AI1110 Assignment 23 in LaTeX

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10.15.1.9: Question In a hurdle race, a player has to cross 10 hurdles. The probability that he will clear each hurdle is $\frac{5}{6}$. What is the probability that he will knock down fewer than 2 hurdles?
Solution:

$$X \sim \text{Bin}(n, p), \tag{1}$$
$$p = \frac{5}{6}, \tag{2}$$
$$n = 10 \tag{3}$$

where p is the probability of a person knocking down a hurdle and n is the number of hurdles
The desired probability is
Let i be the number of hurdles he knocks down.

$$\therefore \Pr(X = i) = {}^{n}C_i p^i (1-p)^{n-i} \tag{4}$$
$$\tag{5}$$

Let Cumulative Distribution function be:

$$F_X(i) = \Pr(X \le i) \tag{6}$$
$$\Pr(X = i) = {}^{10}C_i p^i (1-p)^{10-i} \tag{7}$$
$$\therefore F_X(i) = \sum_{r=0}^{i} {}^{10}C_r p^r (1-p)^{10-r} \tag{8}$$
$$\therefore F_X(1) = \Pr(X \le 1) \tag{9}$$
$$= \sum_{i=0}^{1} \Pr(X = i) \tag{10}$$
$$= \sum_{i=0}^{1} {}^{10}C_i (\frac{1}{6})^i (\frac{5}{6})^{10-i} \tag{11}$$
$$= (\frac{5}{6})^{10} + (10)(\frac{1}{6})(\frac{5}{6})^9 \tag{12}$$
$$= \frac{(5)^{10}}{2 * (6)^9} \tag{13}$$

$\therefore$ The required probability is

$$\frac{(5)^{10}}{2 * (6)^9}$$