Your Title

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Your name

Email: XXX@xxx.cuhk.edu.hk
Office: Pavilion of Harmony, CUHK

The Chinese University of Hong Kong

March 26, 2024

Outline

Outline

Cite and Footnote

Attention Is All You Need[1]

[1] Vaswani et al., “Attention is All you Need”, 2017.

Outline

Text and lists

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Text and lists

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- Time-dependent Schrödinger's equation:

$$i\hbar\frac{\partial}{\partial t}|\Psi(t)\rangle = \hat{H}|\Psi(t)\rangle$$

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- Mathematically, a function $f(x)$ is linear iff $f(u+v) = f(u) + f(v)$ and $f(cu) = cf(u)$.

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Figure

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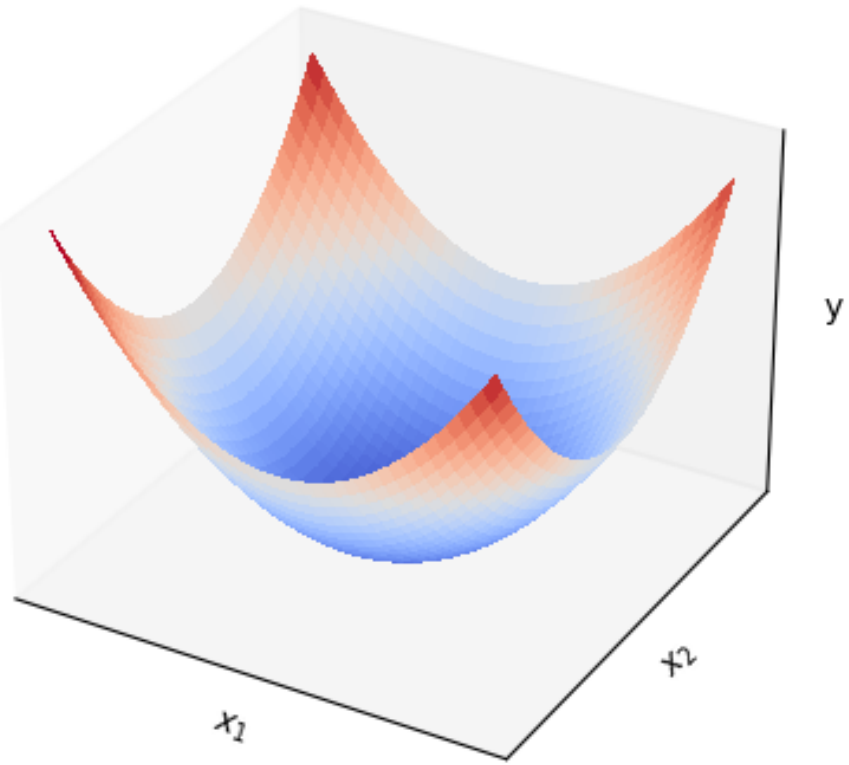

Figure 1: Convex Surface

Table

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Index	Areas (m^2)	Rent (HKD)
1	40	134072
2	92	182241
3	37	134731
4	124	204325
5	88	187375
...	...	...

Outline

Columns

1. Sed ut perspiciatis unde omnis iste natus error sit voluptatem accusantium doloremque laudantium.
2. Nemo enim ipsam voluptatem quia voluptas sit aspernatur aut odit aut fugit.
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Figure 2: Lenna

Code

Algorithm 1 An algorithm with caption

Require: $n \geq 0$
Ensure: $y = x^n$
$y \leftarrow 1$
$X \leftarrow x$
$N \leftarrow n$
while $N \neq 0$ **do**
  if N is even **then**
    $X \leftarrow X \times X$
    $N \leftarrow \frac{N}{2}$ ▷ This is a comment
  else if N is odd **then**
    $y \leftarrow y \times X$
    $N \leftarrow N - 1$
  end if
end while

Links

- Beamer (LaTex) - Wikipedia
- Please refer to page 2.
- https://en.wikipedia.org/wiki/Beamer_(LaTeX)

Footnote

- **Beamer** is a LaTeX document class for creating presentation slides, with a wide range of templates and a set of features for making slideshow effects. It supports pdfLaTeX, LaTeX + dvips, LuaLaTeX and XeLaTeX. The name is taken from the German word "Beamer" as a pseudo-anglicism for "video projector". [1]

[1] https://en.wikipedia.org/wiki/Beamer_(LaTeX)

Outline

Example

Example

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Theorem

$\mathbf{X}^T\mathbf{X}$ *is invertible* $\iff$ $\mathbf{X}$ *has linearly independent columns.*

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$\mathbf{X}^T\mathbf{X}$ *is invertible* $\iff$ $\mathbf{X}$ *has linearly independent columns.*

Proof.

Firstly, note that $\mathbf{X}^T\mathbf{X} \in \mathbf{R}^{n\times n}$. We denote $N(\mathbf{X})$ as the kernel (nullspace) of $\mathbf{X}$, and $R(\mathbf{X})$ as the range (column space) of $\mathbf{X}$.
We prove $\mathbf{X}^T\mathbf{X}$ and $\mathbf{X}$ share the same kernel such that once $N(\mathbf{X}) = 0$, $N(\mathbf{X}^T\mathbf{X}) = 0$ and vice versa. □

Proof

Proof.

1) Prove $N(\mathbf{X}) \subset N(\mathbf{X}^T\mathbf{X})$

$\forall v \in N(\mathbf{X})$, $\mathbf{X}^T\mathbf{X}v = \mathbf{X}^T 0 = 0$

$\implies v \in N(\mathbf{X}^T\mathbf{X}) \implies N(\mathbf{X}) \subset N(\mathbf{X}^T\mathbf{X})$.

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2) Prove $N(\mathbf{X}^T\mathbf{X}) \subset N(\mathbf{X})$
$\forall v \neq 0 \in N(\mathbf{X}^T\mathbf{X})$, $\mathbf{X}^T\mathbf{X}v = 0 \implies v \in N(\mathbf{X}^T)$ or $\mathbf{X}v \in N(\mathbf{X}^T)$.
However, we have $R(\mathbf{X}) \perp N(\mathbf{X}^T)$ and $\mathbf{X}v \in R(\mathbf{X})$,
$\implies \mathbf{X}v \perp N(\mathbf{X}^T) \implies \mathbf{X}v \notin N(\mathbf{X}^T) \implies v \in N(\mathbf{X}^T)$
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1), 2) $\implies \mathbf{N(X^T X) = N(X)}$ □

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References I

[1] Ashish Vaswani et al. "Attention is All you Need". In: *Advances in Neural Information Processing Systems*. Ed. by I. Guyon et al. Vol. 30. Curran Associates, Inc., 2017. URL: https://proceedings.neurips.cc/paper_files/paper/2017/file/3f5ee243547dee91fbd053c1c4a845aa-Paper.pdf.

Reference Links

- Overleaf Documentation
- Learn LaTeX in 30 Minutes
- LaTeX Beamer - Overleaf
- Beamer Presentations: A Tutorial for Beginners