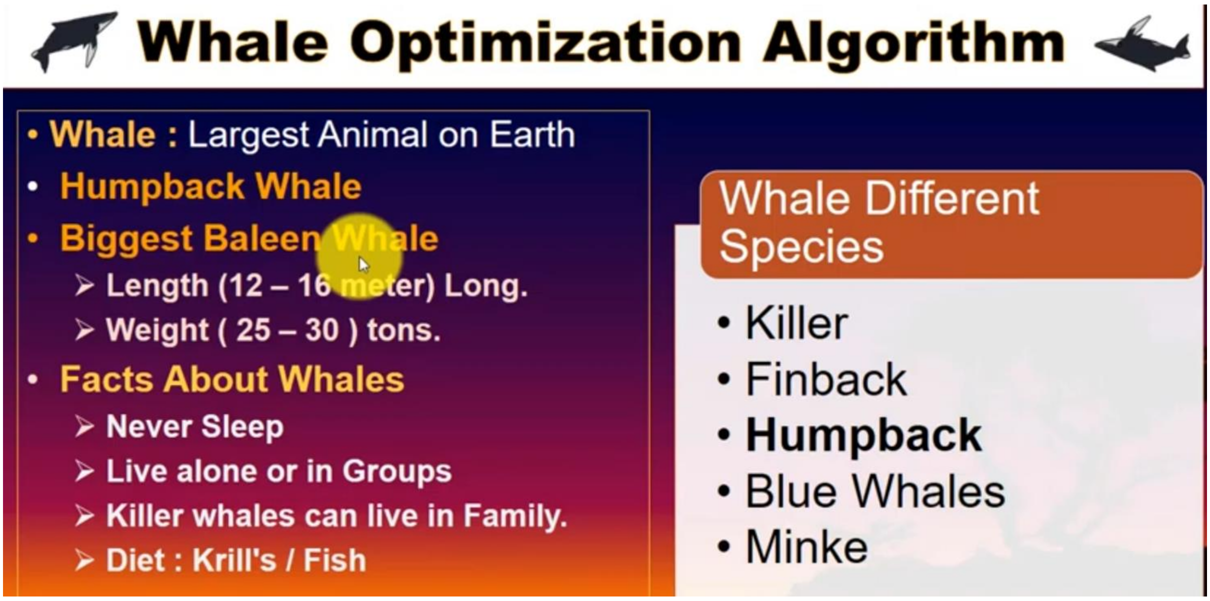
Whale Optimization Algorithm



Whale Optimization Algorithm

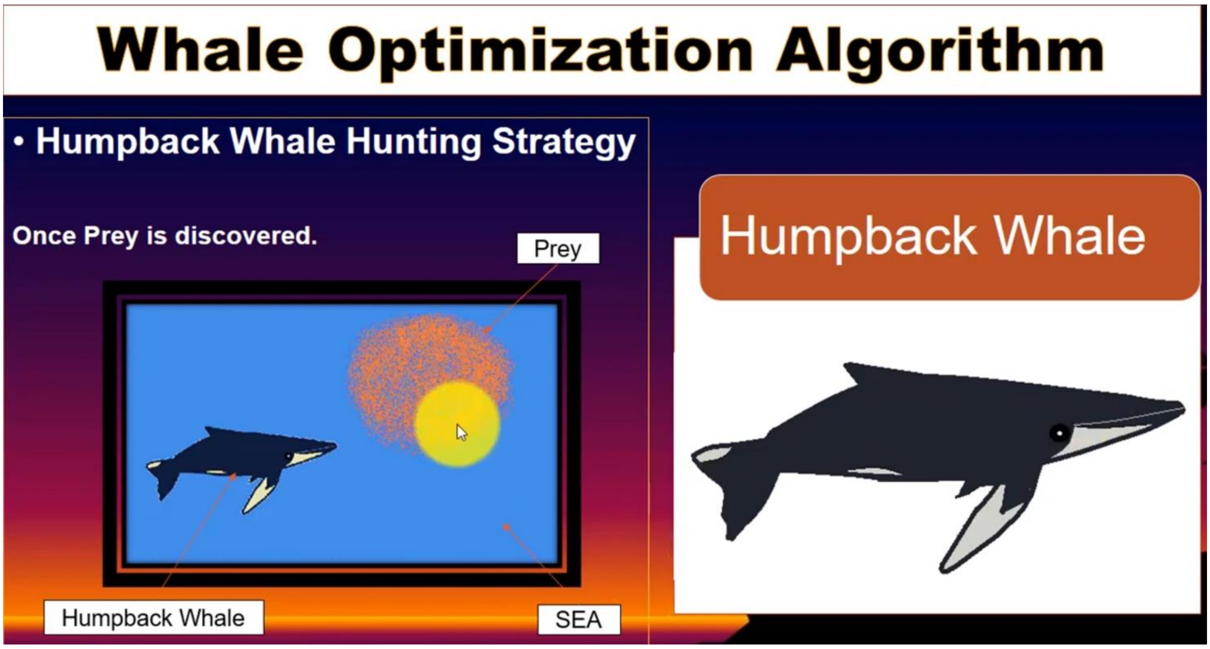
- **Whale :** Largest Animal on Earth
- **Humpback Whale**
- **Biggest Baleen Whale**
  - ➢ Length (12 – 16 meter) Long.
  - ➢ Weight (25 – 30) tons.
- **Facts About Whales**
  - ➢ Never Sleep
  - ➢ Live alone or in Groups
  - ➢ Killer whales can live in Family.
  - ➢ Diet : Krill's / Fish

