CS195F Recitation:

Viterbi Algorithm Example

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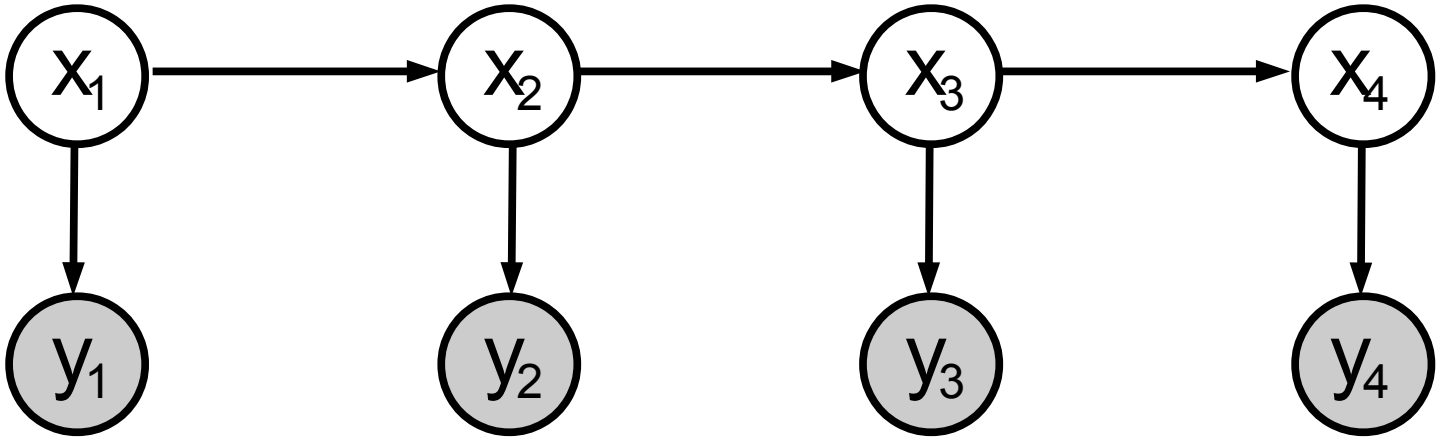
4/27/11

