Cognitive Science and Machine Learning

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Agenda

What is Cognitive Bias?

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Introduction

1. Bias created by human cognition
2. Has an active role in decision making
3. Not always logical
4. Notation: $B(q|p)$, How strongly one belives q occurs after observing p
5. $0 \leq B(q|p) \leq 1$

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What is Cognitive Bias?

Types of cognitive bias we use

- **Symmetry Bias**
  Example: 'If the weather was rainy, then the ground is wet'
  $\Longrightarrow$ 'Only if the ground is wet, then the weather was rainy a while ago' [**shi07**]
- **Mutual Exclusitivity Bias**
  Example: 'if you do not clean your room, then you will not be allowed to play'
  $\Longrightarrow$ 'If I clean up my room, then my mum will allow me to play' [**bar07**]

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What is Cognitive Bias?

Illogical bias

p: 'The shoe is white'
q: 'A star is printed on it'
$p \implies q$: 'If the shoe is white, then a star is printed on it' [**tan18**]

Symmetry Bias

$q \implies p$: 'If a star is printed on a shoe, then the shoe is white' [**tan18**]

Mutual Exclusitivity Bias

$\neg p \implies \neg q$: 'If the shoe is not white, then a star is not printed on it' [**tan18**]

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What is Cognitive Bias?

Properties and biases

- **Symmetry Bias (S)**: $B(q|p) \sim B(p|q)$
- **Mutual Exclusitivity Bias (MX)**: $B(q|p) \sim B(\neg q|\neg p)$
- **The law of excluded middle (XM)**: $B(q|p) \sim 1 - B(\neg q|p)$
- **Estimation relativity (ER)**: $B(q|p) \sim 1 - B(q|\neg p)$

Note: Adapted from “Cognitive Symmetry: Illogical but Rational Biases” by T. Takahashi, M. Nakano, and S. Shinohara, Symmetry Culture and Science. 21. 1-3 p. 7 [**tak10**]

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ML Implementation

ML Implementation

Interpretation

	q	$\neg q$
p	a	b
$\neg p$	c	d

	$L(x) = L(w^x)$	$L(x) \neq L(w^x)$
$L(w_i) = L(w^x)$	a	b
$L(w_i) \neq L(w^x)$	c	d

- x: sample
- w_i: ith prototype
- w_x: winner prototype of sample x
- $L(y)$: label of y

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ML Implementation

Updating learning rates

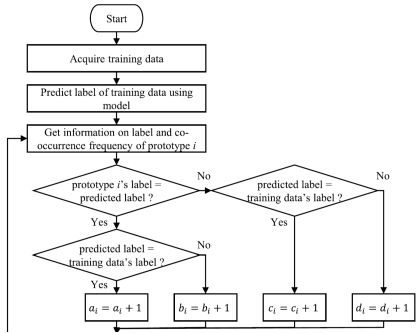

Figure: Learning rate update flowchart part 1

ML Implementation

Updating learning rates

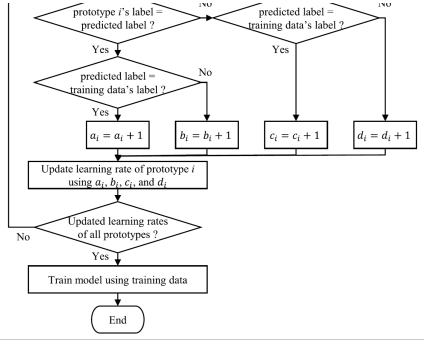

Figure: Learning rate update flowchart part 2

Anwendungshinweise

Was es zu beachten gilt

- Für die Verwendung in lokalen TeX-Distributionen oder auch Overleaf geeignet
- Verzeichnisstruktur für das Auffinden der Dateien notwendig
  - Funktionen und Aufbau auf mehrere Quelldateien verteilt
    - beamerthemehsmw.sty: Optionen, Pakete und Macros (lädt die restlichen Dateien)
    - beamerouterthemehsmw.sty: Allgemeine Layout-Einstellungen (Folientitel, Fußzeilen, ...)
    - beamerinnerthemehsmw.sty: Inhaltsbezogene Layout-Einstellungen (Titelseite, Aufzählungen, ...)
    - beamerfontthemehsmw.sty: Die verwendeten Schriftstile und -größen
    - beamercolorthemehsmw*.sty: Das spezifische Farbschema für die einzelnen Elemente (inkl. Fakultätsfarben)
  - Unterverzeichnis für zusätzliches Bildmaterial: ./figures/*

Besonderheiten

Eventuelle Probleme, die gar keine sind

- Bei überlangen (Unter-)Titeln auf der Titelseite und auf den Folien wird bei Bedarf die Schriftgröße heruntergesetzt
- Sie erhalten dafür eine Paket-Warnung in der Logdatei, die Sie darauf hinweist:

  "Package beamerinnerthemehsmw Warning: Font of text '*<text>*' is scaled down by a factor of *<factor>*"
- Sie können diese Texte ggf. anpassen, damit sie nicht skaliert werden müssen
- Sie können den Warnhinweis allerdings auch einfach ignorieren

Inhalte gestalten

Eine normale Folie mit Fließtext

... und einem Untertitel

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. $\sin^2(\alpha) + \cos^2(\beta) = 1$. If you read this text, you will get no information $E = mc^2$. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. $\sqrt[n]{a} \cdot \sqrt[n]{b} = \sqrt[n]{ab}$. This text should contain all letters of the alphabet and it should be written in of the original language. $\frac{\sqrt[n]{a}}{\sqrt[n]{b}} = \sqrt[n]{\frac{a}{b}}$. There is no need for special content, but the length of words should match the language. $a\sqrt[n]{b} = \sqrt[n]{a^n b}$.

