An example of uncountable set

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Abstract

This is an abstraction!

1 Countable set

Definition 1. A set is **countable** if it is either:

1. **Finite** (has a specific number of elements), or
2. **Countably infinite** (has the same "size" as the set of natural numbers $\mathbb{N}$, meaning its elements can be put into a one-to-one correspondence with $\mathbb{N}$).

$$\oint_{\partial S} P \ \mathrm{dx} + Q \ \mathrm{dy} = \iint_S \left(\frac{\partial Q}{\partial x} - \frac{\partial P}{\partial y} \right) \mathrm{dx} \ \ \mathrm{dy}\,.$$

2 An example of uncountable set

The proof is inspired by Rudin et al. 1953 Rudin (1953).

Theorem 1. *The set of real number $\mathbb{R}$ is uncountable.*

Proof. See Appendix A for detailed proof.

$\square$

2.1 Inline and displayed formulas

This is an inline $\alpha \neq \beta$. This is a text. The following is a displayed formula:

$$\alpha \neq \beta.$$

2.2 Aligned formula

By using the command `\align`:

$$\begin{aligned} f(x) &\leq \|g(x) - h(x)\| \\ &\leq \|g(x) - z(x)\| + \|z(x) - h(x)\|. \end{aligned} \tag{1}$$

By Equation (1), we have xxx.

Note that the command `\eqnarray` is abandoned by AMS.

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2.3 Equation reference

By using the command `\label` and `\eqref`:

$$a^2 + b^2 = c^2 \tag{2}$$

Equation (2) is the Pythagoras equation!

Note that if we use the command `\ref`, we get Equation 2.

3 Shortcuts of Liii STEM

3.1 Lego symbols

> and < is important

$$\alpha$$

is equivalent to

$$\rightarrow \Rightarrow \Leftrightarrow$$

`@` represents circle

$$\infty \oplus \otimes$$

3.2 Tab Cycling

$$\begin{bmatrix} \alpha & & \\ & \beta & \\ & & \gamma \end{bmatrix}$$

$$a \neq \beta, \quad \text{and} \quad \gamma \neq \theta.$$

$$\underset{x \in X}{\text{minimize}} \quad f(x)$$

$$s.t. \quad x - y \leq z.$$

$$\begin{aligned} \underset{x \in X}{\text{minimize}} \quad & f(x) \\ s.t. \quad & x - y \leq z. \end{aligned}$$

$$\left.\begin{array}{l} p \rightarrow q \\ q \rightarrow r \end{array}\right\} \Longrightarrow p \rightarrow r$$

Theorem 2.

$$G^T = f(G^{im}, G^{\mathrm{ai}}, T),$$

Definition 2.

$$G^T = f(G^{\mathrm{im}}, G^{\mathrm{ai}}, T),$$

4 Figures, tables, and algorithms

4.1 Figures

As shown in Fig. 1.

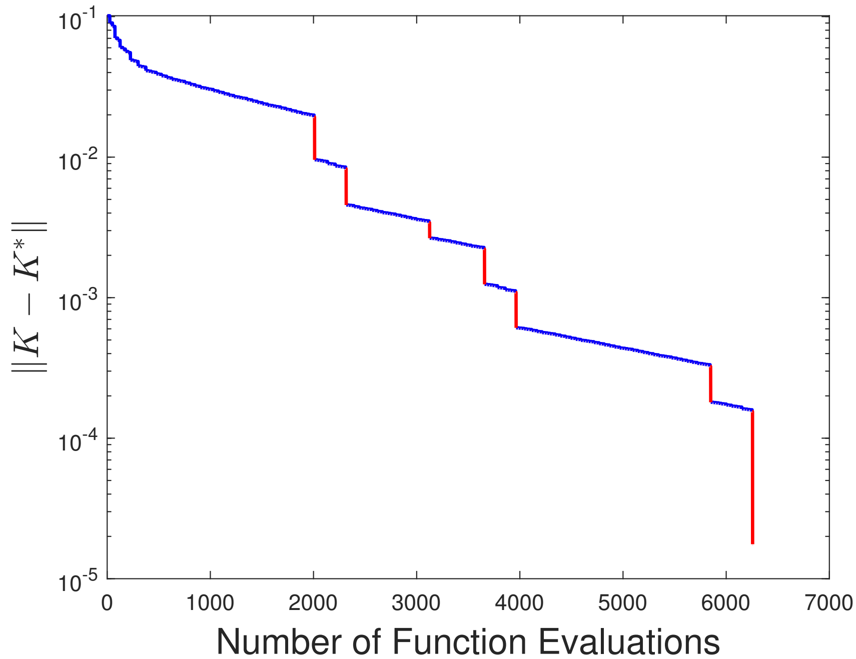
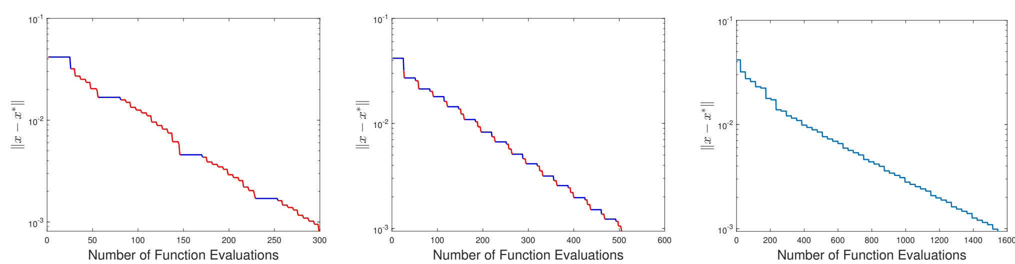


