

# THE STRICTLY SEQUENTIAL TOURNAMENT PROBLEM

(An introduction and a solution)

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*The problem is introduced and explained on page (1). Do not view page (2) if you wish to arrive at a solution independently.*

## (1) PROBLEM EXPLANATION

### INTRODUCTION

A street-fighting tournament is a competition between more than 2 fighters. In general, the competitors may be paired at the primary stage, and the winners of each battle are further paired until one victor emerges from the final fight. The *dimensionality of the tournament* refers to the highest number of fights occurring at a single level. For instance, in a certain tournament, 8 fighters are paired into 4 groups, so that the initial 4 winners are paired into 2 groups, and the last two winners compete for the title. In this case, there are 3 levels or stages and the tournament dimensionality is 4 (occurring at the first level). A *strictly sequential tournament (SST)* begins with only two fighters and the winner competes with the next fighter in their first fight, and the winner from this faces the next first-time fighter until the last one has been fought. The SST has a dimensionality of 1.

### FAIR OR UNFAIR STRICTLY SEQUENTIAL TOURNAMENTS

*In an unfair SST, fight winners earn 1 point per victory regardless of their fight history. A fighter who has been weakened by previous fights stands to gain the same 1 point as their opponent whose current fight is their first. The challenge is to design a set of scoring rules that reward loss or victory based on the competitors' fight history.*

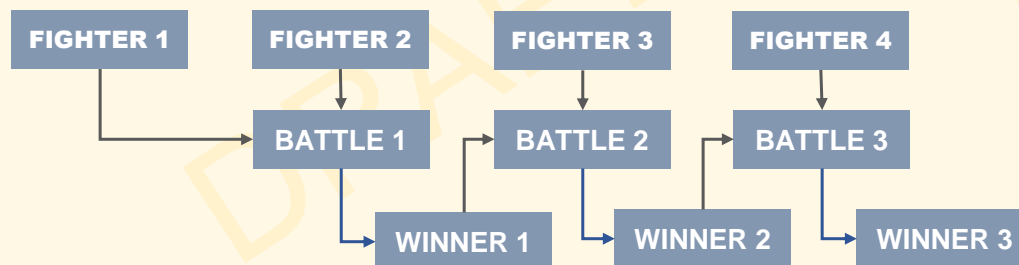
### DEFINITIONS

*Challenger: The first-time fighter.*

*Defender: Winner of the previous fight.*

### ILLUSTRATION

A flowchart illustrating the fight sequence for a strictly sequential tournament.



*Battle 1 is between Fighter 1 and Fighter 2; Battle 2 is between Fighter 3 and (Fighter 1 or Fighter 2); Battle 4 is between Fighter 4 and (Fighter 1 or Fighter 2 or Fighter 3).*

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THE STRICTLY SEQUENTIAL TOURNAMENT PROBLEM

(2) SOLUTION INTRODUCTION

SCORING RULES

|                                    |                                  |
|------------------------------------|----------------------------------|
| WINNER                             | LOSER                            |
| If defender: $+(1 \times h)$       | If defender: $-(1 \times (1/h))$ |
| If challenger: $+(1 \times (1/h))$ | If challenger: $-(1 \times h)$   |

DEFINITIONS

*h*: highest number of fights by any of the two opponents, including the current fight.

THE 'INVERTED BUTTERFLY' TABLE

The scoring rules are implemented for a 7-fighter tournament in the “inverted butterfly” table below.

|           |                |                |                |                |                |                |           |           |           |                |                |                |                |                |  |
|-----------|----------------|----------------|----------------|----------------|----------------|----------------|-----------|-----------|-----------|----------------|----------------|----------------|----------------|----------------|--|
|           | $-\frac{1}{2}$ | $-\frac{1}{3}$ | $-\frac{1}{4}$ | $-\frac{1}{5}$ | $-\frac{1}{6}$ | $-\frac{1}{6}$ | <b>F7</b> | +6        | +6        | +5             | +4             | +3             | +2             |                |  |
|           |                | $-\frac{1}{2}$ | $-\frac{1}{3}$ | $-\frac{1}{4}$ | $-\frac{1}{5}$ | $-\frac{1}{5}$ | <b>F6</b> | +5        | +5        | +4             | +3             | +2             |                |                |  |
|           |                |                | $-\frac{1}{2}$ | $-\frac{1}{3}$ | $-\frac{1}{4}$ | $-\frac{1}{4}$ | <b>F5</b> | +4        | +4        | +3             | +2             |                |                |                |  |
|           |                |                |                | $-\frac{1}{2}$ | $-\frac{1}{3}$ | $-\frac{1}{3}$ | <b>F4</b> | +3        | +3        | +2             |                |                |                |                |  |
|           |                |                |                |                | $-\frac{1}{2}$ | $-\frac{1}{2}$ | <b>F3</b> | +2        | +2        |                |                |                |                |                |  |
|           |                |                |                |                |                | -1             | <b>F2</b> | +1        |           |                |                |                |                |                |  |
|           |                |                |                |                | -1             |                | <b>F1</b> |           | +1        |                |                |                |                |                |  |
| <b>F7</b> | <b>F6</b>      | <b>F5</b>      | <b>F4</b>      | <b>F3</b>      | <b>F2</b>      | <b>F1</b>      | <b>0</b>  | <b>F1</b> | <b>F2</b> | <b>F3</b>      | <b>F4</b>      | <b>F5</b>      | <b>F6</b>      | <b>F7</b>      |  |
| -6        | -5             | -4             | -3             | -2             | -1             |                | <b>F1</b> |           | +1        | $+\frac{1}{2}$ | $+\frac{1}{3}$ | $+\frac{1}{4}$ | $+\frac{1}{5}$ | $+\frac{1}{6}$ |  |
| -6        | -5             | -4             | -3             | -2             |                | -1             | <b>F2</b> | +1        |           | $+\frac{1}{2}$ | $+\frac{1}{3}$ | $+\frac{1}{4}$ | $+\frac{1}{5}$ | $+\frac{1}{6}$ |  |
| -5        | -4             | -3             | -2             |                |                |                | <b>F3</b> |           |           |                | $+\frac{1}{2}$ | $+\frac{1}{3}$ | $+\frac{1}{4}$ | $+\frac{1}{5}$ |  |
| -4        | -3             | -2             |                |                |                |                | <b>F4</b> |           |           |                |                | $+\frac{1}{2}$ | $+\frac{1}{3}$ | $+\frac{1}{4}$ |  |
| -3        | -2             |                |                |                |                |                | <b>F5</b> |           |           |                |                |                | $+\frac{1}{2}$ | $+\frac{1}{3}$ |  |
| -2        |                |                |                |                |                |                | <b>F6</b> |           |           |                |                |                |                | $+\frac{1}{2}$ |  |
|           |                |                |                |                |                |                | <b>F7</b> |           |           |                |                |                |                |                |  |

**NOT THE END.**

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