Natural Computing
Practical Assignment
Why a Practical Assignment

• Hands on experience with the stuff learned during the lectures

• Find the gap between theory and in practice

• Get actively involved

• Find out how cool it is!
Implement in MATLAB three nature-inspired algorithms for solving TSPs, based on:
- Simulated Annealing
- Genetic Algorithms
- Ant Colony Optimization

Test your algorithms on three benchmarks and report your results

Find a full description at: http://natcomp.liacs.nl/NC

Illustration: Mac Evans
Source: http://gtresearchnews.gatech.edu/reshor/rh-f04/tsp.html
The Traveling Salesman Problem

- Given a list of cities and their pairwise distances, find a shortest possible tour that visits each city exactly once

- NP-hard problem combinatorial optimization problem

- We consider Euclidean TSPs where the distance between the cities is measured as Euclidean distance

The nature-inspired algorithms

• The nature-inspired algorithms:
  – Simulated Annealing
  – Genetic Algorithms
  – Ant Colony Optimization

• Over the coming weeks, they will be discussed during the lectures

• Start as soon as possible (you can already start today)
MATLAB

• Implementations should be in MATLAB

• We provide skeleton-files that you should use to implement your algorithms

• We will (try to) run and compare your submissions and identify the best submission (that is why you should use the template provided by us)

A short MATLAB tutorial will follow
We provide

- Skeleton files for your implementations
- The three test problems, and some more
- Helper functions, among which a function for evaluating candidate tours, and a deterministic TSP solver
Your three benchmark problems

Djibouti (38 cities)  
Qatar (194 cities)  
Uruguay (734 cities)
A good submission

• Contains an implementation that works

• Shows that you understand the basics of the nature-inspired algorithm

• Shows pseudocode and a brief description of the algorithms from which the code is reproducible

• Shows results of test runs showing that the implementations work

• Should be neat (i.e., proper layout, no spelling errors, etc.)

• No long stories! Just describe the algorithm and the results!
Important!

• Don’t spend enormous amounts of time on improving your algorithms and trying to obtain better and better results… unless you want to…

• Contact the teaching assistant if you are stuck! The more you ask, the more you learn!
How to obtain above average grades?

- Submitting the best implementation

- Doing more than the minimal required

- Implementing ideas from other papers, e.g.:
Even Santa Struggles with TSP

Found through: http://www.tsp.gatech.edu)
TSP Art


- Optimal tours for a collection of cities tend to have some of the same density properties as the collection itself.

- In regions where cities are packed, you get a lot of traveling in tight little knots; where cities are spaced out, you tend to travel in long straight ways.

- One can convert halftone image into a single line drawings.
A Nice Challenge…

- The China map counts 71,001 locations
- Don’t try to solve this with your desktop machine.., you need something bigger
Recommended Reading

• Two good starting points:
  – http://www.tsp.gatech.edu/

• The Nearest Neighbor algorithm (the deterministic algorithm provided for you):