

# Contrastive Search: How It Works

**Step 1: Get top-8 tokens by probability ( $\alpha=0.6$ )**

- city: 0.45
- town: 0.18
- area: 0.15
- place: 0.12

$$\text{score} = (1-\alpha) \times P(\text{token}) - \alpha \times \text{similarity}$$

$$\begin{aligned} \text{city: } 0.4 \times 0.45 - 0.6 \times 0.92 &= 0.372 \\ \text{town: } 0.4 \times 0.18 - 0.6 \times 0.75 &= 0.378 \\ \text{area: } 0.4 \times 0.15 - 0.6 \times 0.65 &= 0.330 \\ \text{place: } 0.4 \times 0.12 - 0.6 \times 0.60 &= 0.312 \end{aligned}$$

**Step 2: Compute similarity to recent context**

- Context: "the"
- city: 0.92 (cosine similarity)
  - town: 0.75 (cosine similarity)
  - area: 0.65 (cosine similarity)
  - place: 0.60 (cosine similarity)

**Winners: "town" (high prob, lower similarity)**

*Key Insight: Balance probability (coherence) with diversity (novelty)*

  $\alpha=0$ : Pure greedy |  $\alpha=0.6$ : Balanced |  $\alpha=1.0$ : Maximum diversity