Assignments

 Assignment 6

The due date for submitting this assignment has passed. Due on 2018-03-21, 23:59 IST.

Submitted assignment

1) A beam of rectangular cross-section of height h m and width b m and length \(L' = 1.0\) m is supported at two ends, as shown below. A concentrated load of magnitude \(P = 500\) N is acting at its mid-point.

![Beam Diagram]

The beam should be as light as possible. However, it should be able to withstand the above loading. Assume density of the beam material \(\rho = 7.6 \times 10^3\) kg/m\(^3\) and allowable bending stress \(\sigma_{\text{allowable}} = 800\) MPa; \(b\) and \(h\) are allowed to vary in the ranges given below.

\[
0.006 \leq b \leq 0.210 \\
0.006 \leq h \leq 0.180
\]

The mass of the beam and its maximum bending moment are found to be equal to

- (a) 7000 bh kg, 160 N.m
- (b) 6800 bh kg, 110 N.m
- (c) 6500 bh kg, 170 N.m
- (d) 7600 bh kg, 125 N.m

No, the answer is incorrect.

Score: 0

Accepted Answers:
- (d) 7600 bh kg, 125 N.m

2) The maximum developed bending stress of the beam is found to be equal to

\[
\frac{600}{bh^2} \, N/m^2
\]

- (a) \(\frac{600}{bh^2} \, N/m^2\)
- (b) \(\frac{800}{bh^2} \, N/m^2\)
Problem (Contd.)

Lecture 35: A Practical Optimization Problem (Contd.)

Feedback for week 6

Quiz : Assignment 6

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(c) \( \frac{750}{bb} \) \( N/m^2 \)

(d) \( \frac{500}{bb^2} \) \( N/m^2 \)

No, the answer is incorrect.

Score: 0

Accepted Answers:

(c) \( \frac{750}{bb} \) \( N/m^2 \)

3) Use Random Walk Method to solve its weight minimization problem by assuming initial solution \( \begin{bmatrix} b \\ h \end{bmatrix} = \begin{bmatrix} 0.03 \\ 0.01 \end{bmatrix} \) and step length \( \lambda = 0.1 \). Take two random numbers as \( r_1 = 0.5, r_2 = 0.4 \). Its search direction in the first iteration is given by

(a) \( \begin{bmatrix} 0.78 \\ 0.62 \end{bmatrix} \)

(b) \( \begin{bmatrix} 0.30 \\ 0.20 \end{bmatrix} \)

(c) \( \begin{bmatrix} 0.98 \\ 0.55 \end{bmatrix} \)

(d) \( \begin{bmatrix} 0.45 \\ 0.37 \end{bmatrix} \)

No, the answer is incorrect.

Score: 0

Accepted Answers:

(a) \( \begin{bmatrix} 0.78 \\ 0.62 \end{bmatrix} \)

4) Use Steepest Descent Method to solve the weight minimization problem by taking the initial solution \( \begin{bmatrix} b \\ h \end{bmatrix} = \begin{bmatrix} 0.03 \\ 0.01 \end{bmatrix} \). Its search direction in the first iteration is given by

(a) \( \begin{bmatrix} -60 \\ -330 \end{bmatrix} \)

(b) \( \begin{bmatrix} -76 \\ -228 \end{bmatrix} \)

(c) \( \begin{bmatrix} -50 \\ -150 \end{bmatrix} \)

(d) \( \begin{bmatrix} -228 \\ -76 \end{bmatrix} \)

No, the answer is incorrect.

