

## Épreuve de section européenne

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### The game of squash.

In the game of squash, players gain “points” by winning “rallies<sup>1</sup>”. In the original scoring system of squash (known as *English scoring*), if the “server” wins a rally, he or she wins a point; otherwise the service changes hands with no point gained. In this text, we are going to follow those original rules.

Normally the game is won by the first player to reach 9 points – typically by 2 or more points. But if the score reaches 8-8 then the person due to receive serve can call "9" (in which case the first to reach 9 wins) or call "10" (in which case the first to reach 10 wins).

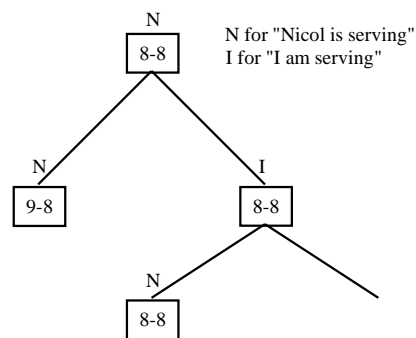
For example, I am playing against Barbara Wall, a former squash player from Australia, and we reach 8-8 with Barbara serving next; I call for a set in 10. I lose the first rally and the score reaches 8-9 in favor of my opponent. I win the next two rallies gaining the serve and one point; the game is now tied at 9-9. I am serving to win the game but my opponent wins this rally; I win the next one recovering the serve. I finally win the game after this serve.

I'm now playing a game against Nicol David, the Malaysian squash champion. I estimate that my chance of winning any particular rally against her, regardless of whether I serve or not, is  $p$ . The score gets to 8-8 and I am due to receive serve. Should I call "9" or "10"?

From the Nrich website.

### Questions

1. In the example given in the text (against Barbara Wall) how many rallies were needed after the 8-8 tie to finish the game ?
2. Explain how a squash game could go on forever.
3. If the probability that I win a rally is  $p$ , what is the probability that my opponent wins this rally ?
4. We suppose in this question, that in my game against Nicol,  $p = 0.4$  and I call 9 when the score is 8-8.
  - (a) Continue the tree started on the right of this text, adding probabilities on the branches. And prove that the probability that I win against Nicol in 3 rallies or less is 0.16.
  - (b) In this situation, the probability that Nicol wins is 0.744. Explain why the sum of the two probabilities is not equal to one.
5. Compute the probability of Nicol winning in 4 rallies or less.



Nicol's score is given first

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<sup>1</sup>rally : échange