Criando um Classificador

Saindo da zona de conforto

CPE XXX - Aprendizado de XXX

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August 12, 2025

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LSTM como baseline para NMT

- Encoder LSTM lê $(x_1, \ldots, x_n)$ e produz estados h_t; o contexto é o último estado $c = h_n$.
- Decoder LSTM gera $(y_1, \ldots, y_m)$ condicionado a c.

$$
\begin{aligned}
i_t &= \sigma(W_i x_t + U_i h_{t-1} + b_i), \quad f_t = \sigma(W_f x_t + U_f h_{t-1} + b_f), \\
o_t &= \sigma(W_o x_t + U_o h_{t-1} + b_o), \quad \tilde{c}_t = \tanh(W_c x_t + U_c h_{t-1} + b_c), \\
c_t &= f_t \odot c_{t-1} + i_t \odot \tilde{c}_t, \quad h_t = o_t \odot \tanh(c_t).
\end{aligned}
$$

- **Gargalo**: toda a informação comprimida em $c = h_n$.

Limitações do LSTM (motivação para atenção)

- Processamento **sequencial** ⇒ baixa paralelização.
- **Dependências longas** ainda são difíceis (mesmo com portas).
- **Gargalo do contexto** (vetor único) degrada qualidade em frases longas.

Atenção no encoder–decoder (Bahdanau/Luong)

Atenção aditiva (Bahdanau):

$$e_{ij} = v^\top \tanh\big(W_1 h_i + W_2 s_j\big), \quad \alpha_{ij} = \mathrm{softmax}_i(e_{ij}), \quad c_j = \sum_i \alpha_{ij} h_i.$$

Atenção multiplicativa (Luong):

$$e_{ij} = s_j^\top W h_i \quad \text{(general)}, \qquad e_{ij} = s_j^\top h_i \quad \text{(dot)}.$$

- Para gerar y_j, o decoder combina todos os h_i via pesos α_{ij} (alinhamento dinâmico).
- **Resolve o gargalo**, melhora frases longas e dá interpretabilidade (mapas de atenção).
- Ainda há recursão no decoder (processo sequencial).

Self-Attention: dependências em paralelo

$$\mathrm{Att}(Q,K,V) = \mathrm{softmax}\left(\frac{QK^\top}{\sqrt{d_k}}\right)V, \quad Q = XW_Q,\ K = XW_K,\ V = XW_V.$$

- Calcula relações *entre todos os tokens* da mesma sequência, **em paralelo**.
- Multi-head:

$$\mathrm{MHA}(X) = \mathrm{Concat}(H_1,\ldots,H_h)\,W_O, \quad H_r = \mathrm{softmax}\left(\frac{Q_r K_r^\top}{\sqrt{d_k}}\right)V_r.$$

- Comparativo: RNN/LSTM exige n passos sequenciais; self-attention faz um passo paralelo com custo $\mathcal{O}(n^2)$.

Attention Is All You Need: nascendo o Transformer

- **Remove** completamente a recorrência (sem LSTM).
- **Positional encodings** preservam ordem:

$$PE_{(pos,2i)} = \sin\left(\frac{pos}{10000^{2i/d_{\text{model}}}}\right), \quad PE_{(pos,2i+1)} = \cos\left(\frac{pos}{10000^{2i/d_{\text{model}}}}\right).$$

- Cada **bloco Transformer** (pré-norm, forma comum):

$$Y = X + \mathrm{MHA}(\mathrm{LN}(X)),$$
$$Z = Y + \mathrm{FFN}(\mathrm{LN}(Y)), \quad \mathrm{FFN}(u) = W_2\,\phi(W_1 u + b_1) + b_2,$$

- Empilha-se vários blocos de atenção+FFN $\Rightarrow$ **arquitetura Transformer**.

