

The background features a light gray field with faint, overlapping circular patterns and numerical scales. Some of the visible numbers include 150, 160, 170, 180, 190, 210, 220, 230, 240, 250, and 260, arranged in a way that suggests a technical or scientific theme.

Genetic Algorithm

Presentation Outline:

- 1) Introducing the 4-Queen problem
- 2) **Activity**: Solving 4-Queen problem using artifacts
- 3) Solution of 4-Queen problem in Backtracking approach
- 4) Demerits of Backtracking approach
- 5) Introducing 8-Queen problem
- 6) Discussion on Genetic Algorithm
- 7) Solution of 8-Queen problem using GA
- 8) Conclusion



The 4-Queen Problem

Once upon a time, there was a great king in India. However, it was a matter of shame that he had 4 Queens. The Queens were so arrogant and they didn't even want to see one another. Therefore, the King built a castle of 4 x 4 rooms. However, he couldn't find a way to place the 4 Queens in 4 separate rooms, so that they couldn't see each other.

Would, you please help the King to place the Queens? Avoid placing two Queens in a same row, same column and even same diagonal rooms.



Solution of the 4-Queen Problem Using Backtracking Approach

Therefore , the king called Professor John Holland of the University of Michigan to solve the 4-Queen problem. And Professor solved the 4-Queen problem in backtracking approach.





The 5-Queen Problem



One month later, Professor received a call from the great King to solve his 5-Queen problem. Professor, solved the 5-Queen problem in backtracking approach.



Solution of the 5-Queen Problem Using Backtracking Approach





6-Queen Problem

John Holland introduced **Genetic Algorithm (GA)**

Darwin's theory of evolution



Fortunately, one month later, the King requested the professor to solve 6-Queen problem. The professor thought that the King may request him to solve 16-Queen problem within next 10 months.

Backtracking approach will not be efficient to solve the 8 or 16-Queen problems.

Therefore, professor invented Genetic Algorithm to solve the n-Queen problem.

