

AI QUALITATIVE ASSIGNMENT 2

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Problem 1: Temperature Constraints.

Variables: {x, y}

Domains: {10, 20, 30}

Constraints:

1. $x = y + 10$
2. $x < 30$

Solution: Variables: {x, y}

Domains: {10, 20, 30}

Graph:

Constraints: $(x = y + 10, x < 30)$

$y \dashv\dashv x$

Possible pairs are (x, y)

$(x = y + 10)$

Since 40 is not there in domain so,

If $y = 10$ then

$$x = y + 10 \Rightarrow x = 10 + 10 = 20$$

$$x < 30 \Rightarrow 20 < 30$$

it works very well, so **final domain is x = {20} and y = {10}**.

Problem 2: Two-City Travel Scheduling.

Variables: {p, q}

Domains = {1, 2, 3, 4}

Graph

Constraints:

$p \dashv\dashv q$

1. $p > q$
2. $p \neq 4$

Solution: Variables: {p, q}

Domains = {1, 2, 3, 4}

Constraints: $p > q, p \neq 4$

If in case $p = 4$, then $p > q \Rightarrow (2 > 1), (3 > 1), (4 > 2)$ and $p \neq q \Rightarrow (2 \neq 1), (3 \neq 1), (4 \neq 2)$.

Final domain is p = {2, 3}, q = {1, 2}.

Problem 3: Worker Shift Assignment

Variables: {A, B, C}

Domains: {M, Tu, W, Th, F}

Graph

Constraints:

A ----- B

1. A = B + 1
2. C != A



Solution: Variables: {A, B, C} (days)

C

Domains: {M, Tu, W, Th, F}

Constraints: (A = B + 1, C != A)

From A = B + 1, here the possible pair given is A = {Tu, W, Th, M} and B = {M, Tu, W, Th}

So, C != A does not remove any value

Therefore the **final domain is A = {Tu, W, Th, F}, B = {M, Tu, W, Th} and C = {M, Tu, W, Th, F}.**

Problem 4: Number Ordering Chain

Variables: {a, b, c}

Domains: {1, 2, 3, 4}

Graph

Constraints:

a --- b --- c

1. a < b
2. b < c

Solution: Variables: {a, b, c}

Domains: {1, 2, 3, 4}

Constraints: (a < b, b < c)

a cannot be 4 because b > 4 so, a = {1, 2, 3}

b cannot be 1 because no a < 1 and cannot be 4 because c > 4 so, b = {2, 3}

c must be >b so, c = {3, 4} then check once a = 3 needs b > 3 (b would need 4) – 4 was removed -> a = 3

final domain is a = {1, 2}

b = {2, 3}

c = {3, 4}

Problem 5: Simple Geometry Constraints.

Variables: {u, v}

Domains: {2, 4, 6, 8}

Constraints: $(u + v = 10)$

Solution: Variables: {u, v}

Domains: {2, 4, 6, 8}

Graph

Constraints: $(u + v = 10)$

u ----- v

Pairs satisfying, sum = 10

So, (2, 8), (4, 6), (6, 4), (8, 2)

Every domain value appears at least one pair

So, **final domain is u = {2, 4, 6, 8}**

$$v = \{2, 4, 6, 8\}$$

Problem 6: Mini Scheduling Problem

Variables: {x, y, z}

Domains: {1, 2, 3}

Graph

Constraints:

y

1. $x = y$
2. $z > x$

|
x ----- z

Solution: Variables: {x, y, z}

Domains: {1, 2, 3}

Constraints: $(x = y, z > x)$

$x = y$ links each other so x and y will have same values

$x = 3 \rightarrow$ no $z > 3$

since maximum number in domain is 3 so, will remove 3 for x and y the z must be $>x$

so z must have 2 or 3

therefore **final domain is x = {1, 2}**

$$y = \{1, 2\}$$

$$z = \{2, 3\}$$

Problem 7: Triangle Side Lengths

Variables: {a, b, c}

Domains: {3, 4, 5, 6}

Constraints:

1. $a + b > c$
2. $a + c > b$
3. $b + c > a$

Solution: Variables: {a, b, c}

Domains: {3, 4, 5, 6}

Constraints: ($a + b > c$, $a + c > b$, $b + c > a$)

Every value in domain has at least one pair with 2 values, so that it satisfies the triangle inequalities.

Final domain is a = {3, 4, 5, 6}

$$b = \{3, 4, 5, 6\}$$

$$c = \{3, 4, 5, 6\}$$

Problem 8: Mini Budget Problem.

Variables: {p, q}

Domain: {5, 10, 15}

Constraints:

1. $p + q \leq 20$
2. $p > q$

Solution: Variables: {p, q}

Domain: {5, 10, 15}

Graph

Constraints: ($p + q \leq 20$, $p > q$)

$p \dashv q$

If $p = 5$ then $5 > q$ then q should not be 10, 15 so $p = 5$ is impossible

If $p = 10$

$p > q$

$10 > q$

Then $q = 5$, it works for $p + q \leq 20 = 10 + 5 < 20$

For $p = 15$, then it works for $p + q \leq 20 = 15 + 5 = 20$

Now for q

If $q = 5$

Then $p = 15$

$p > q$ it works for this principle also

if $q = 15$, $p = 5$ then $p > q$ is not possible so remove $q = 15$

then final domain is $p = \{10, 15\}$

$q = \{5, 10\}$