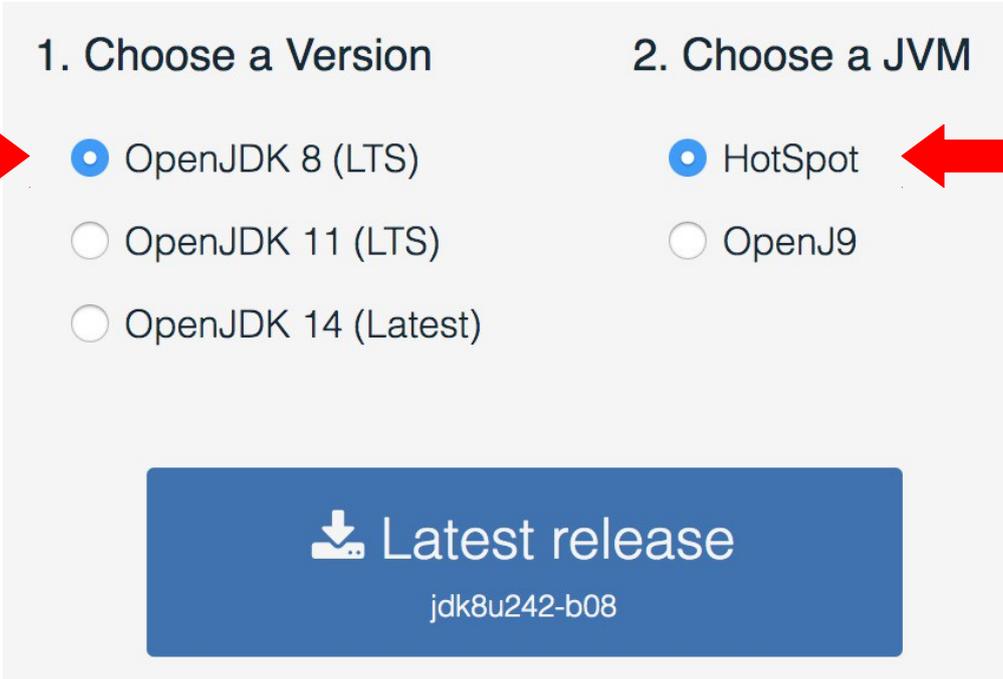


For Lab: Install Java on Your Machine

One-click installation from the AdoptOpenJDK website:

<https://adoptopenjdk.net>



The screenshot shows the AdoptOpenJDK website interface. It is divided into two columns: "1. Choose a Version" and "2. Choose a JVM". In the "1. Choose a Version" column, there are three radio button options: "OpenJDK 8 (LTS)" (selected), "OpenJDK 11 (LTS)", and "OpenJDK 14 (Latest)". A red arrow points to the "OpenJDK 8 (LTS)" option. In the "2. Choose a JVM" column, there are two radio button options: "HotSpot" (selected) and "OpenJ9". A red arrow points to the "HotSpot" option. Below these columns is a large blue button with a download icon and the text "Latest release" and "jdk8u242-b08".

1. Choose a Version

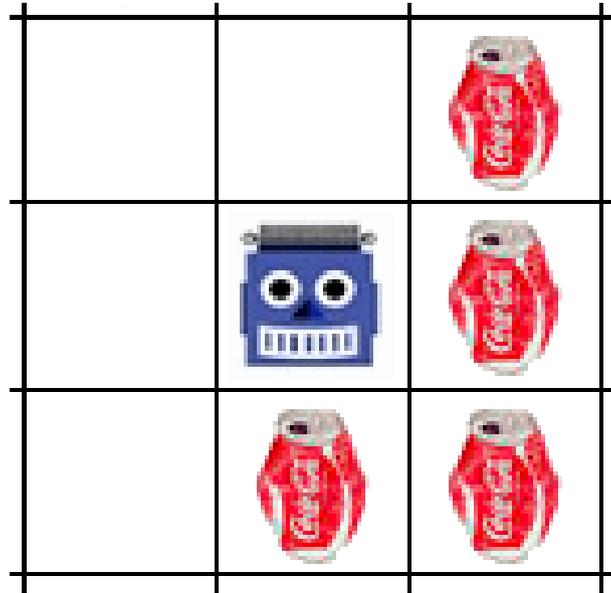
- OpenJDK 8 (LTS)
- OpenJDK 11 (LTS)
- OpenJDK 14 (Latest)

