

# Evolving Prototypes Towards The Best-suited Design and Interaction Schema Using The Genetic Algorithm

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## PART – I

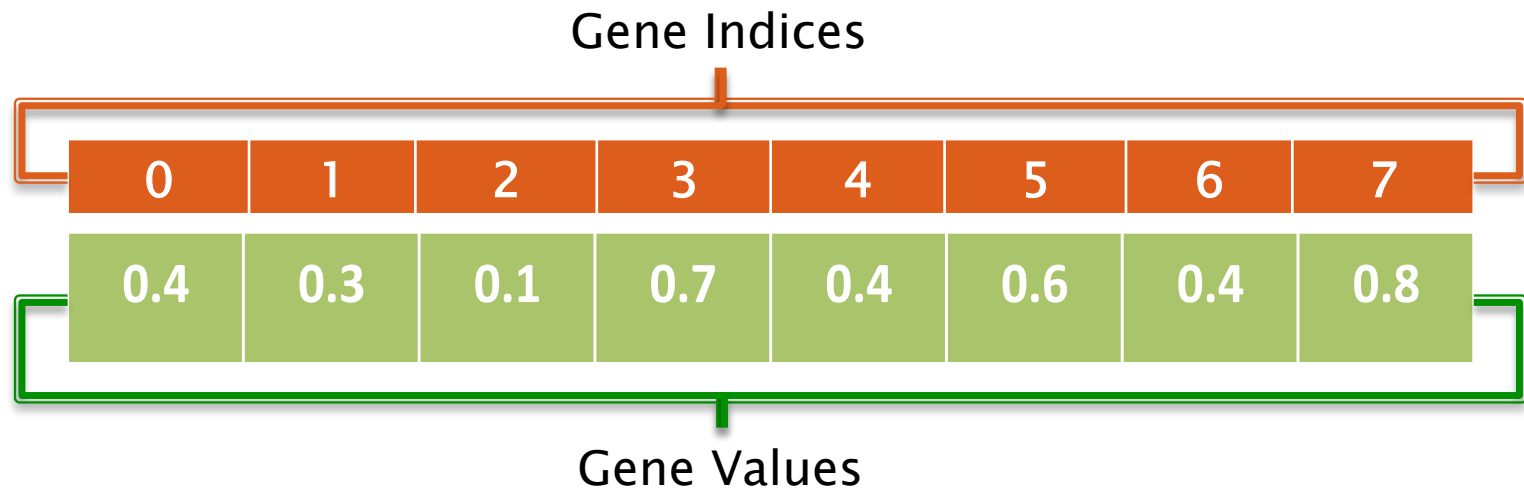
# The Genetic Algorithm

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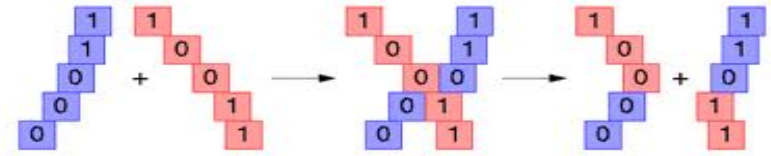
- ▶ Searching Algorithm
- ▶ Applies the natural evolutionary process on a set of potential solutions.
- ▶ Generates a pool of solutions to select one among them.
- ▶ Each generated solution represents one possible chromosome in the final representation.
- ▶ The process consist of four steps:
  - 1 – Chromosome Encoding
  - 2 – Crossover
  - 3 – Mutation
  - 4 – Elitism

