OPTIMIZING OCEAN DEBRIS COLLECTION

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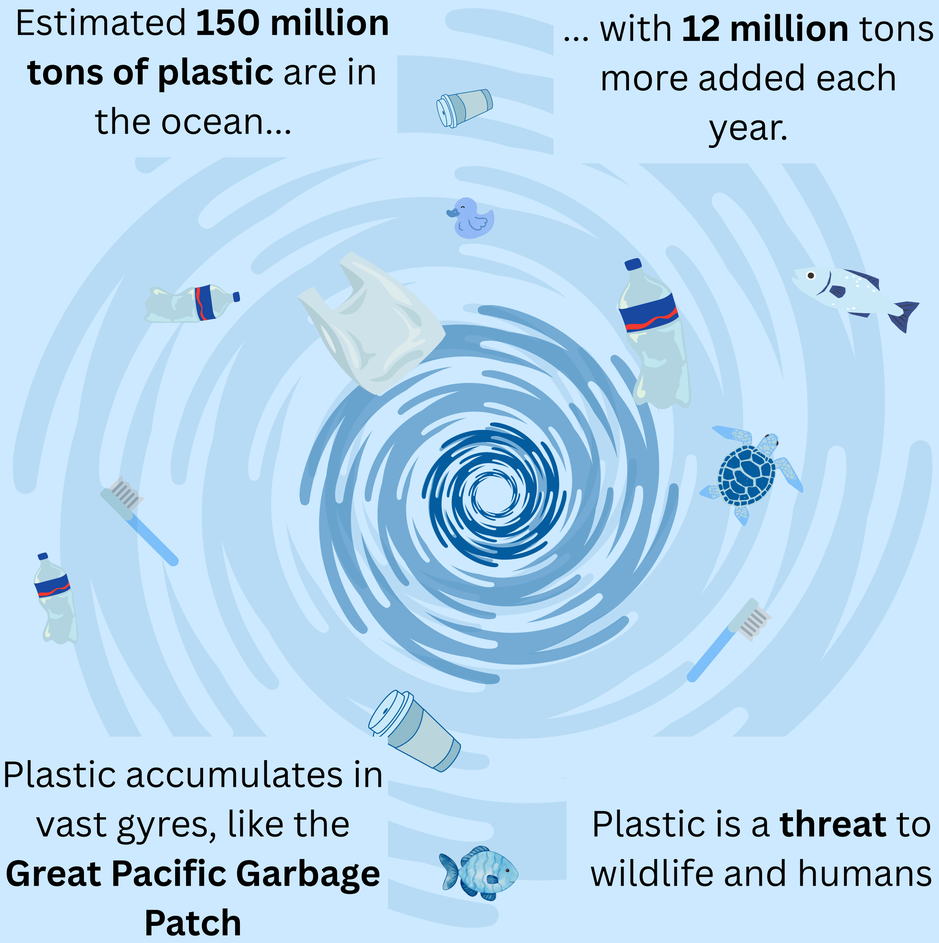
Motivation

Estimated **150 million tons of plastic** are in the ocean...

... with **12 million** tons more added each year.



Plastic accumulates in vast gyres, like the **Great Pacific Garbage Patch**

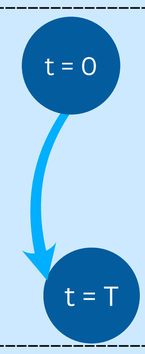
Plastic is a **threat** to wildlife and humans

Problem Modelling

General Question:
How to **collect moving debris effectively?**

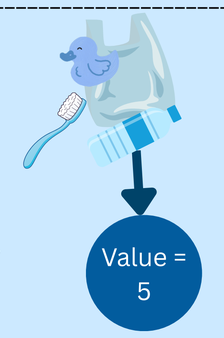
Problem 1:
Currents shift locations

We simulate movement using real ocean current data



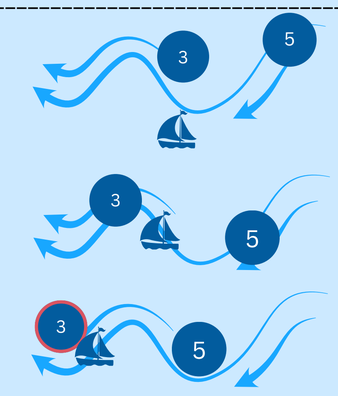
Problem 2:
Debris is **not a solid island**

Cluster debris into hotspots, valued by plastic amount



How can we compute an optimal **time-constrained** collection path that **maximizes the cumulative value of collected plastic?**

At each time step: Evaluate current environment and determine next step



t = 0: Evaluate environment→ select patch V3 as target

t = 1: Move toward target V3

t = 2: Collect V3, re-evaluate environment → select V5 as next target

Reactive Algorithmic Solution Approach

Procedure:

1. **Evaluate** Environment with all active hotspots.
2. **Assign** a target hotspot based on **selection rule.**
3. **Navigate** towards target until within **collection** range.
4. **Reassign** based on current environment.
5. **Repeat** until **time runs out.**

Which selection Rule?

