

# $\text{\LaTeX}$ -cursus Week 2 (slides: versie Vincent)

$\text{\TeX}$ niCie

3 oktober 2022

Slides zijn te vinden op  
[texnicie.nl](https://texnicie.nl)

# Agenda

- ▶ Document & referenties
- ▶ 'Theorem' en 'Lemma'
- ▶ ⟨Oefeningen!⟩
- ▶ Figuren
- ▶ Matrices en tabellen
- ▶ ⟨Oefeningen!⟩

# Pagina marges

```
\documentclass{article}
\usepackage[utf8]{inputenc}

\title{My document}
\author{Vincent Kuhlmann}
\date{1 May 2021}

\begin{document}
  \maketitle
  \section{Introduction}

  Hallo iedereen!
\end{document}
```



My document  
Vincent Kuhlmann  
1 May 2021

**1 Introduction**  
*Hallo iedereen!*

1

# Pagina marges

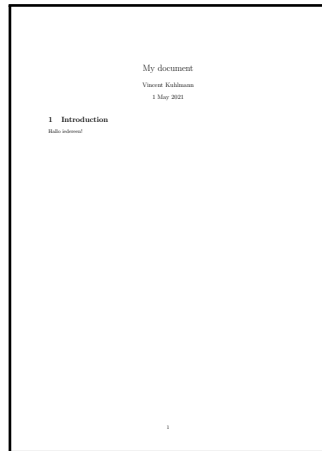
```
\documentclass{article}
\usepackage[utf8]{inputenc}
\usepackage[a4paper,margin=2.54cm]{geometry}
```

```
\title{My document}
\author{Vincent Kuhlmann}
\date{1 May 2021}
```

```
\begin{document}
  \maketitle
  \section{Introduction}
```

Hallo iedereen!

```
\end{document}
```



# Pagina marges

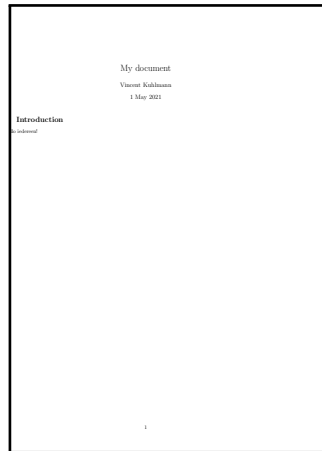
```
\documentclass{article}
\usepackage[utf8]{inputenc}
\usepackage[a4paper,margin=2.54cm,left=-0.5cm]{geometry}
```

```
\title{My document}
\author{Vincent Kuhlmann}
\date{1 May 2021}
```

```
\begin{document}
  \maketitle
  \section{Introduction}
```

Hallo iedereen!

```
\end{document}
```



# Inhoudsopgave

```
\begin{document}
  \maketitle
  \tableofcontents

  \section{AA}
  ...
\end{document}
```

## Contents

|          |              |          |
|----------|--------------|----------|
| <b>1</b> | <b>AA</b>    | <b>1</b> |
| <b>2</b> | <b>BB</b>    | <b>2</b> |
| 2.1      | CC . . . . . | 2        |
| 2.1.1    | DD . . . . . | 2        |
| 2.2      | EE . . . . . | 2        |
| <b>3</b> | <b>FF</b>    | <b>2</b> |
| 3.0.1    | GG . . . . . | 2        |

## 1 AA

Lorem ipsum dolor sit amet, consectetur adipiscing elit.

