared data to enable them to learn patterns and make accurate predictions or decisions.
- **Final development**: Develop the AI application by implementing the chosen algorithms, integrating with necessary components, and designing a user-friendly interface.
- **Testing, deployment, and monitoring**: Thoroughly test the AI app to ensure its functionality and accuracy. Deploy the application to the desired environment and set up monitoring mechanisms to track its performance and make improvements if needed.

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Learning Materials Theory

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Step 1: Problem Identification

- The initial step in building an AI app involves identifying the problem you aim to solve. Consider the specific functions and processes of the app where AI technology will be utilized. Determine the expected outcomes and benefits of implementing AI. Once you have a clear understanding of the problem and your idea, you can proceed to define the product requirements. This analysis will help you understand the purpose of the app and guide your search for suitable technologies and tools.

During the planning stage, it is important to:

- Determine the composition of your technical and non-technical team, including roles such as project managers, business analysts, data engineers, and backend programmers.
- Collaborate with professionals to establish a work schedule.
- Begin exploring the data needed to develop an AI/ML model.

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Step 2: Choosing the best language for AI

- A clear set of requirements is essential for building an AI solution. It also requires the right choice of technologies and AI programming language that will make it possible to help create intuitive AI systems offering users a robust experience. There are many programming languages available, each with its strengths and weaknesses. Depending on your specific needs, you need to select the specific programming language for your AI project. While some AI programming languages are great at processing large amounts of data and crunching huge numbers, others excel at natural language programming. You can determine which language is best suited for your project by understanding the strengths and limitations of each language. Here are some of the most popular programming languages to consider when building an AI app.
- Python
- Java
- C++
- R
- Prolog
- Lisp
- Haskell
- Smalltalk
- Rust

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Step 3: Platform selection

- While creating an AI app, we often use a wide variety of frameworks and APIs to create smart AI algorithms easily. These frameworks and APIs come with in-built features of deep learning, neural networks and NLP applications. Almost all major cloud platforms for AI provide these AI platforms and APIs, which make it easy to implement ready-made solutions for speech, image and language recognition, as well as provide high-level abstractions of complex machine-learning algorithms. These are the main factors that influence your choice of APIs and platform for AI:
- Selecting your preferred cloud, e.g., a hybrid cloud.
- Data storage location and ownership details.
- The selected language limitations.
- Availability of APIs in a particular region.
- Cost of AI development life-cycle.

Frameworks	Keras, PyTorch, Scikit-learn, CNTK, AML, Core ML/Create ML, Caffe2, SparkMLlib, etc.
API and SDKs	Google Vision, Azure Topic Detection, Microsft Face, SiriKit, etc
AI and ML platforms	Google TensorFlow, Microsoft Azure, Amazon Machine Learning, IBM Watson, Oracle AI cloud, etc.

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Step 4: Preparation of data

AI-powered apps are data-driven and typically require large amounts of data in order to function. However, prior to applying the data, it must be collected and prepared appropriately to create an accurate data model. AI labeling team of professionals specialized in AI, and ML-based software solutions can label the collected data. These software engineers carefully study the input information and sources to prepare the data for further use. They often use the Cross-Industry Standard Process for Data Mining (CRISP-DM).

The next step involves verifying the input data for any errors, missing values or incorrect labels and then preparing the data, which includes the following steps:

- Uploading and selecting raw data
- Selecting annotation tools
- Labeling and highlighting the data
- Processed data selection and saving in a file

Using the collected data, you can compare the solutions and move on to the modeling phase. The data previously collected is used to train the ML model via different method

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Step 5: Choosing an algorithm

There are two main types of learning: supervised and unsupervised learning.

Supervised learning involves providing the machine with a dataset on which it trains itself to provide the desired results on a test dataset. Several supervised learning algorithms are available, such as

- Deep Neural Networks
- SVM (Support Vector Machine),
- Logistic Regression,
- Random Forest Generation, and
- Naive Bayes Classification. These algorithms can be used for classification tasks, such as determining the likelihood of a loan defaulting, or for regression tasks, such as determining the amount that might be lost if a loan defaults.

Unsupervised learning does not provide the machine with a labeled dataset. Instead, unsupervised learning algorithms are used for clustering, where the algorithm tries to group similar things; association, where it finds links between objects; and dimensionality reduction, where it reduces the number of variables to decrease noise.

Clustering (K-means, hierarchical, probabilistic – Gaussian mixture)

Association rules (Apriori algorithms)

Dimensionality reduction (Principal component analzsis)

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Step 6: Training the algorithms

Training an algorithm after selecting it is critical to verify its accuracy. Although you can not set any standard metrics or threshold to ensure model accuracy, it is important to ensure that the algorithm works within the chosen framework through training and retraining until it achieves the desired accuracy. As an AI system is data-centric, its efficiency depends solely on the data performance. So, the data is expected to be diverse enough to make the model perform as expected. So, investing time and resources into training the algorithm is beneficial and a mandatory step. This, in turn, will result in increased efficiency, cost savings, as well as a competitive advantage.

