

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

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Tuesday, August 27, 2013
PID-MAD 2013 @ MobileHCI 2013
Munich, Germany



PART - I

The Genetic Algorithm

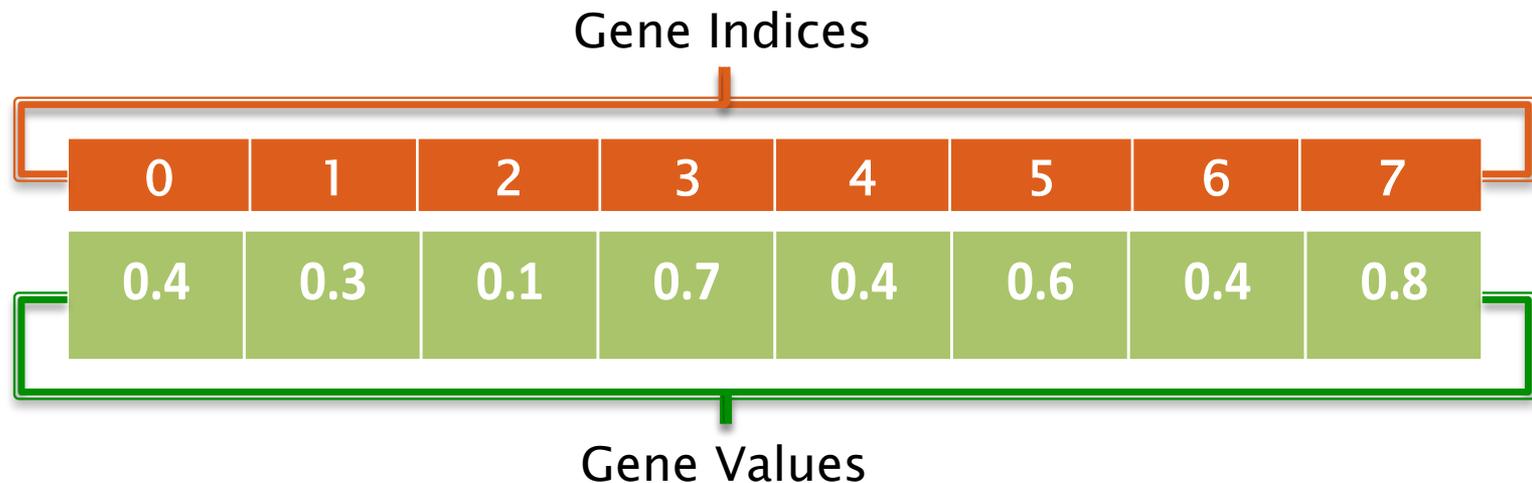


The Genetic Algorithm

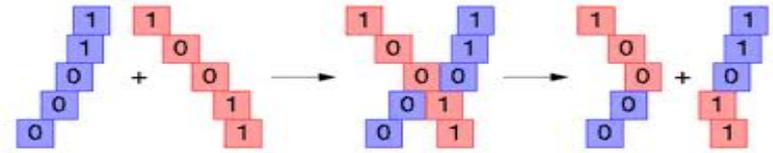
- ▶ Searching Algorithm
- ▶ Applies the natural evolutionary process on a set of potential solutions.
- ▶ Generates a pool of solutions to select one among them.
- ▶ Each generated solution represents one possible chromosome in the final representation.
- ▶ The process consist of four steps:
 - 1 – Chromosome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