Eine normale Folie vertikal zentriert

Unter Verwendung der Folien-Option: `\begin{frame}[c] ... \end{frame}`

Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. $\sin^2(\alpha) + \cos^2(\beta) = 1$. If you read this text, you will get no information $E = mc^2$. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. $\sqrt[n]{a} \cdot \sqrt[n]{b} = \sqrt[n]{ab}$. This text should contain all letters of the alphabet and it should be written in of the original language. $\frac{\sqrt[n]{a}}{\sqrt[n]{b}} = \sqrt[n]{\frac{a}{b}}$. There is no need for special content, but the length of words should match the language. $a\sqrt[n]{b} = \sqrt[n]{a^n b}$.

Eine normale Folie unten ausgerichtet

Unter Verwendung der Folien-Option: `\begin{frame}[b] ... \end{frame}`

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Eine Folie mit zwei Spalten

Einfache Mathematik: Mehr Spalten = mehr Platz

- First item in a list
  - First item in a list
    - First item in a list
    - Second item in a list
    - Third item in a list
  - Second item in a list
  - Third item in a list
- Second item in a list
- Third item in a list

- First item in a list
  - First item in a list
  - Second item in a list
  - Third item in a list
  - Fourth item in a list
- Second item in a list
- Third item in a list
- Fourth item in a list

Eine Folie mit zwei Spalten

Auch passend für Abbildungen

- First item in a list
  - First item in a list
    - First item in a list
    - Second item in a list
    - Third item in a list
  - Second item in a list
  - Third item in a list
- Second item in a list
- Third item in a list

Figure: Das Bild der Danke-Seite

Inhalte absolut positionieren

- Der Koordinatenursprung für ist die obere linke Ecke
- Koordinatensystem in Zentimetern, an Seitenverhältnis 16:9 ausgerichtet
  - $0 \leq x \leq 16$
  - $0 \leq y \leq 9$
- Verwendung von `begin{textblock}{breite}(x-pos, y-pos)`…

```
\begin{textblock}{5}(10, 4.5)
Inhalt
\end{textblock}
```

```
\begin{textblock}{15}(0.5, 6)
\hrule
\end{textblock}
```

Mehrere Folien mittels *Overlays*

Theorem

Es gibt keine “größte” Primzahl.

1. Angenommen p wäre die größte Primzahl.
2. Sei q das Produkt der ersten p Zahlen.
3. Dann ist $q + 1$ durch keine davon teilbar.
4. Aber $q + 1$ ist größer als 1 und daher durch eine Primzahl teilbar, die nicht in den ersten p Zahlen liegt.

Hinweis: Mathe ist super kompliziert!

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Benutzerdefinierte Anpassungen

Zusätzliche, beeinflussbare Macros

… und deren Abhängigkeiten (zur Feinabstimmung der eigenen Präsentation)

- Option hs, cb, … oder faculty=cb, me, … (Farbschema)
  - \insertfacultyicon (Titelseite)
  - \insertfacultyname (Option language) → \institute{\insertfacultyname}
- \insertthankyoutitle, \insertthankyoutext, \insertthankyousidebartext
  - \email → \insertemail
  - \phone → \insertmobilephone, \inserttelephone
  - \office → \insertoffice
  - \courseofstudies → \insertcourseofstudies
  - \additional → \insertadditionalsidebar, \insertadditional
- \setcurrentspeaker, \resetcurrentspeaker (\insertshortauthor)
  - Stern-Version (\setcurrentspeaker*) setzt zusätzlich Label (Option language)
  - \currentspeaker (\currentspeakerlabel) → \insertcurrentspeaker

FAQ

FAQ: Häufig gestellte Fragen

Hier ist noch Platz für Anwendungsfälle oder Antworten auf häufig gestellte Fragen

Es sind alle zum Testen und zur Übermittlung von konstruktivem Feedback eingeladen!

Bei Ideen, Wünschen, Anregungen, Fragen und auch Problemen:

- Offizielle LaTeX-GitLab-Gruppe der Hochschule Mittweida: git.hs-mittweida.de/hsmw-latex
- Kontaktieren Sie mich gern per E-Mail schildba@hs-mittweida.de
- Nutzen Sie einen der anderen verfügbaren Kommunikationskanäle

Bibliography I

Appendix

Zusätzliche Folien

Der Anhang zählt nicht mit zu den regulären Folien

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