# Step 1: Chromosome Encoding

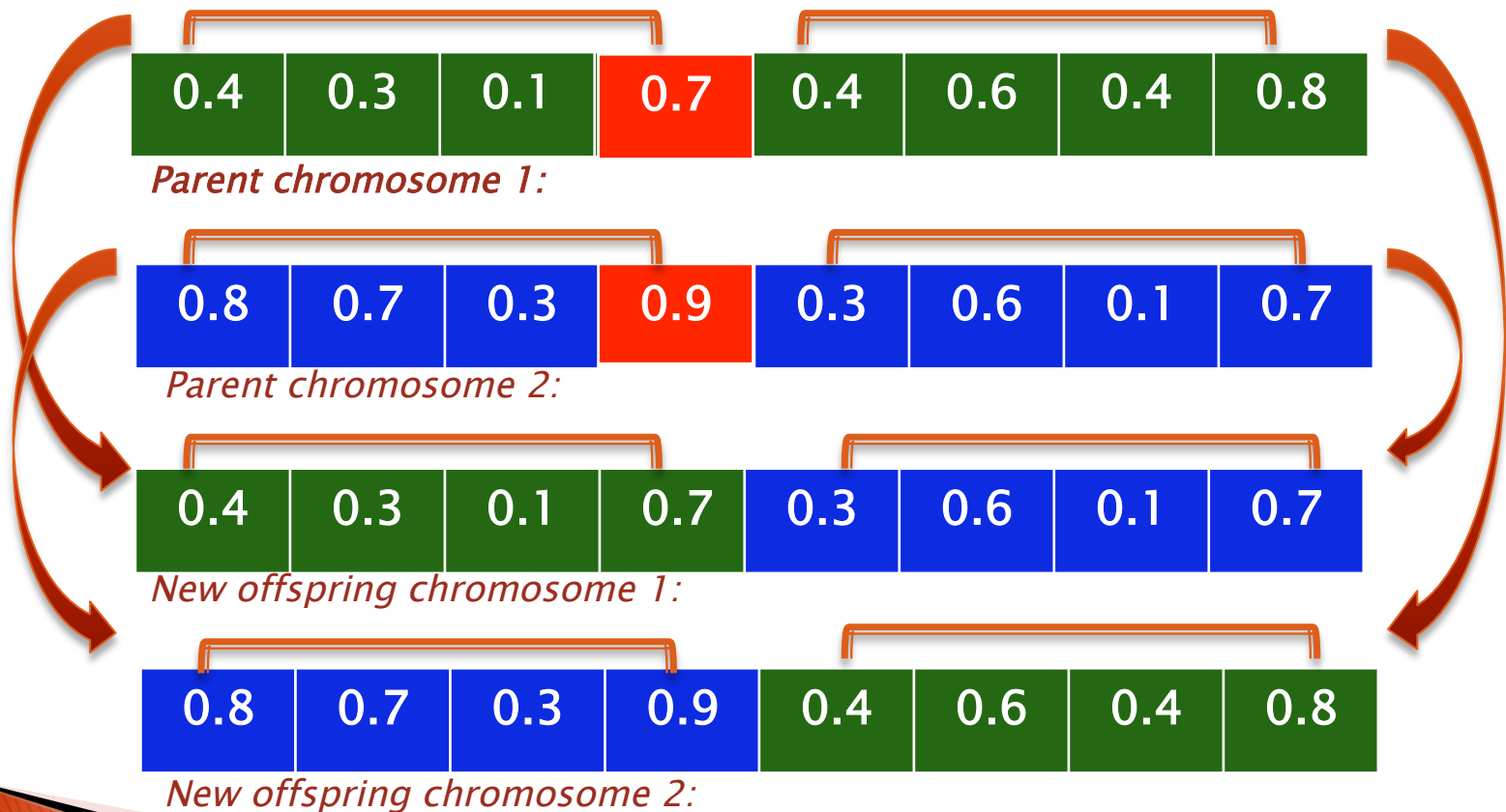
- Representing the data into chromosomes.
- Each chromosome represents one of the candidate solutions in the search space.



# Step 2: Crossover



- Genes are selected from different parent chromosomes, and then new offspring will be created.



# Step 3: Mutation

- ▶ The mutation step changes randomly the new offspring.
- ▶ This prevents falling all solutions in the population into a local optimum of solved problems.

*Chromosome 1:*

0.4	0.3	0.1	0.7	0.4	0.6	0.4	0.8
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*After mutation:*

0.4	0.3	0.1	0.7	0.4	0.9	0.4	0.8
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# The Fitness Function

- ▶ The Optimal Solution is defined as the one with highest fitness value.
- ▶ The Fitness function calculates the fitness value for each chromosome X.

$$F(x) = \sum_{i=0}^{Xsize} w_i$$





# Step 4: Elitism

- ▶ The best chromosomes (or the few best ones) are first copied and then are replaced with the old population in order to eliminate the bad chromosomes.
- ▶ The GA proceeds till the last three stages have repeated to the maximum number of iterations or the GA reaches to the optimal solution.







## PART – II

# The Methodology

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- ▶ Towards the final prototype with the possible *best-suited* design and mobile interaction schema.
- ▶ Applying the Genetic Algorithm for reaching to the best solution through the evolutionary process.
- ▶ **The Input:**
  - A given population of potential solutions (i.e., the created prototypes by interaction designers/users in early stages).
- ▶ **The Acceptance Criteria:**
  - UI elements, design layout, interaction elements and schema, target mobile environment, user preference, etc.
- ▶ **The Output:**
  - A particular solution (the final mobile app prototype) with the *best-suited* design and interaction schema.