# Inhoudsopgave

```
\begin{document}
  \maketitle
  \tableofcontents
  \newpage

  \section{AA}
  ...
\end{document}
```

## Contents

|          |              |          |
|----------|--------------|----------|
| <b>1</b> | <b>AA</b>    | <b>2</b> |
| <b>2</b> | <b>BB</b>    | <b>2</b> |
| 2.1      | CC . . . . . | 2        |
| 2.1.1    | DD . . . . . | 2        |
| 2.2      | EE . . . . . | 2        |
| <b>3</b> | <b>FF</b>    | <b>2</b> |
| 3.0.1    | GG . . . . . | 2        |

# Inhoudsopgave

```
\usepackage[dutch]{babel}
```

```
...
```

```
\begin{document}
```

```
  \maketitle
```

```
  \tableofcontents
```

```
  \newpage
```

```
  \section{AA}
```

```
  ...
```

```
\end{document}
```

## Inhoudsopgave

|          |              |          |
|----------|--------------|----------|
| <b>1</b> | <b>AA</b>    | <b>2</b> |
| <b>2</b> | <b>BB</b>    | <b>2</b> |
| 2.1      | CC . . . . . | 2        |
| 2.1.1    | DD . . . . . | 2        |
| 2.2      | EE . . . . . | 2        |
| <b>3</b> | <b>FF</b>    | <b>2</b> |
| 3.0.1    | GG . . . . . | 2        |



# Vincent's favorite package: `\usepackage[bookmarksnumbered]{hyperref}`

The screenshot shows a PDF viewer interface. On the left is a table of contents with the following structure:

- Preface
- ▼ Introduction
  - Hilbert and the Motivation for Logic
  - What Is to Be Found in This Book?
- Contents
- ▼ 1 Sets
  - ▼ 1.1 Cardinal Numbers
    - 1.1.1 The Continuum Hypothesis
  - 1.2 The Axiom of Choice
  - 1.3 Partially Ordered Sets and Zorn's Lemma
  - 1.4 Well-Ordered Sets
  - 1.5 Principles Equivalent to the Axiom of Choice
- ▼ 2 Models
  - 2.1 Rings and Orders: Examples
  - ▼ 2.2 Languages of First-Order Logic
    - 2.2.1 Free and Bound Variables
    - 2.2.2 Legitimate Substitutions
    - 2.2.3 First-Order Logic and Other Kinds of Logic
  - ▼ 2.3 Structures for First-Order Logic
    - 2.3.1 Validity and Equivalence of Formulas
  - ▼ 2.4 Examples of Languages and Structures

The main content area shows page 69 (83 of 151) with a zoom level of 150%. The text on the page is as follows:

and  $a = a_1, \dots, a_n$  and  $b = b_1, \dots, b_n$  tuples of elements of  $M$  and  $N$ , respectively. Write  $\vec{a} \equiv_{\Gamma} \vec{b}$  if for every formula  $\phi(x_1, \dots, x_n)$  from  $\Gamma$  we have:

$$M \models \phi(a_1, \dots, a_n) \Leftrightarrow N \models \phi(b_1, \dots, b_n).$$

We shall apply this for  $\Gamma$  the set of quantifier-free  $L$ -formulas and for  $L$  simple  $L$ -formulas; in which case we write  $\vec{a} \equiv_{\text{qf}} \vec{b}$ ,  $\vec{a} \equiv_{\text{simple}} \vec{b}$ , respectively.

**Lemma 2.7.4** *Let  $L$  be an arbitrary language. Suppose that an  $L$ -theory  $T$  has the following property:*

Whenever  $M$  and  $N$  are models of  $T$ , and  $\vec{a} = a_1, \dots, a_n$ ,  $\vec{b} = b_1, \dots, b_n$  tuples of elements of  $M$  and  $N$ , respectively, then  $\vec{a} \equiv_{\text{qf}} \vec{b}$  implies  $\vec{a} \equiv \vec{b}$ .

*Then  $T$  has quantifier elimination.*

**Proof.** Assume that  $T$  has the property in the statement of the Lemma 2.7.2 we have to show that every simple  $L$ -formula is  $T$ -equivalent to a quantifier-free formula in the same free variables. So, let  $\exists v \phi(v, \vec{w})$  be a formula, with  $\vec{w} = w_1, \dots, w_n$  the free variables. Let  $\vec{c} = c_1, \dots, c_n$  constants; we write  $L_{\vec{c}}$  for  $L \cup \{c_1, \dots, c_n\}$ .