Máscara causal e síntese da evolução

Máscara causal (para LMs) impede olhar o futuro:

$$\mathrm{softmax}\left(\frac{QK^\top}{\sqrt{d_k}} + M\right), \quad M_{ij} = \begin{cases} 0, & j \le i \\ -\infty, & j > i \end{cases}$$

Linha do tempo (síntese):

- LSTM encoder–decoder: contexto único $c = h_n$ (gargalo).
- LSTM + **atenção** (Bahdanau/Luong): alívio do gargalo.
- **Self-attention**: dependências longas em paralelo.
- **Transformer**: atenção + posição + FFN; várias camadas empilhadas; sem LSTM.

This template is a based on SINTEF Presentation from Federico Zenith and its derivation Beamer-LaTeX-Themes from Liu Qilong and Andrea Gasparini

In the following you find a brief introduction on how to use LaTeX and the beamer package to prepare slides, based on the one written by Federico Zenith for SINTEF Presentation

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Beamer for SINTEF slides

2 Introduction

- We assume you can use LaTeX; if you cannot, you can learn it here
- Beamer is one of the most popular and powerful document classes for presentations in LaTeX
- Beamer has also a detailed user manual
- Here we will present only the most basic features to get you up to speed

Beamer vs. PowerPoint

Compared to PowerPoint, using LaTeX is better because:

- It is not What-You-See-Is-What-You-Get, but What-You-*Mean*-Is-What-You-Get: you write the content, the computer does the typesetting
- Produces a `pdf`: no problems with fonts, formulas, program versions
- Easier to keep consistent style, fonts, highlighting, etc.
- Math typesetting in TeX is the best:

$$\mathrm{i}\,\hbar\frac{\partial}{\partial t}\Psi(\mathbf{r},t) = -\frac{\hbar^2}{2\,m}\nabla^2\Psi(\mathbf{r},t) + V(\mathbf{r})\Psi(\mathbf{r},t)$$

Getting Started

Selecting the SINTEF Theme

To start working with `sintefbeamer`, start a LaTeX document with the preamble:

Minimum SINTEF Beamer Document

```
\documentclass{beamer}
\usetheme{sintef}
\begin{document}
\begin{frame}{Hello, world!}
\end{frame}
\end{document}
```

Title page

2 Introduction

To set a typical title page, you call some commands in the preamble:

The Commands for the Title Page

```
\title{Sample Title}
\subtitle{Sample subtitle}
\author{First Author, Second Author}
\date{\today} % Can also be (ab)used for conference name &c.
```

You can then write out the title page with `\maketitle`.
To set a **background image** use the `\titlebackground` command before `\maketitle`; its only argument is the name (or path) of a graphic file.
If you use the **starred version** `\titlebackground*`, the image will be clipped to a split view on the right side of the title slide.

Writing a Simple Slide

It's really easy!

- A typical slide has bulleted lists

Writing a Simple Slide

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- A typical slide has bulleted lists
- These can be uncovered in sequence

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Code for a Page with an Itemised List

```
\begin{frame}{Writing a Simple Slide}
  \framesubtitle{It's really easy!}
  \begin{itemize}[<+->]
    \item A typical slide has bulleted lists
    \item These can be uncovered in sequence
  \end{itemize}\end{frame}
```

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Changing Slide Style

3 Personalization

- You can select the white or *maincolor* **slide style** *in the preamble* with `\themecolor{white}` (default) or `\themecolor{main}`
  - You should *not* change these within the document: Beamer does not like it
  - If you *really* must, you may have to add `\usebeamercolor[fg]{normal text}` in the slide
- You can change the **footline colour** with `\footlinecolor{color}`
  - Place the command *before* a new `frame`
  - There are four "official" colors: `maincolor`, `sintefyellow`, `sintefgreen`, `sintefdarkgreen`
  - Default is no footline; you can restore it with `\footlinecolor{}`
  - Others may work, but no guarantees!
  - Should *not* be used with the `maincolor` theme!

Standard Blocks

These have a color coordinated with the footline (and grey in the blue theme)

```
\begin{block}{title}
content...
\end{block}
```

Colour Blocks

Similar to the ones on the left, but you pick the colour. Text will be white by default, but you may set it with an optional argument.

```
\begin{colorblock}[black]{sinteflightgreen}{title}
content...
\end{colorblock}
```

The "official" colours of colour blocks are: `sinteflilla`, `maincolor`, `sintefdarkgreen`, and `sintefyellow`.

