KU LEUVEN

January update

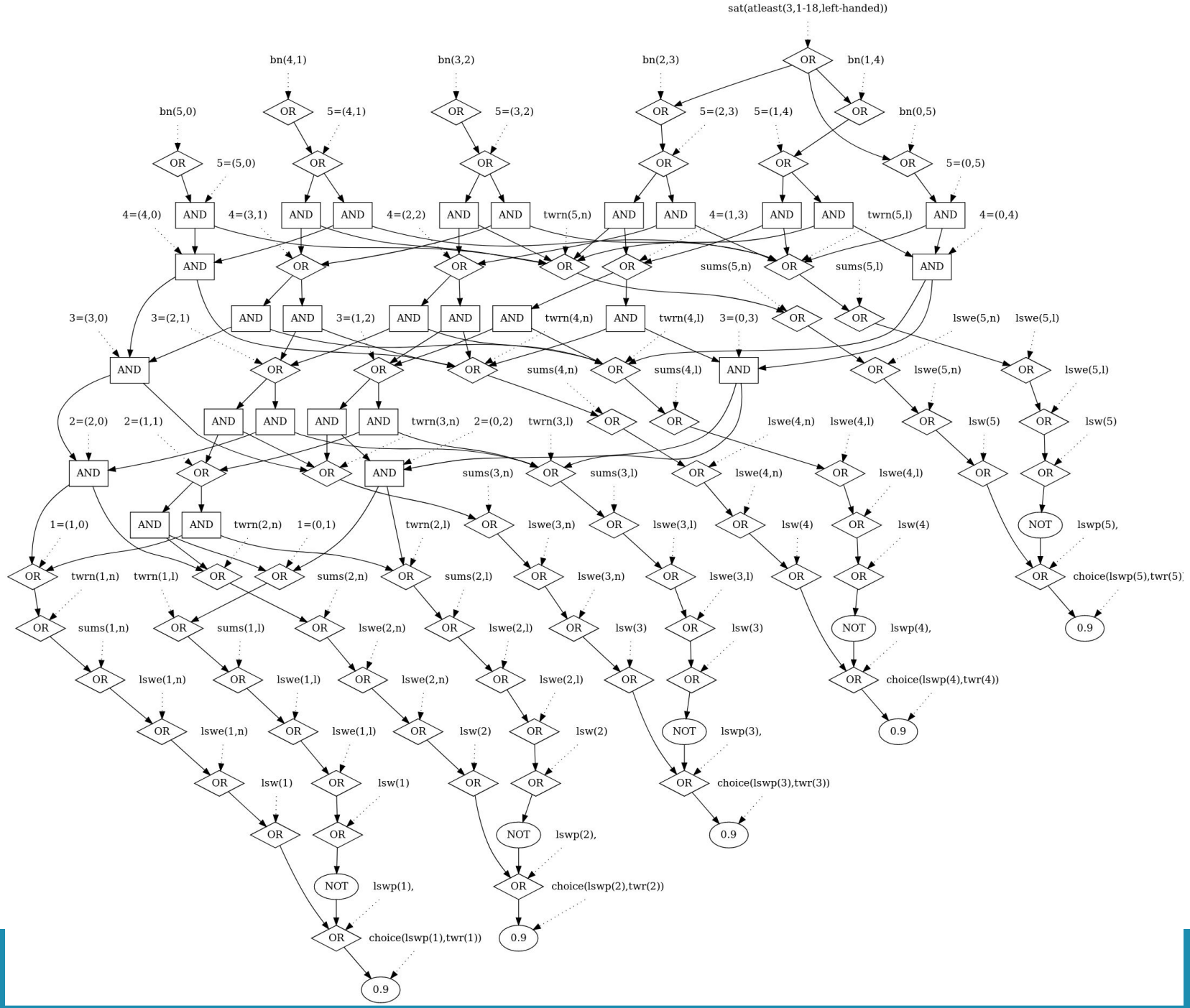
29/01/2019

Grounding

"Given that 10 percent of the population is left-handed, find the probability that out of 15 people, there will be, at least three left-handed students."

```
group(1-9).

given(exactly(rel(10/100,1-9), 1-9,
left-handed)).

take_wr(1-9, 1-18, 15).

probability(atleast(3, 1-18,
left-handed)).

property(outcome(0), [left-handed]).
```

```
0.9::_lists_sw_p(take_wr(1,1-9,1-18),0.9,[0.1],none_of([left-handed]),[left-handed]).
                                                    ⋮
_lists_sw(take_wr(1,1-9,1-18),1.0,[0.9, 0.1],[none_of([left-handed]),
left-handed],none_of([left-handed]),[left-handed]) :-
_lists_sw_p(take_wr(1,1-9,1-18),0.9,[0.1],none_of([left-handed]),[left-handed]).
_lists_sw(take_wr(1,1-9,1-18),1.0,[0.9, 0.1],[none_of([left-handed]),
left-handed],left-handed,[none_of([left-handed])]) :- \+
_lists_sw_p(take_wr(1,1-9,1-18),0.9,[0.1],none_of([left-handed]),[left-handed]).
