

Computer Lab Work: Practical Notes

2nd Semester (MAT-2103SE): LaTeX and HTML

Prepared by: **Dr. Shiva Rao**

Bapujee College, Sarukshetri

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1 Part 1: L^AT_EX Document Preparation

1.1 Practical 1: Error Correction in Math Mode

Objective: To correct syntax errors in basic L^AT_EX math mode inputs.

```
1 \documentclass{article}
2 \begin{document}
3 % Corrected inputs:
4 If $m=1$ and $n=2$, then $m+n=3$.
5
6 If $\theta = \pi$, then $\sin \theta = 0$.
7
8 If $x=3$, then $3x=9$.
9 \end{document}
```

1.2 Practical 2: Typesetting Mathematical Equations

Objective: To typeset fundamental algebraic and series formulas.

```
1 \documentclass{article}
2 \begin{document}
3 \begin{itemize}
4   \item  $3^3 + 4^3 + 5^3 = 6^3$ 
5   \item  $\sqrt{100} = 10$ 
6   \item  $(a+b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$ 
7   \item  $\sum_{k=1}^n k = \frac{n(n+1)}{2}$ 
8   \item  $\frac{\pi}{4} = \frac{1}{1} - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \dots$ 
9 \end{itemize}
10 \end{document}
```

1.3 Practical 3: Typesetting Mathematical Sentences

Objective: To create a document containing standard mathematical statements with inline and display math.

```
1 \documentclass{article}
2 \begin{document}
3 \begin{enumerate}
4   \item  $\cos \theta = \sin(90^\circ - \theta)$ 
5   \item  $e^{i\theta} = \cos \theta + i \sin \theta$ 
6   \item  $\lim_{\theta \rightarrow 0} \frac{\sin \theta}{\theta} = 1$ 
7   \item  $\lim_{x \rightarrow \infty} \frac{\pi(x)}{x / \log x} = 1$ 
8   \item  $\int_{-\infty}^{\infty} e^{-x^2} dx = \sqrt{\pi}$ 
9 \end{enumerate}
10 \end{document}
```

1.4 Practical 4: Large Delimiters and Matrices

Objective: To typeset complex structures requiring scalable delimiters.

```
1 \documentclass{article}
2 \usepackage{amsmath}
3 \begin{document}
4 \[
5 \frac{d}{dx} \left( \frac{x}{x+1} \right) = \frac{1}{(x+1)^2}
6 \]
7
8 \[
9 \lim_{n \rightarrow \infty} \left( 1 + \frac{1}{n} \right)^n = e
10 \]
11
12 \[
13 \left[
14 \begin{array}{cc}
15 a_{11} & a_{12} \\
16 a_{21} & a_{22}
17 \end{array}
18 \right]
19 \left[
20 \begin{array}{cc}
21 b_{11} & b_{12} \\
22 b_{21} & b_{22}
23 \end{array}
24 \right]
25 =
26 \left[
27 \begin{array}{cc}
28 a_{11}b_{11} + a_{12}b_{21} & a_{11}b_{12} + a_{12}b_{22} \\
29 a_{21}b_{11} + a_{22}b_{21} & a_{21}b_{12} + a_{22}b_{22}
30 \end{array}
31 \right]
32 \]
33
34 \[
35 f(x) = \left\{
36 \begin{array}{l}
37 -x^2, \text{ \& } x < 0 \\
38 x^2, \text{ \& } 0 \leq x \leq 2 \\
39 4, \text{ \& } x > 2
40 \end{array}
41 \right.
42 \]
43 \end{document}
```

1.5 Practical 5: Multi-line Equations

Objective: To use the eqnarray environment to typeset chained calculations.

```
1 \documentclass{article}
2 \begin{document}
3 \begin{eqnarray}
4 (a+b)^2 &=& (a+b)(a+b) \\
5 &=& (a+b)a + (a+b)b \\
6 &=& a(a+b) + b(a+b) \\
7 &=& a^2 + ab + ba + b^2 \\
8 &=& a^2 + 2ab + b^2 \\
9 \end{eqnarray}
10 \end{document}
```