Step 1: Chromosome Encoding

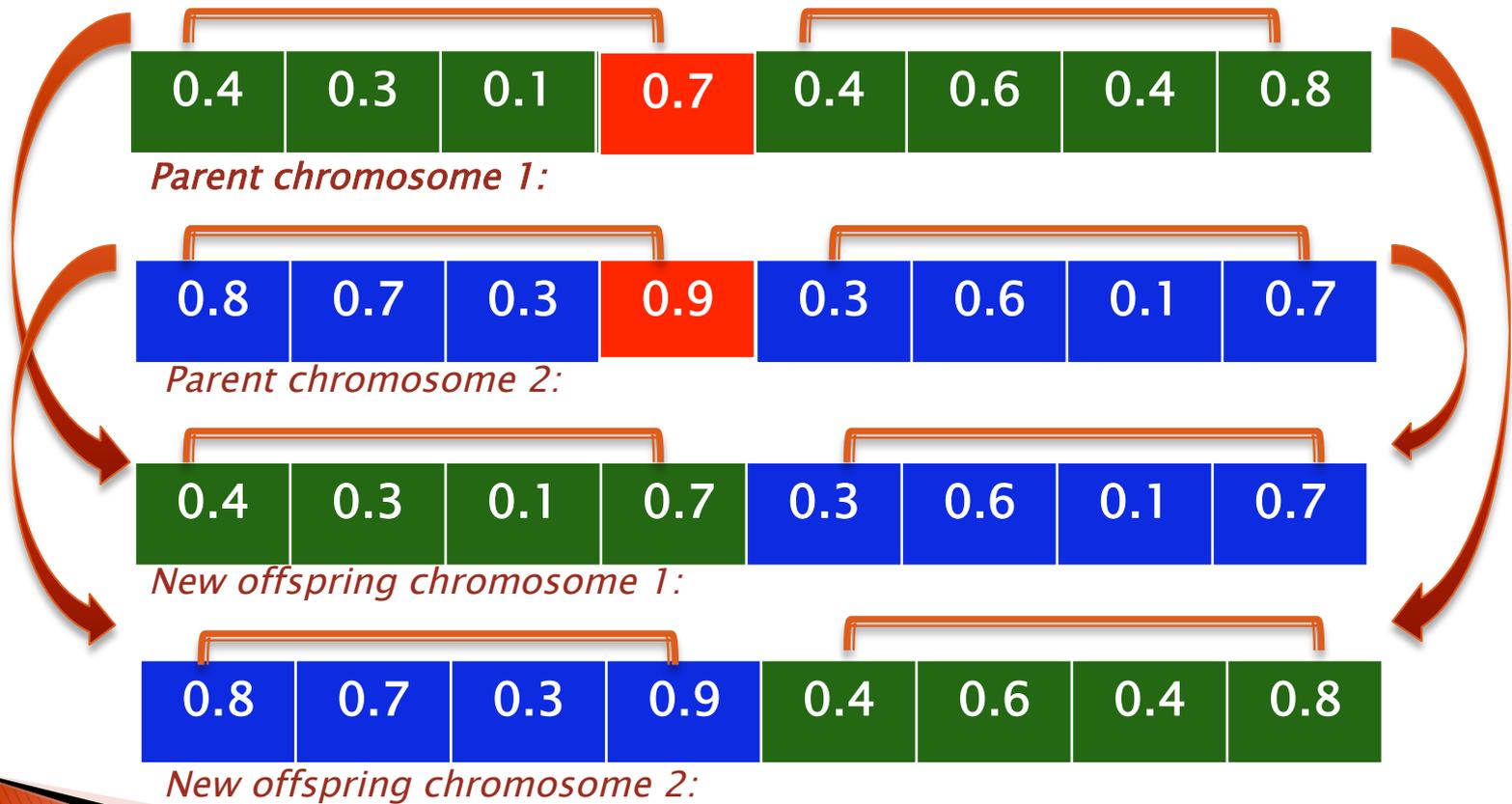
- Representing the data into chromosomes.
- Each chromosome represents one of the candidate solutions in the search space.



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:



After mutation:



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



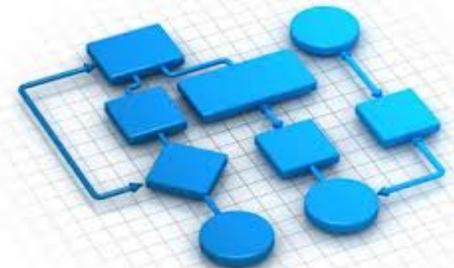
The Methodology

- ▶ 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.

