CMPUT 654 Fa 23: Theoretical Foundations of Machine Learning **Fall 2023**

Lecture 1: September 11

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This lecture's notes illustrate some uses of various LaTeX macros. Take a look at this and imitate.

1.1 Some theorems and stuff

We now delve right into the proof.

Lemma 1.1. *This is the first lemma of the lecture.*

Proof. The proof is by induction on .... For fun, we throw in a figure.

Figure 1.1: A Fun Figure

This is the end of the proof, which is marked with a little box. □

We use the cleveref package to refer to numbered things, like this Lemma 1.1.

1.1.1 A few items of note

Here is an itemized list:

- this is the first item;
- this is the second item.

Here is an enumerated list:

1. this is the first item;
2. this is the second item.

Here is an exercise:

Exercise 1.2. Show that $\mathrm{P} \neq \mathrm{NP}$.

Here is how to define things in the proper mathematical style. Let f_k be the $AND - OR$ function, defined by

$$f_k(x_1, x_2, \ldots, x_{2^k}) = \begin{cases} x_1 & \text{if } k = 0; \\ AND(f_{k-1}(x_1, \ldots, x_{2^{k-1}}), f_{k-1}(x_{2^{k-1}+1}, \ldots, x_{2^k})) & \text{if } k \text{ is even;} \\ OR(f_{k-1}(x_1, \ldots, x_{2^{k-1}}), f_{k-1}(x_{2^{k-1}+1}, \ldots, x_{2^k})) & \text{otherwise.} \end{cases}$$

Theorem 1.3. *This is the first theorem.*

Proof. This is the proof of the first theorem. We show how to write pseudo-code now.

Consider a comparison between x and y:

if x or y or both are in S **then**
    answer accordingly
else
    Make the element with the larger score (say x) win the comparison
    if $F(x) + F(y) < \frac{n}{t-1}$ **then**
        $F(x) \leftarrow F(x) + F(y)$
        $F(y) \leftarrow 0$
    else
        $S \leftarrow S \cup \{x\}$
        $r \leftarrow r + 1$
    endif
endif

This concludes the proof. $\square$

1.2 Next topic

Here are some citations, just for fun: Chen et al. [2018], Kiefer and Wolfowitz [1960], Du et al. [2019].

1.3 Bibliography

Yichen Chen, Lihong Li, and Mengdi Wang. Scalable bilinear π learning using state and action features. In *ICML*, pages 833–842, 2018.

S. S. Du, S. M. Kakade, R. Wang, and L. F. Yang. Is a good representation sufficient for sample efficient reinforcement learning?, 2019.

J. Kiefer and J. Wolfowitz. The equivalence of two extremum problems. *Canadian Journal of Mathematics*, 12(5): 363–365, 1960.