Trigonometric Identities

We have established earlier that

$$
\cos ^{2} x+\sin ^{2} x=1
$$

by using the unit circle with the Pythagoras theorem.
Claim:

$$
\sec ^{2} x=1+\tan ^{2} x
$$

Proof:
we know that $\sec x=\frac{1}{\cos x}$ (by def)

$$
\begin{aligned}
& \text { ") "t that } \tan x=\frac{\sin x}{\cos x} \\
& \sec ^{2} x=1+\tan ^{2} x \\
& \therefore \quad\left(\begin{array}{ll}
\frac{1}{1}+\frac{\sin ^{2} x}{\cos ^{2} x} & \text { (create } \\
\text { common } \\
\cos ^{2} x & \sin ^{2} x
\end{array}\right) \\
& \frac{\sin ^{2} x+\cos ^{2} x}{\cos ^{2} x} \text { since } \sin ^{2} x+\cos ^{2} x=1 \\
& \frac{1}{\cos ^{2} x}=\sec ^{2} x \\
& \therefore \angle H S=\text { RHo } \\
& \text { QED }
\end{aligned}
$$

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Claim:

$$
\begin{aligned}
& 1+\cot ^{2} x=\csc ^{2} x \\
& \because \tan x=\frac{\sin x}{\cos x} \\
& \therefore \cot x=\frac{\cos x}{\sin x} \\
& \frac{1}{1}+\frac{\cos ^{2} x}{\sin ^{2} x} \\
& \frac{\sin ^{2} x}{\sin ^{2} x}+\frac{\cos ^{2} x}{\sin ^{2} x} \\
& \frac{\sin ^{2} x+\cos ^{2} x}{\sin ^{2} x} \\
& \frac{1}{\sin ^{2} x}=C S C X \\
& \therefore H S=R H S \\
& L H S
\end{aligned}
$$

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