E: Repeated tests

With imperfect tests, repeated testing can be valuable

- Can reduce uncertainty substantially

Example: potentially risky medical procedure (e.g., gene therapy)

- Patient has severely debilitating medical condition, e.g., ALS
- Experimental treatment with two outcomes, good G and bad B:

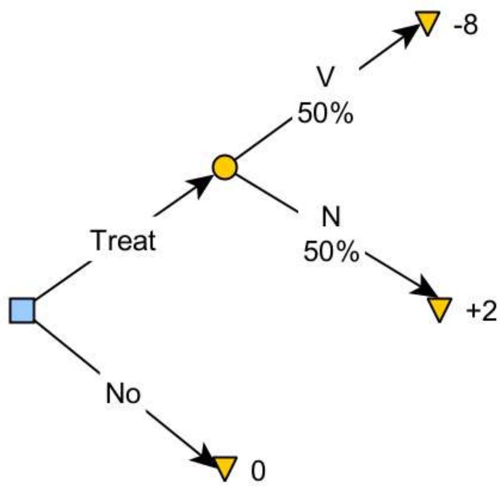
Outcome	Payoff
G: Improves quality of life	\$2 M
B: Immediately fatal	-\$8 M

- Outcome depends on characteristic of patient (e.g., genetics)

State	Probability
Vulnerable to treatment (V), e.g., allergic reaction	50%
Not vulnerable (N)	50%

- Treating a vulnerable person causes the bad outcome

Treat without testing vulnerability:



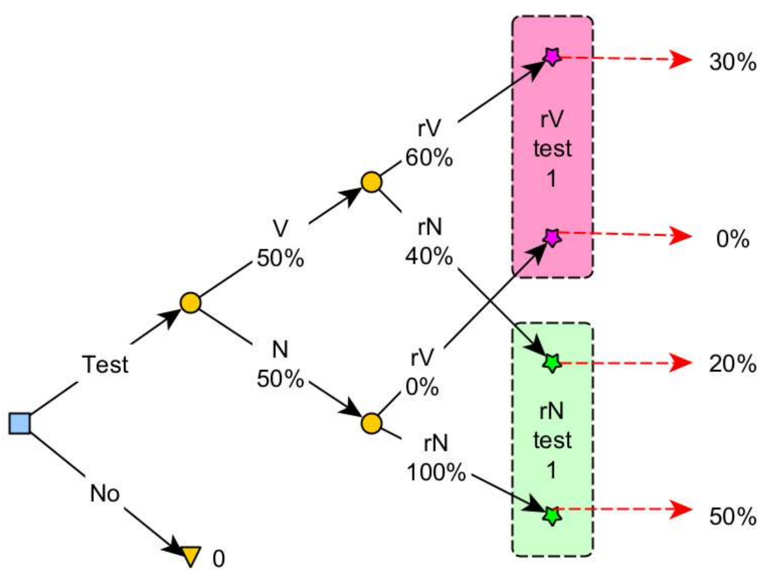
EV = 0.5*(-8) + 0.5*2 = -3

Adding a test:

Test performance:

40% chance of a false negative: sometimes rN when true condition is V

0% chance of a false positive: never rV when true condition is N



Stop if rV:

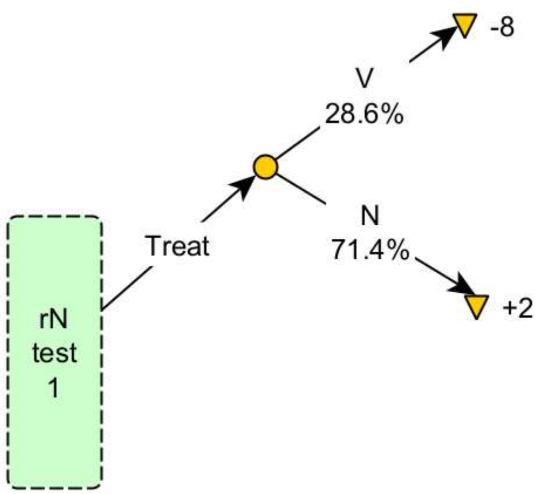
Probability of V given rV = 30%/(30%+0%) = 100%

Question: treat if rN?