                                                    ⋮
bn(take_wr(5,1-9,1-18),[(1, none_of([left-handed])), (4, left-handed)]) :-
bn(take_wr(4,1-9,1-18),[(4, left-handed)]), take_wr_nth(5,1-9,1-18,[(1,
none_of([left-handed]))]).
```


sat(atleast(3,1-18,left-handed))
OR
bn(4,1)
bn(3,2)
bn(2,3)
bn(1,4)
bn(5,0)
bn(0,5)
5=(4,1)
5=(3,2)
5=(2,3)
5=(1,4)
5=(5,0)
5=(0,5)
AND
4=(4,0)
4=(3,1)
4=(2,2)
4=(1,3)
4=(0,4)
twrn(5,n)
twrn(5,l)
sums(5,n)
sums(5,l)
lswe(5,n)
lswe(5,l)
3=(3,0)
3=(2,1)
3=(1,2)
3=(0,3)
twrn(4,n)
twrn(4,l)
sums(4,n)
sums(4,l)
2=(2,0)
2=(1,1)
2=(0,2)
twrn(3,n)
twrn(3,l)
sums(3,n)
sums(3,l)
lswe(4,n)
lswe(4,l)
lsw(5)
1=(1,0)
1=(0,1)
twrn(2,n)
twrn(2,l)
sums(2,n)
sums(2,l)
lswe(3,n)
lswe(3,l)
lsw(4)
twrn(1,n)
twrn(1,l)
sums(1,n)
sums(1,l)
lswe(2,n)
lswe(2,l)
lsw(3)
lswe(1,n)
lswe(1,l)
lsw(2)
lsw(1)
NOT
lswp(5),
lswp(4),
lswp(3),
lswp(2),
lswp(1),
choice(lswp(5),twr(5))
choice(lswp(4),twr(4))
choice(lswp(3),twr(3))
choice(lswp(2),twr(2))
choice(lswp(1),twr(1))
0.9

