GSMST

Applications of Linear Algebra in Programming

Learning LaTeX

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Submitted To:
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Infinite Possibilities
Gwinnett School of Mathematics, Science, and Technology

Contents

1 Mathematical expressions

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1.1 Expression 1

$$\begin{cases} w + x + y + z = 6 \\ w + y + z = 4 \\ w + y = 2 \end{cases}$$

```
\Huge
    \systeme {
        w + x + y + z = 6,
        w + y + z = 4,
        w + y = 2
    }
```

$$\begin{cases} w + x + y + z = 6 \\ w + y + z = 4 \\ w + y = 2 \end{cases}$$

1.2 Expression 2

$$k \neq -1,\ 1$$

$$\frac{1}{k+1}, \frac{1}{k+1}$$

```
\Huge \begin{eqnarray*}
k\neq-1, 1 \\
\\
{\frac{1}{k+1}},{\frac{1}{k+1}}
\end{eqnarray*}
```

$$k \neq -1, 1$$

$$\frac{1}{k+1}, \frac{1}{k+1}$$

1.3 Expression 3

$$\operatorname{tr} A := \sum_{j=1}^{n} a_{jj}.$$

```
\Huge
\operatorname{tr}A:=\sum_{j=1}^{n}a_{jj}
```

$$\operatorname{tr} A := \sum_{j=1}^{n} a_{jj}$$

1.4 Expression 4

$$A(\theta) = \left[\begin{matrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{matrix}\right].$$

```
\begin{eqnarray*}
A(\theta)={\left[
\begin{matrix}
\cos{\theta} & -\sin{\theta} \\
\sin{\theta} & \cos{\theta}
\end{matrix}\right]}.
\end{eqnarray*}
```

$$A(\theta) = \left[\begin{matrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{matrix}\right].$$

1.5 Expression 5

$$A = \left[\begin{matrix} 0 & a & a^2 & a^3 & a^4 \\ 0 & 0 & a & a^2 & a^3 \\ 0 & 0 & 0 & a & a^2 \\ 0 & 0 & 0 & 0 & a \\ 0 & 0 & 0 & 0 & 0 \end{matrix} \right]$$

```
$$
A = \left [ \begin{matrix}
0 & a & a^2 & a^3 & a^4 \\
0 & 0 & a & a^2 & a^3 \\
0 & 0 & 0 & a & a^2 \\
0 & 0 & 0 & 0 & a \\
0 & 0 & 0 & 0 & 0
\end{matrix} \right ]
$$
```

$$A = \left[\begin{matrix} 0 & a & a^2 & a^3 & a^4 \\ 0 & 0 & a & a^2 & a^3 \\ 0 & 0 & 0 & a & a^2 \\ 0 & 0 & 0 & 0 & a \\ 0 & 0 & 0 & 0 & 0 \end{matrix} \right]$$

1.6 Expression 6

3.1.6. Proposition. *Let* $n \in \mathbb{N}$ *and* $\mathbf{M}_{n\times n}$ *be the collection of all* $n \times n$ *matrices. There is exactly one function*

$$\det\colon \mathbf{M}_{n\times n} \to \mathbb{R}\colon A \mapsto \det A$$

```
$$
\textbf{3.1.6 Proposition.} \emph{Let } n \in \mathbb{N} \emph{and } \textbf{M}_{r
\emph{ be the collection of all } n \times n \emph{ matrices. There is exactly }$$
$$\begin{center}
    \det : \mathbf{M}_{n \times n} \rightarrow \mathbb{R}\colon A\mapsto \det A
\end{center}
$$
```

3.1.6 Proposition. *Let* $n \in \mathbb{N}$*and* $\mathbf{M}_{n\times n}$ *be the collection of all* $n{\times}n$ *matrices. There is exactly*

one function

$$\det : \mathbf{M}_{n\times n} \rightarrow \mathbb{R}\colon A\mapsto \det A$$

1.7 Expression 7

3.1.12. Proposition. *If* $A \in \mathbf{M}_{n\times n}$ *and* $1 \le j \le n$, *then*

$$\det A = \sum_{k=1}^{n} a_{jk} C_{jk}.$$

```
\Large \begin{proposition}
If $A \in \mathbb{M}_{n \cross n} $ and $1 \le j \le n$,
\begin{equation*} \hspace{10000pt minus 1fil}
\det A: \sum_{k=1}^{n}a_{jk}C_{jk}  \hfilneg \end{equatio
\end{proposition}
```

