

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

Seventh semester B.Tech examinations (S), September 2020

**Course Code: CS467****Course Name: MACHINE LEARNING**

Max. Marks: 100

Duration: 3 Hours

**PART A***Answer all questions, each carries 4 marks.*

Marks

- |    |   |     |
|----|---|-----|
| 1  | Define VC dimension. How VC dimension is related with no of training examples used for learning.  | (4) |
| 2  | Compare Classification with regression with an example.   | (4) |
| 3  | Distinguish between overfitting and underfitting. How it can affect model generalization?   | (4) |
| 4  | Explain the general MLE method for estimating the parameters of a probability distribution.   | (4) |
| 5  | Compare Cross validation with Bootstrapping Techniques.   | (4) |
| 6  | Calculate the output y of a three input neuron with bias. The input feature vector is $(x_1, x_2, x_3) = (0.8, 0.6, 0.4)$ and weight values are $[w_1, w_2, w_3, b] = [0.2, 0.1, -0.3, 0.35]$ . Use binary Sigmoid function as activation function. | (4) |
| 7  | Describe the significance of Kernel functions in SVM. List any two kernel functions.  | (4) |
| 8  | Explain the basic elements of a Hidden Markov Model (HMM). List any two applications of HMM.  | (4) |
| 9  | Explain any two model combination scheme to improve the accuracy of a classifier.   | (4) |
| 10 | Compare K means clustering with Hierarchical Clustering Techniques.   | (4) |

**PART B***Answer any two full questions, each carries 9 marks.*

- |    |   |     |
|----|---|-----|
| 11 | a) Distinguish between supervised learning and Reinforcement learning. Illustrate with an example.  | (5) |
|    | b) Discuss any four examples of machine learning applications.  | (4) |
| 12 | a) Define Probably Approximately Learning.  | (3) |
|    | b) Explain the procedure for the computation of the principal components of the data.   | (6) |
| 13 | a) Compare Feature Extraction and Feature Selection techniques. Explain how dimensionality can be reduced using subset selection procedure. | (5) |
|    | b) Explain the methods used to learn multiple classes for a K class Classification Problem.   | (4) |

**PART C***Answer any two full questions, each carries 9 marks.*

- 14 a) Identify the first splitting attribute for decision tree by using ID3 algorithm with the following dataset. (6)

Major	Experience	Tie	Hired?
CS	programming	pretty	NO
CS	programming	pretty	NO
CS	management	pretty	YES
CS	management	ugly	YES
business	programming	pretty	YES
business	programming	ugly	YES
business	management	pretty	NO
business	management	pretty	NO

- b) Explain perceptron learning algorithm. (3)
- 15 a) Suppose 10000 patients get tested for flu; out of them, 9000 are actually healthy and 1000 are actually sick. For the sick people, a test was positive for 620 and negative for 380. For the healthy people, the same test was positive for 180 and negative for 8820. Construct a confusion matrix for the data and compute the precision and recall for the data. (4)
- b) Consider the training data in the following table where Play is a class attribute. In the table, the Humidity attribute has values “L” (for low) or “H” (for high), Sunny has values “Y” (for yes) or “N” (for no), Wind has values “S” (for strong) or “W” (for weak), and Play has values “Yes” or “No”. (5)

Humidity	Sunny	Wind	Play
L	N	S	No
H	N	W	Yes
H	Y	S	Yes
H	N	W	Yes
L	Y	S	No

What is class label for the following day (Humidity=L, Sunny=N, Wind=W), according to naïve Bayesian classification?

