

Applications of Evolutionary / nature-inspired algorithms in Computer vision

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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

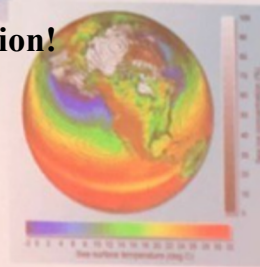
- ❑ Multiple measurements (e.g., temperature)
- ❑ Time series data

❑ Finance

- ❑ Stock markets
- ❑ Time series data



Emerging problems:
High dimensionality problem
AKA:
Curse of Dimensionality (CoD) : too much information!



Steganography Started getting smarter ...

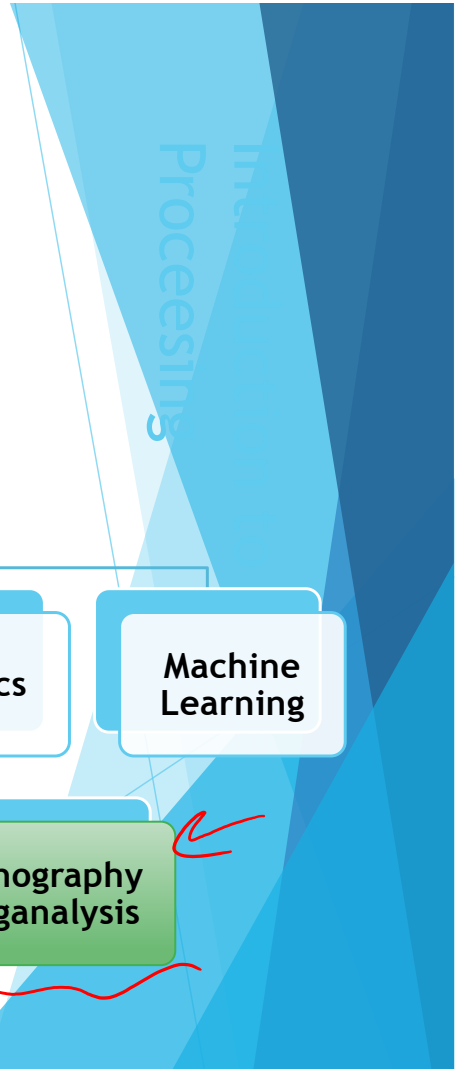
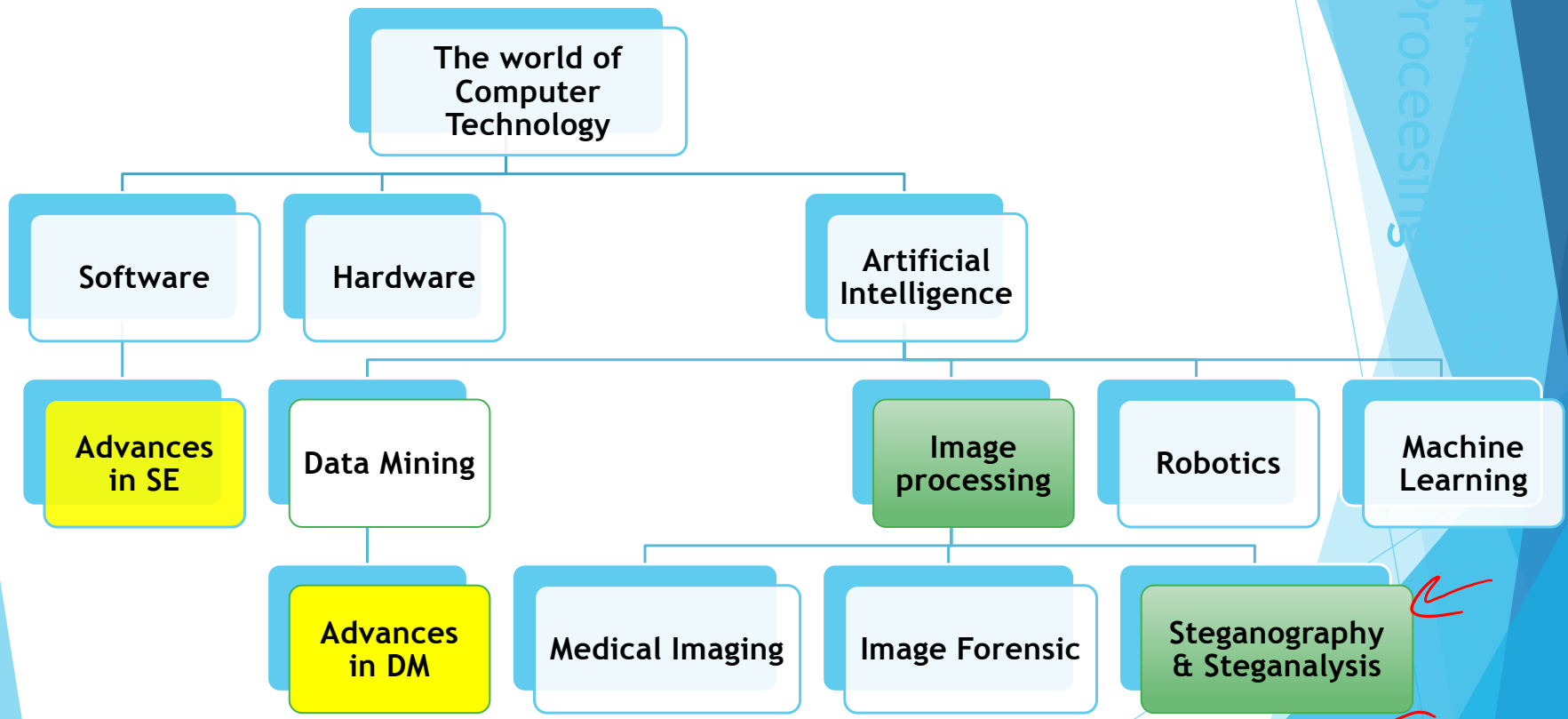
September 11 2001



Steganalysis Started getting important

Outlines:

- **Review Where you are**
- **Image Processing : Image classification**
- **Steganography VS Steganalysis**
- **Evolutionary schema**
- **Summary**