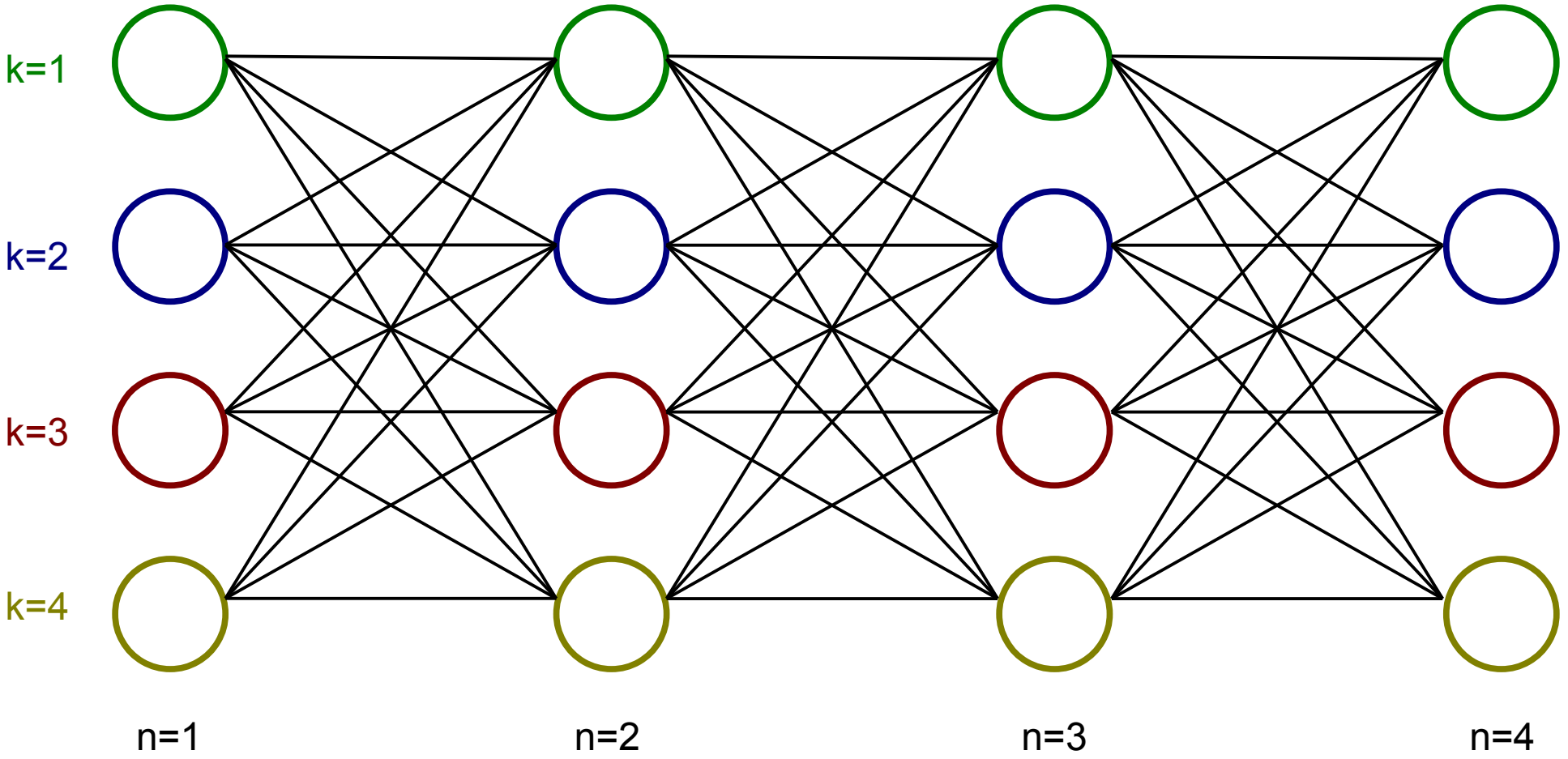
Example Problem

- Assume we have an HMM with
  - Latent variable X = { 1, 2, 3, 4 }
  - Observations Y
  - 4 time scans