1.6 Practical 6: Picture Environment

Objective: To use the native L^AT_EX picture environment to draw geometric shapes.

```
1 \documentclass{article}
2 \begin{document}
3 \begin{center}
4 \begin{picture}(150,150)
5 \put(10,10){\line(1,0){120}}
6 \put(130,10){\line(0,1){50}}
7 \put(130,60){\line(-12,-5){120}}
8 \put(70,0){4}
9 \put(140,30){3}
10 \put(60,45){5}
11 \put(120,10){\line(0,1){10}}
12 \put(120,20){\line(1,0){10}}
13 \end{picture}
14 \end{center}
15 \end{document}
```

2 Part 2: Graphics and Plotting with PSTricks

2.1 Practical 7: PSTricks - 5-12-13 Triangle

Objective: To create a precise Pythagorean triangle diagram using PSTricks.

```
1 \documentclass{article}
2 \usepackage{pstricks}
3 \begin{document}
4 \begin{pspicture}(0,0)(12,5)
5 \psline(0,0)(12,0)(12,5)(0,0)
6 \psline(11.5,0)(11.5,0.5)(12,0.5)
7 \put(6,-0.5){12}
8 \put(12.5,2.5){5}
9 \put(5,3){13}
10 \end{pspicture}
11 \end{document}
```

2.2 Practical 8: PSTricks - Venn Diagram

Objective: To construct a 3-set Venn diagram with a shaded intersection.

```
1 \documentclass{article}
2 \usepackage{pstricks}
3 \begin{document}
4 \begin{pspicture}(-3,-2)(3,2)
5 \psclip{\pscircle(-1,0){2}}
6 \pscircle[fillstyle=solid, fillcolor=lightgray](1,0){2}
7 \endpsclip
8 \pscircle(-1,0){2}
9 \pscircle(1,0){2}
10 \put(-2.5, 0.2){multiples}
11 \put(-2.2, -0.3){of 2}
12 \put(1.5, 0.2){multiples}
13 \put(1.8, -0.3){of 3}
14 \put(-0.6, 0.2){multiples}
15 \put(-0.3, -0.3){of 6}
16 \end{pspicture}
17 \end{document}
```

2.3 Practical 9: PSTricks - Ellipse and Foci

Objective: To draw an ellipse demonstrating the constant sum of focal distances.

```
1 \documentclass{article}
2 \usepackage{pstricks}
3 \begin{document}
4 \begin{pspicture}(-3,-2)(3,2)
5 \psellipse(0,0)(2.5,1.5)
```

```

6 \put(-1.5,0){\circle{0.1}}
7 \put(1.5,0){\circle{0.1}}
8 \put(-1.8,-0.4){$F_1$}
9 \put(1.4,-0.4){$F_2$}
10 \put(1.2,1.3){\circle{0.1}}
11 \put(1.4,1.4){$P$}
12 \psline(-1.5,0)(1.2,1.3)(1.5,0)
13 \end{pspicture}
14 \end{document}

```

2.4 Practical 10: PSTricks - Plotting Piecewise Functions

Objective: To plot a piecewise parabolic function using pst-plot.

```

1 \documentclass{article}
2 \usepackage{pst-plot}
3 \begin{document}
4 \begin{pspicture}(-3,-5)(3,5)
5 \psaxes{->}(0,0)(-2.5,-4.5)(2.5,4.5)
6 \psplot[plotpoints=200]{0}{2}{x 2 exp}
7 \psplot[plotpoints=200]{-2}{0}{x 2 exp -1 mul}
8 \put(2.6,0){$x$}
9 \put(0,4.7){$y$}
10 \end{pspicture}
11 \end{document}

