AI Exercise Set 2 – Mete Harun Akcay

1. Give the name of the algorithm that results from each of the following special cases:

a. Local beam search with k = 1. Hill Climbing

b. Local beam search with one initial state and no limit on the number of states retained. Breadth-First Search

c. Simulated annealing with T = 0 at all times (and omitting the termination test). Hill Climbing

d. Simulated annealing with T = ∞ at all times. Random Walk

e. Genetic algorithm with population size N = 1. Random Walk

2. Read the following statements and decide whether they are true or false:

a. One major drawback of hill climbing is that it is only guaranteed to work for two-dimensional search spaces. FALSE

b. An advantage of hill climbing search is that it requires minimal memory. TRUE

c. Simulated annealing is a variation on hill climbing search that can prevent getting stuck in local minima. TRUE

d. There exist constraint satisfaction problems that can be expressed using three-variable constraints, but not binary constraints. FALSE

e. Simple hill climbing is a complete algorithm for solving constraint satisfaction problems. FALSE

f. Simulated annealing with a temperature T = 0 also behaves identically to a greedy hill climbing search. TRUE

g. Local beam search might find an optimal solution for a beam size k, even if it doesn't find an optimal solution for a beam size > k. TRUE

h. TabuSearch uses experience to explore unvisited areas of the search space. TRUE

i. The probability of making a move, so that it leads to a worse state than the current one as the temperature is decreasing in simulated annealing, is also decreasing. TRUE

j. TabuSearch and greedy hill climbing with sideways moves are equivalent. FALSE

3. There are five classes running in a master's program and only three course instructors who are available to teach them. Keep in mind an instructor can only teach one class at a time.

a. Formulate this as a CSP problem in which there is one variable per class. State the variables, their domains, and the constraints. Constraints should be unary or binary and specified formally.

Variables: X = {X1, X2, X3, X4, X5}

Domains: D = {

D1: {C} (D1 means domain of X1, instructors who can teach Class 1)

D2: {B, C}

D3: {A, B, C}

D4: {A, B, C}

D5: {B, C}

}

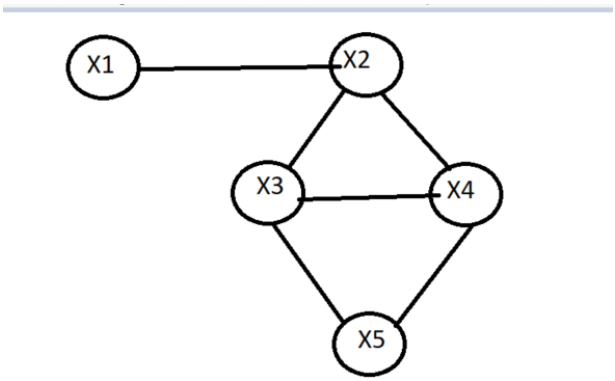
Constraints: C = {

unary: X1 = C, X2 ∈ {B, C}, X3 ∈ {A, B, C}, X4 ∈ {A, B, C}, X5 ∈ {B, C},

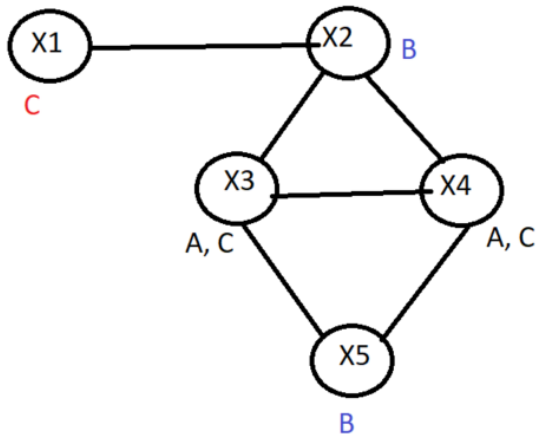
binary: X1 ≠ X2, X2 ≠ X3, X2 ≠ X4, X3 ≠ X4, X3 ≠ X5, X4 ≠ X5

