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SECTION 1 MATHEMATICS

1.1 Linear Algebra

[TBD]

1.1.1 Gauss-Jordan Elimination (Reduced Row Echelon Form)

[TBD]

1.1.2 Matrix Inverse

[TBD]

1.1.3 Eigenvalues & Eigenvectors

[TBD]

1.1.4 Singular Value Decomposition

[TBD]

1.2 Trigonometry

1.2.1 Trigonometric Identities

Basic identities

$$\begin{aligned}\tan(t) &= \frac{\sin(t)}{\cos(t)} & \sec(t) &= \frac{1}{\cos(t)} \\ \cot(t) &= \frac{1}{\tan(t)} & \csc(t) &= \frac{1}{\sin(t)}\end{aligned}$$

Trig functions in terms of their complements

$$\begin{array}{ll}\sin(t) = \cos\left(\frac{\pi}{2} - t\right) & \sec(t) = \csc\left(\frac{\pi}{2} - t\right) \\ \cos(t) = \sin\left(\frac{\pi}{2} - t\right) & \csc(t) = \sec\left(\frac{\pi}{2} - t\right) \\ \tan(t) = \cot\left(\frac{\pi}{2} - t\right) & \cot(t) = \tan\left(\frac{\pi}{2} - t\right)\end{array}$$

Negative angles of trig functions

$$\begin{aligned}\sin(-t) &= -\sin(t) \\ \cos(-t) &= \cos(t) \\ \tan(-t) &= -\tan(t)\end{aligned}$$

Pythagorean Theorem for trig functions

$$\begin{aligned}\sin^2(t) + \cos^2(t) &= 1 \\ \sec^2(t) &= 1 + \tan^2(t)\end{aligned}$$

Sum and difference formulas for trig functions

$$\begin{aligned}\sin(s+t) &= \sin(s) \cdot \cos(t) + \cos(s) \cdot \sin(t) \\ \cos(s+t) &= \cos(s) \cdot \cos(t) - \sin(s) \cdot \sin(t) \\ \tan(s+t) &= \frac{\tan(s) + \tan(t)}{1 - \tan(s) \cdot \tan(t)}\end{aligned}$$

$$\begin{aligned}\sin(s-t) &= \sin(s) \cdot \cos(t) - \cos(s) \cdot \sin(t) \\ \cos(s-t) &= \cos(s) \cdot \cos(t) + \sin(s) \cdot \sin(t) \\ \tan(s-t) &= \frac{\tan(s) - \tan(t)}{1 + \tan(s) \cdot \tan(t)}\end{aligned}$$

Double angle formulas

$$\begin{aligned}\sin(2t) &= 2 \sin(t) \cdot \cos(t) \\ \tan(2t) &= \frac{2 \cdot \tan(t)}{1 - \tan^2(t)}\end{aligned}$$

$$\begin{aligned}\cos(2t) &= \cos^2(t) - \sin^2(t) \\ &= 2 \cdot \cos^2(t) - 1 \\ &= 1 - 2 \cdot \sin^2(t)\end{aligned}$$

Triple angle formulas

$$\begin{aligned}\sin(3t) &= 3 \cdot \sin(t) - 4 \cdot \sin^3(t) \\ \cos(3t) &= 4 \cdot \cos^3(t) - 3 \cdot \cos(t) \\ \tan(3t) &= \frac{3 \tan(t) - \tan^3(t)}{1 - 3 \tan^2(t)}\end{aligned}$$

Half angle formulas

$$\begin{aligned}\sin\left(\frac{1}{2}t\right) &= \pm \sqrt{\frac{1 - \cos(t)}{2}} \\ \cos\left(\frac{1}{2}t\right) &= \pm \sqrt{\frac{1 + \cos(t)}{2}} \\ \tan\left(\frac{1}{2}t\right) &= \frac{\sin(t)}{1 + \cos(t)} = \frac{1 - \cos(t)}{\sin(t)}\end{aligned}$$

Product sum identities

$$\begin{aligned}\sin(s) + \sin(t) &= 2 \cdot \sin\left(\frac{s+t}{2}\right) \cdot \cos\left(\frac{s-t}{2}\right) \\ \sin(s) - \sin(t) &= 2 \cdot \sin\left(\frac{s-t}{2}\right) \cdot \cos\left(\frac{s+t}{2}\right) \\ \cos(s) + \cos(t) &= 2 \cdot \cos\left(\frac{s+t}{2}\right) \cdot \cos\left(\frac{s-t}{2}\right) \\ \cos(s) - \cos(t) &= -2 \cdot \sin\left(\frac{s+t}{2}\right) \cdot \sin\left(\frac{s-t}{2}\right)\end{aligned}$$

Product identities

$$\begin{aligned}\sin(s) \cdot \sin(t) &= \frac{\cos(s-t) \cdot \cos(s+t)}{2} \\ \cos(s) \cdot \cos(t) &= \frac{\cos(s+t) \cdot \cos(s-t)}{2} \\ \sin(s) \cdot \cos(t) &= \frac{\sin(s+t) \cdot \sin(s-t)}{2}\end{aligned}$$

1.3 Calculus

1.3.1 Derivative Rules

1.3.1.1 Chain Rule

$$f(g(x))' = \frac{df}{dx} = \frac{df}{dg} \cdot \frac{dg}{dx}$$

$$y = (Ax^2 + Bx + C)^3$$

$$\frac{dy}{dx} = 3 \cdot (Ax^2 + Bx + C)^2 \cdot (2Ax + B)$$

[TBD]

1.3.1.2 Quotient Rule

$$\left(\frac{f(x)}{g(x)}\right)' = \frac{f(x)'g(x) - g(x)'f(x)}{g(x)^2}$$

[TBD]

1.3.1.3 Product Rule

$$(f(x) \cdot g(x))' = f(x) \cdot g(x)' + f(x)' \cdot g(x)$$

[TBD]

1.4 References

- 1 Joyce, David E., *Clark University – Department of Mathematics and Computer Science*, “Summary of Trigonometric Identities”, <http://www.clarku.edu/~djoyce/trig/identities.html>