Let  $\Gamma$  be the set of all quantifier-free  $L$ -formulas  $\psi(\vec{w})$  such that

$$T \models (\exists v \phi(v, \vec{c})) \rightarrow \psi(\vec{c})$$

# Referenties

De oplossing van de differentiaalvergelijking  $\frac{dv}{dt} = \cos^2(t)$  is

$$\begin{aligned}v(t) &= v_0 + \int_0^t \cos^2(t) dt \\&= v_0 + \int_{t'=0}^{t'=t} \left( \frac{1}{2} \cos^2(t') + \frac{1}{2} (1 - \sin^2(t')) \right) dt' \\&= v_0 + \frac{1}{2} \int_{t'=0}^{t'=t} \left( 1 + \cos^2(t') - \sin^2(t') \right) dt' \\&= v_0 + \frac{1}{2} \int_{t'=0}^{t'=t} \left( 1 + \cos(2t') \right) dt' \\&= v_0 + \frac{1}{4} \int_{2t'=0}^{2t'=2t} \left( 1 + \cos(2t') \right) d(2t') \\&= v_0 + \frac{1}{4} \left( 2t + \sin(2t) \right) \\&= v_0 + \frac{t}{2} + \frac{1}{4} \sin(2t)\end{aligned}$$

# Referenties

De oplossing van de differentiaalvergelijking  $\frac{dv}{dt} = \cos^2(t)$  is

$$\begin{aligned}
 v(t) &= v_0 + \int_0^t \cos^2(t) dt \\
 &= v_0 + \int_{t'=0}^{t'=t} \left( \frac{1}{2} \cos^2(t') + \frac{1}{2} (1 - \sin^2(t')) \right) dt' \\
 &= v_0 + \frac{1}{2} \int_{t'=0}^{t'=t} (1 + \cos^2(t') - \sin^2(t')) dt' \\
 &= v_0 + \frac{1}{2} \int_{t'=0}^{t'=t} (1 + \cos(2t')) dt' \\
 &= v_0 + \frac{1}{4} \int_{2t'=0}^{2t'=2t} (1 + \cos(2t')) d(2t') \\
 &= v_0 + \frac{1}{4} (2t + \sin(2t)) \\
 &= v_0 + \frac{t}{2} + \frac{1}{4} \sin(2t)
 \end{aligned}$$

De oplossing van de differentiaalvergelijking  $\frac{dv}{dt} = \cos^2(t)$  is

$$v(t) = v_0 + \int_0^t \cos^2(t) dt. \quad (1)$$

De cosinus verdubbelingsformule is

$$\begin{aligned}
 \cos(2t) &= \cos^2(t) - \sin^2(t) \\
 &= 2 \cos^2(t) - 1.
 \end{aligned}$$

Beide leden integreren geeft

$$\frac{1}{2} \sin(2t) = \left( 2 \int_0^t \cos^2(t') dt' \right) - t.$$

Hiermee vinden we (1) als

$$v(t) = v_0 + \frac{t}{2} + \frac{1}{4} \sin(2t).$$

# Referenties

De oplossing van de differentiaalvergelijking

```
$ \frac{\dif v}{\dif t} = \cos^2(t) $ is
\begin{align}
v(t) &= v_0 + \int_0^t \cos^2(t) \dif t.
\end{align}
```

...

Hiermee vinden we (1) als

```
\begin{align*}
v(t) &= v_0 + \frac{t}{2} \\
&+ \frac{1}{4} \sin(2t).
\end{align*}
```

De oplossing van de differentiaalvergelijking  $\frac{dv}{dt} = \cos^2(t)$  is

$$v(t) = v_0 + \int_0^t \cos^2(t) dt. \quad (1)$$

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# Referenties

De snelheid  $v$  is gedefinieerd als

```
\begin{align}
v &:= \dfrac{dx}{dt}
\end{align}
```

De oplossing van de differentiaalvergelijking

```
 $\frac{dv}{dt} = \cos^2(t)$  is
```

```
\begin{align}
v(t) &= v_0 + \int_0^t \cos^2(t) dt.
\end{align}
```

...

