**ASSIGNMENT 2**

Q1. WHAT IS THE CONCEPT OF HUMAN LEARNING? PLEASE GIVE TWO EXAMPLES.

ANS. THE CONCEPT OF HUMAN LEARNING REFERES TO THE PROCESS BY WHICH INDIVIDUALS ACQUIRES KNOWLEDGE, SKILLS, ATTITUDES, OR BEHAVIOURS THROUGH EXPERIENCE, STUDY, OBSERVATION, AND PRACTICE. TWO EXAMPLES OF HUMAN LEARNING ARE LEARNING TO DRIVE MOTOR CAR AND LEARNING MUSIC.

Q2. WHAT DIFFERENT FORMS OF HUMAN LEARNING ARE THERE? ARE THERE ANY MACHINE LEARNING EQUIVALENTS?

ANS.DIFFERENT TYPES OF HUMAN LEARNING ARE EXPLICIT LEARNING, IMPLICIT LEARNING, EXPERIENTIAL LEARNING, SOCIAL LEARNING, COGNITIVE LEARNING AND METACOGNITIVE LEARNING. THERE ARE EQUIVALENT MACHINE LEANRNINGS ARE SUPERVISED, UNSUPERVISED LEARNING, REINFORCEMENT LEARNING, TRANSFER LEARNING, DEEP LEARNING, META LEARNING.

Q3. WHAT IS MACHINE LEARNING, AND HOW DOES IT WORK? WHAT ARE THE KEY RESPONSIBILITIES OF MACHINE LEARNING?

ANS. MACHINE LEARNING IS A SUBSET OF ARTIFICIAL INTELLIGENCE THAT FOCUSES ON DEVELOPINGALGORITHMS AND MODELS THAT ALLOW MACHINES TO LEARN FROM DATA AND MAKE PREDICTIONS AND DESCISIONS WITHOUT BEING EXPLICITLY PROGRAMMED. HERE IS THE OVERVIEW OF HOW MACHINE LEARNING WORKS.

1. DATA COLLECTION.
2. DATA PREROCESSING.
3. FEATURE EXTRACTION AND SELECTION.
4. MODEL SELECTION AND TRAINING.
5. MODEL EVALUATION AND VALIDATION.
6. MODEL DEPLOYMENT AND MONITORING.

KEY RESPONSIBILITIES OF MACHINE LEARNING

1. DATA PREPARATION.
2. FEATURE ENGINEERING.
3. MODEL SELECTION AND TRAINING.
4. EVALUATION AND VALIDATION.
5. DEPLOYMENT AND MONITORING.
6. ITERATIVE IMPROVEMENT.

Q4. DEFINE THE TERMS "PENALTY" AND "REWARD" IN THE CONTEXT OF REINFORCEMENT LEARNING.

ANS. IN REINFORCEMENT LEARNING THE ‘PENALTY’ AND ‘REWARD’ ARE THE TERMS USED TO DESCRIBE THE FEEDBACK SIGNALS THAT AN AGENT RECIEVES FROM ITS ENVIRONMENT BASED ON ITS ACTIONS.

1. REWARD – A REWARD IS A POSITIVE SIGNAL.
2. PENALTY – A PENALTY IS KNOWN AS PUNISHMENT OR NEGATIVE FEEDBACK.

Q5. EXPLAIN THE TERM "LEARNING AS A SEARCH"?

ANS. LEARNING AS A SEARCH REFERS TO A CONCEPTUAL FRAMEWORK THAT VIEWS LEARNING PROCESS AS A SEARCH PROBLEM WHERE THE GOAL IS TO FIND AN OPTIMUM SOLUTION OR A SOLUTION THAT MAXIMIZE A SPECIFIC OBJECTIVE. THE FRAMEWORK DRAWS AN ANALOGY BETWEEN LEARNING AND SEARCH ALGORITHMS USED IN PROBLEM SOLVING OR OPTIMIZATION. THIS COULD OPTIMIZE THE VLAUES FOR VARIABLES, WEIGHTS, OR POLICIES THAT MINIMIZE AN ERROR, MAXIMIZE A REWARD, OR ACHIEVE A SPECIFIC GOAL.