```

2.5 Practical 11: PSTricks - Sine and Cosine Plot

Objective: To overlay trigonometric functions with different line styles.

```

1 \documentclass{article}
2 \usepackage{pst-plot}
3 \begin{document}
4 \begin{pspicture}(-0.5,-1.5)(7,1.5)
5 \psset{xunit=1cm, yunit=1cm}
6 \psaxes[trigLabels=true, trigLabelBase=2]{->}(0,0)(0,-1.5)
   (6.5,1.5)
7 \psplot[plotpoints=500, linestyle=solid]{0}{6.28}{x RadtoDeg sin}
8 \psplot[plotpoints=500, linestyle=dotted]{0}{6.28}{x RadtoDeg cos
   }
9 \end{pspicture}
10 \end{document}

```

2.6 Practical 12: PSTricks - Oscillating Curves

Objective: To plot the damping oscillating curve $\sqrt{x} \sin(1/x)$.

```

1 \documentclass{article}
2 \usepackage{pst-plot}
3 \begin{document}
4 \begin{pspicture}(-0.5,-2)(3,2)
5 \psset{xunit=2cm, yunit=2cm}
6 \psaxes{->}(0,0)(-0.2,-1.5)(2.5,1.5)
7 \psplot[plotpoints=2000, linestyle=solid]{0.01}{2}{x sqrt 1 x div
   RadtoDeg sin mul}
8 \psplot[plotpoints=500, linestyle=dotted]{0}{2}{x sqrt}
9 \psplot[plotpoints=500, linestyle=dotted]{0}{2}{x sqrt -1 mul}
10 \end{pspicture}
11 \end{document}

```

2.7 Practical 13: PSTricks - Parametric Plot (Cardioid)

Objective: To use parametric plot commands to render a cardioid.

```

1 \documentclass{article}
2 \usepackage{pst-plot}
3 \begin{document}
4 \begin{pspicture}(-3,-3)(1,3)
5 \psaxes[ticks=none, labels=none]{<->}(0,0)(-2.5,-2.5)(0.5,2.5)
6 \parametricplot[plotpoints=500]{0}{360}{t cos 1 t cos sub mul t
   sin 1 t cos sub mul}
7 \end{pspicture}
8 \end{document}

```

2.8 Practical 14: PSTricks - Bipartite Graph ($K_{3,3}$)

Objective: To draw a network graph utilizing pst-node.

```

1 \documentclass{article}
2 \usepackage{pst-node}
3 \begin{document}
4 \begin{pspicture}(0,0)(4,4)
5 \psset{radius=0.2}
6 \put(1,3){\Circnode{U1}{}}
7 \put(1,2){\Circnode{U2}{}}
8 \put(1,1){\Circnode{U3}{}}
9 \put(3,3){\Circnode{V1}{}}
10 \put(3,2){\Circnode{V2}{}}
11 \put(3,1){\Circnode{V3}{}}
12 \ncline{U1}{V1} \ncline{U1}{V2} \ncline{U1}{V3}
13 \ncline{U2}{V1} \ncline{U2}{V2} \ncline{U2}{V3}
14 \ncline{U3}{V1} \ncline{U3}{V2} \ncline{U3}{V3}
15 \end{pspicture}
16 \end{document}

```

2.9 Practical 15: PSTricks - Complete Graph (K_5)

Objective: To draw a fully connected graph of five nodes.

```
1 \documentclass{article}
2 \usepackage{pst-node}
3 \begin{document}
4 \begin{pspicture}(-2,-2)(2,2)
5 \psset{radius=0.2}
6 \put(0,2){\Circlenode{1}{}}
7 \put(1.9,0.6){\Circlenode{2}{}}
8 \put(1.1,-1.6){\Circlenode{3}{}}
9 \put(-1.1,-1.6){\Circlenode{4}{}}
10 \put(-1.9,0.6){\Circlenode{5}{}}
11 \ncline{1}{2} \ncline{1}{3} \ncline{1}{4} \ncline{1}{5}
12 \ncline{2}{3} \ncline{2}{4} \ncline{2}{5}
13 \ncline{3}{4} \ncline{3}{5}
14 \ncline{4}{5}
15 \end{pspicture}
16 \end{document}
```

