

Dimension Reduction Using Genetic Algorithm



ASIP PROJECT PRESENTATION

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Content



- Input from User
- Methodology
- Structure of the candidates.
- Initialisation, Mutation, Crossover, Fitness and Selection of Candidates
- Demonstration
- Future Scope

Input from User



- Input image
- No of Bands to be selected
- No of Candidates in a Pool.
- No of Generations.
- Probability of Mutation of a candidate.
- Probability of Crossover of a candidate.
- Type of Fitness Function.
- Amount of Randomness in Selection of candidates.
- Saving the selected bands image.

Methodology

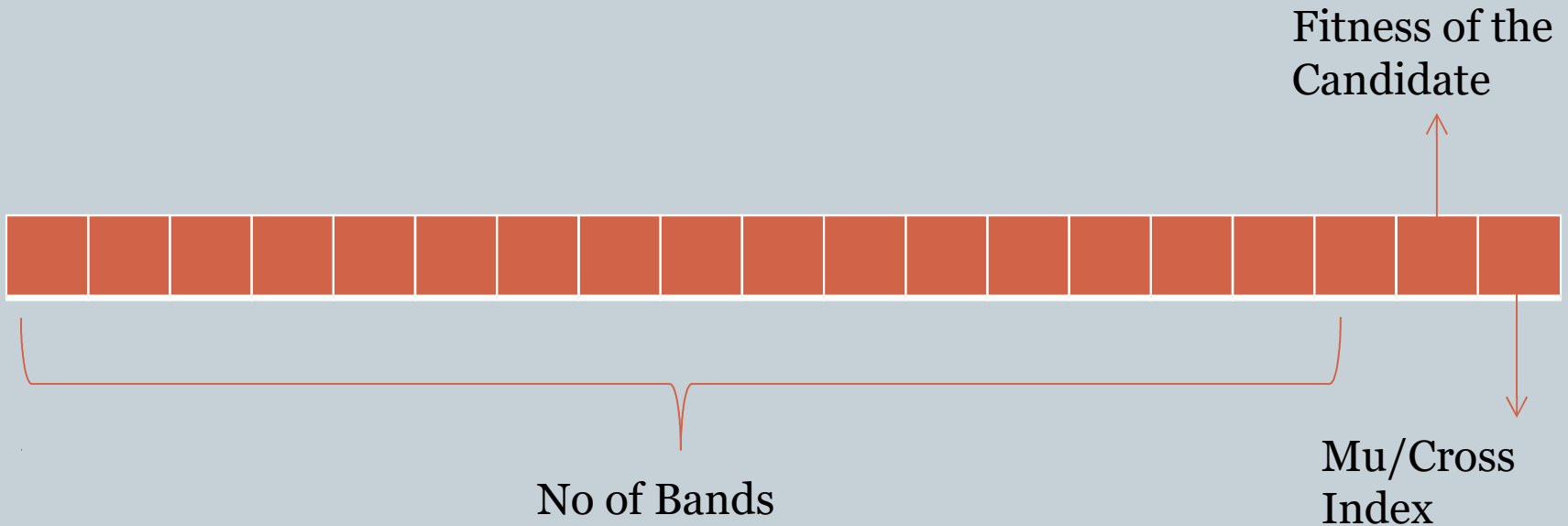


- Inputs from User.
- Initializing the Pool.
- Generating new population using Crossover, Mutation, assessing their fitness and Selection of candidates.
- Looping the above step with the mentioned no of generations.
- After the end of all generations, Best fit candidate is selected.

Structure of a Candidate



- A 1D array of No of Bands + 2 extra cells.



