

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

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:

$y \text{ ----- } x$

$(x = y + 10)$

### 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  $p \neq 4 \Rightarrow (2 \neq 1), (3 \neq 1), (4 \neq 2)$ .

**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}

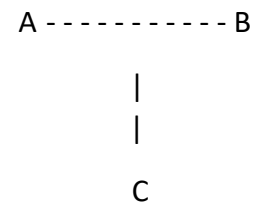
Constraints: ( $A = B + 1$ ,  $C \neq A$ )

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:

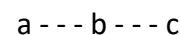
1.  $a < b$
2.  $b < c$

**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  $p = \{10, 15\}$**

**$q = \{5, 10\}$**