Whale Different Species

- Killer
- Finback
- **Humpback**
- Blue Whales
- Minke

- **An Adult Humpback whale is almost as size of School Bus.**
- **Humpback Whales eat Krill's and small Fishes.**

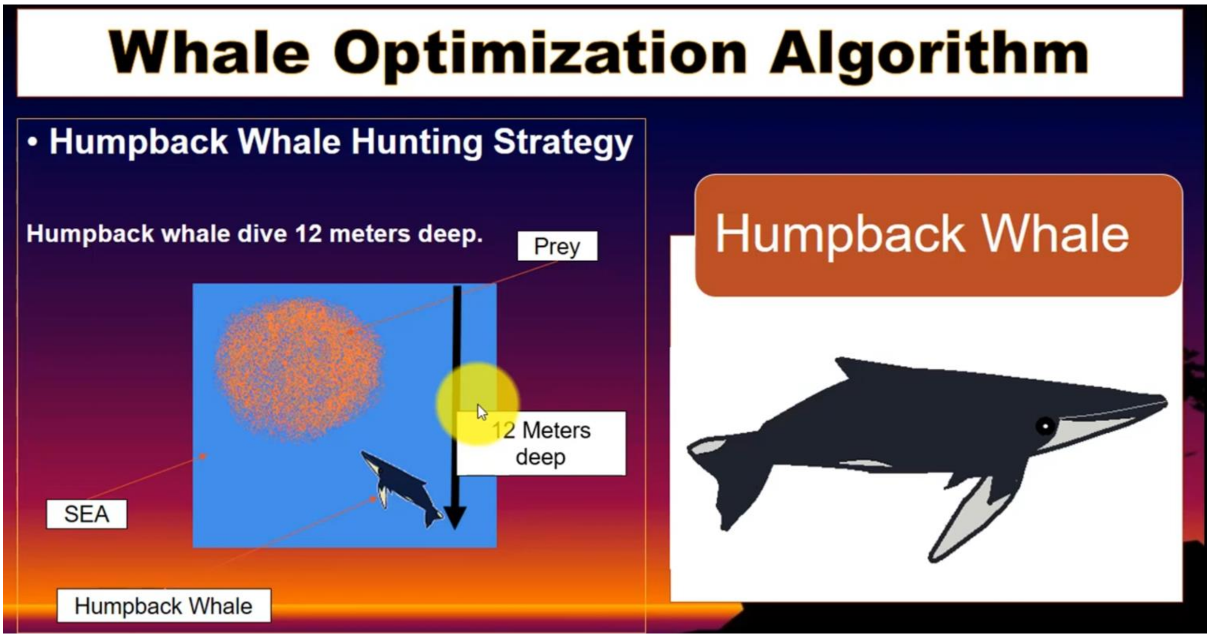
Humpback Whale



Whale Optimization Algorithm

- Humpback Whale Hunting Strategy

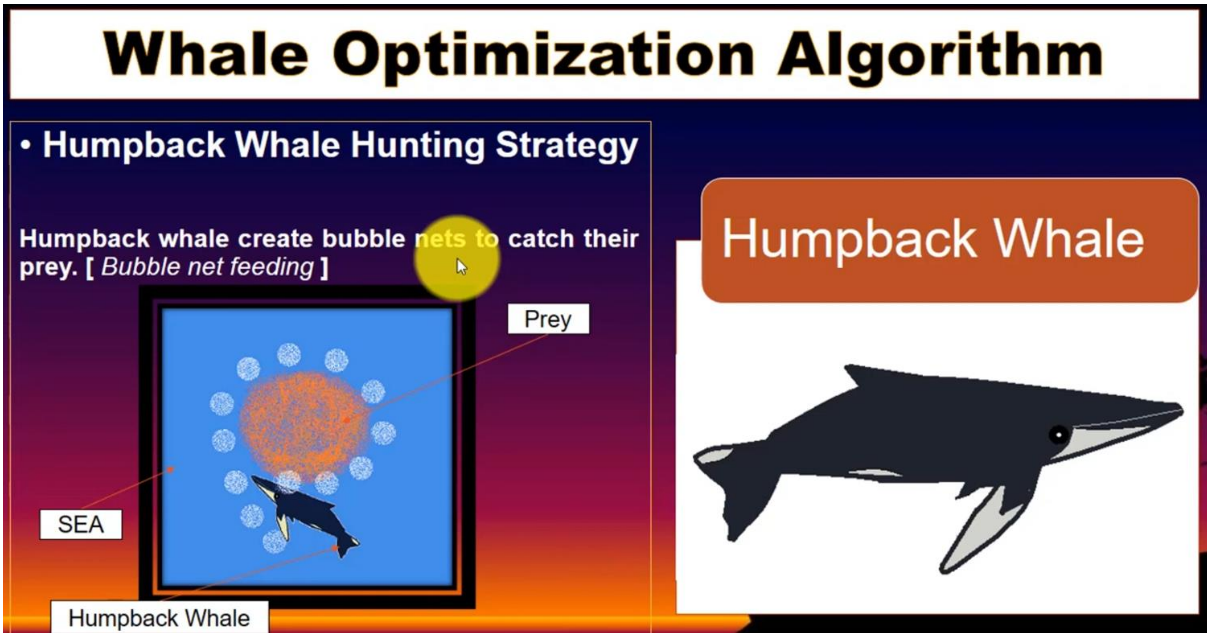
Once Prey is discovered.