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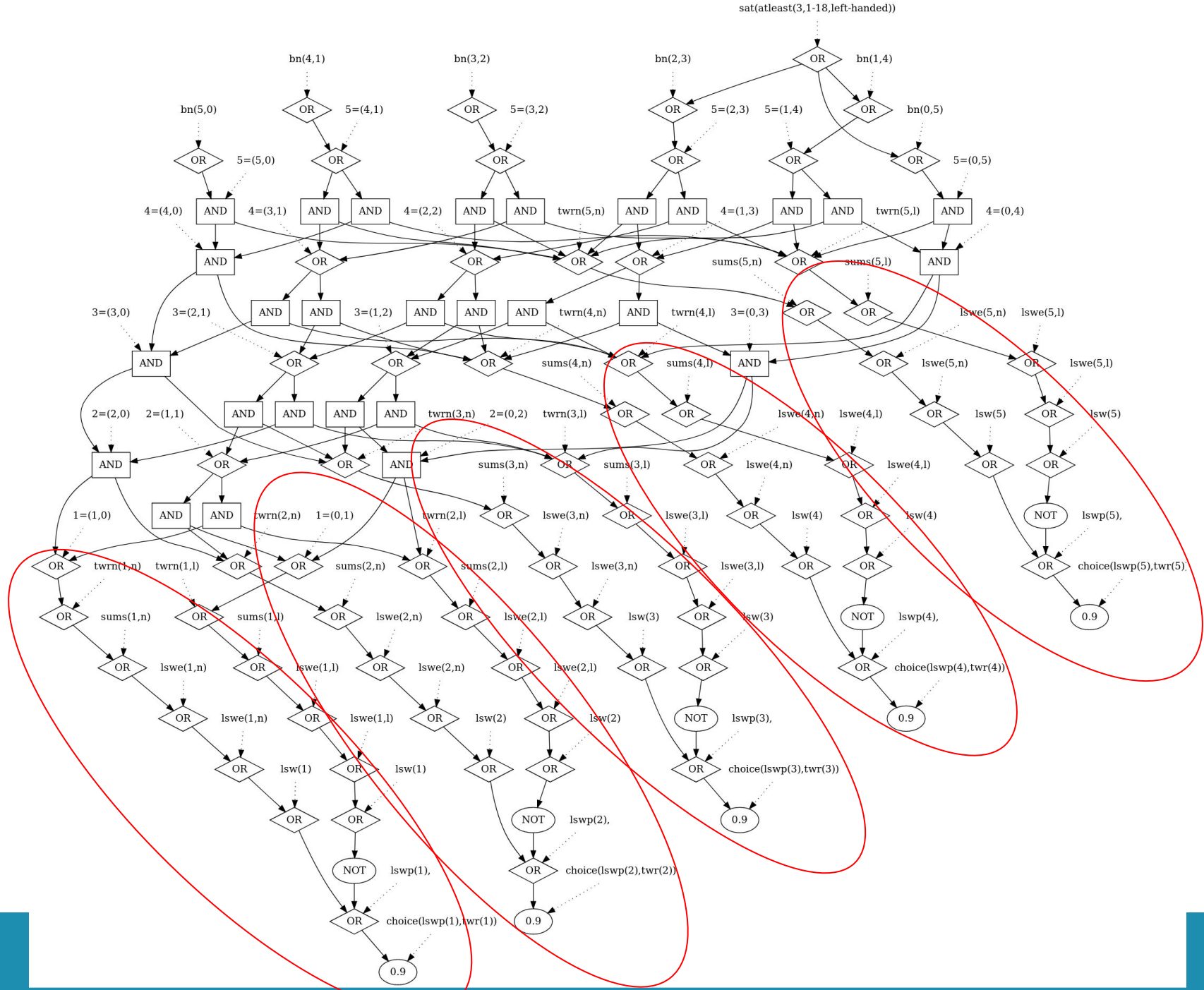
sat(atleast(3,1-18,left-handed))
bn(4,1)
bn(3,2)
bn(2,3)
bn(1,4)
bn(5,0)
bn(0,5)
5=(4,1)
5=(3,2)
5=(2,3)
5=(1,4)
5=(5,0)
5=(0,5)
4=(4,0)
4=(3,1)
4=(2,2)
4=(1,3)
4=(0,4)
twrn(5,n)
twrn(5,l)
sums(5,n)
sums(5,l)
lswe(5,n)
lswe(5,l)
3=(3,0)
3=(2,1)
3=(1,2)
3=(0,3)
twrn(4,n)
twrn(4,l)
sums(4,n)
sums(4,l)
lsw(5)
2=(2,0)
2=(1,1)
2=(0,2)
twrn(3,n)
twrn(3,l)
sums(3,n)
sums(3,l)
lswe(4,n)
lswe(4,l)
lsw(4)
1=(1,0)
1=(0,1)
twrn(2,n)
twrn(2,l)
sums(2,n)
sums(2,l)
lswe(3,n)
lswe(3,l)
lsw(3)
twrn(1,n)
twrn(1,l)
sums(1,n)
sums(1,l)
lswe(2,n)
lswe(2,l)
lsw(2)
lswe(1,n)
lswe(1,l)
lsw(1)
lswp(5),
lswp(4),
lswp(3),
lswp(2),
lswp(1),
choice(lswp(5),twr(5))
choice(lswp(4),twr(4))
choice(lswp(3),twr(3))
choice(lswp(2),twr(2))
choice(lswp(1),twr(1))
0.9
AND
OR
NOT

