

In[20]:=

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(*by Nasser M. Abbasi, Nov 1,
2015. Bouncing ball of the floor with different coefficient of restituion*)
Manipulate[
  tick;
  h = 1;
  g = 9.8;
  If[(statex == "RUN" || statex == "STEP") && statex2 == "",
    If[state == "down",
      delS = currentV * delT + 1/2 g delT^2;
      currentV += g * delT;
      currentH -= delS
    ,
      delS = currentV * delT - 1/2 g delT^2;
      currentV -= g * delT;
      currentH += delS
    ];
    distantTravelled += delS
  ];

gr = Graphics[
  {
    Line[{{-.3, -r/2}, {.3, -r/2}}],
    (*{LightGray,Dashed,Line[{{0,0},{0,1}}]},*)
    {Red, Disk[{0, currentH}, r]}
  },
  PlotRange -> {{-.3, .3}, {-4 r, 1 + 4 r}},
  Axes -> {False, True}, ImageSize -> {300, 300}];
(*gr=Grid[{
  {"current time ", "current h", "state",
  "current V", "max H", "N", "delS", "distantTravelled"},
  { currentT, currentH, state, currentV, maxH, n, delS, distantTravelled},
  {gr, SpanFromLeft}}, Frame -> All];*)

gr = Grid[{
  {Grid[{
    {"height", "speed", "cycle #", "Δs", "direction"},
    {padIt2[currentH, {3, 2}],
    padIt2[currentV, {4, 3}], padIt2[n, {1}], padIt2[delS, {4, 3}], state}
  }, Frame -> All]
  },
  {Grid[
```

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    {
      {Column[{"Theoretical", "total time"}], Column[{"Current", "time"}],
      Column[{"Theoretical", Column[{"total", "distant"}]}],
      Column[{"current", "distance"}]},
      {padIt2[tTime, {6, 3}], padIt2[currentT, {6, 3}],
      padIt2[tDistance, {3, 2}], padIt2[totalDist, {6, 3}]
    }
  }, Frame → All
]
},

{gr, SpanFromLeft}}];

If[statex2 == "pass",
  statex2 = ""
  ,
  currentT += delT;
  totalDist += delS;
  If[Abs@distantTravelled ≥ maxH,
    distantTravelled = 0;

    If[state == "down",
      currentV = e * currentV;
      state = "up";
      n = n + 1;
      maxH = e^(2 * n) * h;
      currentH = 0
    ,
      state = "down";
      currentV = 0;
      currentH = maxH
    ]
  ]
];

If[statex == "RUN" && currentT < tTime,
  tick = Not[tick]
];
gr,
{{tick, False}, None},
Text@Grid[{
  {Grid[{
    {Button[Text@Style["run", 12], {statex = "RUN"};

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    tick = Not[tick]], ImageSize → {50, 40}],
  Button[Text@Style["step", 12], {statex = "STEP";
    tick = Not[tick]], ImageSize → {50, 40}],
  Button[Text@Style["stop", 12], {statex = "STOP";
    tick = Not[tick]], ImageSize → {50, 40}],
  Button[Text@Style["reset", 12], {statex = "STEP";
    currentH = 1;
    currentT = 0;
    n = 0;
    distantTravelled = 0;
    currentV = 0;
    maxH = 1;
    state = "down";
    totalDist = 0;
    statex2 = "";
    tDistance = If[e == 1, Infinity, (1 + e^2) / (1 - e^2)];
    tTime = If[e == 1, Infinity, Sqrt[2/9.81] * ((1 + e) / (1 - e))];
    tick = Not[tick]], ImageSize → {50, 40}]]
}, Frame → True, FrameStyle → Gray
], SpanFromLeft},
{Grid[{
  {"Coefficient of restitution",
  Manipulator[Dynamic[e, {e = #;
    statex = "STEP";
    currentH = 1;
    currentT = 0; n = 0;
    distantTravelled = 0;
    currentV = 0;
    maxH = 1;
    state = "down";
    totalDist = 0;
    tDistance = If[e == 1, Infinity, (1 + e^2) / (1 - e^2)];
    tTime = If[e == 1, Infinity, Sqrt[2/9.81] * ((1 + e) / (1 - e))];
    tick = Not[tick];
    statex2 = "pass"} &], {0, 1, .01}, ImageSize → Tiny],
  Dynamic[padIt2[e, {2, 2}]],
  SpanFromLeft},
  {"Animation speed",
  Manipulator[Dynamic[delT, {delT = #} &], {0.001, 0.03, 0.001},
    ImageSize → Tiny], Dynamic[padIt2[delT, {3, 3}]],
  SpanFromLeft},

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    {"ball size",
     Manipulator[Dynamic[r, {r = #;
       tick = Not[tick], statex2 = "pass"} &],
      {0.01, 0.1, 0.001}, ImageSize → Tiny], Dynamic[padIt2[r, {3, 3}]],
     SpanFromLeft]

    }, Alignment → Left, Frame → True, FrameStyle → Gray]
  ]}],
{{n, 0}, None},
{{currentH, 1}, None},
{{currentT, 0}, None},
{{state, "down"}, None},
{{statex, "STEP"}, None},
{{statex2, ""}, None},
{{distantTravelled, 0}, None},
{{currentV, 0}, None},
{{maxH, 1}, None},
{{gr, 0}, None},
{{e, .9}, None},
{{delT, 0.02}, None},
{{r, 0.04}, None},
{{totalDist, 0}, None},
{{tDistance,  $(1 + (.9)^2) / (1 - (.9)^2)$ }, None},
{{tTime,  $\text{Sqrt}[2/9.81] * ((1 + .9) / (1 - .9))$ }, None},
TrackedSymbols ⇒ {tick},
Alignment → Center,
SynchronousUpdating → True,
SynchronousInitialization → True,
FrameMargins → 1,
ImageMargins → 1,
ControlPlacement → Left,
Initialization ⇒
{
  padIt1[v_, f_List] := AccountingForm[Chop[v], f,
    NumberSigns → {"-", "+"}, NumberPadding → {"0", "0"}, SignPadding → True];
  padIt2[v_, f_List] := AccountingForm[Chop[v], f, NumberSigns → {"", ""},
    NumberPadding → {"0", "0"}, SignPadding → True]
}
]

```

run

step

stop

reset

Coefficient of restitution ▣ 0.75

Animation speed ▣ 0.020

ball size ▣ 0.020

height	speed	cycle #	$\Delta s$	direction
1.00	0.196	0	0.002	down

Theoretical total time	Current time	Theoretical total distance	current distance
003.161	000.000	3.57	000.000