Hiermee vinden we (1) als

```
\begin{align*}
v(t) &= v_0 + \frac{t}{2} \\
&+ \frac{1}{4} \sin(2t).
\end{align*}
```

De snelheid  $v$  is gedefinieerd als

$$v := \frac{dx}{dt} \quad (1)$$

De oplossing van de differentiaalvergelijking  $\frac{dv}{dt} = \cos^2(t)$  is

$$v(t) = v_0 + \int_0^t \cos^2(t) dt. \quad (2)$$

De cosinus verdubbelingsformule is

$$\begin{aligned} \cos(2t) &= \cos^2(t) - \sin^2(t) \\ &= 2\cos^2(t) - 1. \end{aligned}$$

Beide leden integreren geeft

$$\frac{1}{2} \sin(2t) = \left( 2 \int_0^t \cos^2(t') dt' \right) - t.$$

Hiermee vinden we (1) als

$$v(t) = v_0 + \frac{t}{2} + \frac{1}{4} \sin(2t).$$

# Referenties

De snelheid  $v$  is gedefinieerd als

```
\begin{align}
v &:= \dfrac{dx}{dt}
\end{align}
```

De oplossing van de differentiaalvergelijking

```
 $\frac{dv}{dt} = \cos^2(t)$  is
```

```
\begin{align}
v(t) &= v_0 + \int_0^t \cos^2(t) dt.
\label{eq:exprVelocity}
\end{align}
```

...

Hiermee vinden we ([\ref{eq:exprVelocity}](#)) als

```
\begin{align*}
v(t) &= v_0 + \frac{t}{2} \\
&\quad + \frac{1}{4} \sin(2t).
\end{align*}
```

De snelheid  $v$  is gedefinieerd als

$$v := \frac{dx}{dt} \quad (1)$$

De oplossing van de differentiaalvergelijking  $\frac{dv}{dt} = \cos^2(t)$  is

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$$\frac{1}{2} \sin(2t) = \left( 2 \int_0^t \cos^2(t') dt' \right) - t.$$

Hiermee vinden we (2) als

$$v(t) = v_0 + \frac{t}{2} + \frac{1}{4} \sin(2t).$$

# 'Theorem' en 'Lemma': Gebruik

```
\usepackage{amsthm}
\newtheorem{theorem}{Stelling}
\newtheorem{lemma}[theorem]{Lemma}
...

\begin{lemma}
  Lorem ipsum dolor sit
  ... eget dolor.

  \begin{proof}
    Aenean massa. Cum
    ... quis enim.
  \end{proof}
\end{lemma}
```

**Lemma 1.9.** *Lorem ipsum dolor sit amet, consectetur adipiscing elit. Aenean commodo ligula eget dolor.*

*Proof.* Aenean massa. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Donec quam felis, ultricies nec, pellentesque eu, pretium quis, sem. Nulla consequat massa quis enim.  $\square$

# Oefeningen!



# Figure

Hier zie je een pinguïn:

```
\begin{center}  
  \includegraphics[height=2cm]{penguin.jpg}  
\end{center}
```

Foto door Sue Flood.

Hier zie je een pinguïn:



Foto door Sue Flood.

# Figure

```
Een pinguïn zie je in Figuur~\ref{fig:pinguin}.  
\begin{figure}[h]  
  \centering  
  \includegraphics[height=2cm]{pinguin.jpg}  
  \caption{Een schattige pinguïn.  
Foto door Sue Flood.}  
  \label{fig:pinguin}  
\end{figure}
```

Een pinguïn zie je in Figuur 1.



**Figuur 1:** Een schattige pinguïn. Foto door Sue Flood.

# Figuurplaatsing

`\begin{figure}[h]`

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetur id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum. Zie hiervoor Figuur 1.



Figure 1: Voorbeeld van figuurplaatsing.

Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Do-

1

nec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris.

2

# Figuurplaatsing

```
\begin{figure}[t]
```



Figure 2: Voorbeeld van figuurplaatsing.

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetur id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus ut tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

Zie hiervoor Figuur 2.

Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Do-

nec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris.

