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(*Зачетная Задача Номер 6*)
(*Руслан Голов*)

(*Нарисовать серединные перпендикуляры к сторонам
 треугольника на сфере (геометрии Лобачевского).*)
(*Требования:Вершина и стороны угла менять динамически (с помощью Locator)*)
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In[139]:=

$$g[z\_, z00\_] := \frac{z - z00}{1 - z\,\text{Conjugate}[z00]};$$

$$ginv[z\_, z0\_] := \frac{z + z0}{1 + z\,\text{Conjugate}[z0]};$$

$$function[z\_, z0\_] := \frac{1 - \sqrt{1 - \text{Abs}[g[z, z0]]^2}}{\text{Abs}[g[z, z0]]^2};$$

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line[z1_, z2_, t_] := ginv[t * g[z2, z1], z1];
(*Построение геодезической дуги*)

gg[z_, z0_] := g[g[z, z0], function[z, z0] * g[z, z0]];
func[z_, z0_] := i * gg[z, z0];
result[z_, z0_, t_] :=
  ginv[ginv[t * func[z, z0], function[z, z0] * g[z, z0]], z0];
(*Построение серединного перпендикуляра*)
Manipulate[
 Show[
  Graphics[Circle[]], (*Рисовалка*)
  ParametricPlot[
   With[{Z1 = line[Complex[p1[[1]], p1[[2]]], Complex[p2[[1]], p2[[2]]], t]},
    {Re[Z1], Im[Z1]}], {t, 0, 1}, PlotStyle → Thick, ColorFunction →
    Function[{x, y, t}, Blend[{Cyan, Cyan, Black}, Min[1, Sqrt[x^2 + y^2]]]],
   ColorFunctionScaling → False],
  ParametricPlot[
   With[{Z2 = line[Complex[p1[[1]], p1[[2]]], Complex[p3[[1]], p3[[2]]], t]},
    {Re[Z2], Im[Z2]}], {t, 0, 1}, PlotStyle → Thick, ColorFunction →
