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Group # 1 Artificial Life

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Flower petals

It grows in a consistent manner with fibonacci sequence that has three petals and but sepals with their five petals that can be seen easily.

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Source: https://sunnysports.com/blog/5-examples-of-the-fibonacci-sequence-in-plants/

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F_n be fibonacci sequence that $\lim_{n\to\infty} \frac{F_{n+1}}{F_n} = \phi$ (golden ratio),

Question asks whether fibonacci sequence is growing faster than exponential function,

1 then $\lim_{n\to\infty} \frac{F_n}{e^n} = \lim_{n\to\infty} \frac{\phi^n}{e^n} = 0$ because $e > \phi$ and exponential grows faster
(2.71) (1.61)

So, the statement is false because golden ratio is smaller than exponential growth.

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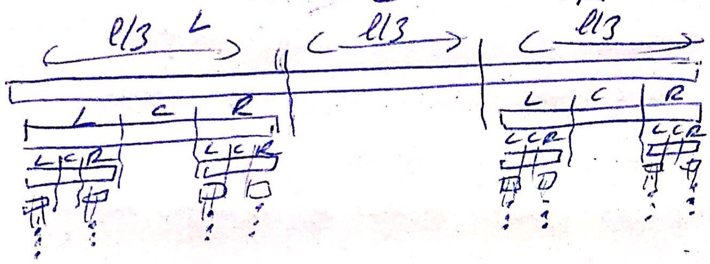

Cantor set is a single line that has been divided into pieces with specific properties. In there, each step, length is divided into 3 pieces and as remains, then it is removed into 3 new pieces. So Cantor set is a set of points and remaining proportion must can be found by total length removed.

$C_n = \frac{C_{n-1}}{3} \cup \left(\frac{2}{3} + \frac{C_{n-1}}{3}\right)$ for $n \geq 1$

2 $C = \bigcap_{n=1}^{\infty} C_n$, in total we have $\sum_{n=0}^{\infty} \frac{2^n}{3^{n+1}} = \frac{1}{3} + \frac{2}{9} + \dots = \frac{1}{3}\left(\frac{1}{1-\frac{2}{3}}\right) = 1$

the proportion remaining unit left is $1 - 1 = 0$, so actually there is no anything left because each time we count $\frac{2}{3}$ and $\frac{1}{3}$ but at each step, after going infinitely, we take entire $\frac{1}{3}$ remaining into account and there is ~~not~~ no remaining left. $= 0$ //

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- some of components, keywords or special words should be specified whether they should be counted or not
- some of most common words (slang) should not be used.
- code comments should be discarded in natural language corpora
- word frequencies should be considered by comparing word forms and lemmas in long texts so that we can make decision which one is stable

We can analyze the large amount of data by using log-log plot to see it clearly because word frequencies will hold for different aspects of languages and also word choices.

source = https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0129031

2

4a.) In the Ant Algorithm, the individual decision of an ant to take a path k out of the K possible paths, is depending on the pheromone concentration C_k on that very path.
This pheromone dependent decision is typically implemented using softmax, or a Boltz-mann distribution.
Describe and explain the decision algorithm; write down the formulas for both variants possibilities, and explain how they are used to gain a decision for the ant.

In the iteration, each ant constructs a complete solution to the problem according to a probabilistic state ~~to~~ transition rule. The state transition rule depends mainly on the state of the pheromone and visibility of the ant.
For path between i to j, it is represented ~~by~~ as η_{ij}. ~~and to~~
The node transition is probabilistic. The ant decision table is obtained by combining the visibility and pheromone trails as:

$$a_{ij}(t) = \frac{[\tau_{ij}(t)]^{\alpha} \cdot [\eta_{ij}]^{\beta}}{\sum_{l \in N_i} [\tau_{il}(t)]^{\alpha} \cdot [\eta_{il}]^{\beta}} \quad \forall j \in N_i$$

Where, the ant is in the city i.

$\tau_{ij}(t) \rightarrow$ amount of pheromone in the i to j path,

$N_i \rightarrow$ set of neighbouring cities from city i

α and $\beta \rightarrow$ represent constants that determine the relative influence of pheromone and visibility respectively.

For the xth ant on node i, the selection of the next node j to follow is according to the node transition probability:

$$P^{x}_{ij}(t) = \frac{a_{ij}(t)}{\sum_{l \in N^{x}_i} a_{il}(t)} \quad \forall j \in N^{x}_i$$

Scanned by CamScanner

where $N_i^x \in N_i$ is the list of neighboring nodes from node i available to ant x at time t.
When every ant has constructed a solution, the intensity of pheromone trails on each edge is updated by the pheromone updating rule (global pheromone updating rule). The global pheromone updating rule is applied in two phases. First an evaporation phase where a fraction of the pheromones evaporates and then a reinforcement phase, where the elitist ant, which has the best solution among others, deposits an amount of pheromone:

$$\tau_{ij}(t+d) = (1-\rho)\cdot \tau_{ij}(t) + \rho \cdot \Delta\tau_{ij}^{+}$$

where, $\rho\ (0<\rho<1) \Rightarrow$ the persistence of pheromone trails ($(1-\rho)$ is the evaporation rate)

$d \rightarrow$ number of variables or movement an ant must take to complete a tour.

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$\Delta\tau_{ij}^{+} \rightarrow$ amount of pheromone increase ~~from~~ for the elitist ant. ~~and equals:~~

At the end of each movement, the local pheromone update reduces the level of the ~~pher~~ pheromone trail on paths selected by the ant colony during the preceding iteration.
When an ant travels to node j from node i, the local update rule ~~adject~~ adjects the intensity of pheromone on the path connecting the two nodes as:

$$\tau_{ij}(t+1) = \xi \cdot \tau_{ij}(t)$$

where, $\xi \Rightarrow$ adjustable parameter between 0 and 1 representing the persistence of the pheromone.