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Step 7: Final development

As mentioned above, creating an AI-driven software application is similar to other software development, except for CRISP-DM. The following steps are integral parts of AI development:

- Architecture design of the solution
- Design of the user interface
- Frontend and backend creation

Also, during development, you can optimize performance, expand functionality, and adapt the product for updates.

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Step 8: Testing, Deployment and Monitoring

Once the development stage is over, you must test the product with the help of QA engineers. They can use automated, manual or mixed tools. You can deliver the app only if it has been thoroughly tested and functions as expected. Once the testing is done, the product must be deployed to the production server. Post-deployment, the support team offers regular maintenance to your solution in order to prevent data drift. AI maintenance is unique in that it requires continuous data and concept updates. This will ensure that your algorithm accuracy does not suffer any degradation, including regular updates like security patches and version changes..

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Question for you all

Description of 3 real cases (freely accessible) as examples.

Deeply study one of the real cases from 2.

Which ones do you consider best?

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Module 9 - AI-based solutions for SmartCity

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AI-based solutions for SmartCity

1: Introduction to Smart Cities and AI (Definition and characteristics of smart cities, Role of AI in smart city development, Case studies of AI applications in smart cities

2: Data Analytics and IoT for Smart Cities (Introduction to data analytics and its role in smart cities, IoT technologies and their integration with AI in smart cities, Data collection, processing, and visualization for smart city applications)

3: Machine Learning for Smart City Solutions (Supervised, unsupervised, and reinforcement learning in smart cities, Predictive analytics and anomaly detection for smart city systems)

4: Deep Learning and Computer Vision for Smart Cities (Computer vision techniques for smart city applications, Image and video analysis for smart city surveillance, traffic management, etc.)

5: Natural Language Processing for Smart City Services (Text mining and sentiment analysis for smart city services, Chatbots and virtual assistants for smart city interactions)

6: Intelligent Transportation Systems (AI-based traffic management and optimization, Vehicle routing and congestion control using AI, Smart parking solutions and traffic flow prediction)

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AI-based solutions for SmartCity 2

7: Energy Management and Sustainability (AI applications in energy management for smart cities, Predictive energy analytics and optimization, Renewable energy integration and demand response systems)

8: Urban Planning and Infrastructure Management (AI-driven urban planning and development, Infrastructure monitoring and maintenance using AI, Smart waste management and environmental monitoring)

9: Safety, Security, and Emergency Response (AI-based video surveillance and threat detection, Intelligent emergency response systems,Crime prediction and prevention in smart cities)

10: Citizen Engagement and Social Services (AI-driven citizen engagement platforms, AI for personalized social services in smart cities, Ethical considerations and privacy concerns in citizen-centric AI applications)

11: Case Studies and Real-World Projects (Analysis of successful AI-based smart city projects, Group discussions and presentations on real-world case studies, Identification and design of AI-based smart city solutions)

12: Project Implementation and Evaluation (Hands-on project development based on a smart city challenge, Implementation and evaluation of AI-based smart city solutions, Final project presentations and feedback)

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Question for you all

Description of real cases (freely accessible) as examples

- **UrbanFootprint** (Berkeley, California, USA): UrbanFootprint is a cloud-based software that helps cities plan for growth and sustainability. It is used by city planners and policy makers to understand the potential impact of various scenarios on aspects such as traffic congestion, carbon emissions, and housing affordability.
- Reference: UrbanFootprint
- **FIWARE** (Various Cities, Europe): FIWARE is an open-source platform that provides a simple yet powerful set of APIs (Application Programming Interfaces) that ease the development of Smart Applications in multiple vertical sectors. It's being used in various cities across Europe and beyond to power their smart city initiatives.
- Reference: FIWARE
- **CitySourced** (Various Cities, Worldwide): CitySourced provides a mobile engagement platform for local governments, allowing citizens to report civic issues such as public works, quality of life, and environmental issues.
- Reference: CitySourced

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Question for you all

Description of real cases (freely accessible) as examples

- **ShotSpotter** (Various Cities, USA): ShotSpotter is a gunfire detection system that uses sensor-based technology to detect, locate, and alert law enforcement agencies of illegal gunfire incidents in real time.
- Reference: ShotSpotter
- **One Concern** (Various Cities, Worldwide): One Concern uses AI to predict the impact of natural disasters, helping cities prepare for and respond to these events. The platform models potential earthquake, flood, and fire scenarios to help city leaders make informed decisions about infrastructure and emergency planning.
- Reference: One Concern
- **Wiffinity** (Various Cities, Spain): Wiffinity is a mobile app that provides access to a constantly updated database of public and semi-public Wi-Fi hotspots, helping users stay connected as they travel around a city.
- Reference: Wiffinity

Deeply study one of the real cases from 2.

Which ones do you consider best?

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Thank you for attention!

Question??

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