



Algorithms In Nature

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UCAS students open day 22/3/2013 & 5/4/2013

Algorithms

"Algorithms are just computer talk..."

Algorithms are a set of instructions to be performed to accomplish some task.

http://publications.csail.mit.edu/abstracts/abstracts07/patrycja/patrycja.html

Muḥammad ibn Mūsā al-Khwārizmī

Algebra

Arithmetic

Astronomy

Cartography

The number Zero

and Algorithms



http://en.wikipedia.org/wiki/File:Abu_Abdullah_Muhammad_bin_Musa_al-Khwarizmi_edit.png

Morphogenesis

Morphogenesis

from the Greek

Morph – shape or from

Genesis – origin or creation

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Origin of the form

Sea Shells

Where do sea shells come from?





http://asiber.ifs.hr/alien_seashells_en.html

Sea Shells

Where do sea shells come from?



The outer layer protecting molluscs or other sea creatures.

Creature has died and rotten away (or eaten)



http://asiber.ifs.hr/alien_seashells_en.html

Sea Shells



Sound



http://www.huddersfield-phil.org.uk/wp-content/uploads/2009/12/28.4.2012-HTH-Concert.-150th-Anniv.3.jpg

An algorithm for decomposing complex waves into component frequencies



http://www.yalescientific.org/2010/12/fourier-transform-natures-way-of-analyzing-data/

Cochlea

This is all done in the ear



Cochlea - Morphogenesis

Recognise this shape? 2,000 Hz A 1,500 Hz 3,000 Hz 400 Hz 600 Hz cochlear duct base 00 H: 800 Hz 4,000 Hz 1,000 Hz 20,000 Hz basilar 7,000 Hz membrane 5,000 Hz ©1997 Encyclopaedia Britannica, Inc.

http://en.wikipedia.org/wiki/File:French_horn_front.png http://en.wikipedia.org/wiki/File:NautilusCutawayLogarithmicSpiral.jpg

Morphogenesis - Spirals







Ants

Ant live in complex colonies

Tiny brains

Achieve tremendous feats

Work together: *synergy*



Need to move all rings onto another pole

Can only move one ring at a time

Can't place a larger ring on top of a smaller one

Complexity 2ⁿ - 1 where n is the number of rings.



http://korpisworld.blogspot.co.uk/2009/09/tower-of-hanoi.html

Tower of Hanoi – Ant Solution



Represent the problem as a maze

Ants lay pheromones as they explore and find food

Ants quickly adapt to changes in the maze

Ramsch et al. Jorunal of Theoretical Biology, Vol 306, 2012

Slime



Physarum polycephalum

A form of slime mould

Can also solve the Hanoi maze

Seen here replicating the Tokyo train network with protoplasmic veins

> Reid and Beekman Jorunal of Experimental Biology, Vol -, 2013

Tero et al. Science, 2010



Thanks for listening,

any questions?

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