Notes on Computability & Complexity

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May the force of P and NP be with you.

Contents

1 Basic concepts **1**

1.1 Representations 2

References **3**

Citation testing: [1]

One of the important scientific advances in the first half of the twentieth century was that the notion of "computation" received a much more precise definition.

At roughly 50 years (1970s – 2020s), complexity theory is still an infant science, and many important results are less than 30 years old.

1 Basic concepts

If S is a *finite* set, called *alphabet set*, then a *string* over S is a finite ordered tuple of elements from S.

We will typically consider the *binary* alphabet $2 = \{0, 1\}$.

$S^0 = \{\epsilon\}$

$S^* = \bigcup_{n\geq 0} S^n$ is the set of all strings over S.

The *concatenation* of strings x, y is denoted by $x^\frown y$, $x \circ y$, or simply xy.

x^k denotes the concatenation of k copies of x for $k \geq 1$. For example, 1^3 is '111'.

The length of a string x is denoted by $|x|$.

1.1 Representations

we implicitly identify any function f whose domain and range are not strings with the function

$$g\colon \{0,1\}^* \to \{0,1\}^*$$

that given a representation of an object x as input, outputs the representation of $f(x)$.

1.2 Big–Oh

References

[1] Sanjeev Arora and Boaz Barak. *Computational Complexity: A Modern Approach*. Cambridge: Cambridge University Press, 2009. xxiv+579. ISBN: 978-0-511-53381-5. URL: https://doi.org/10.1017/CBO9780511804090 (cit. on p. 1).