    Function[{x, y, t}, Blend[{Cyan, Cyan, Black}, Min[1, Sqrt[x^2 + y^2]]]],
   ColorFunctionScaling → False],
  ParametricPlot[
   With[{Z3 = line[Complex[p2[[1]], p2[[2]]], Complex[p3[[1]], p3[[2]]], t]},
    {Re[Z3], Im[Z3]}], {t, 0, 1}, PlotStyle → Thick, ColorFunction →
    Function[{x, y, t}, Blend[{Cyan, Cyan, Black}, Min[1, Sqrt[x^2 + y^2]]]],
   ColorFunctionScaling → False],
  ParametricPlot[
   With[{Z4 = result[Complex[p2[[1]], p2[[2]]], Complex[p1[[1]], p1[[2]]], t]},
    {Re[Z4], Im[Z4]}], {t, -1, 1}, PlotStyle → Dashed, ColorFunction →
    Function[{x, y, t}, Blend[{Orange, Red}, Min[1, Sqrt[x^2 + y^2]]]],
   ColorFunctionScaling → False],
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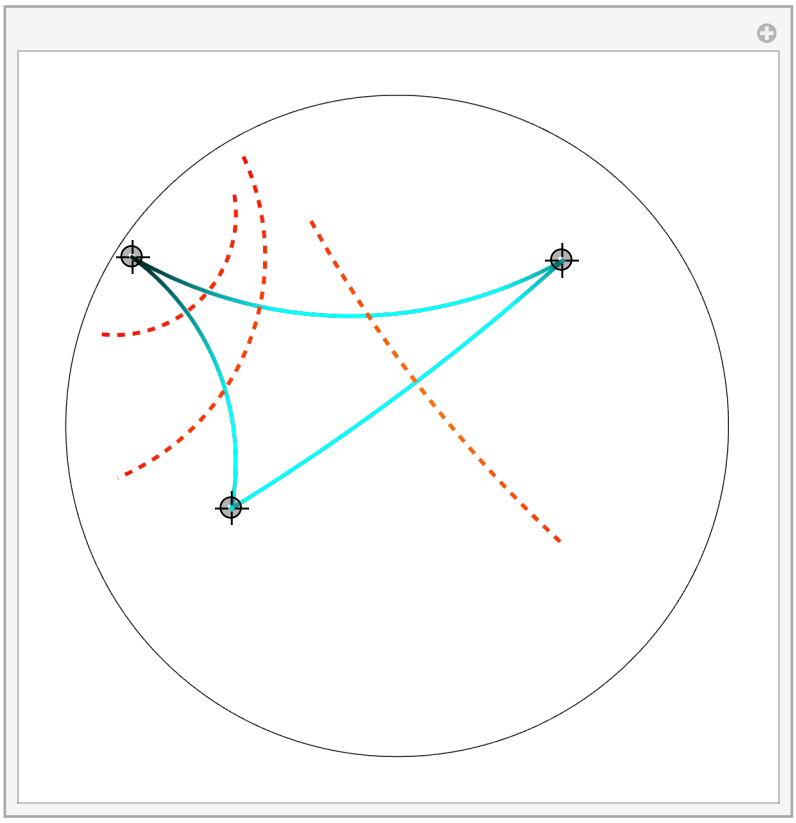
  ParametricPlot[
   With[{Z5 = result[Complex[p3[[1]], p3[[2]]], Complex[p2[[1]], p2[[2]], t]},
    {Re[Z5], Im[Z5]}], {t, -1, 1}, PlotStyle → Dashed, ColorFunction →
    Function[{x, y, t}, Blend[{Orange, Red}, Min[1, Sqrt[x^2 + y^2]]]],
   ColorFunctionScaling → False],
  ParametricPlot[
   With[{Z6 = result[Complex[p1[[1]], p1[[2]]], Complex[p3[[1]], p3[[2]], t]},
    {Re[Z6], Im[Z6]}], {t, -1, 1}, PlotStyle → Dashed, ColorFunction →
    Function[{x, y, t}, Blend[{Orange, Red}, Min[1, Sqrt[x^2 + y^2]]]],
   ColorFunctionScaling → False]
 ],
 {{p1, {0.5, 0.5}}, Locator},
 {{p2, {-0.5, 0.25}}, Locator},
 {{p3, {-0.5, -0.25}}, Locator}
]
```

Out[146]=



