Session 1

Inline Mode

Equation

Math Symbo

Greek Letters

Symbols

Advanced

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Environment

Environments

Text in Equation

ISGS LATEX Beginner's Workshop 2016 Session 2 – Math

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Recap of Session

Math Mode Inline Mode Equation

Math Symbols
Greek Letters
Symbols
Common Constructs

Math
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Theorem

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1. Recap of Session 1

- Exercise Sheet -

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- 5 Minutes -

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2. Math Mode

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Inline Mode

\$... \$

- Mode for quick typing of small formulas
- Can change the line height

Math

Equation Environments Text in Equations

Theorem:

Inline Mode

Inline Mode

\$... \$

- Mode for quick typing of small formulas
- Can change the line height

Good Use

The relation between the three sides a, b, c of a right-angled triangle ($a^2 + b^2 = c^2$) was discovered by the Greek mathematician Pythagoras.

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Inline Mode – Bad Use

Bad Use

For a very big natural number n the quotient $\frac{1}{n}$ becomes very small. We often write $\lim_{n\to\infty}\frac{1}{n}=0$ to express this in a very mathematical fashion. Unfortunately, the text looks very crowded when overly complex formulas are set using inline mode. Also, the line height is not uniform.

Thoorom

Equation Environment

Quick Equation (not numbered)

$$[a^2+b^2=c^2]$$
 \$\$ $a^2+b^2=c^2$ \$\$

$$a^2+b^2=c^2$$

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Equation Environment

Quick Equation (not numbered)

$$\[a^2+b^2=c^2 \]$$
\$\$ $a^2+b^2=c^2$ \$\$

$$a^2+b^2=c^2$$

Equation

\begin{equation} ... \end{equation}

$$a^2 + b^2 = c^2 (1)$$

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Equation Environment – Example

Example

For a very big natural number n the quotient $\frac{1}{n}$ becomes very small. We often write

$$\lim_{n\to\infty}\frac{1}{n}=0$$

to express this in a very mathematical fashion. Note how nice and much more professional this looks.

Theorems

Referencing Equations

```
\begin{equation}
  \label{eq:pythagoras}
  a^2+b^2=c^2
\end{equation}
```

$$a^2 + b^2 = c^2 (2)$$

- \ref{eq:pythagoras} = 2
- \eqref{eq:pythagoras} = (2)

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Greek Letters

 $\alpha \beta \gamma \dots$ \alpha \beta \gamma...

 $\Gamma \Delta \Theta \dots$ \Gamma \Delta \Theta...

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Greek Letters

```
\alpha \beta \gamma \dots \alpha \beta \gamma...
```

 $\Gamma \mathrel{\Delta} \Theta \dots \quad \texttt{\ \ } \texttt{\ \ }} \texttt{\ \ } \texttt{\ \ }} \texttt{\ \ } \texttt{\ \ }} \texttt{\ \ } \texttt{\ \ }} \texttt{\ \ } \texttt{\ \ }} \texttt{\ \ } \texttt{\ \ } \texttt{\ \ }} \texttt{\ \ } \texttt{\ \ } \texttt{\ \ }} \texttt{\ \ \ } \texttt{\ \ }} \texttt{\ \ } \texttt{\ \ } \texttt{\ \ }} \texttt{\ \ } \texttt{\ \ } \texttt{\ \ }} \texttt{\ \ } \texttt{\ \ }} \texttt{\ \ \ } \texttt{\ \ \ }} \texttt{\ \ \ } \texttt{\ \ }} \texttt{\ \ \ } \texttt{\ \ }} \texttt{\ \ \ } \texttt{\ \ }} \texttt{\ \ }} \texttt{\ \ \$

 $\epsilon \, \varepsilon$ \epsilon \varepsilon

 $\theta \, \vartheta$ \theta \vartheta

 $\pi \varpi \$ \pi \varpi

 $\rho \, \varrho \,$ \rho \varrho

 $\sigma \varsigma$ \sigma \varsigma

 $\phi \varphi$ \phi \varphi

Note

Greek letters which look exactly like Latin letters have no special command.

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Useful Symbols

· \cdot

× \times

 $\pm \mp \pm \pm$

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Useful Symbols

· \cdot

× \times

 $\pm \mp \pm \pm$

 $\leq \geq \neq \approx$ \leq \geq \neq \approx

 $\subset \subseteq \in \$ \subset \subseteq \in

 $\supset \supseteq \ni$ \supset \supseteq \ni

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Useful Symbols

· \cdot

× \times

 $\pm \mp \pm \pm$

 $\leq \geq \neq \approx$ \leq \geq \neq \approx

 $\subset \subseteq \in \$ \subset \subseteq \in

 $\supset \supseteq \ni$ \supset \supseteq \ni

 ∞ \infty

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Useful Symbols

```
\mathbb{R} \mathbb{C} \setminus \mathbb{R} \setminus \mathbb{C}
```

- $\mathcal{O}(n)$ \mathcal{0}(n)
- $\Theta(n)$ \Theta(n)
- $\Omega(n)$ \Omega(n)

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```
\hat{a} \bar{a} \tilde{a} \hat{a} \bar{a} \tilde{a}
```

$$\dot{a}\ddot{a}\ddot{a}$$
 \dot{a} \dot{a} \vec{a}

Theorems

Math Accents

