**Question 1**(10 points)

If all eight queens are placed in the first row of an 8x8 board, the n-queens heuristic discussed in lecture for this state would take what value?  (Note that for this heuristic, a queen can skip over pieces.)

Question 1 options:

|  |  |
| --- | --- |
|  | 0 |
|  | 7 |
|  | 32 |
|  | 64 |
|  | none of the above |

**Question 2**(10 points)

How does a local beam search with width k, starting with k random states, improve on k hill-climbing searches run in parallel from the same k starting states? (Select the single best answer)

Question 2 options:

|  |  |
| --- | --- |
|  | search from one starting point can recruit from other starting regions |
|  | k-width beam search can make more informed decisions on when a random restart is needed |
|  | a beam of width k benefits from batch processing of the members of the beam |
|  | beam members synergize to generate better successors than single states can |
|  | k-width beam search considers more successors at each iteration than k parallel hill-climbing searches combined |

**Question 3**(10 points)

Which search would most naturally benefit from a hash table? (Select the single best answer)

Question 3 options:

|  |  |
| --- | --- |
|  | hill climbing with random restart |
|  | hill climbing with lateral moves allowed |
|  | simulated annealing |
|  | genetic algorithms |
|  | tabu search |

**Question 4**(10 points)

Lateral moves help simple hill climbing escape (Select all that apply)  
[ grade with fraction correct ]

Question 4 options:

|  |  |
| --- | --- |
|  | illegitimate states |
|  | plateaus |
|  | global optima |
|  | basins |
|  | ridges / shoulders |

**Question 5**(10 points)

Nearest neighbor learning and K means learning both: (Select all that apply)

Question 5 options:

|  |  |
| --- | --- |
|  | leverage a distance metric in the feature space |
|  | need to process all the training examples for each test query |
|  | are unsupervised learning techniques |
|  | are supervised learning techniques |
|  | learn a Voronoi diagram |

**Question 6**(10 points)

In K-means learning, the centroids found by learning can be affected by: (Select all that apply)

Question 6 options:

|  |  |
| --- | --- |
|  | choosing a different initial location for the centroids |
|  | rescaling all features and the initial centroids by a factor of two |
|  | the units used for features (say, whether a given feature is reported in meters or centimeters) |
|  | doubling the size of the data set by duplicating all points |

**Question 7**(10 points)

Given enough data, nearest neighbor learning can learn an arbitrarily complex hypothesis without scaling up the number of features. (Select all that apply)

Question 7 options:

|  |  |
| --- | --- |
|  | requires little memory in deployed predictors |
|  | can learn an arbitrarily complex hypothesis |
|  | is limited in expressive power |
|  | learns extremely quickly |
|  | predicts extremely quickly |

**Question 8**(10 points)

In simulated annealing, high temperature refers to  (Select the single best answer)

Question 8 options:

|  |  |
| --- | --- |
|  | a high frequency of randomly generated restarts |
|  | a high likelihood of taking a step that scores poorly on the heuristic |
|  | a learning rate that may take too big a step along the gradient |
|  | the computer has a viral infection |
|  | a high speed of improvement in the heuristic per step |

**Question 9**(10 points)

The K means algorithm is an instance of what general approach to optimization? (Select the single best answer)

Question 9 options:

|  |  |
| --- | --- |
|  | simulated annealing |
|  | alternately optimize one set of choices while holding another set fixed |
|  | follow the gradient to a global optimum |
|  | follow the gradient to a local optimum |
|  | hill climb until a local optimum is reached |

**Question 10**(10 points)

Which of the following clusters in 3-dimensional space CANNOT be discriminated perfectly by learning a K means clustering? (Select all that apply)

Question 10 options:

|  |  |
| --- | --- |
|  | cluster 1: points at distance less than 1 from the origin, cluster 2: points at distance greater than 2 from the origin |
|  | cluster 1: points at distance less than 1 from the origin, cluster 2: points at distance greater than 2 from (1,0,0) |
|  | cluster 1: points at distance less than 1 from the origin, cluster 2: points at distance less then 2 from (5,0,0) |
|  | cluster 1: points with x<0, |y|<5, |z|<5, cluster 2: points with x>0, |y|<5, |z|<5 |
|  | cluster 1: points with x<0, |y|<5, |z|<5, cluster 2: points with x>1, |y|<5, |z|<5 |

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