Implementation of Cuckoo Search Algorithm

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Mini Project Presentation
Department of Computer Science and Engineering
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Group Members

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- Anoop Gopan - 10
- Ashik Salman P - 16
- Lal Krishna Raj - 32

What!?

Context

Let's discuss something NEW..!!

- Algorithms.

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- Algorithms.
- Swarm Intelligence.

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- Algorithms.
- Swarm Intelligence.
- Nature Inspired Algorithms.
- Intractable problems.
- Optimization Algorithms.
  - PSO.
  - ACO.
  - DE.
  - GA.
  - ABC.

Abstract

Cuckoo Search Algorithm

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- New Metaheuristics optimisation algorithm.

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- Implementation in Python.

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- Comparative study with existing MATLAB implementation.

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- New Metaheuristics optimisation algorithm.
- Implementation in Python.
- Comparative study with existing MATLAB implementation.
- Future Scope.

System Specification

Software Requirements

- Front end : Tkinter module in Python.
- Back end : Python 2.7.1+
- Platform : Linux.

Hardware Requirements

- Processor : Intel Pentium 4 or above.
- RAM : 2 GB or above
- Hard Disk : 1 GB free space or more

Cuckoo Search

Introduction

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Cuckoo Search

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- Finds Optimal solutions.
- Two efficient implementations have been introduced.
- Yang and Deb implemented CS in MATLAB.
- Nebojsa Bacanin developed an object oriented version in JAVA.

Why it is "Cuckoo" Search..?

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Why it is "Cuckoo" Search..?

- Breeding behaviour of Cuckoo Species.
- Random walk.
- Mimics host's egg.
- Survives unless NOT found by HOST.
- Mimics call of host chicks.

Implementation

Four Phases.

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- Understanding Algorithm Concepts.

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- GUI Development.
- Comparison study.

Implementation

Python.

- General purpoes High Level Language.
- Interpreted Language.
- Supports Multi paradigm.
- Rich in library function.
- Pylab and Mayavi to Plot

TKinter

- Ease of use and design.

Cuckoo Search

Objective function $f(\boldsymbol{x})$, $\boldsymbol{x} = (x_1, ..., x_d)^T$;
Initial a population of n host nests $\boldsymbol{x}_i$ $(i = 1, 2, ..., n)$;
while (t <MaxGeneration) or (stop criterion);
  Get a cuckoo (say i) randomly by Lévy flights;
  Evaluate its quality/fitness F_i;
  Choose a nest among n (say j) randomly;
  if $(F_i > F_j)$,
    Replace j by the new solution;
  end
  Abandon a fraction (p_a) of worse nests
    [and build new ones at new locations via Lévy flights];
  Keep the best solutions (or nests with quality solutions);
  Rank the solutions and find the current best;
end while
Postprocess results and visualisation;

