可视化动物解剖结构

"AnimalAnatomicalStructure" 实体域提供常见家畜的身体结构信息。目前仅限于狗和马的动物实体，包括主要身体部位、器官系统、内部器官、骨骼和肌肉。

```
In[ ]:= EntityValue["AnimalAnatomicalStructure", "SampleEntities"]
        实体属性值
Out[ ]=
{alimentary system (dog), biceps brachii (dog), hindlimb (dog),
 humerus (horse), left forefoot (horse), liver ($Failed), lung (horse),
 muscular system (horse), skeleton (dog), trapezius (horse)}
```

您可以使用 AnatomyPlot3D 功能探索狗的身体内部结构。还可以使用 ClipPlanes 选项有选择地切割皮肤和肌肉，以展示图形的内部结构。

```
In[ ]:= AnatomyPlot3D[{alimentary system (dog) ANIMAL ANATOMICAL STRUCTURE,
        三维解剖图
  respiratory system (dog) ANIMAL ANATOMICAL STRUCTURE,
  cardiovascular system (dog) ANIMAL ANATOMICAL STRUCTURE,
  nervous system (dog) ANIMAL ANATOMICAL STRUCTURE,
  urinary system (dog) ANIMAL ANATOMICAL STRUCTURE,
  Opacity[0.5], skeleton (dog) ANIMAL ANATOMICAL STRUCTURE,
  不透明度
  ClipPlanes → {InfinitePlane[{{-78, -200, 0}, {-78, 300, 0}, {-28, 0, 500}}]},
  剪切平面
  Opacity[0.1`], muscular system (dog) ANIMAL ANATOMICAL STRUCTURE,
  不透明度
  Opacity[0.7], skin (dog) ANIMAL ANATOMICAL STRUCTURE}, ViewPoint → Left]
  不透明度                                                  视点        左

  ••• AnatomyPlot3D: 无法下载数据.
```

In[ ]:=
```
AnatomyPlot3D[{alimentary system (dog) ANIMAL ANATOMICAL STRUCTURE,
  respiratory system (dog) ANIMAL ANATOMICAL STRUCTURE,
  cardiovascular system (dog) ANIMAL ANATOMICAL STRUCTURE,
  nervous system (dog) ANIMAL ANATOMICAL STRUCTURE,
  urinary system (dog) ANIMAL ANATOMICAL STRUCTURE,
  Opacity[0.5`], skeleton (dog) ANIMAL ANATOMICAL STRUCTURE,
  Opacity[0.1`], muscular system (dog) ANIMAL ANATOMICAL STRUCTURE,
  Opacity[0.7`], skin (dog) ANIMAL ANATOMICAL STRUCTURE}, ViewPoint → Left]
```
三维解剖图 不透明度 剪切平面 不透明度 不透明度 视点 左

AnatomyPlot3D: 无法下载数据.

Out[ ]=
```
AnatomyPlot3D[
 {alimentary system (dog), respiratory system (dog), cardiovascular system (dog),
  nervous system (dog), urinary system (dog), Opacity[0.5], skeleton (dog),
  ClipPlanes → {InfinitePlane[{{-78, -200, 0}, {-78, 300, 0}, {-28, 0, 500}}]},
  Opacity[0.1], muscular system (dog), Opacity[0.7], skin (dog)}, ViewPoint → Left]
```

In[ ]:=
```
AnatomyPlot3D[{skin (dog) ANIMAL ANATOMICAL STRUCTURE}]
```
三维解剖图

AnatomyPlot3D: 无法下载数据.