# Figuurplaatsing

```
\begin{figure}[b]
```

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetur id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

Zie hiervoor Figuur 3.

Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Do-



Figure 3: Voorbeeld van figuurplaatsing.

5

nec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris.

6

# Figuurplaatsing

```
\begin{figure}[p]
```

Lorem ipsum dolor sit amet, consectetur adipiscing elit. Ut purus elit, vestibulum ut, placerat ac, adipiscing vitae, felis. Curabitur dictum gravida mauris. Nam arcu libero, nonummy eget, consectetur id, vulputate a, magna. Donec vehicula augue eu neque. Pellentesque habitant morbi tristique senectus et netus et malesuada fames ac turpis egestas. Mauris ut leo. Cras viverra metus rhoncus sem. Nulla et lectus vestibulum urna fringilla ultrices. Phasellus eu tellus sit amet tortor gravida placerat. Integer sapien est, iaculis in, pretium quis, viverra ac, nunc. Praesent eget sem vel leo ultrices bibendum. Aenean faucibus. Morbi dolor nulla, malesuada eu, pulvinar at, mollis ac, nulla. Curabitur auctor semper nulla. Donec varius orci eget risus. Duis nibh mi, congue eu, accumsan eleifend, sagittis quis, diam. Duis eget orci sit amet orci dignissim rutrum.

Zie hiervoor Figuur 4.

Nam dui ligula, fringilla a, euismod sodales, sollicitudin vel, wisi. Morbi auctor lorem non justo. Nam lacus libero, pretium at, lobortis vitae, ultricies et, tellus. Donec aliquet, tortor sed accumsan bibendum, erat ligula aliquet magna, vitae ornare odio metus a mi. Morbi ac orci et nisl hendrerit mollis. Suspendisse ut massa. Cras nec ante. Pellentesque a nulla. Cum sociis natoque penatibus et magnis dis parturient montes, nascetur ridiculus mus. Aliquam tincidunt urna. Nulla ullamcorper vestibulum turpis. Pellentesque cursus luctus mauris.

7



Figure 4: Voorbeeld van figuurplaatsing.

8

# Figuurplaatsing

Specificeer een of meer van de onderstaande letters:

- ▶ h (HERE): Figuur mag hier.
- ▶ t (TOP): Figuur mag bovenaan een pagina.
- ▶ b (BOTTOM): Figuur mag onderaan een pagina.
- ▶ p (PAGE): Figuur mag op aparte pagina voor figuren.
- ▶ !: Override interne parameters voor floats.
- ▶ H (HERE): Geen floating, altijd hier. (`\usepackage{float}`)

Bijvoorbeeld: `\begin{figure}[ht]`

Wanneer je werkt met afbeeldingen: `\usepackage{graphicx}`

# Dimensies

- Hele regelbreedte

```
\includegraphics[width=\linewidth]{assets/pinguin.jpg}
```

- 90% regelbreedte

```
\includegraphics[width=0.9\linewidth]{assets/pinguin.jpg}
```

- Maximaal 90% regelbreedte en maximaal 5 cm hoog

```
\includegraphics[  
    width=0.9\linewidth,height=5cm,keepaspectratio  
]{assets/pinguin.jpg}
```



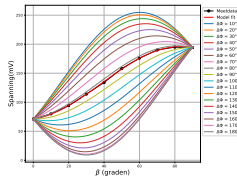
# Subfigure

```

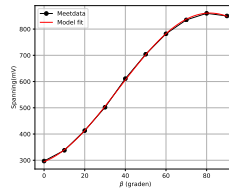
\usepackage{subcaption}
...

\begin{figure}[htbp]
  \centering
  \begin{subfigure}[b]{0.45\textwidth}
    \includegraphics[width=\textwidth]{...}
    \caption{BB}
    \label{fig:dphiExample}
  \end{subfigure}\quad
  \begin{subfigure}[b]{0.45\textwidth}
    \includegraphics[width=\textwidth]{...}
    \caption{CC}
    \label{fig:fitExample}
  \end{subfigure}
  \caption{Meerdere afbeeldingen naast elkaar!}
\end{figure}

```



(a) BB



(b) CC

Figuur 1: Multiple images next to eachother!

