

# Dr. Chun's Numb3rs & Løgic

## *Russian Roulette*



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# Russian Roulette

"Let's play a game of **Russian roulette**. You are tied to your chair and can't get up. Here's a gun. Here's the barrel of the gun, **six chambers**, all empty.

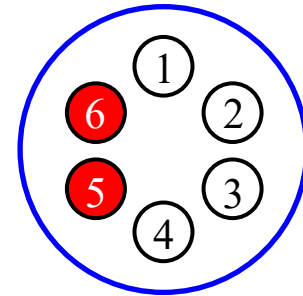
Now watch me as I put two bullets in the gun. See how I put them in **two** adjacent chambers? I close the barrel and spin it.

I put the gun to your head and pull the trigger. Click. You're still alive. Lucky you! Now, I'm going to pull the trigger one more time.

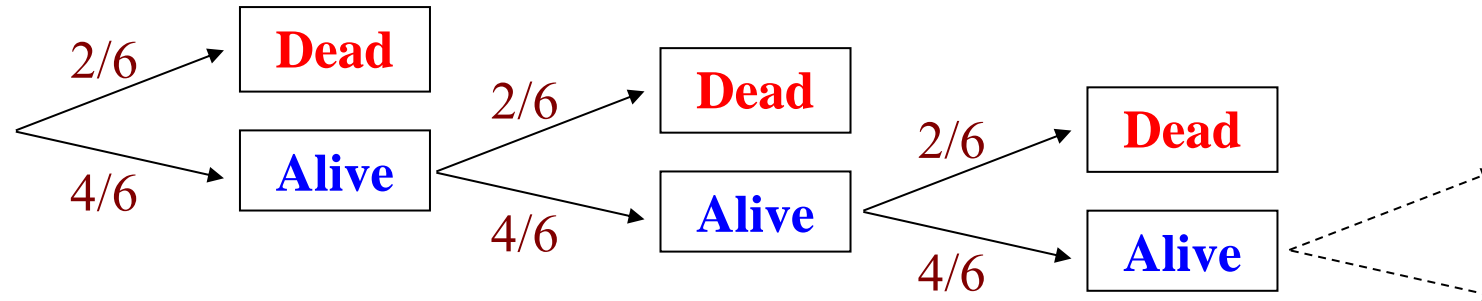
Which would you prefer, that **I spin the barrel first**, or that **I just pull the trigger?**"

- One of the **job interview questions** at **Microsoft**



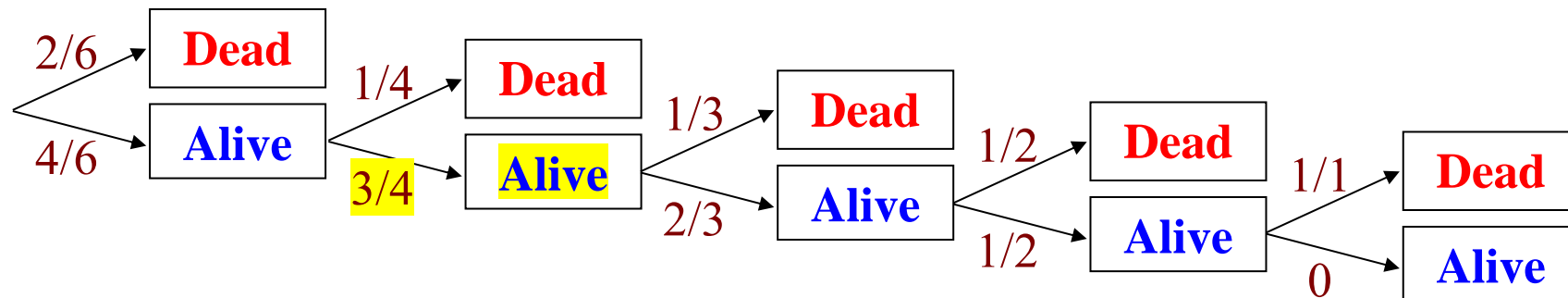


- **Case 1. Spin the Barrel Again**



$$P[\text{Alive next} | \text{Alive first}] = 4/6 = \underline{66.66\%}$$

- **Case 2. Just Pull the Trigger**

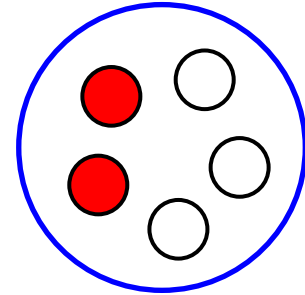


$$P[\text{Alive next} | \text{Alive first}] = 3/4 = \boxed{75\%}$$

## Variation #1



"two bullets in **six** chambers."  
=> "**five** chambers."