- 16 a) What are the benefits of pruning in decision tree induction? Explain different approaches to tree pruning? (5)
- b) Given the set of values  $X = (3, 9, 11, 5, 2)^T$  and  $Y = (1, 8, 11, 4, 3)^T$ . Evaluate the regression coefficients. (4)

**PART D***Answer any two full questions, each carries 12 marks.*

- 17 a) Explain DBSCAN algorithm for density based clustering. List out its advantages compared to K-means. (6)

- b) Describe How Evaluation problem can be solved by using Hidden Markov Model. (6)
- 18 a) Describe the significance of soft margin hyperplane and explain how they are computed. (6)
- b) Illustrate K means clustering algorithm with an example. (6)
- 19 a) State the mathematical formulation of the SVM problem. Give an outline of the method for solving the problem. (6)
- b) Show the final result of hierarchical clustering with complete link by drawing a dendrogram. (6)

	A	B	C	D	E	F
A	0					
B	0.12	0				
C	0.51	0.25	0			
D	0.84	0.16	0.14	0		
E	0.28	0.77	0.70	0.45	0	
F	0.34	0.61	0.93	0.20	0.67	0

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## CBCS SCHEME

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15CS73

Seventh Semester B.E. Degree Examination, Jan./Feb. 2021

## Machine Learning

Time: 3 hrs.

Max. Marks: 80

*Note: Answer any FIVE full questions, choosing ONE full question from each module.*Module-1

- 1 a. Define machine learning. Explain with specific examples. (06 Marks)
- b. How you will design a learning system? Explain with examples. (06 Marks)
- c. List and explain perspectives and issues in Machine Learning. (04 Marks)

OR

- 2 a. Define concept learning. Explain the task of concept learning. (06 Marks)
- b. How the concept learning can be viewed as the task of searching? Explain. (04 Marks)
- c. Explain with examples:
  - i) Find-S algorithm
  - ii) Candidate Elimination algorithm (06 Marks)

Module-2

- 3 a. Define decision tree learning. List and explain appropriate problems for decision tree learning. (06 Marks)
- b. Explain the basic decision tree learning algorithm. (05 Marks)
- c. Describe Hypothesis space search in decision tree learning. (05 Marks)

OR

- 4 a. Define inductive bias. Explain inductive bias in decision tree learning. (06 Marks)
- b. Give the differences between the hypothesis space search in ID3 and candidate elimination algorithm. (04 Marks)
- c. List and explain issues in decision tree learning. (06 Marks)

Module-3

- 5 a. Define Artificial neural networks. Explain biological learning systems. (05 Marks)
- b. Explain representations of Neural network. (05 Marks)
- c. Describe the characteristics of Back propagation algorithm. (06 Marks)

OR

- 6 a. Define Perceptron. Explain representational power of Perceptrons. (05 Marks)
- b. Explain gradient descent algorithm. (06 Marks)
- c. Describe derivation of the back propagation rule. (05 Marks)

Module-4

- 7 a. List and explain features of Bayesian learning methods. (06 Marks)
- b. Describe Brute-Force map learning algorithm. (05 Marks)
- c. Explain maximum likelihood and least-squared error hypothesis. (05 Marks)

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15CS73

**Seventh Semester B.E. Degree Examination, Dec.2019/Jan.2020**  
**Machine Learning**

Time: 3 hrs.

Max. Marks: 80

*Note: Answer any FIVE full questions, choosing ONE full question from each module.*

**Module-1**

- 1 a. What do you mean by well-posed learning problem? Explain with example. (04 Marks)  
 b. Explain the various stages involved in designing a learning system in brief. (08 Marks)  
 c. Write Find\_S algorithm and discuss the issues with the algorithm. (04 Marks)

OR

- 2 a. List the issues in machine learning. (04 Marks)  
 b. Consider the given below training example which finds malignant tumors from MRI scans.

Example	Shape	Size	Color	Surface	Thickness	Target concept
1	Circular	Large	Light	Smooth	Thick	Malignant
2	Circular	Large	Light	Irregular	Thick	Malignant
3	Oval	Large	Dark	Smooth	Thin	Benign
4	Oval	Large	Light	Irregular	Thick	Malignant
5	Circular	Small	Light	Smooth	Thick	Benign

Show the specific and general boundaries of the version space after applying candidate elimination algorithm. (Note: Malignant is +ve, Benign is -ve). (08 Marks)

- c. Explain the concept of inductive bias in brief. (04 Marks)

