Picture Creation And Synthesis Using Bacterial Evolution Algorithm

Content of This Presentation:

- Brief Introduction to BEA
- Making Pictures using BEA

Client: Tom Gedeon
Supervisor: Alistair Rendell
Student: Jian Yin Shen
What is it?

An algorithm that searches suitable solution for a given problem.

What is it good for?

Solving NP-hard problems, finding a better answer in the solution space. (Although not optimal)

What kind of algorithm is this?

An algorithm of Genetic Algorithm class.

So What is Genetic Algorithm? (Next page explains...)
A Concept Borrowed From Darwin

Evolutionism: how could species perfect themselves?

An Iterative Procedure:

- Multiplication, Crossover (Chromosome Interchange)
- Random Mutation
- Natural Selection

Result:

*Individuals that carries better DNA (or RNA) have a better chance to survive, and descent their characteristics to their successors*
The deeper the color, the better the individual
“X” indicates that the individual is washed out thus has no successor.
How Genetic Algorithm solve NP-Hard problems?

- Randomly select solutions from solution space
- Put these solutions as the first generation of a simulated evolution:
  1. Crossover (Combine 2 or more solutions into new solutions)
  2. Mutation (Randomly change a small amount of expressions of the solution)
  3. Selection (by using a fitness function)
  4. Repeat from 1 until requirement is satisfied

Result:

Solution(s) strong enough to survive many generations could be a good answer to the NP-Hard problem (not optimal)
How does bacteria multiply?

- Autogeny (duplicate itself)
- DNA absorb
Target:
Making NICE pictures Using BEA

(How?)
Sample: a picture generated by computer using BEA

Picture from:
“Evolutionary Image Synthesis Using a Model of Aesthetics”
Brian J. Ross, William Ralph, and Hai Zong
**Problem Analysis**

**Requirement**

*Make a nice picture.*

**Definition of “Picture”**

*A 2D Matrix of pixels whose values are expressed by RGB.*

**Solution Space**

*All possible pictures.*

*A picture using 8bit RGB of 1024 x 768 resolution, number of all possible pictures would be:*

\[(256^3)^{(1024 \times 768)} = 16777126^{786432} \text{ (pictures)}\]

**Target**

*Find a nice one from these possibilities.*

*NP-Hard.*
- Randomly generate pictures (which are probably not nice) as first generation

- Multiplication
  (a picture absorbs pixels from other pictures, like bacteria does in its multiplication)

- New generation is evaluated by a fitness function
1. Generating pictures which fit human taste.
   *Principles of aesthetics maybe implemented to generate sketch.*

2. Way to evaluate pictures – how nice they are?
   *(implementation of the fitness function) possible impl: color analysis using statistics.*

3. A Proper Bacterial DNA Absorb Behavior
   *Implementation of synthesis between pictures in same generation*
Could be one from:

**Java**
*Strong Typing. Perfect library support*
*Not agile enough. Fussy.*

**Python**
*Dynamic. Good library support*
*Agile. Function Programming supported.*

**Ruby**
*Extremely dynamic and agile. FP supported.*
*Unknown library support.*
*Need to learn.*