

- Tables contd.
- Arrays and some further uses of math mode
- Shading
- Including graphics
- Using PSTricks to draw simple diagrams

1 Merging table cells

1. When we looked at tables last session, we saw how it was possible to merge table cells horizontally using the `\multicolumn` command. There is also a `multirow` package, which may be downloaded from CTAN. Syntax: `\multirow{# of rows}{column width}{text}`.

	SINGULAR	DUAL	PLURAL
NOMINATIVE	<i>hodós</i>	<i>hodoó</i>	<i>hodoí</i>
VOCATIVE	<i>hodé</i>		<i>hodoús</i>
ACCUSATIVE	<i>hodón</i>		
GENITIVE	<i>hodóoi</i>	<i>hodóin</i>	<i>hodóon</i>
DATIVE	<i>hodóu</i>		<i>hodóis</i>

```

\begin{tabular}{|l|l|l|l|}
\hline
& \textsc{singular} & \textsc{dual} & \textsc{plural}\\
\hline
\textsc{nominative} & \textit{hod\'os} & & \\
\multirow{3}{1.5cm}{\textit{hod\textbf{o\'o}}}& & & \\
\multirow{2}{1.5cm}{\textit{hod\textbf{o\'{i}}}}& & & \\
\cline{1-2}
\textsc{vocative} & \textit{hod\'e} & & \\
\cline{1-2}\cline{4-4}
\textsc{accusative} & \textit{hod\'on} & & \\
& \textit{hod\textbf{o\'u}s}& & \\
\hline\hline
\textsc{genitive} & \textit{hod\'ooi} & & \\
\multirow{2}{1.5cm}{\textit{hod\'oin}}& & & \\
& \textit{hod\'oon}& & \\
\cline{1-2}\cline{4-4}
\textsc{dative} & \textit{hod\'ou} & & \textit{hod\'ois}

```

```

\cline{1-2}
\hline
\end{tabular}

```

2 Arrays

2. Last week we looked at the `tabular` environment. The `array` environment functions in a similar way, but is used in math mode, i.e. $\$ \dots \$$. The values of *pos* (= {t, b}) and *columns* (= {l, r, c, p{width}}) are the same as for `tabular`.

```

\begin{array}[pos]{columns} rows \end{array}

```

3. In linguistics, arrays are most immediately useful for representing feature matrices. The array must be typeset in math mode. Within math mode, normal text may be typeset using the command `\mbox{ }`.

4. $x^2 + \text{je ne sais quoi} = z^2$

```

 $x^2 + \mbox{je ne sais quoi} = z^2$ 

```

son

5. *cont*
voice

```


$$\begin{array}{l}
\text{son} \\
\text{cont} \\
\text{voice}
\end{array}$$


```

6. *son*
cont
voice

```


$$\begin{array}{l}
\mbox{son} \\
\mbox{cont}
\end{array}$$


```

```

\mbox{voice}
\end{array}
$

```

7.
$$\begin{array}{l} -\text{son} \\ -\text{cont} \\ -\text{voice} \end{array}$$

```

$
\begin{array}{l}
\mbox{$-$son}\\
\mbox{$-$cont}\\
\mbox{$-$voice}
\end{array}
$

```

8. The next stage is to provide the array with delimiters.

9.
$$\left[\begin{array}{l} -\text{son} \\ -\text{cont} \\ -\text{voice} \end{array} \right]$$

```

$
\left[
\begin{array}{l}
\mbox{$-$son}\\
\mbox{$-$cont}\\
\mbox{$-$voice}
\end{array}
\right]
$

```

Other possible delimiters are $\{, \}, (,), \langle, \rangle$.