**Module-2**

- 3 a. Discuss the two approaches to prevent over fitting the data. (08 Marks)  
 b. Consider the following set of training examples:

Instance	Classification	$a_1$	$a_2$
1	1	1	1
2	1	1	1
3	0	1	0
4	1	0	0
5	0	0	1
6	0	0	1

- (i) What is the entropy of this collection of training examples with respect to the target function classification?  
 (ii) What is the information gain of  $a_2$  relative to these training examples? (08 Marks)

OR

- 4 a. Define decision tree. Construct the decision tree to represent the following Boolean functions:

i)  $A \wedge \neg B$

ii)  $A \vee [B \wedge C]$

iii)  $A \text{ XOR } B$

(06 Marks)

- b. Write the ID3 algorithm. (06 Marks)

- c. What do you mean by gain and entropy? How it is used to build the decision tree. (04 Marks)



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**Module-3**

- 5 a. Define perceptron. Explain the concept of single perceptron with neat diagram. (06 Marks)  
b. Explain the back propagation algorithm. Why is it not likely to be trapped in local minima? (10 Marks)

OR

- 6 a. List the appropriate problems for neural network learning. (04 Marks)  
b. Discuss the perceptron training rule and delta rule that solves the learning problem of perceptron. (08 Marks)  
c. Write a remark on representation of feed forward networks. (04 Marks)

**Module-4**

- 7 a. Explain Naïve Bayes classifier. (08 Marks)  
b. Explain brute force MAP learning algorithm. (08 Marks)

OR

- 8 a. Discuss Minimum Description Length principle in brief. (08 Marks)  
b. Explain Bayesian belief networks and conditional independence with example. (08 Marks)

**Module-5**

- 9 a. Define: (i) Simple Error (ii) True Error (04 Marks)  
b. Explain K-nearest neighbor learning algorithm. (08 Marks)  
c. What is reinforcement learning? (04 Marks)

OR

- 10 a. Define expected value, variance, standard deviation and estimate bias of a random variable. (04 Marks)  
b. Explain locally weighted linear regression. (08 Marks)  
c. Write a note on Q-learning. (04 Marks)

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15CS73

Seventh Semester B.E. Degree Examination, Aug./Sept.2020

## Machine Learning

Time: 3 hrs.

Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

- 1 a. What is Machine Learning? Explain different perspectives and issues in machine learning. (06 Marks)
- b. Explain the steps in designing a learning system. (10 Marks)

OR

- 2 a. Describe the Candidate-Elimination algorithm. Explain its working, taking the enjoy sport concept and training instances given below:

Example	Sky	Air Temp	Humidity	Wind	Water	Forecast	Enjoy sport
1	Sunny	Warm	Normal	Strong	Warm	Same	Yes
2	Sunny	Warm	High	Strong	Warm	Same	Yes
3	Rainy	Clod	High	Strong	Warm	Change	No
4	Sunny	Warm	High	Strong	Warm	Change	Yes

- (10 Marks)
- b. Explain how to model inductive systems by their equivalent deductive systems for Candidate-Elimination Algorithm. (06 Marks)

Module-2

- 3 a. Explain the concepts of entropy and information gain. (06 Marks)
- b. Describe the ID3 algorithm for decision tree learning. (10 Marks)

OR

- 4 a. Apply ID3 algorithm for constructing decision tree for the following training example.

Day	Outlook	Temperature	Humidity	Wind	Play Tennis
D1	Sunny	Hot	High	Weak	No
D2	Sunny	Hot	High	Strong	No
D3	Overcast	Hot	High	Weak	Yes
D4	Rain	Mild	High	Weak	Yes
D5	Rain	Cool	Normal	Weak	Yes
D6	Rain	Cool	Normal	Strong	No
D7	Overcast	Cool	Normal	Strong	Yes
D8	Sunny	Mild	High	Weak	No
D9	Sunny	Cool	Normal	Weak	Yes
D10	Rain	Mild	Normal	Weak	Yes
D11	Sunny	Mild	Normal	Strong	Yes
D12	Overcast	Mild	High	Strong	Yes
D13	Overcast	Hot	Normal	Weak	Yes
D14	Rain	Mild	High	Strong	No

- b. Explain the issues in decision tree learning.