Very Quick Shot

Steganography

Art of embedding messages

Art of detecting the hidden Messages

Steganalysis

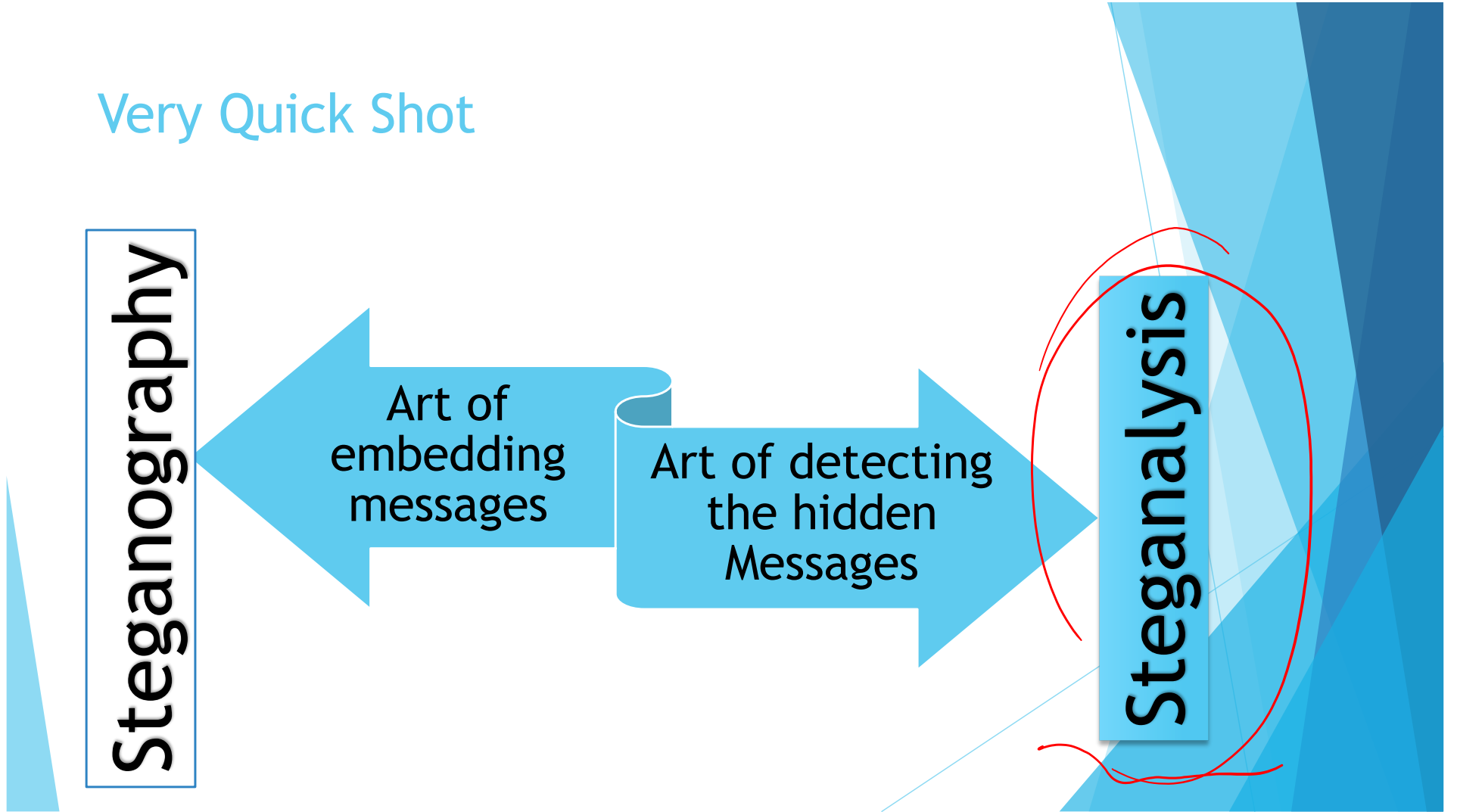
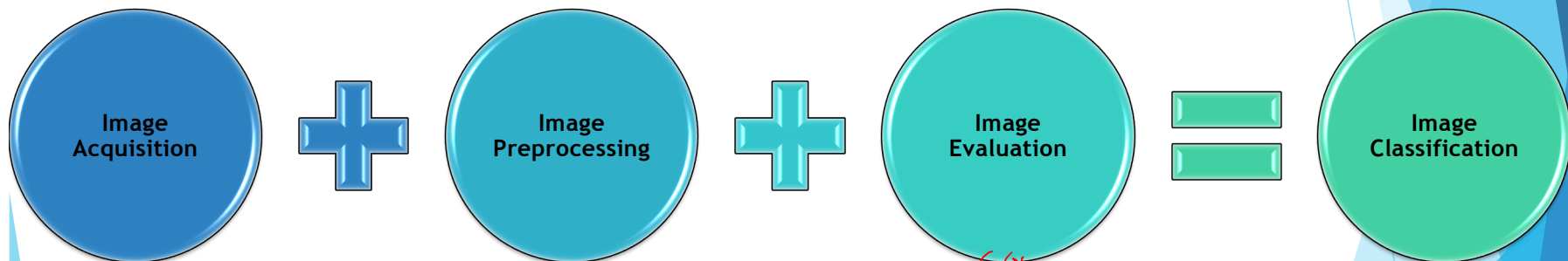


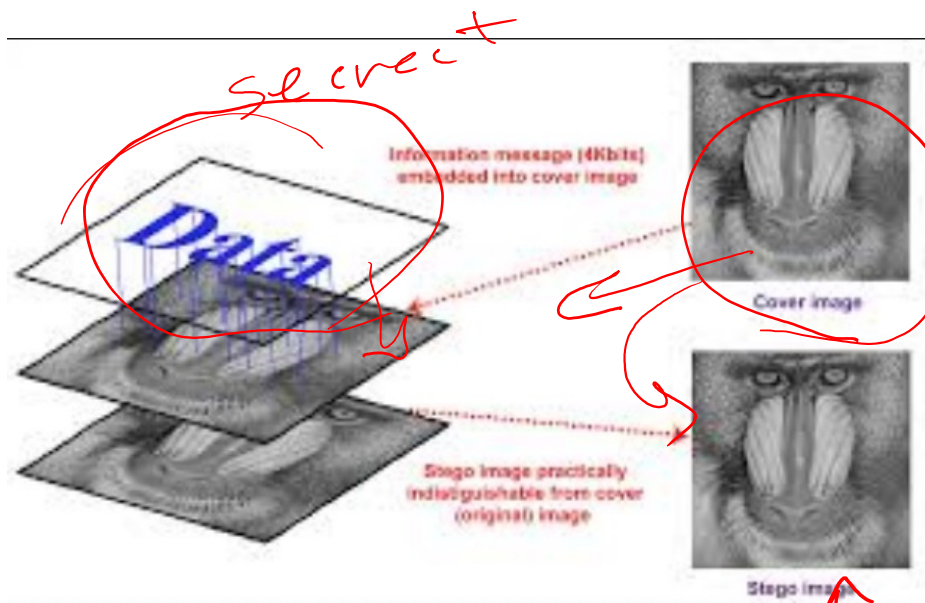
Image Processing : Image classification



features

A handwritten red circle around the word "features" with an arrow pointing to the "Image Evaluation" step.