```
(*Нарисовать серединные перпендикуляры к сторонам
 треугольника на сфере (сферической геометрии).*)
(*Требования:Вершина и стороны угла менять динамически (с помощью Locator)*)
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In[388]:=

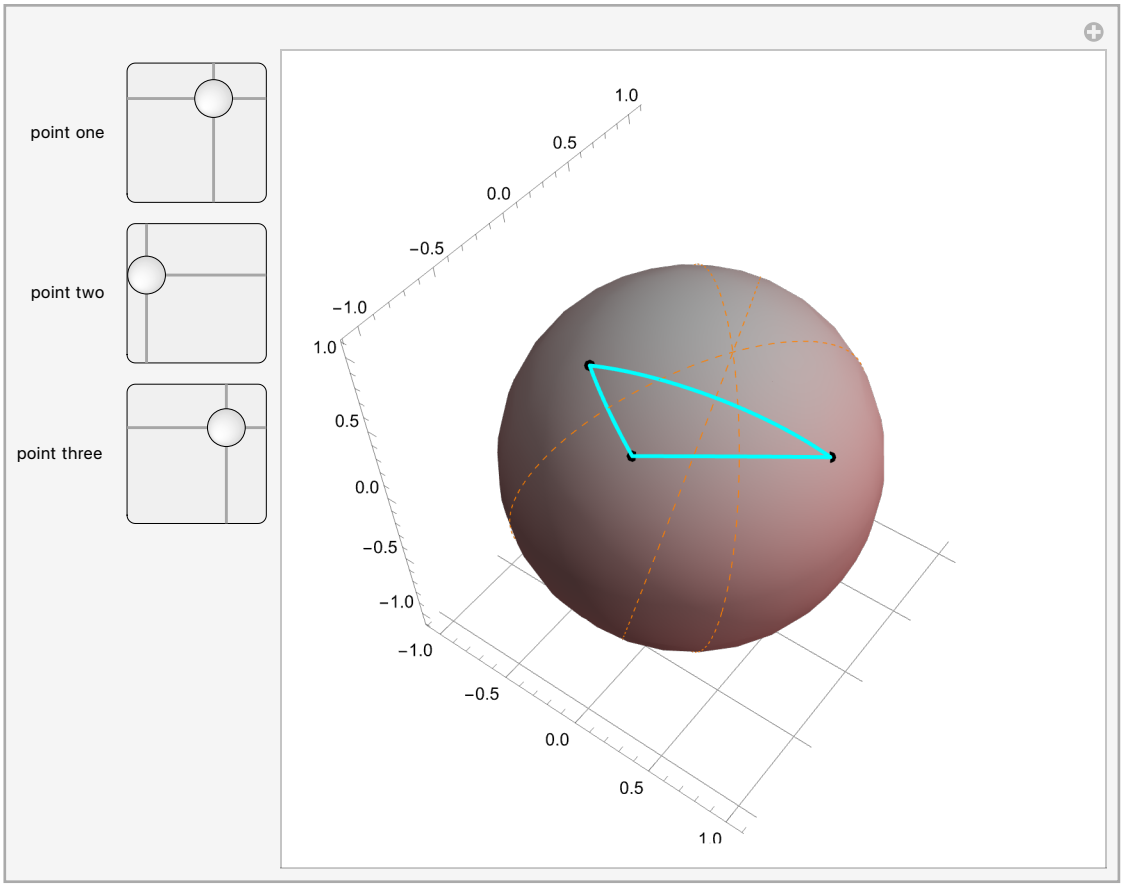
```
(*сферические координаты*)
sp[{φ_, θ_}] := {Sin[θ] Cos[φ], Sin[θ] Sin[φ], Cos[θ]};

(*дуга большого круга*)
ark[{r1_, r2_}, nt_ : 60] := Table[
   RotationTransform[t VectorAngle[r1, r2], Cross[r1, r2]][r1], {t, 0, 1, 1 / nt}];
eps = 10^-6;

bisArc[{r1_, r2_}, nt_ : 240] := Module[{n = Normalize[r1 - r2], u}, u =
    Normalize@If[Abs[n.{0, 0, 1}] < .9, Cross[n, {0, 0, 1}], Cross[n, {0, 1, 0}]];
   Table[Cos[t] u + Sin[t] Cross[n, u], {t, 0, 2 π, 2 π / nt}]];

Manipulate[If[p1 == p2, p1 = .99 p2];
 If[p1 == p3, p1 = .99 p3];
 If[p2 == p3, p3 = .99 p2];
 Module[{pts = sp /@ {p1, p2, p3}, sides, bis}, sides = ark /@ Subsets[pts, {2}];
  bis = bisArc /@ Subsets[pts, {2}];
  Show[{ParametricPlot3D[{Sin[θ] Cos[φ], Sin[θ] Sin[φ], Cos[θ]}, {φ, 0, 2 π},
     {θ, 0, π}, Mesh → None, ColorFunction → (Blend[{Pink, Gray}, (#3 + 1) / 2] &),
     ColorFunctionScaling → False],
    Graphics3D[{
      {Cyan, Thick, Line /@ sides},
      {Orange, Dashed, Line /@ bis}, {Black, PointSize[.015], Point[pts]}}]},
   Boxed → False, ImageSize → {400, 400}, FaceGrids → {{0, 0, -1}},
   FaceGridsStyle → GrayLevel[.5]]],
 {{p1, {4.2, 0.5}, "point one"}, {eps, π (1 - eps)}, {2 π (1 - eps), eps}},
 {{p2, {0, 1}, "point two"}, {eps, π (1 - eps)}, {2 π (1 - eps), eps}},
 {{p3, {5, 0.75}, "point three"}, {eps, π (1 - eps)}, {2 π (1 - eps), eps}},
 ControlPlacement → Left, SaveDefinitions → True]
```