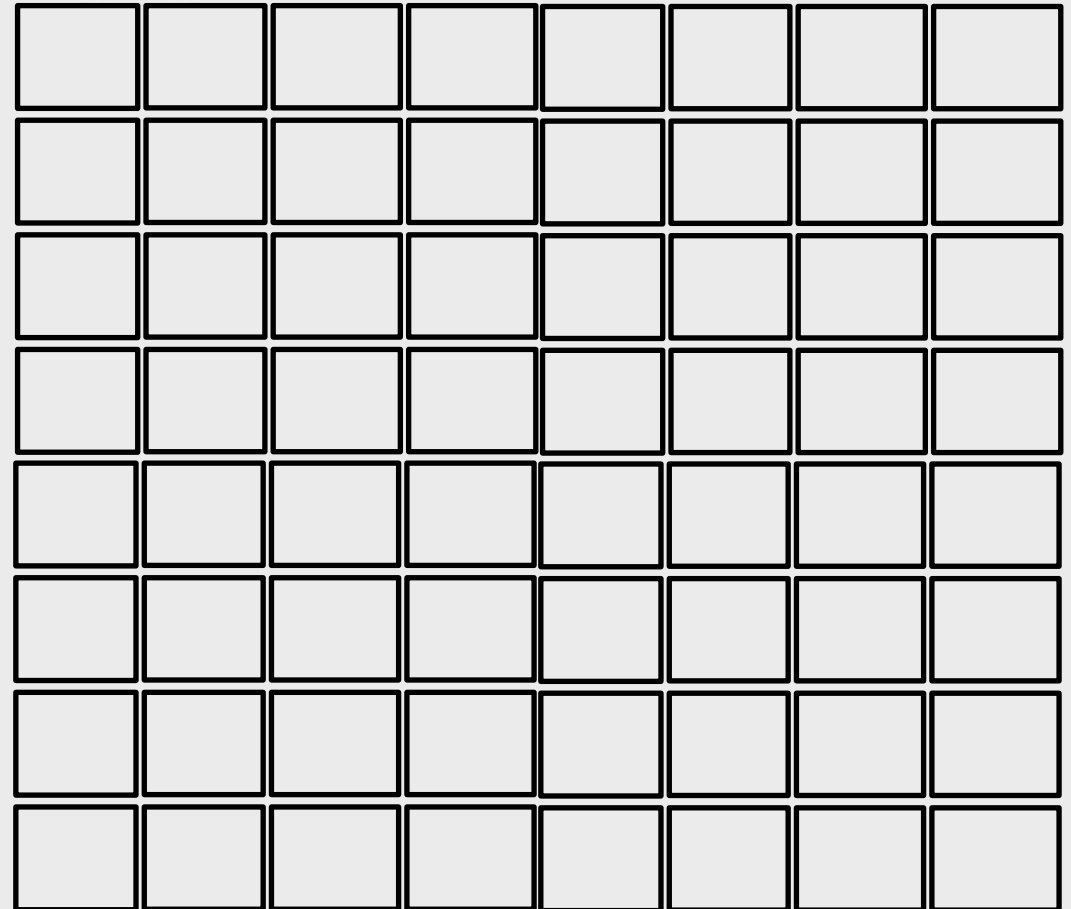


8-Queen Problem



John Holland introduced **Genetic Algorithm (GA)**

Darwin's theory of evolution



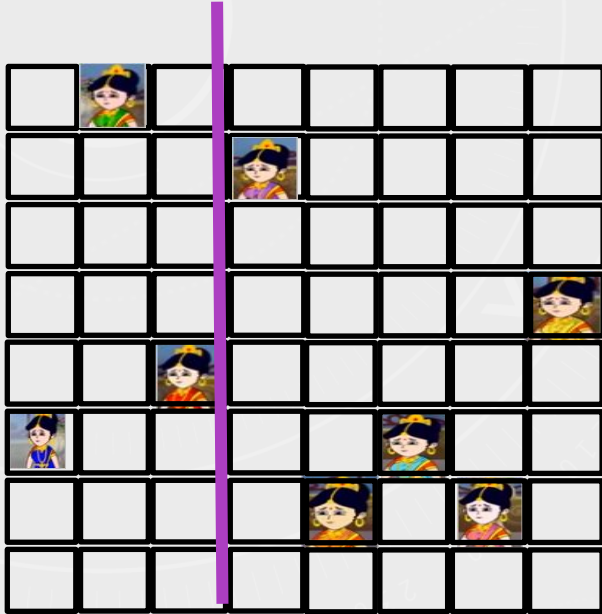
Introduced in the 1970s by John Holland at University of Michigan

- ▶ begin with k randomly generated states (population)
- ▶ each state (individual) is a string over some alphabet (chromosome)
- ▶ fitness function (bigger number is better)
- ▶ crossover
- ▶ mutate (evolve?)



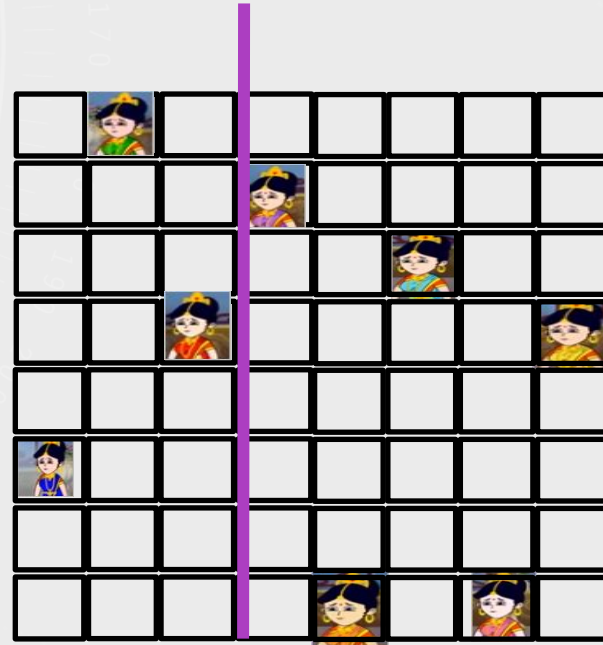
Formulation of Genetic Algorithm

John Holland introduced **Genetic Algorithm (GA)**
Darwin's theory of evolution



3 8 4 7 2 3 2 5

Fitness=28-7=21



3 8 5 7 1 6 1 5

Fitness=28-4=24

Fitness function: number of non-attacking pairs of queens

Maximum number of pairs: $8 \times 7/2 = 28$

[Q1 Q2]

[Q1 Q3]

[Q1 Q4]

[Q1 Q5]

[Q1 Q6]

[Q1 Q7]

[Q1 Q8]

.....

