CMPUT 654 Fa 23: Theoretical Foundations of Machine Learning

Fall 2023

Lecture 1: September 11

Lecturer: Csaba Szepesvári Scribes: scribe-name1,2,3

Note: LaTeX template courtesy of UC Berkeley EECS dept. (link to directory)

Disclaimer: These notes have <u>not</u> been subjected to the usual scrutiny reserved for formal publications. They may be distributed outside this class only with the permission of the Instructor.

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 $P \neq NP$.

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

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

Theorem 1.3. *This is the first theorem.*

```
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
```

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

This concludes the proof.

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.