Cosine Rule

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(*Minimal Working Triangle Solver for Cloud Deployment*)
(*Core Triangle Solving Function-Exactly as in original code*)
CosineRuleTriangleSolver[input_Association] := Module[{a, b, c, A, B, C,
    result = input}, (*Extract known values*)a = Lookup[input, "a", Null];
   b = Lookup[input, "b", Null];
   c = Lookup[input, "c", Null];
   A = Lookup[input, "A", Null];
   B = Lookup[input, "B", Null];
   C = Lookup[input, "C", Null];
   (*Case:Three sides known*)
   If[a =!= Null && b =!= Null && c =!= Null, If[a + b ≤ c || a + c ≤ b || b + c ≤ a,
     Return["Invalid triangle: Triangle inequality violated."]];
    A = N[ArcCos[(b^2 + c^2 - a^2) / (2 * b * c)] * 180 / Pi];
    B = N[ArcCos[(a^2 + c^2 - b^2) / (2 * a * c)] * 180 / Pi];
    C = N[ArcCos[(a^2 + b^2 - c^2) / (2 * a * b)] * 180 / Pi];
    result = Append[result, "A" → A];
    result = Append[result, "B" → B];
    result = Append[result, "C" → C];
    Return[result]];
   (*Case:Two sides and the included angle*)If[a =!= Null && b =!= Null && C =!= Null,
    c = N[Sqrt[a^2 + b^2 - 2 * a * b * Cos[C * Pi / 180]]];
    A = N[ArcCos[(b^2 + c^2 - a^2) / (2 * b * c)] * 180 / Pi];
    B = N[ArcCos[(a^2 + c^2 - b^2) / (2 * a * c)] * 180 / Pi];
    result = Append[result, "c" → c];
    result = Append[result, "A" → A];
    result = Append[result, "B" → B];
    Return[result]];
   If[a =!= Null && c =!= Null && B =!= Null,
    b = N[Sqrt[a^2 + c^2 - 2 * a * c * Cos[B * Pi / 180]]];
    A = N[ArcCos[(b^2 + c^2 - a^2) / (2 * b * c)] * 180 / Pi];
    C = N[ArcCos[(a^2 + b^2 - c^2) / (2 * a * b)] * 180 / Pi];
    result = Append[result, "b" → b];
    result = Append[result, "A" → A];
    result = Append[result, "C" → C];
    Return[result]];
   If[b =!= Null && c =!= Null && A =!= Null,
    a = N[Sqrt[b^2 + c^2 - 2 * b * c * Cos[A * Pi / 180]]];
    B = N[ArcCos[(a^2 + c^2 - b^2) / (2 * a * c)] * 180 / Pi];
    C = N[ArcCos[(a^2 + b^2 - c^2) / (2 * a * b)] * 180 / Pi];
    result = Append[result, "a" → a];
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    result = Append[result, "B" → B];
    result = Append[result, "C" → C];
    Return[result]];
   (*Case:Two sides and the opposite angle (ambiguous case)*)
   If[a =!= Null && b =!= Null && A =!= Null,
    Module[{sinB}, sinB = (b * Sin[A * Pi / 180]) / a;
     If[sinB > 1,
      Return["No solution: The given values do not form a valid triangle."]];
     If[sinB == 1, B = 90;
      C = 180 - A - B;
      c = N[Sqrt[a^2 + b^2 - 2 * a * b * Cos[C * Pi / 180]]];
      result = Append[result, "B" → B];
      result = Append[result, "C" → C];
      result = Append[result, "c" → c];
      Return[result]];
     If[sinB < 1, Module[{B1, C1, c1, B2, C2, c2}, B1 = N[ArcSin[sinB] * 180 / Pi];
       C1 = 180 - A - B1;
       c1 = N[Sqrt[a^2 + b^2 - 2 * a * b * Cos[C1 * Pi / 180]]];
       B2 = 180 - B1;
       C2 = 180 - A - B2;
       c2 = N[Sqrt[a^2 + b^2 - 2 * a * b * Cos[C2 * Pi / 180]]];
       If[C2 > 0, Return[{<|"a" → a, "b" → b, "c" → c1, "A" → A,
            "B" → B1, "C" → C1|>, <|"a" → a, "b" → b, "c" → c2, "A" → A,
            "B" → B2, "C" → C2|>}];, result = Append[result, "B" → B1];
        result = Append[result, "C" → C1];
        result = Append[result, "c" → c1];
        Return[result]]]]];
   (*Case:Isosceles triangle*)If[a =!= Null && c =!= Null && B =!= Null && a == c,
    b = N[Sqrt[a^2 + c^2 - 2 * a * c * Cos[B * Pi / 180]]];
    A = C = (180 - B) / 2;
    result = Append[result, "b" → b];
    result = Append[result, "A" → A];
    result = Append[result, "C" → C];
    Return[result]];
   (*If we get here,we don't have enough information*)