Score: 0

Accepted Answers:

(b) \( \begin{bmatrix} -76 \\ -228 \end{bmatrix} \)

5) Let us use a binary-coded GA to solve this weight minimization problem. Ten bits are utilized to represent each of the two real variables: b and h counting from the left-
most bit.
The fitness of the GA-string: 1010101110 1000101110 is found to be equal to

- (a) 35.84
- (b) 102.99
- (c) 350.18
- (d) 210.55

No, the answer is incorrect.
Score: 0
Accepted Answers:
(b) 102.99

6) To solve this weight minimization problem, let us use a real-coded genetic algorithm (RCGA) with tournament selection, simulated binary crossover (SBX) and polynomial mutation. In SBX, the probability distributions for creating children solutions in the contracting and expanding zones are given by

\[ C(\alpha) = 0.5(q + 1)\alpha^q \]

\[ Ex(\alpha) = 0.5(q + 1) \frac{1}{\alpha^{q+2}} \]

respectively, where \( \alpha \) is the spread factor and assume the value of exponent \( q = 5 \).

Let us consider the two parents participating in the SBX are as follows:

\[
\begin{align*}
\text{Pr 1:} & \quad 0.030 \quad 0.010 \\
\text{Pr 2:} & \quad 0.120 \quad 0.025 
\end{align*}
\]

Let us also consider the random numbers \( r = 0.4 \) and \( 0.6 \), to implement the SBX in order to determine the children solutions in \( b \) and \( h \), respectively.

Children solutions (\( b \) and \( h \)) are approximately found to be as follows:

- (a) \( b \quad h \)
  - Ch 1: 0.125    0.010
  - Ch 2: 0.085    0.021
- (b) \( b \quad h \)
  - Ch 1: 0.018    0.050
  - Ch 2: 0.021    0.060
- (c) \( b \quad h \)
  - Ch 1: 0.095    0.078
  - Ch 2: 0.086    0.085
- (d) \( b \quad h \)
  - Ch 1: 0.032    0.0097
  - Ch 2: 0.118    0.0253

No, the answer is incorrect.
Score: 0
Accepted Answers:
(d) \( b \quad h \)
  - Ch 1: 0.032    0.0097
  - Ch 2: 0.118    0.0253

7) To solve this weight minimization problem, let us use a real-coded genetic algorithm (RCGA) with tournament selection, simulated binary crossover (SBX) and polynomial mutation. For polynomial mutation, perturbation factor is represented as follows:

\[
\delta = \begin{cases} 
(2r)^{\frac{1}{q+1}} - 1, & \text{if } r < 0.5 \\
1 - \left[2(1-r)\right]^{\frac{1}{q+1}}, & \text{if } r \geq 0.5 
\end{cases}
\]

Take \( q=6 \), random number \( r = 0.3 \), maximum value of perturbation \( \delta_{max} = 0.001 \).
The mutated solution corresponding to \( b = 0.040 \) is found to be equal to

- (a) 0.051
- (b) 0.062
- (c) 0.018
8) Use Simulated Annealing to solve this optimization problem. Assume initial temperature of molten metal $T_0 = 4400 \, ^\circ K$; initial solution selected at random $\begin{bmatrix} b \\ h \end{bmatrix}_0 = \begin{bmatrix} 0.01 \\ 0.01 \end{bmatrix}$ and termination criterion $\epsilon = 0.001$. Let us assume the random numbers as follows: 0.5, 0.7 and so on. Change in objective function (i.e., energy) at the end of the first iteration is approximately found to be as follows:

- (a) 204.168
- (b) 350.172
- (c) 189.146
- (d) 104.138

No, the answer is incorrect.
Score: 0
Accepted Answers:
(d) 104.138

9) In Particle Swarm Optimization (PSO) algorithm, velocity of a particle is updated iteratively using the concept(s) of

- (a) initial momentum
- (b) initial momentum and social interaction
- (c) initial momentum, social and cognitive components
- (d) social and cognitive components

No, the answer is incorrect.
Score: 0
Accepted Answers:
(c) initial momentum, social and cognitive components

10) To solve the above practical optimization problem, if you are told to choose the best optimization tool, which one will you select out of the four tools mentioned below?

- (a) Random walk method
- (b) Binary-coded Genetic Algorithm
- (c) Particle Swarm Optimization
- (d) Exhaustive Search Method

No, the answer is incorrect.
Score: 0
Accepted Answers:
(c) Particle Swarm Optimization