MIT2019103

$\boxed{\text{Answer 1}}$

$A_1 = 11101111$, $A_2 = 00010100$

$H_1 = 1*******$ $H_2 = 0*******$

$H_3 = ******11$, $H_4 = ***0*01*$

$H_5 = 1*****1*$, $H_6 = 1*****1*$

A_1 matches H_1

A_2 matches H_2

A_1 matches H_3

ϕ matches H_4

A_1 matches H_5

A_1 matches H_6

Prob. of survival under mutation

$P_m = 0.001$, $1 - P_m = 0.999$

$S_m(H) = (1-P_m)^{o(H)}$

$H_1 \Rightarrow o(H_1) = 1$, $S_m(H_1) = (0.999)^1 = 0.999$

$H_2 \Rightarrow o(H_2) = 1$, $S_m(H_2) = (0.999)^1 = 0.999$

$H_3 \Rightarrow o(H_3) = 2$, $S_m(H_3) = (0.999)^2 = 0.998$

$H_4 \Rightarrow o(H_4) = 3$, $S_m(H_4) = (0.999)^3 = 0.997$

$H_5 \Rightarrow o(H_5) = 2$, $S_m(H_5) = (0.999)^2 = 0.998$

$H_6 \Rightarrow o(H_6) = 2$, $S_m(H_6) = (0.999)^2 \simeq 0.998$

Prob. of surviving cross-over

$S_c(H) \geq 1 - P_c \frac{\delta(H)}{l-1}$

$P_c = 0.85$,

$l = 8$, $l-1 = 7$

$H_1 \Rightarrow \delta(H_1) = 0$, $\therefore S_c(H_1) = 1$

$H_2 \Rightarrow \delta(H_2) = 0$, $\therefore S_c(H_2) = 1$

$H_3 \Rightarrow \delta(H_3) = 1$, $\therefore S_c(H_3) = 0.878$

$H_4 \Rightarrow \delta(H_4) = 3$, $\therefore S_c(H_4) = 0.636$

$H_5 \Rightarrow \delta(H_5) = 6$, $\therefore S_c(H_5) = 0.27$

$H_6 \Rightarrow \delta(H_6) = 6$, $\therefore S_c(H_6) = 0.27$

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Answer 2

	S_i	f_i
S1	10001	20
S2	11100	10
S3	00011	5
S4	00011	15
	Total fitness	50

avg fitness $(\bar{f}) = \frac{50}{4} = 12.5$

$P_m = 0.01$, $P_c = 0.7$

Let $H = 1****$

$o(H) = 1$, $\delta(H) = 0$

matched strings $= S_1, S_2$ ∴ $m(H, 0) = 2$

$f(H, 0) = \frac{20+10}{2} = \frac{30}{2} = 15$

$$\therefore E[m(H,1)] \geq m(H,0) \frac{f(H,0)}{\bar{f}} \times \left(1 - \frac{P_c\,\delta(H)}{l-1}\right) \cdot (1-P_m)^{o(H)}$$

$$= 2 \times \frac{15}{12.5} \left(1 - 0.7 \times \frac{0}{4}\right)(1-0.01)^1$$

$$\therefore \boxed{E[m(H,1)] \geq \cancel{0.7448}} = \boxed{2.376}$$

Let $H = 0**1*$

$o(H) = 2$, $\delta(H) = 3$

matched strings = S_3, S_4, $\therefore m(H,0) = 2$

$$f(H,0) = \frac{5+15}{2} = \frac{20}{2} = 10$$

$\therefore$ Using the same ~~formul~~ formula as in previous H,

$$E[m(H,1)] \geq 2 \times \frac{10}{12.5}\left(1 - \frac{0.7 \times 3}{4}\right)(1-0.01)^2$$

$$\therefore \boxed{E[m(H,1)] \geq 0.7449}$$

Let $H_1 = 1****$
$H_2 = 0**1*$

$$\therefore \boxed{\begin{array}{l} E[m(H_1,1)] \geq 2.376 \\ E[m(H_2,1)] \geq 0.7449 \end{array}}$$