Markov Chain Monte Carlo

9/10 points (90%)

Quiz, 10 questions

✔ **Congratulations! You passed!**

Next Item

✔   1 / 1
     points

1.

Select correct statements

☐   One can obtain sample from gaussian distribution using one
    sample from uniform

▲

Un-selected is correct

☐   One can obtain n multivariate gaussian samples $x \in \mathbb{R}^n$ from n
    standard 1d gaussian samples.

▲

Un-selected is correct

☐   One can obtain sample from exponential distribution using one
    sample from uniform

▲

Correct
Correct: If $X \sim \mathcal{F}$ is a random variable with CDF $F(x)$ that can be
inverted analytically then $F^{-1}(u) \sim \mathcal{F}$ where $u \sim \mathrm{U}[0, 1]$.
Correspondingly $-\frac{\log u}{\lambda} \sim Exp(\lambda)$.

☐   One can obtain multivariate gaussian sample $x \in \mathbb{R}^n$ from n
    standard 1d gaussian samples

▲

Correct
Correct: any multivariate gaussian $X \sim \mathcal{N}(\mu, \Sigma)$ can be represented
as $\mu + \Sigma^{1/2}\epsilon$, where $\epsilon \sim \mathcal{N}(0, \mathrm{I})$.

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✓ 1 / 1
points

2.

What is a time complexity of an algorithm for sampling a random number from an arbitrary discrete distribution with support $\{1, \ldots, N\}$

○ O(log N)

○ O(N log N)

◉ O(N)

▲

Correct
Correct: prior to sampling we need to compute cumulative sums which is O(N) operations.

○ O(1)

✓ 1 / 1
points

3.

What we can use Monte-Carlo method for?

☑ Do full bayesian inference to estimate the uncertainty of you model.

▲

Correct
Correct: see example in the lecture.

☑ Compute the exact mode of a posterior distribution (MAP-estimation)

▲

Un-selected is correct

☑ Compute an integral of an arbitrary function over a simple area (e.g. a multidimensonal cube)

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Correct

Correct: just sample random points uniformly in the area and average the function values in those points. Note that usually this is not the best approach, although very scalable.

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☐   Estimate the expected values of arbitrary random variables

Correct

Correct: this is what Monte-Carlo method is for.

✔   1 / 1
points

4.

Which of the statements below are correct?

☐   Markov chain does not "remember" states other than current

Correct

Correct.

☐   Any Markov chain is a sequence of discrete random variables, for example: $\{0, 1, 0, 0, 1, 0, 0, \dots\}$.

Un-selected is correct

☐   All elements X_n of a Markov chain $X_n : n \in \mathbb{N}$ are independent random variables.

Un-selected is correct

☐   Any sequence of random variables $X_n : n \in \mathbb{N}$ can be considered as a Markov chain.

Un-selected is correct

☐   Any Markov chain converges to a stationary distribution

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Un-selected is correct

9/10 points (90%)

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✔   1 / 1
points

5.

Which of the statements below are correct?

☐   MCMC techniques are used when ones cannot perform bayesian inference analytically

Correct
Correct.

☐   MCMC provides i.i.d. samples from desired distribution

Un-selected is correct

☐   MCMC can be used to sample from the distribution known up to a normalization constant

Correct
Correct.

✔   1 / 1
points

6.

Which of the statements below are correct?

☐   Gibbs sampling reduces multidimensional sampling to one-dimensional sampling.

Correct
Correct.

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☐ Each iteration of Gibbs sampling changes only one coordinate of a latent vector

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Correct
Correct.

☐ Gibbs sampling is a special case of a Metropolis-Hastings algorithm.

Correct
Correct. Gibbs sampling is a special case of MH with acceptance rate equal to 1.

☐ Gibbs sampling converges really fast because it provides very uncorrelated samples compared to Metropolis-Hastings algorithm

Un-selected is correct

✔ 1 / 1 points

7.
Which of the following is random in Bayesian Neural Networks?

☐ Weights of the network w

Correct
Correct

☐ Prediction of the network y given fixed input x

Correct
Correct. Prediction of the network y depends on the weights which are random variables.

☐ Number of units on each layer of the network

Un-selected is correct

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☐ Number of active layers of the network

▲

Un-selected is correct

✔ 1 / 1
points

8.

What is a good way to train (find the posterior distribution $p(w|D)$) Bayesian Neural Network?

○ Compute the posterior distribution $p(w|D)$ analytically.

○ Iteratively sample each weight from the conditional distribution given all other weights and the data.

◯ Run the stochastic gradient descent perturbing all network weights with independent Gaussian noise after each iteration.

▲

Correct
Correct. This algorithm is called Langevin Monte Carlo and is proved to converge to the true posterior.

✔ 1 / 1
points

9.

What does the word "Collapsed" means in the Collapsed Gibbs Sampling algorithm?

○ It means that the posterior approximation *collapses* to the are posterior distribution.

◯

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It means that posterior distribution over some of the variables is computed analytically, while other variables are sampled using Gibbs Sampling.

Correct
Correct

○ It means that we train the model on the subsample of the original data.

✖ 0 / 1
points

10.
Which of the variables are randomly sampled in Collapsed Gibbs Sampling for LDA?

○ Z

⦿ Φ, Θ

This should not be selected
Wrong

○ Φ, Θ, Z

○ Φ