1 Probabilistic or Stochastic DP- Finite Horizon

a) The next state is certain but the reward/cost obtained in the current state is stochastic,

$$f_t(i) = \min_x [Expected\ Cost\ c(i,x) + f_{t+1}(j)], \tag{1}$$

where

$$c(i,x) = \sum_j p(i,x,j)c(i,x,j) \tag{2}$$

b) The next state is uncertain and the reward/cost obtained in the current state is stochastic. In general

$$f_t(i) = \min_x [Expected\ Cost\ c(i,x) + \sum_j p(i,x,j)f_{t+1}(j)], \tag{3}$$

c) There are problems where $c(i,x)$ is fixed (not an expected value) and the next state is uncertain.

$$f_t(i) = \min_x [c(i,x) + \sum_j p(i,x,j)f_{t+1}(j)], \tag{4}$$

d) There are also problems where $c(i,x)$ does not exist. The next state is obviously uncertain.

$$f_t(i) = \min_x [\sum_j p(i,x,j)f_{t+1}(j)], \tag{5}$$

Stochastic DP (finite horizon) is also represented as decision trees.