Example Problem

Below is the trellis representation for this problem



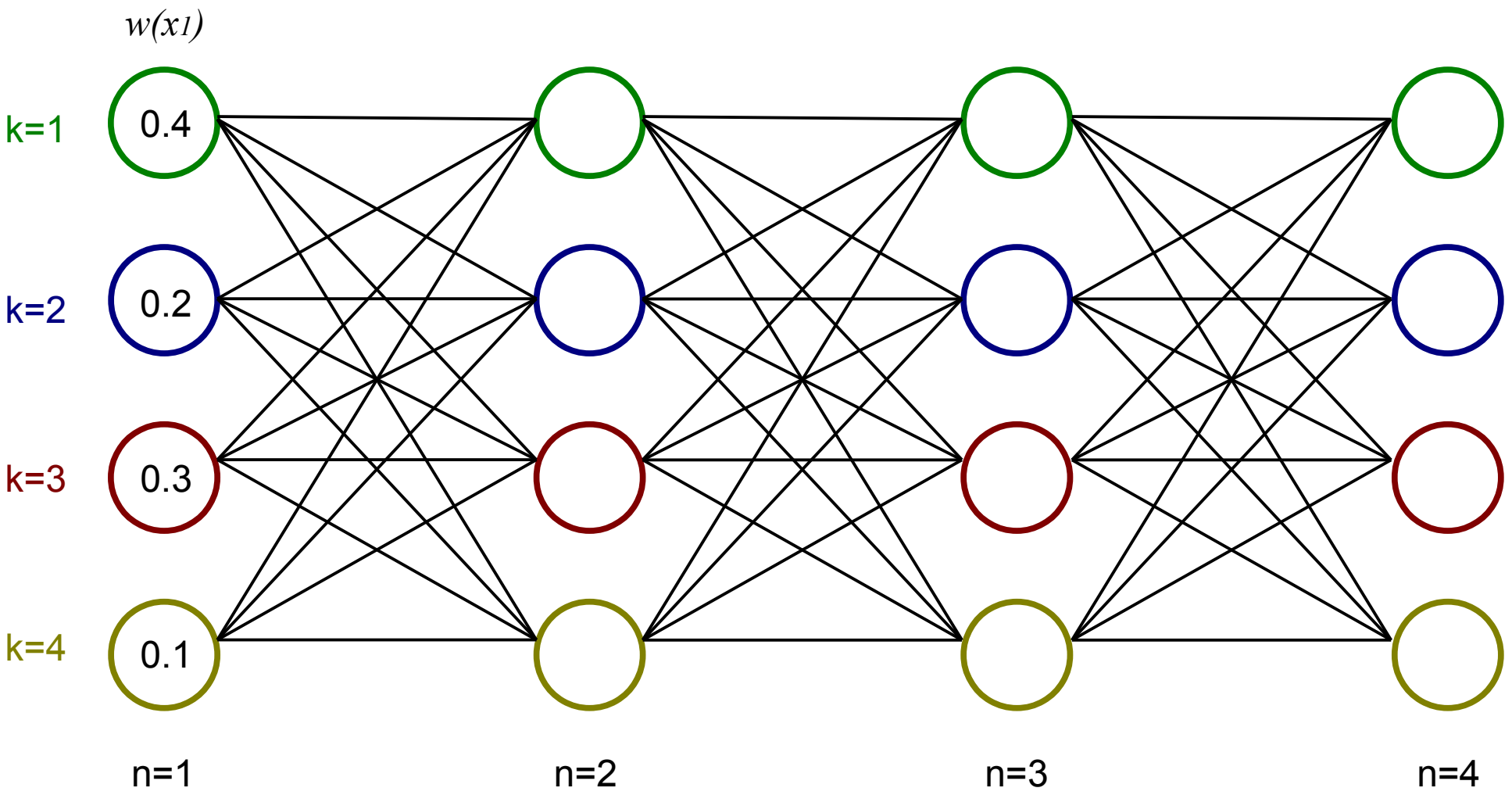
Viterbi Example

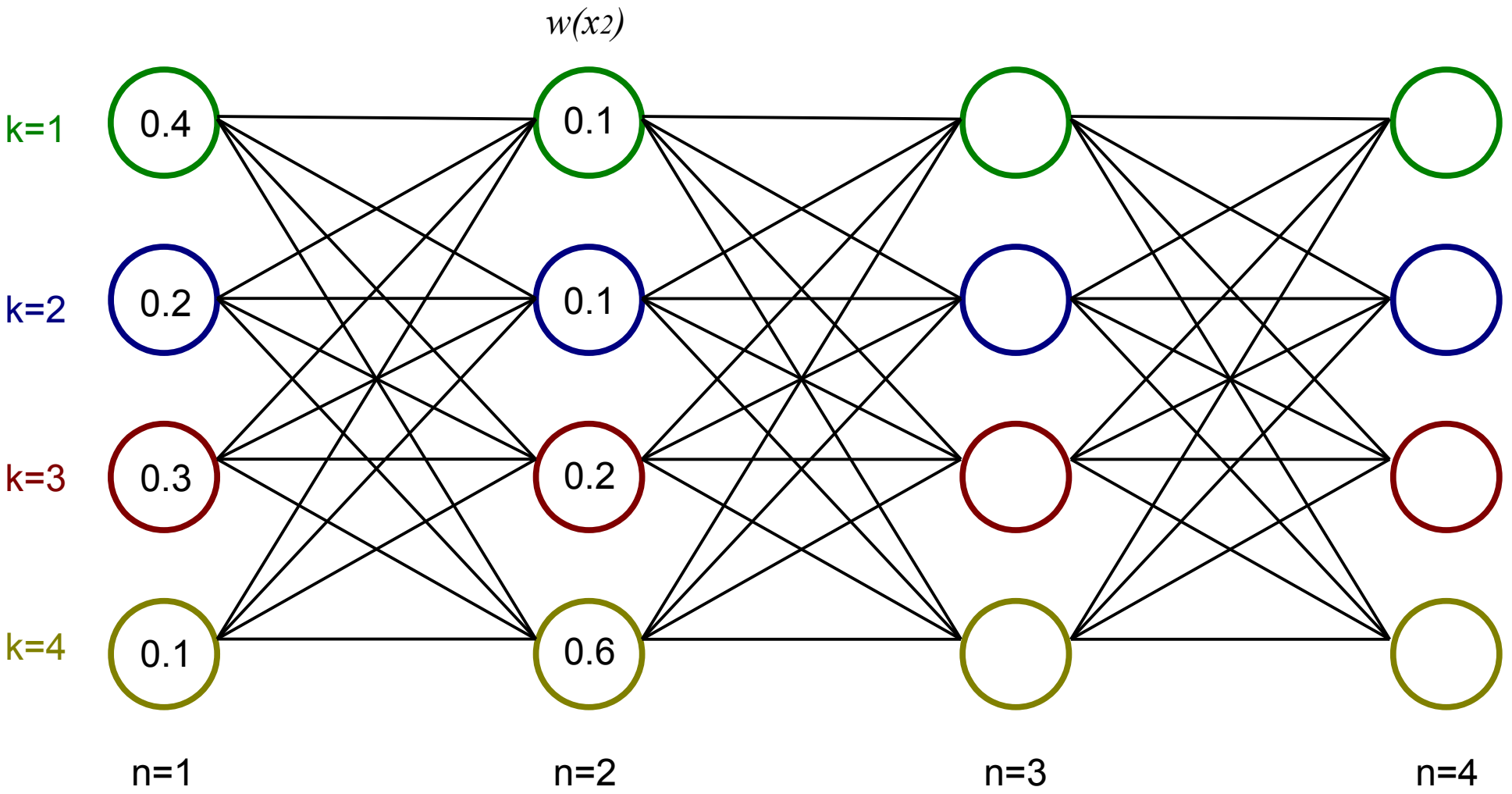
- Recall the Viterbi algorithm yields a maximizing assignment of the latent variables:

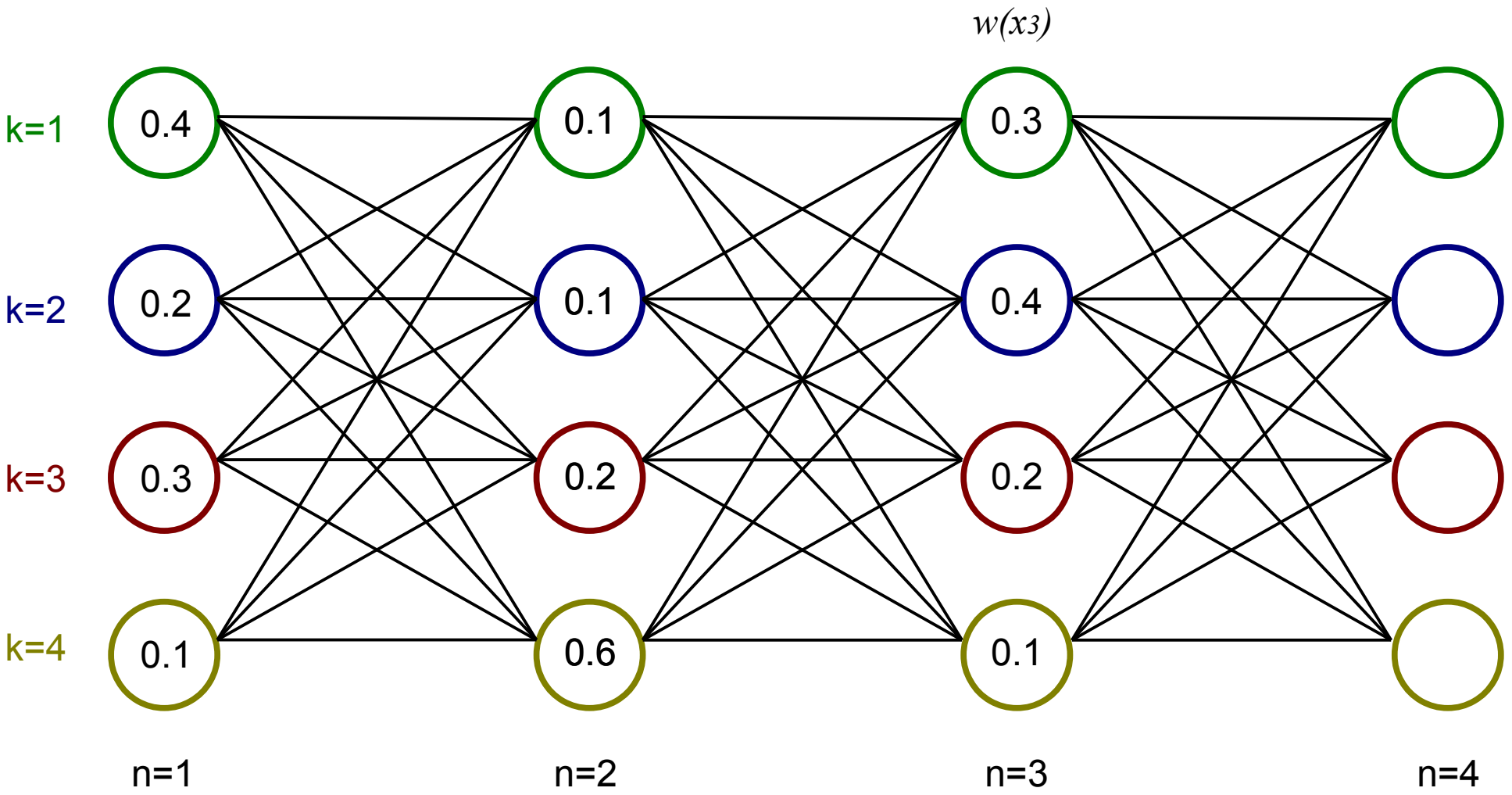
- The algorithm consists of two passes
  - A forward pass which calculates the max marginals

