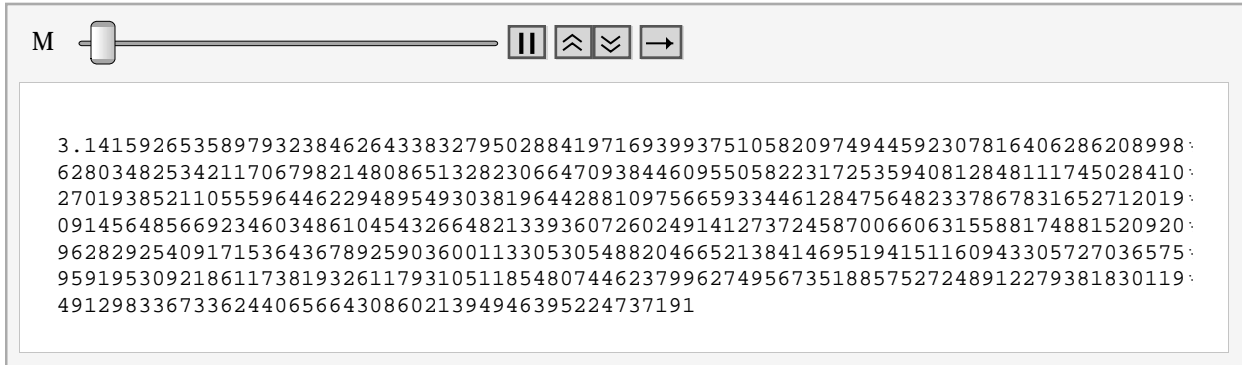


In[6]:= **An approximation to  $\pi$**

Out[6]= An approximation  $\pi$  to

In[7]:= **Animate**[N[Pi, M], {M, 1, 2500, 1},  
AnimationRepetitions  $\rightarrow$  1, DefaultDuration  $\rightarrow$  250, LabelStyle  $\rightarrow$  Medium]

Out[7]=



The image shows a Mathematica Animate interface. At the top, there is a slider labeled 'M' with a value of 1. To the right of the slider are four control buttons: a pause button (II), a zoom in button (upward arrow), a zoom out button (downward arrow), and a next button (right arrow). Below the slider, a large text box displays the first 2500 digits of pi, with a dot after every 100 digits for readability.

3.141592653589793238462643383279502884197169399375105820974944592307816406286208998·  
62803482534211706798214808651328230664709384460955058223172535940812848111745028410·  
27019385211055596446229489549303819644288109756659334461284756482337867831652712019·  
09145648566923460348610454326648213393607260249141273724587006606315588174881520920·  
96282925409171536436789259036001133053054882046652138414695194151160943305727036575·  
95919530921861173819326117931051185480744623799627495673518857527248912279381830119·  
49129833673362440656643086021394946395224737191

# Infinite Sums with Alternating Terms

In[8]:=

Out[8]= Alternating Infinite Sums Terms with

In[9]:= **Manipulate**[

```
N[Sum[(-1)^(n+1)/n, {n, 1, M}], 1000],
{M, 1, 1000, 1, Appearance -> "Labeled", LabelStyle -> Medium}]
```

Out[9]=

```
In[10]:= axis := Plot[.1, {x, 0, 1}, Axes -> {True, False},
PlotStyle -> {RGBColor[0, 0, 1], Thickness[.01], Opacity[.2]},
PlotRange -> {{.65, .75}, {-1.1, .2}}]
```

```
In[11]:= int[a_, b_] := Graphics[{Thickness[.015], Line[{{a, .1}, {b, .1}}]}
```

```
In[12]:= upper[M_] := N[Sum[(-1)^(n+1)/n, {n, 1, 2 M - 1}]
lower[M_] := N[Sum[(-1)^(n+1)/n, {n, 1, 2 M}]]
```

```
In[14]:= Slider[Dynamic[M], {1, 1000, 1}]
```