Out[ ]=
```
AnatomyPlot3D[{skin (dog)}]
```

可以用 “ConstitutionalParts” 属性获得构成给定身体部位的解剖结构列表。

In[ ]:=
```
EntityValue[
 Entity["AnimalAnatomicalStructure", "Shoulder::CanisLupusFamiliaris::4t62p"],
 EntityProperty["AnimalAnatomicalStructure", "ConstitutionalParts"]]
```
实体属性值 / 实体 / 实体属性

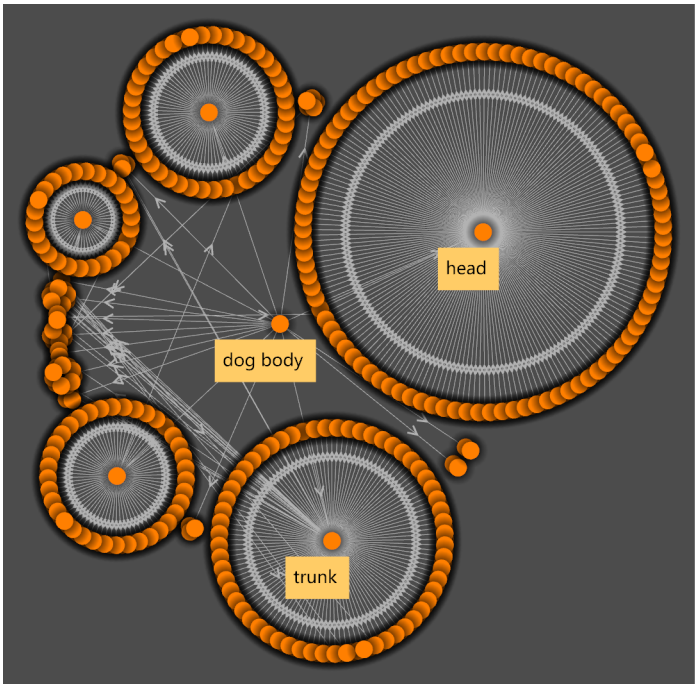
Out[ ]=

{clavicle (dog), deltoid (dog), glenohumeral joint (dog), infraspinatus (dog), pectoralis descendes (dog), pectoralis profundus (dog), pectoralis transversus (dog), scapula (dog), serratus ventralis thoracis (dog), subscapularis (dog), supraspinatus (dog), teres major (dog), teres minor (dog), trapezius (dog)}

通过访问 “ConstitutionalParts” 属性，可以检索狗的身体的所有结构部分。可以使用单个 NestGraph 函数来体现层次关系。

In[ ]:=
```
g = NestGraph[DeleteMissing[EntityValue[#,
    EntityProperty["AnimalAnatomicalStructure", "ConstitutionalParts"]]] &,
  Entity["AnimalAnatomicalStructure", "DogBody::CanisLupusFamiliaris::4t62p"],
  2, Sequence[VertexLabels → {Entity["AnimalAnatomicalStructure",
      "DogBody::CanisLupusFamiliaris::4t62p"] → Placed[Panel["dog body", Background →
        RGBColor[1, Rational[4, 5], Rational[2, 5]], FrameMargins → 2], {0, -0.75}],
     Entity["AnimalAnatomicalStructure", "Head::CanisLupusFamiliaris::4t62p"] →
      Placed[Panel["head", Background → RGBColor[1, Rational[4, 5], Rational[2, 5]],
        FrameMargins → 2], {0, -0.75}],
     Entity["AnimalAnatomicalStructure", "Trunk::CanisLupusFamiliaris::4t62p"] →
      Placed[Panel["trunk", Background → RGBColor[1, Rational[4, 5], Rational[2, 5]],
        FrameMargins → 2], {0, -0.75}],
     PatternTest[Pattern[x, Blank[]], Not[MatchQ[#, Alternatives[Entity[
          "AnimalAnatomicalStructure", "DogBody::CanisLupusFamiliaris::4t62p"],
         Entity["AnimalAnatomicalStructure", "Head::CanisLupusFamiliaris::4t62p"],
         Entity["AnimalAnatomicalStructure",
          "Trunk::CanisLupusFamiliaris::4t62p"]]]] &] :> Placed[x, Tooltip]},
   VertexSize → 3, EdgeStyle → GrayLevel[0.7], VertexStyle →
    Directive[RGBColor[1, 0.5, 0], EdgeForm[None]],
   GraphLayout → "BalloonEmbedding",
   PlotTheme → "Marketing"]]
```