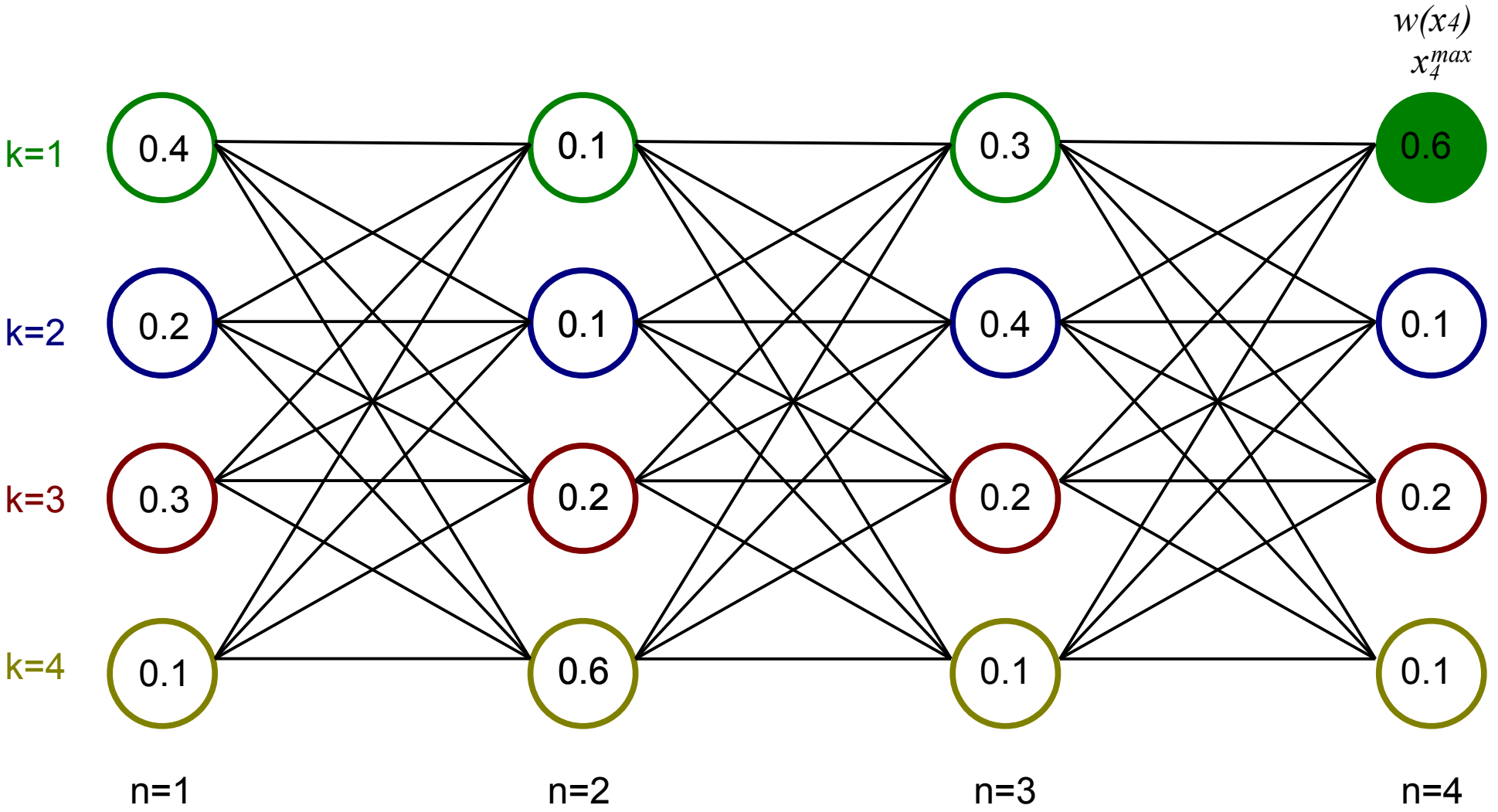
$$w(x_n) = \max_{x_1, \ldots, x_{n-1}} p(y_1, \ldots, y_n, x_1, \ldots, x_n)$$