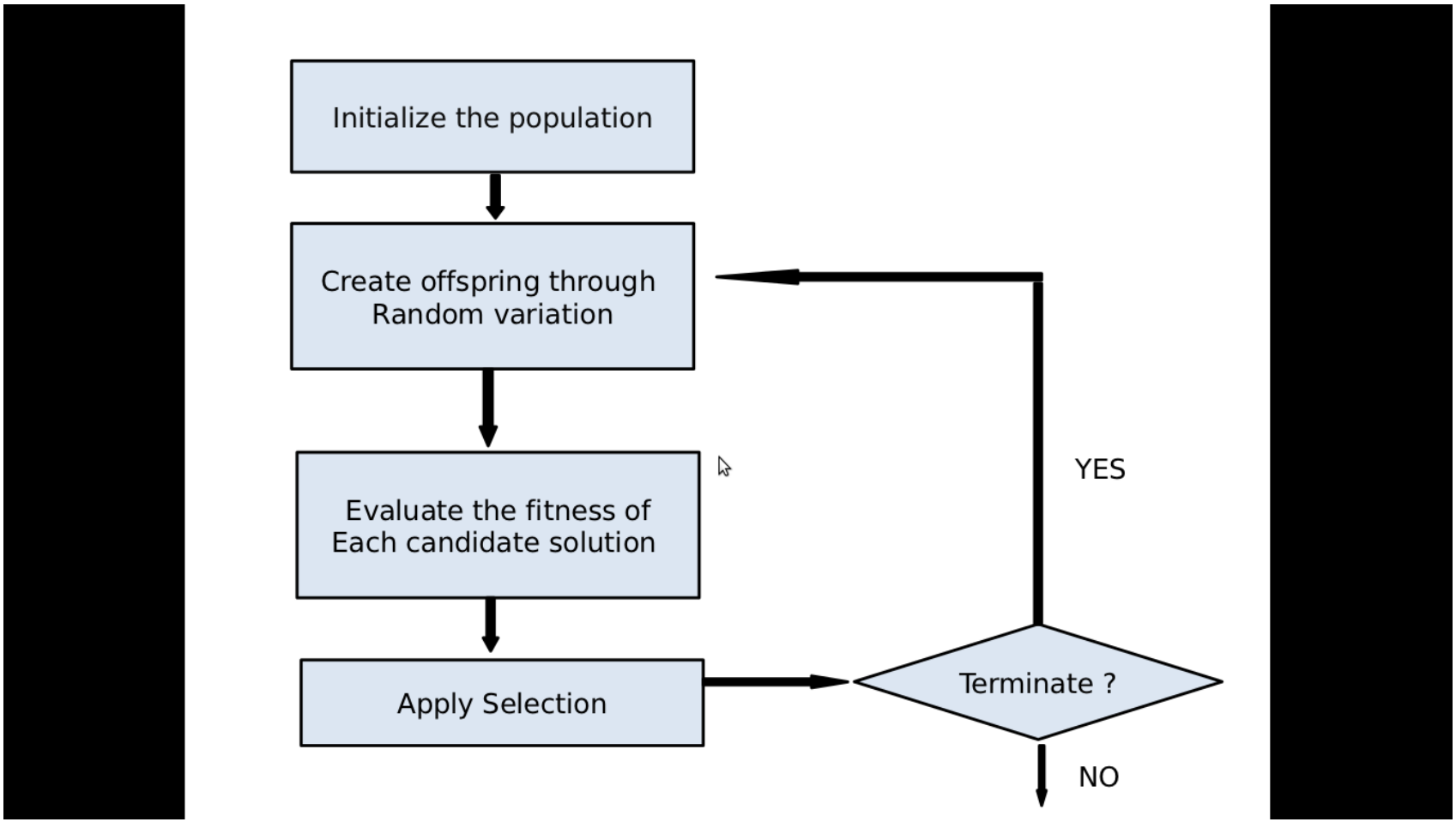
Implementation

Understanding Algorithm Concepts.