Image Processing Steganography VS Steganalysis



Steganography In others



Original Image



Watermarked Image

iy

Stego VS Cover



Image Processing Steganography VS Steganalysis

LSB IN IMAGES

144	141	81
145	140	81
146	142	81

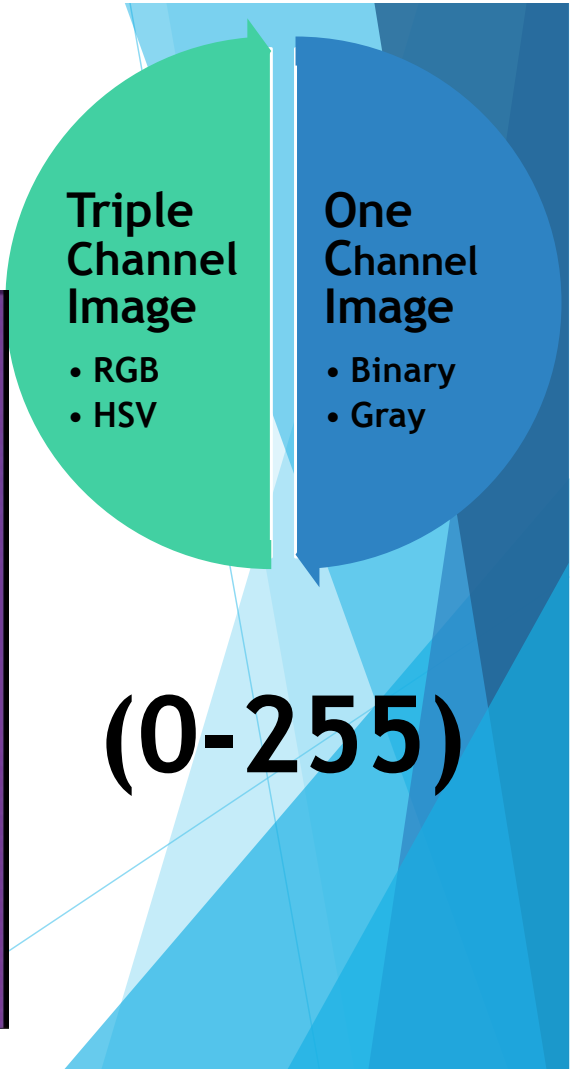
10010000 10001101 01010001

→ **Hidden message: 101001...**

10010000 10001100 01010001

10010000 10001101 01010001

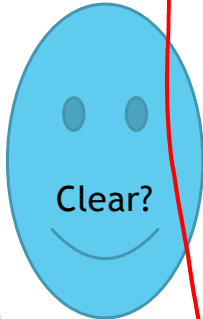
The diagram shows a grid of colored squares representing RGB values. The values are: 144 (Red), 141 (Green), 81 (Blue) for the first row; 145 (Red), 140 (Green), 81 (Blue) for the second row; 146 (Red), 142 (Green), 81 (Blue) for the third row. The binary representations are shown below each row. The hidden message '101001...' is extracted from the LSBs of the red and green channels. The binary strings are: 10010000 10001101 01010001 for the first row, 10010000 10001100 01010001 for the second row, and 10010000 10001101 01010001 for the third row. The hidden message '101001...' is formed by the LSBs of the red and green channels: 1 (from 144), 0 (from 141), 1 (from 145), 0 (from 140), 0 (from 146), 1 (from 142).



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.

MfBuylwubfsTldttmntTgiLaUMwuNlptcosnatpptaafs
etcAlaswttltintplpibtpxlfanhtitqompCA



Cover Message

$\pi = 3.14159265589793...$

Message

BuubdlupnpsspX

Secret Key

Yes

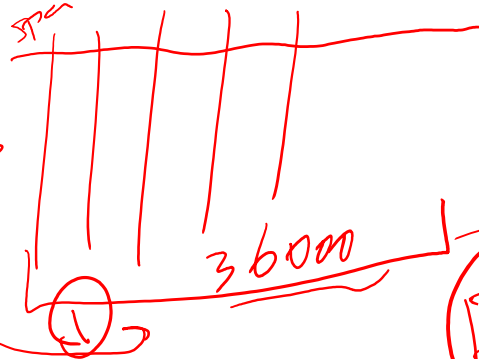
Secret Key

Attack Tomorrow

Why EA / NIA?