- **Case 1. Spin the Barrel Again**

$$P[\text{Alive next} | \text{Alive first}] = 3/5 = 60\%$$

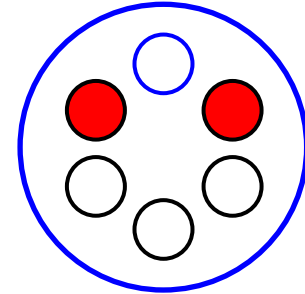
- **Case 2. Just Pull the Trigger**

$$P[\text{Alive next} | \text{Alive first}] = 2/3 = 66.66\%$$

## Variation #2



"put two bullets in two **adjacent** chambers."  
=> "**randomly** put two bullets in two chambers."



- **Case 1. Spin the Barrel Again**

$$P[\text{Alive next} | \text{Alive first}] = 4/6 = 66.66\%$$

- **Case 2. Just Pull the Trigger**

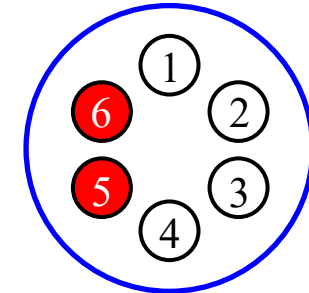
$$P[\text{Alive next} | \text{Alive first}] = C(4, 2)/C(5, 2) = 6/10 = 60\%$$

# Markov Chain



\* **State** = {1, 2, 3, 4, and 5&6}

\* **Stage** = the *i*th click

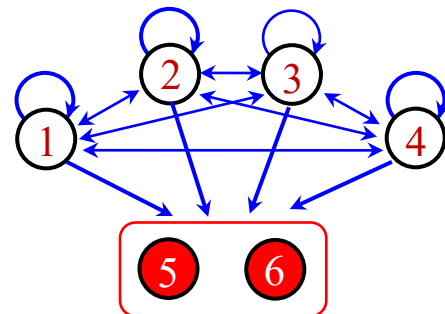


\* **Stage 1:** Click and survived:

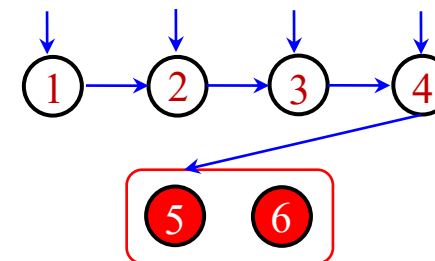
▪ Current **state**:  $\mathbf{q} = [0.25., 0.25, 0.25, 0.25, 0]$

\* **Stage 2:**

▪ **Case 1:** Spin and click



▪ **Case 2:** Click again





- **Case 1.** Spin and click

$$\mathbf{P} = \begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \& 6 \end{array} \begin{array}{ccccc} 1 & 2 & 3 & 4 & 5 \& 6 \\ \left[ \begin{array}{ccccc} 1/6 & 1/6 & 1/6 & 1/6 & 2/6 \\ 1/6 & 1/6 & 1/6 & 1/6 & 2/6 \\ 1/6 & 1/6 & 1/6 & 1/6 & 2/6 \\ 1/6 & 1/6 & 1/6 & 1/6 & 2/6 \\ 0 & 0 & 0 & 0 & 1 \end{array} \right]
 \end{array}$$

$$\mathbf{q} \mathbf{P} = [1/6, 1/6, 1/6, 1/6, \mathbf{2/6}]$$

- **Case 2.** Click again

$$\mathbf{P} = \begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \\ 5 \& 6 \end{array} \begin{array}{ccccc} 1 & 2 & 3 & 4 & 5 \& 6 \\ \left[ \begin{array}{ccccc} 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \\ 0 & 0 & 0 & 0 & 1 \end{array} \right]
 \end{array}$$