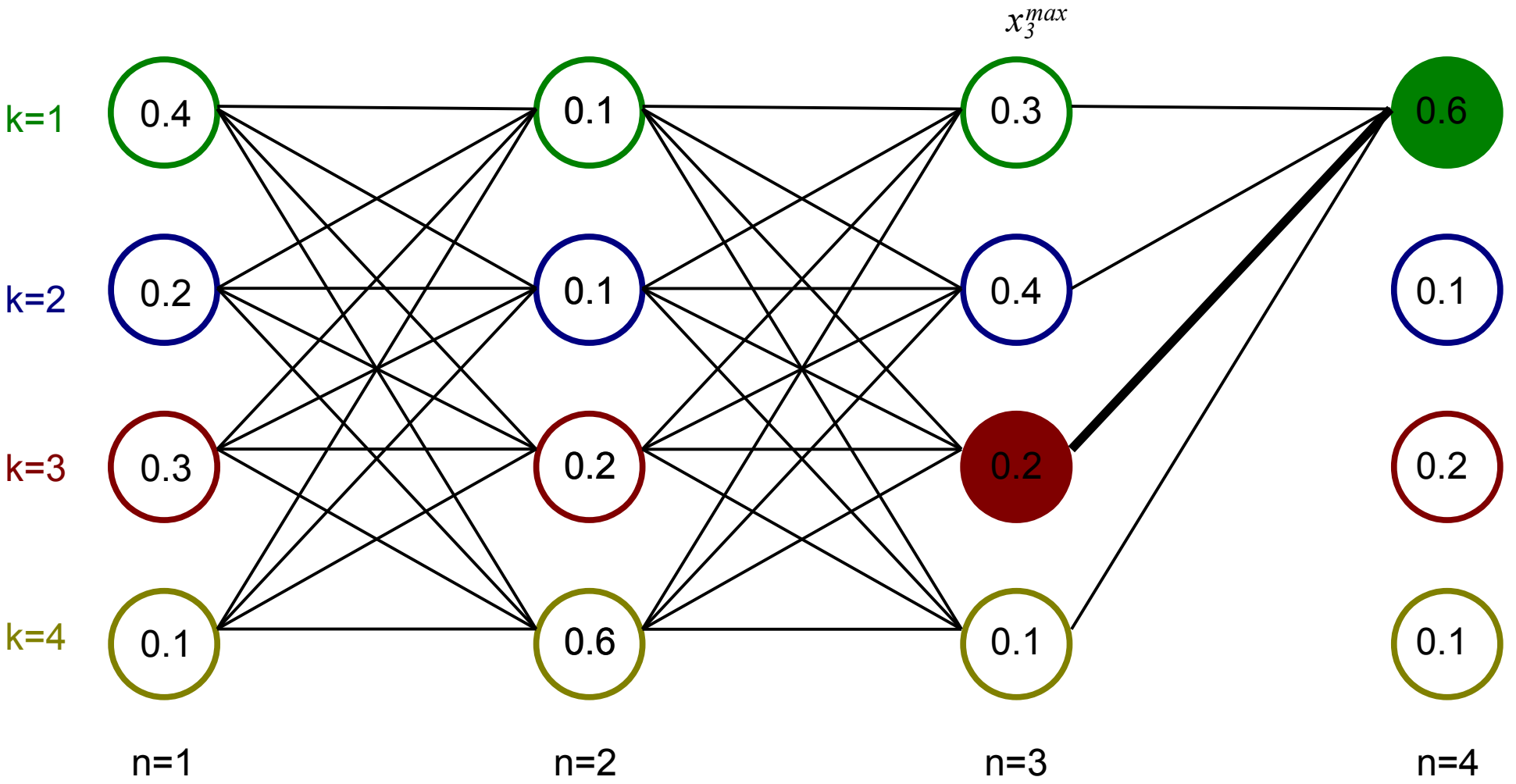
  - A backward pass which propagates the assignment of variables x_n^{max}