10. Now we can incorporate the matrix into a rewrite rule.

$$\begin{bmatrix} -\text{son} \\ -\text{cont} \\ -\text{voice} \end{bmatrix} \rightarrow \begin{bmatrix} -\text{son} \\ +\text{cont} \\ -\text{voice} \end{bmatrix} / \text{---}_{[Wd] \dots}$$

```

$
\left[
\begin{array}{l}
\mbox{$-\text{son}$}\\
\mbox{$-\text{cont}$}\\
\mbox{$-\text{voice}$}
\end{array}
\right]
\rightarrow
\begin{array}{l}
-\text{son} \\
+\text{cont} \\
-\text{voice}
\end{array}
/ \text{---}_{[Wd] \dots}

```

11. Sometimes it might be desirable to open an array with a { delimiter while leaving the righthand side empty. In this case, the right delimiter has to be explicitly specified as null using a full stop: \right .

$$\begin{bmatrix} -\text{son} \\ -\text{cont} \\ -\text{voice} \end{bmatrix} \rightarrow \begin{bmatrix} -\text{son} \\ +\text{cont} \\ -\text{voice} \end{bmatrix} / \text{---} \left\{ \begin{array}{l} [Wd \dots \\ \dot{V} \dots \end{array} \right.$$

```

$
\left[
\begin{array}{l}
\mbox{$-$son}\\
\mbox{$-$cont}\\
\mbox{$-$voice}
\end{array}
\right]
\rightarrow
\left[
\begin{array}{l}
\mbox{$-$son}\\
\mbox{$+$cont}\\
\mbox{$-$voice}
\end{array}
\right]
/ \text{---} \left\{ \begin{array}{l} [Wd \dots \\ \dot{V} \dots \end{array} \right.
$

```

3 Shading

12. The package `colortab` allows us to shade table cells. Important: `colortab` requires `pstricks`, so you must load this package as well. Note these examples use `\newcommand{\ipa}{\textipa}`.

	/kæt + z/	AGREE VOI	RT-IDENT[voi]	IDENT[voi]
a. 	kæts			*
b.	kædz		*	*
c.	kætz	*		

```

\begin{tabular}{|l|l|c|c|c|}
\hline
& & \ipa{/k\ae t $+ $ z/} & \textsc{AgreeVoi} & \textsc{Rt-Ident}[voi] & \textsc{Ident}[voi] \\

```

```

\hline
\hline
a. & \ding{43} & \ipa{k\ae ts} & & *\\
\hline
b. & & \ipa{k\ae dz} & & * & *\\
\hline
c. & & \ipa{k\ae tz} & * & & \\
\hline
\end{tabular}

```

/kæt + z/		AGREEVOI	RT-IDENT[voi]	IDENT[voi]
a.	☞ kæts			*
b.	kædz		*	*
c.	kætz	*		

```

\begin{tabular}{|l|l|l|l|c|c|c|}
\hline
& & \ipa{/k\ae t $+ $ z/} & & \textsc{AgreeVoi} & & \\
& & \textsc{Rt-Ident}[voi] & & \textsc{Ident}[voi] & & \\
\hline
\hline
\hline
\hline
\hline
& & & & & & \lightgray\\
a. & \ding{43} & \ipa{k\ae ts} & & *\\
\hline
b. & & \ipa{k\ae dz} & & * & *\\
\hline
\hline
\hline
& & & & & & \lightgray & \lightgray\\
c. & & \ipa{k\ae tz} & & * & & \\
\hline
\hline
\hline
\end{tabular}

```

4 PSTricks

- There are a variety of ways to include graphics in $\text{\LaTeX}$. Many of these are dedicated packages which do one thing well, e.g. Feynman diagrams, molecular structures for inorganic chemistry, chess. Others are more general.

One of the most complete, versatile and accessible of these is the PSTricks package, an interface between T_EX and Postscript, the language of high quality printers. PSTricks enables you to

- draw lines, polygons, circles, curves
- place and manipulate text
- plot data in a graph
- draw nodes, connectors and trees
- color lines and fill objects

PSTricks is huge, and so is the documentation, so we'll only illustrate with a couple of examples of how it might be used. For other things, refer to the PSTricks documentation, e.g. <http://tug.org/applications/PSTricks/>.