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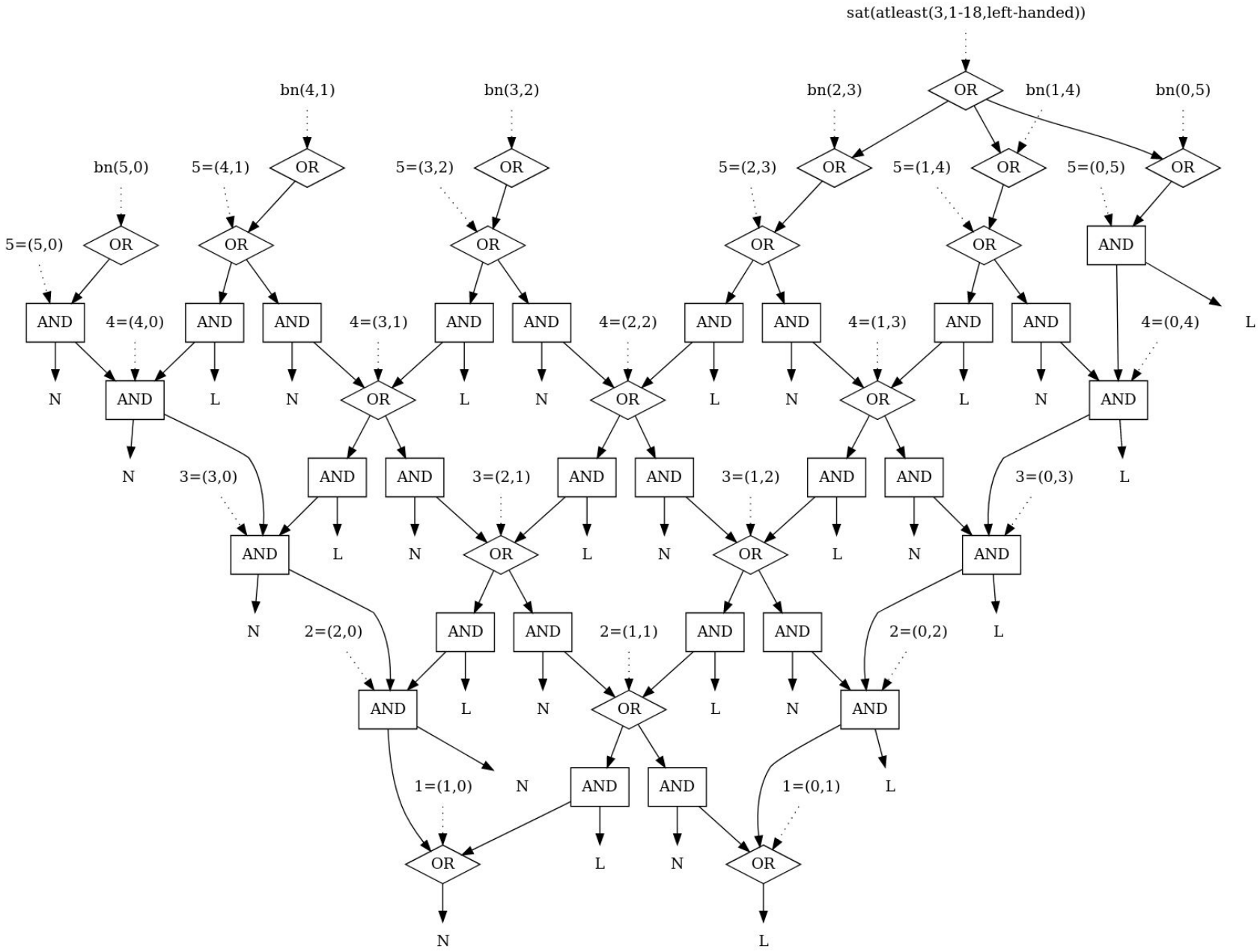
sat(atleast(3,1-18,left-handed))
OR
bn(2,3)
bn(1,4)
bn(0,5)
5=(2,3)
5=(1,4)
5=(0,5)
AND
4=(0,4)
3=(0,3)
2=(0,2)
1=(0,1)
bn(4,1)
bn(3,2)
bn(5,0)
5=(4,1)
5=(3,2)
5=(5,0)
4=(4,0)
4=(3,1)
4=(2,2)
4=(1,3)
3=(3,0)
3=(2,1)
3=(1,2)
2=(2,0)
2=(1,1)
1=(1,0)
N
L

