Math 291: Lecture 3

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January 30, 2017 1 / 18



- 2 Grouping Symbols
- Symbols Placed Above and Below Other Characters



Typesetting Several Equations

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2 Grouping Symbols

3 Symbols Placed Above and Below Other Characters

4 Typesetting Several Equations

Display versus In-line Math

Compare the following:

- The fraction $\frac{3}{4}$
- The fraction

3 4

- The convergence of the infinite sum $\sum_{i=1}^{\infty} \frac{1}{n^p}$ is determined by the value of the parameter p.
- The convergence of the infinite sum

$$\sum_{i=1}^{\infty} \frac{1}{n^p}$$

is determined by the value of the parameter p.

Display versus In-line Math

- Notice that in each pair, there are differences in the size and subscript locations in the typeset formulae.
- LATEX uses \$ · · · \$ to typeset "in-line" equations.
- For displayed equations, there are a few options:
 - \$\$ · · · \$\$
 - \begin{displaymath}, \end{displaymath}
 - \begin{equation}, \end{equation} (this command adds an equation number)
 - \begin{equation*}, \end{equation*} (the * tells the compiler **not** to assign an equation number)
 - Antiquated Method: \[, \]

(a)

The Displaystyle Command

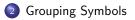
- Use of the \displaystyle command:
 - This command forces the size and format of a typeset formula to behave like a displayed equations while the equation itself remains in-line.
 - For example, compare these two: $\bigcap_{i=1}^{\infty} A_i \text{ (displaystyle) and } \bigcap_{i=1}^{\infty} A_i \text{ (regular in-line style).}$
- Changes to the size and subscript behavior occur in all "large symbols" such as: $\sum_{i}, \int_{i}, \bigcap_{i}, \bigcup_{i}, \bigvee_{i}$, etc.
- Changes to only subscript behavior occur in the commands: lim, lim inf, min, max etc.
 - For example consider: $\min_{D} L(P, f)$ and $\min_{P} L(P, f)$

Practice Exercises:

- Type $\lim_{n\to\infty} \frac{n^2}{3n^2-2n+1} = \frac{1}{3}$ in four ways:
 - As an in-line equation (using \cdots)
 - As a displayed equation (using \$\$...\$\$)
 - As a displayed equation with line numbers (using \begin{equation}, \end{equation})
 - As an in-line equation (using using the \displaystyle command).

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3) Symbols Placed Above and Below Other Characters

4 Typesetting Several Equations

Sizing Grouping Symbols

- Compare the form of the statements: $\left(\frac{1}{2} + \frac{1}{5}\right)$ and $\left(\frac{1}{2} + \frac{1}{5}\right)$.
- Sizable grouping symbols are added using the commands: \left and \right
- Possible arguments for these commands include: () [] || [] etc.
- The compiler prefers for \left and \right arguments to be matched, and gives errors if they are not, but the command: "\right." . can be used to match a left grouping symbol with an "empty" right grouping symbol (the corresponding command "\left." creates an empty left grouping symbol).

(a)

Sizing of Grouping Symbols

Practice:

- Typeset the formula: $\left(1+\frac{1}{n}\right)^n \to e.$
- Typeset the formula:

$$\left[\frac{1}{x} + 3x\right]_{1}^{5} = \frac{76}{5} - 4 = \frac{56}{5}$$

Actual Code:

- \$\left(1+\frac{1}{n}\right)^n \rightarrow e\$
- \$\$\left[\frac{1}{x}+3x\right|_1^5
 =\frac{76}{5}-4=\frac{56}{5}\$\$





Symbols Placed Above and Below Other Characters

4 Typesetting Several Equations

Accents

- Here are some of the most frequently used accent characters:
 - â, ŵ, x
 - These are typeset using: \hat{a}, \tilde{w}, \vec{x}
 - A few other common ones are: \bar{}, \dot{}, \acute{},
 - Some special cases: we often use \vec{i} and \vec{j} instead of \vec{i} and \vec{j}
 - Use the special commands\imath and \jmath to get the un-dotted versions. (e.g. \vec{\imath})
- Two more related symbols are \widehat{} and \widetilde{}
- For example, we used these instead of regular hats and tildes in these expressions: \widehat{xyz} and $\widetilde{3xy}$