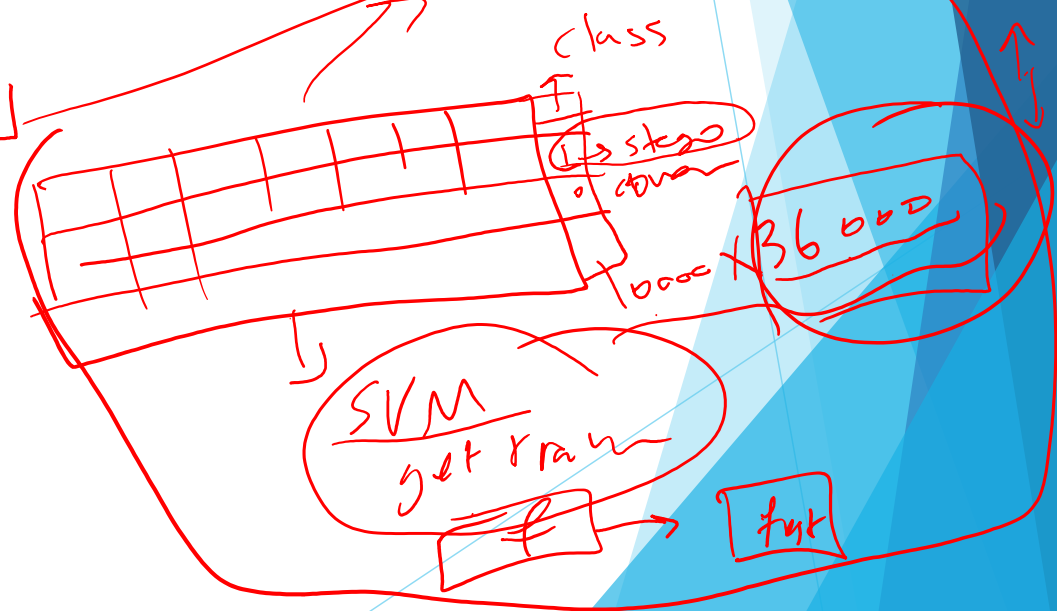


extract features

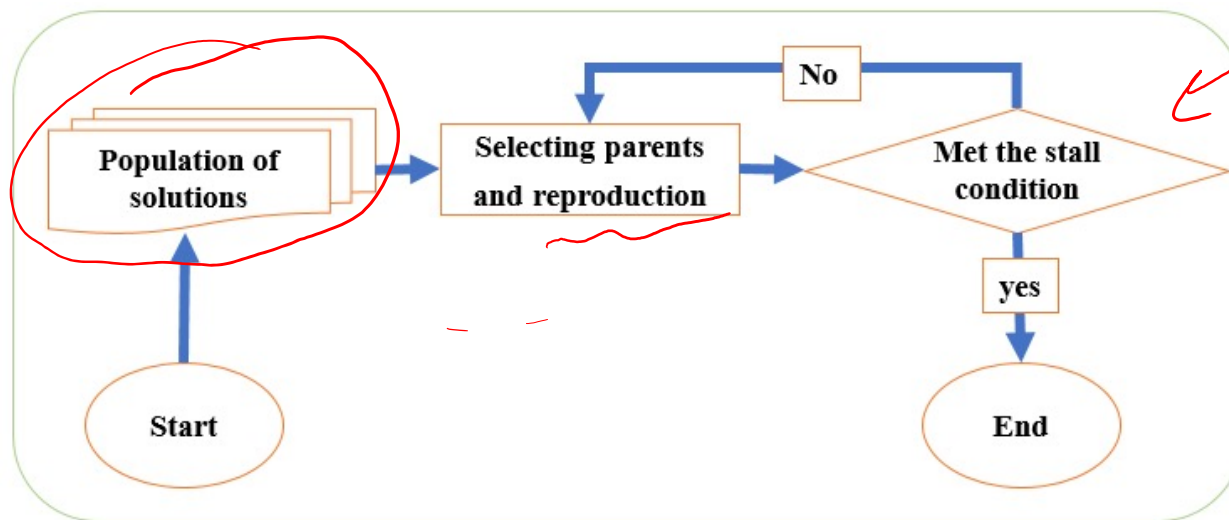


10k images $\times 36000 =$

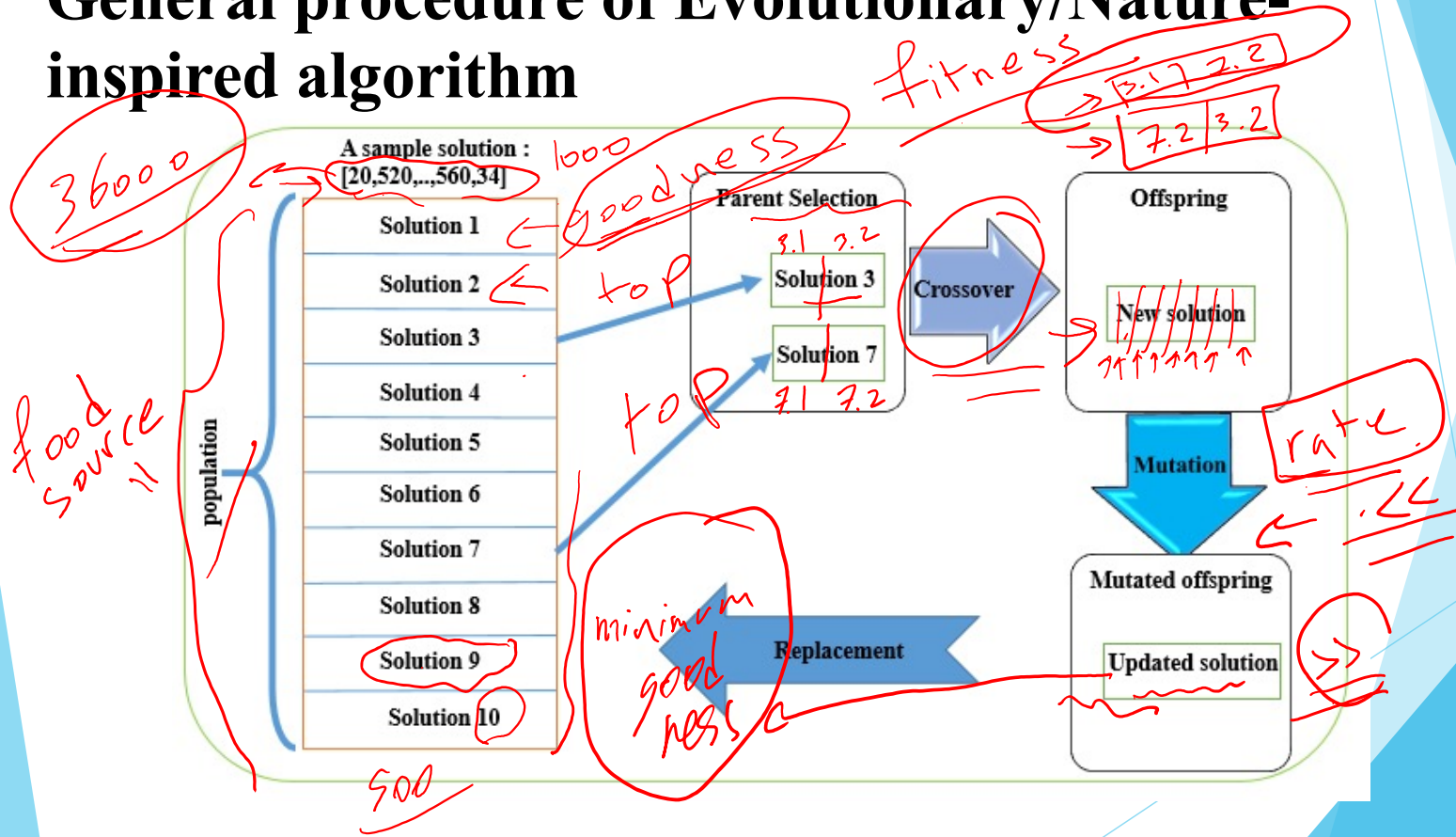