Initialization of Candidates

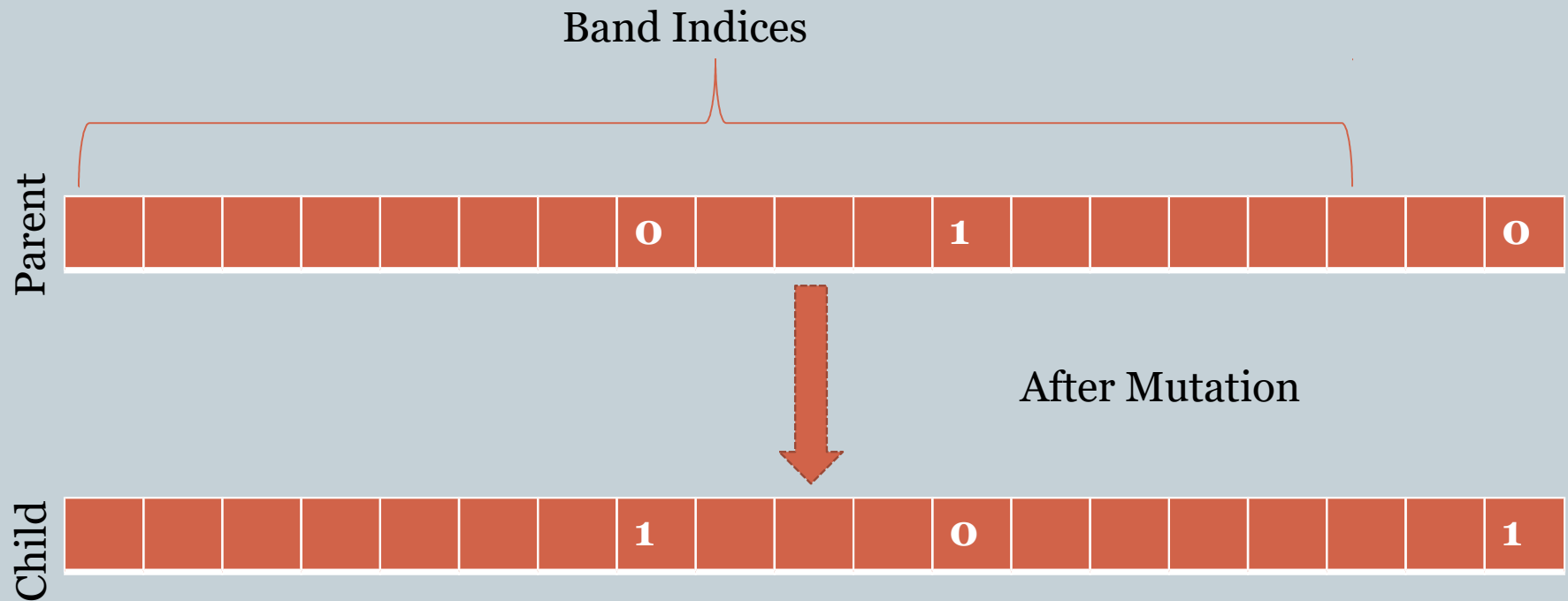


- Randomly assign the ones in the candidate (till the second last cell)
- The no of ones are equal to the no of bands to be selected.
- Assigning the fitness of the candidate in the initialization.

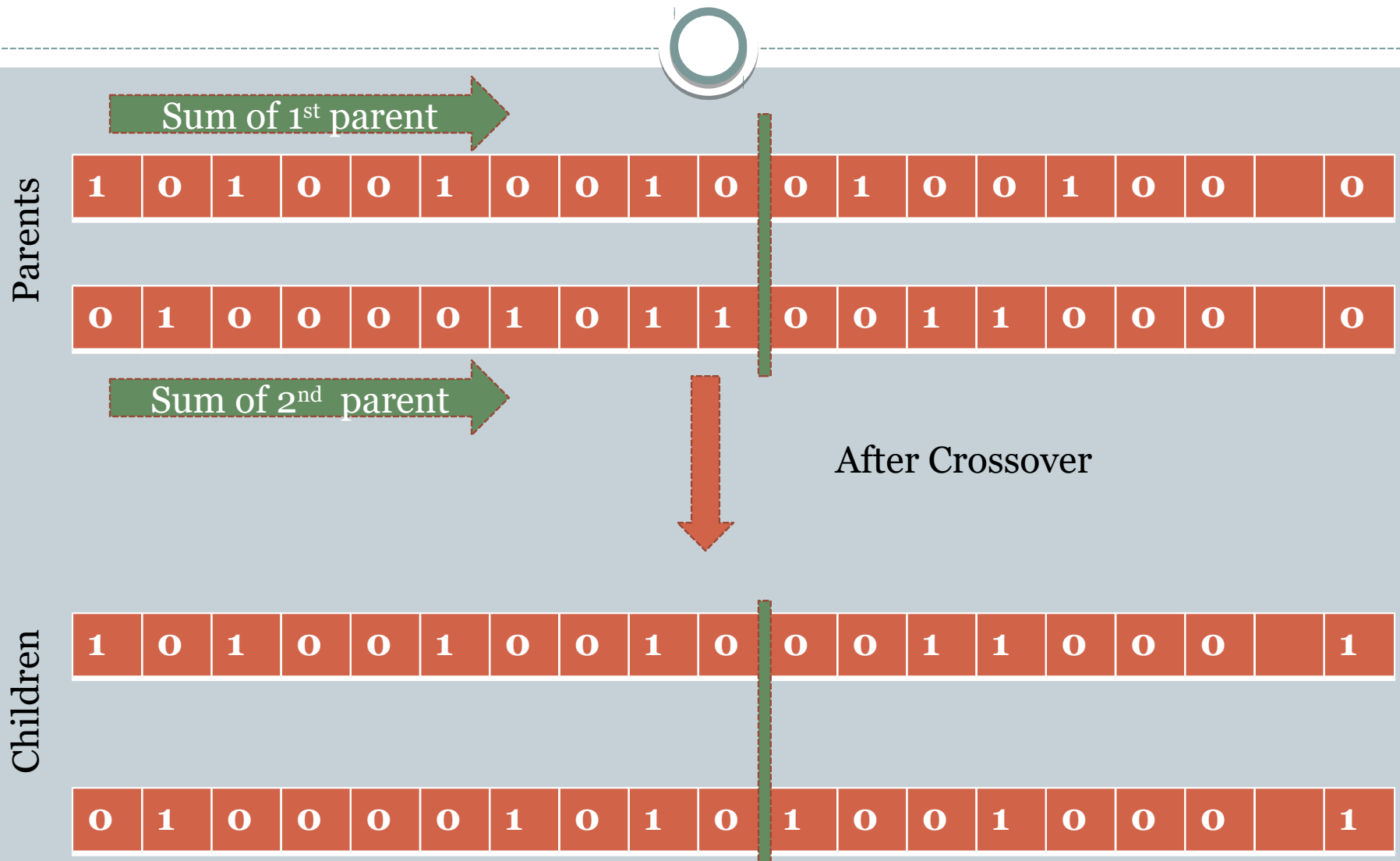
Mutation of Candidates



- In the Band indices, change a random 0 into 1 and vice versa.
- Calculated the fitness of the child candidate.