14. The `psmatrix` environment is an tabular/array-like environment for use with PSTricks. To access it, you will need to specify the package `pst-node`. Notice that you don't have to specify the number of columns in a `psmatrix`.
15. Say you want a diagram of the syllable structure in the word /leitek/. (I) Get the alignment of the nodes in the tree right.

σ		σ			
μ	μ	μ			
l	e	i	t	e	k

```

\begin{psmatrix}
  & $\sigma$ & & & $\sigma$ & \\
  & $\mu$ & & $\mu$ & & $\mu$ & \\
l & e & & i & & t & & e & & k
\end{psmatrix}

```

16. (II) fill in the straight line node connectors with the command `\ncline{ }{ }`. This command takes two table cells as its arguments. Table cells are specified by giving {row #, column #}.

σ σ μ μ μ

```

\ncline{1,2}{2,2}\ncline{1,2}{2,3}\ncline{1,5}{2,5}
\ncline{2,2}{3,2}\ncline{2,3}{3,3}\ncline{2,5}{3,5}
\ncline{1,5}{3,6}

```

```

\begin{psmatrix}
& \sigma & & \sigma \\
& \mu & \mu & \mu \\
l & e & i & t & e & k \\
\end{psmatrix}

```

```

\ncline{1,2}{2,2}\ncline{1,2}{2,3}\ncline{1,5}{2,5}
\ncline{2,2}{3,2}\ncline{2,3}{3,3}\ncline{2,5}{3,5}
\ncline{1,5}{3,6}

```

17. (III) fill in the arcing node connectors with the command `\ncarc[ ]{ }{ }`. Mandatory arguments are first and second node respectively. Optional argument is a specification of the settings.

```

\ncarc{1,2}{3,1}\ncarc{1,5}{3,4}

```

```

\begin{psmatrix}
& \sigma & & \sigma \\
& \mu & \mu & \mu \\
l & e & i & t & e & k \\
\end{psmatrix}

```

```

\end{psmatrix}
\ncline{1,2}{2,2}\ncline{1,2}{2,3}\ncline{1,5}{2,5}
\ncline{2,2}{3,2}\ncline{2,3}{3,3}\ncline{2,5}{3,5}
\ncline{1,5}{3,6}

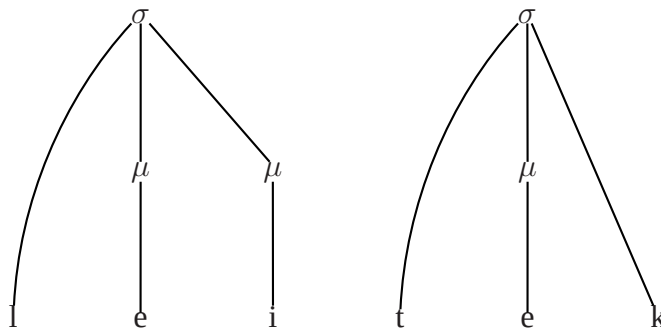
```

```

\ncarc{1,2}{3,1}\ncarc{1,5}{3,4}

```

18. (IV) correct the angle of the arc by specifying the *arcangle* parameter in the settings.

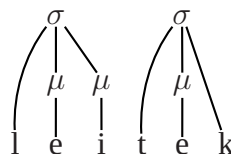


```

\begin{psmatrix}
& $\sigma$ & & $\sigma$ \\
& $\mu$ & $\mu$ & $\mu$ \\
l & e & i & t & e & k
\end{psmatrix}
\ncline{1,2}{2,2}\ncline{1,2}{2,3}\ncline{1,5}{2,5}
\ncline{2,2}{3,2}\ncline{2,3}{3,3}\ncline{2,5}{3,5}
\ncline{1,5}{3,6}
\ncarc[arcangle=-20]{1,2}{3,1}\ncarc[arcangle=-20]{1,5}{3,4}

```

19. (V) improve the overall aesthetic quality of the diagram by reducing the distance between matrix levels and columns. The `\psset` declaration allows you to set things such as distance between rows and columns, line widths and a great deal else.