Q6. WHAT ARE THE VARIOUS GOALS OF MACHINE LEARNING? WHAT IS THE RELATIONSHIP BETWEEN THESE AND HUMAN LEARNING?

ANS. VARIOUS GOALS OF MACHINE LEARNING ARE PREDICTION, CLASSIFICATION, CLUSTERING, ANAMOLLY DETECTION, RECOMMENDATION, OPTIMIZATION. THE RELATIONSHIP BETWEEN THE MACHINE LEARNING GOALS AND HUMAN LEARNING IS ROOTED IN HTEIR COMMON OBJECTIVE OF AQUIRING KNOWLEDGE, RECOGNIZING PATTERNS IND AMKING INFORMED DESCISIONS. MACHINE LEARNING ALGORITHMS ARE INSPIRED BY HUMANS IN ORDER TO MIMIC CERTAIN ASPECTS OF HUMAN COGNITION.

Q7. ILLUSTRATE THE VARIOUS ELEMENTS OF MACHINE LEARNING USING A REAL-LIFE ILLUSTRATION.

ANS. WE WILL UNDERSTAND THE MACHINE LEARNING ELEMENTS BY USING EMAIL SPAM DETECTION.

1. DATA COLLECTION – FOR EMAIL SPAM DETECTION WE NEED TO COLLECT LARGE DATASET OF EMAILS, WHICH INCLUDE BOTH SPAM AND NON SPAM EMAILS.
2. DATA PREPROCESSING – THIS STEP INCLUDES DATA CLEANING OF DATA BY REMOVING IRREVELENT INFORMATION SUCH AS HTML TAGS OR SPECIAL CHARECTERS, IT ALSO INCLUDES TOKENIZATION WHICH BREAKS DOWN THE EMAIL IN TO INDIVIDUAL WORDS AND PHRASES.
3. FEATURE EXTRACTION – TO MAKE DATA SUITABLE FOR MACHINE LEARNING ALGORITHM, RELEVENT FEATURES NEEDED TO BE EXTRACTED. IN CASE OF EMAIL DETECTION, FEATURES COULD INCLUDE THE PRESENCE OF CERTAIN KEYWORDS, THE FREQUENCY OF SPECIFIC WORDS, OR EVEN SENDERS’S EMAIL ADDRESS.
4. TRAINING DATA SPLIT – THE DATASET IN USUALLY DIVIDED INTO TWO SUBSETS, THE TRAINING DATA AND TESTING DATA, TRAINING DATA IS USED TO TRAIN THE MMODEL AND TESTING DATA IS USED TO TES THE MODEL ACCURACY.
5. MODEL SELECTION – CHOOSING AN APPROPRIATE MODEL IS CRUCIAL. FOR EMAIL SPAM DETECTION COMMON CHOICES ARE NAÏVE BAYES, SUPPORT VECTOR MACHINES (SVM) , OR EVEN DEEP LEARNING MODELS LIKE RECURRENT NEURAL NETWORK (RNN) OR CONVOLUTIONAL NEURAL NETWORK(CNN).
6. MODEL TRAINING – THE MODEL IS TRAINED USING THE LABELED TRAINING DATA SET. MODEL LEARNS THE PATTERNS AND RELATIONSHIPS BETWEEN FEATURES AND THE CORRESPONDING SPAM AND
7. MODEL EVALUATION – THE MODEL IS EVALUATED BY USING TESTING DATA SET. VARIOUS PERFORMANCE METRICS, SUCH ACCURACY, PRECISION, RECALL, AND F1 SCORE, ARE CALCULATED TO ASSESS HOW WELL THE MODEL PERFORMS IN DISTINGUISHING BETWEEN SPAM AND NON SPAM EMAILS.
8. MODEL OPTIMIZATION – IF THE MODEL PERFORMANCE IS NOT SATISFACTORY, THE HYPERPARAMETER TUNING AND OPTIMIZATION TECHNIQUES CAN BE APPLIED TO IMPROVE ITS ACCURACY. THIIS INVOVES ADJUSTING MODEL’S PARAMETER OR TRYING DIFFERENT ALGORITHMS TO FIND OPTIMAL CONFIGURATION.
9. DEPLOYMENT – IN THIS STEP THE MODEL CAN BE DEPLOYED TO DETECT SPAM EMAILS IN REAL TIME . NEW UNSEEN EMAILS ARE FED IN TO THE MODEL, AND IT WILL PREDICT WHETHER THE ARE SPAM OR NOT BASED ON THE LEARNED PATTERNS.
10. MONITORING AND MAINTENANCE – MODEL SHOULD BE REGULARLY MONITORED TO ENSURE THAT IT CONTINUOUS TO PERFORMS WELL. IT MAY REQUIRE PERIODIC UPDATES OR RETAINING TO ADAPT TO EVOLVING SPAMMING TECHNIQUES OR CHANGES IN EMAIL PATTERNS.