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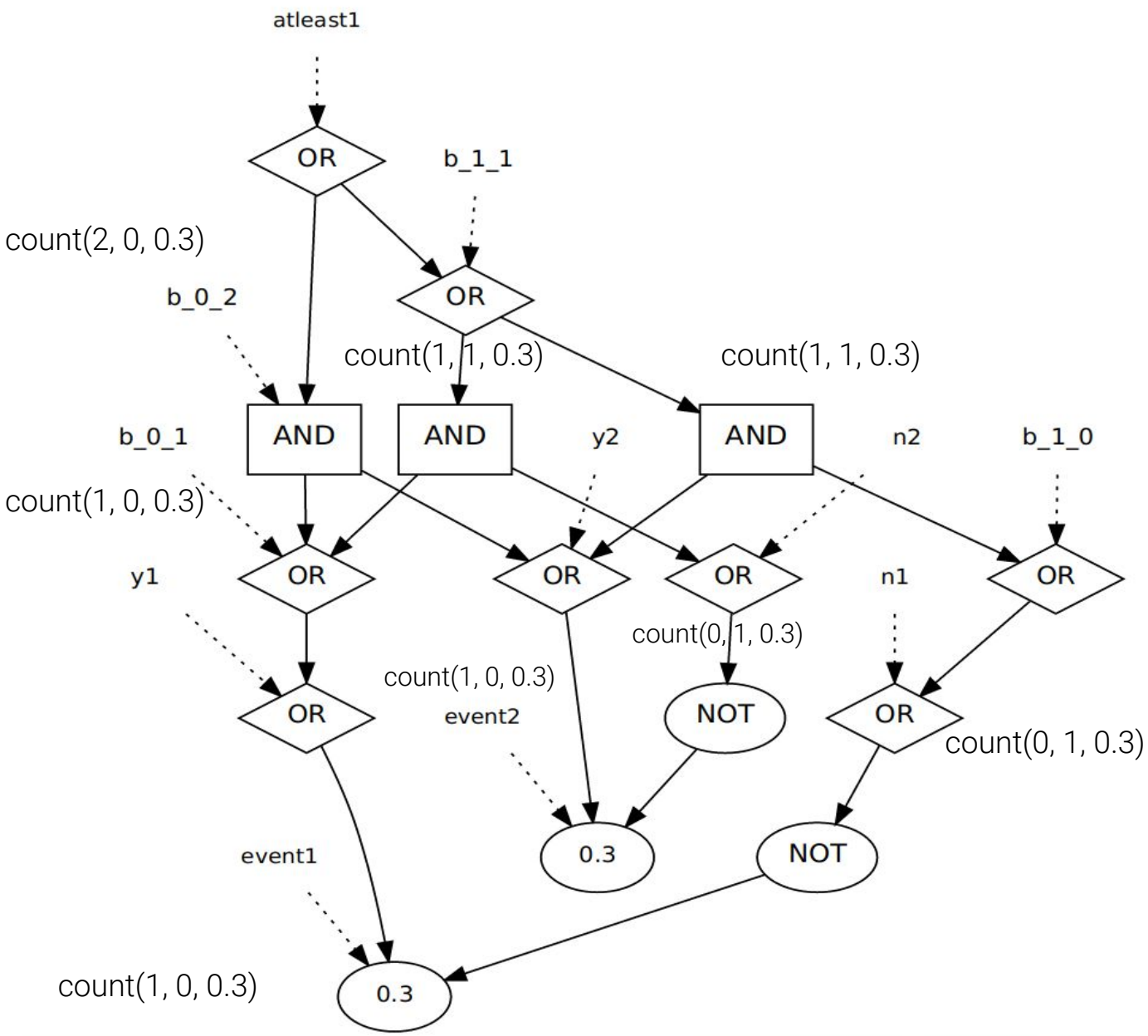
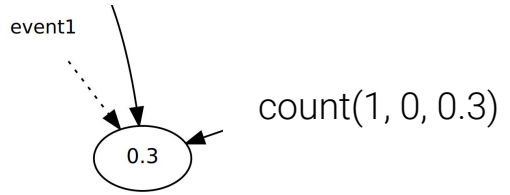
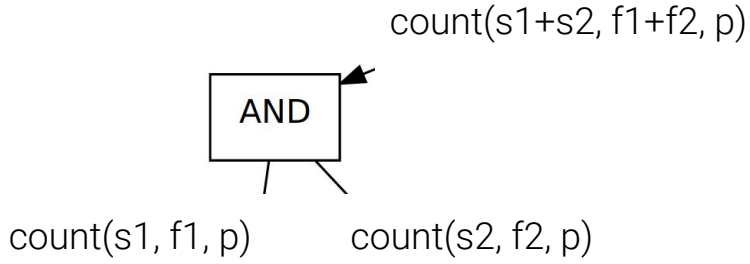
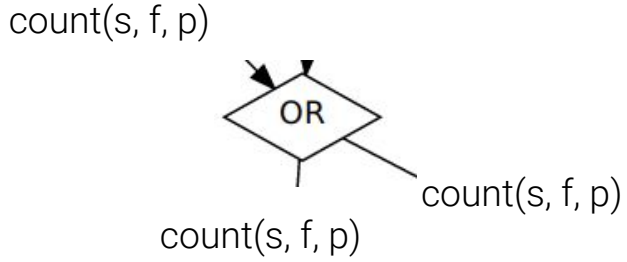
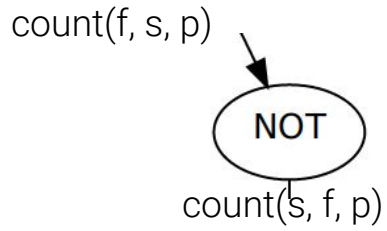


count(successes, failures, probability)









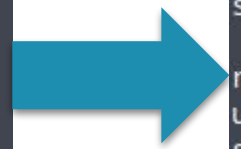
Helps:

- Simple binomial computations, esp. “balanced” binomials, i.e. $\binom{2n}{n}$

“In an examination, 20 questions of true-false type are asked. Suppose a student tosses a fair coin to determine his answer to each question. If the coin falls heads, he answers ` true ' ; if it falls tails, he answers ` false '. Find the probability that he answers at least 12 questions correctly.”

```
Timeout exceeded

real    1m0,176s
user    0m59,846s
sys     0m0,306s
```



```
sat(atleast(12,1-11,correctly)):        0.23146688

real    0m5,357s
user    0m5,319s
sys     0m0,018s
```

Does not help:

- Problems with large formulas (hundreds of events)

" A television station is broadcasting a program during a thunderstorm which causes, on average, one image in 200 to fall below its standard for picture quality. In broadcasting 500 images what is the probability that exactly 5 of them do not meet standards?"