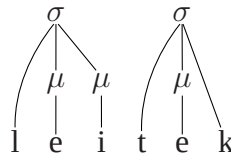


```

\psset{rowsep=10pt,colsep=10pt,nodesep=1pt}
\begin{psmatrix}
  & $\sigma$ & & $\sigma$ \\
  & $\mu$ & & $\mu$ \\
l & e & i & t & e & k
\end{psmatrix}
\ncline{1,2}{2,2}\ncline{1,2}{2,3}\ncline{1,5}{2,5}
\ncline{2,2}{3,2}\ncline{2,3}{3,3}\ncline{2,5}{3,5}
\ncline{1,5}{3,6}
\ncarc[arcangle=-20]{1,2}{3,1}\ncarc[arcangle=-20]{1,5}{3,4}

```

20. (VI) with a little work, we can get it looking even better, by eliminating the spaces between the connection points and making the lines thinner. The reason we get this space is that $\text{\TeX}$ is taking the reference point of the node connector to be the centre of the node. We'd ideally like the node connectors to enter the same point at the bottom of the node. To do this, we construct another node, a `rnode` ('reference point node') around the one supplied by the matrix. Syntax: `\rnode[ref point]{name}{text}`. The reference point is one of {t, b, l, r, c}.

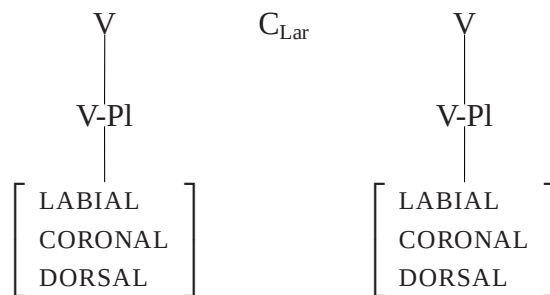


```

\psset{rowsep=10pt,colsep=10pt,nodesep=1pt,linewidth=.4pt}
\begin{psmatrix}
  & \rnode[b]{s1}{$\sigma$} & & \rnode[b]{s2}{$\sigma$} \\
  & $\mu$ & & $\mu$ \\
l & e & i & t & e & k
\end{psmatrix}
\ncline{s1}{2,2}\ncline{s1}{2,3}\ncline{s2}{2,5}
\ncline{2,2}{3,2}\ncline{2,3}{3,3}\ncline{2,5}{3,5}
\ncline{s2}{3,6}
\ncarc[arcangle=-20]{s1}{3,1}\ncarc[arcangle=-20]{s2}{3,4}

```

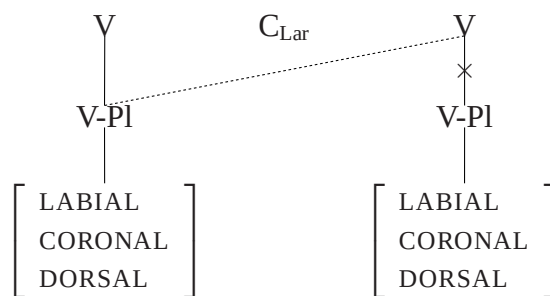
21. Autosegmental diagrams. Suppose we have a diagram such as the following, and we want to show delinking of the second V-Pl node and the spreading of the first V-Pl node to the second V.



```

\psset{rowsep=20pt,colsep=20pt,linewidth=.4pt}
\begin{psmatrix}
V & C\textsubscript{Lar} & V \\
| & & | \\
V-Pl & & V-Pl \\
| & & | \\
\left[ \begin{array}{l} LABIAL \\ CORONAL \\ DORSAL \end{array} \right] & & \left[ \begin{array}{l} LABIAL \\ CORONAL \\ DORSAL \end{array} \right]
\end{psmatrix}
\ncycle{1,1}{2,1}\ncycle{1,3}{2,3}
\ncycle{2,1}{3,1}\ncycle{2,3}{3,3}

