

4511W, Fall-2019
ASSIGNMENT 4 :

Assigned: 10/29/19 Due: 11/5/19 at 11:55 PM (submit via Canvas, you may take a picture of handwritten solutions, but you must put them in a pdf) Submit only pdf or txt files

Written/drawn:

Problem 1. (15 points)

Find the Nash equilibrium and Pareto optimal for mixed strategies on the following game (first number in the pair is the reward for the “row player”):

(13,3)	(4,11)	(5,10)
(12,14)	(17,15)	(16,7)
(9,10)	(18,1)	(8,2)

(Note: the key to solving this lies in understanding why you can remove a purely dominated strategy from the game. Pure dominance is not the only condition for removing certain actions...)

Problem 2. (15 points)

(2.1) What is a “cooperative” move (pure strategy) if you are the row player for the following game? If you think the opponent is trying to “take advantage” of you, how should you play? Justify both of these choices.

(2.2) Based off your answers in (2.1), assume you are playing 5 rounds against a tit-for-tat agent. What is the maximum reward you can accumulate (sum rewards between rounds)? (Assume you are the row player and list the sequence of actions along with the summed reward.)

(2,6)	(6,5)	(0,0)
(1,3)	(2,2)	(10,1)
(3,4)	(1,7)	(9,2)

Problem 3. (5 points)

This problem uses the website: <http://ncase.me/trust/>

(1) Go to section “2. Repeated Game” and determine what the maximum score possible is and the sequence of moves to achieve that score (break it up by opponent)

(2) Go to section “7. Sandbox mode” and adjust the “player mistake chance” in the “rules” tab (related to section “6. making mistakes”). What are the largest effects of increasing/decreasing the mistake chance? Are there any “special” values or ranges?

Problems 4, 5 and 6 relate to the following constraint satisfaction problem:

Assume you need to solve the simplified crossword puzzle (not very “cross-word-y”) below. Like a normal crossword, the words need to be arranged left-to-right or top-to-bottom such that the words are

formed with the letters overlapping are the same for both words. The problem is “simplified” as the rather than needing to solve clues to guess the word, the set of words is given upfront that need to be placed on the puzzle.

Words:

Ooze

Oops

Eh

ER

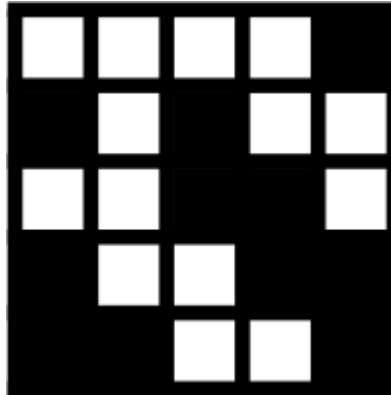
EZ

He

HR

Sh

RP



Problem 4. (10 points)

What are your variables (and domains) for the problem? Write out all the constraints involving these variables (and define any supporting functions you want to use).

Problem 5. (25 points)

Apply 1-consistency and show the resultant domains for variables.

Apply 2-consistency until completion and show the resultant domains for variables.

Apply 3-consistency until completion and show the resultant domains for pairs of variables.

Problem 6. (15 points)

Do a “backtracking search” by using domain size, inference and smart backtracking (these are “improvements” 1, 3 and 4 in the slides) to search this problem. When doing inference after picking a variable, only do 2-consistency with variables directly using your choice (much like the example with letter addition in the slides). When choosing which value to pick, simply choose alphabetically without using improvement 2 in the slides.

Show the full tree as it is searched given the process above.

Programming (python/lisp):

Problem 7. (15 points)

The “Zebra” problem is a classic constraint satisfaction problem defined as a set of 5: houses, people (of nationality), pets, cigars, drinks and colors. House 1 is on the far left with house 5 on the far right (house 3 is in the middle). Each house (numbered) has a single person (nationality), pet, cigar, drink and color associated with the house. No two houses share the same of any property (for example, each house has its own unique pet). The rules are:

- There are five houses.
- The Englishman lives in the red house.
- The Spaniard owns the dog.

- Coffee is drunk in the green house.
- The Ukrainian drinks tea.
- The green house is immediately to the right of the ivory house.
- The Old Gold smoker owns snails.
- Kools are smoked in the yellow house.
- Milk is drunk in the middle house.
- The Norwegian lives in the first house.
- The man who smokes Chesterfields lives in the house next to the man with the fox.
- Kools are smoked in the house next to the house where the horse is kept.
- The Lucky Strike smoker drinks orange juice.
- The Japanese smokes Parliaments.
- The Norwegian lives next to the blue house.

The question is then: Who owns the Zebra? And who drinks water?

(5/15 points) This classic problem is what is already put in as the Zebra problem. Run the `backtracking_search()` on this problem and report the answer to the two questions above. (It is fine to use the default parameters for `backtracking_search()`.)

(10/15 points) Modify the problem to match the “Zebra” problem below (with names, family structure, vehicle choice and hair color) and report: Who has blond hair? Who has a motorcycle?

- There are five houses.
- The owner of the 4th house is single (marital status).
- Aziz owns a Toyota.
- Erastus lives next to Chea.
- The house with the white hair owner is to the right of the house with three children.
- The person who owns a Toyota has one daughter and no sons.
- The 2nd house owners drives a minivan.
- The person with blond hair lives between the person with white hair and the person with black hair.
- Bérénice lives to the right of the person who does not own a car.
- The owner of the house with red hair owns a Toyota.
- Chea does not own a car.
- Bérénice has two sons and no daughters as children.
- The person who owns a Jeep has eight children.
- Dragana has brown hair.