

AI QUALITATIVE ASSIGNMENT 2

RANJITHA S

25MCAR104

Problem 1: Temperature Constraints.

Variables: $\{x, y\}$

Domains: $\{10, 20, 30\}$

Constraints:

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

Solution: Variables: $\{x, y\}$

Domains: $\{10, 20, 30\}$

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

Possible pairs are (x, y)

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 $y = \{10\}$.**

Graph:

$$\begin{array}{l} y \text{ ----- } x \\ (x = y + 10) \end{array}$$

Problem 2: Two-City Travel Scheduling.

Variables: $\{p, q\}$

Domains = $\{1, 2, 3, 4\}$

Constraints:

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

Graph

$$p \text{ ----- } q$$

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}

Constraints:

1. $A = B + 1$
2. $C \neq A$

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

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

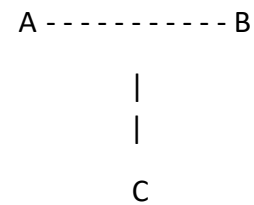
Constraints: ($A = B + 1$, $C \neq A$)

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

So, $C \neq A$ does not remove any value

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

Graph



Problem 4: Number Ordering Chain

Variables: {a, b, c}

Domains: {1, 2, 3, 4}

Constraints:

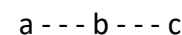
1. $a < b$
2. $b < c$

Solution: Variables: {a, b, c}

Domains: {1, 2, 3, 4}

Constraints: ($a < b$, $b < c$)

Graph



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 $\rightarrow a = 3$

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: $\{2, 4, 6, 8\}$

Constraints: $(u + v = 10)$

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 $u = \{2, 4, 6, 8\}$**

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

Graph

u - - - - - v

Problem 6: Mini Scheduling Problem

Variables: $\{x, y, z\}$

Domains: $\{1, 2, 3\}$

Constraints:

1. $x = y$

2. $z > x$

Graph

y

|

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: $\{5, 10, 15\}$

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

Graph

$p \text{ ----- } q$

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 $p = \{10, 15\}$

$q = \{5, 10\}$