Out[ ]=

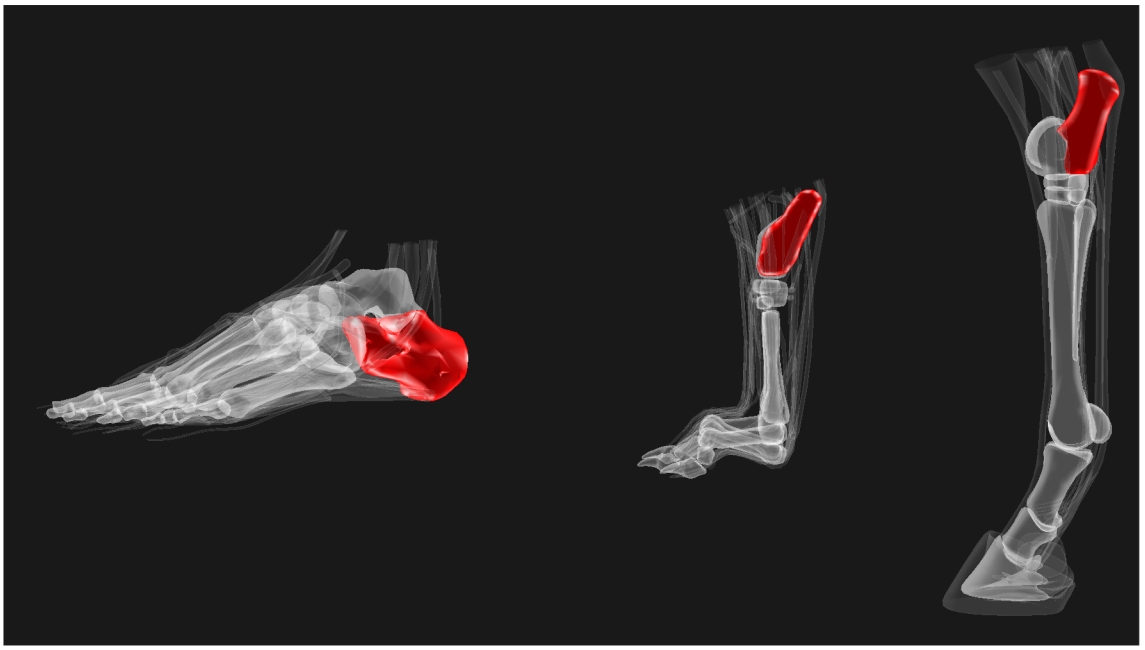


您还可以在视觉上将动物的解剖部位与同源结构进行比较，清晰地看到哪些是进化后仍被保存下来的。

以 X 射线样式突出显示人类、狗和马的脚部中最大的骨骼之一的跟骨。

In[ ]:=
```
GraphicsRow[
 Map[AnatomyPlot3D[{AnatomyStyling[<|#[[1]] → Directive[Red, Opacity[1]]|>], #[[2]]},
     PlotTheme → "XRay", ViewPoint → Right] &,
  {{Entity["AnatomicalStructure", "LeftCalcaneus"],
    Entity["AnatomicalStructure", "LeftFoot"]},
   {Entity["AnimalAnatomicalStructure", "LeftCalcaneus::CanisLupusFamiliaris::4t62p"],
    Entity["AnimalAnatomicalStructure", "LeftHindfoot::CanisLupusFamiliaris::4t62p"]},
   {Entity["AnimalAnatomicalStructure", "LeftCalcaneus::EquusCaballus::9ycwb"],
    Entity["AnimalAnatomicalStructure", "LeftHindfoot::EquusCaballus::9ycwb"]}}],
 Background → GrayLevel[.1]]
```

