Application of evolutionary computation to the advanced image processing

Farid Ghareh Mohammadi

Ph.D Student in Computer Science Department at

 University of Georgia

Outlines:

Problem statement

Curse of Dimensionality

Steganography VS Steganalysis

Preliminaries of Evolutionary algorithms

Stegnalaysis Examples IFAB and RISAB

Summary

Emerging problems:

High-Dimensional Data

- ❏ Multimedia
  - ❏ High-resolution images; High-resolution videos
  - ❏ Data from multiple sensors
- ❏ Bioinformatics
  - ❏ Expressions of genes
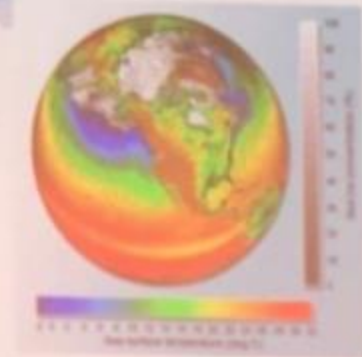 - ❏ Neurons
- ❏ Social networks
  - ❏ Tweets/likes/friendships
  - ❏ Other interactions
- ❏ Weather and climate
  - ❏ Multiple measurements (e.g., temperature)
  - ❏ Time series data
- ❏ Finance
  - ❏ Stock markets
  - ❏ Time series data

Steganalysis Started getting important ...

September 11 2001

Work to be discussed

IFAB

Image steganalysis using a bee colony based feature selection algorithm
FG Mohammadi, MS Abadeh - Engineering Applications of Artificial ..., 2014 - Elsevier
Feature selection is one of the most significant phases of pre-analysis processing, which can influence the performance of steganalysis. In this paper, we have proposed a new feature-based blind steganalysis method for detecting stego images from the cover images in JPEG images using a feature selection technique based on artificial bee colony (IFAB). Most usual techniques for feature selection are wrapper methods and filter methods which IFAB is one of the wrapper based feature selection methods. Artificial bee colony (ABC) algorithm is ...
☆ 99 Cited by 72 Related articles All 3 versions Web of Science: 42

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RISAB
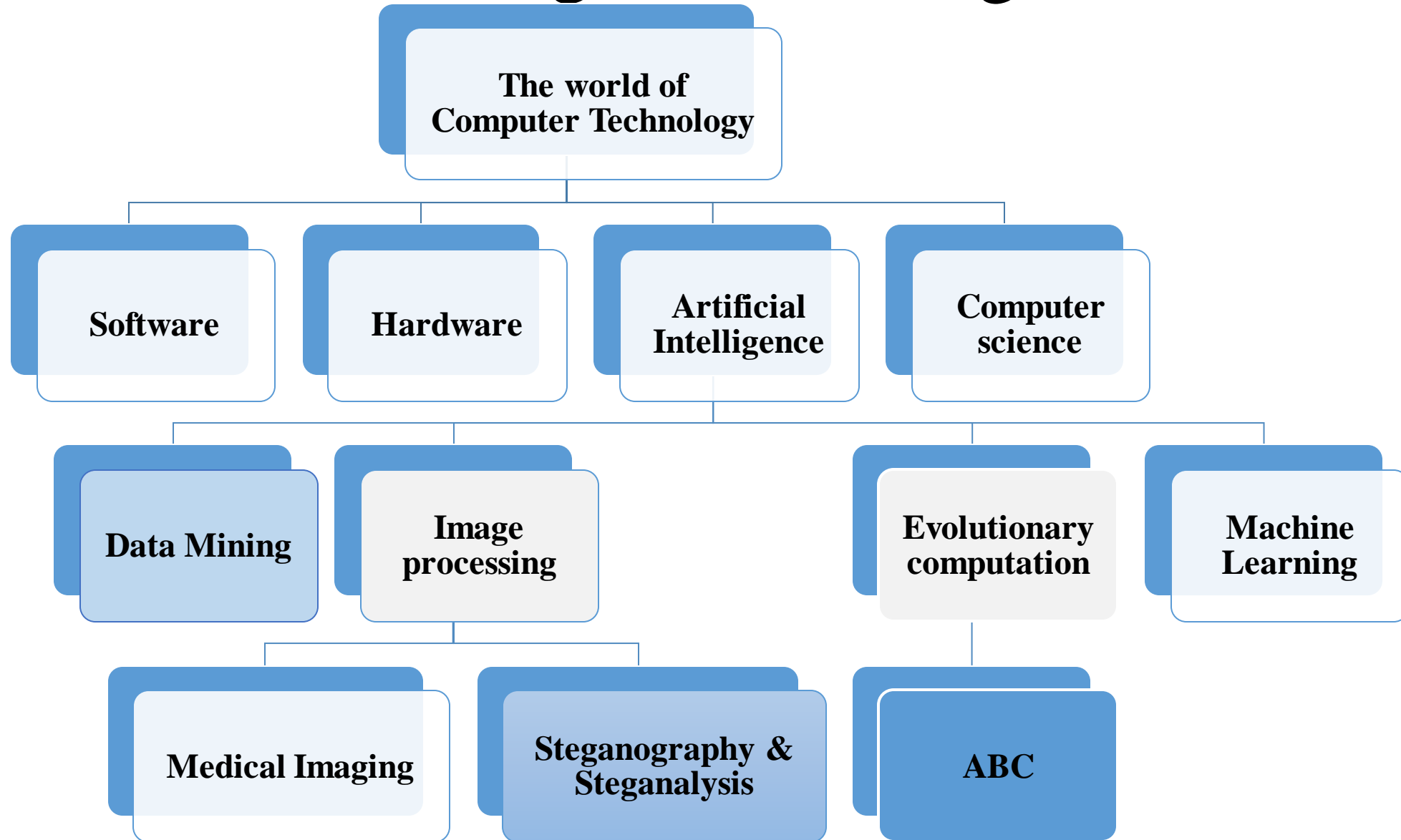
Region based image steganalysis using artificial bee colony
FG Mohammadi, H Sajedi - Journal of Visual Communication and Image ..., 2017 - Elsevier
Steganalysis is the art and skill of discriminating stego images from cover images. Image steganalysis algorithms can be divided into two broad categories, specific and universal. In this paper, a novel universal image steganalysis algorithm is proposed which is called RISAB, Region based Image Steganalysis using Artificial Bee colony. The goal of the proposed method is to realize a sub-image from stego and cover images through ABC with respect to density according to the cover, stego and difference images. In our method, we ...
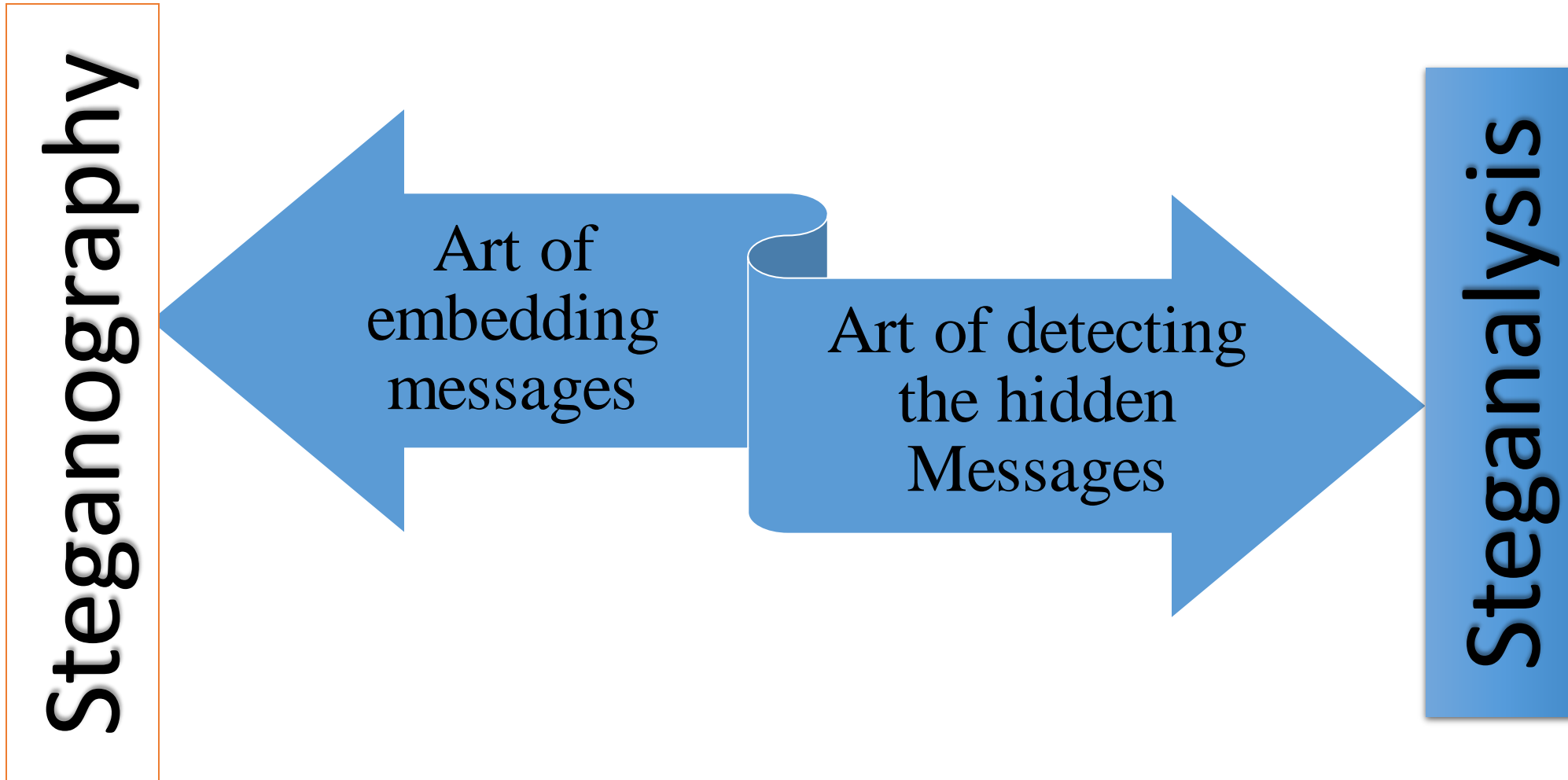☆ 99 Cited by 12 Related articles All 2 versions Web of Science: 5

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Introduction to Image Proceesing

