Exercise 1 [The Sieve of Sundaram]
The sieve of Sundaram is an algorithm to find all the prime numbers up to a specified integer. It was discovered by the Indian mathematician S. P. Sundaram in 1934. Fixed $N \in \mathbb{N}$ and given the list of the integers between 1 and $N$, remove all the numbers of the form 

$$i + j + 2ij \quad \text{where} \quad i \in \mathbb{N} \quad , \quad j \in \mathbb{N} \quad , \quad 1 \leq i \leq j \quad \text{and} \quad i + j + 2ij \leq N \ .$$

All the remaining numbers, doubled and incremented by one, give all the prime numbers smaller than $M \equiv 2N + 2$ except 2.

(i) Implement the Sieve of Sundaram in a code which gets the value $N$ as first command line option $argv[1]$ and either prints all the prime numbers smaller than $M$ or prints how many prime numbers exist up to $M$.

Time to Test! For $N = 500$, your code should tell that there are 168 prime numbers up to $M = 1002$.

(ii) Run your code with $N \in \{2 \cdot 10^4, 5 \cdot 10^4, 2 \cdot 10^5, 5 \cdot 10^5, 2 \cdot 10^6\}$ and measure the execution time, saving it in a file. Plot the obtained data as function of $M$ on a bi-logarithmic scale. How does the algorithm compare to a naive prime numbers search?

Hint: Even if it could sound natural, do not use an array of int variables. Instead, think of the array index as your starting list for the sieve and use a smart data type to keep track of deleted numbers, which are indeed never deleted.

Exercise 2 [Palindrome-ness of strings]
A palindrome is a sequence of characters which reads the same backward as forward, such as racecar. Sentence-length palindromes may be written when allowances are made for adjustments to capital letters such as in Madam, and word dividers, such as in Was it a car or a cat I saw.

(i) You are requested to write a program that should achieve a case-sensitive and space-sensitive check on a maximally 100-characters-long string, telling the user whether the string is or is not palindrome. To read the input string you can use once again the scanf function, with the special conversion specifier %[^\n] matching all characters until a new line character \n is met. Can you devise an alternative to the usage of scanf in order to read the input string?

(ii) Optional: Your code can easily be extended to perform a non case-sensitive check. Just look into ctype.h for a function that can help you in this task.

(iii) Optional: As a further extension of your program you could have it neglecting (read deleting) spaces to get a neither case-sensitive nor space-sensitive check.

Time to Test! According to a correct implementation of (i) racecar is palindrome, while Racecar and race car are not. Also Madam and Racecar will instead be considered as palindromes by your program extended according to (ii). Finally, if you were able to extend your program according to (iii), even Was it a car or a cat I saw, along with race car should be recognized as palindromes.