Out[ ]=



下图说明了不同生物体的同源骨骼结构。颜色显示人类、狗和马肢体中的关联骨骼。

In[ ]:=
```
legend = SwatchLegend[{Yellow, Green, Blue, Purple, Cyan, Pink, Red},
   {"clavicle", "scapula", "humerus", "radius", "ulna", "carpals", "metacarpals"},
   LegendMarkerSize → 10, LabelStyle → {14, White}];
GraphicsRow[{AnatomyPlot3D[{AnatomyStyling[<|Entity["AnatomicalStructure",
          "Clavicle"] → Yellow, Entity["AnatomicalStructure", "Scapula"] → Green,
        Entity["AnatomicalStructure", "Humerus"] → Blue, Entity["AnatomicalStructure",
```

```
    "Radius"] → Purple, Entity["AnatomicalStructure", "Ulna"] → Cyan,
                紫色      实体                                  蓝绿色
   Entity["AnatomicalStructure", "SetOfCarpalBones"] → Pink,
   实体                                                 粉色
   Entity["AnatomicalStructure", "MetacarpalBone"] → Red|>],
   实体                                               红色
  Entity["AnatomicalStructure", "SkeletonOfUpperLimb"]}, PlotTheme → "Business"],
  实体                                                   绘图主题
AnatomyPlot3D[{AnatomyStyling[<|Entity["AnimalAnatomicalStructure",
三维解剖图          解剖学样式          实体
    "Scapula::CanisLupusFamiliaris::4t62p"] → Green,
                                              绿色
   Entity["AnimalAnatomicalStructure", "Humerus::CanisLupusFamiliaris::4t62p"] →
   实体
    Blue, Entity["AnimalAnatomicalStructure",
    蓝色   实体
    "Radius::CanisLupusFamiliaris::4t62p"] → Purple,
                                              紫色
   Entity["AnimalAnatomicalStructure", "Ulna::CanisLupusFamiliaris::4t62p"] → Cyan,
   实体                                                                    蓝绿色
   Entity["AnimalAnatomicalStructure",
   实体
    "SetOfCarpalBones::CanisLupusFamiliaris::4t62p"] → Pink, Entity[
                                                  粉色   实体
    "AnimalAnatomicalStructure", "MetacarpalBone::CanisLupusFamiliaris::4t62p"] →
    Red|>], Entity["AnimalAnatomicalStructure",
    红色     实体
  "SkeletonOfForelimb::CanisLupusFamiliaris::4t62p"]},
 PlotTheme → "Business"], AnatomyPlot3D[{AnatomyStyling[<|
 绘图主题                 三维解剖图          解剖学样式
   Entity["AnimalAnatomicalStructure", "Scapula::EquusCaballus::9ycwb"] → Green,
   实体                                                                 绿色
   Entity["AnimalAnatomicalStructure", "Humerus::EquusCaballus::9ycwb"] → Blue,
   实体                                                                 蓝色
   Entity["AnimalAnatomicalStructure", "Radius::EquusCaballus::9ycwb"] → Purple,
   实体                                                                 紫色
   Entity["AnimalAnatomicalStructure", "Ulna::EquusCaballus::9ycwb"] → Cyan,
   实体                                                               蓝绿色
   Entity["AnimalAnatomicalStructure", "SetOfCarpalBones::EquusCaballus::9ycwb"] →
   实体
    Pink, Entity["AnimalAnatomicalStructure",
    粉色   实体
    "MetacarpalBone::EquusCaballus::9ycwb"] → Red|>],
                                              红色
  Entity["AnimalAnatomicalStructure", "SkeletonOfForelimb::EquusCaballus::9ycwb"]},
  实体
 PlotTheme → "Business"], legend}, Spacings → 0, Background → Hue[.58, 1, .5]]
 绘图主题                          间隔          背景色          色相
```

AnatomyPlot3D: 无法获得 skeleton of forelimb (horse) 的三维模型.

Out[ ]=