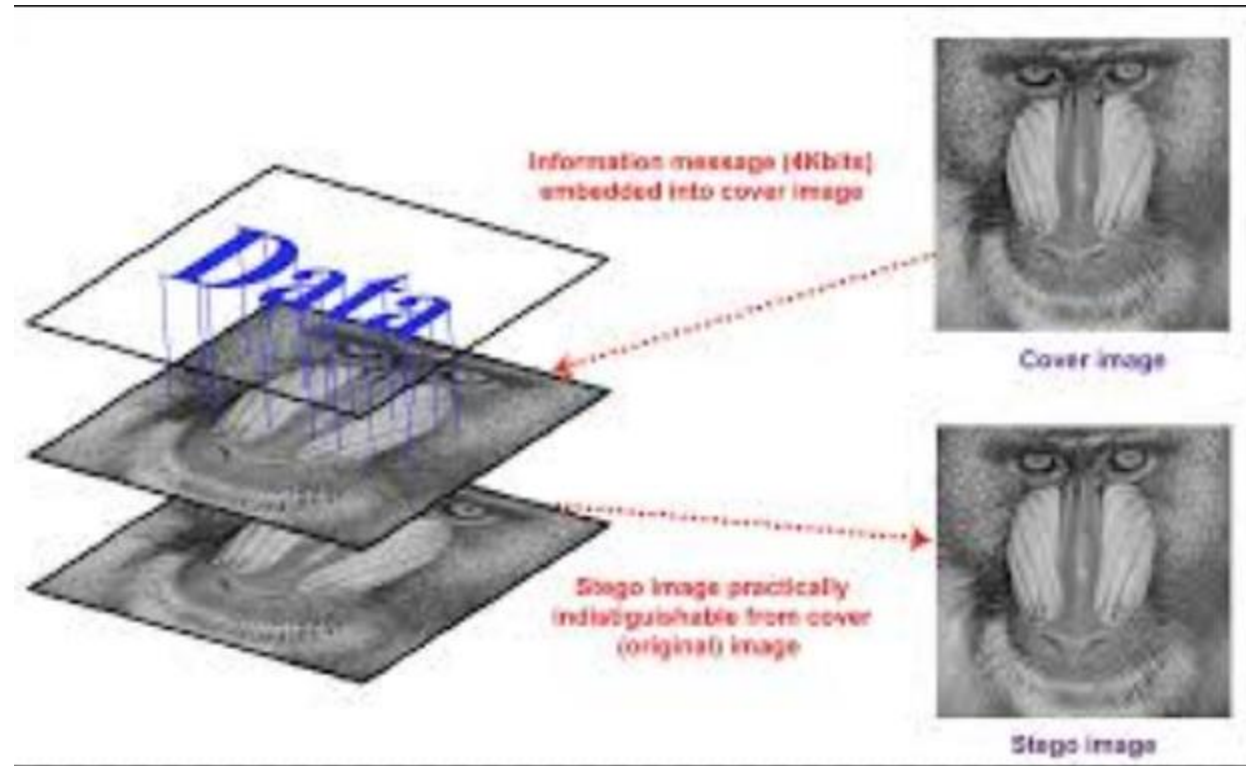# Very Quick Shot

Steganography

Art of embedding messages

Art of detecting the hidden Messages

Steganalysis

Image Processing
Steganography VS Steganalysis

Steganography

Security level

Original Image

Watermarked Image

Stego VS Cover

Image Processing
Steganography VS Steganalysis

LSB IN IMAGES

Hidden message: 101001...
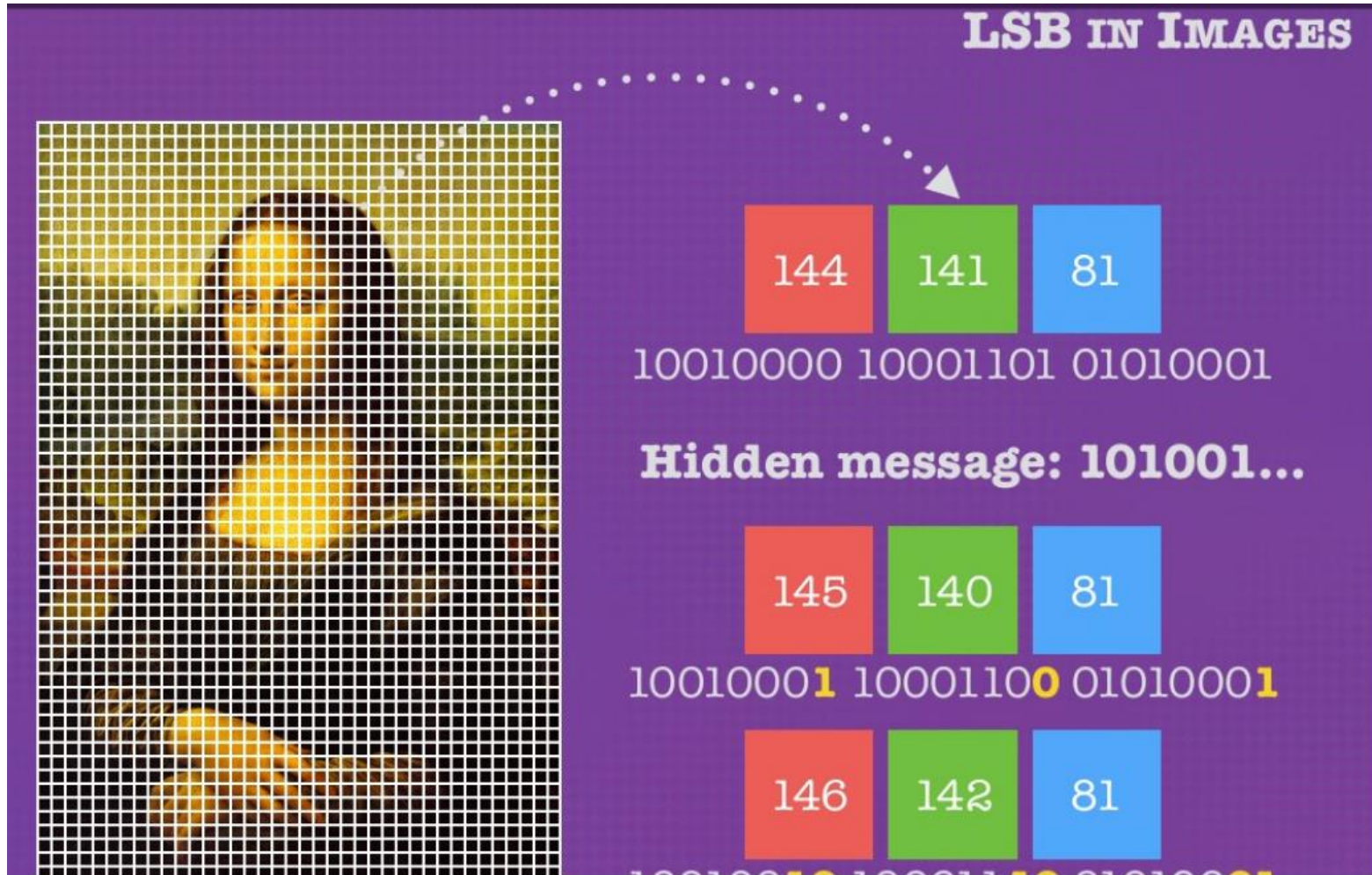
Triple Channel Image
- RGB
- HSV

One Channel Image
- Binary
- Gray

(0-255)

General Steganography

My friend Bob,

until yesterday I was using binoculars for stargazing. Today, I decided to try my new telescope. The galaxies in Leo and Ursa Major were unbelievable! Next, I plan to check out some nebulas and then prepare to take a few snapshots of the new comet. Although I am satisfied with the telescope, I think I need to purchase light pollution filters to block the xenon lights from a nearby highway to improve the quality of my pictures.

Cheers,
Alice.

MfBuyIwubfsTIdttmntTgiLaUMwuNIptcosnatpttafs
otcAlaswttItIntplpftbtxlfanhtitqompCA

$\pi = 3.14159265589793\ldots$

Clear?

Cover Message

Secret Key

Buubdlupnpsspx

Yes

Cover Message

Secret Key

Attack Tomorrow

Preliminaries of Evolutionary algorithms

Ghareh Mohammadi *et al* 2019

Preliminaries of Evolutionary algorithms

A sample solution : [20,520,..,560,34]

Current generation of population

Generation t
Solution 1
Solution 2
Solution 3
Solution 4
Solution 5
Solution 6
Solution 7
Solution 8
Solution 9
Solution 10

Parent Selection

Solution 3

Solution 7

Crossover

Offspring

New solution

Mutation

Mutated offspring

Updated solution

Next generation of population

Generation t+1
Updated Solution 1
Updated Solution 2
Updated Solution 3
Updated Solution 4
Updated Solution 5
Updated Solution 6
Updated Solution 7
Updated Solution 8
Updated Solution 9
Updated Solution 10

Ghareh Mohammadi *et al* 2019

Preliminaries of Evolutionary algorithms

Cross over: regular combination through all generation

Mutation: Random updating solution, after crossover

Reproduction

Genome: ATTGCGCCATGAT   ATTAAACCATAGT

Crossover:
ATTG | CGCCATGAT
ATTA | AACCATAGT

ATTG | AACCATAGT

Mutation:
ATTGAACCATAGT
ATTGAAGCATAGT

Why Evolutionary algorithms?

**AKA:**   **Curse of Dimensionality (CoD) : too much information!**

	Dimension			
SRMQ1	12,753	SRMQ1.m	Spatial	[10]
SPAM	686	spam686.m	Spatial	[6]
CC-PEV	548	ccpev548.m	JPEG	[5,3]
J+SRM	35,263	see Notes	Both	[2]
PSRM3 (PSRM8)	12870 -34320	PSRM.m PSRM.zip PSRM.tar	Spatial	[11]
PSRM	12870	PSRM.m PSRM.zip PSRM.tar	Spatial	[12]
CSR	1183	CSR.m	Spatial	[13]
DCTR	8000	DCTR.m DCTR.zip DCTR.tar	JPEG	[14]
maxSRM	34,671 (12,753)	maxSRMq2d2.zip	Spatial	[15]
SCRMQ1, CRMQ1	12753 + 5404	SCRMQ1.m	Spatial, color	[16]
PHARM	12600	PHARM.m PHARM.zip PHARM.tar	JPEG	[17]
CFA-aware CRM	5514, 4146, 10323	SRMQ1CFA.m	Spatial, color	[18]
GFR	17000	GFR.m	JPEG	[19]
sigma-features	1980	sigma-spamPSRM.m	spatial	[20]

Feature Extraction Optimization
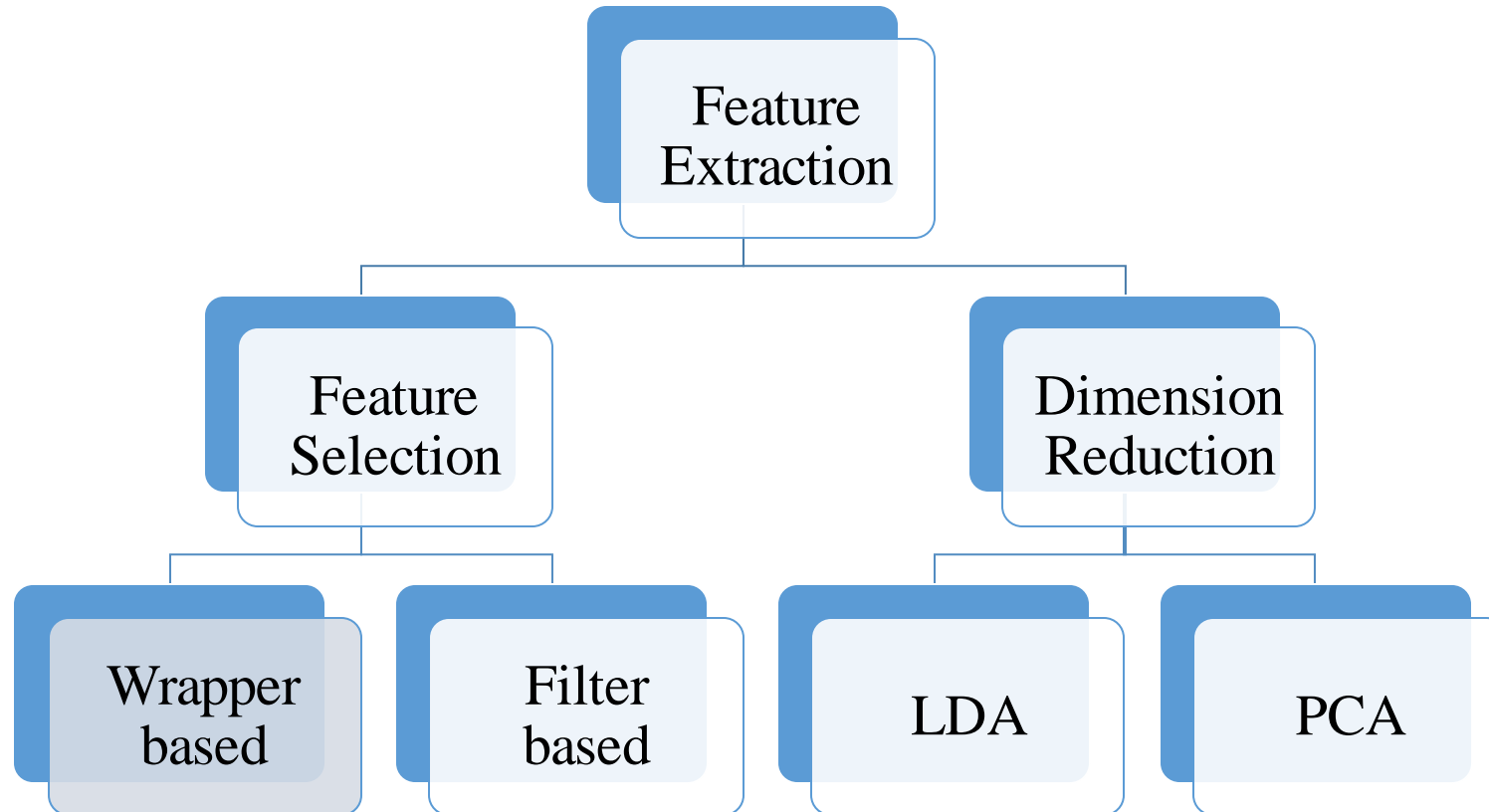
General procedure of Evolutionary algorithm

