Introduction to Deep Learning M2177.0043
Seoul National University

Homework #(**1**)
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INSTRUCTIONS

- Anything that is received after the deadline will be considered to be late and we do not receive late homeworks. We do however ignore your lowest homework grade.
- Answers to every theory questions need to be submitted electronically on ETL. Only PDF generated from LaTex is accepted.
- Make sure you prepare the answers to each question separately. This helps us dispatch the problems to different graders.
- Collaboration on solving the homework is allowed. Discussions are encouraged but you should think about the problems on your own.
- If you do collaborate with someone or use a book or website, you are expected to write up your solution independently. That is, close the book and all of your notes before starting to write up your solution.

1 Q1. Learning LaTeX

1.1 2 by 2 table

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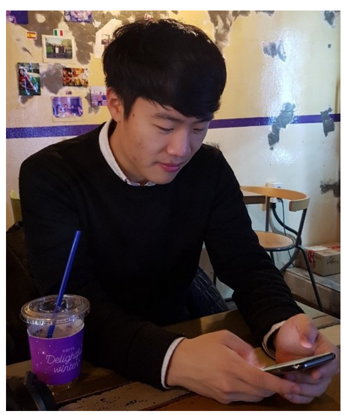
1.2 Profile photo



2 Q2. Inverse transform sampling

2.1 Probability integral transform

By definition of continous uniform distribution, if the random variable $Y = F_X(X)$ is uniformly distributed in $[0,1]$, $F_Y(y) = y$ for all $y \in [0,1]$ and vice versa. As $F_X(x)$ is defined to be equal to $Pr[X \leq x]$, $F_Y(y) = Pr[Y \leq y]$. Random variable Y is defined as $F_X(X)$, thus $F_Y(y) = Pr[Y \leq y] = Pr[F_X(X) \leq y]$. There may be many values such that $F_X(X) \leq y]$. If we denote such values as $F_X^{-1}([0,1])$, then $Pr[F_X(X) \leq y]$ can be written as $Pr[X \in F_X^{-1}([0,y])]$, thus $F_Y(y) = Pr[X \in F_X^{-1}([0,y])]$.

As F_X is continous, there exists a supremum in $F_X^{-1}([0, y])$, and as this is a closed set, this is also a maximum. Let this maximum value be denoted as k, such that $k = max(F_X^{-1}([0, y]))$. Then, $F_Y(y) = Pr[X \in F_X^{-1}([0, y])] = Pr[X \leq k] = F_X(k) = y$ as we defined k to be a maximum element such that $F_X^{-1}([0, y])$.

2.2 Inverse transform sampling

Let a random variable $V = F_X^{-1}(U)$. By definition of continuous uniform distribution, $F_V(x) = Pr[V \leq x]$. If F is applied to the both sides in $V = F_X^{-1}(U)$, then we get $U = F_X(V)$. Therefore $Pr[V \leq x] = Pr[U \leq F_X(x)]$. As U is given as a uniform distribution in $[0, 1]$, $Pr[U \leq F_X(x)] = F_X(x)$. Thus $F_V(x) = F_{F_X^{-1}(U)}(x) = Pr[F_X^{-1}(U) \leq x] = F_X(x)$, implying that $F_X(x)$ is a CDF of $F_X^{-1}(U)$.

2.3 Sampling from exponential distribution

$f(x; \frac{1}{\beta}) = \frac{1}{\beta} \exp(-\frac{x}{\beta})$,

3 Q3

4 Q4