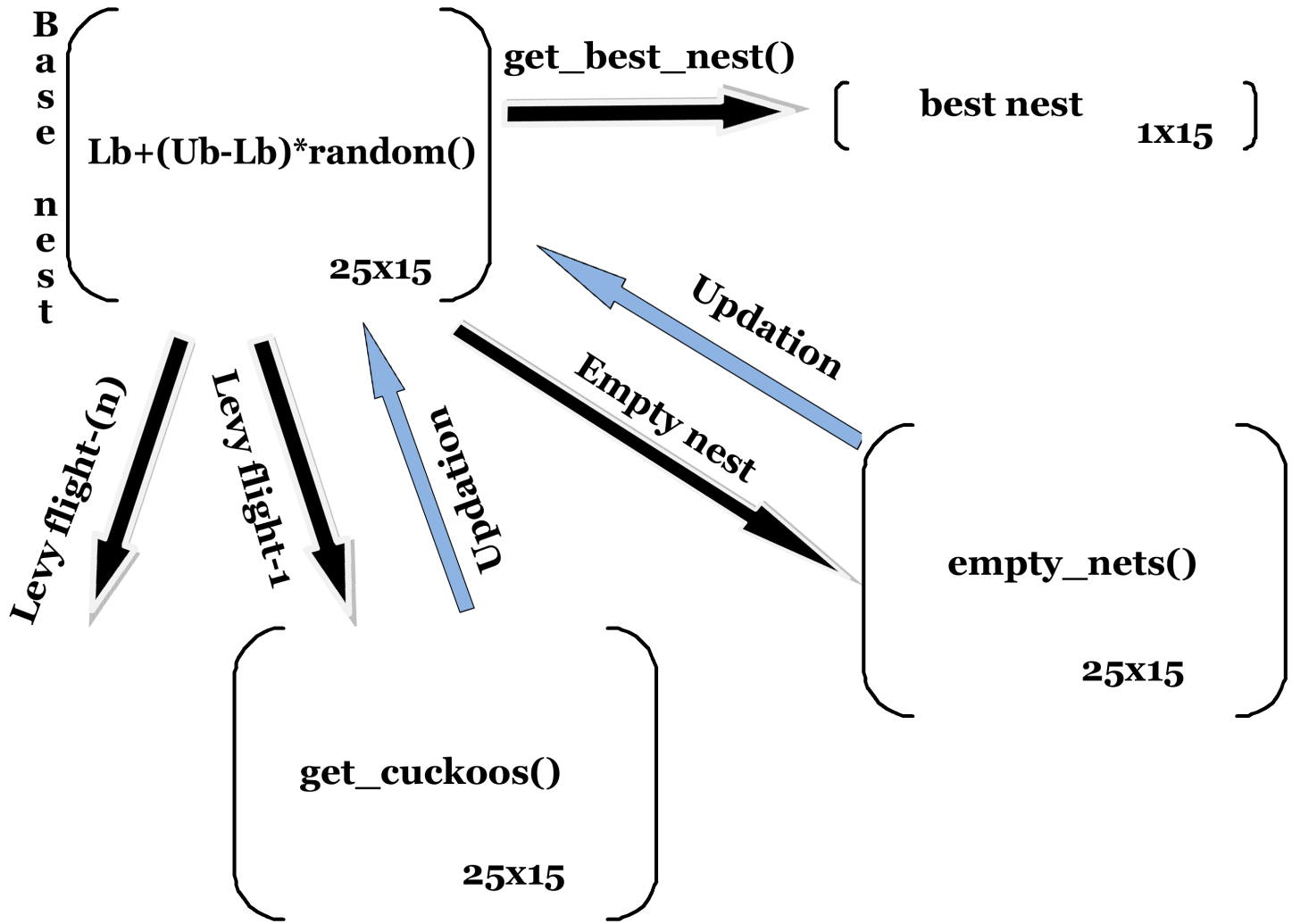
- Creating random candidate solutions.
- Checking for the fitness of solutions.
- Getting a minimum value.
- If min value meets the tolerance condition stop iteration.
- Else create a set by Levy flight
  and checks iteratively for a better solution.

Data Flow Diagram

How it works..?



What actually happens



Implementation

Mapping to Python.

- Representing Nests as arrays and Matrices.
  - Python Numpy Module - ease of math operations.
- Creating initial random candidate solution set.
  - Python Random module - generates random variables.
- User defined functions.
  - get-best-nest, get-cuckoos, empty-nest etc.
- Loops
  - Checks iteratively to meet tolerance condition.
- Output.
  - Prints fmin, best-nest, execution time, iterations.

Conclusion

In this project we have implemented Cuckoo Search Algorithm in Python and tested using Sphere function, a standard benchmark.

Result

- Testing using Sphere function resulted in obtaining optimization of function.
- It is found that Cuckoo Search Algorithm can outperform the existing Metaheuristics algorithms.
- The optimal solution obtained by CS are far better than the best solutions obtained by an efficient PSO.
    - Courtesy : Engineering optimisation by Cuckoo Search, IEEE arXiv:1005.2908v3 [math.OC] 23 Dec 2010.

Performance.

- Promising results obtained with minimum number of iterations.

Application.

Engineering Optimization Problems.

- Spring Design.

$$\text{Minimise } f(\boldsymbol{x}) = (L+2)w^2 d,$$

- Welded Beam.

$$\text{minimise } \ f(\boldsymbol{x}) = 1.10471 w^2 L + 0.04811 dh(14.0 + L),$$

Nurse Scheduling Problems

Future Scope

- Data Fusion In Wireless Sensor Networks.
- Modified CS Algorithm is a powerful gradient free optimisation algorithm.
- Can be integrated with many existing optimisation algorithms to get better performance.

Contribution by members.

Ashik Salman P
Lal Krishna Raj

- Understanding Algorithm Concepts and MATLAB implementation.

Anand Krishnan R

- Coding in Python.