Ghareh Mohammadi *et al* 2019
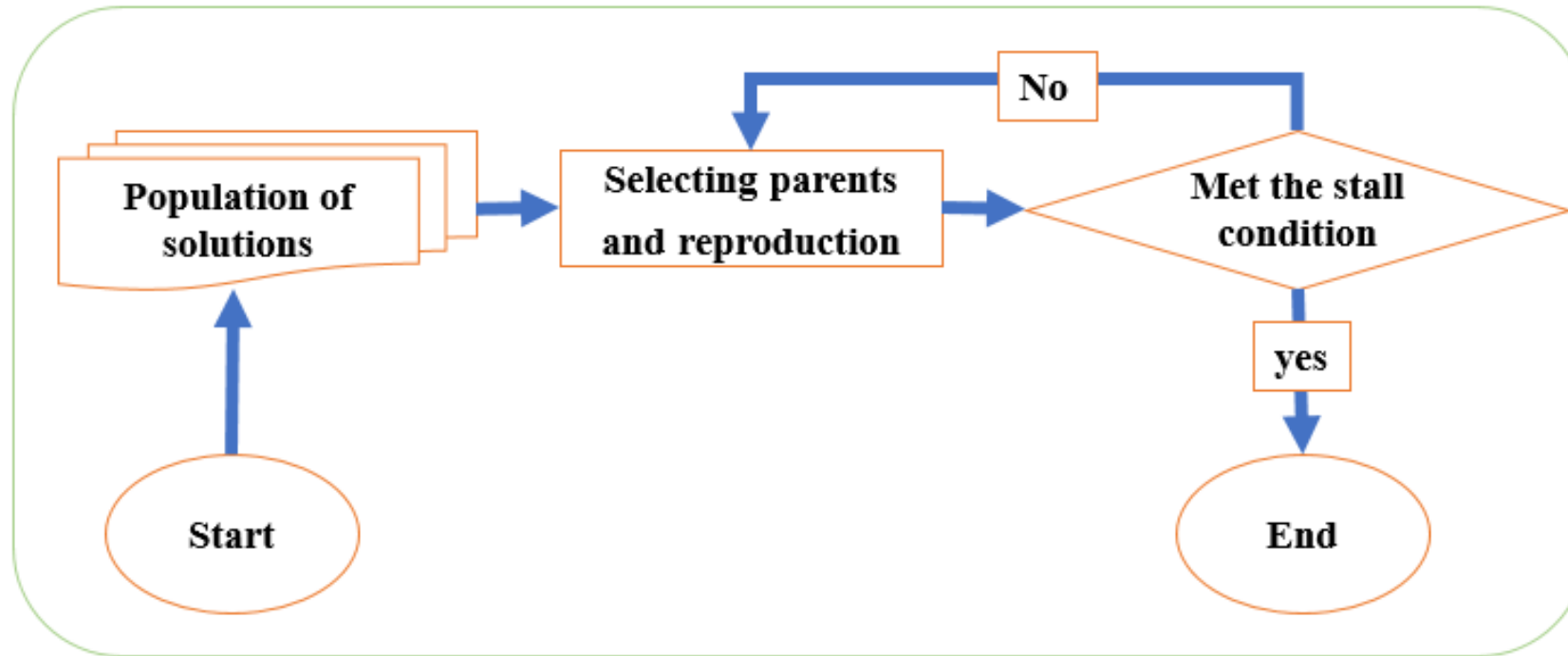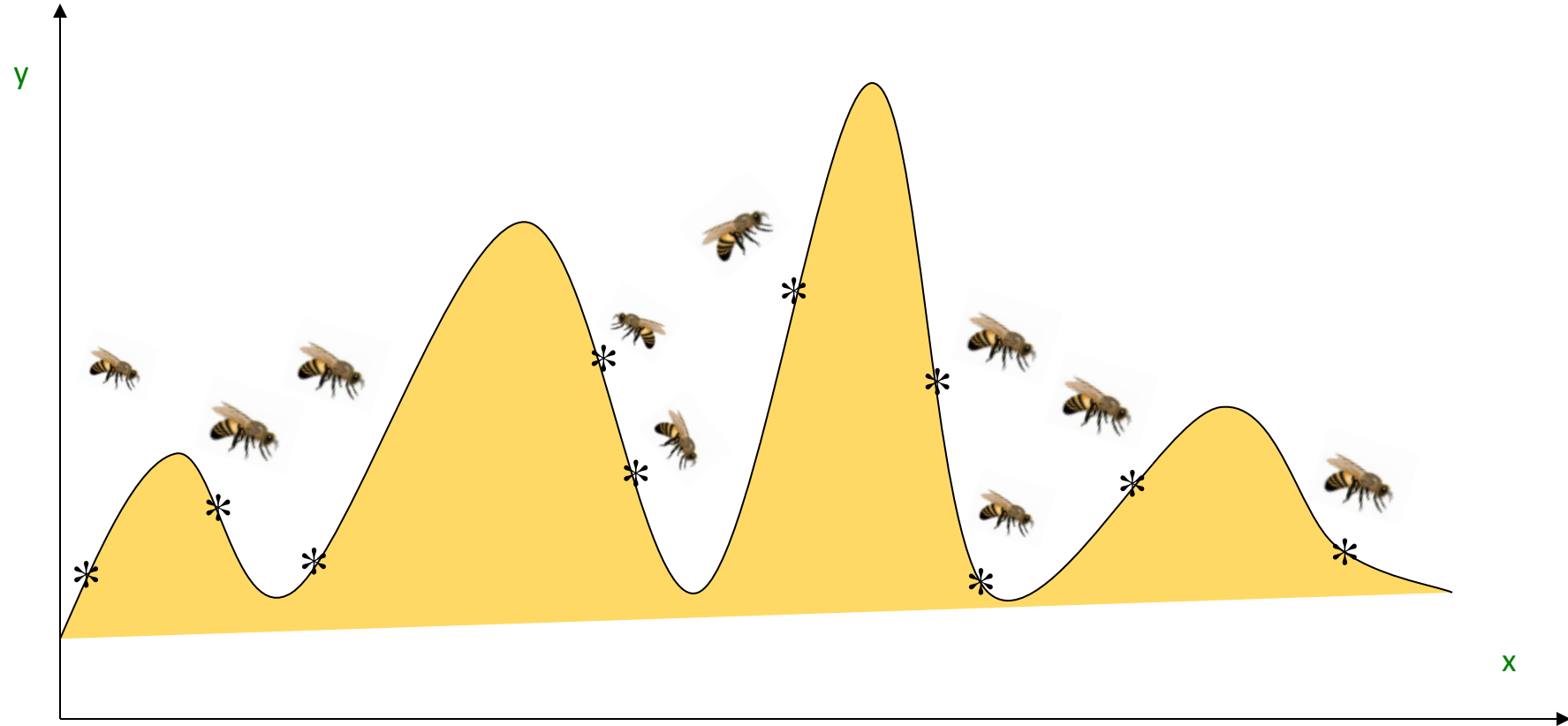
General procedure of Evolutionary algorithm
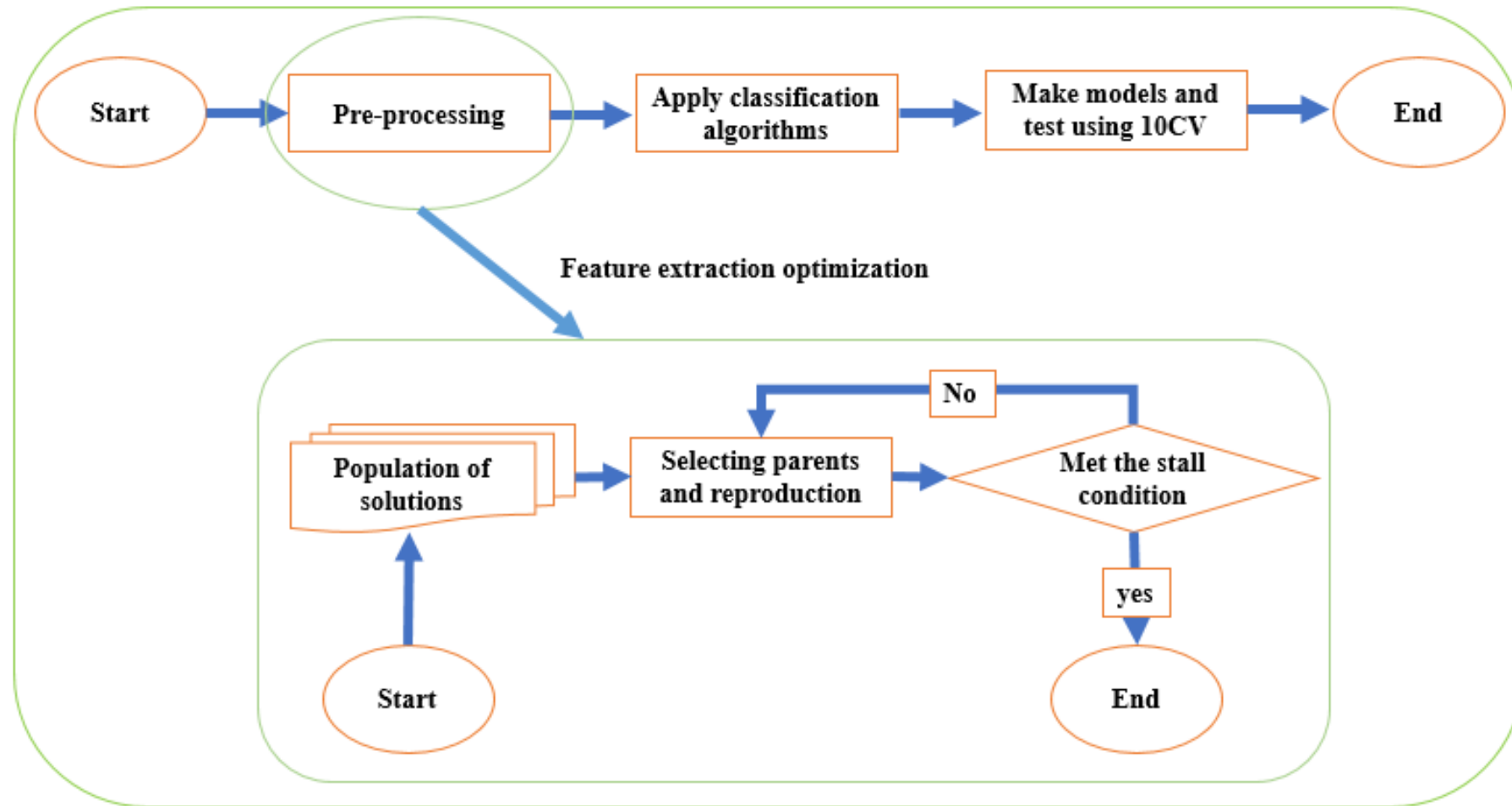
Artificial Bee Colony

Presented by Karaboga in 2005
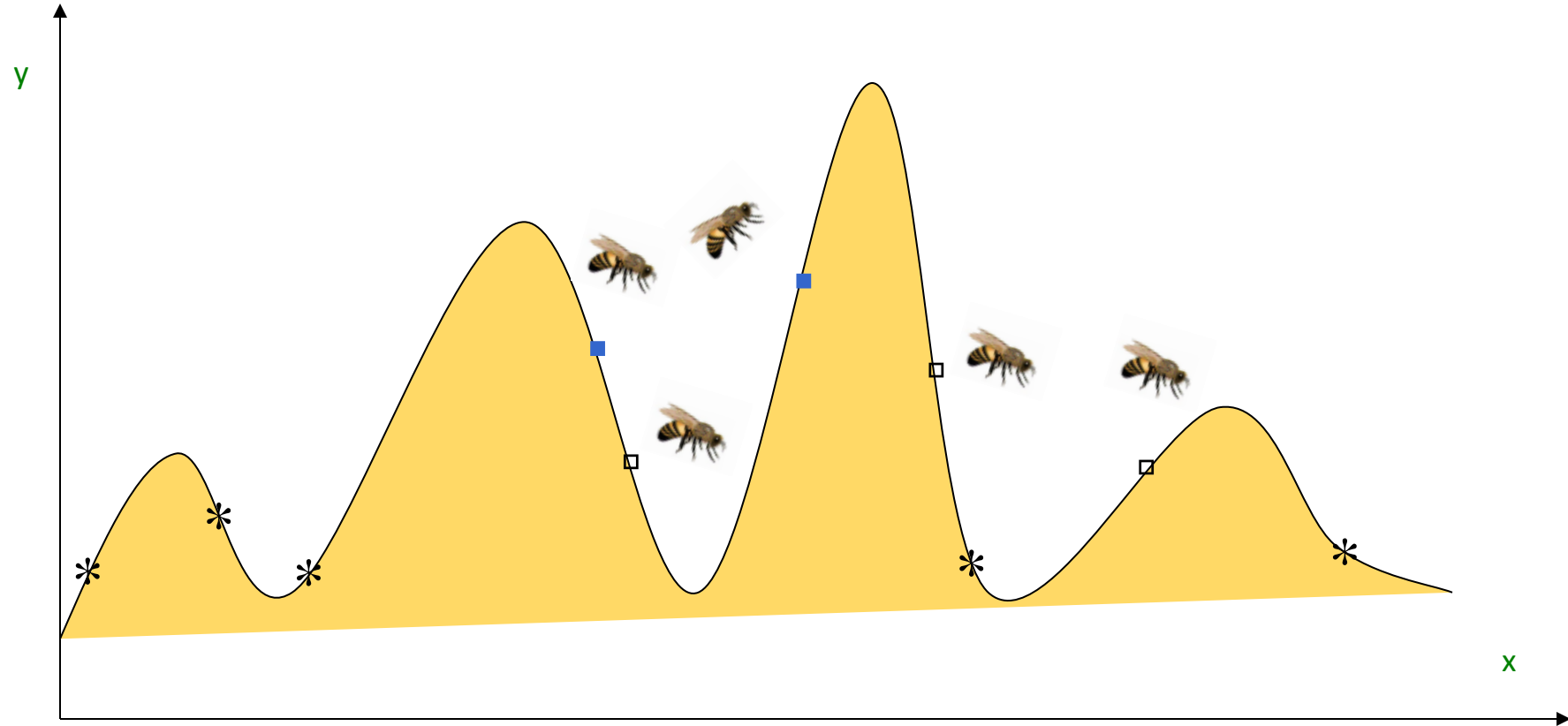
➤ Continues problems

