

## Programming C++

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### Project Kaprekar Constant

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The Indian mathematician D.R. Kaprekar<sup>1</sup> found a constant named after him which can be achieved using the rule described in Wikipedia<sup>2</sup>. There are unique constants for 3- and for 4-digit numbers with base 10, but we get non-unique constants and/or non-unique cycles for all other numbers of digits with base 10.

The final goal of this project consists in determining the constants and cycles for 2-20 digit numbers in base 10 and afterwards in an arbitrary base.

1. Implement the rule for 3 or 4 digit numbers of base 10. One possible course of action:
  - Write function(s) that generate the smallest and the largest number from a given number  $n$  with digits  $abcd$  contained in the given base.
  - Compare your constants with those from literature.
  - Take care that the result of, e.g.  $221 - 122$  is again interpreted as 3-digit number. Similar with more digits.

Storing the numbers:

- You might store your numbers as `int` or `unsigned long long int` and extract the digits from this representation.
  - On the other hand you might store the numbers in its digits representation and provide the necessary functionality (min, max, subtract, ...). A (template?) class would encapsulate that.
2. Extend you algorithm such that cycles as well as constants are determined for others than 3 or 4 digits. (6 Pkt.)
    - Use 2-10 digits<sup>3</sup> in base 10.
    - Use 11-20 digits<sup>4</sup> in base 10.  
Data type `long long int` fully includes up to 17 digits.
    - More than 20 digits?
  3. Extend your algorithms to an arbitrary base. Check the results for special bases with available results<sup>5</sup>. (+2 Pkt.)

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<sup>1</sup>[https://en.wikipedia.org/wiki/D.\\_R.\\_Kaprekar](https://en.wikipedia.org/wiki/D._R._Kaprekar)

<sup>2</sup>[https://de.wikipedia.org/wiki/Kaprekar-Konstante#Verfahren\\_zur\\_Berechnung\\_der\\_Kaprekar-Konstante](https://de.wikipedia.org/wiki/Kaprekar-Konstante#Verfahren_zur_Berechnung_der_Kaprekar-Konstante)

<sup>3</sup><http://kaprekar.sourceforge.net/output/sample.php>

<sup>4</sup><http://kaprekar.sourceforge.net/output/sample2.php>

<sup>5</sup>[https://en.wikipedia.org/wiki/Kaprekar's\\_routine#Kaprekar's\\_constants\\_and\\_cycles\\_of\\_the\\_Kaprekar\\_mapping\\_for\\_specific\\_base\\_b](https://en.wikipedia.org/wiki/Kaprekar's_routine#Kaprekar's_constants_and_cycles_of_the_Kaprekar_mapping_for_specific_base_b)