

# Pretest (Not counted into final grades)

- You are flying from City A to City C. But there is no direct flight between the two cities. It is known that there are 2 non-stop flights from City A to City B, and then 3 non-stop flights from City B to City C. How many different routes can you possibly have from City A to City C by visiting City B exactly once?
- Department X has 5 500-level classes and 6 600-level classes. As part of the program requirement, a PhD student needs to take 2 500-level classes and 3 600-level classes. So how many different study plans are possible in Department X? (For 500- and 600-level classes only)
- Professors are just one occupation on campus. In University X, 80% of the PhDs are professors while 60% of all employees (professors and all other occupations) are PhDs. What is the chance to meet a random employee on campus who is a PhD and a professor?
- Let the set  $S = \{x \in \mathbb{N}^+ | \forall y \in [2, \dots, x-1] : (x \bmod y) \neq 0\}$  where  $\mathbb{N}^+ = \{1, 2, 3, \dots\}$  and  $\bmod$  is the modulo operator (returns the remainder of integer division). List the smallest 3 elements of the set  $S$ .
- Given a function  $b : \mathcal{O} \times \mathcal{P} \mapsto \mathcal{Q}$ , whose function table is as follows:

$\mathcal{O}$	$\mathcal{P}$	$\mathcal{Q}$
"cow"	2	1.5
"cow"	4	0.5
"home"	2	0.3
"home"	4	1.8

what is  $\arg \max(b)$ ?
- Given the same function  $b$  above, list all elements of the set  $D = \{p | b(d, p) > 1, d \in \mathcal{O}, \text{ and } p \in \mathcal{P}\}$
- Given two sets  $S = \{1, 2\}$  and  $T = \{4, 5\}$ , list all elements of the Cartesian product  $S \times T \times S$ . Use round brackets to delimit tuples.
- Let  $f(x, y) = x^2 + \sqrt{y}$ . What is  $f(y, x)$ ?
- Let  $f(x, y) = x^3 + y^2$ . What is  $\frac{\partial f}{\partial x} \Big|_{x=3, y=0}$ ?
- Let's write some code in C/C++/Java/Python/etc. Suppose that you are programming a robot, which has many sensors and displays. According to the manual, you have the following functions:
  - $\mathbf{h}(\mathbf{x})$  that converts a floating point number ( $\mathbf{x}$ ) into an array of ASCII code as the return
  - $\mathbf{i}(\mathbf{x}, \mathbf{y})$  that takes an array of ASCII code ( $\mathbf{x}$ ) as the input and displays them on display number  $\mathbf{y}$  of the robot. (no return).

If sensor number 5 and number 17 are temperature sensors, and you want to display the average temperature from the two on display number 6, write one line of code to do so by calling the functions above.
- Evaluate the formula:  $\prod_{x \in X} x$  where  $X$  is a set  $\{1, 2, 3\}$ .
- What is the dot product between the two vectors  $\vec{x} = [1, 2, 3]$  and  $\vec{y} = [2, 0, 1]$ ?
- What is the Manhattan distance between two vectors  $\vec{x}$  and  $\vec{y}$  above?
- What is the inverse of the matrix  $\begin{bmatrix} 1 & 1 & 2 \\ 2 & 2 & 4 \\ 5 & 6 & 7 \end{bmatrix}$ ? If you believe it does not exist, explain why.
- On UNIX systems, what command will you use to rename a file?
- In order to ssh into the server gauss.cs.iastate.edu with the username `nlp`, what will you type on your BASH in order to login?
- MATLAB user manual describes the installation of MATLAB on Linux as follows: "Downloaded installer file — Use the `unzip` command to extract the files from the archive file that you downloaded from the MathWorks website. After extracting the files, execute the installer command: `./install` "

Supposet that when you are doing it, the terminal shows the follows:

```
nlp@isu:~/ $ ./install
bash: ./install: Permission denied
nlp@isu:~/ $ ls -l ./install
-rw-r--r-- 1 nlp cs 0 Aug 28 20:49 ./install
```

What command would you run to fix the "permission denied" issue?

## Appendix 1: Multiplication and Addition Tables

$\times$	0	1	2	3	4	5	6	7	8	9
0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9
2	0	2	4	6	8	10	12	14	16	18
3	0	3	6	9	12	15	18	21	24	27
4	0	4	8	12	16	20	24	28	32	36
5	0	5	10	15	20	25	30	35	40	45
6	0	6	12	18	24	30	36	42	48	54
7	0	7	14	21	28	35	42	49	56	63
8	0	8	16	24	32	40	48	56	64	72
9	0	9	18	27	36	45	54	63	72	81

+	0	1	2	3	4	5	6	7	8	9
0	0	1	2	3	4	5	6	7	8	9
1	1	2	3	4	5	6	7	8	9	10
2	2	3	4	5	6	7	8	9	10	11
3	3	4	5	6	7	8	9	10	11	12
4	4	5	6	7	8	9	10	11	12	13
5	5	6	7	8	9	10	11	12	13	14
6	6	7	8	9	10	11	12	13	14	15
7	7	8	9	10	11	12	13	14	15	16
8	8	9	10	11	12	13	14	15	16	17
9	9	10	11	12	13	14	15	16	17	18