➤ Exploring
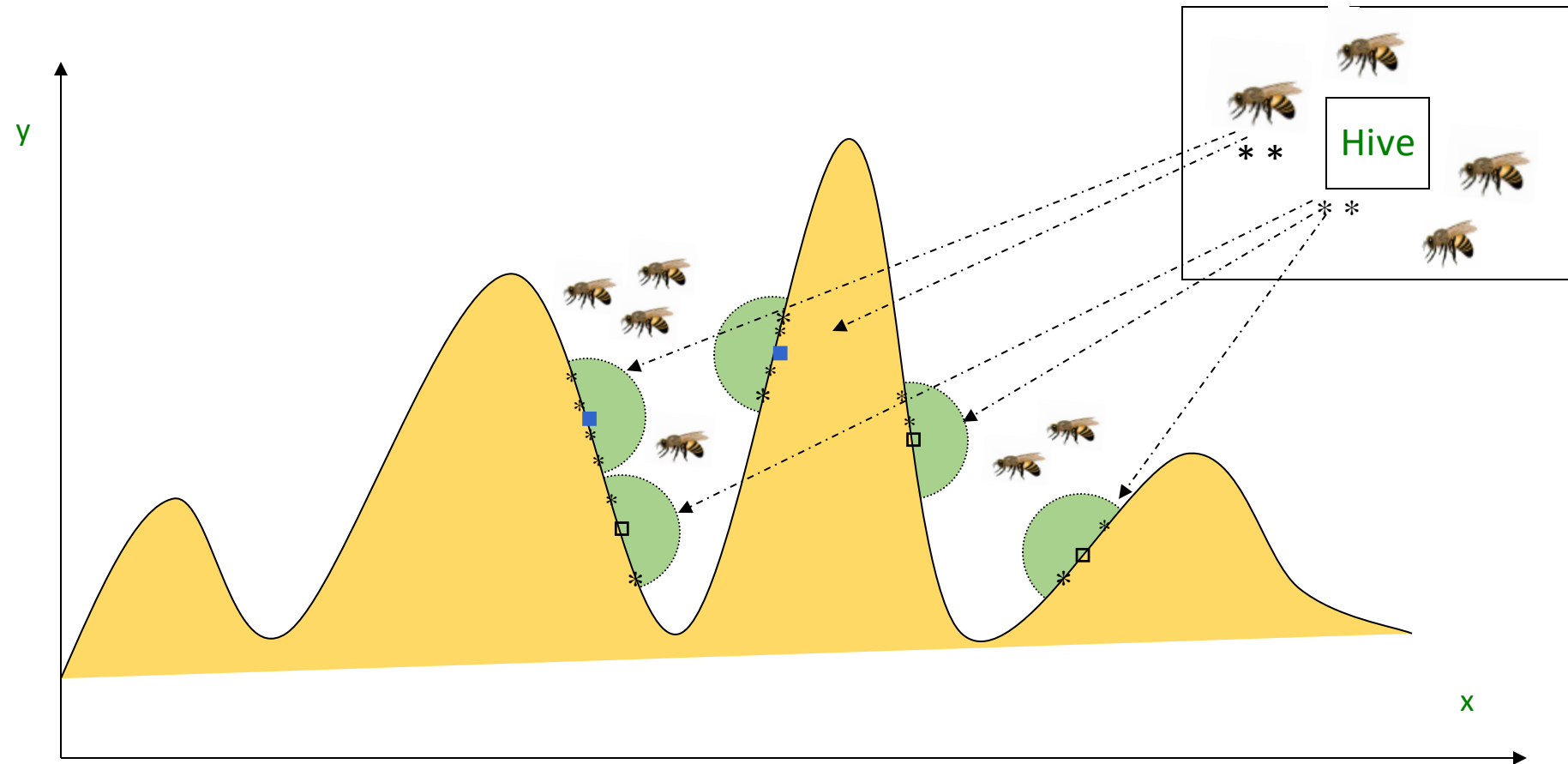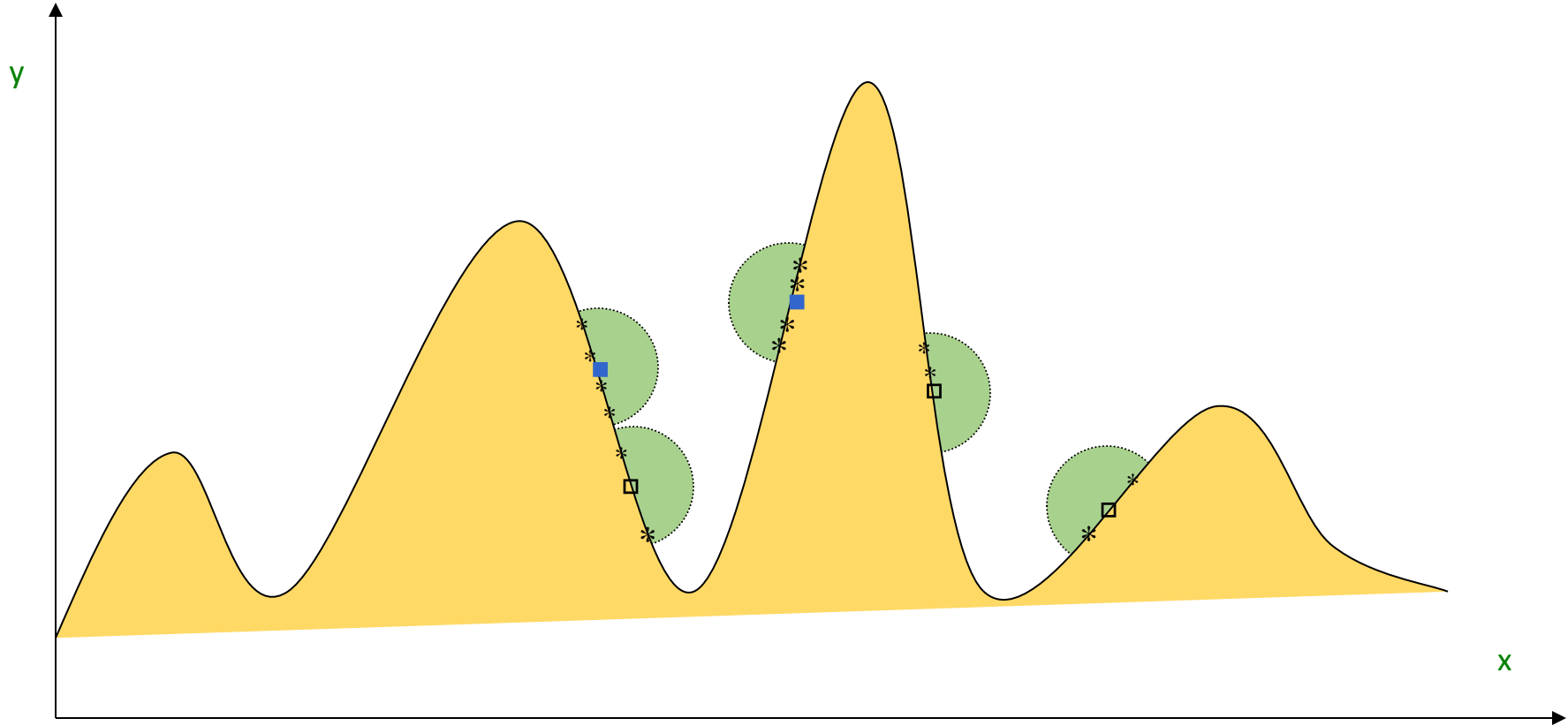➤ Exploiting
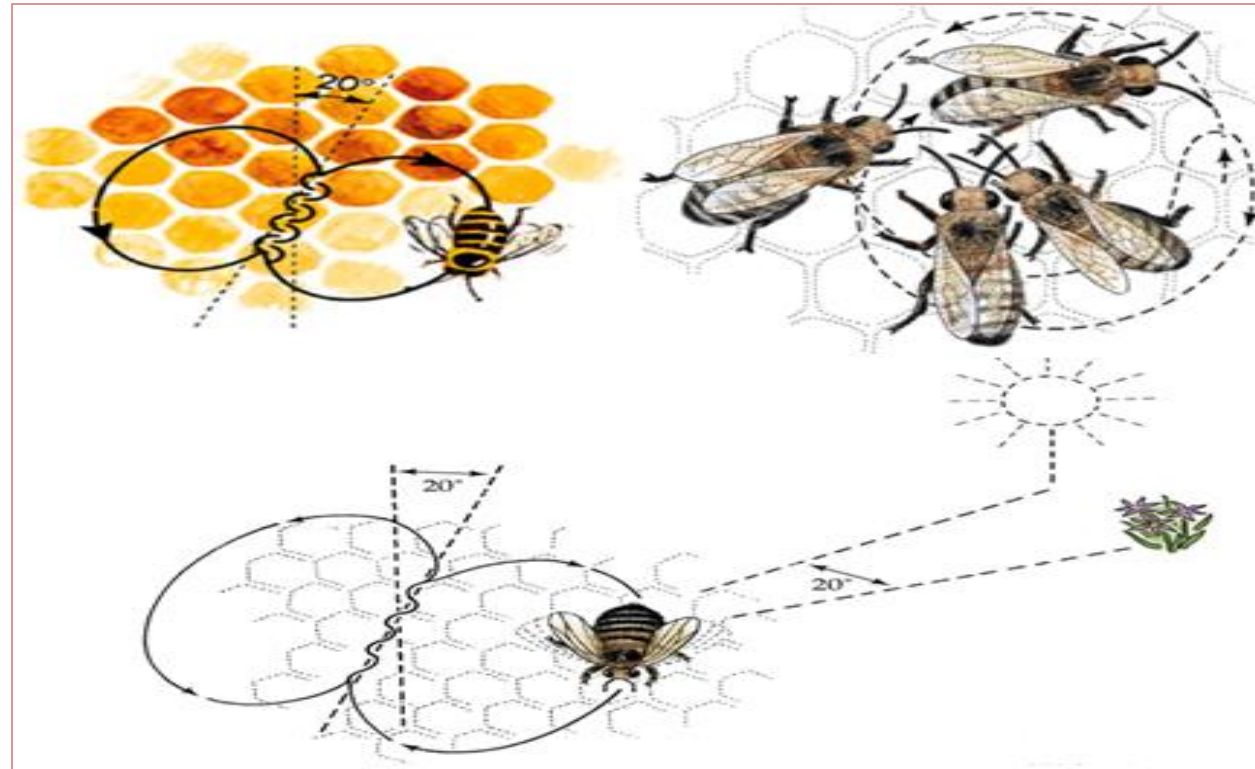
Task: gather nectars using Employed bee #=10
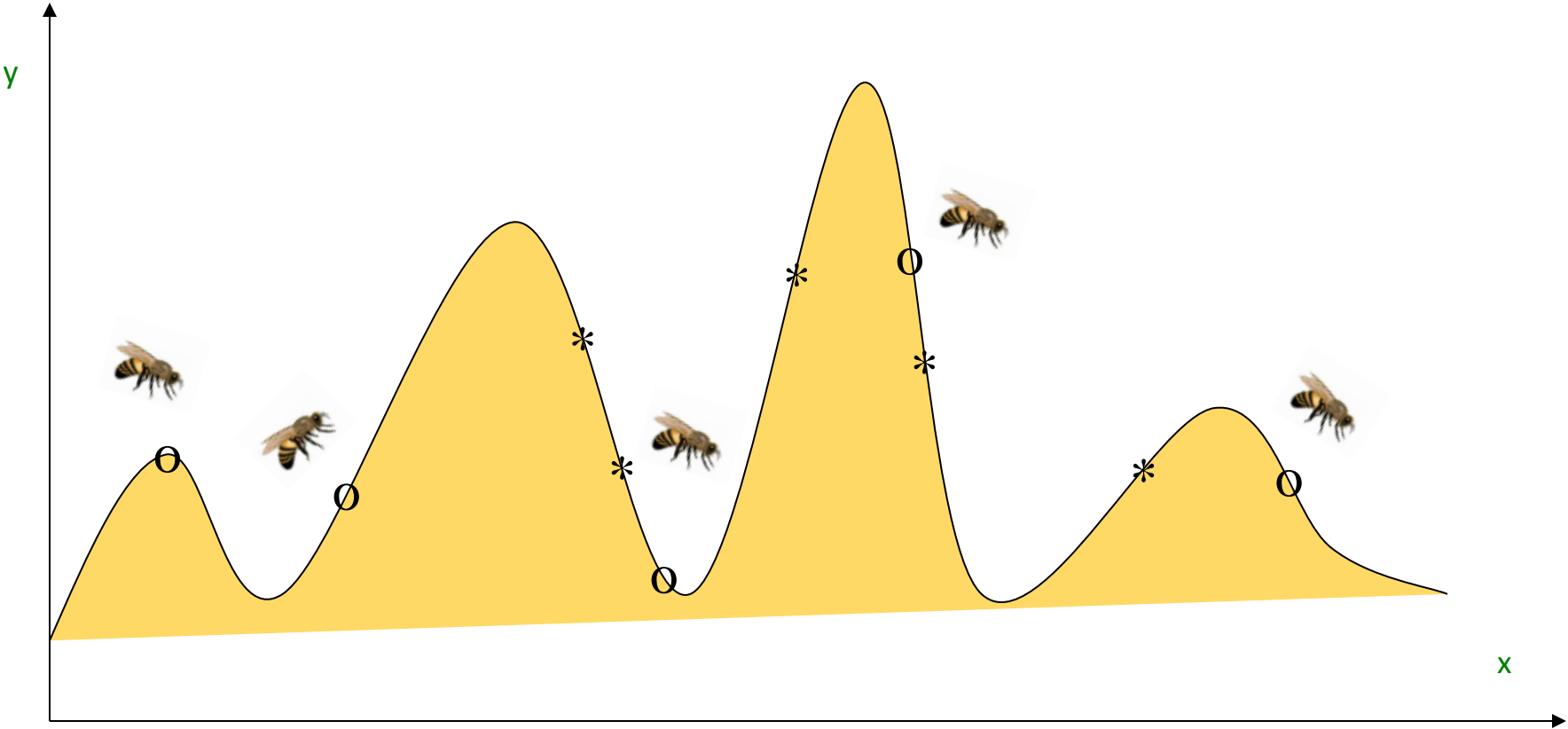
5 best places have been chosen by onlooker