}

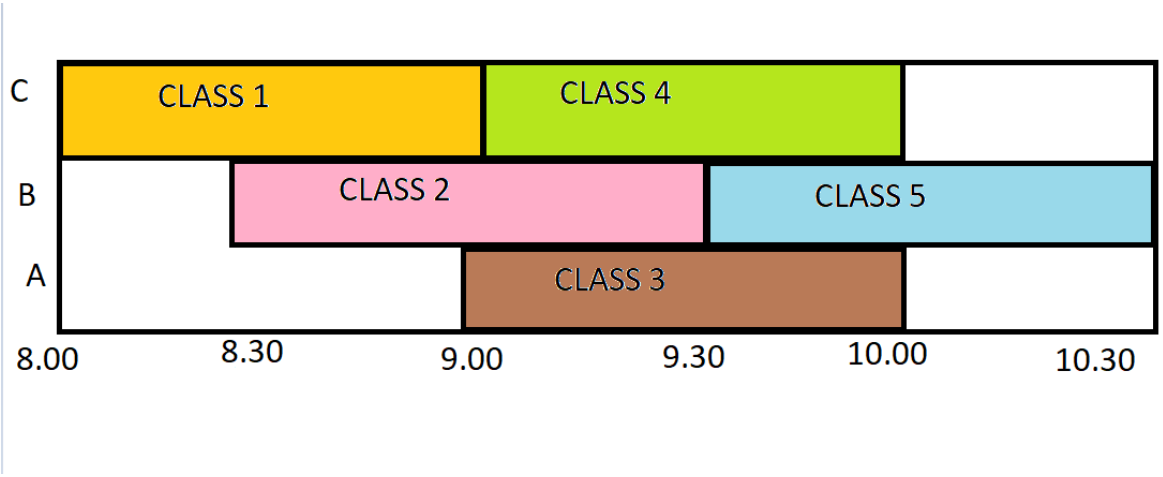
b. Draw the associated constraint graph.



c. Show the domains of the variables after running arc-consistency on the initial graph (i.e. after having already enforced any unary constraints).



d. Give one solution.



X1 = C,

X2 = B,

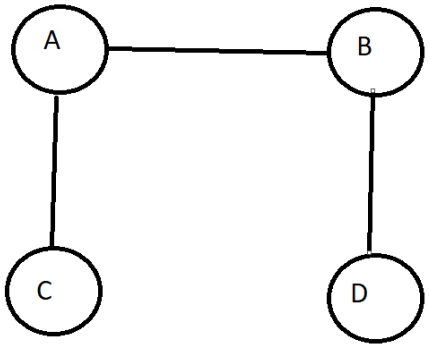
X3 = A,

X4 = C,

X5 = B

4. Assume the responsibility of designing a menu for an event.

a. Draw the constraint graph over the variables A, B, C, and D.



b. First assign A = e. Then cross out eliminated values to show the domains of the variables after forward checking.

A [e]
B [w ~~s~~ ~~m~~]
C [f ~~b~~ p]
D [a i ch]

According to co1, main course must be pasta or fish; thus, beef (b) is eliminated.

According to c2, water must be selected; thus, soda (s) and milk (m) are eliminated.

c. Again, first assign A = e. Then cross out eliminated values to show the domains of the variables after arc-consistency has been enforced.

A [e]
B [w ~~s~~ ~~m~~]
C [f ~~b~~ p]
D ~~[a~~ i ch]

According to co1, main course must be pasta or fish; thus, beef (b) is eliminated.

According to c2, water must be selected; thus, soda (s) and milk (m) are eliminated.

According to co3, ice cream or cheese platter must be selected; thus, apple pie (a) is eliminated.

d. Does a solution for this CSP exist? If yes, give one. If not, explain why.

A = e

B = w

C = p

D = ch

5. Given a GA with chromosomes represented using a 5-bit string of the form…

a. Complete the table showing the probabilities of selecting each of the chromosomes below according to the standard selection method shown in class.

Chromosome	Fitness	Probability of being selected
00101	0+0+1+0+1+0 = 2	2/14 ~ 0.14
11101	1+1+1+0+1+0=4	4/14 ~ 0.29
00000	0+0+0+0+0+0=0	0/14 = 0
10010	1+0+0+1+0+0=2	2/14 ~ 0.14
11111	1+1+1+1+1+1=6	6/14 ~ 0.43

b. Assume a 1-point crossover. This point has been chosen as the point between the 3rd and 4th bits. Show the two offsprings that will result from crossing over the next 2 chromosomes:

011.01 → 01100

101.00 → 10101