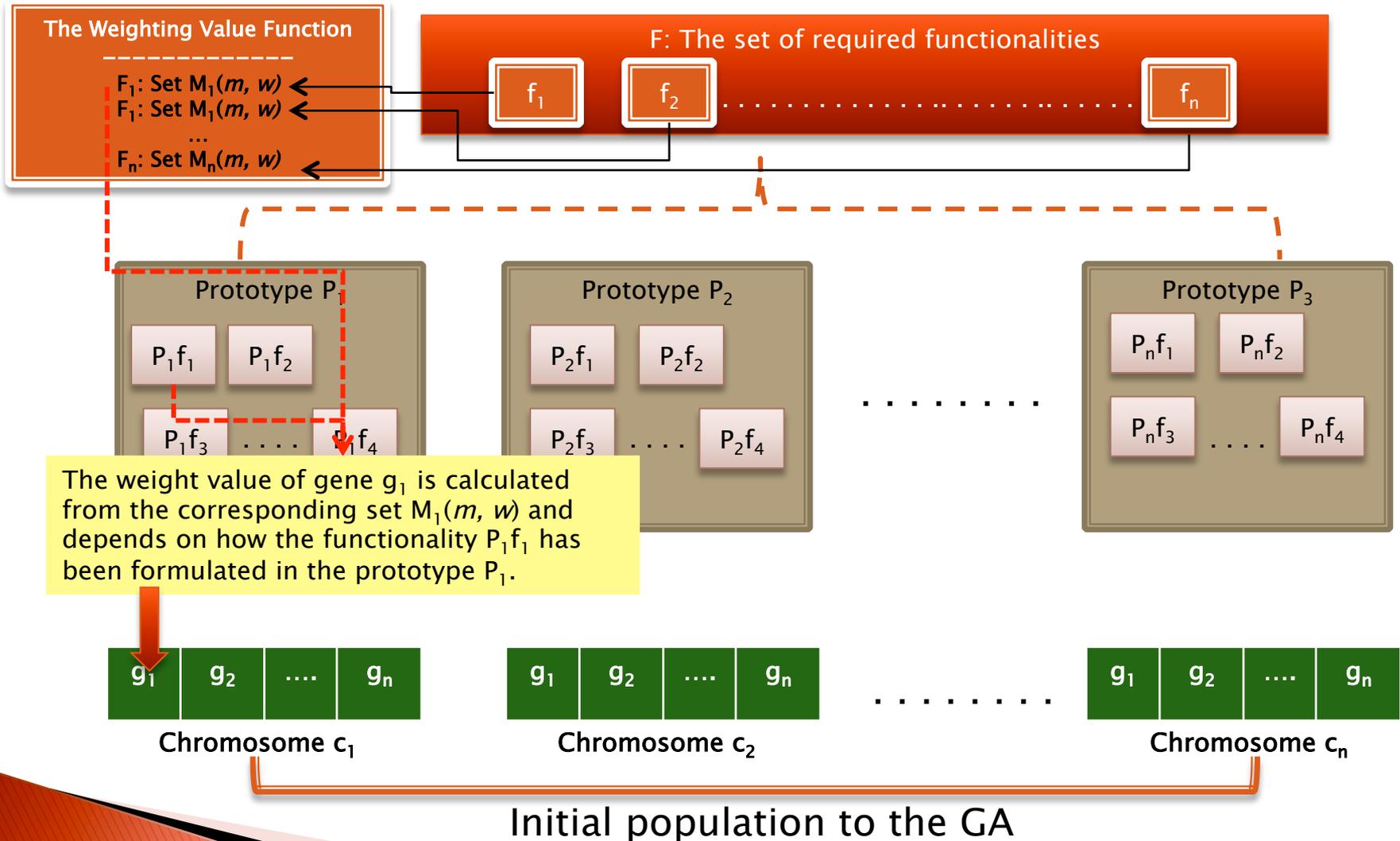


The Methodology

- ▶ 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



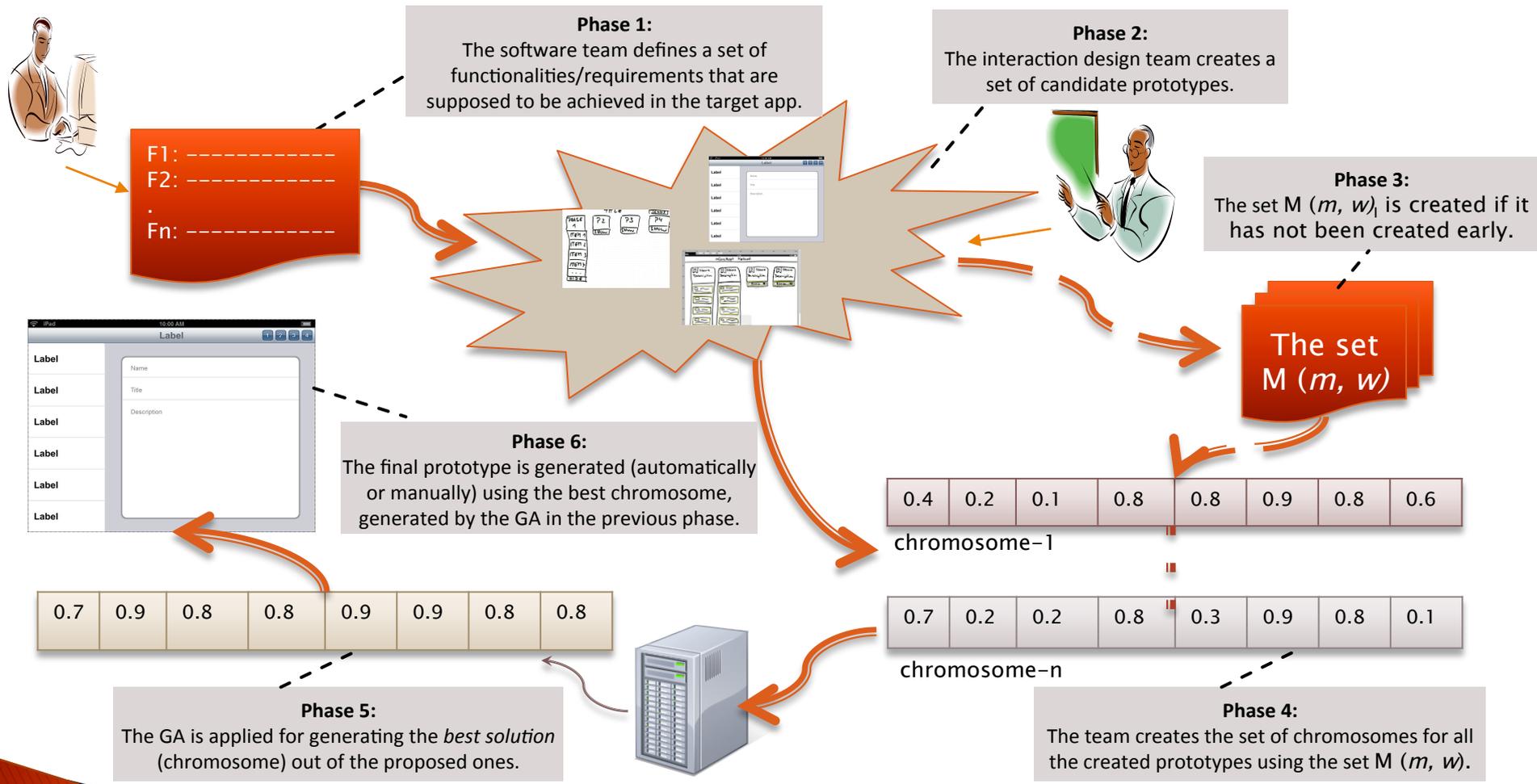
Example:



- ▶ **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



Concluding Remarks

- ▶ 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???