Sending onlooker bees to be at the best places
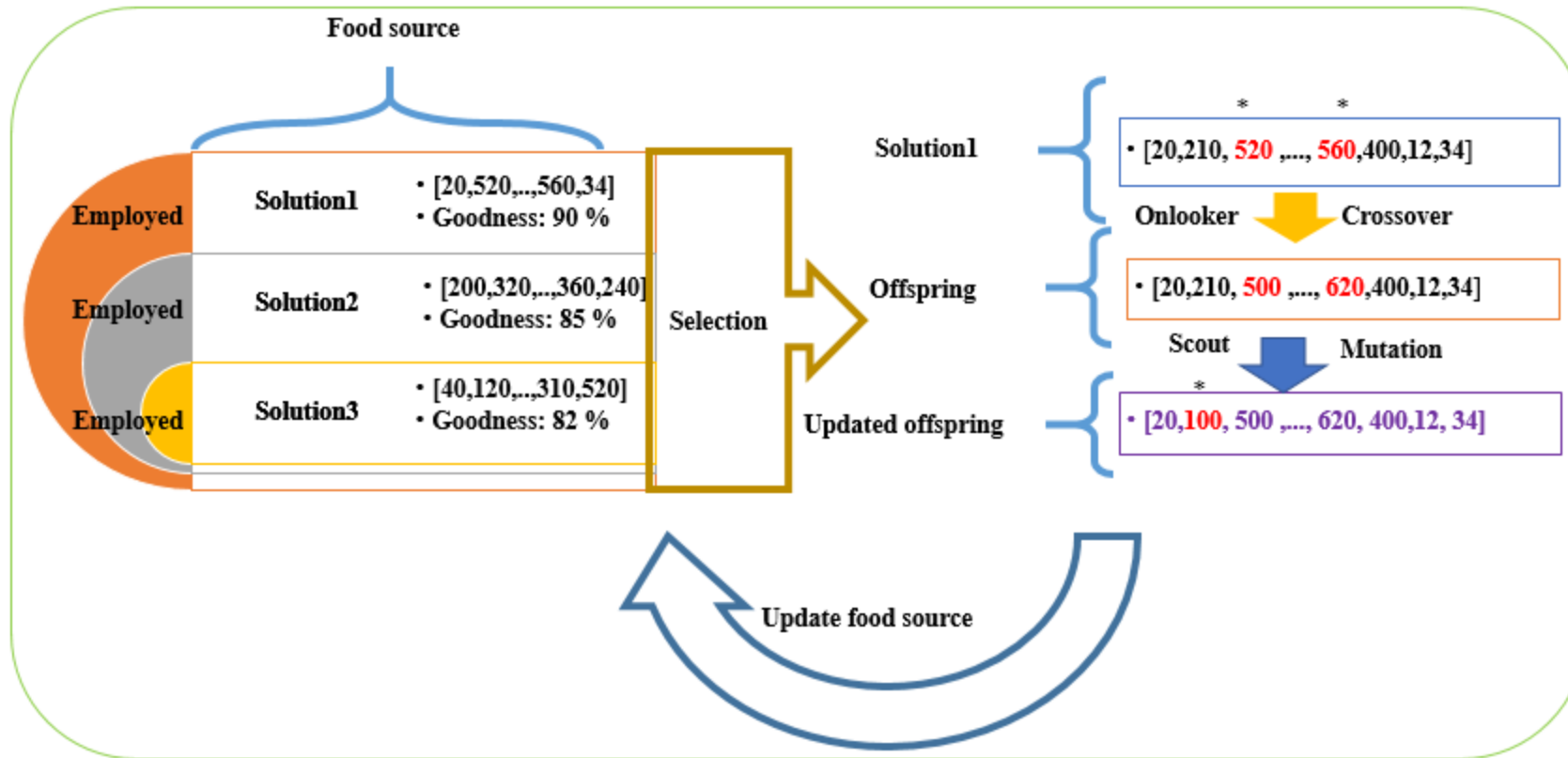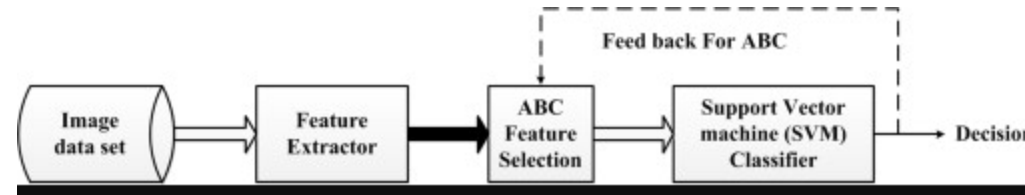
Exploiting the best point in the environment

Choosing scout bee one at a time to explore

Goal is finding the global maximum

IFAB

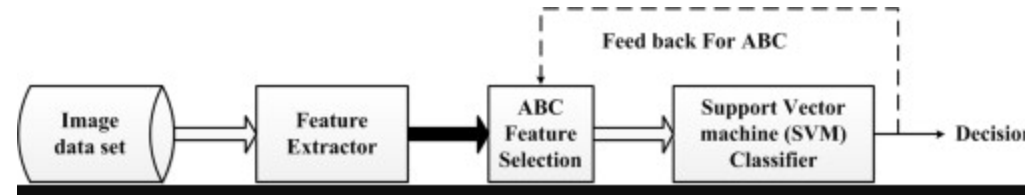
Ghareh mohammadi *et al 2014*, 2019

IFAB

Ghareh mohammadi *et al* 2014
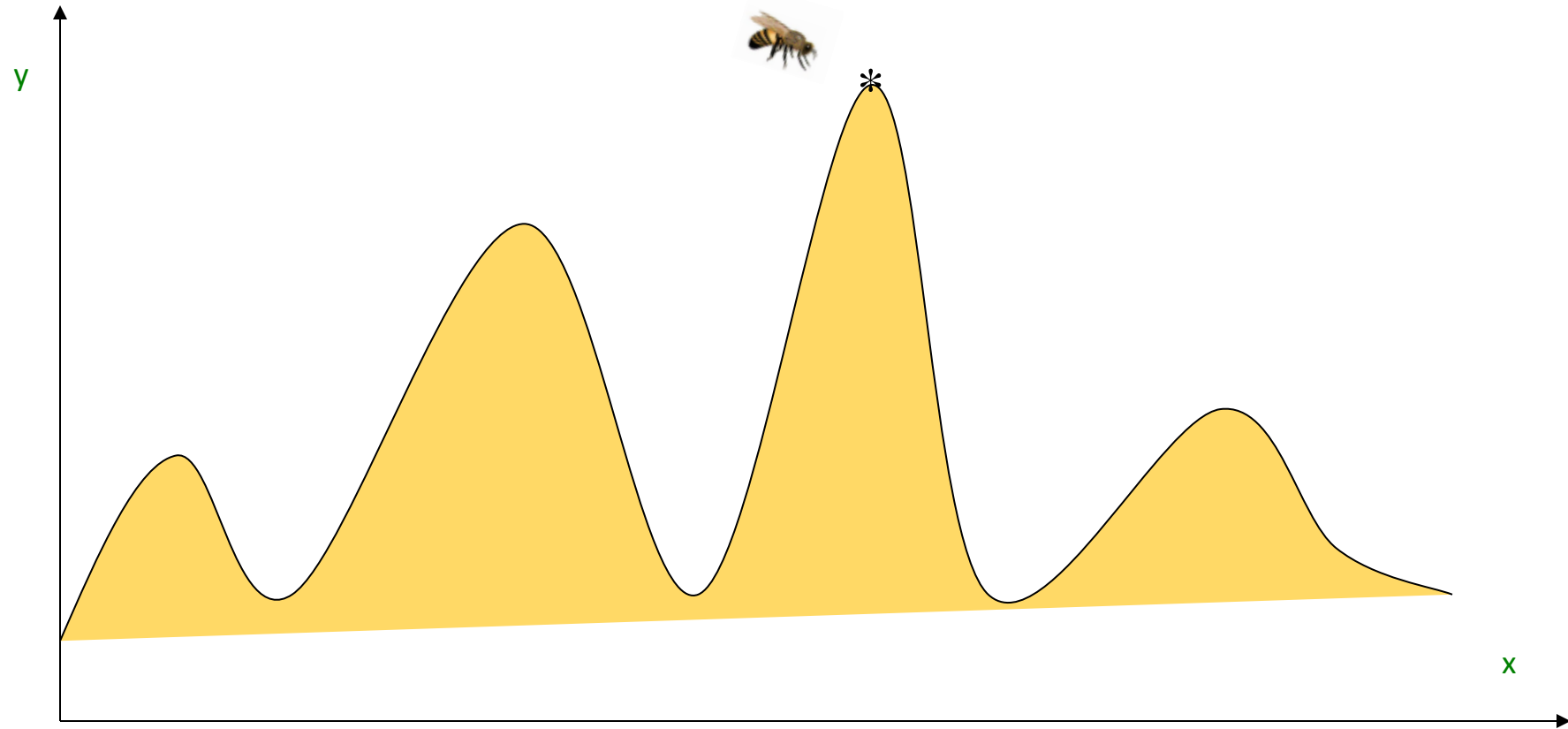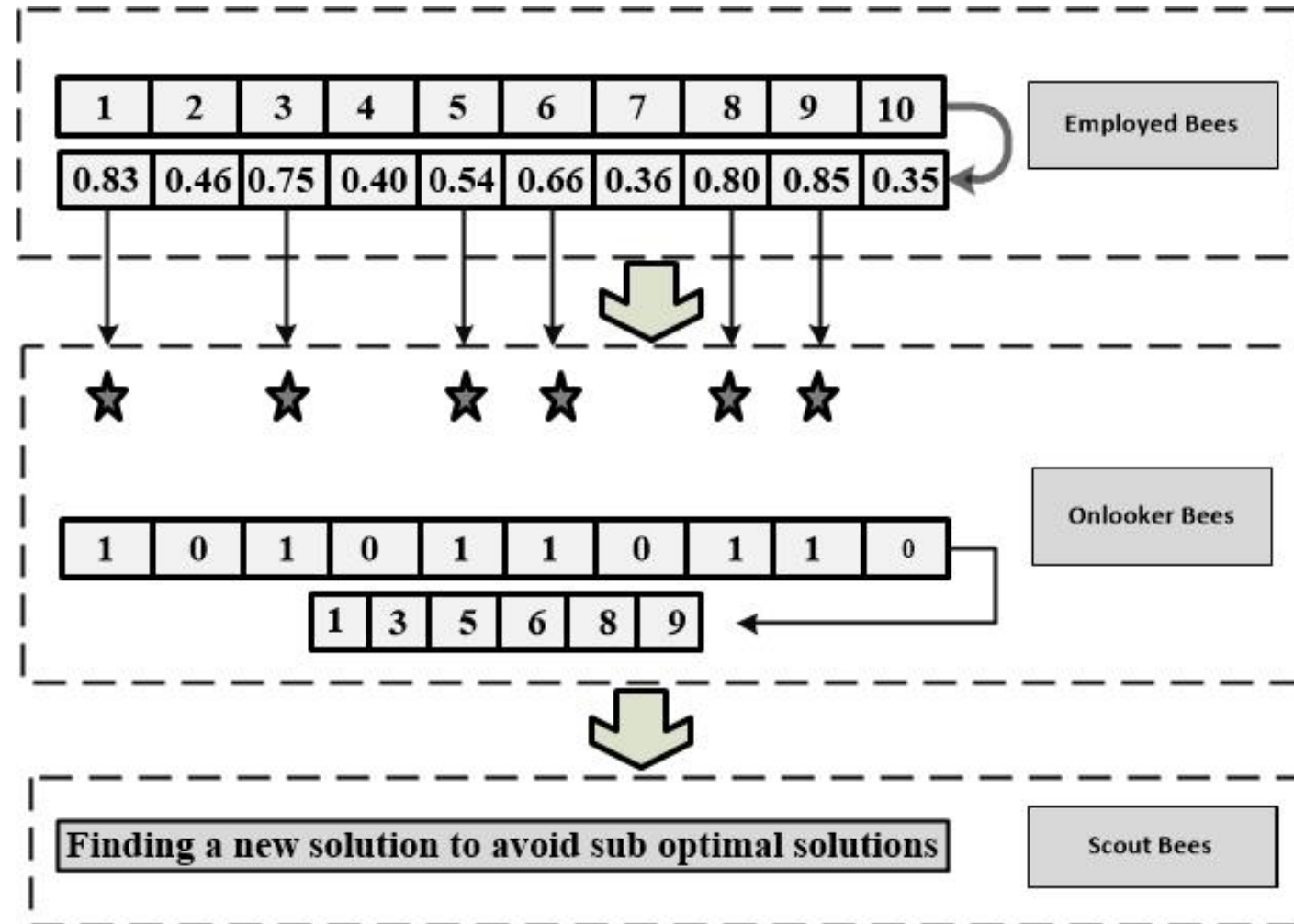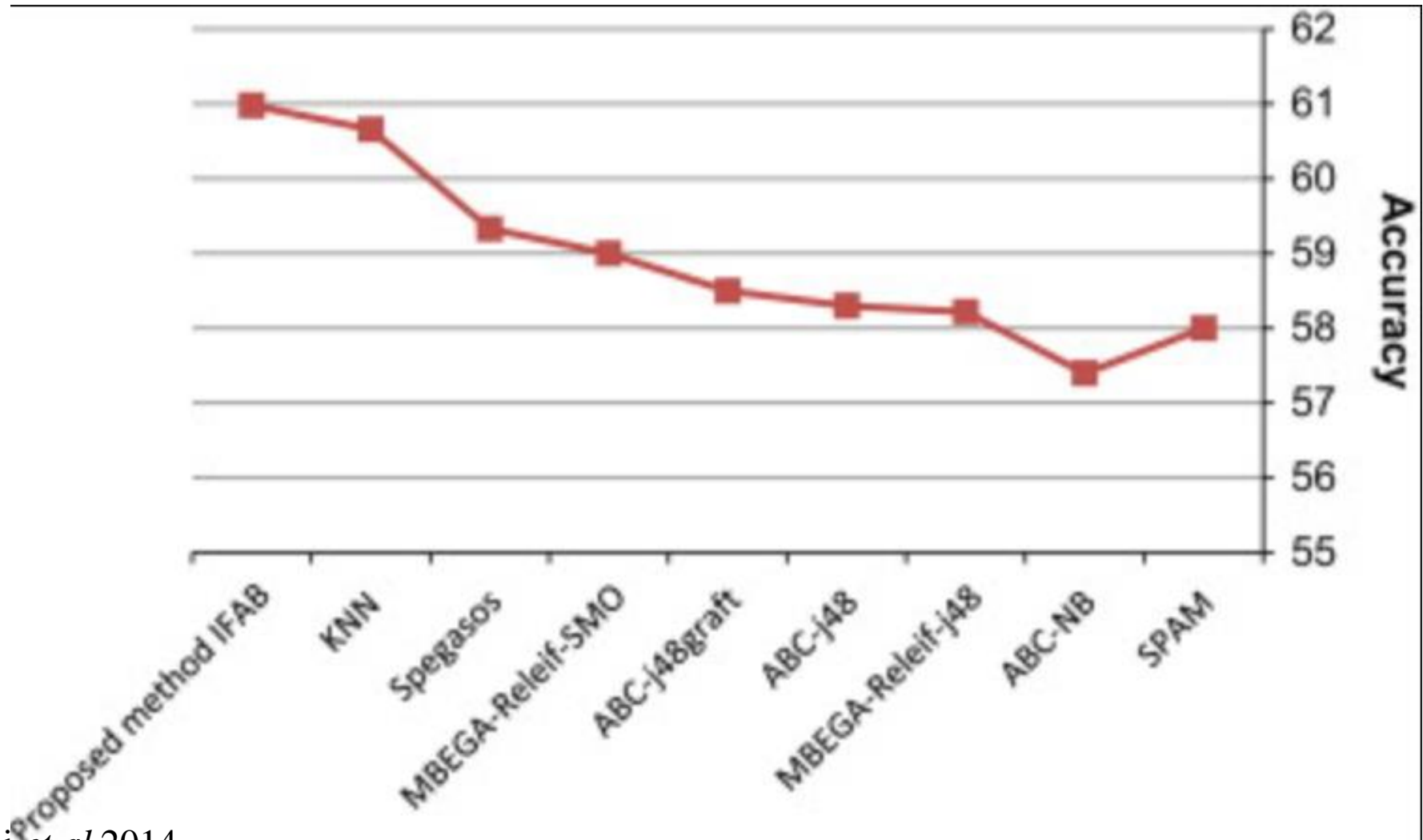
IFAB-parameters