Out[14]=



```
In[15]:= Dynamic[Show[axis, int[lower[M], upper[M]]]]
```



Out[15]=

# Infinite Sums with Alternating Terms

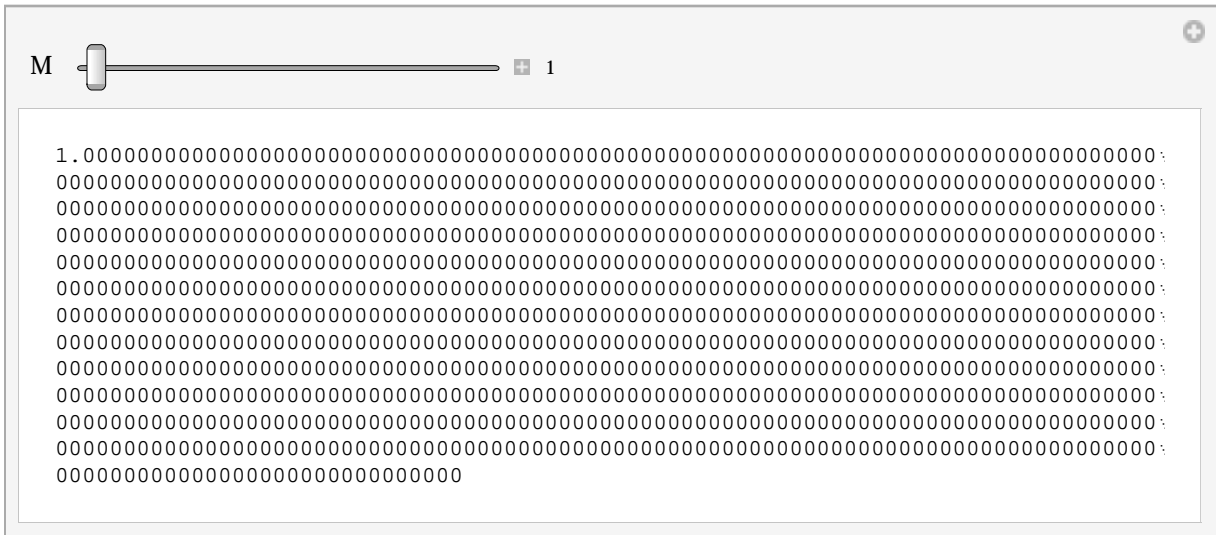
In[16]:=

Out[16]= Alternating Infinite Sums Terms with

In[17]:= **Manipulate**[

```
N[Sum[(-1)^(n+1)/n!, {n, 1, M}], 1000],
{M, 1, 550, 1, Appearance -> "Labeled"}, LabelStyle -> Medium]
```

Out[17]=



```
In[18]:= axis1 := Plot[.1, {x, 0, 1}, Axes -> {True, False},
PlotStyle -> {RGBColor[0, 0, 1], Thickness[.01], Opacity[.2]},
PlotRange -> {{.6, .7}, {-1.1, .2}}]
```

```
In[19]:= upper1[M_] := N[Sum[(-1)^(n+1)/n!, {n, 1, 2 M - 1}]]
lower1[M_] := N[Sum[(-1)^(n+1)/n!, {n, 1, 2 M}]]
```

```
In[21]:= Slider[Dynamic[M1], {1, 10, 1}]
```

Out[21]=

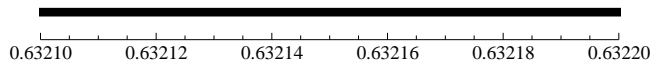
```
In[22]:= Dynamic[Show[axis1, int[lower1[M1], upper1[M1]]]]
```



Out[22]=

```
In[23]:= axis11 := Plot[.1, {x, 0, 1}, Axes -> {True, False},
PlotStyle -> {RGBColor[0, 0, 1], Thickness[.01], Opacity[.2]},
PlotRange -> {{.6321, .6322}, {-1.1, .2}}]
```

```
In[24]:= Dynamic[Show[axis11, int[lower1[M1], upper1[M1]]]]
```



Out[24]=

## Mapping intervals

```

In[25]:= axis21[L_] := Plot[1, {x, 0, L}, Axes → {True, False},
  PlotStyle → {RGBColor[0, 0, 1], Thickness[.01], Opacity[.2]},
  PlotRange → {{0, L}, {-1.5, 1.5}}]

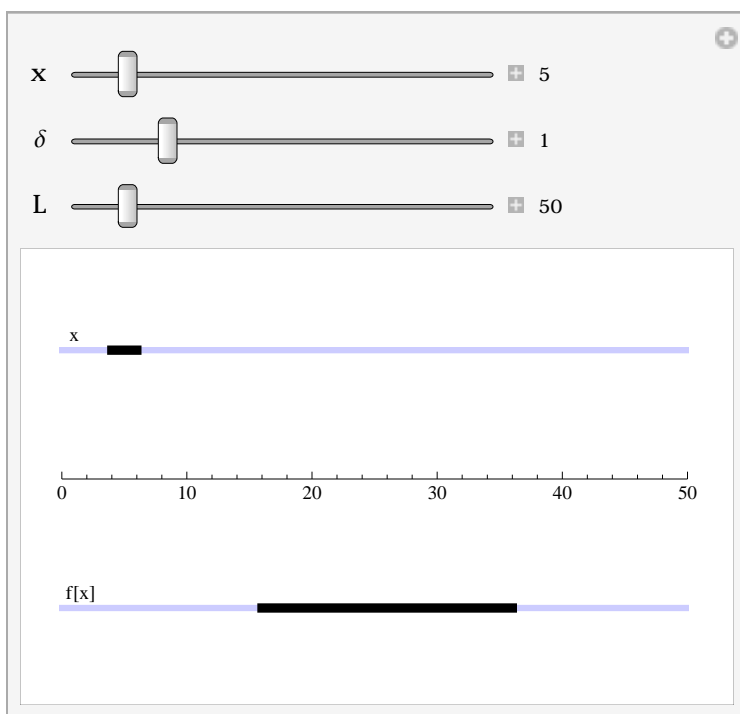
In[26]:= axis2[L_] := Plot[-1, {x, 0, L}, Axes → {True, False},
  PlotStyle → {RGBColor[0, 0, 1], Thickness[.01], Opacity[.2]},
  PlotRange → {{0, L}, {-1.5, 1.5}}]

In[27]:= f[x_] := x^2

In[28]:= Manipulate[
  Show[
    axis21[L], axis2[L],
    Graphics[{Thickness[.015], Line[{{x - ε, 1}, {x + ε, 1}]}]},
    Graphics[{Thickness[.015], Line[{{f[x - ε], -1}, {f[x + ε], -1}]}]},
    Graphics[Text["x", {1, 1.1}]],
    Graphics[Text["f[x]", {1.5, -.9}]]
  ],
  {{x, 5, x}, 0, L, Appearance → "Labeled"}, {{ε, 1, δ}, 0, 5, Appearance → "Labeled"},
  {{L, 50}, .1, 500, Appearance → "Labeled"}, LabelStyle → Medium]