2. Choose a JVM

- HotSpot
- OpenJ9

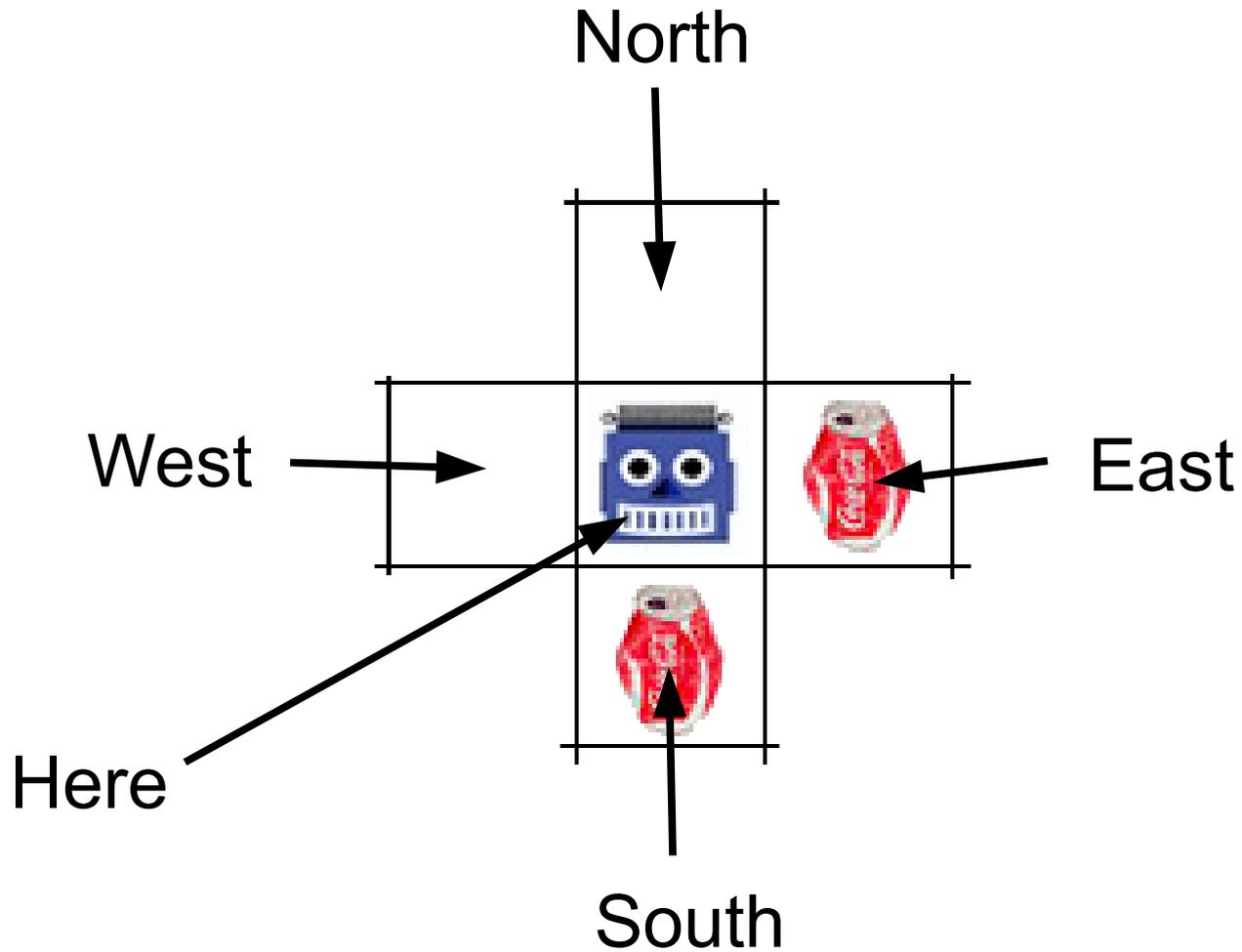
 Latest release
jdk8u242-b08

Robby the Robot

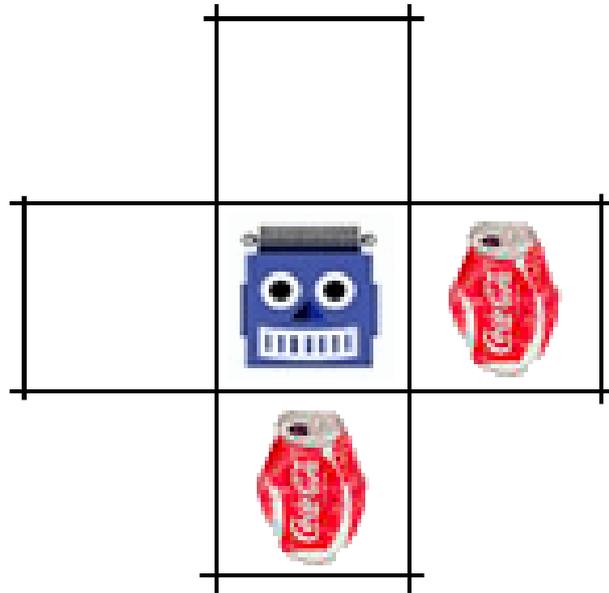


Complexity: A Guided Tour, by Melanie Mitchell, Oxford U. Press, 2009

Robby the Robot



Robby the Robot



North
Empty

