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Q1-3: Consider binary classification in 2D where the intended label of a point x = (x1, x2) is positive if x1>x2 and negative otherwise. Let the training set be all points of the form x = [4a, 3b] where a,b are integers. Each training item has the correct label that follows the rule above. With a 1NN classifier (Euclidean distance), which ones of the following points are labeled positive? Multiple answers.

1. [5.52, 2.41]
2. [8.47, 5.84]
3. [7 , 8.17]
4. [6.7 , 8.88]

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1. [5.52, 2.41] ⬅
2. [8.47, 5.84] ⬅
3. [7 , 8.17]
4. [6.7 , 8.88]

Nearest neighbors are

[4,3] => positive

[8,6] => positive

[8,9] => negative

[8,9] => negative

Individually.

Q2-1: Consider a variant of II Nim game where there are 2 piles, with 1 and 3 sticks, respectively. Each time one player takes some stick(s) from only one pile (can take 1 or 2 or 3 sticks). What’s the game theoretic value of the initial state?

A. 1
B. 0
C. -1

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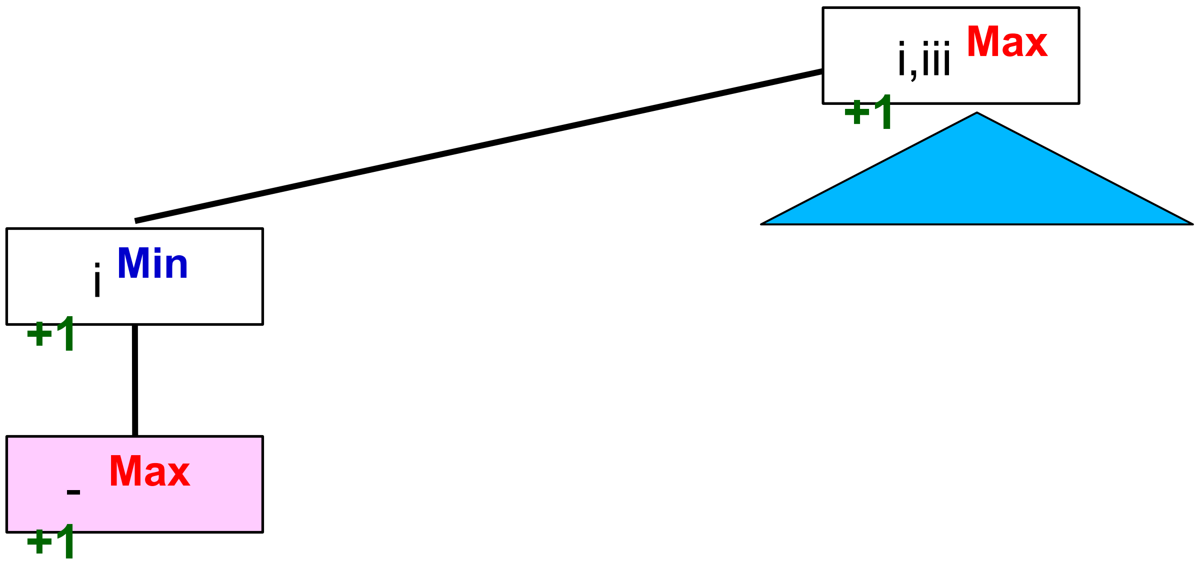

The first player could always take 3 sticks from the pile with 3 sticks, which guarantees the game value +1. No need to check the other branches.