CoD



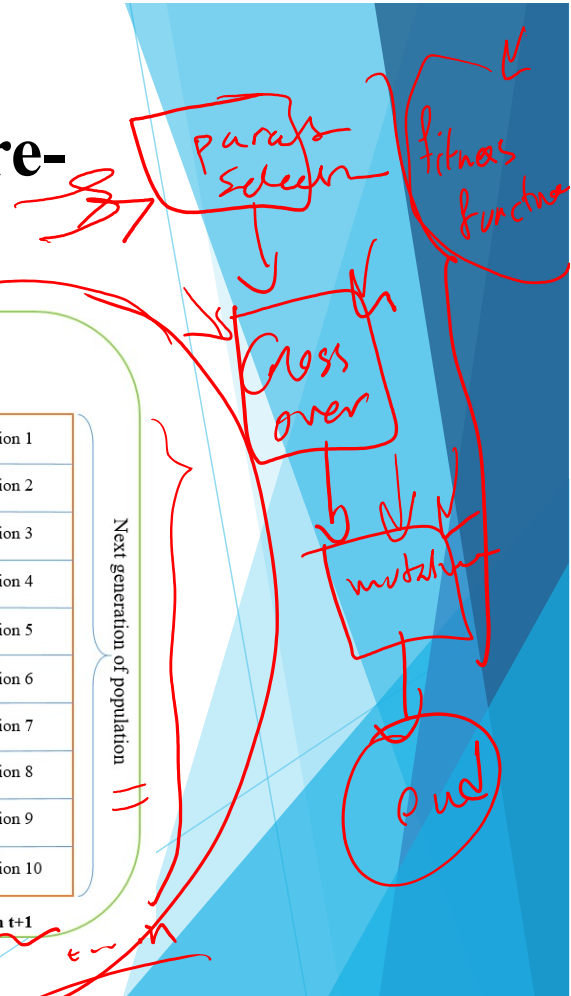
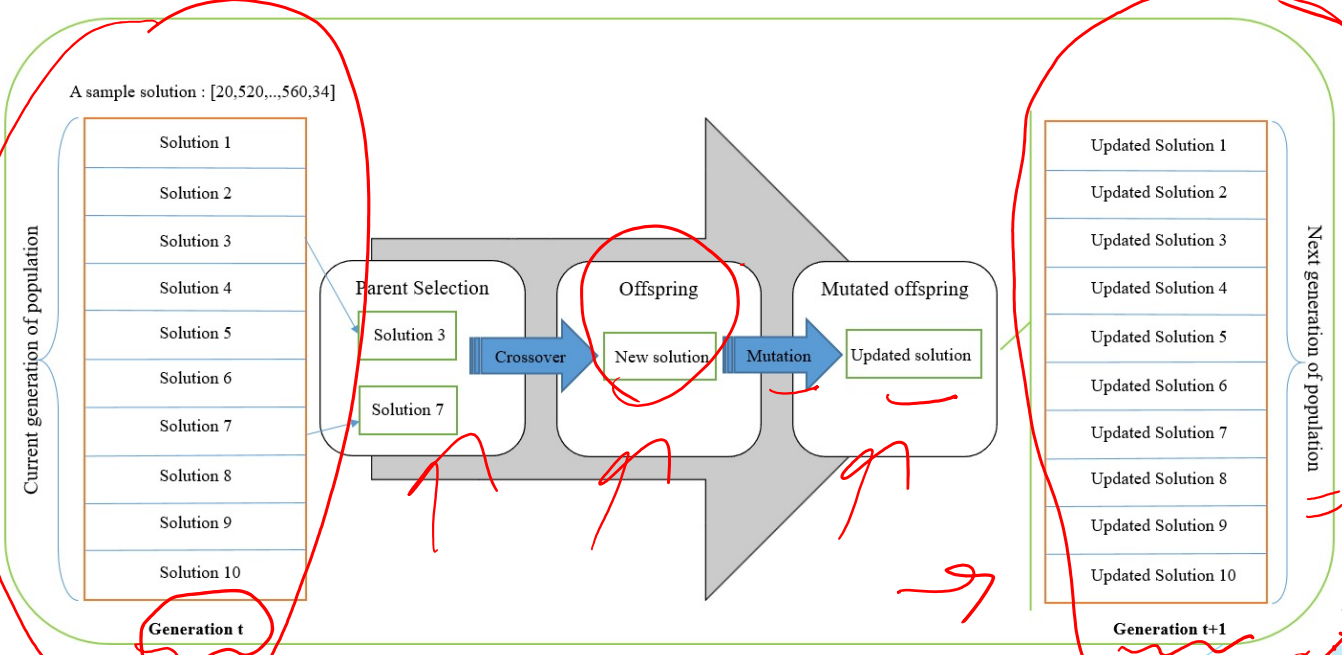
General procedure of Evolutionary/Nature-inspired algorithm



