Machine Learning Foundations - HW1

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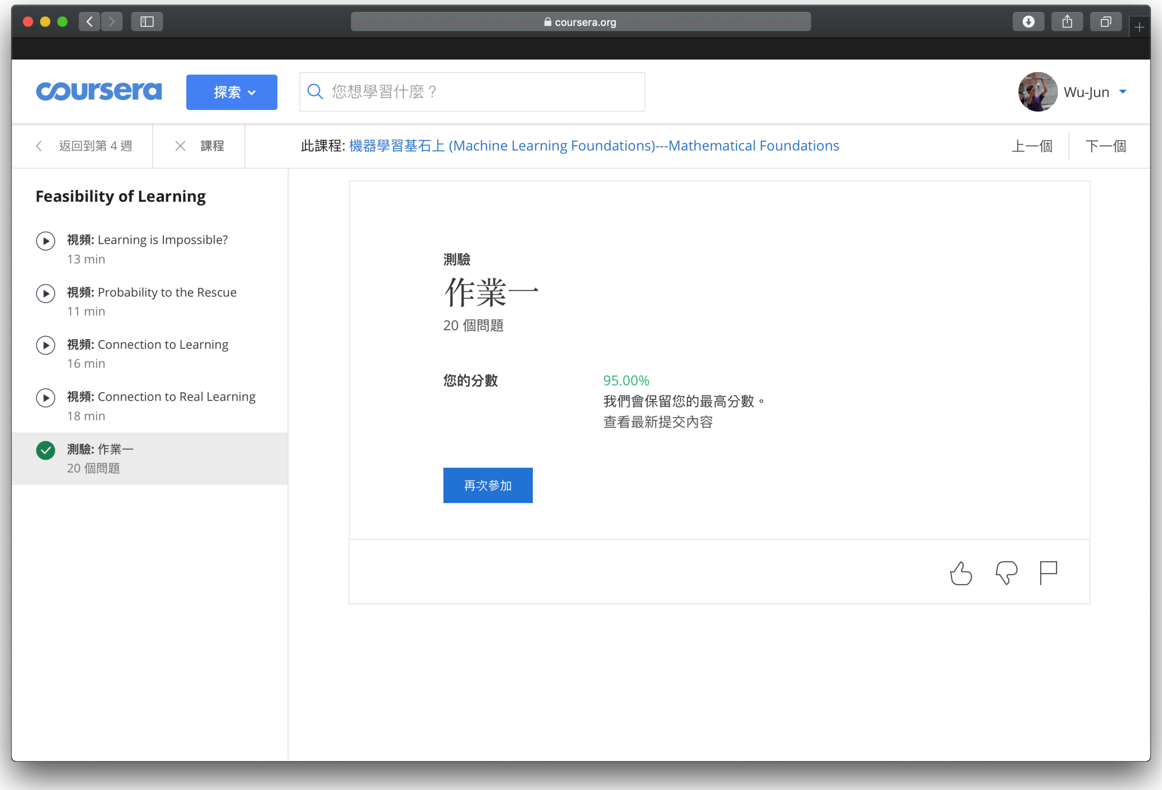
1.



2.

It is easy to observe that

$$
\begin{aligned}
E_{OTS} &= \frac{1}{L} \times (\text{number of even numbers in } [N+1, N+L]) \\
&= \frac{1}{L} \times (\lfloor \frac{N+L}{2} \rfloor - \lfloor \frac{N}{2} \rfloor)
\end{aligned}
$$

3.

Since those every f are equally in probability, given D, there are still 2^L f's generating different outputs of the test input. Let g_1 be the hypothesis generated from A_1 and g_2 be the hypothesis generated from A_2. It is easy to observe that the expected value of E_{OTS} is 0.5.

$$
\mathbb{E}_f\{E_{OTS}(g_1, f)\} = \mathbb{E}_f\{E_{OTS}(g_2, f)\} = \frac{1}{2}
$$

4.

If $v \leq 0.1$, than the number of orange marbles is either 0 or 1. So the probability is

$$
\begin{aligned}
P &= \binom{10}{0} \times (0.8)^0 \times (0.2)^{10} + \binom{10}{1} \times (0.8)^1 \times (0.2)^9 \\
&= (0.2 + 8) \times (0.2)^9 \\
&= 4.1984 \times 10^{-6}
\end{aligned}
$$

If $v \geq 0.9$, than the number of orange marbles is either 9 or 10. So the probability is

$$
\begin{aligned}
P &= \binom{10}{9} \times (0.8)^9 \times (0.2)^1 + \binom{10}{10} \times (0.8)^{10} \times (0.2)^0 \\
&= (2 + 0.8) \times (0.8)^9 \\
&\approx 0.3758
\end{aligned}
$$

5.

To get a green 1's, we need to choose dice from either group A or D, so the probability is

$$
P = \frac{2^5}{4^5} = \frac{1}{32}
$$

6.

To get some number that is purely green, we can discuss each number seperately.

Number	Possible Groups
1	A, D
2	B, D
3	A, D
4	B, C
5	A, C
6	B, C

we can ignore 3 and 6. So the probability is

$$
\begin{aligned}
P &= 4 \times \frac{1}{32} - 4 \times \frac{1}{4^5} \\
&= \frac{32}{256} - \frac{1}{256} \\
&= \frac{31}{256}
\end{aligned}
$$

7.

The way I choose random seed is:

On the t^{th} round, the random seed is t^{29}.