Parameter	Value
Population size	2* Number of feature in data set(SPAM=686
Food source	Number of feature in data set(SPAM=686)
Feature Dimension (D)	80
Lower Bound	1
Upper Bound	N= Number of feature in data set
No. of runs	20
Limit	100

Parameter	Value
Population size	2*548
Food source	548
Feature Dimension (D)	80
Lower Bound	1
Upper Bound	N=548
No. of runs	20
Limit	100

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IFAB

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Result-SPAM

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Result-CCPEV

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RISAB

Ghareh Mohammadi *et al* 2017
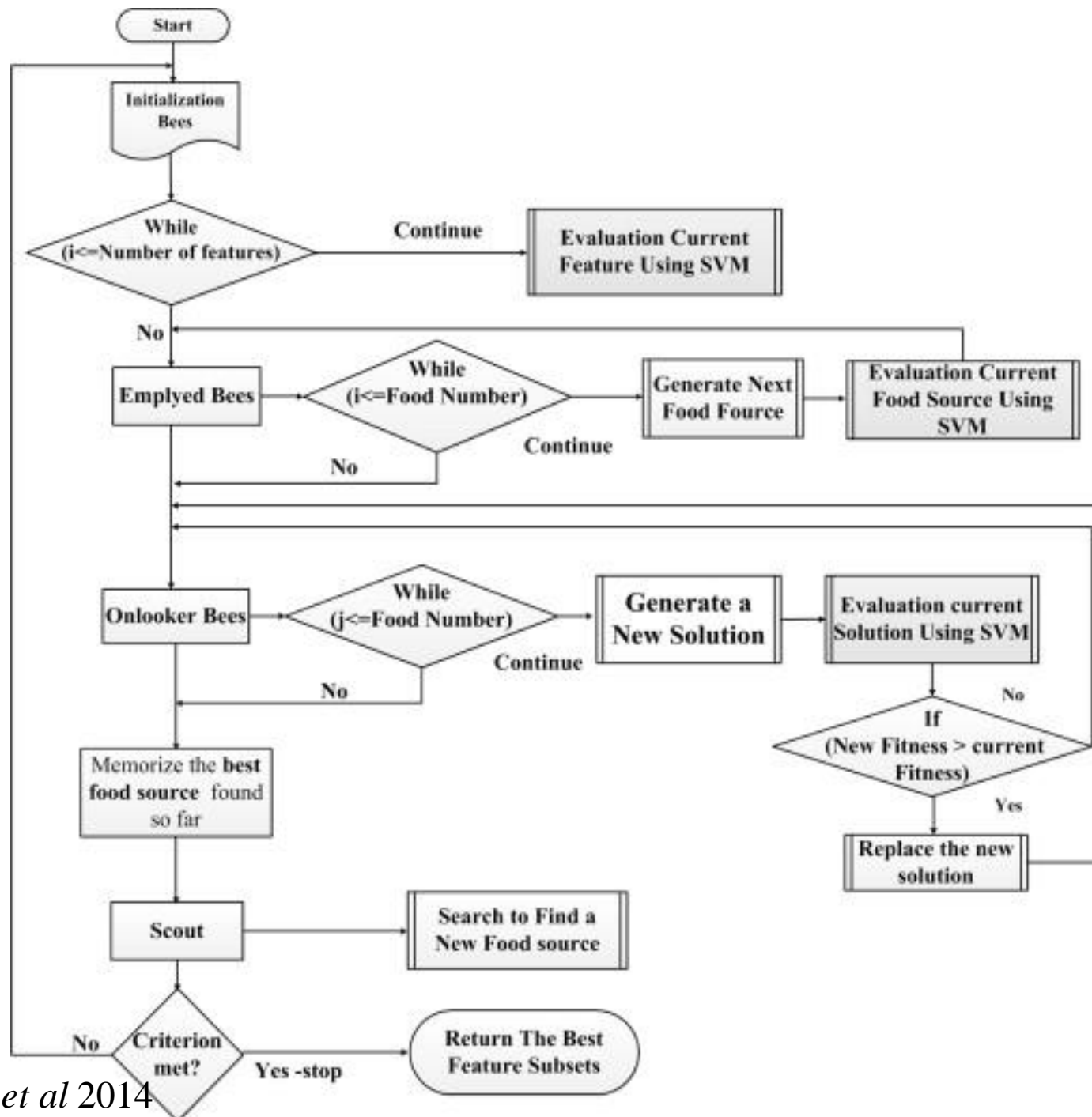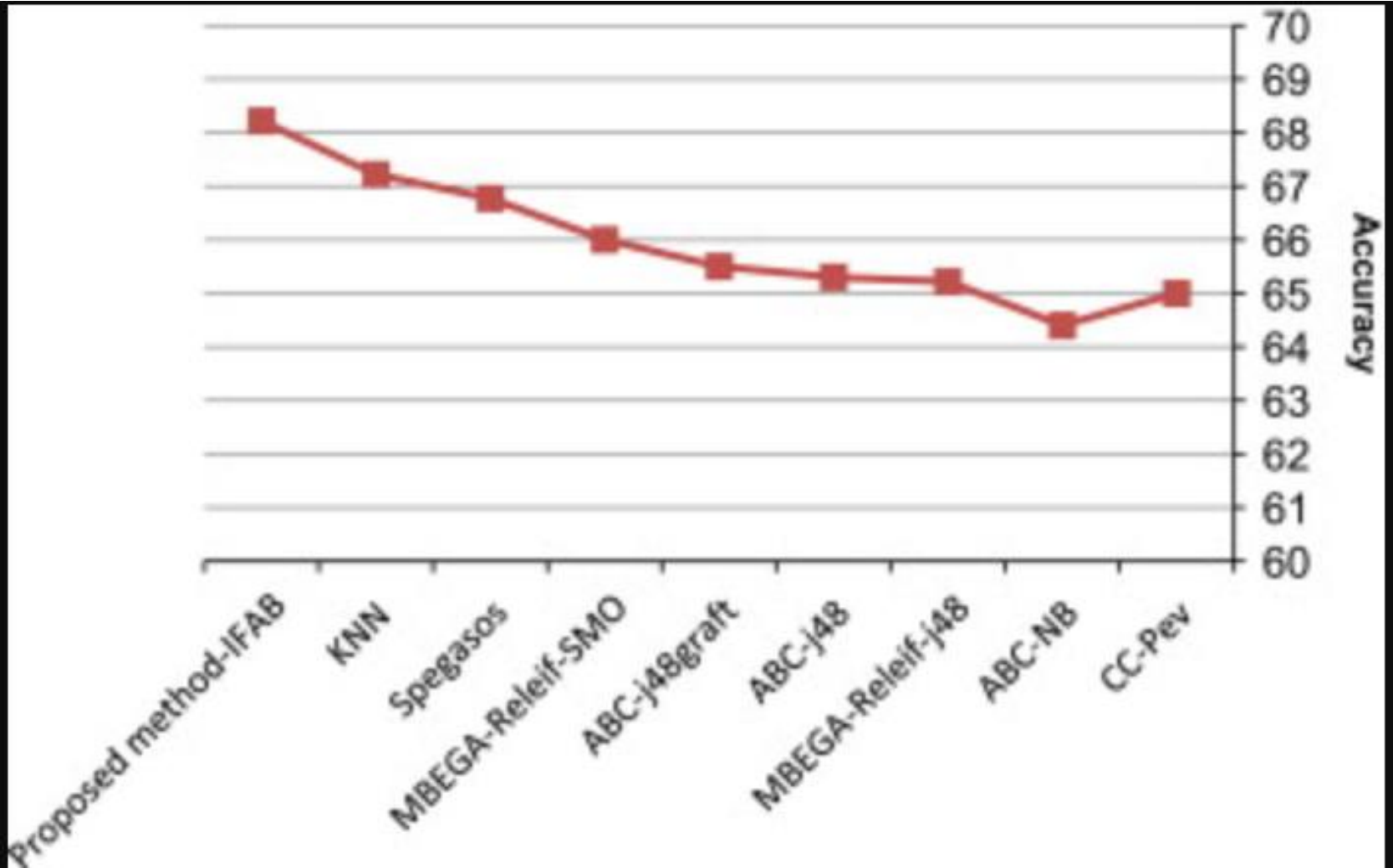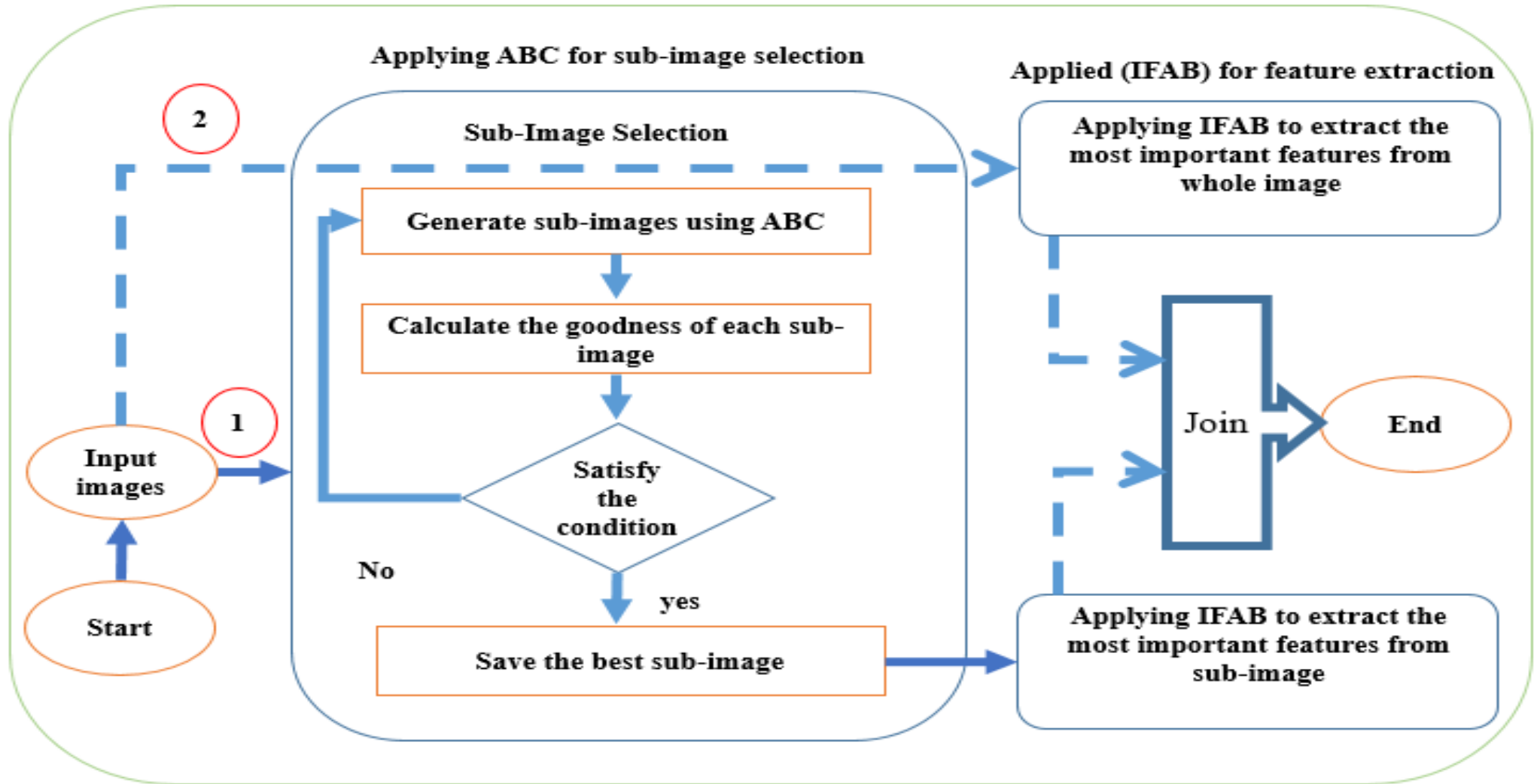
Risab -Parameters