Proposition 1. *If* $A \in \mathbb{M}_{nn}$ *and* $1 \le j \le n$, *then*

$$\det A : \sum_{k=1}^{n} a_{jk} C_{jk}$$

1.8 Expression 8

$$|ad + be + cf| \leq \sqrt{a^2 + b^2 + c^2}\sqrt{d^2 + e^2 + f^2}.$$

```
\begin{eqnarray*}
\vert a d+b e+c f\vert\leq{\sqrt{a^{2}+b^{2}+c^{2}}}{\sqrt{d^{2}+e^{2}+f^{2}}}
\end{eqnarray*}
```

$$|ad + be + cf| \leq \sqrt{a^2 + b^2 + c^2}\sqrt{d^2 + e^2 + f^2}$$

1.9 Expression 9

Let V be the set of all real numbers x such that $x \geq 0$. Define an operation of "addition" by

$$x \boxplus y = xy + 1$$

for all x, $y \in V$. Define an operation of "scalar multiplication" by

$$\alpha \boxdot x = \alpha^2 x$$

for all $\alpha \in \mathbb{R}$ and $x \in V$.

```
\text{Let $V$ be the set of real numbers $x$ such that $x >= 0$. Define an operati
\begin{center}
x \boxplus \ y = xy+1
\end{center}
\begin{flushleft}
\text{for all $x, y \in V$. Define an operation of "scalar multiplication" by} \\
\end{flushleft}
\begin{center}
a \boxdot \ x = a^2x
\end{center}
\begin{flushleft}
\text{for all $a \in R$ and $x \in V$.}
\end{flushleft}
```

Let V be the set of real numbers x such that $x >= 0$. Define an operation of "addition" by

$$\text{x} \boxplus \ y = xy+1$$

for all $x, y \in V$. Define an operation of "scalar multiplication" by

$$\text{a} \boxdot \ x = a^2x$$

for all $a \in R$ and $x \in V$.

1.10 Expression 10

$$\left[\begin{matrix} 0 & -\frac{1}{2} & 0 & \frac{1}{2} & \vdots & 1 & 0 & 0 & 0 \\ 0 & 0 & \frac{1}{2} & \frac{1}{2} & \vdots & 0 & 1 & 0 & 0 \\ \frac{1}{2} & 0 & -\frac{1}{2} & 0 & \vdots & 0 & 0 & 1 & 0 \\ 1 & 0 & \frac{1}{2} & \frac{1}{2} & \vdots & 0 & 0 & 0 & 1 \end{matrix} \right] \xrightarrow{X_1} \left[\begin{matrix} 1 & 0 & \frac{1}{2} & \frac{1}{2} & \vdots & & & & \\ 0 & 0 & \frac{1}{2} & \frac{1}{2} & \vdots & & & & \\ \frac{1}{2} & 0 & -\frac{1}{2} & 0 & \vdots & & & & \\ 0 & -\frac{1}{2} & 0 & \frac{1}{2} & \vdots & & & & \end{matrix} \right]$$

```
\begin{eqnarray*}
\left [ \begin{matrix}
0 & -\frac{1}{2} & 0 & \frac{1}{2} & : & 1 & 0 & 0 & 0 \\
0 & 0 & \frac{1}{2} & \frac{1}{2} & : & 0 & 1 & 0 & 0 \\
\frac{1}{2} & 0 & -\frac{1}{2} & 0 & : & 0 & 0 & 1 & 0 \\
1 & 0 & \frac{1}{2} & \frac{1}{2} & : & 0 & 0 & 0 & 1 \\
\end{matrix} \right ] \xrightarrow{X_1}
\left [ \begin{matrix}
1 & 0 & \frac{1}{2} & \frac{1}{2} & : &  &  &  &  \ \ \ \ \ \ \ \ \ \ \ \ \ \\
0 & 0 & \frac{1}{2} & \frac{1}{2} & : &  &  &  &  \\
\frac{1}{2} & 0 & -\frac{1}{2} & 0 & : &  &  &  &  \\
0 & -\frac{1}{2} & 0 & \frac{1}{2} & : &  &  &  &  \\
\end{matrix} \right ]
\end{eqnarray*}
```

