REPORT

1) **[solution,score]=ga_mapcoloring();**

The particular map has zero error, score=0; It took 23 iterations to complete.

No changes were made to the recommended parameters, **except TOURNAMENT=5 initilally**→ this gave better results.

(a)

RUN	no of wro	iterations	accuracy
run 1	0	97	100
run 2	2	500	96
run 3	0	100	100
run 4	0	99	100
run 5	4	500	92
run 6	0	101	100
run 7	0	86	100
run 8	0	66	100
run 9	0	231	100
run 10	0	99	100
AVERAGE	0.6		98.8

Mean score of wrong items=0.6

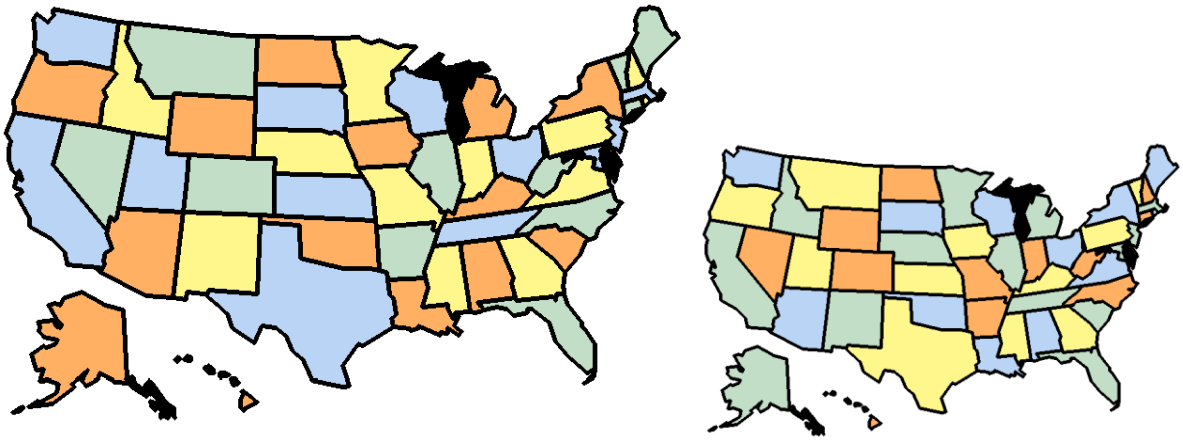
Mean score of correct items=49.4

b)

Yes the results match my intiution.This is because more is the no of iterations more difficult it is to find the correct mapping.Had I inscresed the number of iterations the accuracy would have ben better.

c) you can run this by using the following code

[solution,score]=ga_mapcoloring_2();



Case 1 case 2

	population	offspring size	tournamnet	iterations	score	time
case 1	100	98	2	500	48	less
case 2	1000	998	20	500	46	more

More pop and less pop both have negative impact on the algorithm.

d) I can keep running the code until the 33 and 40th have a value of 1

Please check ga_mapcoloring_partd()

2)

$F = x_1 - x_2$

$g1: \quad 2x_1 + 3x_2 - 10 \leq 0$

$g2: \quad 5x_1 + 2x_2 - 2 \geq 0$

$2 - 5x_1 - 2x_2 \leq 0$

$g3: \quad 7x_2 - 2x_1 - 8 \leq 0$

$L = (x_1 - x_2)$

~~$+ \mu_1(1 - x_1 - x_2) +$~~

$\mu_2(2x_1 + 3x_2 - 10)$

$+ \mu_2(2 - 5x_1 - 2x_2)$

$+ \mu_3(7x_2 - 2x_1 - 8)$

	x_1	x_2
objective	+	−
g_1	+	+
g_2	−	−
g_3	−	+

$\frac{\partial F}{\partial x_1} = 1 \qquad \frac{\partial F}{\partial x_2} = -1$

				RULE 1	RULE 2	RULE 3
Case 1)	INACTIVE g_1	ACTIVE g_2	ACTIVE g_3	✓	✓	✓
Case 2)	g_2	g_1	g_3	✓	✗	✓
Case 3)	g_3	g_1	g_2	✓	✓	✓

Hence Case 3) works & Case 1) works & Case (2) works

~~(Case 4)~~

	INACTIVE	~~INACTIVE~~	ACTIVE	RULE1	RULE2	RULE3
Case 4)	g_1	g_2	g_3	✓	~~X~~	✓
Case 5)	g_1	g_3	g_2	X	✓	✓
Case 6)	g_2	g_3	g_1	X	✓	✓

Case 4) works.

I] Case 3

∴ The ~~only active~~ condition that works is

g_1 or $g_2 \Rightarrow$ active } Case (3)

$g_3 \Rightarrow$ inactive.

$$\nabla L = \begin{bmatrix} 1 + 2\mu_1 - 5\mu_2 - 2\mu_3 \\ -1 + 3\mu_1 - 2\mu_2 + 7\mu_3 \end{bmatrix}$$

$g_3 < 0$

$\mu_3 = 0$

∴ $2\mu_1 - 5\mu_2 = -1 \times 3$

$3\mu_1 - 2\mu_2 = 1 \times 2$

$6\mu_1 - 15\mu_2 = -3$

$6\mu_1 \pm 4\mu_2 = 2$

$-11\mu_2 = -5$

$\mu_2 = \frac{5}{11}$

$2\mu_1 = \frac{25}{11} - 1 = \frac{14}{11}$ $\mu_1 = \frac{7}{11}$

∴ $\mu_2 = \frac{5}{11}$ $\mu_1 = \frac{7}{11}$

∴ $2x_1 + 3x_2 = 10$

$5x_1 + 2x_2 = 2$ $\Rightarrow$ $x_1 = 46/11$, $x_2 = -14/11$ } does not satisfy Case g3