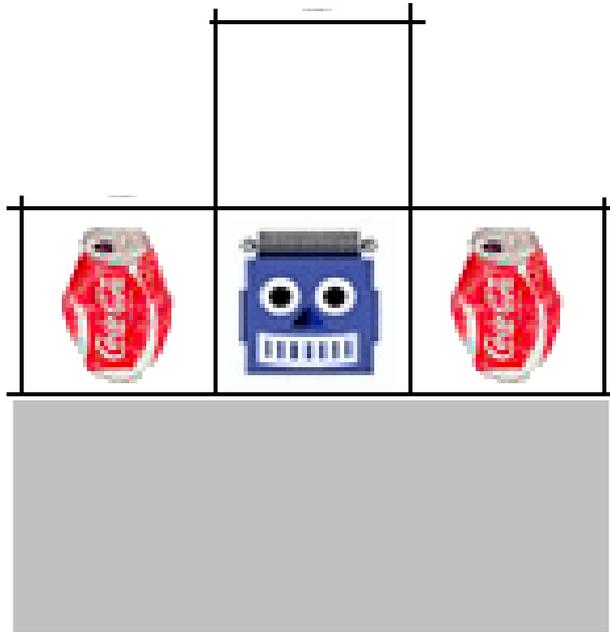
South
Can

East
Can

West
Empty

Here
Empty

Robby the Robot



North
Empty

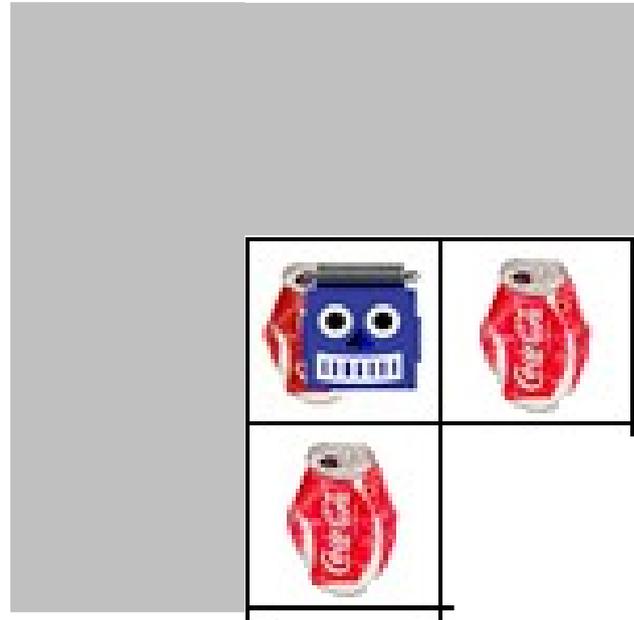
South
Wall

East
Can

West
Can

Here
Empty

Robby the Robot



North
Wall

South
Can

East
Can

West
Wall

Here
Can

Question:

How many possible **situations** are there?

$$3 \times 3 \times 3 \times 3 \times 3 = 3^5 = 243$$

All Possible Situations

	<i>North</i>	<i>South</i>	<i>East</i>	<i>West</i>	<i>Here</i>	=	Code
#1	Empty	Empty	Empty	Empty	Empty	=	EEEEEE
#2	Empty	Empty	Empty	Empty	Can	=	EEEECC
#3	Empty	Empty	Empty	Empty	Wall	=	EEEEWW
#4	Empty	Empty	Empty	Can	Empty	=	EEECEC
#5	Empty	Empty	Empty	Can	Can	=	EEECCC
#6	Empty	Empty	Empty	Can	Wall	=	EEECWW
#7	Empty	Empty	Empty	Wall	Empty	=	EEEWEE
#8	Empty	Empty	Empty	Wall	Can	=	EEEWCC
							<i>... etc. ...</i>
#243	Wall	Wall	Wall	Wall	Wall	=	WWWWW

Robot Actions

- Action Codes

0 = Move North

1 = Move South

2 = Move East

3 = Move West

4 = Stay Put

5 = Pick Up Can

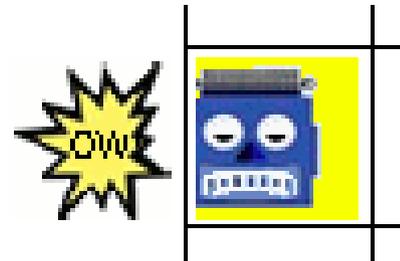
6 = Move at Random

- Rewards / Punishments

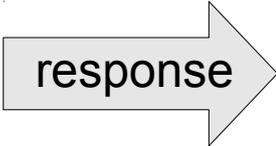
+10 Successfully picked up a can

-1 Tried to pick up a can that wasn't there

-5 Crashed into a wall



One Possible Control Strategy

	Situation Code		Action Code
#1	EEEEEE		3 (Move West)
#2	EEEEEC		4 (Stay Put)
#3	EEEEEW		6 (Move at Random)
#4	EEECE		6 (Move at Random)
#5	EEEC		0 (Move North)
#6	EEECW		5 (Pick Up Can)
#7	EEWE		2 (Move East)
#8	EEWC		1 (Move South)

#243	WWWW		5 (Pick Up Can)

Genome: 34660521 ... 5

243 digits long

Question:

How many possible **strategies** are there?

$$7 \times 7 \times 7 \times \dots \times 7 \quad (243 \text{ times})$$

$$= 7^{243}$$

That's a lot of strategies!

$$7^{243} =$$

22,846,712,859,873,746,480,447,821,666,592,
346,426,694,132,333,435,558,998,983,412,854,
961,114,186,622,574,870,902,442,510,049,863,
025,667,206,258,127,311,451,949,520,409,822,
391,138,243,055,993,672,121,915,936,570,990,
365,106,665,813,437,806,284,123,385,754,752,
042,992,343

How to Evaluate a Strategy's Fitness?

- Just test it out!
- Cleaning Session:
 - Scatter cans around at random (50% can density)
 - Have Robby follow strategy for 200 time steps
 - Score = total reward received
- Strategy Fitness:
 - Average score over **100 cleaning sessions**

Hand-Designed “Smart” Strategy

656353656252353252656353656151353151252353252151353151656353656252353252656353656
050353050252353252050353050151353151252353252151353151050353050252353252050353050
656353656252353252656353656151353151252353252151353151656353656252353252656353454

- If you're sitting on a can, pick it up
- If you see a can to the north, move north
- If you see a can to the south, move south
- If you see a can to the east, move east
- If you see a can to the west, move west
- Otherwise, move in a random direction