Anoop Gopan

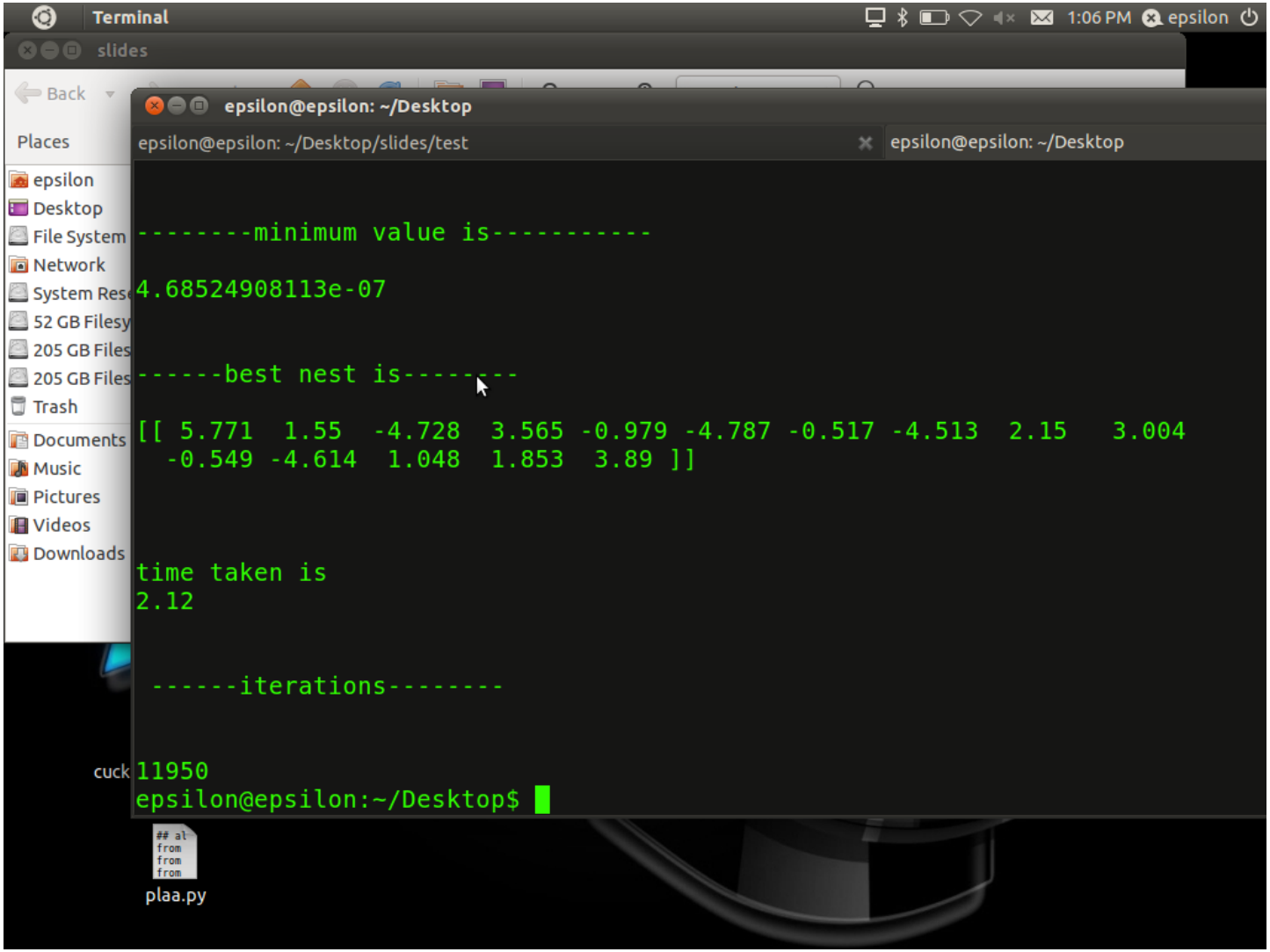
- Comparison Study.