```
\hat{a} \, \bar{a} \, \bar{a} \hat{a} \bar{a} \tilde{a}
\dot{a} \, \ddot{a} \, \bar{a} \dot{a} \ddot{a} \vec{a}
```

Dotted Letters

The letters i and j are available in a dot-less version $\forall i = i$ and $\forall j = j$. \vec{i} looks nicer than \vec{i} .

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x_{n}

Xn

Exponent

x^{a}

xa

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Indices & Exponents

Combined

$$x^{a}_{n} = x_{n}^{a}$$

$$x_n^a = x_n^a$$

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Indices & Exponents

Combined

$$x^{a}_{n} = x_{n}^{a}$$

$$x_n^a = x_n^a$$

Nested

$$x^{a_n} \neq x_{n^a}$$

$$x^{a_n} \neq x_{n^a}$$

In Front

Fractions

Simple Fraction

The size of a formula depends on the mode you are in, you get $\frac{1}{n}$ in inline mode

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Simple Fraction

 $\frac{1}{n}$

The size of a formula depends on the mode you are in, you get $\frac{1}{n}$ in inline mode

Nested Fraction

$$\frac{a}{b} + \frac{c}{d}$$

$$\frac{a}{b+\frac{c}{a}}$$

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Roots

$$\sqrt{x+y} = \sqrt{x+y}$$

$$\sqrt{X+y} = \sqrt{X+y}$$

$$\sqrt[2]{x+y} = \sqrt{x+y}$$

$$\sqrt[2]{x+y} = \sqrt{x+y}$$

$$\sqrt{3} \{x+y\} = \sqrt{x+y}$$

$$\sqrt[3]{x+y} = \sqrt{x+y}$$

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Basic

 $\sin \cos \tan \ln \log \lim$

sin cos tan In log lim

Sum, etc.

\sum \prod \int \iint \oint

$$\sum \prod \int \int$$

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Operators II

Limits

$$\sum_{n=0}^{N} a_n \qquad \int_0^2 x^2 dx \qquad \int_0^2 x^2 dx$$

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rext III Equal

Normal Braces

$$a_n = (\{1\}\{n\})$$

$$a_n=(\frac{1}{n})$$

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Normal Braces

$$a_n = (\{1\}\{n\})$$

$$a_n=(\frac{1}{n})$$

Automatic Size

$$a_n = \left(\frac{1}{n} \right) \right)$$

$$a_n = \left(\frac{1}{n}\right)$$

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More examples:

 $x \in \left[1\right]$; $n \in \left[1\right] = \dots$

$$x \in \left[\frac{1}{n}; n\right] = \left(\frac{1}{n}; n\right]$$

An error is reported when number of \left and \right braces does not match.

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Overbrace & Underbrace

Underbrace

 $\underbrace{1+2+3+\cdots+n}_{abc}$

$$\underbrace{1+2+3+\cdots+n}_{abc}$$

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Overbrace & Underbrace

Underbrace

 $\underbrace{1+2+3+\cdots+n}_{abc}$

$$\underbrace{1+2+3+\cdots+n}_{abc}$$

Overbrace

= $\operatorname{\{1+2+3+\cdots+n\}}_{\{abc\}}$

$$\frac{=}{1+2+3+\cdots+n_{abc}}$$

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Time for a Break

- 5 Minutes -

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4. Advanced Math Environments

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AMS Math Package

LATEX math extensions from the American Mathematical Society.

- Include \usepackage{amsmath} into the preamble
- Additional symbols
- New environments for equation spanning multiple lines and for equation alignment
- Some handy commands for vectors and matrices

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Equation/Split

```
\begin{equation}
  \begin{split}
  a = & b + c \\ & + d + f
  \end{split}
\end{equation}
```

$$\begin{array}{l}
a = b + c \\
+ d + f
\end{array} \tag{3}$$

- Alignment is done using &
- You always get only one equation number (centered vertically)

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```
\begin{equation}
  \begin{pmatrix}
    a & b & c \\ d & e & f \\ g & h & i
  \end{pmatrix}
\end{equation}
```

$$\begin{pmatrix} a & b & c \\ d & e & f \\ g & h & i \end{pmatrix} \tag{4}$$

Theorems

Multline

\begin{multline}
 a = b+c+d+e\\+f+g+h+k+l\\+m\\+n+o+p+q+r+s
\end{multline}

$$a = b + c + d + e$$

 $+ f + g + h + k + l$
 $+ m$
 $+ n + o + p + q + r + s$ (5)

- · First line is aligned left, last line is aligned right
- Equation number in the last line

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\begin{gather}
 a = b+c\\ d = e+f+g+h \\
 g=h+i \notag \\ j+k=l
\end{gather}

$$a = b + c \tag{6}$$

$$d = e + f + g + h \tag{7}$$

$$g = h + i$$

$$j + k = I$$
 (8)

- Just a simple collection of equations
- \notag command skips numbering

Align

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Theorem:

\begin{align}
 a &= b+c & d &= e+f+g+h \notag \\
 j+k&=l & z+y =& x
\end{align}

$$a = b + c$$
 $d = e + f + g + h$
 $j + k = l$ $z + y = x$ (9)

 The & symbol serves as both alignment marker and column separator

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Text in Equations

Writing text in an equation using \text{...}:

```
$$
  \text{If } a<b
  \text{ and } b<c
  \text{ then } a<c
$$</pre>
```

If a < b and b < c then a < c

Note

You have to take care of the spaces!

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5. Theorems

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Theorems & Definitions

Package

\usepackage{amsthm}

Scheme for usage

\newtheorem{<name>} {<output>} }

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Theorems & Definitions

Example

```
% in preamble
\usepackage{amsthm}
\newtheorem{mydefinition}{Definition}
```

```
% in text
\begin{mydefinition}
   This is a definition.
\end{mydefinition}
```

Result

Definition

This is a definition