Crossover of Candidates



Fitness of the Candidate



- Make a temporary array of selected bands of a candidate.

Determinant Method

- In this method the determinant of covariance matrix is calculated.

Ratio Method

- Inspired by Pearson Coefficient of Correlation.

$$r = \frac{\sigma_1 * \sigma_2 * \sigma_3 \dots \sigma_{bands}}{C_{12} * C_{23} * C_{34} \dots C_{(bands-1)bands}}$$

- Assigned as fitness value by taking log of the value.

Selection of the Candidates



- The randomness in the selection is defined by the user.
- Say if User inputs 80% randomness, the top 20% of the required candidate will be directly selected and rest will be randomly selected.

Snapshots of the GUI



GA_dim_red

Browse File

Image Properties

File name

Indian_pines.mat

No of Rows

145

No of Columns

145

No of Bands

220

Composite Colors display

Genetic Algorithm for Dimensionality Reduction

GA Parameters

No. of Bands to be selected

10

Population Size

100

No. of Generations

100

Crossover

Probability of Crossover

☐ 0.6

☐ 0.7

☒ 0.8

Mutation

Probability of Mutation

☐ 0.01

☐ 0.02

☒ 0.05

Fitness

☒ Determinant

☐ Ratio

Selection

Percentage of Random Selection

100

Run Genetic Algorithm

Selected Bands

	1	2	3	4
1	17	21	51	64

< >

Display New Dataset

Red

51

Green

21

Blue

17

Display New Dataset

Save

14:04

08-05-2018

ENG

Snapshots of the GUI



GA_dim_red

Browse File

Image Properties

File name

Indian_pines.mat

No of Rows

145

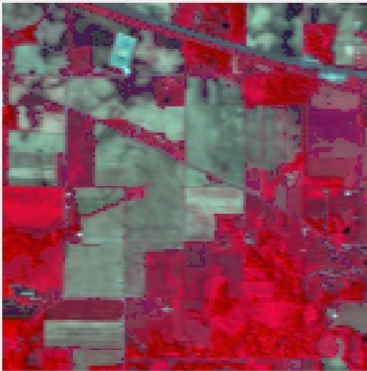
No of Columns

145

No of Bands

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Composite Colors display



Genetic Algorithm for Dimensionality Reduction

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Mutation

Probability of Mutation

☐ 0.01

☐ 0.02

☒ 0.05

Fitness

☐ Determinant

☒ Ratio

Selection

Percentage of Random Selection

100

Run Genetic Algorithm

Selected Bands

	1	2	3	4
1	6	34	75	83

< >

Display New Dataset

Red

75

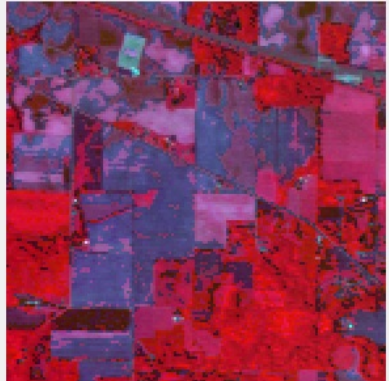
Green

34

Blue

6

Display New Dataset



Save

Windows Taskbar

14:22

08-05-2018

Snapshots of the GUI



GA_dim_red

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Genetic Algorithm for Dimensionality Reduction

Browse File

Image Properties

File name	Indian_pines.mat
No of Rows	145
No of Columns	145
No of Bands	220

Composite Colors display

GA Parameters

No. of Bands to be selected

Population Size

No. of Generations

Crossover

Probability of Crossover

Mutation

Probability of Mutation

Fitness

Selection

Percentage of Random Selection

Run Genetic Algorithm

Selected Bands

	1	2	3	4	
1	23	33	53	74	
< [Progress Bar] >					

Display New Dataset

Red

Green

Blue

Display New Dataset

Save

Some Comparison



- Dataset Indian Pines
- No of selected Bands 10
- Pool size 1000
- No of generations 1000
- Mutation Probability 2%
- Crossover Probability 80%

With ratio as Fitness function

- Time Elapse 1141 s ~ 19min

- Bands Selected

15 17 40 100 101 156 158 187
215 218

With Determinant as Fitness function

- Time Elapse 1127 s ~ 19min

- Bands Selected

11 18 24 30 36 63 81 139
173 188

Future Scope



- Assessment of feature selection can be done with Supervised Classification Accuracy.
- Quantitative assessment of different scenarios with varying randomness, fitness function, etc.



Thank You