[Q8 Q7]

Chromosome of Father: 3 8 4 7 2 3 2 5

Chromosome of Mother: 3 8 5 7 1 6 1 5

Pseudo-code of GA:

START

 Generate the initial population

 Compute fitness

 REPEAT

 Selection

 Crossover

 Mutation

 Compute fitness

 UNTIL population has converged

STOP

Crossover:

Chromosome of Father:

3 8 4 7 2 3 2 5

Chromosome of Mother:

3 8 5 7 1 6 1 5

Crossover point

3 8 4 7 2 3 2 5

3 8 5 7 1 6 1 5

2 4 4 1 5 1 2 4

3 2 5 4 3 2 1 3

Chromosome of Father:

3 8 4 7 2 3 2 5

Chromosome of Mother:

3 8 5 7 1 6 1 5

Offspring 1:

3 8 4 7 1 6 1 5

Offspring2:

3 8 5 7 2 3 2 5

Mutation:

Before Mutation:

Offspring 1: 3 8 4 7 1 6 1 5









Offspring2: 3 8 5 7 2 3 2 5

After Mutation:

Offspring 1: 3 8 4 7 1 6 2 5









Offspring2: 3 8 6 7 2 3 2 5

Offspring 1:

							
							
							
							
							
							
							
							
3	8	4	7	1	6	2	5

Fitness=28-0=28

Offspring2:

							
							
							
							
							
							
3	8	6	7	2	3	2	5

Fitness=28-5=23

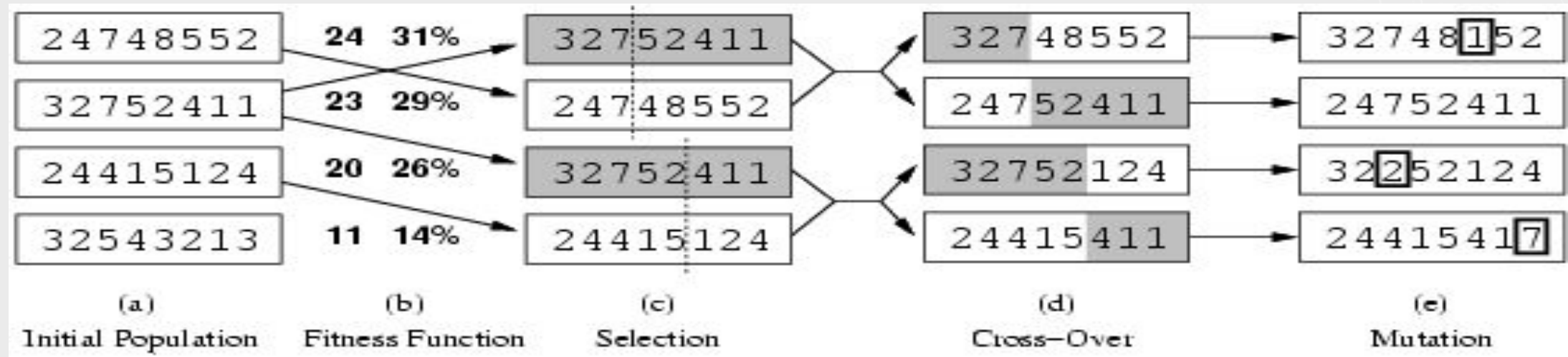
Represent states and compute fitness function.

24748552	24
32752411	23
24415124	20
32543213	11
	<u>77</u>

(a)