# Align

De verdubbelingsformule herschrijven we nu als

```
\begin{align*}
\cos(2\theta) &= \cos^2(\theta) - \sin^2(\theta) \\
&= 2\cos^2(\theta) - 1.
\end{align*}
```

De verdubbelingsformule herschrijven we nu als

$$\begin{aligned}\cos(2\theta) &= \cos^2(\theta) - \sin^2(\theta) \\ &= 2\cos^2(\theta) - 1.\end{aligned}$$

# Matrices

```
\begin{align*}
  R(\theta) &= \begin{pmatrix}
    \cos(\theta) & -\sin(\theta) \\
    \sin(\theta) & \cos(\theta)
  \end{pmatrix}
\end{align*}
```

$$R(\theta) = \begin{pmatrix} \cos(\theta) & -\sin(\theta) \\ \sin(\theta) & \cos(\theta) \end{pmatrix}$$

# Matrices

```
\begin{align*}
  R(\theta) &= \begin{bmatrix} \cos(\theta) & -\sin(\theta) \\ \sin(\theta) & \cos(\theta) \end{bmatrix} \\
\end{align*}
```

$$R(\theta) = \begin{bmatrix} \cos(\theta) & -\sin(\theta) \\ \sin(\theta) & \cos(\theta) \end{bmatrix}$$

# Matrices

```
\begin{align*}
R(\theta) &= \begin{bmatrix} \cos(\theta) & -\sin(\theta) \\ \sin(\theta) & \cos(\theta) \end{bmatrix} \\
&= \begin{matrix} \begin{matrix} \cos(\theta) & -\sin(\theta) \\ \sin(\theta) & \cos(\theta) \end{matrix} \end{matrix} \\
\end{align*}
```

$$\begin{aligned} R(\theta) &= \begin{bmatrix} \cos(\theta) & -\sin(\theta) \\ \sin(\theta) & \cos(\theta) \end{bmatrix} \\ &= \begin{matrix} \cos(\theta) & -\sin(\theta) \\ \sin(\theta) & \cos(\theta) \end{matrix} \end{aligned}$$

# Matrices

```

\begin{align*}
R(\theta) &= \begin{bmatrix} \cos(\theta) & -\sin(\theta) \\ \sin(\theta) & \cos(\theta) \end{bmatrix} \\
&= \begin{matrix} \begin{bmatrix} \cos(\theta) & -\sin(\theta) \\ \sin(\theta) & \cos(\theta) \end{bmatrix} \end{matrix} \\
&= \left( \begin{matrix} \begin{bmatrix} \cos(\theta) & -\sin(\theta) \\ \sin(\theta) & \cos(\theta) \end{bmatrix} \end{matrix} \right)
\end{align*}

```

$$\begin{aligned}
 R(\theta) &= \begin{bmatrix} \cos(\theta) & -\sin(\theta) \\ \sin(\theta) & \cos(\theta) \end{bmatrix} \\
 &= \begin{matrix} \cos(\theta) & -\sin(\theta) \\ \sin(\theta) & \cos(\theta) \end{matrix} \\
 &= \left( \begin{matrix} \cos(\theta) & -\sin(\theta) \\ \sin(\theta) & \cos(\theta) \end{matrix} \right)
 \end{aligned}$$

# Matrices

```
\begin{align*}
\abs{x} &= \left\{ \begin{matrix}
x & \text{if } x \geq 0 \\
-x & \text{else}
\end{matrix} \right. \\
&\end{align*}
```

$$|x| = \begin{cases} x & \text{if } x \geq 0 \\ -x & \text{else} \end{cases}$$

# Matrices

```

\begin{align*}
\abs{x} &= \left\{ \begin{matrix} x & \text{if } x \geq 0 \\ -x & \text{else} \end{matrix} \right. \\
&\end{align*}

\begin{align*}
\abs{x} &= \left\{ \begin{array}{rl} x & \text{if } x \geq 0 \\ -x & \text{else} \end{array} \right. \\
&\end{align*}