Out[392]=




```
(*Нарисовать серединные перпендикуляры к
 сторонам треугольника на сфере (евклидовой геометрии).*)
(*Требования:Вершина и стороны угла менять динамически (с помощью Locator)*)
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In[408]:=

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sp[{φ_, θ_}] := {Sin[θ] Cos[φ], Sin[θ] Sin[φ], Cos[θ]};

(*сторона и серединный перпендикуляр к стороне, в плоскости треугольника*)
edge[{r1_, r2_}] := {r1, r2};

perpLine[{r1_, r2_, r3_}] :=
  Module[{m = (r1 + r2) / 2, nS = r2 - r1, nP = Cross[r2 - r1, r3 - r1],
    dir, a, b, c, Δ, t1, t2}, dir = Normalize[Cross[nP, nS]];
   {a, b, c} = {dir.dir, 2 dir.m, m.m - 1};
   Δ = b^2 - 4 a c;
   If[Δ < 0, {m - 2 dir, m + 2 dir}, t1 = (-b - Sqrt[Δ]) / (2 a);
    t2 = (-b + Sqrt[Δ]) / (2 a);
    {m + t1 dir, m + t2 dir}]];

eps = 10^-6;

Manipulate[Module[{pts, sides, bis}, pts = sp /@ {p1, p2, p3};
  sides = Line /@ (edge /@ Subsets[pts, {2}]);
  bis = Line /@ {perpLine[{pts[[1]], pts[[2]], pts[[3]]}],
     perpLine[{pts[[1]], pts[[3]], pts[[2]]}], perpLine[{pts[[2]], pts[[3]], pts[[1]]}]};