Food source

RIS = Row image size
CIS = Column image size
PV = Pixel Value

i	j	i'	j'

RIS-PV	CIS-PV	RIS	CIS

Parameter	Value
Population size(P)	2*512
Food source	P/2
Feature Dimension (D)	4
Lower Bound	1
Upper Bound	N=548-PV (PV=159)
No. of runs	20
Limit	100

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RISAB

- Training

PROPOSED IMAGE STEGANALYSIS FRAMEWORK-RISAB

RISAB

• Testing

Proposed Image Steganalysis framework-RISAB

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RISAB-example

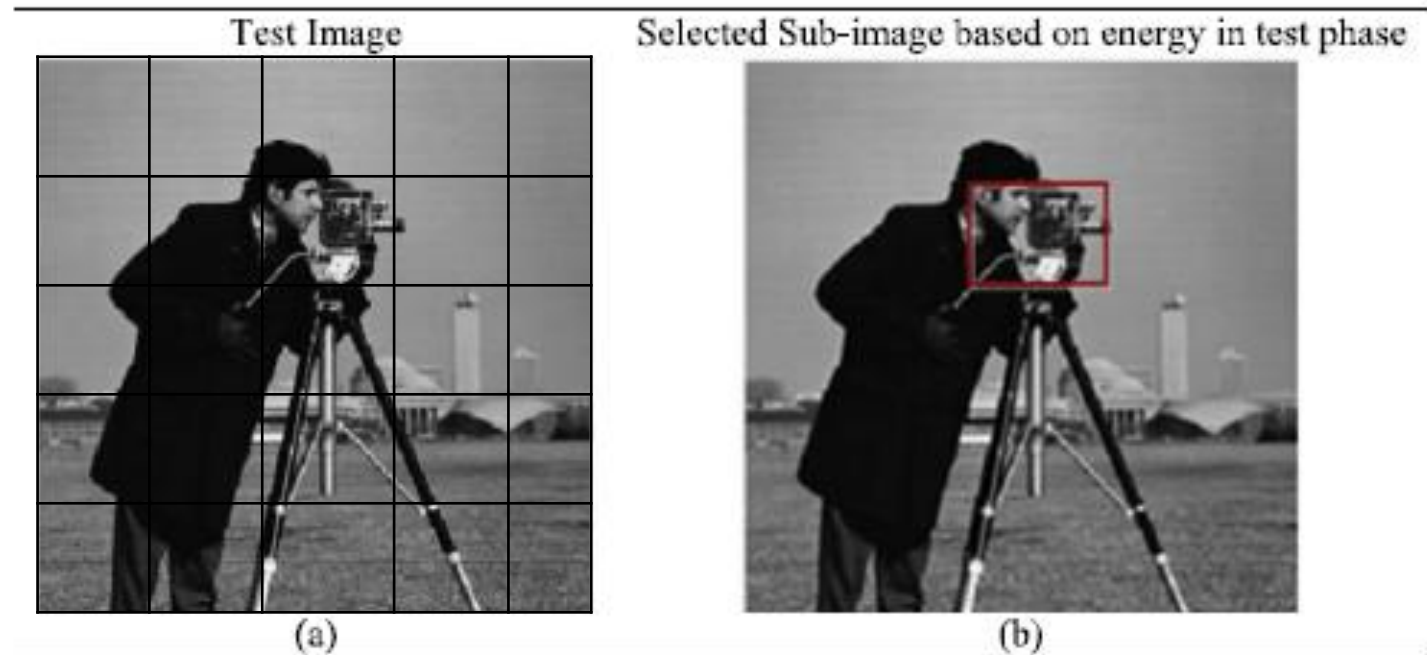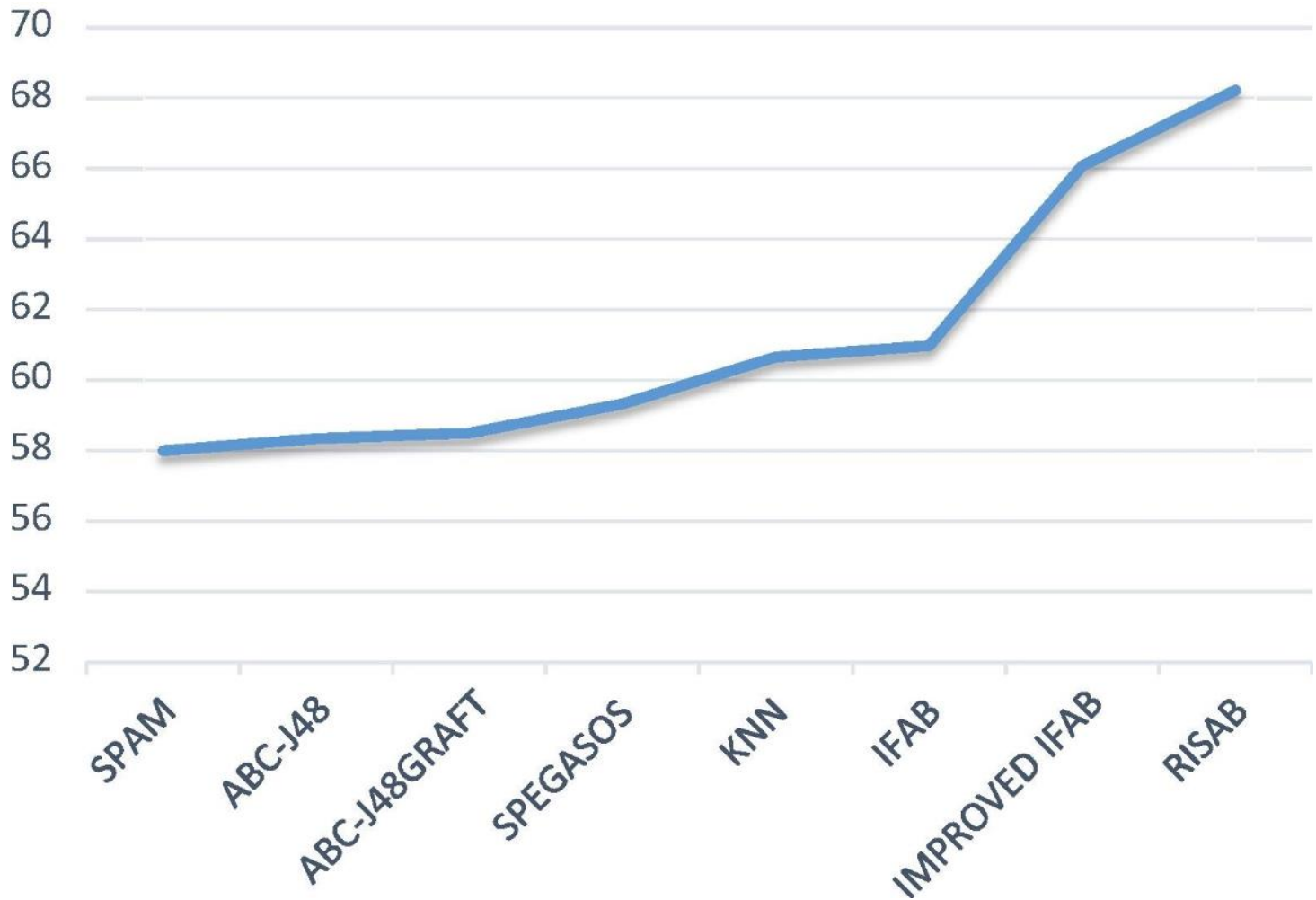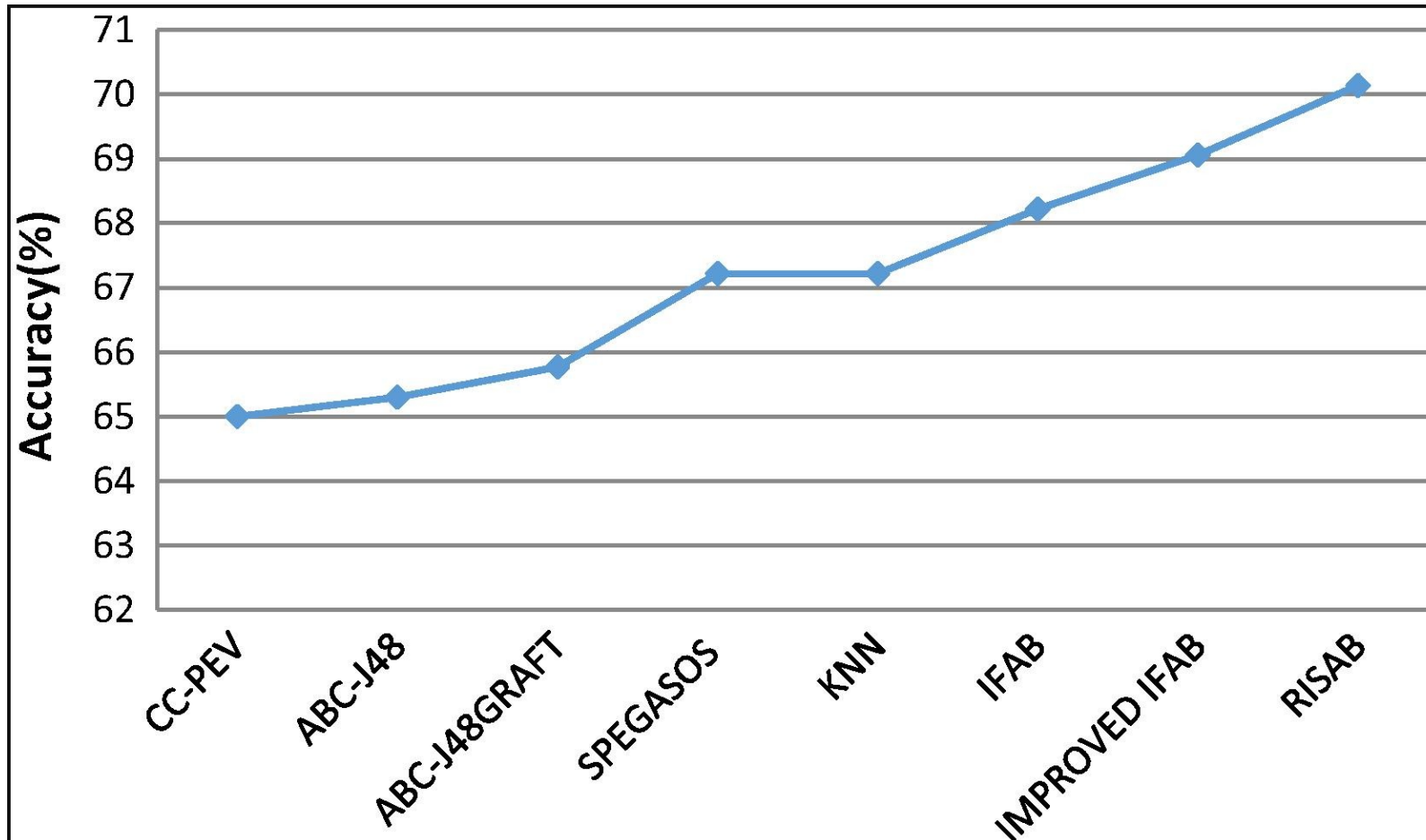Test Image   Selected Sub-image based on energy in test phase