Reference

- Engineering Optimisation by Cuckoo Search - Paper presented by Xin-She Yang and Suash Deb.
  - IEEE reference : arXiv: 1005.2908v3 [math.OC] 23 Dec 2010.
- An Object-oriented software implementation of a novel cuckoo search algorithm - paper presented by Nebojsa Bacanin.
  - Proceedings of the European Computing Conference, Ministry of Science, Republic of Serbia, Project No. 44006

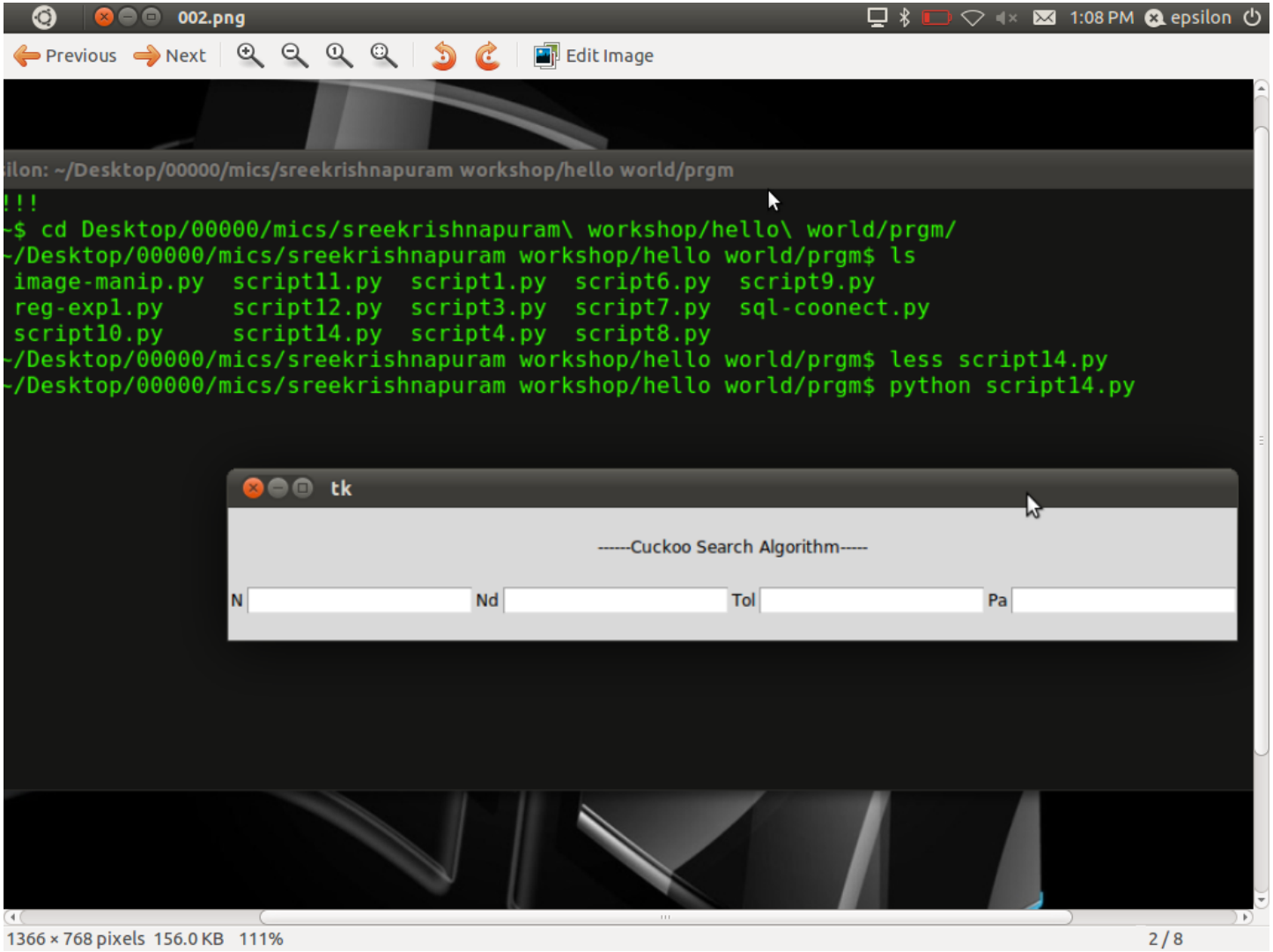
Screen Shots

Code Execution



Screen Shots

GUI Interface



Thank you!