2.10 Practical 16: PSTricks - Petersen Graph

Objective: To draw the standard Petersen graph using nested geometric alignment.

```
1 \documentclass{article}
2 \usepackage{pst-node}
3 \begin{document}
4 \begin{pspicture}(-3,-3)(3,3)
5 \psset{radius=0.2}
6 % Outer pentagon
7 \put(0,2.5){\Circlenode{O1}{}}
8 \put(2.37,0.77){\Circlenode{O2}{}}
9 \put(1.47,-2.02){\Circlenode{O3}{}}
10 \put(-1.47,-2.02){\Circlenode{O4}{}}
11 \put(-2.37,0.77){\Circlenode{O5}{}}
12 \ncline{O1}{O2} \ncline{O2}{O3} \ncline{O3}{O4} \ncline{O4}{O5} \ncline{O5}{O1}
13 % Inner star
14 \put(0,1.2){\Circlenode{I1}{}}
15 \put(1.14,0.37){\Circlenode{I2}{}}
16 \put(0.7,-0.97){\Circlenode{I3}{}}
17 \put(-0.7,-0.97){\Circlenode{I4}{}}
18 \put(-1.14,0.37){\Circlenode{I5}{}}
19 \ncline{I1}{I3} \ncline{I3}{I5} \ncline{I5}{I2} \ncline{I2}{I4} \ncline{I4}{I1}
20 % Connections
21 \ncline{O1}{I1} \ncline{O2}{I2} \ncline{O3}{I3} \ncline{O4}{I4} \ncline{O5}{I5}
22 \end{pspicture}
23 \end{document}
```

2.11 Practical 17: PSTricks - Finite State Automaton

Objective: To draw an automaton with accepting states and labeled directed arcs.

```
1 \documentclass{article}
2 \usepackage{pst-node}
3 \begin{document}
4 \begin{pspicture}(0,0)(8,3)
5 \psset{radius=0.5}
6 \put(1,1.5){\Circlenode{A}{Start}}
7 \put(4,1.5){\Circlenode{B}{Ends 0}}
8 \put(7,1.5){\Circlenode[doubleline=true]{C}{Bad}}
9 \ncarc{->}{A}{B} \aput{0.5}{0}
10 \ncarc{->}{B}{C} \aput{0.5}{0}
11 \nccircle{->}{A}{0.5} \Bput{1}
12 \ncarc{->}{B}{A} \aput{0.5}{1}
13 \nccircle{->}{C}{0.5} \Bput{0,1}
14 \end{pspicture}
15 \end{document}
```

3 Part 3: Slide Presentations with Beamer

3.1 Practical 18: Beamer - The Pythagorean Theorem

Objective: To create a presentation slide explaining a core geometric theorem.

```
1 \documentclass{beamer}
2 \begin{document}
3 \begin{frame}
4 \frametitle{The Pythagorean Theorem}
5 \begin{itemize}
6   \item For any right-angled triangle, the square of the
7     hypotenuse is equal to the sum of the squares of the other
8     two sides.
9   \item Expressed algebraically:
10  \[
11  a^2 + b^2 = c^2
12  \]
13  \item Common integer solutions (Pythagorean triples) include:
14  \begin{itemize}
15    \item 3, 4, 5
16    \item 5, 12, 13
17  \end{itemize}
18 \end{itemize}
19 \end{frame}
20 \end{document}
```