Figure 1: This is a figure



(a) (b) (c)

Figure 2

5 Tables

As shown in Line 2 of Table 1.

5.1 Algorithms

By Line 11 in Algo. 1.

Table 1: Contrastive Evaluation Results for different cost and synchronization interval

S	c_1	c_e		cifar10 (%)			SVHN (%)		
				m	e	differ.	m	e	differ.
sync.	1.0	0.25	$r(x) = $ LOCAL	74.8	82.8	**8.0**	90.1	93.2	**3.1**
			$r(x) = $ REMOTE	54.5	68.6	**14.1**	62.0	72.5	**10.5**
sync.	1.25	0.25	$r(x) = $ LOCAL	73.9	81.9	**8.0**	90.6	93.3	**2.7**
			$r(x) = $ REMOTE	54.5	67.7	**13.2**	61.2	72.8	**11.6**

Algorithm 1 Inference Phase of Stochastic Post-hoc Method When $q < q_1$

Input: Client Classifier m, Trained Rejector r^n, Trained Sever Classifier e^n, Input Sample x, Bounded reject rate q, empirical reject rate q_1.
Output: y

$p = q/q_1$
if $r(x) \leq 0$ **then**
  Sample i from $(0, 1)$ uniform distribution.
  if $i \leq p$ **then**
    $\hat{y} \leftarrow e^n(x)$
  else
    $\hat{y} \leftarrow m(x)$
  end if
else
  test
  $\hat{y} \leftarrow m(x)$
end if
return $\hat{y}$
while $x \geq 0$ **do**
  $x \leftarrow 1.$
end while

6 Citations

The problem is first solved by Li et al. Li and Han (2023).

It is well-known that the set of real number is uncountable Rudin (1953).

The problem is first solved by Li and Han (2023).

It is well-known that the set of real number is uncountable (Rudin, 1953).

By Li et al. (2024), we have xxxx.

7 Macros

$$\psi(x) \triangleq \int_3^x f(a)\mathrm{d}a \in \mathbb{R}\mathcal{D}$$

Stochastic Gradient Descent (SGD) is known for xxx.

SGD

SGD

Stochastic Gradient Descent (SGD)

References

Li, Y., Dong, Z., Luo, E., Wu, Y., Wu, S., and Han, S. (2024). When to trust your data: Enhancing dyna-style model-based reinforcement learning with data filter.

Li, Y. and Han, S. (2023). Solving Strongly Convex and Smooth Stackelberg Games Without Modeling the Follower.

Rudin, W. (1953). *Principles of Mathematical Analysis*. McGraw-Hill.

A Proof of Theorem 1

Proof. To prove that the set of real numbers is uncountable, we use Cantor's diagonal argument. Here are the key steps:

1. **Assume the contrary**: Suppose the interval $(0, 1)$ is countable. Then, there exists a bijection $f : \mathbb{N} \to (0, 1)$. This means we can list all real numbers in $(0, 1)$ as a sequence $r_1, r_2, r_3, \ldots$.

2. **Decimal expansions**: Each real number r_i in the list can be written in decimal form as:

$$r_1 = 0.d_{11}d_{12}d_{13}\ldots$$

$$r_2 = 0.d_{21}d_{22}d_{23}\ldots$$

$$r_3 = 0.d_{31}d_{32}d_{33}\ldots$$

   and so on, where d_{ij} is the j-th digit after the decimal point of r_i.

3. **Construct a new number**: Create a new number $x = 0.x_1x_2x_3\ldots$ where each digit x_i is chosen such that $x_i \neq d_{\text{ii}}$. To avoid issues with dual decimal representations (e.g., 0.999... = 1.000...), we can choose x_i to be 1 if d_{ii} is not 1, and 2 if d_{ii} is 1. This ensures x has a unique decimal expansion.

4. **Contradiction**: The number x differs from each r_i in the list at the i-th digit. Therefore, x is not in the list, contradicting the assumption that the list contains all real numbers in $(0, 1)$.

5. **Conclusion**: Since our assumption leads to a contradiction, the interval $(0, 1)$ must be uncountable. As $(0, 1)$ is a subset of $\mathbb{R}$, the set of all real numbers $\mathbb{R}$ is also uncountable.

$\square$

B Experiment details

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