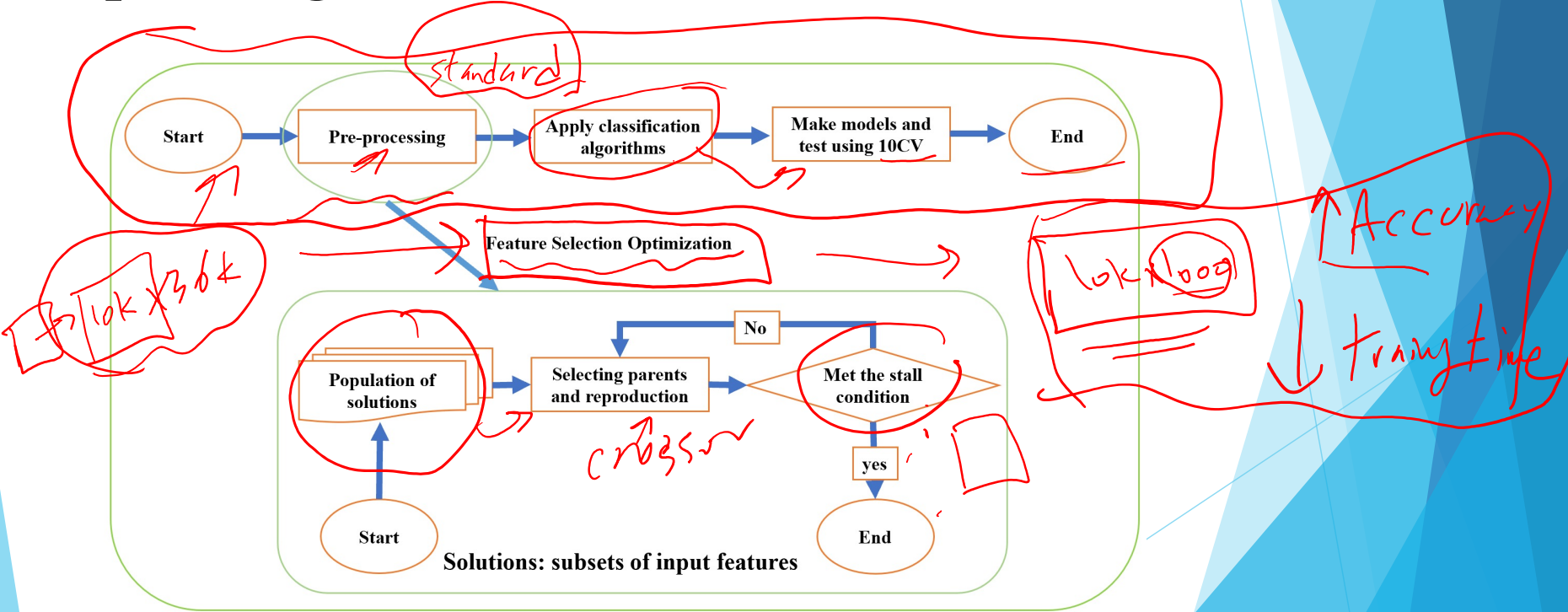
General procedure of Evolutionary/Nature-inspired algorithm



General procedure of Evolutionary/Nature-inspired algorithm



General procedure of Evolutionary/Nature-inspired algorithm



IFAB : Image steganalysis using feature selection-based ABC

Artificial Bee Colony

Employed

Onlooker

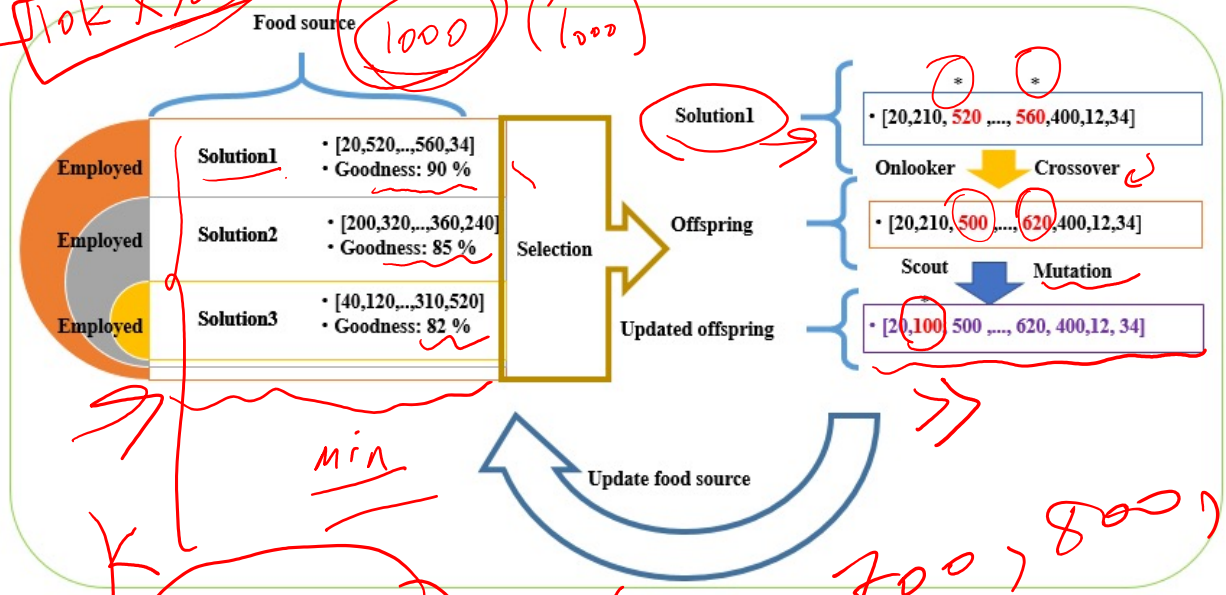
Scout

$10k \times 36000$

Food source

1000

36000 (1000)