   Return["Insufficient information to solve the triangle."]];

{"a = ",
 InputField[Dynamic[a], String, FieldSize → {10, 1}, Background → LightYellow,]}
(*Create a simple cloud-friendly UI*)
TriangleSolverCloudUI[] := DynamicModule[{a = "", b = "", c = "", A = "",
   B = "", C = "", angleUnit = "degrees", result = "", showResults = False},
  Column[{(*Header*)Style["Cosine Rule", Bold, 24, Blue],
    Style["Enter any 3 values to solve the triangle", 14],
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(*Input Controls*)Row[{Style["Angle input type: ", Bold],
  RadioButtonBar[Dynamic[angleUnit], {"degrees", "radians"}]}],
(*Inputs*)Grid[{{Style["Sides:", Bold, 14], SpanFromLeft},
  {"a = ", InputField[Dynamic[a], String, FieldSize → 10,
    Background → LightYellow]}, {"b = ", InputField[Dynamic[b],
    String, FieldSize → 10, Background → LightYellow]}, {"c = ",
   InputField[Dynamic[c], String, FieldSize → 10, Background → LightYellow]},
  {Style["Angles:", Bold, 14], SpanFromLeft}, {"A = ",
   InputField[Dynamic[A], String, FieldSize → 10, Background → LightYellow]},
  {"B = ", InputField[Dynamic[B], String, FieldSize → 10,
    Background → LightYellow]}, {"C = ", InputField[Dynamic[C], String,
    FieldSize → 10, Background → LightYellow]}}, Alignment → Left],
Style["Hint: You can enter mixed numbers like 2+3/4", Italic, 12, Gray],
(*Solve Button*)Button["Cosine Rule",
 Module[{input = ⟨| |⟩, val}, (*Process inputs*)If[a ≠ "", val = ToExpression[a];
   If[NumberQ[val], AppendTo[input, "a" → N[val]]]];
  If[b ≠ "", val = ToExpression[b];
   If[NumberQ[val], AppendTo[input, "b" → N[val]]]];
  If[c ≠ "", val = ToExpression[c];
   If[NumberQ[val], AppendTo[input, "c" → N[val]]]];
  (*Convert angles if necessary*)If[A ≠ "", val = ToExpression[A];
   If[NumberQ[val],
    AppendTo[input, "A" → If[angleUnit == "radians", N[val * 180 / Pi], N[val]]]]];
  If[B ≠ "", val = ToExpression[B];
   If[NumberQ[val],
    AppendTo[input, "B" → If[angleUnit == "radians", N[val * 180 / Pi], N[val]]]]];
  If[C ≠ "", val = ToExpression[C];
   If[NumberQ[val],
    AppendTo[input, "C" → If[angleUnit == "radians", N[val * 180 / Pi], N[val]]]]];
  (*Solve the triangle*)result = CosineRuleTriangleSolver[input];
  showResults = True;], Background → LightBlue,
 BaseStyle → {Bold, 14}, ImageSize → {150, 40}], (*Results Section*)
Dynamic[If[showResults, Column[{Style["Results:", Bold, 18, Blue],
    If[StringQ[result], Style[result, Bold, 14, Red], (*Display the
      triangle data*)Column[{Grid[{{"Side", "Value", "Angle", "Value"},
         {"a", NumberForm[Lookup[result, "a", "-"], {5, 2}], "A",
          ToString[NumberForm[Lookup[result, "A", "-"], {5, 2}]] <> "°"},
         {"b", NumberForm[Lookup[result, "b", "-"], {5, 2}], "B",
          ToString[NumberForm[Lookup[result, "B", "-"], {5, 2}]] <> "°"},
         {"c", NumberForm[Lookup[result, "c", "-"], {5, 2}], "C",
          ToString[NumberForm[Lookup[result, "C", "-"], {5, 2}]] <> "°"}},
        Frame → All, Background → {None, {LightCyan, LightBlue}}]}]]}],
  (*No results yet*)Style["Enter at least 3 values and click 'Cosine Rule'",
   Italic, 14, Gray]]]},
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    Alignment → Center, Spacings → 1]]
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In[•]:=
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CosineRuleTriangleSolver[<|"A" → 50, "b" → 5, "c" → 10|>]
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Out[•]=
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<| A → 50, b → 5, c → 10, a → 7.79238, B → 29.4415, C → 100.559 |>
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