(10 Marks)

(06 Marks)

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**Module-3**

- 5 a. Explain appropriate problems for Neural Network Learning with its characteristics. (10 Marks)  
b. Explain the single perceptron with its learning algorithm. (06 Marks)

OR

- 6 a. Explain Back Propagation algorithm. (10 Marks)  
b. Explain the remarks of Back propagation algorithm. (06 Marks)

**Module-4**

- 7 a. Explain Naïve Bayes classifier. (10 Marks)  
b. Explain Bayesian Belief Networks. (06 Marks)

OR

- 8 a. Explain EM algorithm. (08 Marks)  
b. Explain the derivation of K-means algorithm. (08 Marks)

**Module-5**

- 9 a. Explain K-nearest neighbor learning algorithm with example. (10 Marks)  
b. Explain case based reasoning with example. (06 Marks)

OR

- 10 Write short note on:  
a. Q learning  
b. Radial basis function  
c. Locally weighted regression  
d. Sampling theory. (16 Marks)



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15CS73

Seventh Semester B.E. Degree Examination, Dec.2018/Jan.2019

## Machine Learning

Time: 3 hrs.

Max. Marks: 80

Note: Answer FIVE full questions, choosing ONE full question from each module.

## Module-1

- 1 a. Specify the learning task for 'A checkers learning problem'. (03 Marks)  
 b. Discuss the following with respect to the above.  
 (i) Choosing the training experience.  
 (ii) Choosing the target function and  
 (iii) Choosing a function approximation algorithm. (09 Marks)  
 c. Comment on the issues in machine learning. (04 Marks)

## OR

- 2 a. Write candidate elimination algorithm. Apply the algorithm to obtain the final version space for the training example. (10 Marks)

Sl. No.	Sky	Air temp	Humidity	Wind	Water	Forecast	Enjoy sport
1	Sunny	Warm	Normal	Strong	Warm	Same	Yes
2	Sunny	Warm	High	Strong	Warm	Same	Yes
3	Rainy	Cold	High	Strong	Warm	Change	No
4	Sunny	Warm	High	Strong	Cool	Change	Yes

- b. Discuss about an unbiased Learner. (06 Marks)

## Module-2

- 3 a. What is a decision tree & discuss the use of decision tree for classification purpose with an example. (08 Marks)  
 b. Write and explain decision tree for the following transactions: (08 Marks)

Tid	Refund	Marital status	Taxable Income	Cheat
1	Yes	Single	125 K	No
2	No	Married	100 K	No
3	No	Single	70 K	No
4	Yes	Married	120 K	No
5	No	Divorced	95 K	Yes
6	No	Married	60 K	No
7	Yes	Divorced	220 K	No
8	No	Single	85 K	Yes
9	No	Married	75 K	No
10	No	Single	90 K	Yes

## OR

- 4 a. For the transactions shown in the table compute the following :  
 (i) Entropy of the collection of transaction records of the table with respect to classification.  
 (ii) What are the information gain of  $a_1$  and  $a_2$  relative to the transactions of the table? (08 Marks)

Instance	1	2	3	4	5	6	7	8	9
$a_1$	T	T	T	F	F	F	F	T	F
$a_2$	T	T	F	F	T	T	F	F	T
Target class	+	+	-	+	-	-	-	+	-

- b. Discuss the decision learning algorithm. (04 Marks)  
 c. List the issues of decision tree learning. (04 Marks)

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**Module-3**

- 5 a. Draw the perceptron network with the notation. Derive an equation of gradient descent rule to minimize the error. (08 Marks)  
 b. Explain the importance of the terms : (i) Hidden layer (ii) Generalization (iii) Overfitting (iv) Stopping criterion (08 Marks)

**OR**

- 6 a. Discuss the application of Neural network which is used for learning to steer an autonomous vehicle. (06 Marks)  
 b. Write an algorithm for back propagation algorithm which uses stochastic gradient descent method. Comment on the effect of adding momentum to the network. (10 Marks)