\min

$K = 900$

$600 \rightarrow 700, 800$

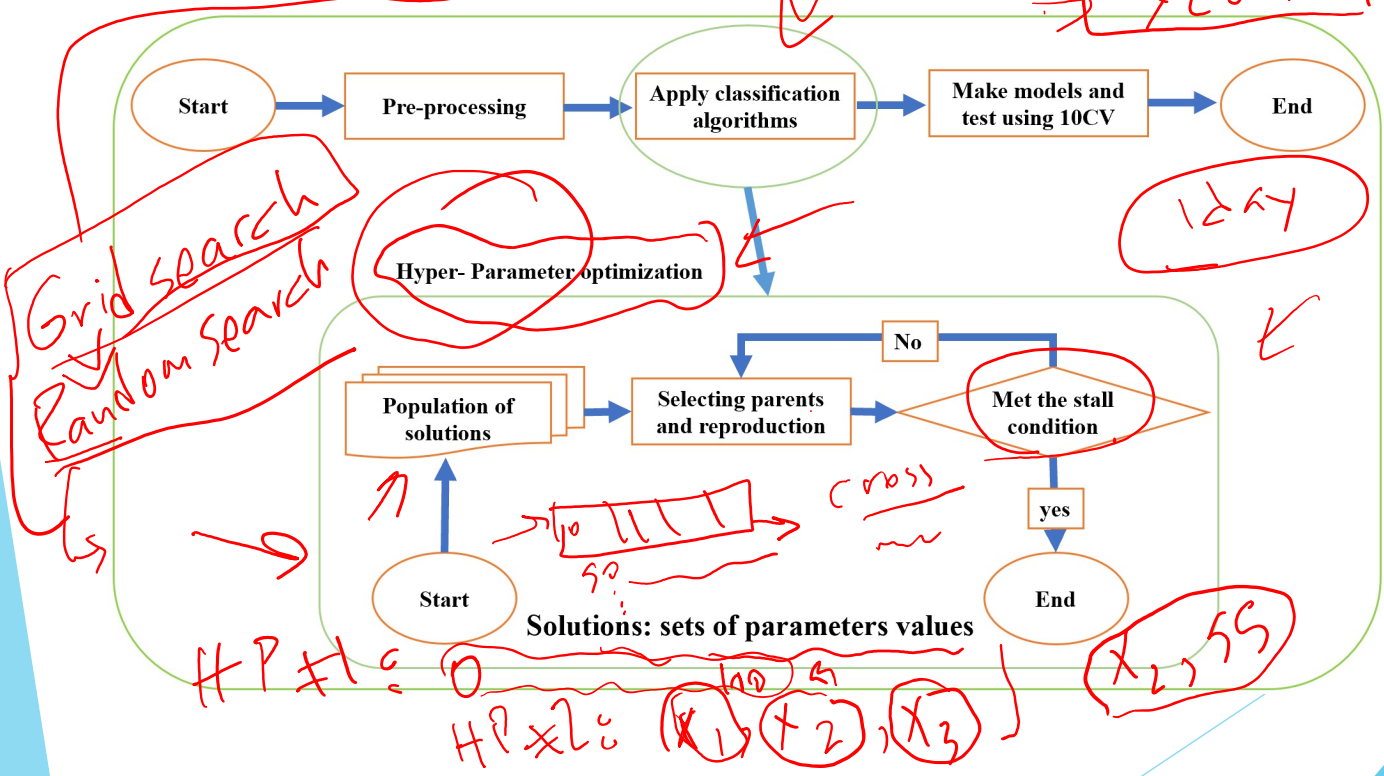
700, 1000

General procedure of Evolutionary/Nature-inspired algorithm

$6 \times 5000 \times 2 = 6 \times 10000 = 60000$
 → year

Classifier

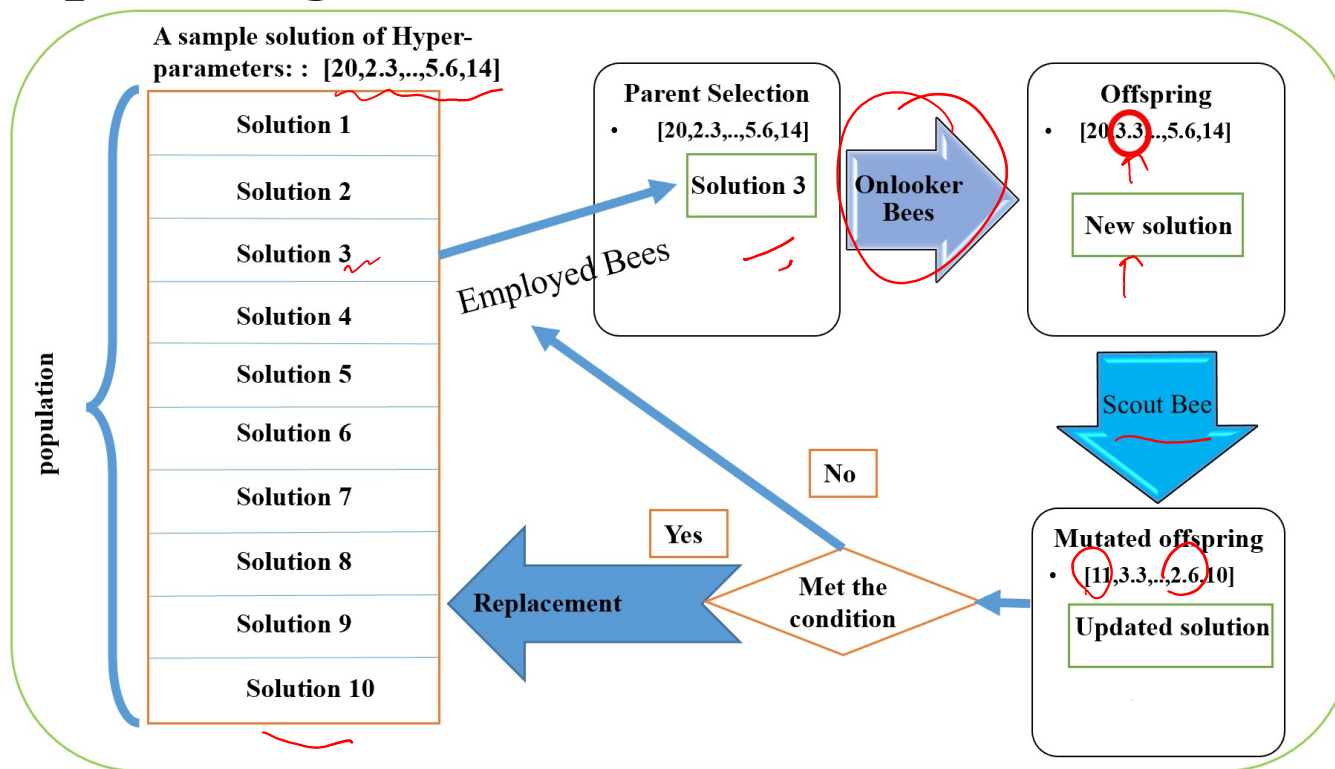
SVM



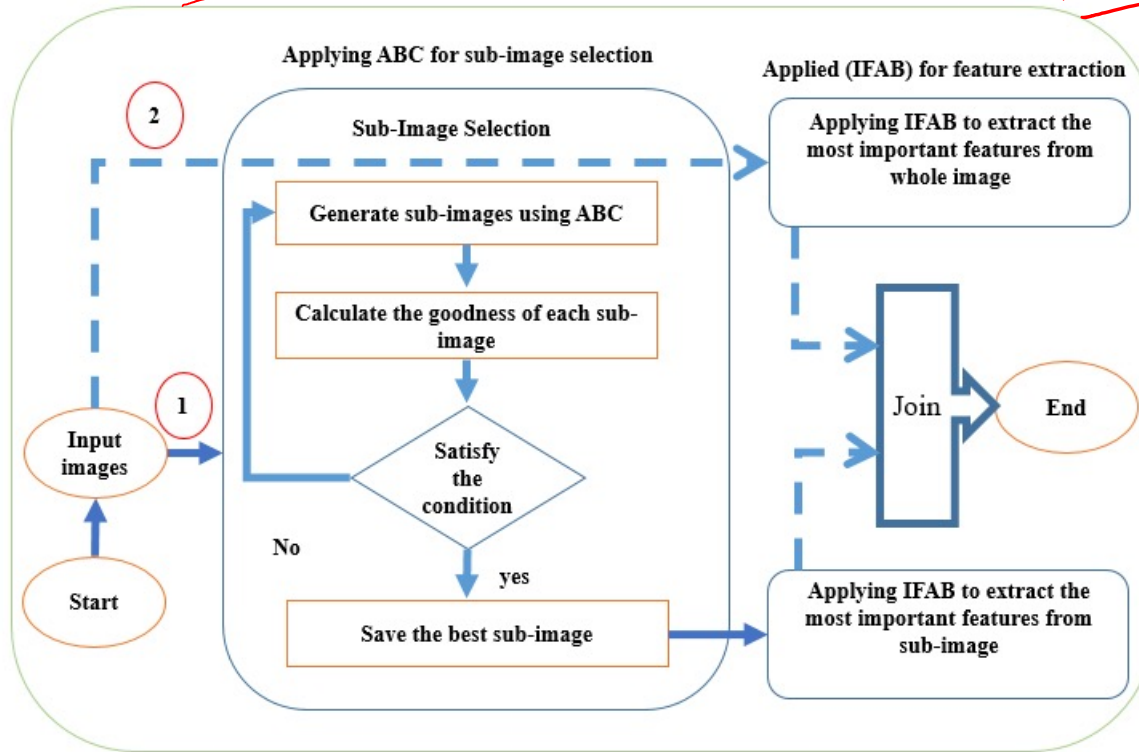
Hyper-Parameters
 when only when SVM starts to run use these parameters



General procedure of Evolutionary/Nature-inspired algorithm