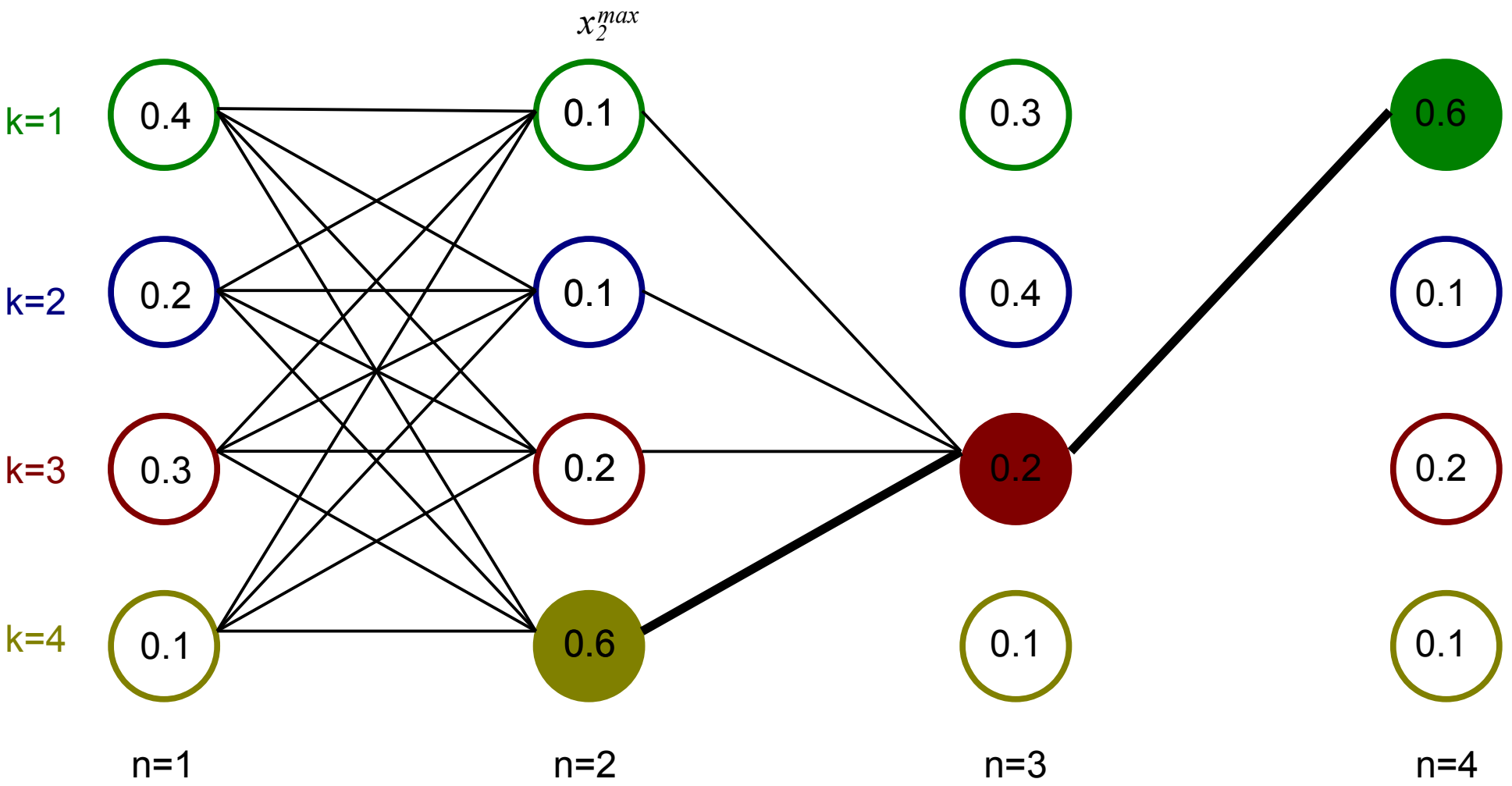

w(x1)
k=1
k=2
k=3
k=4
0.4
0.2
0.3
0.1
n=1
n=2
n=3
n=4

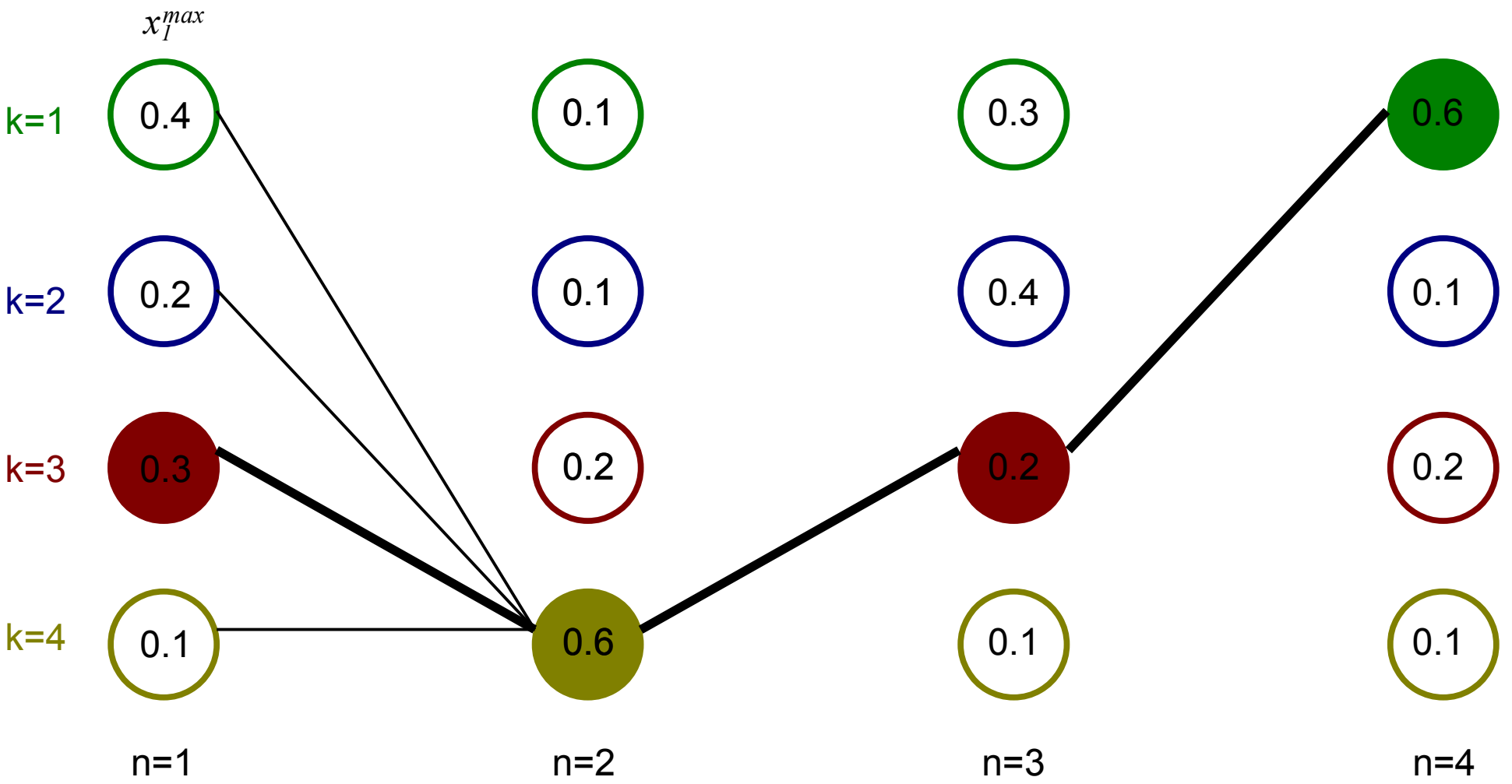

w(x2)
k=1
k=2
k=3
k=4
0.4
0.2
0.3
0.1
0.1
0.1
0.2
0.6
n=1
n=2
n=3
n=4


w(x3)
k=1
k=2
k=3
k=4
0.4
0.2
0.3
0.1
0.1
0.1
0.2
0.6
0.3
0.4
0.2
0.1
n=1
n=2
n=3
n=4


$w(x_4)$
x_4^{max}
k=1
k=2
k=3
k=4
0.4
0.2
0.3
0.1
0.1
0.1
0.2
0.6
0.3
0.4
0.2
0.1
0.6
0.1
0.2
0.1
n=1
n=2
n=3
n=4


x_3^{max}
k=1
k=2
k=3
k=4
0.4
0.2
0.3
0.1
0.1
0.1
0.2
0.6
0.3
0.4
0.2
0.1
0.6
0.1
0.2
0.1
n=1
n=2
n=3
n=4


x_2^{max}
k=1
k=2
k=3
k=4
0.4
0.2
0.3
0.1
0.1
0.1
0.2
0.6
0.3
0.4
0.2
0.1
0.6
0.1
0.2
0.1
n=1
n=2
n=3
n=4


x_I^{max}
k=1
k=2
k=3
k=4
0.4
0.2
0.3
0.1
0.1
0.1
0.2
0.6
0.3
0.4
0.2
0.1
0.6
0.1
0.2
0.1
n=1
n=2
n=3
n=4

$$X^{max} = (3, 4, 3, 1)$$