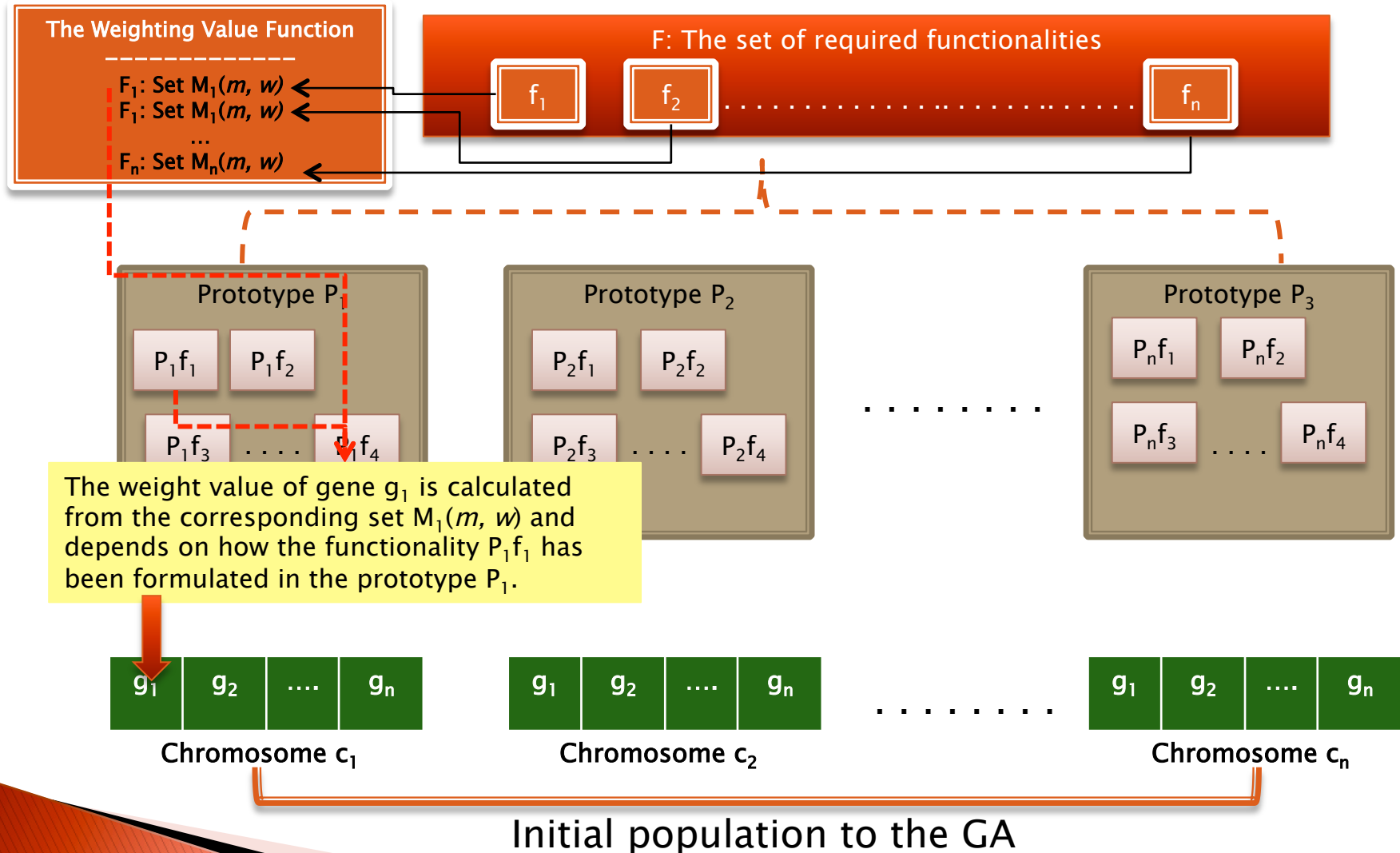


# The Methodology

- ▶ The best solution is based on the highest acceptance ratio.
- ▶ The highest acceptance ratio is measured using the weight value of the acceptance criteria, which is:
  - *A combination of the design layout, the UI elements, the mobile interaction elements and schema, the target mobile environment, and the target users and their preference.*
- ▶ The weight value of a particular functionality depends on the how this is formulated in the underlying prototype.
- ▶ The different variations between the weight value, due to the different formulation of combinational elements, define the fitness of the proposed solution.