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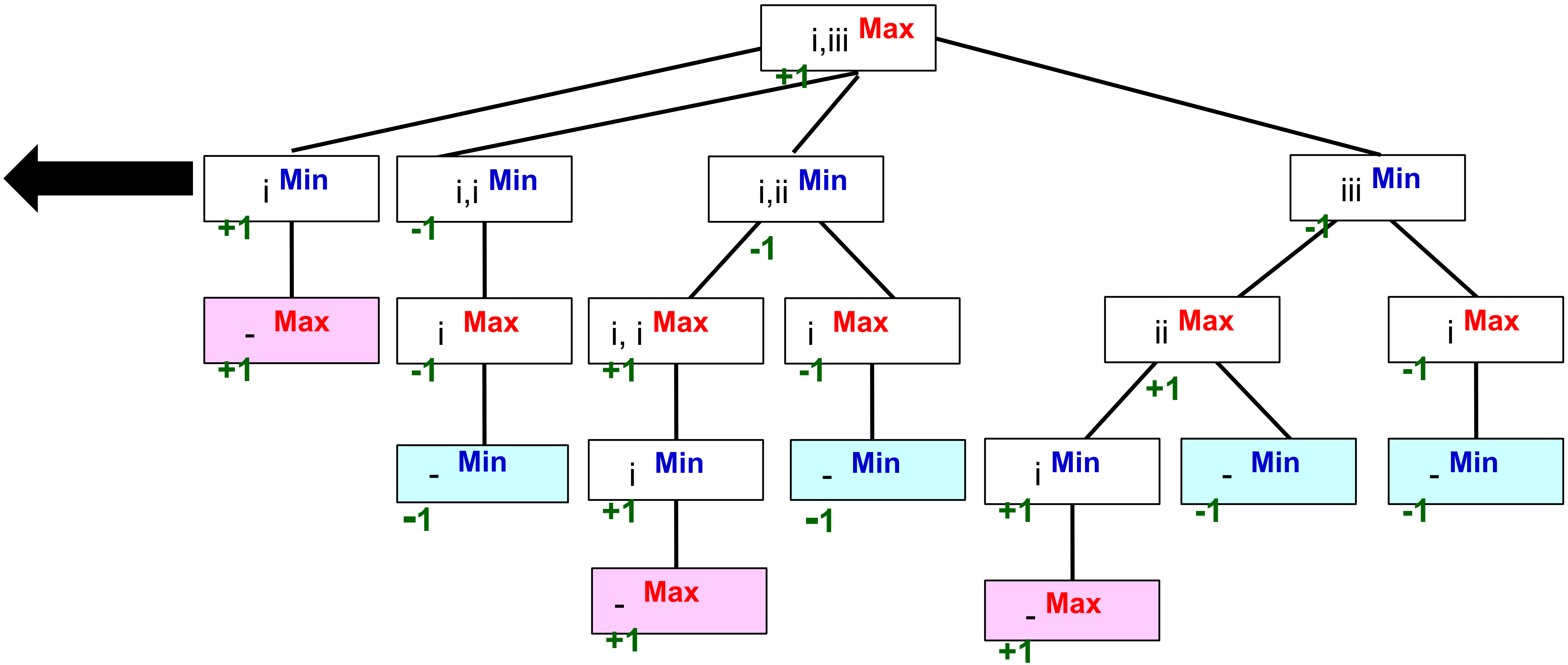

Q2-2: We know that the game theoretic value of the initial state is -1 in II Nim game where there are 2 piles, each with 2 sticks. Now consider a variant of II Nim game where there are 2 piles, with 2 and 3 sticks, respectively. Each time one player takes some stick(s) from only one pile (can take 1 or 2 or 3 sticks). What's the game theoretic value of the initial state?

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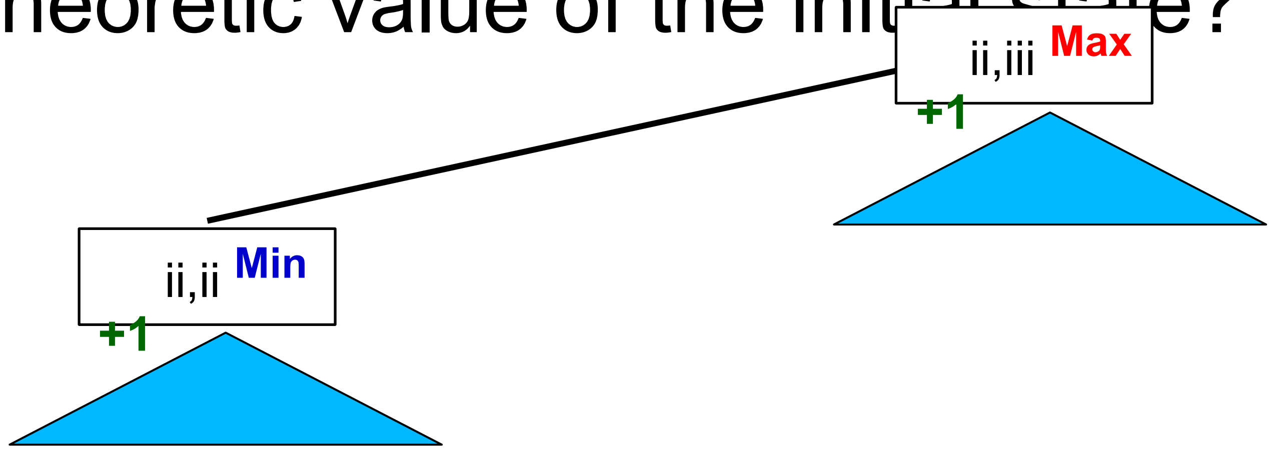

The first player could always take 1 stick from the pile with 3 sticks and make it a (2,2) state, in which case the second player will always lose.