Q8. PROVIDE AN EXAMPLE OF THE ABSTRACTION METHOD.

ANS. from abc import ABCMeta , abstractmethod

class parentclass(metaclass = ABCMeta):

    @abstractmethod

    def area():

        return 0

#if we don’t create area function in any class then it will show error

class childclass(parentclass):

    def \_\_init\_\_(self):

        self.length=2

        self.breadth=3

    def area(self):

        return self.length \* self.breadth

object = childclass()

Q9. WHAT IS THE CONCEPT OF GENERALIZATION? WHAT FUNCTION DOES IT PLAY IN THE MACHINE LEARNING PROCESS?

ANS. THE CONCEPT OF GENERALIZATION IN MACHINE LEARNING REFERS TO THE ABILITY OF MACHINE LEARNING MODEL TO PERFORM WELL ON UNSEEN DATA OR DATA THAT IS HAS NOT BEEN TRAINED ON. IT INVOLVES MODEL’s ABILITY TO LEARN PATTERNS AND RELATIONSHIPS FROM THE TRAINING DATA AND APPLY THAT KNOWLEDGE TO MAKE ACCURATE PREDICTIONS AND CLASSIFICATIONS ON NEW, UNSEEN DATA.

THE FUNCTIONS OF GENERALIZATIONS IN MACHINE LEARNING PROCESS CAN BE SUMMARIZED AS

1. MODEL EVALUATIONS.
2. MODEL SELECTION.
3. PREVENTING OVERFITTING.
4. DEPLOYMENT AND REAL WORLD PERFORMANCE.

Q10. WHAT IS CLASSIFICATION, EXACTLY? WHAT ARE THE MAIN DISTINCTIONS BETWEEN CLASSIFICATION AND REGRESSION?

ANS. THE CLASSIFICATION IS A MACHINE LEARNING TASK THAT INVOLVES CATEGORIZING OR ASSIGNING PREDEFINED CLASSES OR LABELS TO INPUT DATA BASED ON THEIR FEATURES. THE GOAL OF CLASSIFICATION IS TO LEARN A MAPPING OR DISCISION BOUNDARY BETWEEN THE INPUT FEATURES AND THE CORRESPONDING CLASS LABELS.

THE MAIN DISTINCTION BETWEEN CLASSIFICATION AND REGRESION

|  |  |  |
| --- | --- | --- |
|  | **CLASSIFICATION** | **REGRESSION** |
| **NATURE OF OUTPUT** | DISCRETE | CONTINUOUS |
| **TYPE OF LEARNING TASK** | THE INPUT IS PAIRED WITH CORRESPONDING CLASS LABELS | THE DATA IS PAIRED WITH CONTINUOUS NUMERICAL VALUES |
| **MODEL OUTPUT REPRESENTATION** | OUTPUT IS REPRESENTED AS PROBABILITIES OR DISCRETE CLASS LABELS | OUTPUT IS NUMERICAL OR SET OF NUMERICAL VALUES. |
| **EVALUATION METRICS** | ACCURACY , PRECISION , RECALL , F1 SCORE , | MEAN SQUARED ERROR (MSE) , MEAN ABSOLUTE ERROR (MAS) , ROOR MEAN SQUARED ERROR (RMSE) , R-SQUARED OR OTHERS |

Q11. WHAT IS REGRESSION, AND HOW DOES IT WORK? GIVE AN EXAMPLE OF A REAL-WORLD PROBLEM THAT WAS SOLVED USING REGRESSION.