Whale Optimization Algorithm

- Humpback Whale Hunting Strategy

Humpback whale dive 12 meters deep.



Whale Optimization Algorithm

- Humpback Whale Hunting Strategy

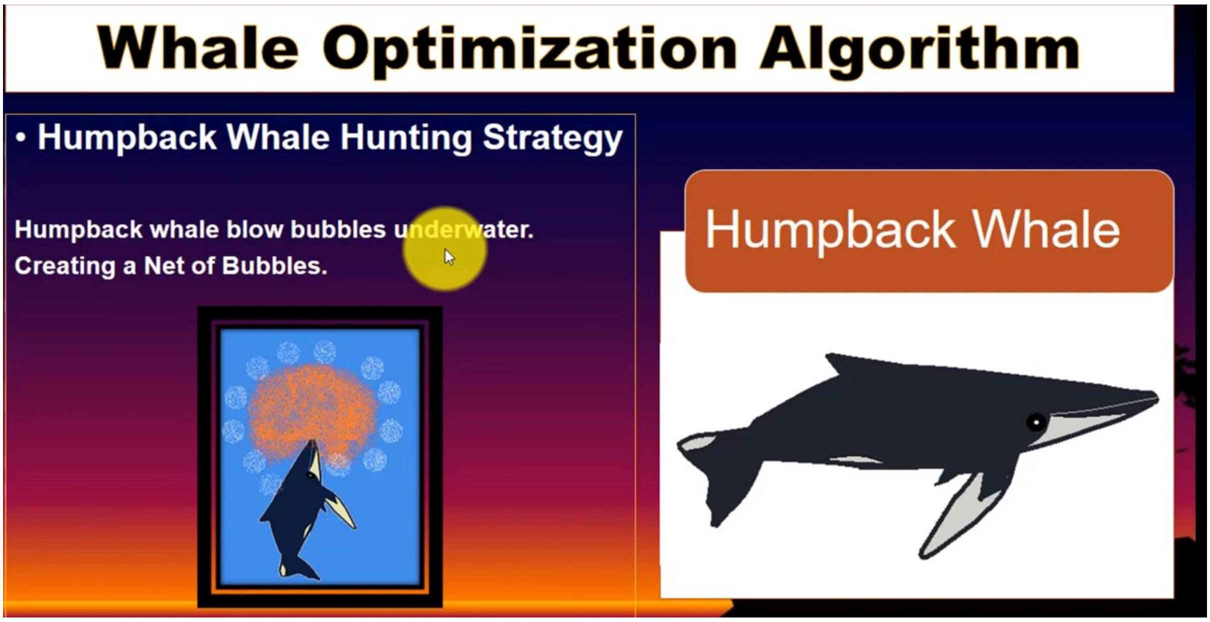
Humpback whale create bubble nets to catch their prey. [*Bubble net feeding*]