```

$$|x| = \begin{cases} x & \text{if } x \geq 0 \\ -x & \text{else} \end{cases}$$

$$|x| = \begin{cases} x & \text{if } x \geq 0 \\ -x & \text{else} \end{cases}$$



# Matrices

```

\begin{align*}
  |\abs{x}| &= \left\{ \begin{array}{l} x \\ -x \end{array} \right. \begin{array}{l} \text{if } x \geq 0 \\ \text{else} \end{array} \\
\end{align*}

\begin{align*}
  |\abs{x}| &= \left\{ \begin{array}{rl} x & \text{if } x \geq 0 \\ -x & \text{else} \end{array} \right. \\
\end{align*}

\begin{align*}
  |\abs{x}| &= \begin{cases} x \\ -x \end{cases} \begin{array}{l} \text{if } x \geq 0 \\ \text{else} \end{array} \\
\end{align*}

```

$$|x| = \begin{cases} x & \text{if } x \geq 0 \\ -x & \text{else} \end{cases}$$

$$|x| = \left\{ \begin{array}{rl} x & \text{if } x \geq 0 \\ -x & \text{else} \end{array} \right.$$

$$|x| = \begin{cases} x & \text{if } x \geq 0 \\ -x & \text{else} \end{cases}$$

# Tabellen

| With $n = 6$          | $k = 1$ | $k = 2$ | $k = 3$ | $k = 4$ | $k = 5$            |
|-----------------------|---------|---------|---------|---------|--------------------|
| $f(e) = \text{id}_A$  | 6       |         |         |         | $\binom{6}{5} = 6$ |
| $f(r) = T = (012345)$ | 0       |         |         |         | 0                  |
| $f(r^2) = T^2 =$      | 0       |         |         |         | 0                  |
| $f(r^3) = T^3 =$      | 0       |         |         |         | 0                  |
| $f(r^4) = T^4 =$      | 0       |         |         |         | 0                  |
| $f(r^5) = T^5 =$      | 0       |         |         |         | 0                  |
| $f(s) = S = (15)(24)$ | 2       |         |         |         | 2                  |
| $f(sr) = ST =$        | 0       |         |         |         | 0                  |
| $f(sr^2) = ST^2 =$    | 2       |         |         |         | 2                  |
| $f(sr^3) = ST^3 =$    | 0       |         |         |         | 0                  |
| $f(sr^4) = ST^4 =$    | 2       |         |         |         | 2                  |
| $f(sr^5) = ST^5 =$    | 0       |         |         |         | 0                  |
| Total                 | 12      | 36      | 36      | 36      | 12                 |
| Number of orbits      | 1       | 3       | 3       | 3       | 2                  |

**Question (d).** Prove that the amount of equivalence classes of elements of  $A$  with  $k = 6$  and  $n = 12$  equals 50.

With the same methodology as in Question (c) we can compute a table of  $|A^g|$ .

| With $n = 12$ , part 1 | $k = 6$ |
|------------------------|---------|
| $\text{id}_A$          |         |
| $T = (0,$              |         |
| $T^2 =$                |         |
| $T^3 = (0$             |         |
| $T^4 = (0$             |         |
| $T^5 = (0$             |         |
| $T^6 = (0$             |         |
| $T^7 = (0$             |         |
| $T^8 = (0$             |         |
| $T^9 = (0$             |         |
| $T^{10} = ($           |         |
| $T^{11} = ($           |         |

# Tabellen

De resultaten:

```
\begin{tabular}{cc|l}  
1 & 2 & 3\\  
400 & 500 & 600\\  
\hline  
70 & 80 & 90  
\end{tabular}
```

|                |     |     |     |
|----------------|-----|-----|-----|
|                | 1   | 2   | 3   |
| De resultaten: | 400 | 500 | 600 |
|                | 70  | 80  | 90  |