More Accents

- Three more common commands are: \overline{}, \underline, \underbrace{}.
- For example, consider: $\overline{a}^2 + xy + \overline{\overline{z}}$

• or:
$$(a+b)^2 = a^2 + ab + ab + b^2 = a^2 + 2ab + b^2$$

- If we include the package amsmath, we can also make use of additional commands like: \overleftarrow{}, \underleftrightarrow{}, \xrightarrow[below]{above} etc.
 - Recall: In LaTEX commands, [] indicates an optional argument, while { } indicates a required argument (empty is allowed).

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Stacking Commands

There are several commands that allow us to place objects on top of one another.

- \stackrel{upper}{lower}
- {upper \choose lower}
- {upper \atop lower}
- For example, we can typeset: $\binom{n}{k} \stackrel{\text{def}}{=} \frac{n!}{k! (n-k)!}$ • Practice: Typeset $\overrightarrow{AB} + \overrightarrow{BC} + \overrightarrow{CD} \xrightarrow{\text{vector}} \overrightarrow{AC} + \overrightarrow{CD} \stackrel{\text{simp}}{=} \overrightarrow{AD}$
- Here is the code to do this:

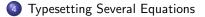
\$\$\underbrace{\overrightarrow{AB}+\overrightarrow{BC}}
+\overrightarrow{CD}
\xrightarrow[\mbox{addition}]{\mbox{vector}}
\overrightarrow{AC}+\overrightarrow{CD}
\stackrel{\mbox{\tiny simp}}{=} \overrightarrow{AD}\$\$\$

(a)

Display Math

2 Grouping Symbols

3 Symbols Placed Above and Below Other Characters



Long Equations

- The commands: eqnarray, eqnarray*, align, align* are all environments for typesetting multiple equations. The work as follows:
 - Each command compiles as if in math mode.
 - They are most often used for long derivations
 - They make use of the special alignment character &.
- "multline" and "split" are two special environments for a single long equation
- The "multline" command:
 - Compiles as if in math mode.
 - Allows line breaks to be added manually.
 - Equation numbers are placed either to the left of the first line or to the right of the last line.
 - Lines are justified as: left, center, ..., center, right
- The "split" command:
 - Does not compile as if in math mode (so you can use it inside another environment such as equation or equation*).
 - Line breaks are still done manually.
 - Equation numbers are vertically centered (at least by default).
 - Lines are lined up with the use of the alignment character &.

Long Equations

```
Practice: Type (with align or align*)
\begin{align}
\sin t \left( \csc t - \sin t \right)
&= \sin t \left( \frac{1}{\sin t} - \sin t \right) \\
&= 1 - \sin^2 t \\
&= \cos^2 t
\end{align}
```

• Your output should look like:

$$\sin t \left(\csc t - \sin t\right) = \sin t \left(\frac{1}{\sin t} - \sin t\right)$$
(1)
$$= 1 - \sin^2 t$$
(2)
$$= \cos^2 t$$
(3)

• & indicates the location in each line that should act as the alignment reference, \\ says when to end a line.

Long Equations

• Next, try:

```
\begin{multline}
382x^{13}+32x^{12}+x^{11}+x^{10}+x^9+x^8+x^7+321x^6\\
+x^5+19x^4+x^3+38x^2+x+1
\end{multline}
```

• Your output should look like:

$$382x^{13} + 32x^{12} + x^{11} + x^{10} + x^9 + x^8 + x^7 + 321x^6 + x^5 + 19x^4 + x^3 + 38x^2 + x + 1$$
(4)

• Try this again using the commands \begin{equation}\begin{split}, etc.

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