Prey

SEA

Humpback Whale

Humpback Whale

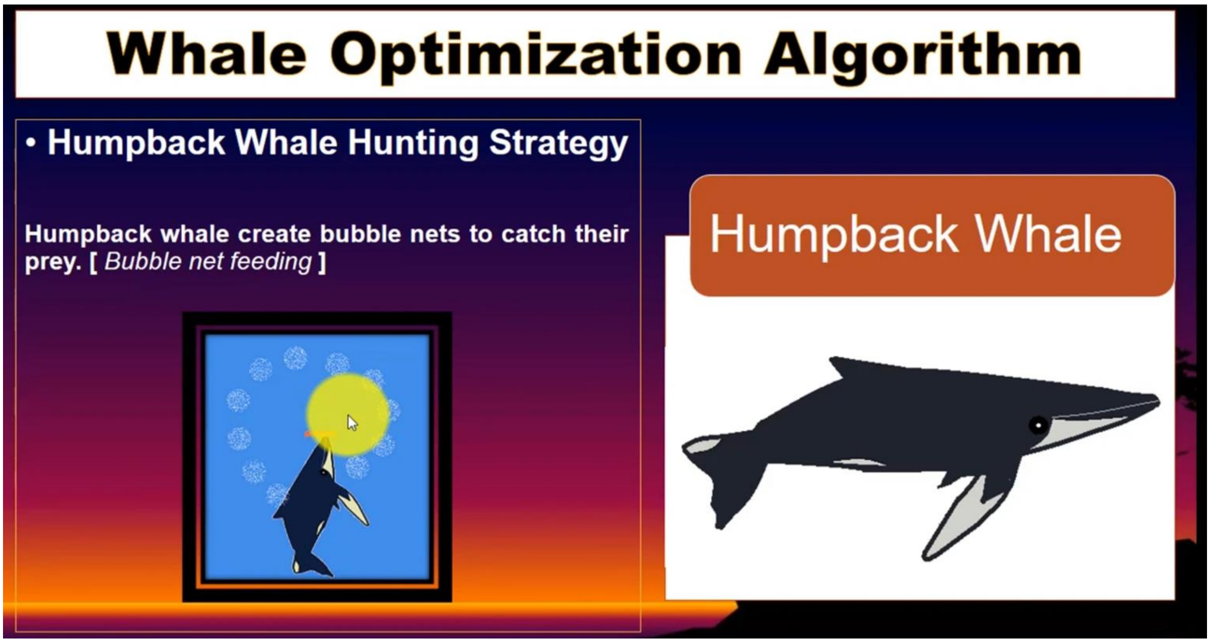


Whale Optimization Algorithm

- Humpback Whale Hunting Strategy

Humpback whale blow bubbles underwater. Creating a Net of Bubbles.

Humpback Whale

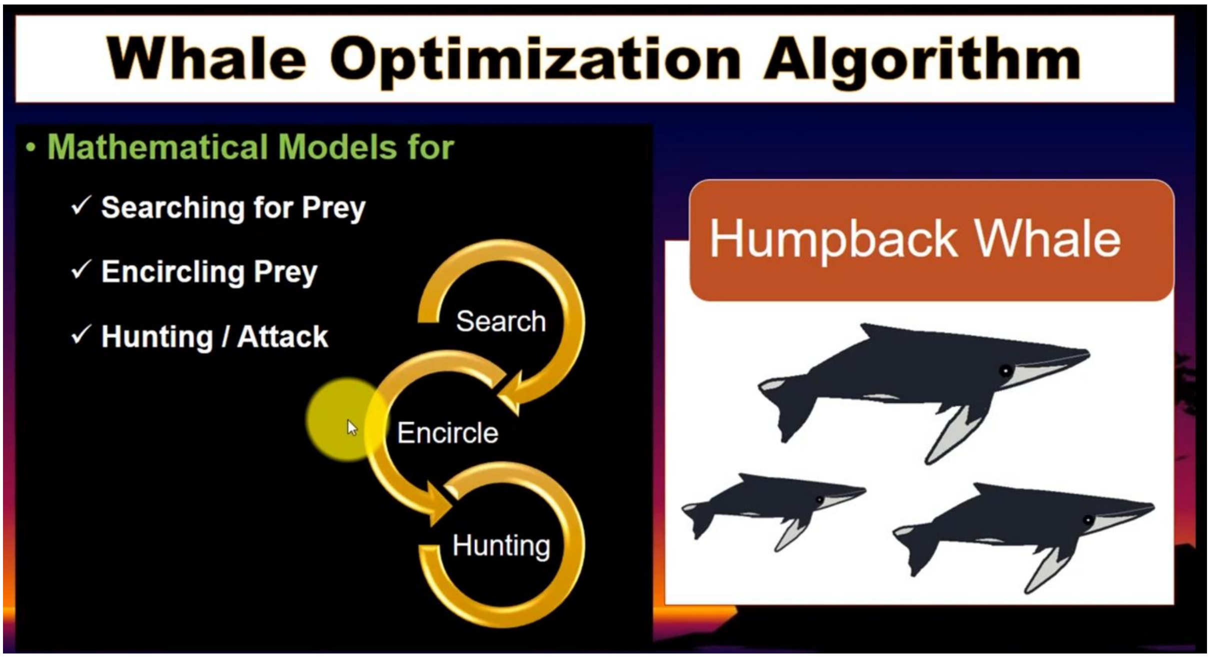


Whale Optimization Algorithm

- **Humpback Whale Hunting Strategy**

Humpback whale create bubble nets to catch their prey. [*Bubble net feeding* **]**

