In [1]:
```
import numpy
```

In [6]:
```
# using Algorithm 1
# step 1:
a = numpy.array([[0.95, 0.05], [0.10, 0.90]])
b = numpy.array([[1/6, 1/6, 1/6, 1/6, 1/6, 1/6], [1/10, 1/10, 1/10, 1/10, 1/10
pi = [1/2, 1/2]
file_name = './Five Die Roll Strings Dishonest Casino.docx'
# doc = docx.Document(file_name);
s = [
    '3151162464466442453211316311641521336251445436316566265666666',
    '6511664531326512456366646316366631623264552352666666251516631',
    '2225554416665665635643243641315134651463534111264146262533356',
    '3661636664662325344136616611632525624622552652522664353533336',
    '2331216253644144323351632436336655624666626326666123552452 42',
]

D =['FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFLLLLLLLLLLLLLLL', 'LLLLLLFFF
N = 2
for roll in range(0, 5):
    delta = []
    d = [[], []]
    for i in range(1, N + 1):
        o1 = int(s[roll][0])-1
        d[i - 1] = pi[i - 1] * b[i - 1][o1]
    delta.append(d)

    psi = []
    ps = [[], []]
    for i in range(1, N + 1):
        ps[i - 1] = 0
    psi.append(ps)


    # step 2:
    T = len(s[0])
    for t in range(2, T + 1):
        dd = []
        psiii = []
        for i in range(1, N + 1):
            d = []
            for k in range(1, N + 1):
                d.append(delta[(t - 1) - 1][k - 1] * a[k - 1][i - 1])
            maxim = max(d[0], d[1])
            dd.append(maxim * b[i - 1][int(s[roll][t - 1]) - 1])
            psiii.append(d.index(maxim))
        delta.append(dd)
        psi.append(psiii)

    # step 3
    P_star = max(delta[T - 1][0], delta[T - 1][1])
    Q_star = delta[T - 1].index(P_star)

    # step4
    qt_star = [None] * 60
    qt_star[T - 1] = Q_star
    for t in range(T - 2, -1, -1):
        qt_star[t] = psi[t + 1][qt_star[t + 1]]
```

```
    print()
    print()
    print()
    print('Rolls ',s[roll])
    print('Die ', D[roll])
    print('Viterbi ', end='')
    for viterbi in qt_star:
        if viterbi == 1:
            print("L", end='')
        else:
            print("F", end='')
    print()
```

```
Rolls  315116246446644245321131631164152133625144543631656626566666
Die  FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFLLLLLLLLLLLLLLL
Viterbi FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFLLLLLLLLLLLL
```

```
Rolls  651166453132651245636664631636663162326455235266666625151631
Die  LLLLLLFFFFFFFFFFFFLLLLLLLLLLLLLLLLFFFLLLLLLLLLLLLLLFFFFFFFFF
Viterbi FFFFFFFFFFFFFFFFFLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLLFFFFFFFF
```

```
Rolls  22255544166656656356432436413151346514635341112641462625335 6
Die  FFFFFFFLLLLLLLLLLLLLFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFL
Viterbi FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
```

```
Rolls  366163666466232534413661661163252562462255265252266435353336
Die  LLLLLLLLFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
Viterbi LLLLLLLLLLLLFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
```

```
Rolls  233121625364414432335163243633665562466662632666612355245242
Die  FFFFFFFFFFFFFFFFFFFFFFFFFLLLLLLLLLLLLLLLLLLLLLFFFFFFFFFF
Viterbi FFFFFFFFFFFFFFFFFFFFFFFFFFFFLLLLLLLLLLLLLLLLLLLFFFFFFFFFF
```