We consider a independent *bernoulli* trials here of flipping a fair coin "n" times.

$$choice\_prob = \begin{cases} p & \text{if } d \text{ value is 1 corresponding to getting a "heads"} \\ 1 - p & \text{if } d \text{ value is 0 corresponding to getting a "tails"} \end{cases}$$

```
probability_0 >= 0.0000001,
probability_0 <= 0.99999999999999,

d_0_0 >= 0,                 d_0_0 <= 1,
choice_0_0 ==
         If(d_0_0 == 1, probability_0, 1 - probability_0),

d_1_0 >= 0,                 d_1_0 <= 1,
choice_1_0 ==
         If(d_1_0 == 1, probability_0, 1 - probability_0),

d_2_0 >= 0,                 d_2_0 <= 1,
choice_2_0 ==
         If(d_2_0 == 1, probability_0, 1 - probability_0),

d_3_0 >= 0,                 d_3_0 <= 1,
choice_3_0 ==
         If(d_3_0 == 1, probability_0, 1 - probability_0),

d_4_0 >= 0,                 d_4_0 <= 1,
choice_4_0 ==
         If(d_4_0 == 1, probability_0, 1 - probability_0),

d_5_0 >= 0,                 d_5_0 <= 1,
choice_5_0 ==
         If(d_5_0 == 1, probability_0, 1 - probability_0),

d_6_0 >= 0,                 d_6_0 <= 1,
choice_6_0 ==
         If(d_6_0 == 1, probability_0, 1 - probability_0),

d_7_0 >= 0,                 d_7_0 <= 1,
choice_7_0 ==
         If(d_7_0 == 1, probability_0, 1 - probability_0),

d_8_0 >= 0,                 d_8_0 <= 1,
choice_8_0 ==
         If(d_8_0 == 1, probability_0, 1 - probability_0),

d_9_0 >= 0,                 d_9_0 <= 1,
choice_9_0 ==
         If(d_9_0 == 1, probability_0, 1 - probability_0),
```

Fig. 1. Constraints over choice variables.

Path weight is the product of the choice probabilitiy values.

$$w_i = (p)^{x_i} * (1-p)^{10-x_i} \tag{1}$$

```
path_prob_0 == 1 *choice_0_0 * choice_1_0*
choice_2_0 * choice_3_0 * choice_4_0 * choice_5_0 *
choice_6_0 * choice_7_0 * choice_8_0 * choice_9_0
```

Fig. 2. Expression for path_prob variable.

For approximation of the expected value of heads in n trials,

$$EV(heads) = (\sum_{i=1}^{k} w_i * sum_i) \tag{2}$$

```
ToReal(sum_d_heads_0) ==
        ToReal(0 + d_0_0 + d_1_0 + d_2_0 + d_3_0 +
        d_4_0 + d_5_0 + d_6_0 + d_7_0 + d_8_0 + d_9_0) * 1 *
        (choice_0_0 * choice_1_0 * choice_2_0 * choice_3_0 *
        choice_4_0 * choice_5_0 * choice_6_0 * choice_7_0 *
        choice_8_0 * choice_9_0)
```

Fig. 3. Expression for expected heads value.

We want to maximize the value of path prob here.

$$maximize(\sum_{i=1}^{k} (p)^{x_i} * (1-p)^{n-x_i}) \tag{3}$$

```
d_9_0 = 0,
d_3_0 = 0,
d_7_0 = 0,
d_5_0 = 0,
d_1_0 = 0,
d_8_0 = 0,
d_2_0 = 0,
sum_d_heads_0 = 0,
d_0_0 = 0,
d_6_0 = 0,
d_4_0 = 0,
```

Fig. 4. One possible model given by z3 after computing for 2 hours

```
path_prob_0 = 0.951110130465771,
choice_9_0 = 0.995,
choice_8_0 = 0.995,
choice_7_0 = 0.995,
choice_6_0 = 0.995,
choice_5_0 = 0.995,
choice_4_0 = 0.995,
choice_3_0 = 0.995,
choice_2_0 = 0.995,
choice_1_0 = 0.995,
choice_0_0 = 0.995,
probability_0 = 0.005
```

Fig. 5. One possible model given by z3 after computing for 2 hours