# Artificial Intelligence

Candidates for this certification have a foundational knowledge the procedures used to develop an artificial intelligence (AI) solution, as well as an understanding of the issues surrounding the governance, transparency, security, and ethics of AI. Successful candidates will be able to analyze and classify a problem. They should be able to demonstrate knowledge of data collection, data processing, and feature engineering strategies.

Candidates should be able to choose an appropriate algorithm for training a model, and understand the metrics used to evaluate model performance. They should understand the AI development lifecycle and how a production pipeline is used to allow for continuous improvement. Candidates at least 150 hours of instruction and/or exploration of artificial intelligence methodology and solutions.

## 1. AI Problem Definition

### 1.1 Identify the problem you are trying to solve using AI (e.g., user segmentation, improving customer service)

- Identify the user persona – who is the solution for?
- Identify the need that will be addressed by the solution
- Consider input and output requirements and constraints of the solution
- Determine whether AI is called for
- Identify whether interaction between AI and humans is required
- Consider advantages and disadvantages of using AI in the situation
- Define measurable success
- Benchmark against domain or organization-specific risks to which the project may be susceptible

### 1.2 Identify the areas of expertise and resource requirements needed to solve the problem

- Identify business expertise required
- Identify the need for domain (subject-matter) expertise on the problem
- Identify AI expertise needed
- Identify implementation expertise needed
- Assess whether the problem is solvable with available computing resources
- Consider the budget of the project and the resources that are available

### 1.3 Classify the problem (e.g., regression, unsupervised learning)

- Examine available data
- Determine problem type (e.g., classification, regression, unsupervised, reinforcement)
- Recognize when a pre-trained model is appropriate, if you can fine-tune an existing model, or if you need to train the model from scratch
- Conduct feasibility analysis to determine whether it can be realistically modeled

### 1.4 Plan for AI to be used responsibly

- Identify potential ways that the AI can mispredict and harm specific user groups
- Set guidelines for data gathering and use



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- Set guidelines for algorithm selection based on user requirements
- Consider how the user of the solution can interpret the results
- Consider out-of-context use of AI results

### 1.5 Choose transparency and validation activities

- Communicate the intended purpose of data collection
- Decide who should see the results
- Review legal requirements specific to the industry with the problem being solved
- Describe explainability methods for communicating AI decisions to stakeholders

## 2. Data Collection and Transformation

### 2.1 Identify data sources and requirements

- Determine type/characteristics of data needed
- Decide if there is an existing dataset or if you need to generate your own
- Choose data collection methods
- When generating your own dataset, decide whether collection can be automated or requires user input

### 2.2 Assess data quality

- Identify missing or corrupt data elements
- Examine collection techniques for potential sources of bias
- Make sure the amount and variety of data is enough to build an unbiased model
- Assess the quality of the annotation

### 2.3 Convert data into suitable formats (e.g., numerical, image, time series)

- Convert data to binary (e.g., images become pixels)
- Convert computer data into features suitable for AI (e.g., sentences become tokens)
- Annotate the data if necessary

## 3. Feature Engineering

### 3.1 Select features for the AI model

- Determine which data features to include
- Build initial feature vectors for test/train dataset
- Consult with subject-matter experts to confirm feature selection

### 3.2 Engage in feature engineering

- Review features and determine what standard transformations are needed
- Create processed datasets
- Identify whether transformations have been applied correctly

### 3.3 Identify training and test datasets

- Separate available data into training and test datasets
- Ensure test dataset is representative



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### 3.4 Document data decisions

- List assumptions, predicates, and constraints upon which design choices have been reasoned
- Make this information available to regulators and end users who demand deep transparency
- Identify situations in which particular types of documentation are relevant

## 4. AI Algorithms and Models

### 4.1 Consider applicability of specific algorithms

- Evaluate AI algorithm families:
  - *Supervised learning*
  - *Unsupervised learning*
  - *Reinforcement learning*
  - *Natural language processing (NLP)*
  - *Regression*
- Decide which algorithms are suitable, e.g., neural network, decision tree, k means

### 4.2 Train a model using the selected algorithms

- Train model using an algorithm with starting parameters
- Tune the model by changing parameters
- Identify performance metrics for the model
- Determine whether additional iterations are required

### 4.3 Evaluate model accuracy, precision, and sensitivity

- Check for overfitting, underfitting
- Generate metrics or KPIs (accuracy, precision, recall, F1 score, etc.)
- Introduce new test data to cross-validate robustness, testing how model handles unforeseen data
- Interpret performance metrics (sensitivity, specificity, confusion matrix)
- Identify appropriate techniques to improve model performance

### 4.4 Identify potential sources of bias

- Verify that inputs resemble training data
- Confirm that training data do not contain irrelevant correlations we do not want the classifier to rely on
- Check for imbalances in data
- Guard against creating self-fulfilling prophecies based upon historical biases

### 4.5 Select specific model after experimentation

- Consider cost, speed, and other factors when evaluating models
- Determine whether the selected model meets explainability requirements

### 4.6 Tell data stories and obtain stakeholder approval

- Identify which visualization types will represent the data story most appropriately
- Where feasible, create visualizations of the results
- Look for trends
- Verify that visualizations are useful for making a decision
- Collect results and benchmark risks and hold sessions to evaluate the solution



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## 5. Application Integrity and Deployment

### 5.1 Design a production pipeline, including application integration

- Plan for continuous integration and deployment (CI/CD)
- Design a pipeline that integrates with existing data stores and connects to the application
- Build the connection between the AI and the application
- Test accuracy, robustness, and latency of AI through application
- Test application to fit the size of use case (e.g., in AI for mobile applications)

### 5.2 Identify potential challenges of models in production and plan for AI solution support

- Understand the types of challenges you are likely to encounter
- Understand the indicators of challenges
- Understand how each type of challenge could be mitigated
- Document the functions within the AI solution to allow for maintenance (updates, fixing bugs, handling edge cases)
- Train a support team
- Implement a feedback mechanism
- Implement drift detector
- Implement ways to gather new data

### 5.3 Build a security plan

- Consider internal access levels or permissions
- Consider infrastructure security
- Assess the risk of using a certain model or potential attack surfaces (e.g., adversarial attacks on real-time learning models)

### 5.4 Train customers on how to use product and what to expect from it

- Inform users of model limitations
- Inform users of intended model usage
- Share documentation
- Manage customer expectations

## 6. Maintaining and Monitoring AI in Production

### 6.1 Engage in oversight

- Log and monitor application and model performance to facilitate security, debug, accountability, and audit
- Act upon alerts
- Observe the system over time in a variety of contexts to check for drift or degraded modes of operation
- Detect ways the system fails to support new information
- Evaluate outputs according to thresholds defined in regulatory requirements

### 6.2 Assess business impact (key performance indicators)

- Track impact metrics to determine whether the solution has solved the problem
- Compare previous metrics with new metrics when changes are made
- Act on unexpected metrics by finding problems and fixing them



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### 6.3 Measure impacts on individuals and communities

- Identify impact on specific subgroups
- Identify and mitigate issues
- Identify opportunities for optimization

### 6.4 Handle feedback from users

- Measure user satisfaction
- Assess whether users are confused (e.g., do they understand what the AI is supposed to do for them?)
- Incorporate feedback into future versions

### 6.5 Evaluate operation on a regular basis

- Combine impact observations (e.g., business, community, technology trends) to assess AI value
- Decide whether to retrain AI, continue to use AI as-is, or to decommission AI



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