```

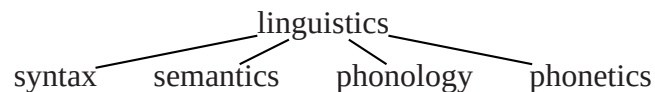


```

\psset{rowsep=20pt,colsep=20pt,linewidth=.4pt}
\begin{psmatrix}
V & C\textsubscript{Lar} & \rnode[b]{V2}{V} \\\
\rnode[b]{VPl1b}{\rnode[t]{VPl1t}{V-Pl}} & & V-Pl \\\
$
\left[
\begin{array}{l}
\textsc{labial}\\\
\textsc{coronal}\\\
\textsc{dorsal}
\end{array}
\right]
& &
\left[
\begin{array}{l}
\textsc{labial}\\\
\textsc{coronal}\\\
\textsc{dorsal}
\end{array}
\right]
\\
\end{psmatrix}
\ncline{1,1}{VPl1t}\ncline{1,3}{2,3}\ncput{\small$\times$}
\ncline{VPl1b}{3,1}\ncline{2,3}{3,3}
\ncline[linestyle=dashed,dash=1pt 1pt]{VPl1t}{V2}

```

22. *n*-ary trees may be drawn by loading the package `pst-tree` in the preamble. Trees are called by a command which takes two mandatory arguments, `\pstree{mother node}{daughter node(s)}`. Each node is specified using the command `\TR{text}`.



```

\psset{levelsep=20pt}
\pstree {\TR{linguistics}}%
{
\TR{syntax}
\TR{semantics}

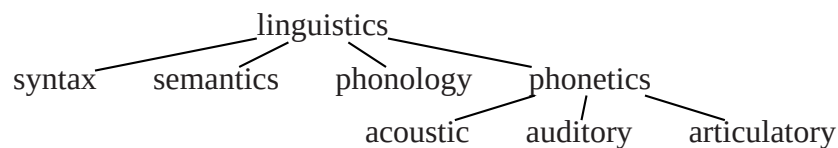
```

```

\TR{phonology}
\TR{phonetics}
}

```

Trees may be embedded. If we want to blow up the ‘phonetics’ node, we introduce a new `pstree` in the location occupied by `\TR{phonetics}` and set this node as root in the embedded `pstree`.



```

\psset{levelsep=20pt}
\pstree {\TR{linguistics}}%
{
\TR{syntax}
\TR{semantics}
\TR{phonology}
\pstree {\TR{phonetics}}%
{
\TR{acoustic}
\TR{auditory}
\TR{articulatory}
}
}

```

`pstree` is one of those places conscientious coding practice is essential. If you aren’t generous with white space and tabbing, you’ll be utterly lost before you know it! (As you’ll find out in this week’s homework ...)

5 Homework

1. Give the source for the following Latin paradigm. Note that this table necessitates the use of both `multicolumn` and `multirow`, both singly and in combination!

		MASC	NEUT	FEM
SG	NOM	<i>magnus</i>	<i>magnum</i>	<i>magna</i>
	ACC	<i>magnum</i>		<i>magnam</i>
	ABL			<i>magnā</i>
	DAT	<i>magnō</i>		
	GEN	<i>magnī</i>		<i>magnae</i>
PL	NOM	<i>magnī</i>	<i>magna</i>	<i>magnae</i>
	ACC	<i>magnōs</i>		<i>magnās</i>
	ABL		<i>magnīs</i>	
	DAT			
	GEN	<i>magnōrum</i>		<i>magnārum</i>

2. Typeset the West Germanic family tree. To get the positioning on the page right, issue the command `\hspace*{-1.5in}` before the tree. Play around with the font size to get it to fit.