Humpback Whale



Whale Optimization Algorithm

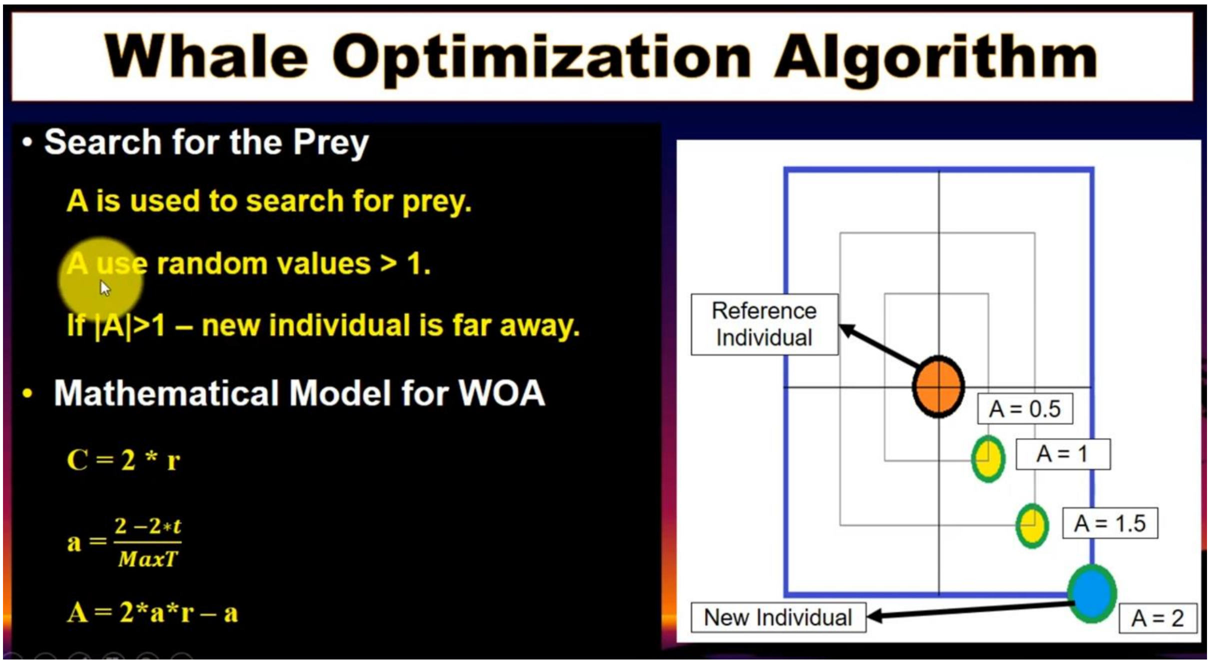
- **Mathematical Models for**
  - ✓ **Searching for Prey**
  - ✓ **Encircling Prey**
  - ✓ **Hunting / Attack**

Search

Encircle

Hunting

Humpback Whale



Whale Optimization Algorithm

- Search for the Prey

  A is used to search for prey.

  A use random values > 1.

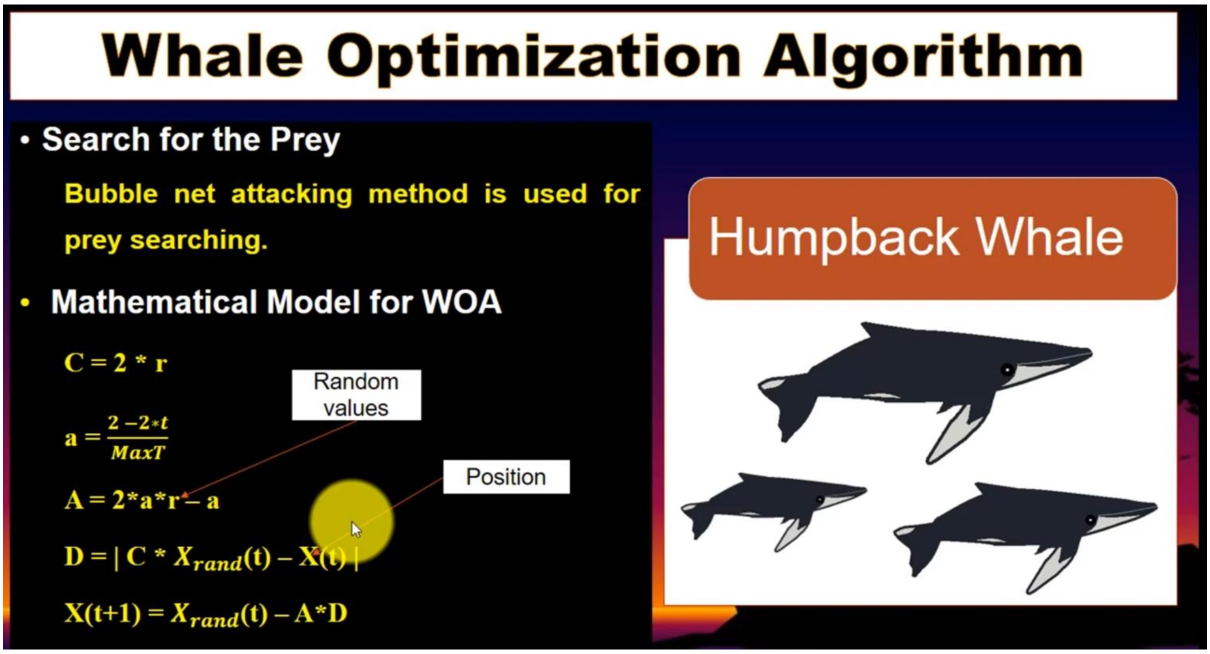
  If |A|>1 – new individual is far away.

- Mathematical Model for WOA

  $C = 2 * r$

  $a = \frac{2 - 2*t}{MaxT}$

  $A = 2*a*r - a$



Whale Optimization Algorithm

- Search for the Prey

  Bubble net attacking method is used for prey searching.