$$\mathbf{q} \mathbf{P} = [0, 0.25, 0.25, 0.25, \mathbf{0.25}]$$

$$\mathbf{M} = (\mathbf{I} - \mathbf{Q})^{-1} = \begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \end{array} \begin{array}{cccc} 1 & 2 & 3 & 4 \\ \left[ \begin{array}{cccc} 1.5 & 0.5 & 0.5 & 0.5 \\ 0.5 & 1.5 & 0.5 & 0.5 \\ 0.5 & 0.5 & 1.5 & 0.5 \\ 0.5 & 0.5 & 0.5 & 1.5 \end{array} \right] \Rightarrow \begin{array}{c} 1 \\ 2 \\ 3 \\ 4 \end{array} \left[ \begin{array}{c} 3 \\ 3 \\ 3 \\ 3 \end{array} \right]
 \end{array}$$

Average number of clicks = **3.0**

$$\mathbf{M} = (\mathbf{I} - \mathbf{Q})^{-1} = \begin{array}{c} \\ 1 \\ 2 \\ 3 \\ 4 \end{array} \begin{array}{cccc} 1 & 2 & 3 & 4 \\ \left[ \begin{array}{cccc} 1 & 1 & 1 & 1 \\ 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 0 & 1 \end{array} \right] \Rightarrow \begin{array}{c} 1 \\ 2 \\ 3 \\ 4 \end{array} \left[ \begin{array}{c} 4 \\ 3 \\ 2 \\ 1 \end{array} \right]
 \end{array}$$

Average number of clicks = **2.5**

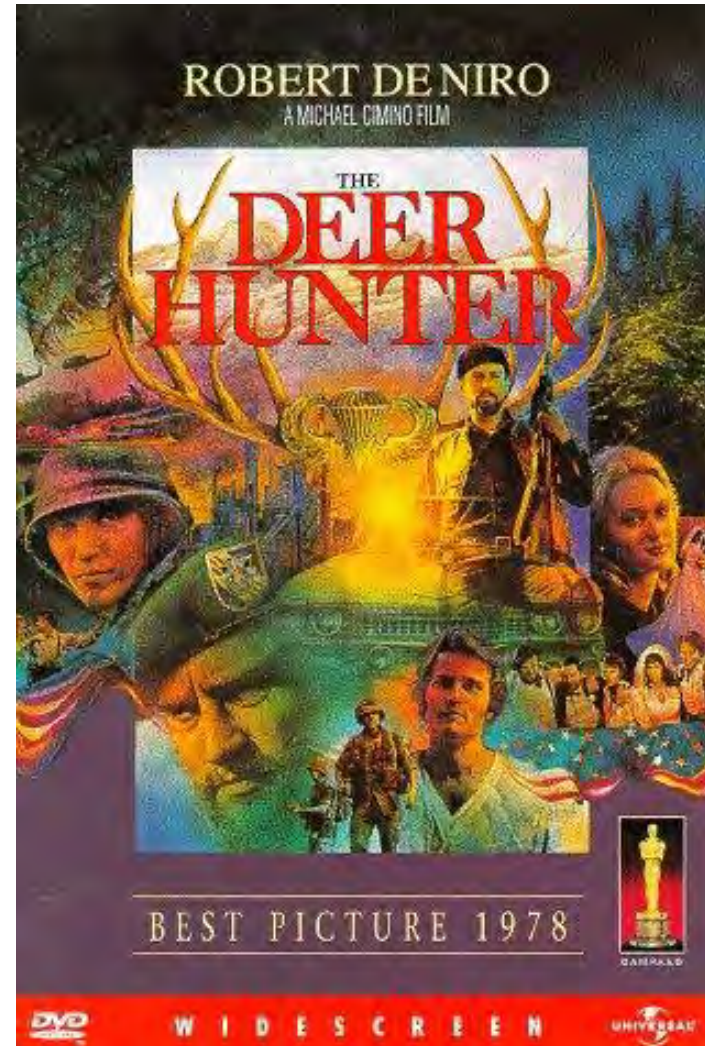
# Movie Trivia



An in-depth examination of the way that the [Vietnam War](#) affects the lives of people in a small industrial town in the USA.



# The Deer Hunter (1978)



An in-depth examination of the way that the **Vietnam War** affects the lives of people in a small industrial town in the USA.