

## HW0: Survey and basic concepts

Use the handin system to submit your assignments. Remember that only PDF submissions are accepted. We encourage using  $\text{\LaTeX}$  to produce your writeups. See `hw0.tex` for an example of how to do so. You can make a `.pdf` out of the `.tex` by running “`pdflatex hw0.tex`”. **Due: Aug 30**

### 1 Student Survey

Please note the following information on your assignment:

1. Which of the following courses have you taken: Differential calculus; Integral calculus; Multivariate calculus; Linear algebra; Probability and statistics; Artificial intelligence; Algorithms; Computer vision; Image processing; Natural language processing; Robotics; Optimization (linear, quadratic, convex, etc.)
2. List a few (research/CS/math/whatever) topics that interest you.
3. How would you rate your programming skills (1-10, 10 best)? How would you rate your math skills?
4. What are your goals in this class?
5. Please provide a 4-8 character identifier that we can use to post grades only pseudo-anonymously. Use only alpha-numeric (no spaces).
6. Please be sure that you have subscribed to the class mailing list.

### 2 Written Problems

Answer the following questions in 50-100 words each:

1. What is the difference between supervised, unsupervised and reinforcement learning?
2. List at least two real-world problems (other than those discussed in class) for each of the categories: supervised, unsupervised and reinforcement. For one of the supervised problems, what is the form of the output and what might be a reasonable input? For the reinforcement learning problem, what might be the state space, action space and reward function?
3. What is overfitting? What is underfitting? How is overfitting controlled?
4. Getting labeled data for supervised learning is expensive. What are some of the approaches to deal with this problem?

### 3 Additional Exercises

The following are true/false questions. You don't need to answer the questions. Just tell us which ones you can't answer confidently in less than one minute. (You won't be graded on this.) If you can't answer at least 6, you should probably spend some extra time outside of class beefing up on elementary math.

1.  $\log x + \log y = \log(xy)$

2.  $\log[ab^c] = \log a + (\log b)(\log c)$

3.  $\frac{\partial}{\partial x}[5x^2 + 3x] = 10x + 3$

4.  $\frac{\partial}{\partial x} \log x = -\frac{1}{x}$

5.  $p(a \mid b) = p(a, b)/p(b)$

6.  $p(x \mid y, z) = p(x \mid y)p(x \mid z)$

7.  $\|\alpha \mathbf{u} + \mathbf{v}\|^2 = \alpha^2 \|\mathbf{u}\|^2 + \|\mathbf{v}\|^2$ , where  $\|\cdot\|$  denotes Euclidean norm,  $\alpha$  is a scalar and  $\mathbf{u}$  and  $\mathbf{v}$  are vectors

8.  $|\mathbf{u}^\top \mathbf{v}| \geq \|\mathbf{u}\| \times \|\mathbf{v}\|$ , where  $|\cdot|$  denotes absolute value and  $\mathbf{u}^\top \mathbf{v}$  is the dot product of  $\mathbf{u}$  and  $\mathbf{v}$

9.  $\int_{-\infty}^{\infty} dx \exp[-(\pi/2)x^2] = \sqrt{2}$