- Mathematical Model for WOA

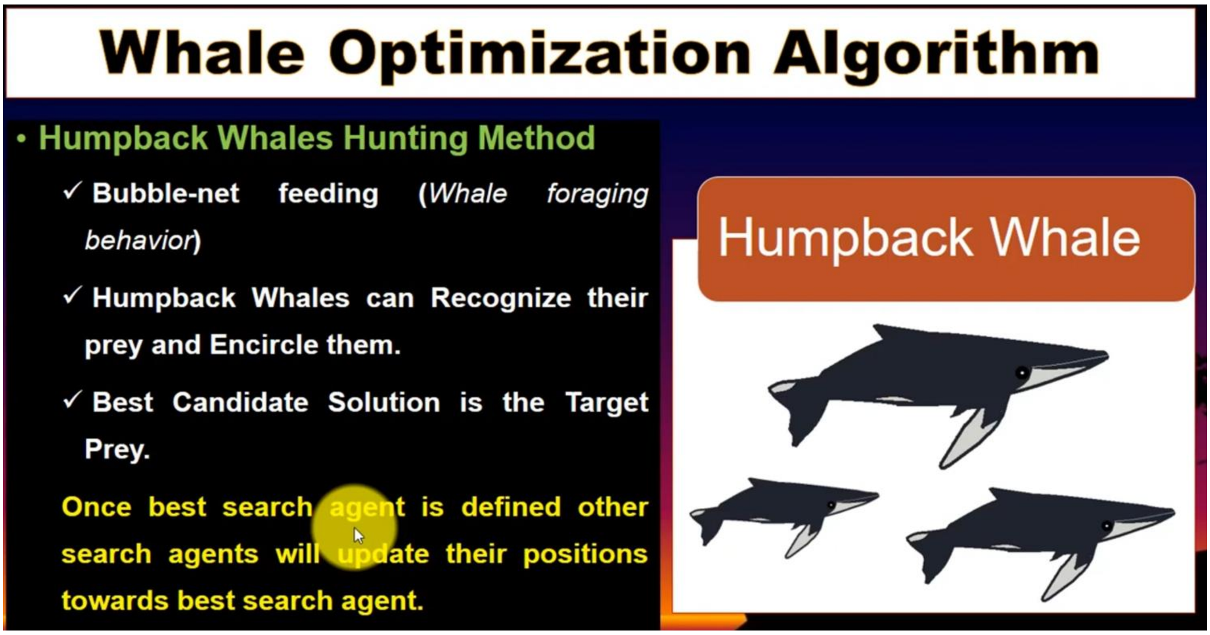
  $C = 2 * r$

  $a = \frac{2 - 2*t}{MaxT}$

  $A = 2*a*r - a$

  $D = | C * X_{rand}(t) - X(t) |$

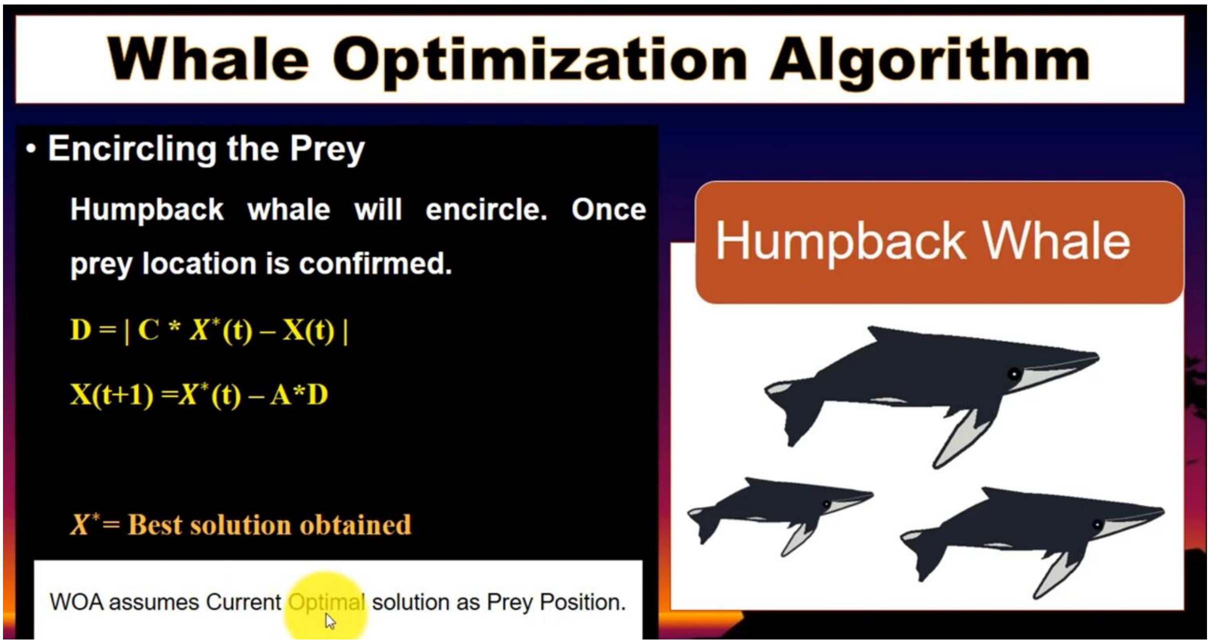
  $X(t+1) = X_{rand}(t) - A*D$



Whale Optimization Algorithm

- Humpback Whales Hunting Method
  - ✓ Bubble-net feeding (*Whale foraging behavior*)
  - ✓ Humpback Whales can Recognize their prey and Encircle them.
  - ✓ Best Candidate Solution is the Target Prey.

