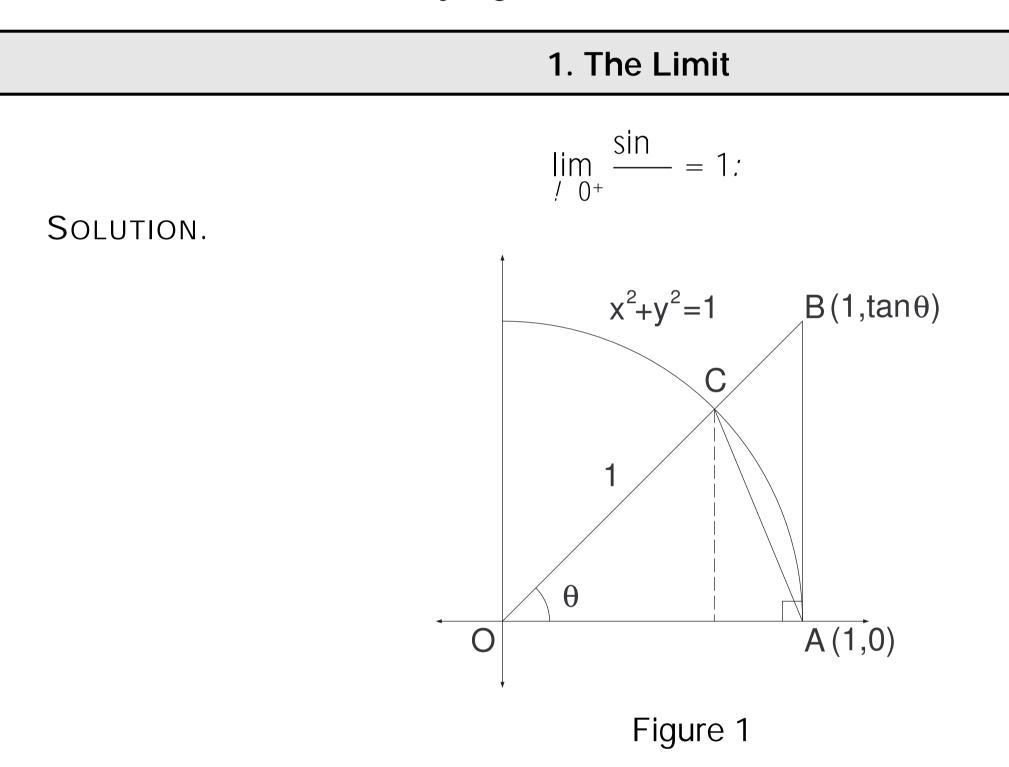
## L'Hospital's Rule Can be Used to Evaluate $\lim_{x \neq 0} \frac{\sin x}{x}$

Suppose f and g are differentiable on (a; b) and  $g^{\ell}(x) \neq 0$  for a < x < b. If  $\lim_{x/a^+} f(x) = \lim_{x/a^+} g(x) = 0$  and  $\lim_{x/a^+} \frac{f^{\ell}(x)}{g^{\ell}(x)} = L$ , then  $\lim_{x/a^+} \frac{f(x)}{g(x)} = \lim_{x/a^+} \frac{f^{\ell}(x)}{g^{\ell}(x)} = L$ .

## Abstract

The standard proof presented in calculus courses concludes that  $\frac{d}{dx} \sin x = \cos x$  using the limit  $\lim_{x \neq 0} \frac{\sin x}{x} = 1$ . A natural question then becomes can you logically use L'Hospital's Rule on this limit? The objective of this project is to name another method to find  $\frac{d}{dx} \sin x$ without using the limit  $\lim_{x \neq 0} \frac{\sin x}{x}$ . Once this proof is established, L'Hospital's Rule can then be used on this limit without any logical uncertainties.



Using Figure 1, we obtain the following equations, which are valid for 0 < =2: area of triangle  $OAC = \frac{1}{2}$  base height  $= \frac{1}{2}$  1 sin  $= \frac{\sin 1}{2}$ 

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L'HOSPITAL'S RULE