ANS. REGRESSION IS A MACHINE LEARNING TASK THT AIMS TO PREDICT OR ESTIMATE CONTINUOUS NUMERICAL VALUES BASED ON INPUT FEATURES IT INVOLVES LEARNING THE RELATIONSHIP BETWEEN THE INPUT VARIABLES AND OUTPUT VAIRIABLES.

HOW DOES REGRESSION WORKS

REGRESSION MODELS TRY TO FIND A MATHEMATICAL FUNCTION OR ALGORITHM THAT BEST FITS THE TRAINING DATA AND CAN GENERALIZE TO MAKE PREDICTIONS ON NEW UNSEEN DATA. THE MODEL LEARNS THE PATTERNS AND RELATIONSHIPS PRESENT IN THE TRAINING DATA AND USES THAT KNOWLEDGE TO MAKE PREDICTIONS OR ESTIMATE VALUES FOR NEW INSTANCES.

REAL WORLD PROBLEM THAT WAS SOLVED USING REGRESSION IS HOUSE PRICE PREDICTION.

Q12. DESCRIBE THE CLUSTERING MECHANISM IN DETAIL.

ANS. CLUSTERING IN A MACHINE LEARNING TECHNIQUE USED TO GROUP SIMILAR DATA POINTS TOGETHER BASED ON THEIR INHERITENT PATTERNS OR SIMILARITIES.

MEHCANISM

1. DATA PREPARATION – DATASET IS PREPARED BY COLLECTING RELEVANT DATA POINTS.
2. DISTANCE OR SIMILARITY METRIC – A DISTANCE OR SIMILARITY METRIC IS SELECTED TO QUANTIFY THE SIMILARITY OR DISSIMILARITY BETWEEN THE PAIRS OF DATA POINTS
3. SELECTION OF CLUSTERING ALGORITHM – ALGORITHM IS SELECTED ON THE BASIS OF CHARECTERSTICS OF THE DATA SET AND THE DESIRED OUTCOMES.
4. INITIALIZATION – DEPENDING ON THE CLUSTERING ALGORITHM THE INITIALCONDITIONS ARE SET.
5. ITERATIVE PROCESS – THE CLUSTERING ALGORITHM ITERATIVELY UPDATES THE CLUSTER ASSIGNMENTS BASED ON THE SIMILARITY OR DISTANCE METRICS.
6. EVALUATION AND INTERPRETATION – QUALITY AND COHERENCE OF THE RESULTING CLUSTER NEED TO BE EVALUATED.
7. INTERPRETATION AND VISUALIZATION – INTERPRETATION AND ANALYZATION TO GAIN INSIGHTS AND AND MAKE MEANINGFUL CONCLUSIONS

Q13. MAKE BRIEF OBSERVATIONS ON TWO OF THE FOLLOWING TOPICS:

I. MACHINE LEARNING ALGORITHMS ARE USED

II. STUDYING UNDER SUPERVISION

III. STUDYING WITHOUT SUPERVISION

IV. REINFORCEMENT LEARNING IS A FORM OF LEARNING BASED ON POSITIVE REINFORCEMENT.

ANS. I. MACHINE LEARNING ALGORITHMS ARE USED

MACHINE LEARNING ALGORITHMS ARE USED TO ANALYZE DATA, IDENTIFY PATTERNS, MAKE PREDICTIONS, AND AUTOMATE DECISION-MAKING. THESE ALGORITHMS UTILIZE STATISTICAL AND MATHEMATICAL TECHNIQUES TO LEARN FROM DATA AND IMPROVE THEIR PERFORMANCE OVER TIME.

II. STUDYING UNDER SUPERVISION

SUPERVISED LEARNING IS A MACHINE LEARNING APPROACH WHERE A MODEL IS TRAINED ON LABELED DATA, MEANING THE INPUT DATA POINTS ARE PAIRED WITH CORRESPONDING TARGET VALUES OR LABELS. THE GOAL OF SUPERVISED LEARNING IS TO LEARN A MAPPING FUNCTION THAT CAN MAKE ACCURATE PREDICTIONS OR CLASSIFICATIONS ON UNSEEN DATA.