Introduction

Applications of discrete mathematics:

- Formal Languages (computer languages)
- Compiler Design
- Data Structures
- Computability
- Automata Theory
- Algorithm Design
- Relational Database Theory
- Complexity Theory (counting)

Example (counting):

The Traveling Salesman Problem

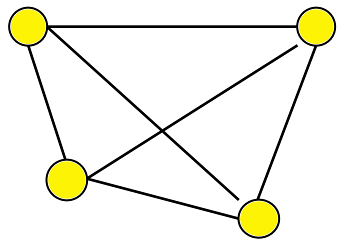
Important in

- circuit design
- many other CS problems

Given:

- n cities $c_1, c_2, \ldots, c_n$
- distance between city i and j, d_{ij}

Find the shortest tour.



Assume a very fast PC:

1 flop = 1 nanosecond
= 10^{-9} sec.
= 1,000,000,000 ops/sec
= 1 GHz.

A tour requires n-1 additions. How many different tours?

Choose the first city n ways,
the second city n-1 ways,
the third city n-2 ways,

etc.

tours = n (n-1) (n-2) . . . .(2) (1) = n! (*Combinations*)

<u>Total number of additions</u> = (n-1) n! (*Rule of Product*)

If n=8, T(n) = 7•8! = 282,240 flops < 1/3 second.

HOWEVER . . . .

If n=50, T(n) = 49•50!
= 1.48 10^{66}

$= 1.49\ 10^{57}$ seconds
$= 2.48\ 10^{55}$ minutes
$= 4.13\ 10^{53}$ hours
$= 1.72\ 10^{52}$ days
$= 2.46\ 10^{51}$ weeks
$= 4.73\ 10^{49}$ years.

...a long time. You'll be an old person before it's finished.

There are some problems for which we do not know if efficient algorithms exist to solve them!