  Show[{ParametricPlot3D[
     {Sin[θ] Cos[φ], Sin[θ] Sin[φ], Cos[θ]}, {φ, 0, 2 π}, {θ, 0, π}, Mesh → None,
     ColorFunction → (Blend[{Pink, Gray}, (#3 + 1) / 2] &),
     ColorFunctionScaling → False, PlotStyle → Opacity[0.333]],
    Graphics3D[{
      {Opacity[0.5], Cyan, Polygon[pts]},
      {Cyan, Dashed, sides},
      {Orange, Dashed, bis}, {Black, PointSize[.015], Point[pts]}}]},
   Boxed → False, ImageSize → {400, 400}, FaceGrids → {{0, 0, -1}},
   FaceGridsStyle → GrayLevel[.5]]],
 {{p1, {4.2, 0.5}, "point one"}, {eps, π (1 - eps)}, {2 π (1 - eps), eps}},
 {{p2, {0, 1}, "point two"}, {eps, π (1 - eps)}, {2 π (1 - eps), eps}},
 {{p3, {5, 0.75}, "point three"}, {eps, π (1 - eps)}, {2 π (1 - eps), eps}},
 ControlPlacement → Left, SaveDefinitions → True]
```
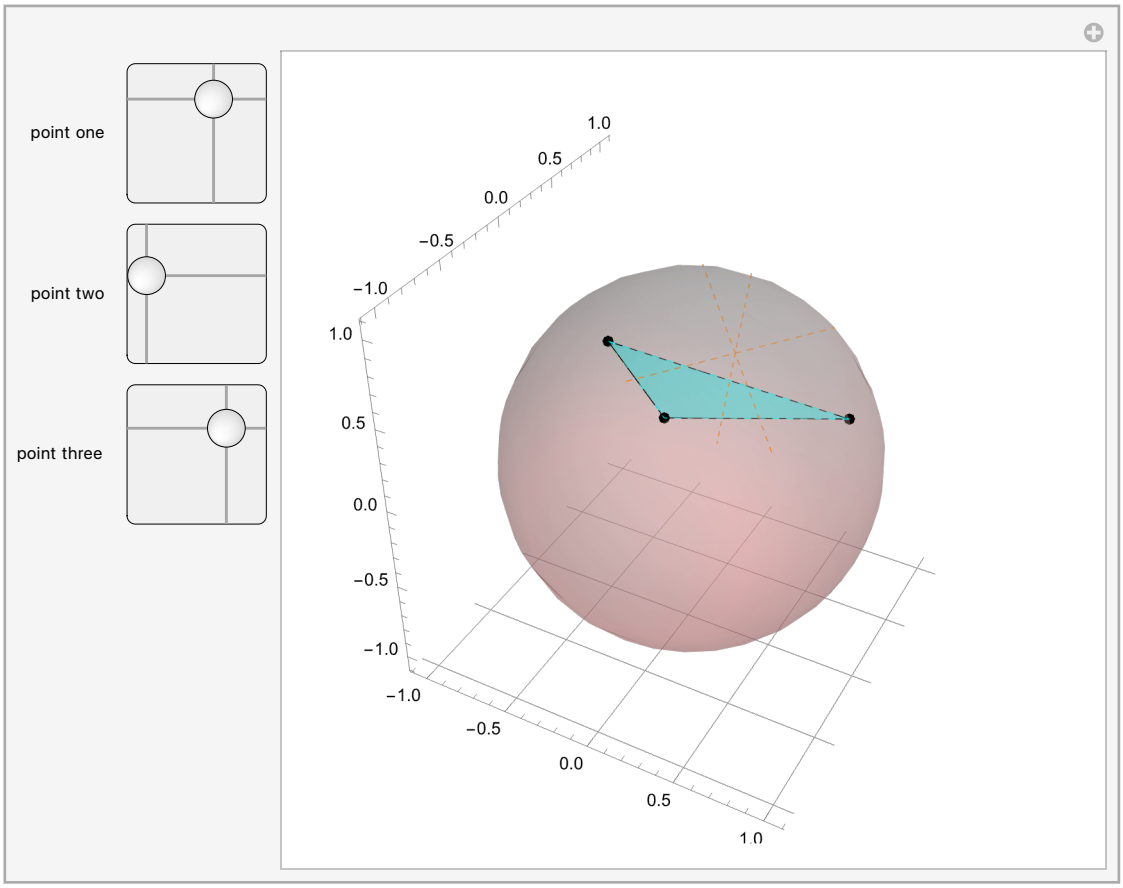
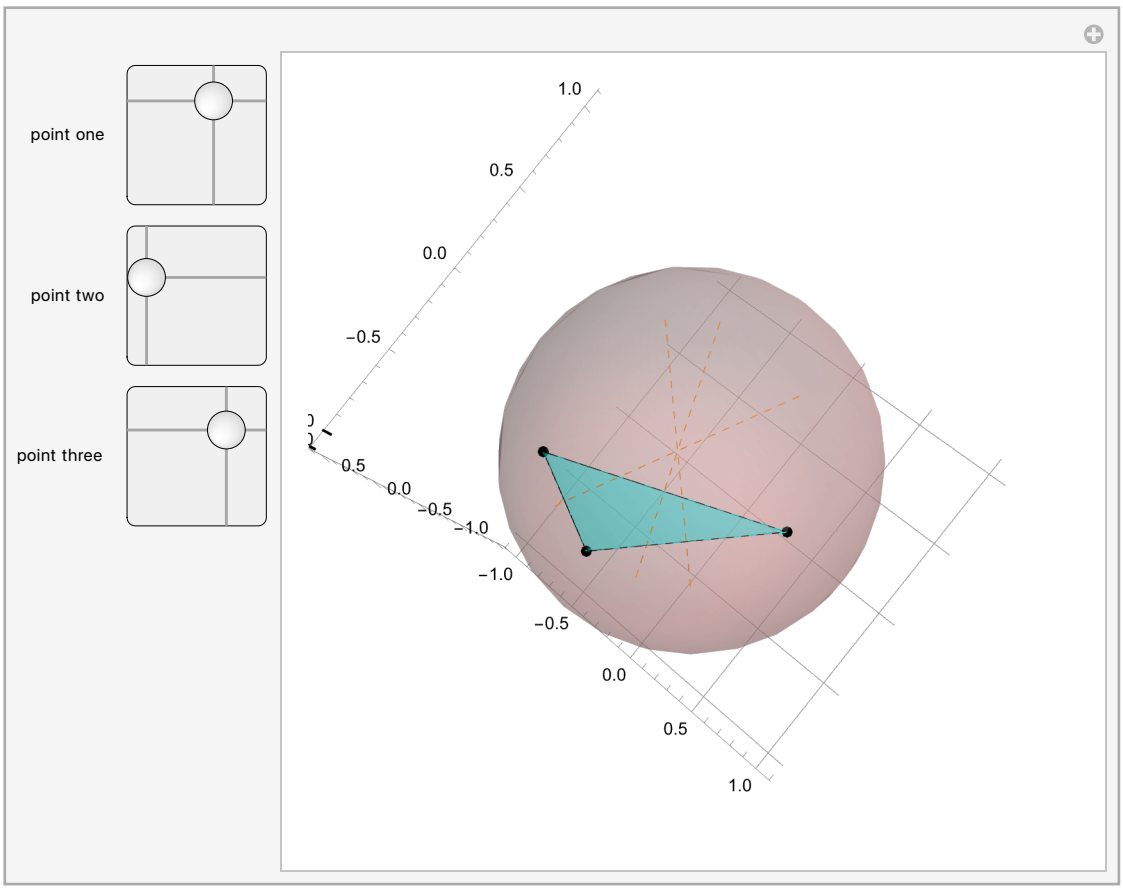

In[413]:=


point one
point two
point three
1.0
0.5
0.0
−0.5
−1.0
1.0
0.5
0.0
−0.5
−1.0
−1.0
−0.5
0.0
0.5
1.0


point one
point two
point three
1.0
0.5
0.0
−0.5
0.5
0.0
−0.5
−1.0
−1.0
−0.5
0.0
0.5
1.0