

1. (a) (5 points) Write a **recursive** Python function that takes a string as input, and returns the number of vowels(*i.e.*, a, e, i, o, u) in this string.
- (b) (10 points) An n -gram is defined as a continuous sequence of words, where the length of the sequence is n . For example, 3-grams in "to be or not to be" are ["to", "be", "or"], ["be", "or", "not"], ["or", "not", "to"] and ["not", "to", "be"]. Given a string and n , write a Python function that returns n -grams in this string as a list of lists. You can assume n is not larger than the number of words in the string, and it is positive.

2. Given a list of words(`[word1, word2, word3, ...]`), use `map`, `filter` or `reduce` functions to write Python programs that can compute the following:
- (a) (3 points) Append " `word`" to the end of each and every word
 - (b) (3 points) Return only the words that have more than one "x" letters
 - (c) (3 points) All words appended together
 - (d) (3 points) Return the words that have more than one "x" letter with " `word`" appended to the end
 - (e) (3 points) Return sum of the numbers of letters in the words where there are more than one "x" letters

3. Perl programming.

- (a) (9 points) Write a Perl subroutine that takes two words as separate parameters. If the first word is longer than the second one, the subroutine should return the first string reversed. If the second word is longer than the first one, the subroutine should remove the last letter of the second string and return as a new variable. If two strings are of the same length, the subroutine should concatenate them and return this concatenated string.
- (b) (6 points) Write a Perl program that prompts user to enter a sentence, and prints two things: (i) total number of letters in this sentence, except spaces(*e.g.*, "hello world" will have 10 letters) and (ii) lengths of the individual words as an array.

4. For the regular expressions presented below, provide **one** string that is matched by the whole regular expression in the **first** bullet, and **one** string that is not matched by the whole regular expression in the **second** bullet.

(a) (2 points) `^\d{3}\d*(-)\d{3}(-)\d{4}$`

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(b) (2 points) `[^\w]+`

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(c) (2 points) `(\w{1,3})*[a-z]+\d`

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(d) (2 points) `(\D)(\d)(\w)(\b)(\W)(\d)\d`

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(e) (2 points) `[cat|dog]`

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5. (a) (2 points) Write a regular expression to match only letters (but not digits, and both lowercase and uppercase), for arbitrary number of (*i.e.*, 0 or more) times.

(b) (3 points) Write a regular expression to match email addresses, and capture the part before the domain name (*e.g.*, capture "name" in name@domain.com).

(c) (3 points) Write a regular expression that can match `<TAG>` and `</TAG>` and capture the string in between.

(d) (2 points) Write a regular expression that can match and replace digits with the corresponding letter in the first 10 letters of the alphabet (lowercase) (*e.g.*, $0 \rightarrow a$, $1 \rightarrow b$, ..)

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6. (a) (4 points) Write the set of commands to list all of the currently logged in users in a computer, get the line corresponding to the username with the lowest ASCII order(*i.e.*, one starting with the letter with lowest ASCII value), and append this to a pre-existing usernames.txt file.
- (b) (4 points) Write a shell script that takes two parameters from the command line(*i.e.*, `./code.sh param1 param2`), adds the first parameter to the \$PATH environment variable, and searches for the second parameter in the whole filesystem.

Fill-in-the-blanks questions:

- (c) (1 point) _____, _____ and _____ are three BASH commands one can use to display all content of a file.
- (d) (1 point) _____ command is used for searching a specified pattern in a string.
- (e) (1 point) _____ command is used for deleting a variable.
- (f) (1 point) Retrieving a resource from web can be done using _____ command.
- (g) (1 point) _____ contains the number of command line arguments in a shell script.
- (h) (1 point) _____ command is used for scheduling jobs in a UNIX environment.
- (i) (1 point) Locations of executable programs are stored in a variable named _____ .

True/False Questions:

- (j) (1 point) ____ Pipes are usually used between commands and files while redirection is usually used between two commands.
- (k) (1 point) ____ `mkdir` command is needed to move directories.
- (l) (1 point) ____ `2 >` operator redirects only STDERR.
- (m) (1 point) ____ Pipes and redirections cannot be used together in the same command.
- (n) (1 point) ____ Current directory is stored in \$HOME environment variable.

7. (15 points) Explain the structure and the purpose of the components of a Flask application(*e.g.*, models, forms, functions in routes file, templates), and what happens when a user requests a URL served by a Flask application. Try to be as specific as possible.