Q2-3: Consider a variant of II Nim game with 2 piles, both with 3 sticks. Each time one player takes some stick(s) from only one pile (can take 1 or 2 or 3 sticks). What’s the game theoretic value of the initial state? (Hint: use the answers of the last two questions)

A. 1
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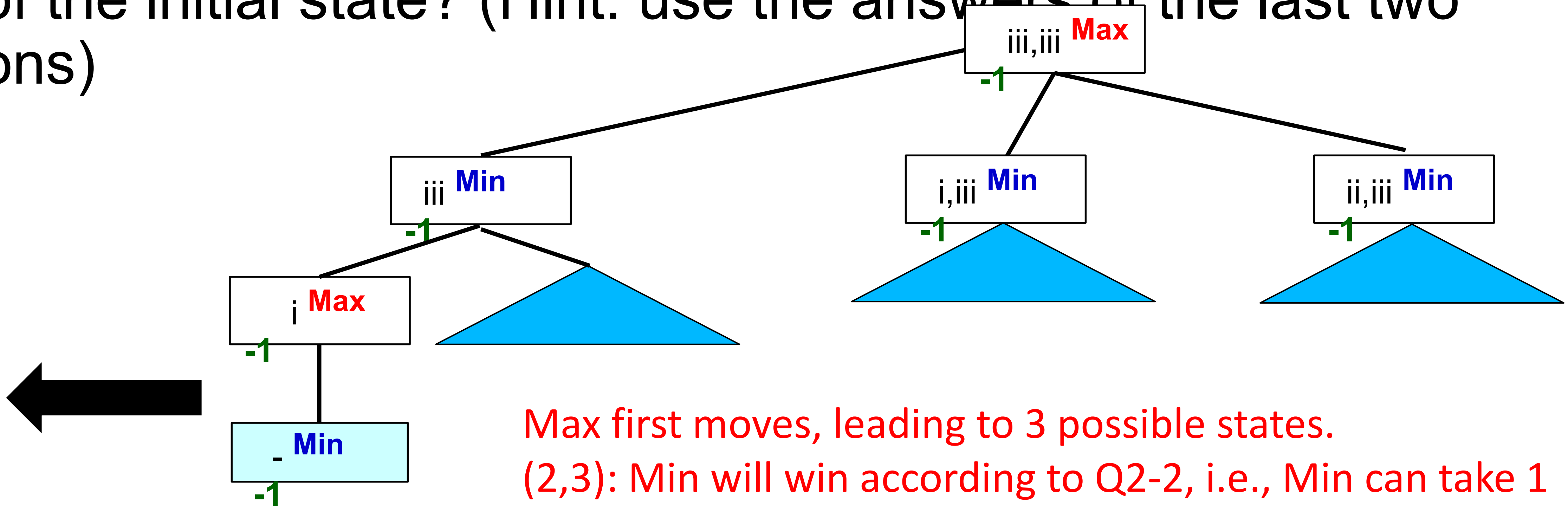
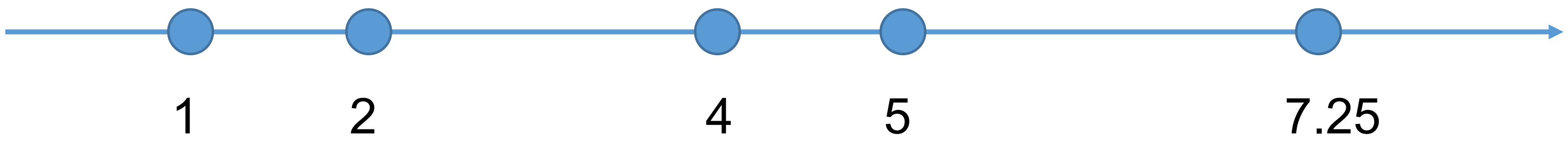


Max first moves, leading to 3 possible states.
(2,3): Min will win according to Q2-2, i.e., Min can take 1 stick from the pile with 3 sticks and make it (2,2).
(1,3): Min will win according to Q2-1, i.e., Min can take all the second pile, and make it (1,-).
(0,3): Min can take 2 sticks and will win.