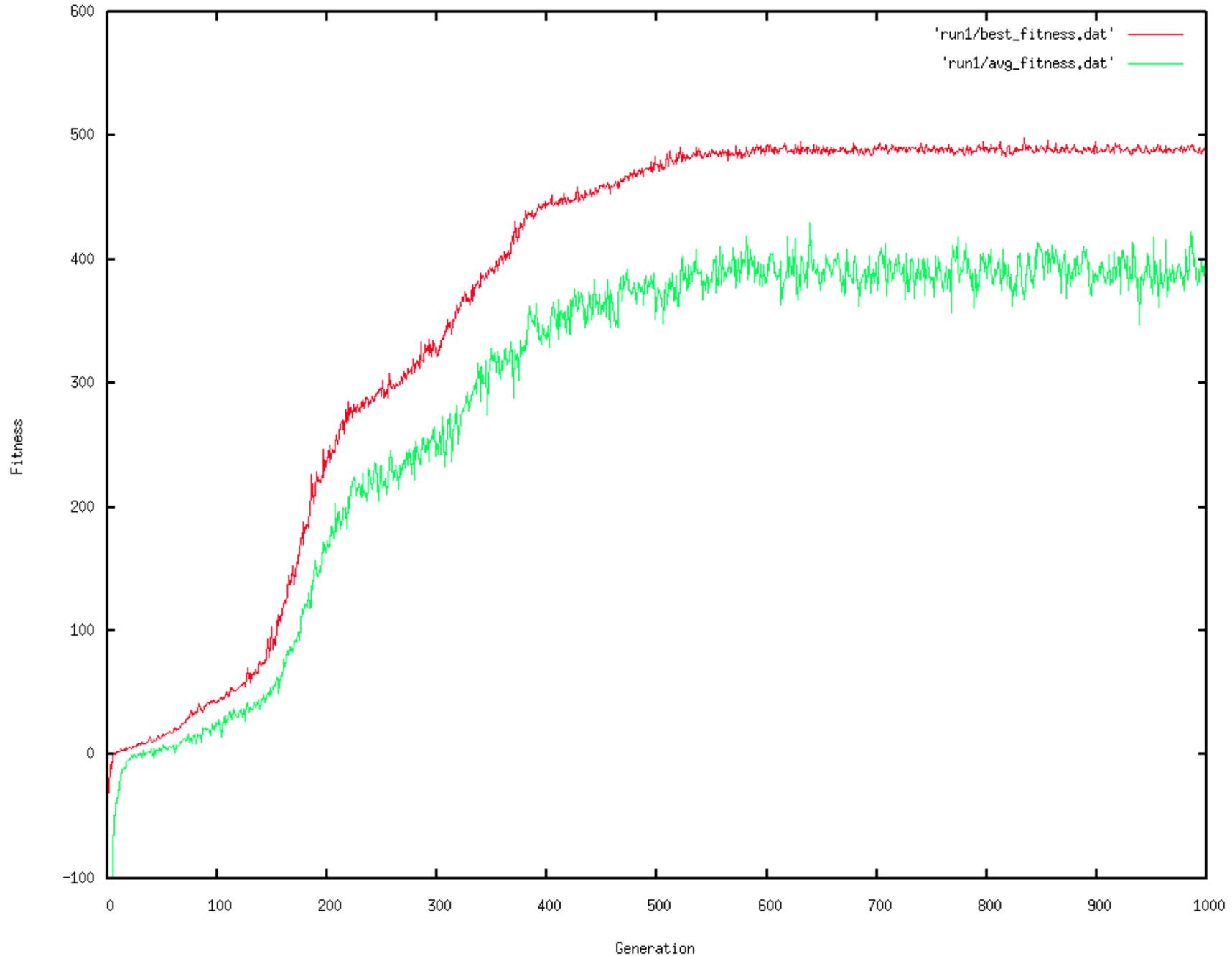
Average score: **+346**

The Genetic Algorithm

- Parameter Settings:
 - Population size: 200 strategies
 - Crossover rate: 100%
 - Mutation rate: 0.5%
 - Evolved for 1000 generations
- Results:
 - Average fitness (generation 1000): **+407**
 - Best fitness: **+489**
 - Best evolved strategy:

255034152255631250055335531153253153150250255054342646052054252051354255134026516
050353651051356001055035535055261204056063001053006343045435366230426040620162662
356356155154353152351355432154355153356150126452035014450632124006465064000003652

The Genetic Algorithm



Robby the Robot Demo