Once best search agent is defined other search agents will update their positions towards best search agent.



Whale Optimization Algorithm

- Encircling the Prey

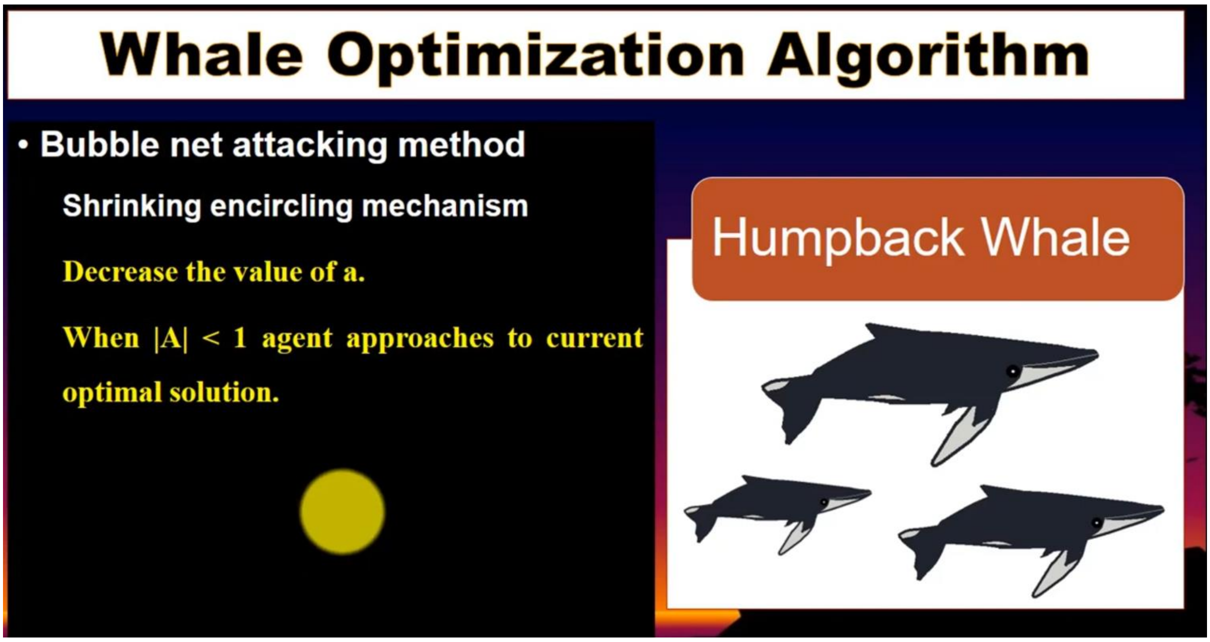
Humpback whale will encircle. Once prey location is confirmed.

$$D = | C * X^*(t) - X(t) |$$

$$X(t+1) = X^*(t) - A*D$$

X^* = Best solution obtained

WOA assumes Current Optimal solution as Prey Position.



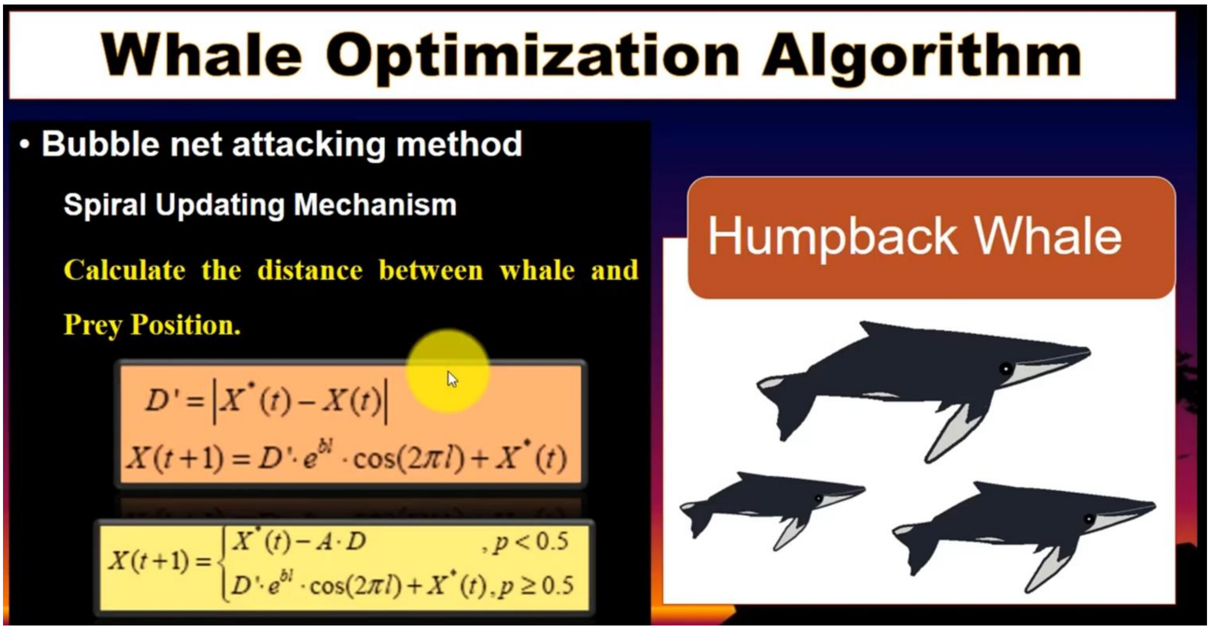
Whale Optimization Algorithm

- Bubble net attacking method

Shrinking encircling mechanism

Decrease the value of a.