Q3-1: Suppose we run average linkage on the following data set to get two clusters. What is the result?

A. {1}, {2,4,5,7.25}
B. {1,2}, {4, 5, 7.25}
C. {1,2,4}, {5, 7.25}
D. {1,2,4,5}, {7.25}



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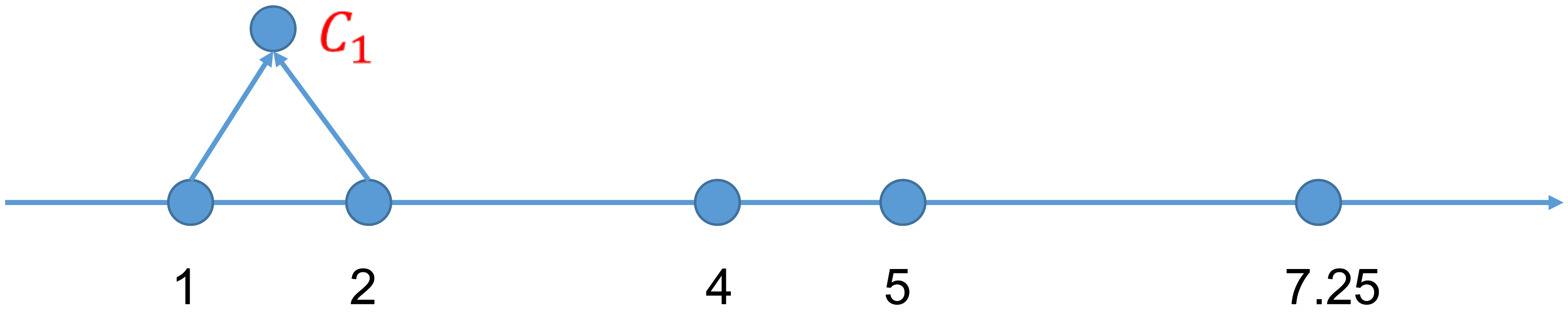
$$d(C_1, \{4\}) = \frac{3+2}{2} = 2.5,$$
$$d(\{4\},\{5\}) = 1$$



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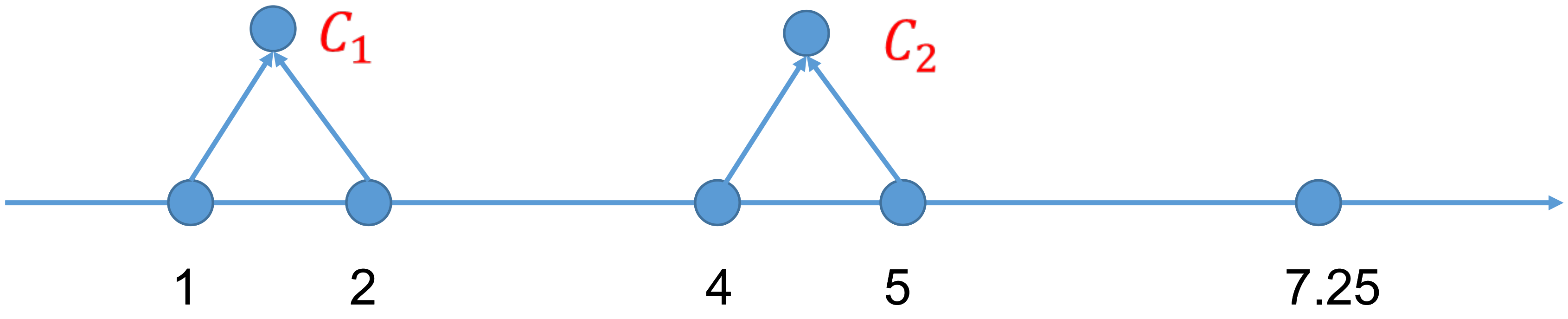
C. {1,2,4}, {5, 7.25}
D. {1,2,4,5}, {7.25}