Initial Population

GENETIC ALGORITHMS

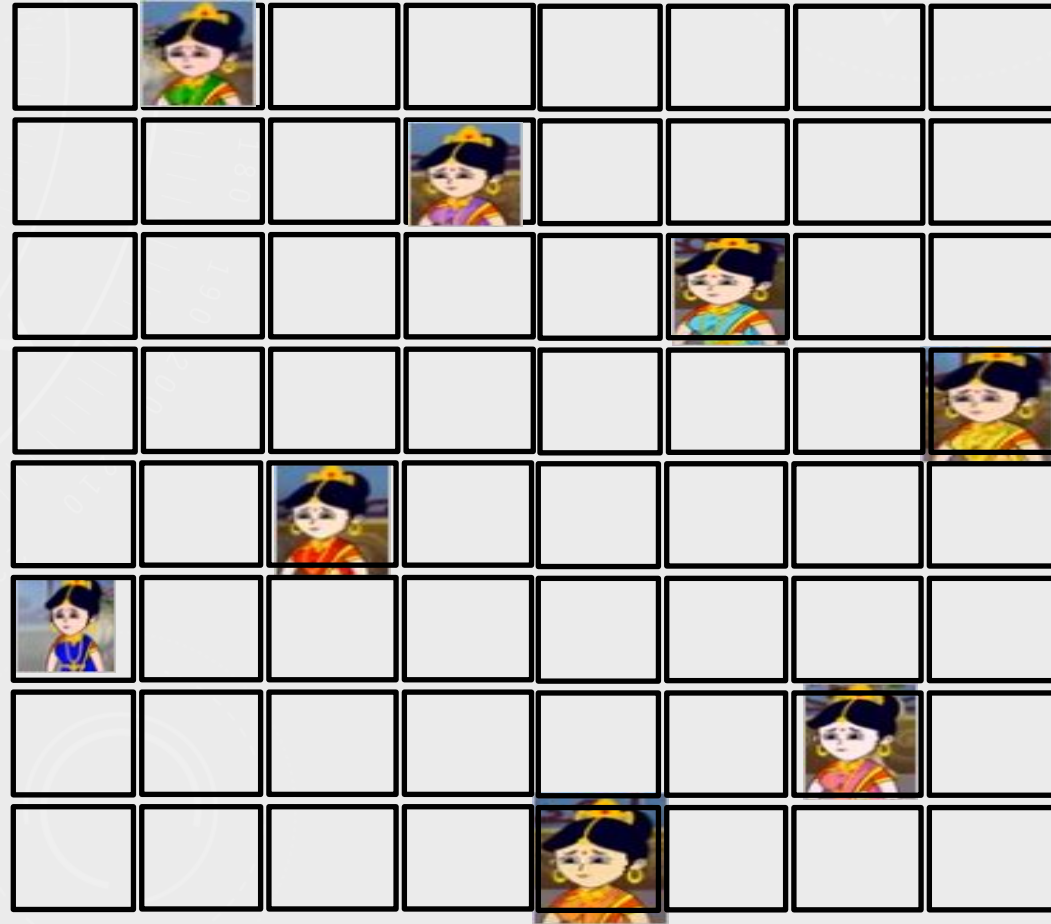


- Fitness function: number of non-attacking pairs of queens (min = 0, max = $8 \times 7/2 = 28$)
 $24/(24+23+20+11) = 31\%$
 $23/(24+23+20+11) = 29\%$ etc