(a)   (b)
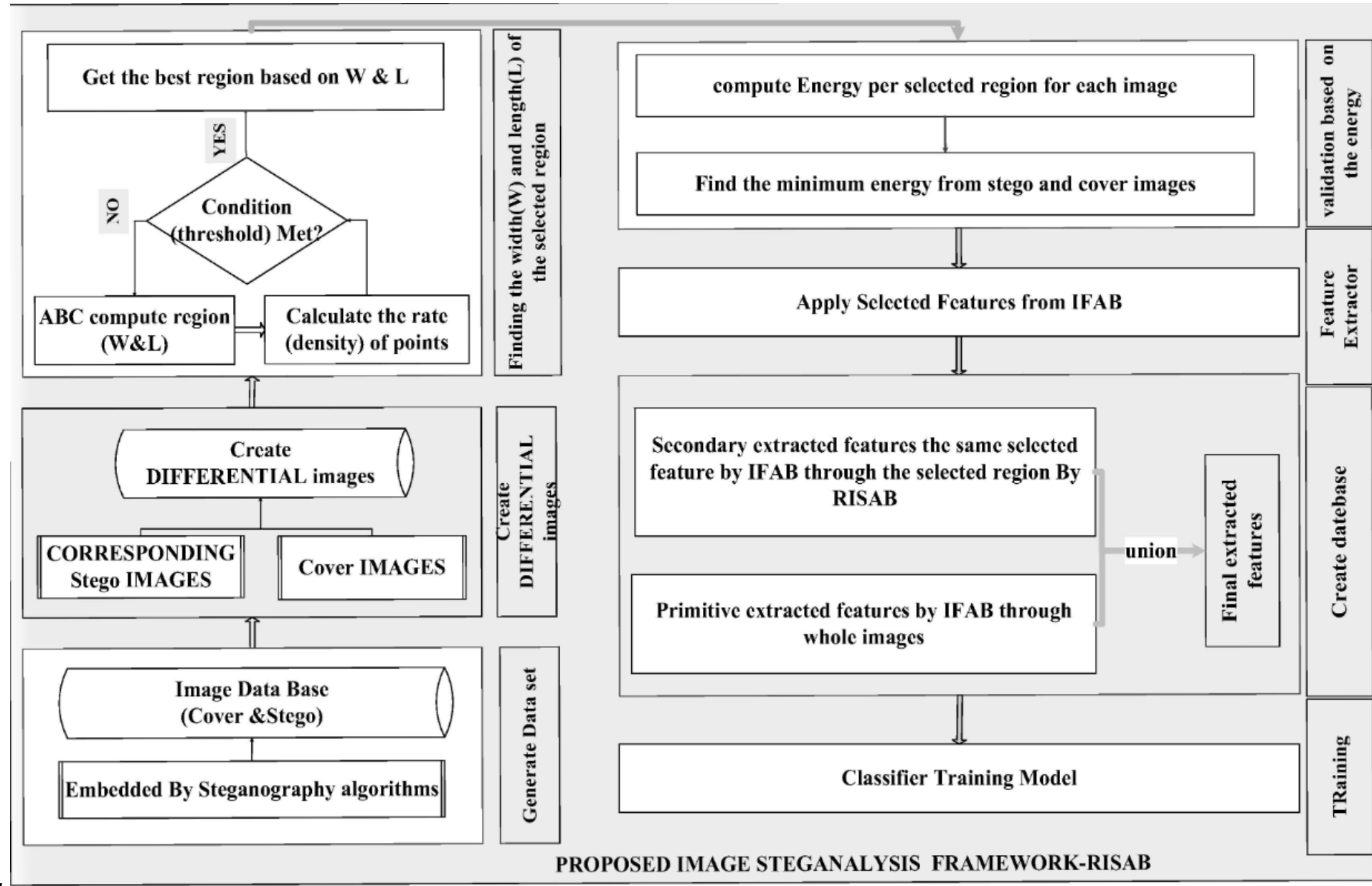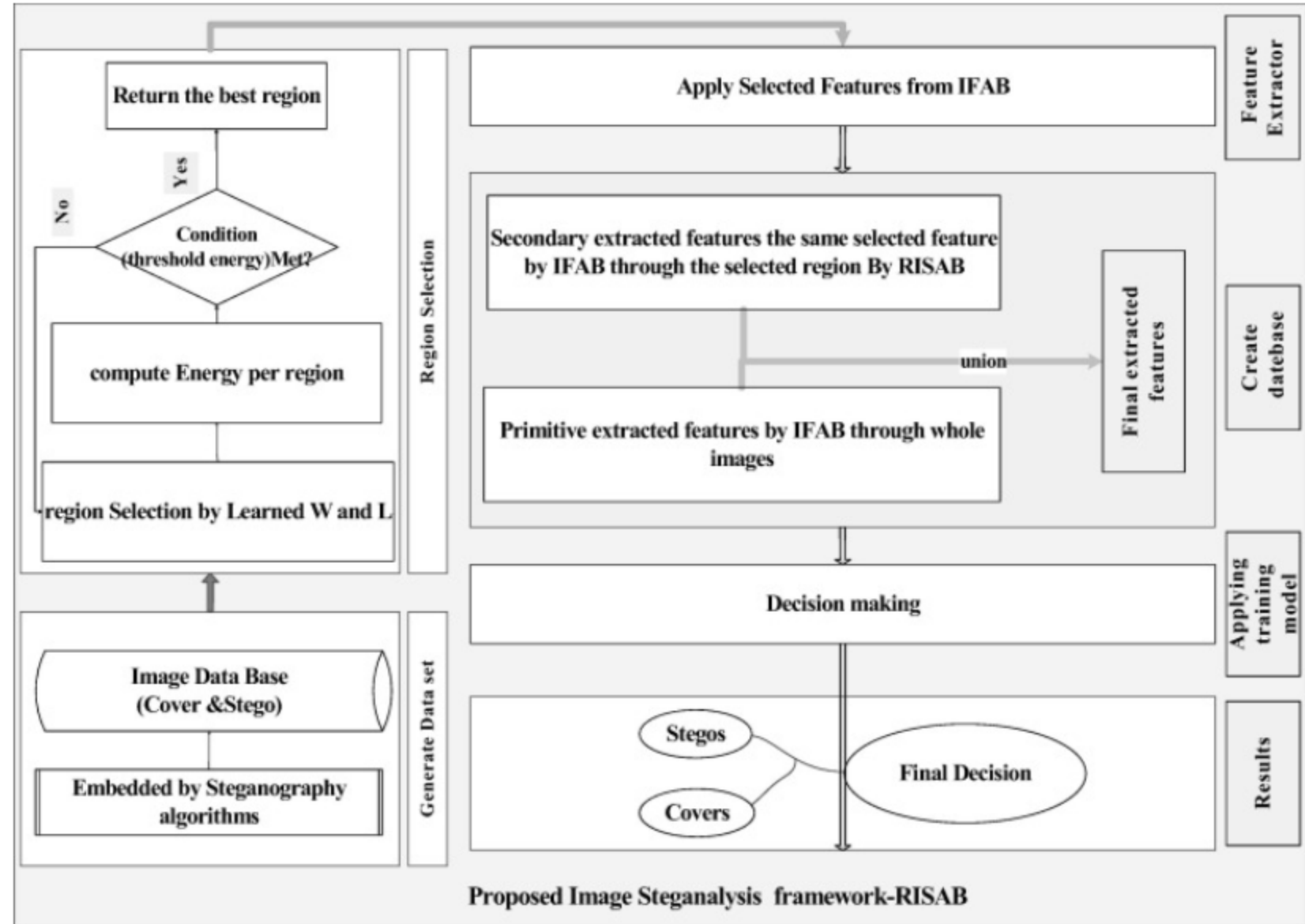
Fig. 8. A sample of (a) test image, (b) the selected sub-image shown with a red rectangle. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)
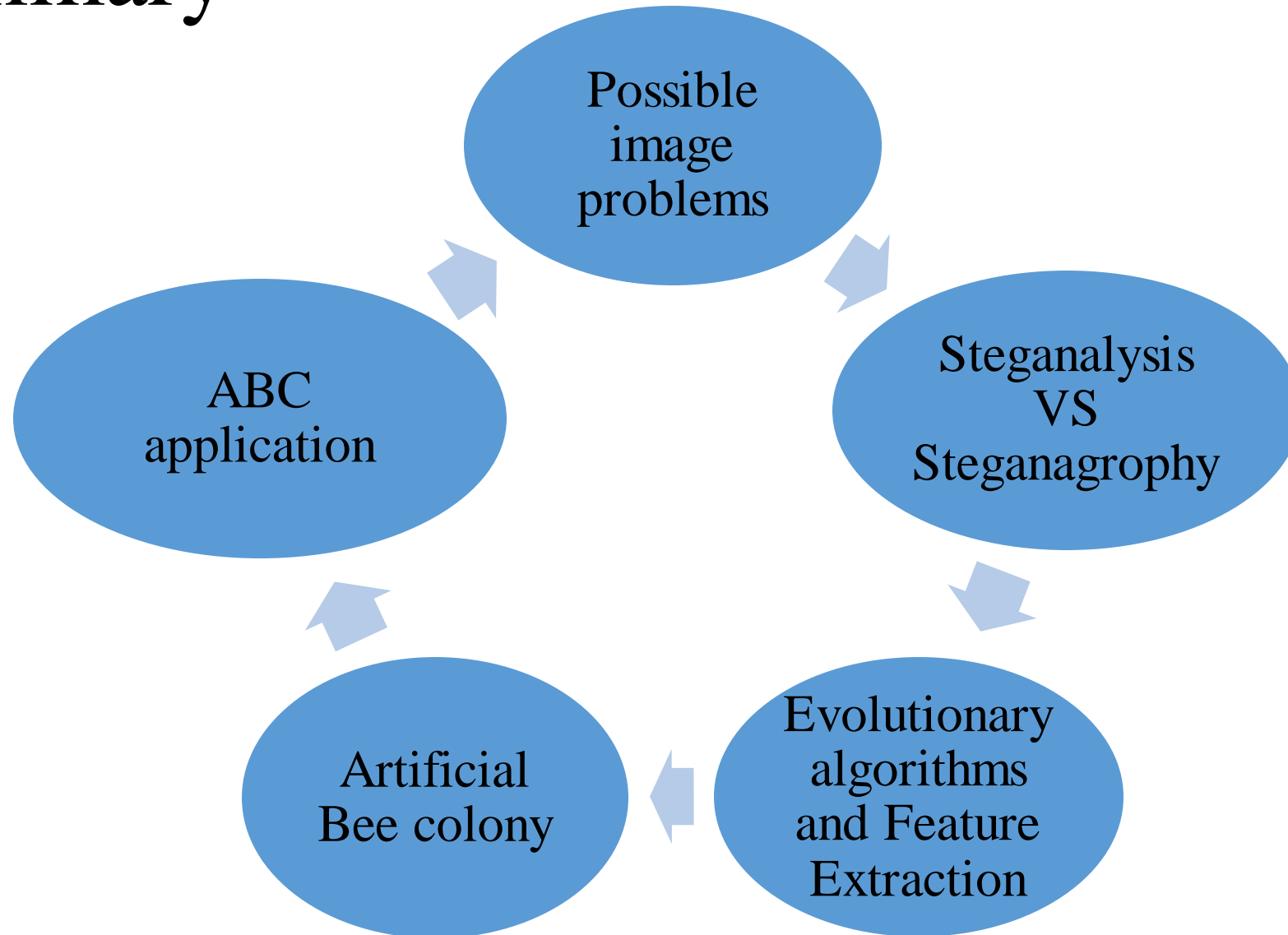
Ghareh Mohammadi *et al* 2017

Result-SPAM

Ghareh Mohammadi *et al* 2017

Result-CC-PEV

Ghareh Mohammadi *et al* 2017

Summary

Thank you

References:

- http://ice.dlut.edu.cn/LiMing/research.html
- https://doi.org/10.1016/j.jvcir.2016.12.003
- https://www.redcom.com/introduction-to-cryptography/
- https://www.slideshare.net/ankushkr007/digital-watermarking-15450118
- Steganography in Digital Media,Principles, Algorithms, and Applications By Dr Jessica Fridrich
- http://www.ws.binghamton.edu/fridrich/
- https://www.sciencedirect.com/science/article/pii/S0952197613001905#f0010
- https://www.sciencedirect.com/science/article/pii/S1047320316302516#f0070
- https://arxiv.org/pdf/1908.08006.pdf
- https://arxiv.org/pdf/1908.08563.pdf