Target the hotspot:

- that is **closest to the current position** *(dynamic)*

OR

- with the **highest Value** *(static)*

Focus only on **Distance**

Focus only on **Value**

Extreme strategies lead to suboptimal results:

Distance-only:

- misses valuable patches → total collected value: 42

Value-only

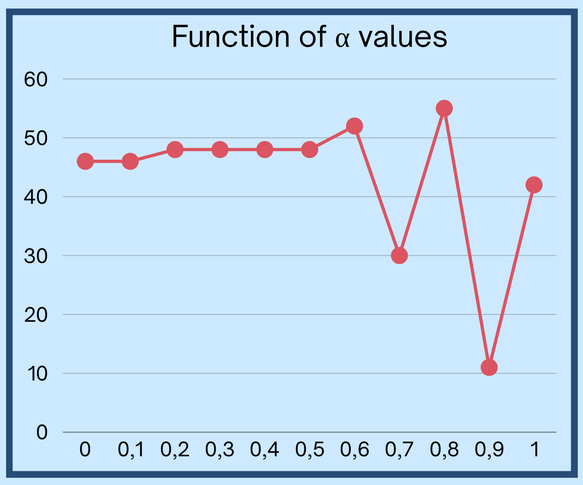
- long detours → total collected value: 46

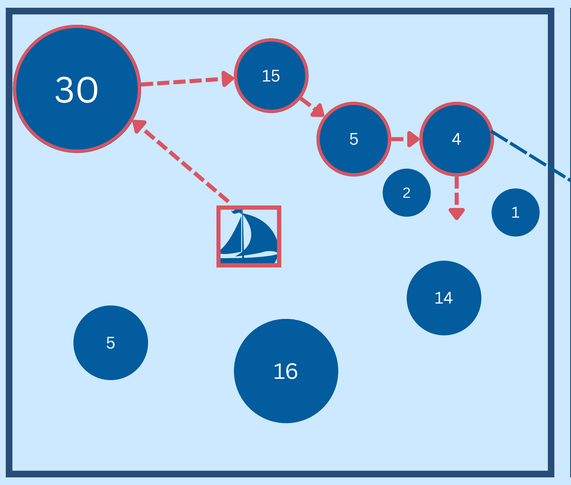
Evaluate current environment, assign a Score to each hotspot based on **Value AND Distance**:

Score = α × proximity + (1−α) × value

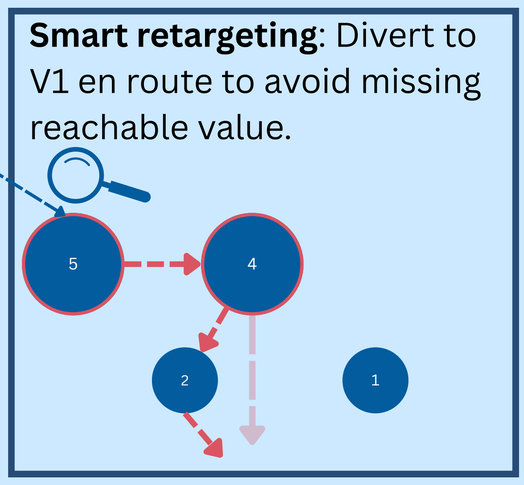
- α ∈ (0,1) → Balanced trade-off

→ Select hotspot with **highest score** (dynamic)





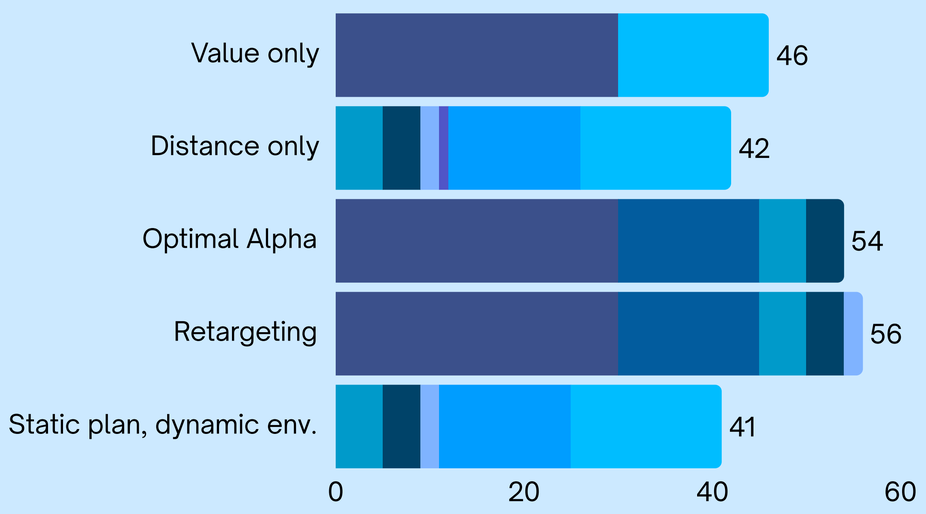
Smart retargeting: Divert to V1 en route to avoid missing reachable value.



Results & Conclusion

Important Findings

- **Dynamic hotspot** allocation boosts collection by up to **35%** vs. static strategies.
- Real-time **retargeting** increases the score furthermore.
- Best performance at **α weighting ~0.8**, balancing value and travel cost.
- Distance-only performs almost equal to static plan.



Technical View

This poster requires no technical knowledge, but the actual work was mostly **coding and mathematical optimization**.

This link leads to more detailed and technical information.