Solution of 8-Queen Problem using Genetic Algorithm

John Holland introduced **Genetic Algorithm (GA)**
Darwin's theory of evolution

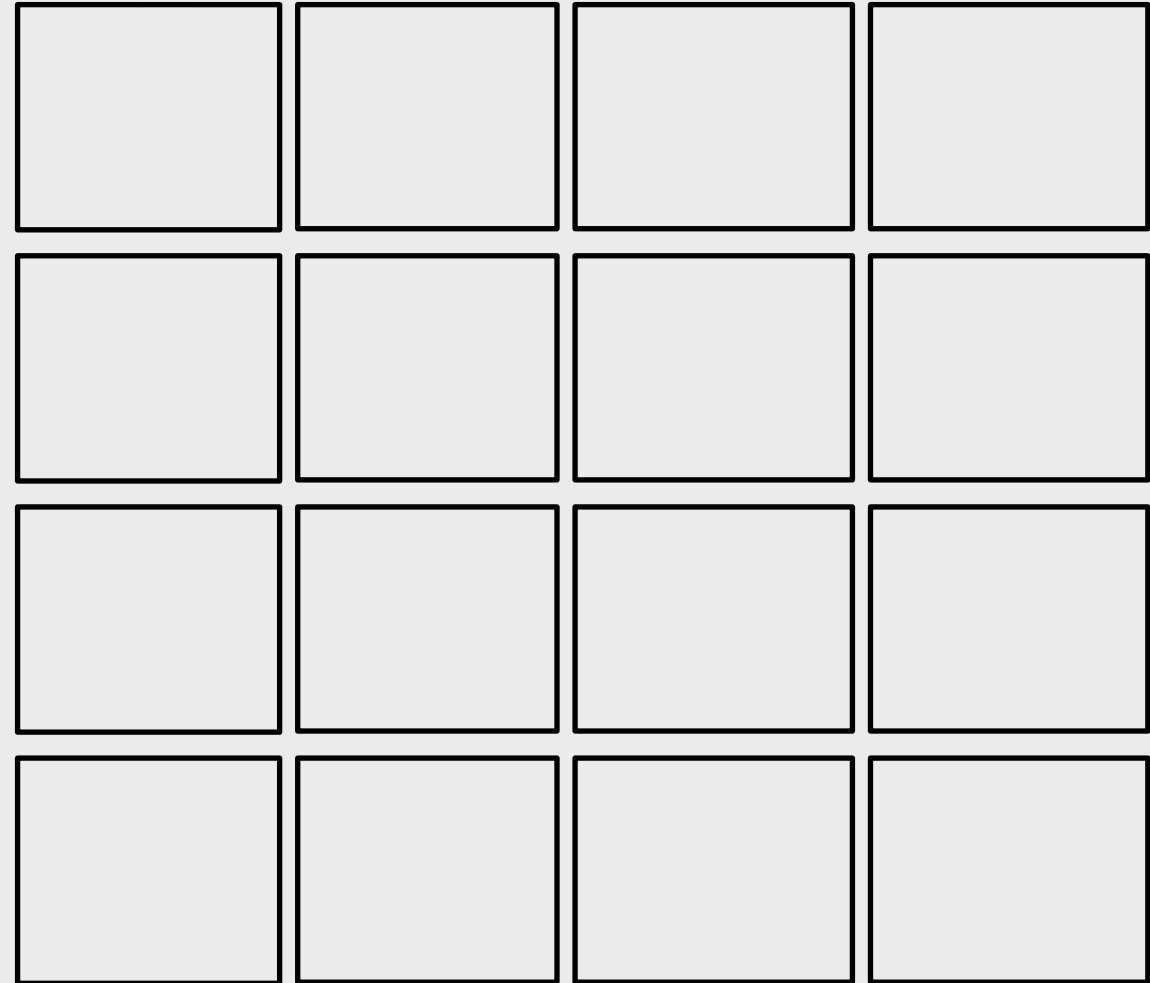




The 4-Queen Problem

Fitness function: number of non-attacking pairs of queens

What is the Maximum fitness value: ????





4-Queen Problem Using Backtracking Approach

Therefore , the king called Professor John Holland of the University of Michigan to solve the 4-Queen problem. And solved the 4-Queen problem in backtracking approach.





Solution of the 4-Queen Problem Using GA



Initial Population

Conclusion

Application areas of GA:

- Game programming
- Cloud resource allocation
- Job scheduling of operating systems
- Channel assignment in communication system
- Combinatorial optimization
- Creative design (NASA antenna)
- Operational research

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RESEARCH

A Dynamic Scheduling Method for Collaborated Cloud with Thick Clients

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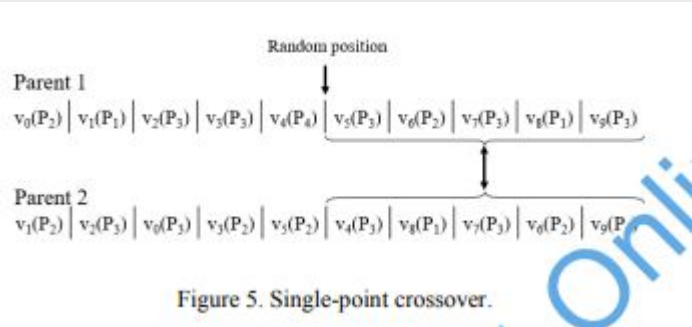


Figure 5. Single-point crossover.

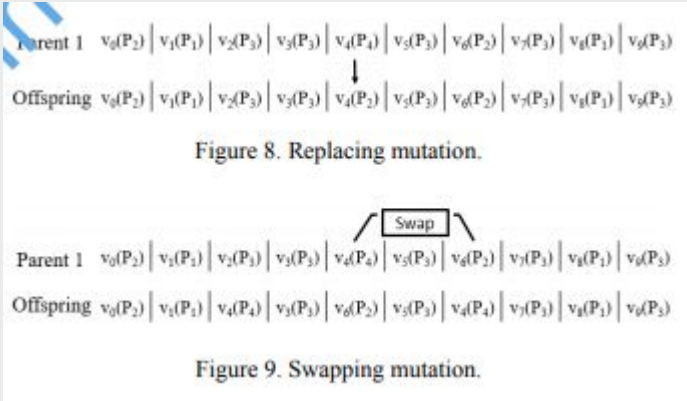


Figure 8. Replacing mutation.

Figure 9. Swapping mutation.