RISAB: Region-based Image Steganalysis using ABC



message is embedded

512×512

x, y, x', y' Goodness \rightarrow Energy

energy

\rightarrow threshold

complete

extract 1000

1000

sub-image

10k x 1000

RISAB-example

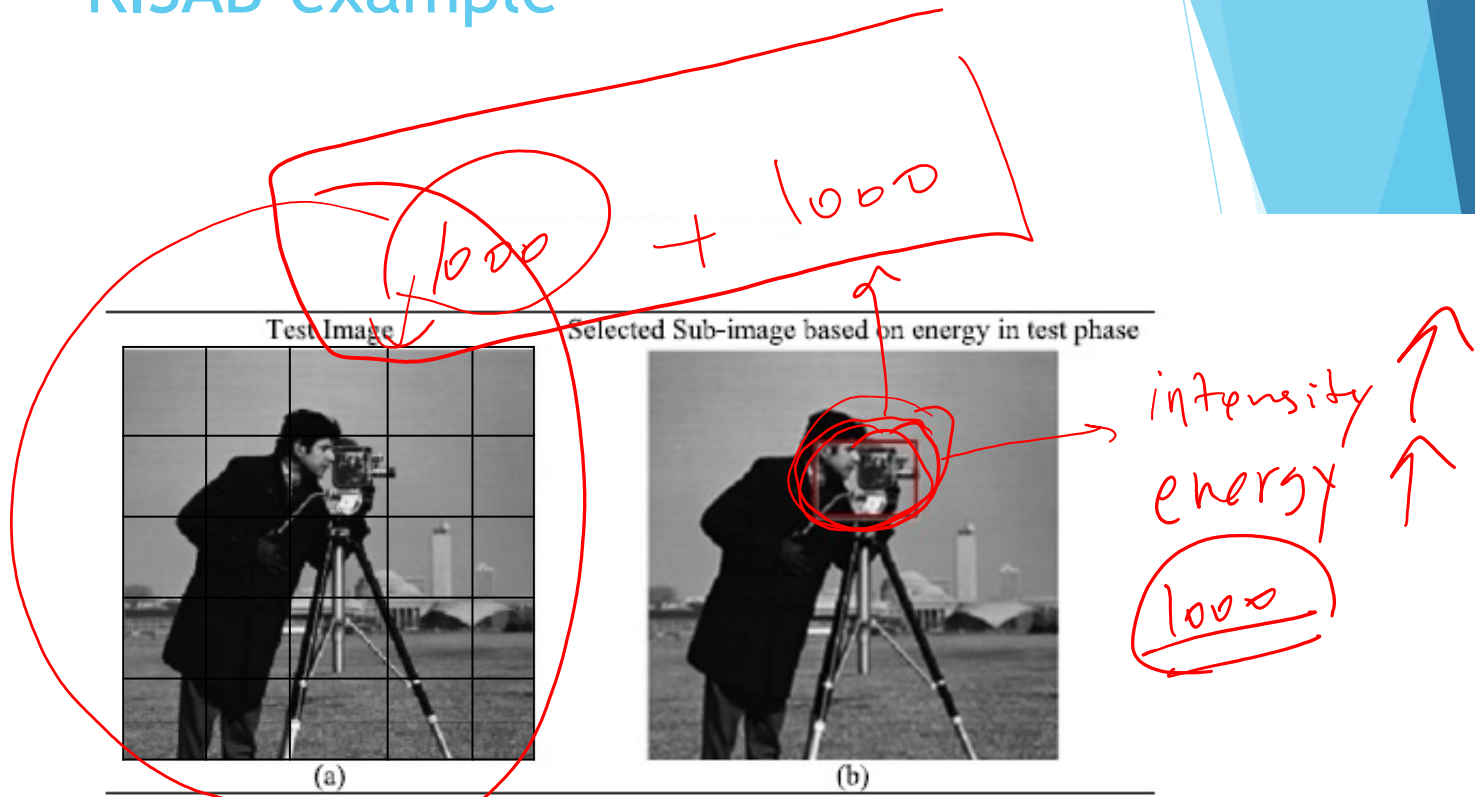


Fig. 8. A sample of (a) test image, (b) the selected sub-image shown with a red rectangle. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)



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