# The Chromosomes Creation Process



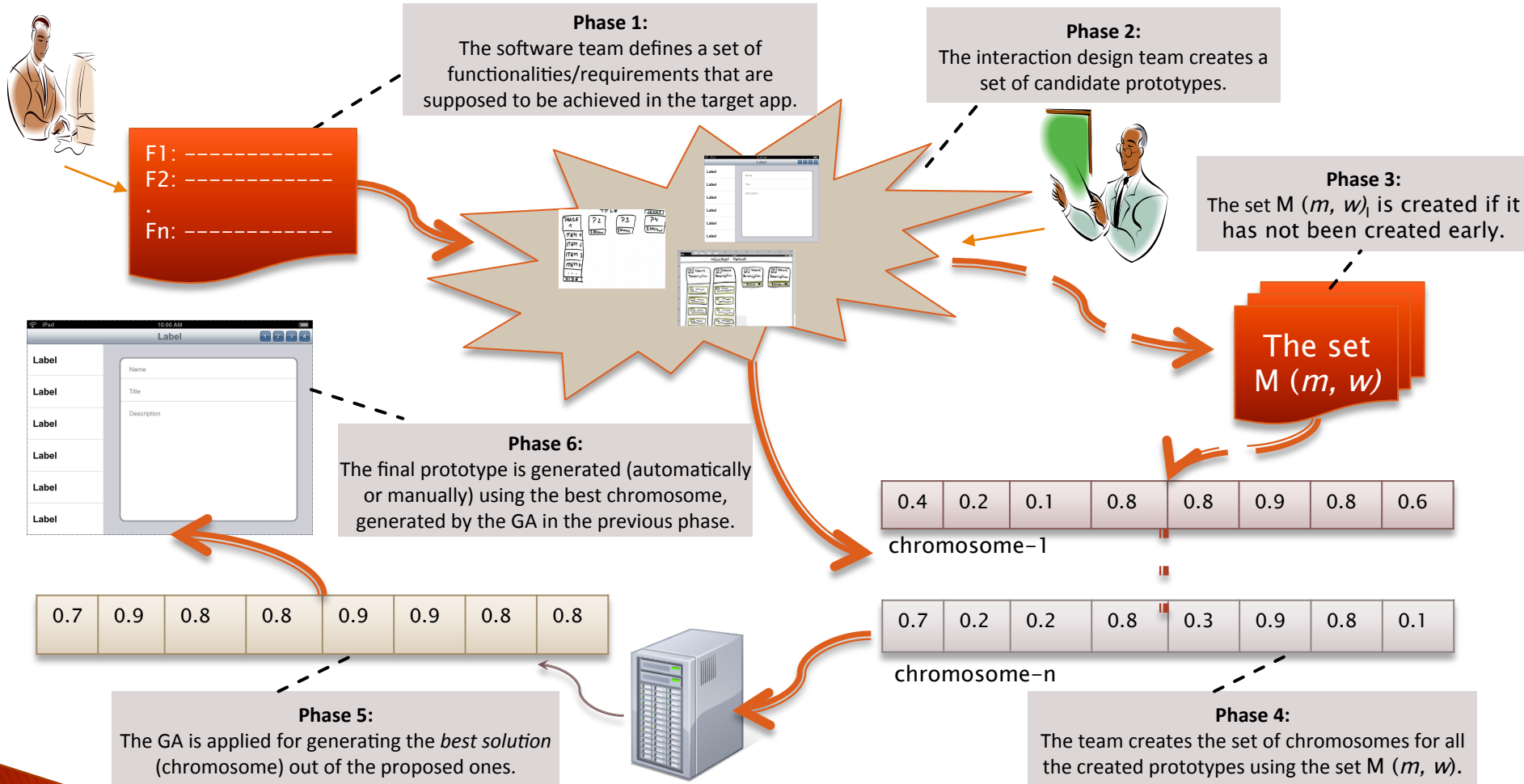
# Example:



- ▶ Functionality: *A zooming functionality to a frame area*
- ▶ Formulation Possibilities:
  - A plus-and-minus button
  - A zooming in-out touch gesture with two figures
  - A combination of above two

Functionality name	Formulation	Weight Value
Zooming	Plus-minus button	0.5
Zooming	in-out touch gesture	0.7
Zooming	Both	0.9

# The Workflow



## PART – III

# Concluding Remarks





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- ▶ This is a first work towards applying the Genetic Algorithm in mobile app prototyping.
- ▶ Many things need to be done in order to utilize the approach with its full power.
- ▶ Future Plan:
  - Studies for finding out the different combinational formulations of functionalities in prototyping and the weight value allocation to these formulations.
  - Evaluation studies with mobile interaction design team to check the feasibility and effectiveness of the approach.





THANK YOU!

Questions???