3.2 Practical 19: Beamer - Fundamental Theorem of Calculus

Objective: To use the `\pause` command to reveal theorem steps sequentially.

```
1 \documentclass{beamer}
2 \begin{document}
3 \begin{frame}
4 \frametitle{Fundamental Theorem of Calculus}
5 \begin{enumerate}
6   \item Let  $f$  be a continuous real-valued function defined on
7     a closed interval  $[a, b]$ . \pause
8   \item Let  $F$  be the function defined, for all  $x$  in  $[a, b]$ 
9     ], by:
10  \[
11  F(x) = \int_a^x f(t) dt
12  \] \pause
13  \item Then  $F$  is uniformly continuous on  $[a, b]$  and
14    differentiable on the open interval  $(a, b)$ , and  $F'(x) =$ 
15     $f(x)$ .
16 \end{enumerate}
17 \end{frame}
18 \end{document}
```

3.3 Practical 20: Beamer - Linear Programming

Objective: To outline the Simplex Algorithm mathematically on a slide.

```
1 \documentclass{beamer}
2 \begin{document}
3 \begin{frame}
4 \frametitle{Linear Programming: The Simplex Algorithm}
5 \begin{itemize}
6   \item Used to find the optimal solution to linear programming
7     problems.
8   \item Standard form of the optimization problem:
9   \begin{align}
10    \text{Maximize: } & \mathbf{c}^T \mathbf{x} \\
11    \text{Subject to: } & A\mathbf{x} \leq \mathbf{b} \\
12    & \mathbf{x} \geq 0
13  \end{align}
14   \item The algorithm moves along the edges of the polytope
15     defined by the constraints to locate the vertex with the
16     maximum objective value.
17 \end{itemize}
18 \end{frame}
19 \end{document}
```

4 Part 4: Web Page Design with HTML

4.1 Practical 21: HTML - Correcting Syntax

Objective: To correct nested tag errors in HTML syntax.

```
1 <html>
2 <head>
3 <title>Syntax Correction</title>
4 </head>
5 <body>
6 <!-- Corrected nested tags -->
7 <p> This is <strong><em>bold and italics</em></strong>.</p>
8 </body>
9 </html>
```

4.2 Practical 22: HTML - Personal Academic Page

Objective: To structure a basic web page using lists and paragraphs.

```
1 <html>
2 <head>
3 <title>Academic Profile</title>
4 </head>
5 <body>
6 <h2>Research Interests</h2>
7 <p>I am a mathematics student focusing on the following core
  areas:</p>
8 <ul>
9   <li>Complex Analysis</li>
10  <li>Differential Equations</li>
11  <li>Algebraic Structures</li>
12 </ul>
13 <p>Currently researching the application of Taylor series
  expansions.</p>
14 </body>
15 </html>
```

4.3 Practical 23: HTML - Hyperlinks

Objective: To embed external reference links within web page text.

```
1 <html>
2 <head>
3 <title>Math Resources</title>
4 </head>
5 <body>
6 <h2>Professional Organizations</h2>
7 <p>Check out the
```

```

8 <a href="http://www.maa.org/">Mathematical Association of America
  </a> for educational resources.</p>
9 <p>Also visit the
10 <a href="http://www.ams.org/">American Mathematical Society</a>
   for research publications.</p>
11 </body>
12 </html>

```

4.4 Practical 24: HTML - Multimedia Integration

Objective: To insert images with appropriate size attributes and descriptive text.

```

1 <html>
2 <head>
3 <title>Graph Theory Diagrams</title>
4 </head>
5 <body>
6 <center>
7 <h2>The Complete Graph K5</h2>
8 
9 <p>This image depicts a complete graph with 5 vertices,
   containing exactly 10 edges connecting every node.</p>
10 </center>
11 </body>
12 </html>

```

4.5 Practical 25: HTML - Multi-page Linking

Objective: To use an image as a clickable link to a secondary HTML page.

```

1 <html>
2 <head>
3 <title>Two Proofs of the Pythagorean Theorem</title>
4 </head>
5 <body>
6 <center>
7 <h2>Geometric Proof</h2>
8 <p>Click the image below to view the detailed geometric proof:</p>
  <
9 <a href="geometric_proof.html">
10   
11 </a>
12 </center>
13 </body>
14 </html>

```