# Tabellen

De resultaten:

```
\begin{tabular}{cc|l}
  1 & 2 & 3\\
  400 & 500 & 600\\
  \hline
  70 & 80 & 90
\end{tabular}
```

|                |     |     |     |
|----------------|-----|-----|-----|
|                | 1   | 2   | 3   |
| De resultaten: | 400 | 500 | 600 |
|                | 70  | 80  | 90  |

Zie Tabel `\ref{tbl:nummers}` voor de resultaten.

```
\begin{table}[htbp]
  \begin{tabular}{cc|l}
    ...
  \end{tabular}
  \caption{Interessante nummers}
  \label{tbl:nummers}
\end{table}
```

# Tabellen

De resultaten:

```
\begin{tabular}{cc|l}
  1 & 2 & 3\\
  400 & 500 & 600\\
  \hline
  70 & 80 & 90
\end{tabular}
```

Zie Tabel `\ref{tbl:nummers}` voor de resultaten.

```
\begin{table}[htbp]
  \begin{tabular}{cc|l}
    ...
  \end{tabular}
  \caption{Interessante nummers}
  \label{tbl:nummers}
\end{table}
```

De resultaten:

| 1   | 2   | 3   |
|-----|-----|-----|
| 400 | 500 | 600 |
| 70  | 80  | 90  |

Zie Tabel 1 voor de resultaten.

| 1   | 2   | 3   |
|-----|-----|-----|
| 400 | 500 | 600 |
| 70  | 80  | 90  |

**Tabel 1:** Interessante nummers

# Tabellen

```

\usepackage{booktabs}
...

\begin{table}[htbp]
  \centering
  \begin{tabular}{c c p{2cm}}
    \toprule
    Getal 1 & Getal 2 & Notitie\\
    \cmidrule(lr){1-2}\cmidrule(lr){3-3}
    88 & 94 & Twee grote getallen\\
    89 & 12 & Een grote en een kleintje\\
    96 & 18 & Weer zo\\
    \midrule
    \multicolumn{2}{c}{527} & Totale som\\
    \bottomrule
  \end{tabular}
  \caption{Een tabel!}
\end{table}

```

| Getal 1 | Getal 2 | Notitie                   |
|---------|---------|---------------------------|
| 88      | 94      | Twee grote getallen       |
| 89      | 12      | Een grote en een kleintje |
| 96      | 18      | Weer zo                   |
| 527     |         | Totale som                |

Tabel 2: Een tabel!

# Tabellen

```
\usepackage{booktabs}
```

```
...
```

```
\begin{table}[htbp]
  \centering
  \begin{tabular}{ll}
    \toprule
    Formule & Beschrijving\\
    \midrule
    $ \sqrt{2} $ & Wortel\\
    $ \frac{2}{3} $ & Breuk\\
    $ 6 \geq 3 $ & Symbool\\
    $ a^2 + b^2 $ & Superscript\\
    \bottomrule
  \end{tabular}
  \caption{Een tabel!}
\end{table}
```

| Formule       | Beschrijving |
|---------------|--------------|
| $\sqrt{2}$    | Wortel       |
| $\frac{2}{3}$ | Breuk        |
| $6 \geq 3$    | Symbool      |
| $a^2 + b^2$   | Superscript  |

Tabel 3: Een tabel!

# Tabellen

```

\usepackage{booktabs}
\usepackage{tabularx}
...

\begin{table}[htbp]
  \centering
  \begin{tabularx}{\textwidth}{XX}
    \toprule
    Formule & Beschrijving\\
    \midrule
    $ \sqrt{2} $ & Wortel\\
    $ \frac{2}{3} $ & Breuk\\
    $ 6 \geq 3 $ & Symbool\\
    $ a^2 + b^2 $ & Superscript\\
    \bottomrule
  \end{tabularx}
  \caption{Een tabel!}
\end{table}

```

| Formule       | Beschrijving |
|---------------|--------------|
| $\sqrt{2}$    | Wortel       |
| $\frac{2}{3}$ | Breuk        |
| $6 \geq 3$    | Symbool      |
| $a^2 + b^2$   | Superscript  |

Tabel 4: Een tabel!



# Oefeningen!

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## Contributors

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