

Learning Objectives

After completing this unit, you should be able to:

- Explain the difference between procedural and declarative knowledge.
- Describe the Turing test and how it relates to the technology that you use.
- Give examples of syntactic, semantic, and contextual analysis of language.
- Program a Finch robot to navigate a maze using obstacle and light sensors.
- Identify components of a production system (states, productions, control).
- Construct a search tree for the 8-puzzle using breadth-first and depth-first.
- Explain what a heuristic is in general; compute heuristics for the 8-puzzle.

Textbook Sections

11.1 Intelligence and Machines

11.2 Perception

11.3 Reasoning

11.6 Robotics

Video Lectures

- Artificial Intelligence
- Useless Box with Surprises

Assignments

Act12 The 8-Puzzle; Chapter 11 Problems

Lab12 Codecademy (7 & 8); Finch robot obstacle course

Unit 12 Checklist: Nov 18 – Dec 01

Before Wednesday	Date Completed
FINISH model 1 of the 8-Puzzle activity	
READ textbook 11.1 Intelligence and Machines (take notes) ANSWER question 5 in your notes	
READ textbook 11.2 Perception (take notes) ANSWER questions 2 and 6 in your notes	
DO tutorial: Codecademy (7. Lists and Functions)	
DO tutorial: Codecademy (8. Loops)	
START Lab12: Finch robot obstacle course	(10 pts)
Before Friday	Date Completed
FINISH model 2 of the 8-Puzzle activity	
WATCH video lecture: Production Systems (take notes)	
READ textbook 11.3 Reasoning (take notes) ANSWER questions 3 and 6 in your notes	
READ textbook 11.6 Robotics (take notes) ANSWER question 1 in your notes	
START Act12 exercises (complete at least 75%)	(15 pts)
Before Monday	Date Completed
COMPARE your Lab12 and Act12 with the solutions in Canvas	
SUBMIT Quiz12 – 1st attempt closed: see what you don't know	
STUDY your notes, ask questions on Piazza, meet with the TAs	
SUBMIT Quiz12 – 2nd attempt open: try to get the full 10 points	(10 pts)
TAKE Exam12	(40 pts)

Activity 12: Artificial Intelligence

Today's activity will focus on a classic AI problem: how to make decisions for winning a simple tile game. We will also begin to develop an algorithm for playing the game automatically.

Model 1 The 8-Puzzle

Imagine a 3x3 grid of tiles numbered 1 to 8 that can slide horizontally or vertically. The gray square below represents the empty space into which adjacent tiles can move.

1	2	3
4	5	6
7	8	

A (goal)

1	2	
4	5	3
7	8	6

B (easy)

7	4	8
1	5	3
	6	2

C (hard)

1		3
5	2	6
4	7	8

D (easy)

Explore the puzzle a bit by visiting mypuzzle.org/sliding, and make sure you understand how the tile movement works. Don't spend too much time actually trying to solve the puzzles yet.

Questions (20 min)

Start time: _____

1. How many different tiles can be moved in examples B and C? How many in example D? Describe a general way of classifying the number of moves from any given layout.

2. In the center of the space below, copy the grid from example B. Then draw the possible next grids, one on each side of B, and draw a line between B and each neighbor. Imagine you can transform the puzzle from one grid to another by traveling along the lines. Continue this process for all possible moves two steps from the original example B grid.