Using Colours

3 Personalization

- You can use colours with the `\textcolor{<color name>}{text}` command
- The colours are defined in the `sintefcolor` package:
  - Primary colours: `maincolor` and its sidekick `sintefgrey`
  - Three shades of green: `sinteflightgreen`, `sintefgreen`, `sintefdarkgreen`
  - Additional colours: `sintefyellow`, `sintefred`, `sinteflilla`
    - These may be shaded—see the `sintefcolor` documentation or the SINTEF profile manual
- Do *not* abuse colours: `\emph{}` is usually enough
- Use `\alert{}` to bring the focus somewhere

Using Colours

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    - These may be shaded—see the `sintefcolor` documentation or the SINTEF profile manual
- Do *not* abuse colours: `\emph{}` is usually enough
- Use `\alert{}` to bring the focus somewhere
- If you highlight too much, you don't highlight at all!

Adding images

3 Personalization

Adding images works like in normal LaTeX:

Code for Adding Images

```
\usepackage{graphicx}
% ...
\includegraphics[width=\textwidth]
{assets/logo_RGB}
```

Splitting in Columns

Splitting the page is easy and common; typically, one side has a picture and the other text:

This is the first column

And this the second

Column Code

```
\begin{columns}
    \begin{column}{0.6\textwidth}
        This is the first column
    \end{column}
    \begin{column}{0.3\textwidth}
        And this the second
    \end{column}
    % There could be more!
\end{columns}
```

Special Slides

3 Personalization

- Chapter slides
- Side-picture slides

Chapter slides

3 Personalization

- Similar to `frames`, but with a few more options
- Opened with `\begin{chapter}[<image>]{<color>}{<title>}`
- Image is optional, colour and title are mandatory
- There are seven “official” colours: `maincolor`, `sintefdarkgreen`, `sintefgreen`, `sinteflightgreen`, `sintefred`, `sintefyellow`, `sinteflilla`.
  - Strangely enough, these are *more* than the official colours for the footline.
  - It may still be a nice touch to change the footline of following slides to the same color of a chapter slide. Your choice.
- Otherwise, `chapter` behaves just like `frame`.

Side-Picture Slides

3 Personalization

- Opened with `\begin{sidepic}{<image>}{<title>}`
- Otherwise, `sidepic` works just like `frame`

Fonts

3 Personalization

- The paramount task of fonts is being readable
- There are good ones...
  - Use serif fonts only with high-definition projectors
  - Use sans-serif fonts otherwise (or if you simply prefer them)
- ... and not so good ones:
  - `Never use monospace for normal text`
  - Gothic, calligraphic or weird fonts: should always: be avoided

Look

3 Personalization

- To insert a final slide with the title and final thanks, use `\backmatter`.
  - The title also appears in footlines along with the author name, you can change this text with `\footlinepayoff`
  - You can remove the title from the final slide with `\backmatter[notitle]`
- The aspect ratio defaults to 16:9, and you should not change it to 4:3 for old projectors as it is inherently impossible to perfectly convert a 16:9 presentation to 4:3 one; spacings *will* break
  - The `aspectratio` argument to the `beamer` class is overridden by the SINTEF theme
  - If you *really* know what you are doing, check the package code and look for the `geometry` class.

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Good Luck!

4 Summary

- Enough for an introduction! You should know enough by now
- If you have corrections or suggestions, send them to me!

Exemplo de Referência Bibliográfica

4 Summary

- Estou usando aqui [1]

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Referências Bibliográficas

5 Referências Bibliográficas

[1] N. N. de Moura; J. M. de Seixas; Ricardo Ramos, “Passive sonar signal detection and classification based on independent component analysis,” in *Sonar Systems* (N. Kolev, ed.), InTech, 2011.

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Obrigado pela Atenção!
Alguma Pergunta?

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