$$d(C_1, C_2) = \frac{3+2+4+3}{4} = 3,$$

$$d(C_2, \{7.25\}) = \frac{3.25+2.25}{2} = 2.75$$



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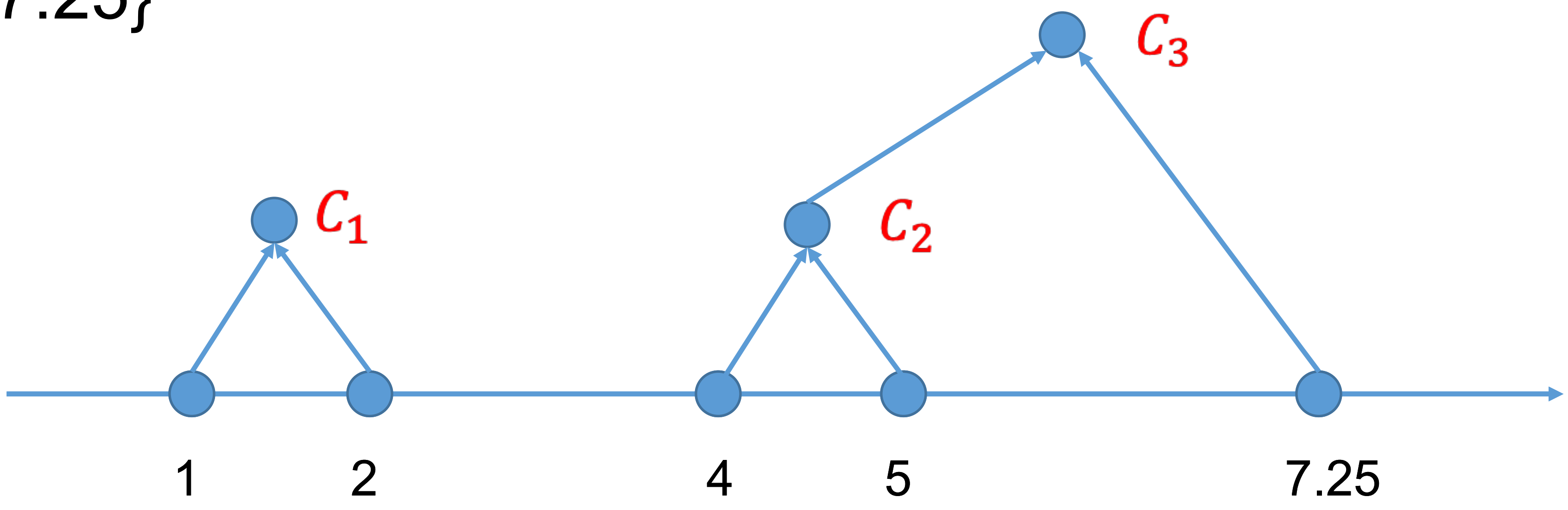

Q3-2: Assume, you want to cluster 7 points in 2-dim into 3 clusters using K-Means clustering algorithm. After the first iteration clusters, C1, C2, C3 has the following points:

C1: {(1,1), (3,3), (5,5)}

C2: {(0,4), (-2,4)}

C3: {(7,7), (9,9)}

What will be the cluster centroids if you want to proceed for the second iteration?

A. C1: (3,3), C2: (-1,4), C3: (8,8)
B. C1: (3,3), C2: (0,4), C3: (8,8)
C. C1: (3,3), C2: (-1,4), C3: (7,8)
D. C1: (2,2), C2: (-1,4), C3: (7,8)

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Compute the average of the data points in each cluster

Q3-3: Which are true about linear regression?
1. When $\lambda \rightarrow +\infty$, ridge regression reduces to OLS.
2. The regression function must be linear in the original input features.
3. Gradient descent can be used to solve OLS.

A. 1,2
B. 1,3
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D. None of the above

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A. 1,2
B. 1,3
C. 2,3
D. None of the above

1: No. when $\lambda \to 0$, ridge regression reduces to OLS
2: No. It only needs to be linear in the parameter
3: Yes. Gradient descent is a general method for optimization.

Q3-4: Which are true about logistic regression?

1. When $\theta^T x_i = 0$, the model will predict label $+1$ with probability close to 1
2. There is ground-truth θ^* that can achieve 0 classification error on the training set
3. Gradient descent can be used to solve the regularized logistic regression problem

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C. 2,3

D. None of the above ←

1: No. predicts ½ for +1, ½ for -1.

2: No. Not 0 classification error. There is randomness in the labels.

3: Yes. Gradient descent is a general method for optimization.

Q3-5: Suppose we have $\theta = [0.5, 0.6, 1]$ for logistic regression. What label will the model predict for $x = [1, -5, 2]$?

A. -1
B. +1
C. Equal probabilities for -1 and +1
D. None of the above

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A. -1
B. +1
C. Equal probabilities for -1 and +1
D. None of the above

The $\theta^T x = -0.5$, so p[y=+1|x]<0.5, so we will predict -1