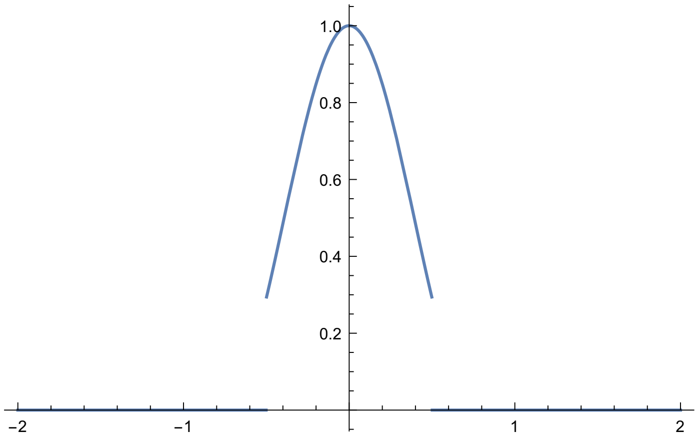
In[1]:= `F[x_, α_] = (UnitStep[x + 0.5] - UnitStep[x - 0.5]) * Cos[α * x] ^ 2`

Out[1]= $\text{Cos}[x\,\alpha]^2\,(-\text{UnitStep}[-0.5 + x] + \text{UnitStep}[0.5 + x])$

In[2]:= `Plot[F[x, 2], {x, -2, 2}]`

Out[2]=



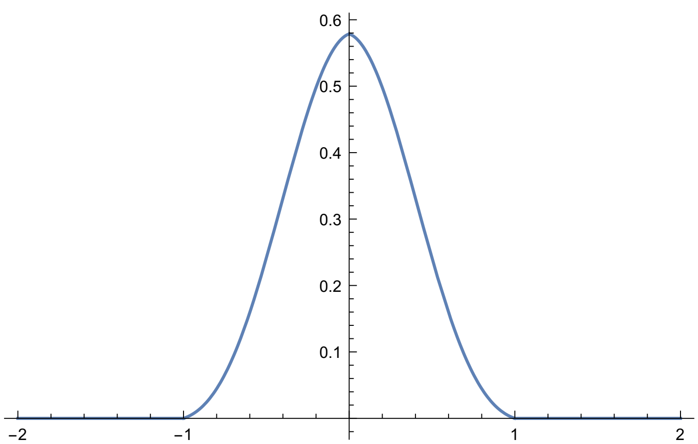
In[29]:= `FAC[Δ_, α_] = Rationalize[Convolve[F[x, α], F[x, α], x, Δ]]`

Out[29]=

$$\frac{1}{\alpha}\left(\left(-\frac{\alpha}{4}+\frac{\alpha\,\Delta}{4}+\alpha\left(-\frac{1}{8}+\frac{\Delta}{8}\right)\text{Cos}[2\,\alpha\,\Delta]-\frac{\text{Sin}[\alpha]}{4}-\frac{1}{4}\,\text{Sin}[\alpha\,(1-2\,\Delta)]-\frac{1}{16}\,\text{Sin}[\alpha\,(2-2\,\Delta)]\right)\text{UnitStep}[-1+\Delta]+\right.$$
$$\left(-\frac{\alpha\,\Delta}{2}-\frac{1}{4}\,\alpha\,\Delta\,\text{Cos}[2\,\alpha\,\Delta]-\frac{1}{2}\,\text{Cos}[\alpha]\,\text{Sin}[2\,\alpha\,\Delta]-\frac{1}{8}\,\text{Cos}[2\,\alpha]\,\text{Sin}[2\,\alpha\,\Delta]\right)\text{UnitStep}[\Delta]+$$
$$\left.\left(\frac{\alpha}{4}+\frac{\alpha\,\Delta}{4}+\alpha\left(\frac{1}{8}+\frac{\Delta}{8}\right)\text{Cos}[2\,\alpha\,\Delta]+\frac{\text{Sin}[\alpha]}{4}+\frac{1}{4}\,\text{Sin}[\alpha\,(1+2\,\Delta)]+\frac{1}{16}\,\text{Sin}[\alpha\,(2+2\,\Delta)]\right)\text{UnitStep}[1+\Delta]\right)$$

In[30]:= `Plot[FAC[t, 2], {t, -2, 2}]`

Out[30]=

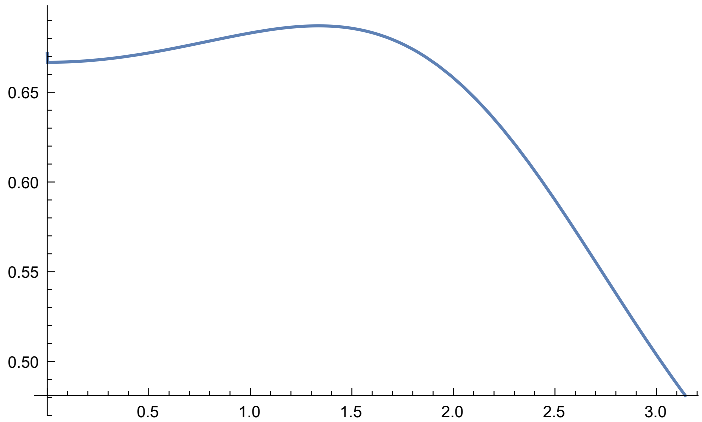


In[22]:=
$$\epsilon[\alpha\_] = \frac{\text{Integrate[Evaluate @ FAC[x, }\alpha\text{]^2, \{x, -1, 1\}]}}{\text{FAC[0, }\alpha\text{]^2}}$$

Out[22]=
$$\left(396\,\alpha + 96\,\alpha^3 + 440\,\text{Sin}[\alpha] + 8\,\alpha\,(-28\,\text{Cos}[\alpha] - 25\,\text{Cos}[2\,\alpha] + 4\,\alpha\,(10 + \text{Cos}[\alpha])\,\text{Sin}[\alpha]) - 92\,\text{Sin}[2\,\alpha] - 72\,\text{Sin}[3\,\alpha] - 3\,\text{Sin}[4\,\alpha]\right) \Big/ \left(2048\,\alpha\left(\frac{3\,\alpha}{8} + \frac{\text{Sin}[\alpha]}{2} + \frac{1}{16}\,\text{Sin}[2\,\alpha]\right)^2\right)$$

In[18]:= `Plot[ϵ[α], {α, 0, π}]`

Out[18]=



In[20]:= `FindMaximum[ϵ[α], {α, 1.5}]`

Out[20]= {0.686981281869 , {α → 1.33592803895 }}