→ Hence case (3) doesn't work

II] Case 1) g_1 is inactive

$$2 - 5x_1 - 2x_2 = 0$$
$$7x_2 - 2x_1 - 8 = 0$$

$$\Rightarrow \quad 5x_1 + 2x_2 = 2 \times 2$$
$$-2x_1 + 7x_2 = 8 \times 5$$

$$10x_1 + 4x_2 = 4$$
$$-10x_1 + 35x_2 = 40$$
$$39x_2 = 44$$
$$x_2 = \frac{44}{39}$$

$$5x_1 = 2 - \frac{88}{39} = \frac{-10}{39}$$

$$x_1 = \frac{-2}{39}$$

Checking for g_1

$\Rightarrow g_1 \leq 0$

Hence case ① works

also

$$1 - 5\mu_2 - 2\mu_3 = 0$$
$$-1 - 2\mu_2 + 7\mu_3 = 0$$

$$5\mu_2 + 2\mu_3 = 1 \times 2$$
$$-2\mu_2 + 7\mu_3 = 1 \times 5$$
$$10\mu_2 + 4\mu_3 = 2$$
$$-10\mu_2 + 35\mu_3 = 5$$
$$39\mu_3 = 7$$
$$\mu_3 = \frac{7}{39}$$

$$\mu_2 = \frac{5}{39}$$

III] Case 2) g_2 is inactive

$$2x_1 + 3x_2 = 10$$
$$7x_2 - 2x_1 = 8$$

$$10x_2 = 18$$
$$x_2 = \frac{18}{10}$$

$$2x_1 = 10 - \frac{54}{10} = \frac{46}{10}$$

$$x_1 = \frac{23}{10}$$

$$1 + 2\mu_1 - 2\mu_3 = 0$$
$$-1 + 3\mu_1 + 7\mu_3 = 0$$

$$\Rightarrow \mu_1 = -1/4$$
$$\mu_3 = 1/4$$

Checking g_2

$$2 - \frac{23}{2} - \frac{18}{5} < 0$$

Hence Case ② works

IV] g_1 & g_2 are inactive

g_3 is active.

$\therefore 7x_2 - 2x_1 = 8$

Cannot determine

$\therefore$ @ Case ①

$x_1 = \frac{-2}{39}$ $x_2 = \frac{44}{39}$ $\mu_2 = \frac{5}{39}$ $\mu_3 = \frac{7}{39}$

$\therefore L = \frac{-2}{39} + \frac{44}{39} + \frac{5}{39}(2 - 5x_1 - 2x_2)$

$+ \frac{7}{39}(7x_2 - 2x_1 - 8)$

$= -46/39$

@ Case ②

$x_1 = \frac{23}{10}$ $x_2 = \frac{18}{10}$ $\mu_1 = -1/4$ $\mu_3 = 1/4$

$L = 1/2$

$\Rightarrow$ Global Minimum occurs @ $x_1 = -2/39$ & $x_2 = 44/39$

& value is $-46/39$

3)

a) Design Variables → d, t

Objective

Min : $C_1 w + C_2 d$

$C_1 = 4 \quad C_2 = 2$

$4w + 2d$

$$w = \frac{0.0025 \times \pi \times 275}{4} \left[(d^2 + 2t)^2 - d^2 \right]$$

Useful 'H', 'E', 'I', 'P', 'Yield Stress'

Constraints

① $d > d_1 = 1 \Rightarrow d > 1 \Rightarrow -d + 1 \leq 0$

② $d < d_2 = 10 \Rightarrow d - 10 \leq 0$

③ $t > t_1 \Rightarrow -t + 0.1 \leq 0$

④ $t < 1 \Rightarrow t - 1 \leq 0$

⑤ $\sigma < \sigma_b \Rightarrow \frac{P}{\pi dt} - \frac{\pi E I}{H^2 dt} \leq 0$

$$\frac{P}{\pi dt} - \frac{\pi^2 \times E}{8 H^2} (d^2 + t^2) \leq 0$$

⑥ $\sigma <$ Yield Stress.

$\sigma -$ Yield Stress ≤ 0

b) Constraints

$-d + 1 \leq 0$

$d - 10 \leq 0$

$-t + 0.1 \leq 0$

$t - 1 \leq 0$

$$\frac{2000}{\pi dt} - \frac{\pi^2 \times 9 \times 10^5 \times (d^2 + t^2)}{8 \times (275)^2} \leq 0$$

$$\frac{2000}{\pi dt} - 550 \leq 0.$$

Min

$$4\left(\frac{0.0025 \times \pi \times 275}{4}\left[(d+2)^2 - d^2\right]\right.$$

The d, t values are:

6.117589
0.189207

c) Please check the matlab files in q3 folder

mainscript-→ Run

confun-→ function for non- linear inequality

objecfun-→ function for linear inequality

x = 3.4269 0.9938

fval = 44.8104

d) Please check the same files again

x2=6.1176 0.1892

fval2 =22.5445

(e) Yes results agree except for Active-Set

After changing initial values to 5 and 0.9

Excel does not change answer

6.117589
0.189207

Active set becomes better

x3 =6.1176 0.1892

fval3 = 22.5445

SQP remains same

x4 =6.1176 0.1892

fval4 =22.5445