Step 1: revised probability of V

Pr(rN) = 20% + 50% = 70%
Pr(V|rN) = 20%/70% = 28.6%

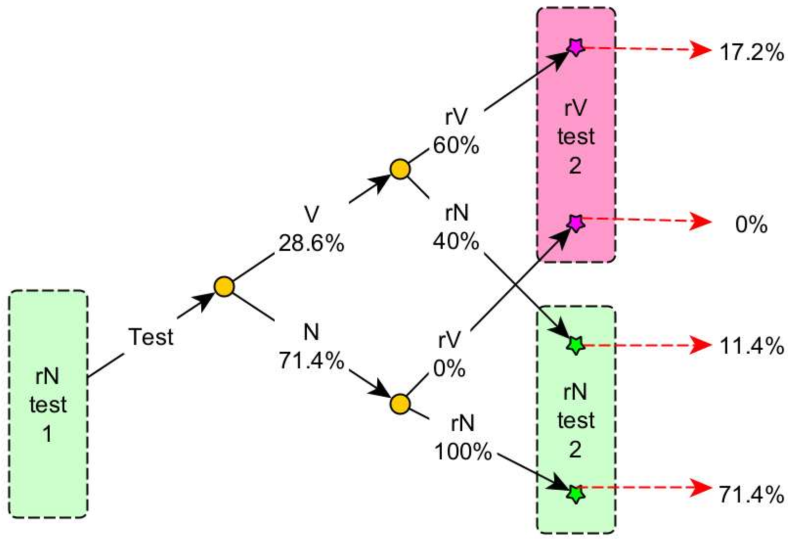
Step 2: decision to treat



EV = 0.286*(-8) + 0.714*2 = -0.86

Getting a second opinion: retesting if first test is rN

Extend tree beyond the test-1 rN information set:

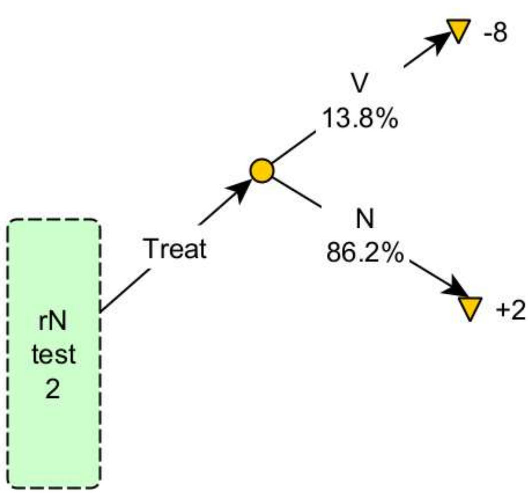


Treat if second rN?

Step 1: revised probability of V

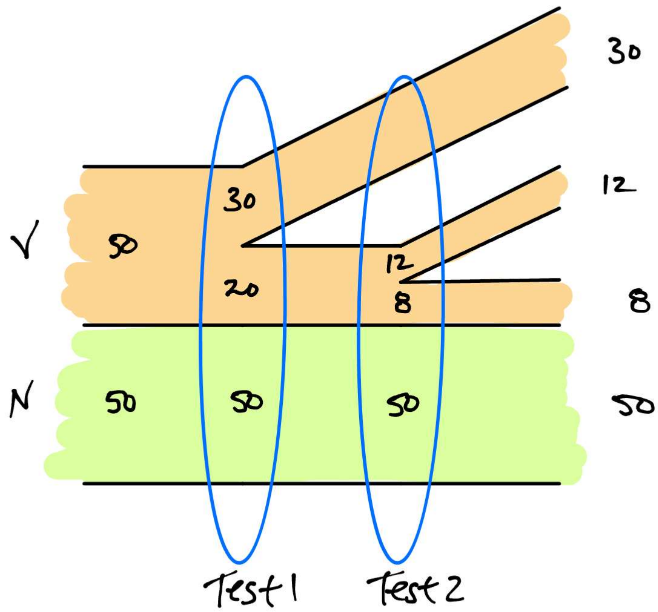
Pr(rN) = 11.4% + 71.4% = 82.8%
Pr(V|rN) = 11.4%/82.8% = 13.8%

Step 2: decision to treat



EV = 0.138*(-8) + 0.862*2 = 0.62

Intuition: repeated tests filter V people out of the pool:



Number of V people in pool after N tests: $50 * 0.4^N$