**Module-4**

- 7 a. What is Bayes theorem and maximum posterior hypothesis? (04 Marks)  
 b. Derive an equation for MAP hypothesis using Bayes theorem. (04 Marks)  
 c. Consider a football game between two rival teams: Team 0 and Team 1. Suppose Team 0 wins 95% of the time and Team 1 wins the remaining matches. Among the games won by team 0, only 30% of them come from playing on team 1's football field. On the other hand, 75% of the victories for team 1 are obtained while playing at home. If team 1 is to host the next match between the two teams, which team will most likely emerge as the winner? (08 Marks)

**OR**

- 8 a. Describe Brute-force MAP learning algorithm. (04 Marks)  
 b. Discuss the Naïve Bayes classifier. (04 Marks)  
 c. The following table gives data set about stolen vehicles. Using Naïve Bayes classifier classify the new data (Red, SUV, Domestic) (08 Marks)

Table

Color	Type	Origin	Stolen
Red	Sports	Domestic	Yes
Red	Sports	Domestic	No
Red	Sports	Domestic	Yes
Yellow	Sports	Domestic	No
Yellow	Sports	Imported	Yes
Yellow	SUV	Imported	No
Yellow	SUV	Imported	Yes
Yellow	SUV	Domestic	No
Red	SUV	Imported	No
Red	Sports	Imported	Yes

**Module-5**

- 9 a. Write short notes on the following:  
 (i) Estimating Hypothesis accuracy. (08 Marks)  
 (ii) Binomial distribution. (08 Marks)  
 b. Discuss the method of comparing two algorithms. Justify with paired to tests method. (08 Marks)

**OR**

- 10 a. Discuss the K-nearest neighbor language. (04 Marks)  
 b. Discuss locally weighted Regression. (04 Marks)  
 c. Discuss the learning tasks and Q learning in the context of reinforcement learning. (08 Marks)

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15CS73

Seventh Semester B.E. Degree Examination, June/July 2019

## Machine Learning

Time: 3 hrs.

Max. Marks: 80

*Note: Answer any FIVE full questions, choosing ONE full question from each module.*Module-1

- 1 a. Define machine learning. Describe the steps in designing learning system. (08 Marks)  
 b. Write Find-S algorithm and explain with example. (04 Marks)  
 c. Explain List-Then-Eliminate algorithm. (04 Marks)

OR

- 2 a. List out any 5 applications of machine learning. (05 Marks)  
 b. What do you mean by hypothesis space, instance space and version space? (03 Marks)  
 c. Find the maximally general hypothesis and maximally specific hypothesis for the training examples given in the table using candidate elimination algorithm. (08 Marks)

Day	Sky	Air Temp	Humidity	Wind	Water	Forecast	Enjoy Sport
1	Sunny	Warm	Normal	Strong	Warm	Same	Yes
2	Sunny	Warm	High	Strong	Warm	Same	Yes
3	Rainy	Cold	High	Strong	Warm	Change	No
4	Sunny	Warm	High	Strong	Cool	Change	Yes

Module-2

- 3 Construct decision tree for the following data using ID3 algorithm.

Day	A1	A2	A3	Classification
1	True	Hot	High	No
2	True	Hot	High	No
3	False	Hot	High	Yes
4	False	Cool	Normal	Yes
5	False	Cool	Normal	Yes
6	True	Cool	High	No
7	True	Hot	High	No
8	True	Hot	Normal	Yes
9	False	Cool	Normal	Yes
10	False	Cool	High	No

(16 Marks)

OR

- 4 a. Explain the concept of decision tree learning. Discuss the necessary measure required to select the attributes for building a decision tree using ID3 algorithm. (08 Marks)  
 b. Discuss the issues of avoiding over fitting the data, handling continuous data and missing values in decision trees. (08 Marks)

