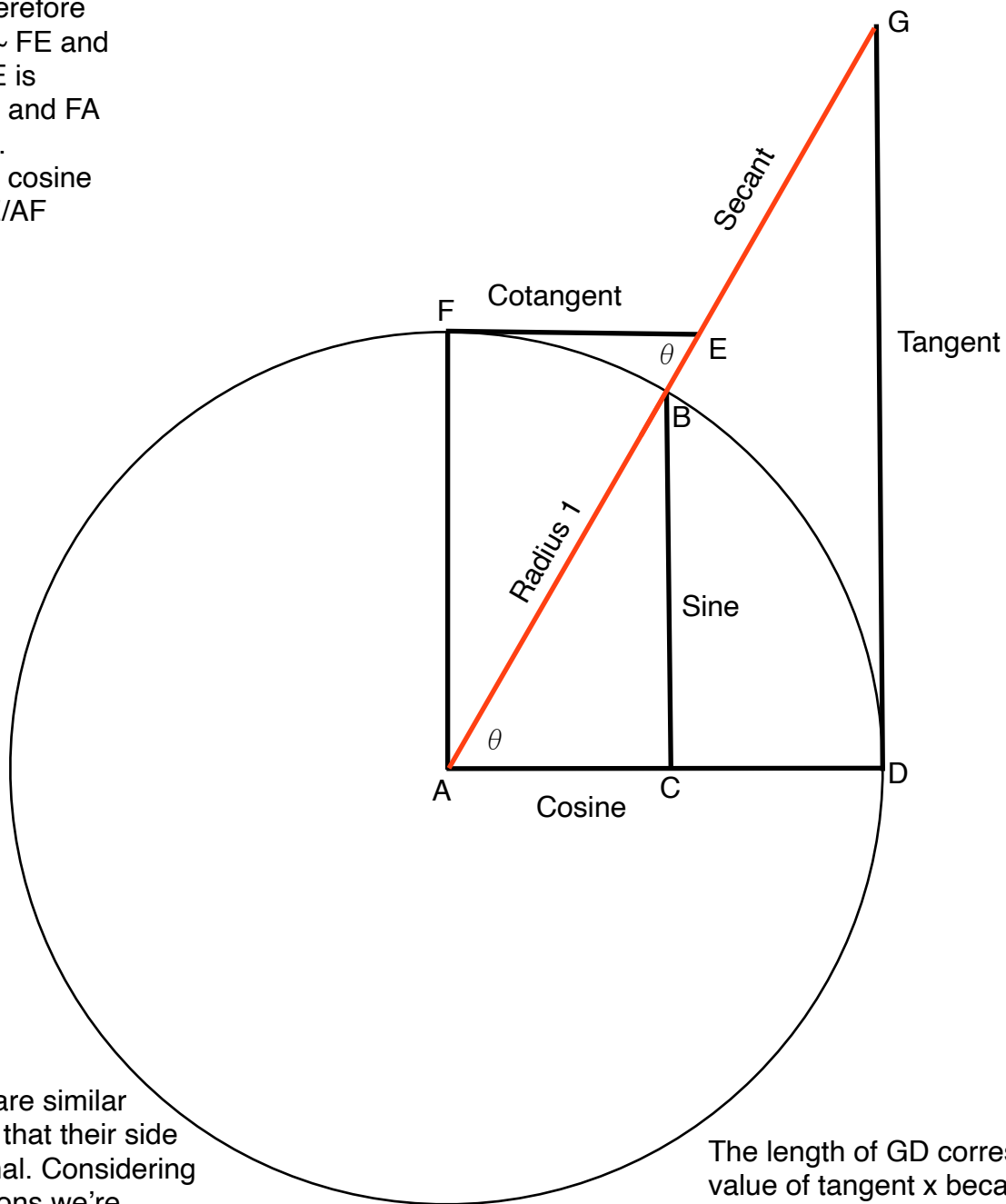The length of FE corresponds to cotangent because AFE and ABC are similar triangles and their sides are therefore proportional. So, AC ~ FE and FA ~ BC, therefore FE is proportional to cosine and FA is proportional to sine. Because cotangent is cosine over sine, we take FE/AF which is equal to FE.

Cosecant = AE

Secant

G

Cotangent

F

Tangent

θ E

B

Radius 1

Sine

θ

A

C

Cosine

D

ABC, AGD, and FAE are similar triangles. This means that their side lengths are proportional. Considering the value of the functions we're dealing with are ratios between lengths, and proportionality does not alter ratios, we are able to use the similar triangles when evaluating these ratios.

The length of AG is equal to secant because ABC ~ ADG. So, AC ~ AD and AB ~ AG. We may say secant is hypotenuse over adjacent thus = AG/AD or AG.

Do the same with AFE for cosecant. hypotenuse over opposite yields AE/AF or AE.

The length of GD corresponds to the value of tangent x because ACB and ADG are similar and therefore they have proportional side lengths. Because BC is proportional to GD and AC is proportional to AD, their resulting ratios will be equal. So BC/AC = GD/AD. Because AD=1, and BC/AC is sin/cos, the length GD is the value of the tangent of any theta.