3. Imagine repeating #2 for example C. How big might the drawing get?

4. What makes example C harder to solve than B and D?

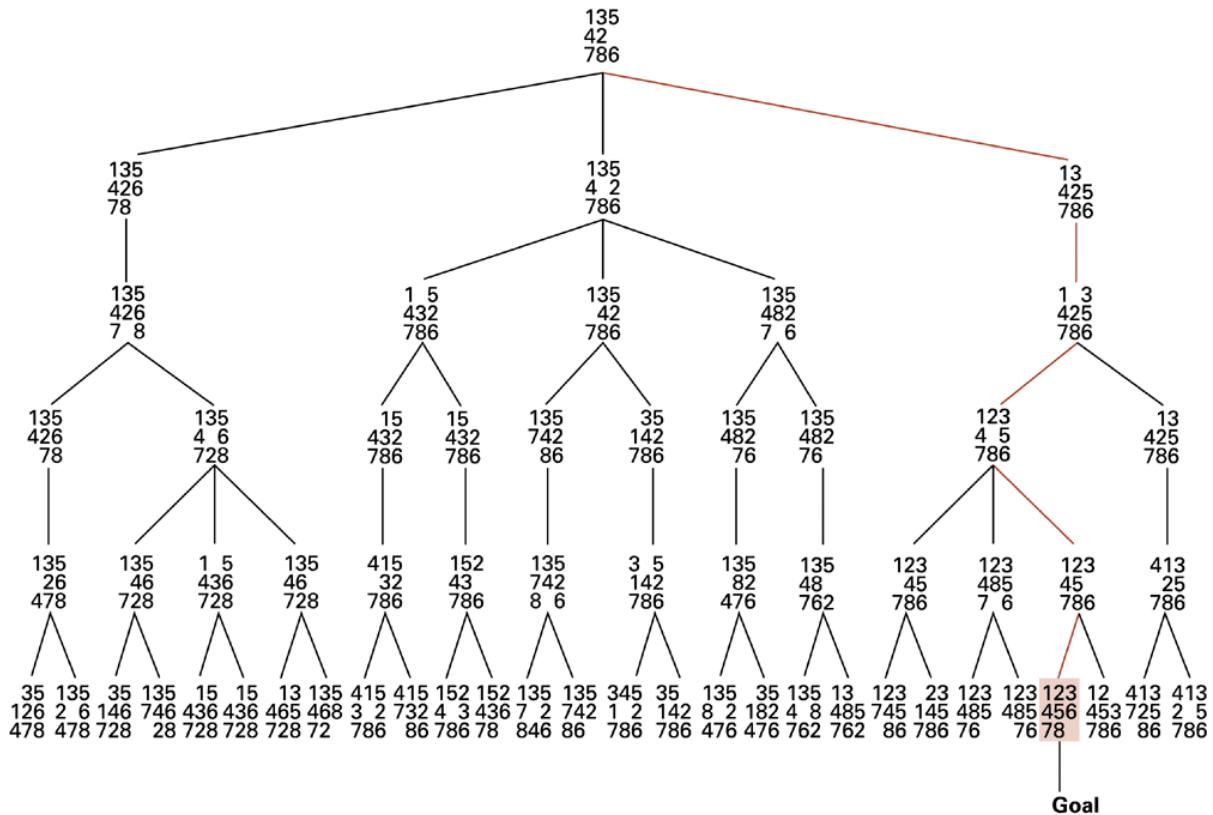
5. Assuming you could remove all the tiles and then place them back on the grid, how many different puzzle layouts are there?

6. Now consider the game of Tic-Tac-Toe (or see playtictactoe.org if you're unfamiliar with it). Draw a diagram similar to #2 for the first two moves, assuming X moves first, starting from an empty 3x3 grid. Don't worry about completely drawing all possible boards, but do sketch enough to illustrate you know how it works.

7. Name three ways the Tic-Tac-Toe diagram differs from what you did in the 8-Puzzle.

8. Would it be possible for a computer to store the solution for all possible 8-tile and tic-tac-toe games? Why or why not?

Model 2 Search Trees



Questions (15 min)

Start time: _____

9. In your own words, describe what the above diagram represents.

10. Given that there are always at least two possible moves, why do some board configurations seem to have only one branch?

11. Consider two methods for making the move choices at each step: *Random* (just choose randomly among all legal moves), and *Lowest* (always choose the lowest numbered available tile to move). Could either of these methods get to a solution?

12. If you were given several puzzle layouts and had to choose the easiest to solve, how would you choose?

13. Describe an algorithm that can take any 8-Puzzle grid and compute some measure of the difficulty. Use your thinking from the previous question: think about how to get to a number that is bigger, the harder the puzzle might be to solve.

14. Apply your algorithm to the second row of Model 2. You should get a number for each of the three board configurations.

15. Describe how you could use your algorithm from #13 to make a better next-step choice method than the methods in #11.

Chapter 11: Artificial Intelligence

Complete the following Chapter Review Problems on pages 520–521.

#5 and #6 (declarative vs procedural knowledge)

#9 (geometric properties of F, E, L, T)

#12 and #15 (analyzing natural language)

#25 (search trees in competitive games)

#26 (production system for checkers)

#29 (apply the algorithm on Page 498) – *note the heuristic is simpler than the one in 11.3*