Module-3

- 5 a. Explain artificial neural network based on perception concept with diagram. (06 Marks)  
 b. What is gradient descent and delta rule? Why stochastic approximation to gradient descent is needed? (04 Marks)  
 c. Describe the multilayer neural network. Explain why back propagation algorithm is required. (06 Marks)

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OR

- 6 a. Derive the back propagation rule considering the output layer and training rule for output unit weights. (08 Marks)  
 b. What is squashing function & why is it needed? (04 Marks)  
 c. List out and explain in briefly representation power of feed forward networks. (04 Marks)

**Module-4**

- 7 a. Explain maximum a posteriori (MAP) hypothesis using Bayes theorem. (06 Marks)  
 b. Estimate conditional probabilities of each attributes {colour, legs, height, smelly} for the species classes: {M, H} using the data given in the table. Using these probabilities estimate the probability values for the new instance – (Colour = Green, Legs = 2, Height = Tall and Smelly = No) (10 Marks)

No	Colour	Legs	Height	Smelly	Species
1	White	3	Short	Yes	M
2	Green	2	Tall	No	M
3	Green	3	Short	Yes	M
4	White	3	Short	Yes	M
5	Green	2	Short	No	H
6	White	2	Tall	No	H
7	White	2	Tall	No	H
8	White	2	Short	Yes	H

OR

- 8 a. Explain Naive Bayes classifier and Bayesian belief networks. (10 Marks)  
 b. Prove that how maximum likelihood (Bayesian learning) can be used in any learning algorithms that are used to minimize the squared error between actual output hypothesis and predicted output hypothesis. (06 Marks)

**Module-5**

- 9 a. Explain locally weighted linear regression. (08 Marks)  
 b. What do you mean by reinforcement learning? How reinforcement learning problem differs from other function approximation tasks. (05 Marks)  
 c. Write down Q-learning algorithm. (03 Marks)

OR

- 10 a. What is instance based learning? Explain K-Nearest neighbour algorithm. (08 Marks)  
 b. Explain sample error, true error, confidence intervals and Q-learning function. (08 Marks)

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**Code No: 137DV****JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD****B. Tech IV Year I Semester Examinations, December - 2019****MACHINE LEARNING****(Computer Science and Engineering)****Time: 3 Hours****Max. Marks: 75****Note:** This question paper contains two parts A and B.

Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b as sub questions.

**PART – A****(25 Marks)**

- 1.a) List the basic design issues to machine learning. [2]
- b) State version space representation theorem. [3]
- c) What is the representational power of perceptrons? [2]
- d) How to compute expected value and variance of a random variable? [3]
- e) State Bayes theorem. [2]
- f) Under what conditions is successful learning possible? [3]
- g) How to use entropy as evaluation function? [2]
- h) What factors contribute to the popularity of genetic algorithm? [3]
- i) What is the essential difference between analytical and inductive learning methods? [2]
- j) What are the limitations of explanation based learning? [3]

**PART – B****(50 Marks)**

2. Which disciplines have their influence on machine learning? Explain with examples. [10]

**OR**

- 3.a) Contrast the hypothesis space search in ID3 and candidate elimination algorithm.
- b) Illustrate the impact of overfitting in a typical application of decision tree learning. [5+5]

4. Discuss how a multi layer network learns using a gradient descent algorithm. [10]

**OR**

- 5.a) Distinguish between inductive bias and estimation bias.
- b) Explain the methods for comparing the accuracy of two hypotheses. [4+6]

- 6.a) Explain the features of Bayesian learning methods.
- b) Discuss the relationship between the maximum likelihood hypothesis and the least-squared error hypothesis. [6+4]

**OR**

- 7.a) Prove C-exhausting the version space theorem.
- b) With suitable example discuss a radial basis function network. [5+5]



8. Describe the representation of hypotheses and genetic algorithms used in this. [10]  
OR
- 9.a) How rules are post pruned? Explain with an example.  
b) What is Q function? Write an algorithm for learning Q. [5+5]
10. Explain an algorithm for regressing a set of literals through a single horn clause. [10]  
OR
11. Describe the TANGENTPROP algorithm to train a neural network to fit both training values and training derivatives. [10]

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