```

Out[28]=



# Uncertainty in Energy

```
In[29]:= axis31 := Plot[0, {x, 0, 10}, Axes → {True, True},  
  PlotStyle → {RGBColor[0, 0, 1], Thickness[.01], Opacity[.2]},  
  PlotRange → {{0, 5}, {0, 5}}]
```

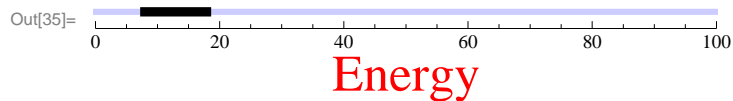
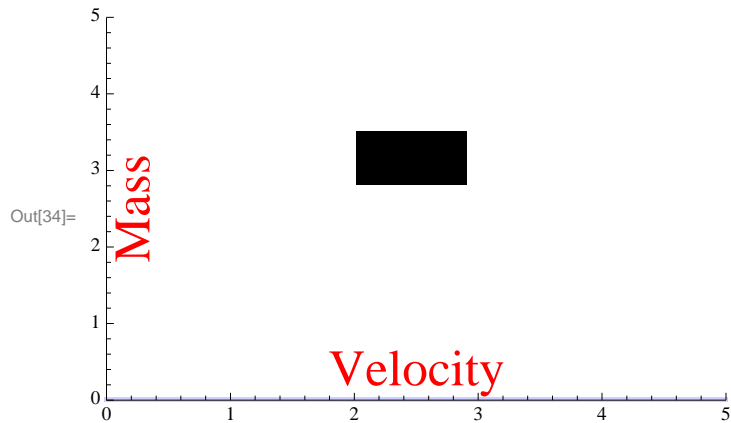
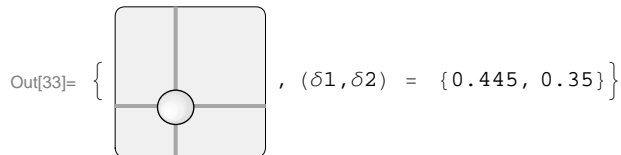
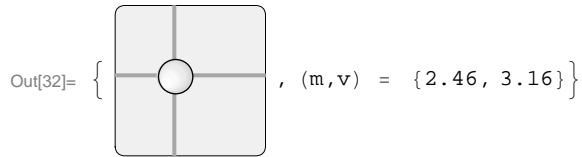
```
In[30]:= axis3 := Plot[.1, {x, 0, 100}, Axes → {True, False},  
  PlotStyle → {RGBColor[0, 0, 1], Thickness[.01], Opacity[.2]},  
  PlotRange → {{0, 100}, {-1.1, 1.2}}]
```

```
In[31]:= En[m_, v_] := (1 / 2) m v^2
```

```

In[32]:= {Slider2D[Dynamic[{m, v}], {1, 5}], "(m,v) = " Dynamic[{m, v}]]
{Slider2D[Dynamic[{δ1, δ2}], {.1, 1}], "(δ1,δ2) = " Dynamic[{δ1, δ2}]]
Dynamic[Show[axis31,
  Graphics[{
    Rotate[Text[Style["Mass", FontSize → 24, FontColor → Red], {.25, 2.5}], Pi / 2],
    Text[Style["Velocity", FontSize → 24, FontColor → Red], {2.5, .35}],
    Polygon[{{m - δ1, v - δ2}, {m - δ1, v + δ2},
      {m + δ1, v + δ2}, {m + δ1, v - δ2}]]]]]
Dynamic[Show[axis3,
  Graphics[{Text[Style["Energy", FontSize → 24, FontColor → Red], {50, -.3}],
    Thickness[.015], Line[{{En[m - δ1, v - δ2], .1}, {En[m + δ1, v + δ2], .1}]]]]]
Dynamic[{En[m - δ1, v - δ2], En[m + δ1, v + δ2]}]

```



Out[36]= {7.95532, 17.8949}