When |A| < 1 agent approaches to current optimal solution.



Whale Optimization Algorithm

- Bubble net attacking method

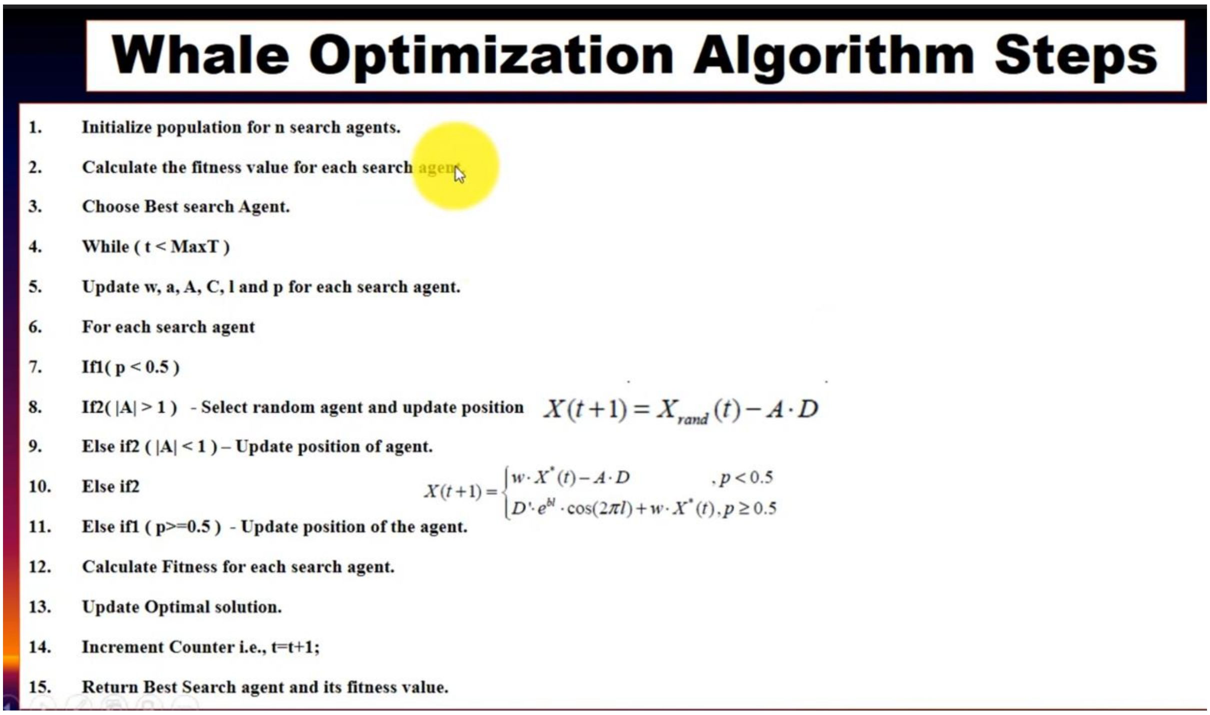
Spiral Updating Mechanism

Calculate the distance between whale and Prey Position.

$$D' = \left| X^*(t) - X(t) \right|$$

$$X(t+1) = D' \cdot e^{bl} \cdot \cos(2\pi l) + X^*(t)$$

$$X(t+1) = \begin{cases} X^*(t) - A \cdot D & , p < 0.5 \\ D' \cdot e^{bl} \cdot \cos(2\pi l) + X^*(t) & , p \ge 0.5 \end{cases}$$



Whale Optimization Algorithm Steps

1. Initialize population for n search agents.
2. Calculate the fitness value for each search agent
3. Choose Best search Agent.
4. While (t < MaxT)
5. Update w, a, A, C, l and p for each search agent.
6. For each search agent
7. If1(p < 0.5)
8. If2(|A| > 1) - Select random agent and update position $X(t+1) = X_{rand}(t) - A \cdot D$
9. Else if2 (|A| < 1) – Update position of agent.
10. Else if2

$$X(t+1) = \begin{cases} w \cdot X^*(t) - A \cdot D & , p < 0.5 \\ D' \cdot e^{bl} \cdot \cos(2\pi l) + w \cdot X^*(t) & , p \geq 0.5 \end{cases}$$

11. Else if1 (p>=0.5) - Update position of the agent.
12. Calculate Fitness for each search agent.
13. Update Optimal solution.
14. Increment Counter i.e., t=t+1;
15. Return Best Search agent and its fitness value.