

III

Autonomous Agents & Self-Organization

Autonomous Agent

- “a unit that interacts with its environment (which probably consists of other agents)
- but acts independently from all other agents in that it does not take commands from some seen or unseen leader,
- nor does an agent have some idea of a global plan that it should be following.”
—Flake (p. 261)

Nest Building by Termites (Natural and Artificial)

Resnick's Termites ("Turmites")

Basic procedure

- Wander randomly
- If you are not carrying anything and you bump into a wood chip, pick it up.
- If you are carrying a wood chip and you bump into another wood chip, put down the woodchip you are carrying

— Resnick, *Turtles, Termites, and Traffic Jams*

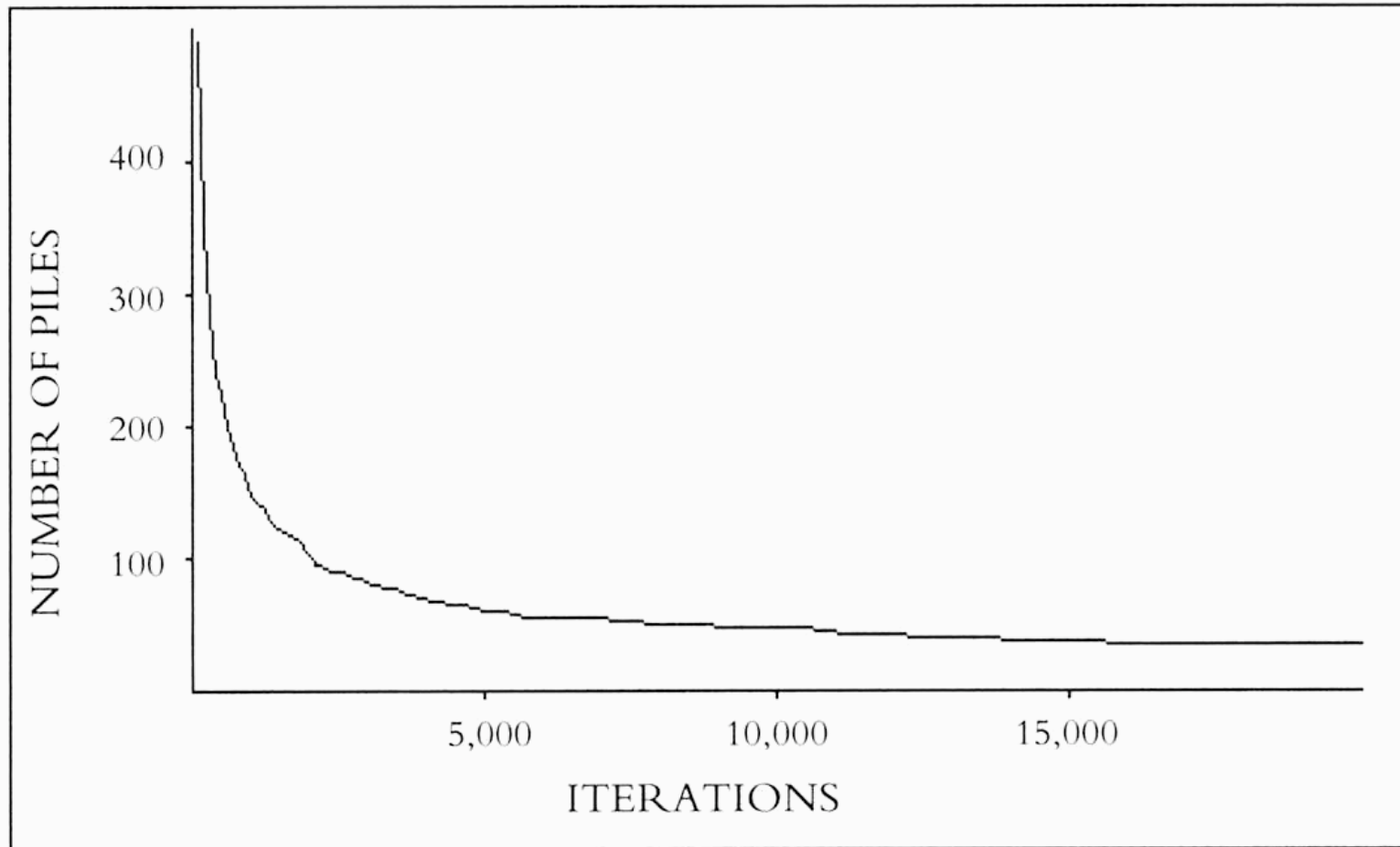
Microbehavior of Turmites

1. *Search for wood chip:*
 - a) If at chip, pick it up
 - b) otherwise wiggle, and go back to (a)
2. *Find a wood pile:*
 - a) If at chip, it's found
 - b) otherwise wiggle, and go back to (a)
3. *Find an empty spot and put chip down:*
 - a) If at empty spot, put chip down & jump away
 - b) otherwise, turn, take a step, and go to (a)

Demonstration

Run Termites.slogo

Decrease in Number of Piles



Why does the number of piles decrease?

- A pile can grow or shrink
- But once the last chip is taken from a pile, it can never restart
- Is there any way the number of piles can increase?
- Yes, and existing pile can be broken into two

More Termites

Termites	2000 steps		10 000 steps		
	num. piles	avg. size	num. piles	avg. size	chips in piles
1000	102	15	47	30	
4000	10		3	80	240

Termite-Mediated Condensation

- Number of chips is conserved
- Chips do not move on own; movement is mediated by termites
- Chips preferentially condense into piles
- Increasing termites, increases number of chips in fluid (randomly moving) state
- Like temperature

An Experiment to Make the Number Decrease More Quickly

- Problem: piles may grow or shrink
- Idea: protect “investment” in large piles
- Termites will not take chips from piles greater than a certain size
- Result: number decreases more quickly
- Most chips are in piles
- But *never* got less than 82 piles

Conclusion

- In the long run, the “dumber” strategy is better
- Although it’s slower, it achieves a better result
- By not protecting large piles, there is a small probability of any pile evaporating
- So the smaller “large piles” can evaporate and contribute to the larger “large piles”
- Even though this strategy makes occasional backward steps, it outperforms the attempt to protect accomplishments

Flake's Version of Termites

[Get CBN Unix version of termites](#)