$$\left[\begin{matrix} 0 & -\frac{1}{2} & 0 & \frac{1}{2} & : & 1 & 0 & 0 & 0 \\ 0 & 0 & \frac{1}{2} & \frac{1}{2} & : & 0 & 1 & 0 & 0 \\ \frac{1}{2} & 0 & -\frac{1}{2} & 0 & : & 0 & 0 & 1 & 0 \\ 1 & 0 & \frac{1}{2} & \frac{1}{2} & : & 0 & 0 & 0 & 1 \end{matrix} \right] \xrightarrow{X_1} \left[\begin{matrix} 1 & 0 & \frac{1}{2} & \frac{1}{2} & : & & & & \ \ \ \ \ \ \ \ \ \ \ \ \ \\ 0 & 0 & \frac{1}{2} & \frac{1}{2} & : & & & & \\ \frac{1}{2} & 0 & -\frac{1}{2} & 0 & : & & & & \\ 0 & -\frac{1}{2} & 0 & \frac{1}{2} & : & & & & \end{matrix} \right]$$

1.11 Expression 11

$$a_{jk} = \begin{cases} 0, & \text{for } |j-k| > 1 \\ 1, & \text{for } |j-k| = 1 \\ 2\cos x, & \text{for } j = k. \end{cases}$$

```
\Huge
a_{jk} = \begin{cases}
0, & \text{for $\vert j-k \vert 1$} \\
1, &\text{for $\vert j-k \vert = 1$} \\
2\cos x, &\text{for $j=k$} \\
\end{cases}
```

$$\mathrm{a}_{jk} = \begin{cases} 0, & \text{for } |j-k|1 \\ 1, & \text{for } |j-k| = 1 \\ 2\cos x, & \text{for } j=k \end{cases}$$

1.12 Expression 12

4.1.3. Definition. Let $\mathbf{x}$ and $\mathbf{y}$ be nonzero vectors in $\mathbb{R}^n$. Then $\measuredangle(\mathbf{x}, \mathbf{y})$, the ANGLE between $\mathbf{x}$ and $\mathbf{y}$, is defined by

$$\measuredangle(\mathbf{x}, \mathbf{y}) = \arccos \frac{\langle \mathbf{x}, \mathbf{y} \rangle}{\|\mathbf{x}\| \, \|\mathbf{y}\|}$$

```
\begin{flushleft}
\text{\textbf{4.1.3 Definition. }Let $\mathbf{x}$ and $\mathbf{y}$ be nonzero vect
\end{flushleft}
\begin{equation*}
\measuredangle{(\mathbf{x}, \mathbf{y})} = \arccos \frac{\langle \mathbf{x}, \math
\end{equation*}
```

4.1.3 Definition. Let $\mathbf{x}$ and $\mathbf{y}$ be nonzero vectors in $\mathbb{R}^n$. Then $\measuredangle(\mathbf{x}, \mathbf{y})$, the ANGLE between $\mathbf{x}$ and $\mathbf{y}$, is defined by

$$\measuredangle(\mathbf{x}, \mathbf{y}) = \arccos \frac{\langle \mathbf{x}, \mathbf{y} \rangle}{\|\mathbf{x}\|\|\mathbf{y}\|}$$

1.13 Expression 13

$$M \cap N$$
$$M \cup N$$

```
\Huge \begin{eqnarray*}
M\cap N \\
M\cup N
\end{eqnarray*}
```

$$M \cap N$$
$$M \cup N$$

1.14 Expression 14

$$\int_{0}^{1} t g(t)\,dt = 0 \qquad \text{and} \qquad \int_{0}^{1} t^{4} g(t)\,dt = 0$$

```
\huge \begin{eqnarray*}
\int_{0}^{1}t g(t)\,d t=0 \hspace{50pt} \text{and} \hspace{50pt} \int_{0}^{1}t^{4}
\end{eqnarray*}
```

$$\int_{0}^{1} t g(t)\,dt = 0 \qquad \text{and} \qquad \int_{0}^{1} t^{4} g(t)\,dt = 0$$

1.15 Expression 15

$$\mathbf{y}=\left(-\frac{1}{2},\frac{\sqrt{3}}{2}\right)$$

```
\mathbf{y}=\left(-{\frac{1}{2}},{\frac{\sqrt{3}}{2}}\right)
```

$$\mathbf{y}=\left(-{\frac{1}{2}},{\frac{\sqrt{3}}{2}}\right)$$

2 A LaTeX Meme