

# Introduction to Complexity (Fall 2016)

## 5.7 Take Unit 5 Test » Unit 5 Test

### Instructions 1

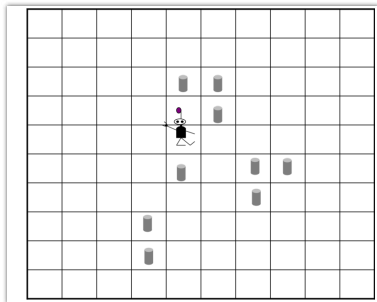
You may use any course materials, websites, Netlogo models, calculators, etc. for this test. Just don't ask another person for the answer and don't share your answers with other people.

### Question 2

Suppose the GA has evolved the following strategy for Robby the Robot (shown in part):

<i>Situation</i>	<i>North</i>	<i>South</i>	<i>East</i>	<i>West</i>	<i>Current Site</i>	<i>Action</i>
1	Empty	Can	Empty	Empty	Empty	Move East
2	Can	Empty	Empty	Empty	Empty	Move North
3	Can	Empty	Empty	Empty	Can	Move West
4	Can	Empty	Can	Empty	Empty	Pick Up Can

Now suppose Robby has a score of 0 and is in the following situation (Situation 1 above):



What is Robby's score after performing **four** actions (according to the above strategy and the scoring system described in the lectures)

- A. -2
- B. -5
- C. 10
- D. -1
- E. 0

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**Question 3**

Recall from Video 5.2 (#3) that the length of a string encoding a strategy is 243.

Suppose that Robby is improved, and can now see the contents of the four positions diagonal to his current position. That is, a situation is now the contents of **North, South, East, West, Current-Site, NorthEast, NorthWest, SouthEast, and SouthWest**. As before, each of them has three possible "contents": *Empty, Can, and Wall*.

If his strategy using these new situations is encoded in the same way as described in Video 5.2 (#3), what would be the length of the string encoding a strategy for this improved Robby?

- A.  $3^5$  (= 243)
  - B.  $5^3$  (= 125)
  - C.  $3^7$  (= 2187)
  - D.  $7^3$  (= 343)
  - E.  $3^9$  (= 19,683)
  - F.  $9^3$  (= 729)
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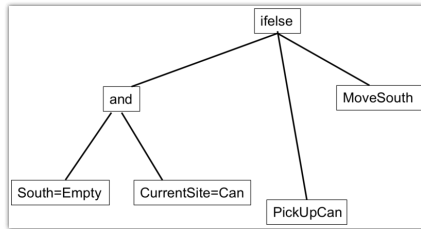
**Question 4**

Recall (again) from Video 5.2 (#3) that the length of a string encoding a strategy is 243, where each symbol in the string corresponds to Robby's 7 possible actions. One (impractical) way to find a good strategy would be to test every possible strategy there is. How many strategies are there?

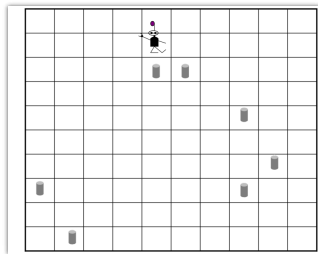
- A.  $243^7$
- B.  $7^{243}$
- C.  $3^{243}$
- D.  $3^7$
- E. 1,701

Question 5

Consider the following genetic programming ("tree") representation of a strategy for Robby the Robot:



Suppose Robby has a score of 0 in the following environment:

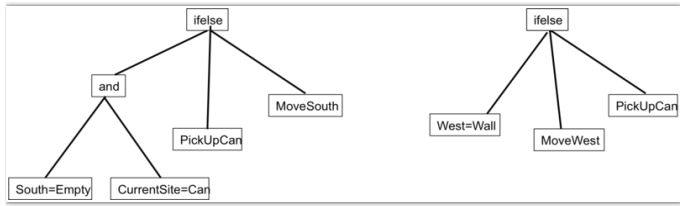


What will his score be after following the strategy above for **three** steps (i.e., to perform 3 actions)?

- A. 0
- B. 10
- C. 20
- D. -1
- E. -2

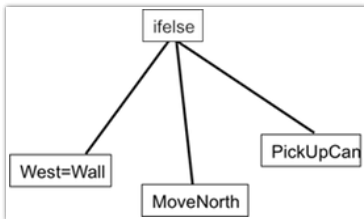
Question 6

Consider the following two genetic programming trees below.

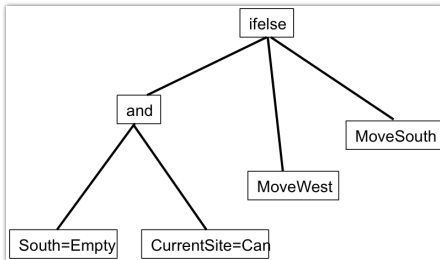


Which of the following trees could result from a single crossover between the two trees above? [See Video 5.3 for description of crossover between trees].

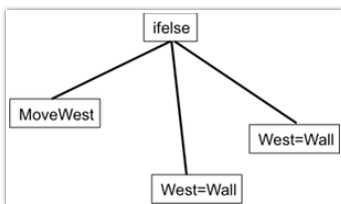
o A.



o B.



o C.



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**Question 7**

In Video 5.2 (#4), it was stated that the GA exhibits "Exaptation". Which of the following best describes what is meant by this?

- A. The GA evolves strategies without assistance from humans.
  - B. Under the GA, evolution proceeds via long periods in which the best fitness changes very little, punctuated by short periods in which the best fitness increases rapidly.
  - C. In some cases, the best fitness in the population of a strategy can decrease for several generations before it increases again.
  - D. At later generations, the fitness of the best strategies are significantly better than at early generations.
  - E. In some cases, the GA evolves a highly fit strategy in which one or more "non-adaptive" traits of earlier strategies have a new, adaptive function.
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**Question 8**

Stephanie Forrest described her current main area of research as which of the following?

- A. Using GAs to evolve computer networks
- B. Using GAs as models of social and cultural evolution
- C. Using GAs to repair bugs in software
- D. Using GAs to model the "major transitions" in biological evolution