

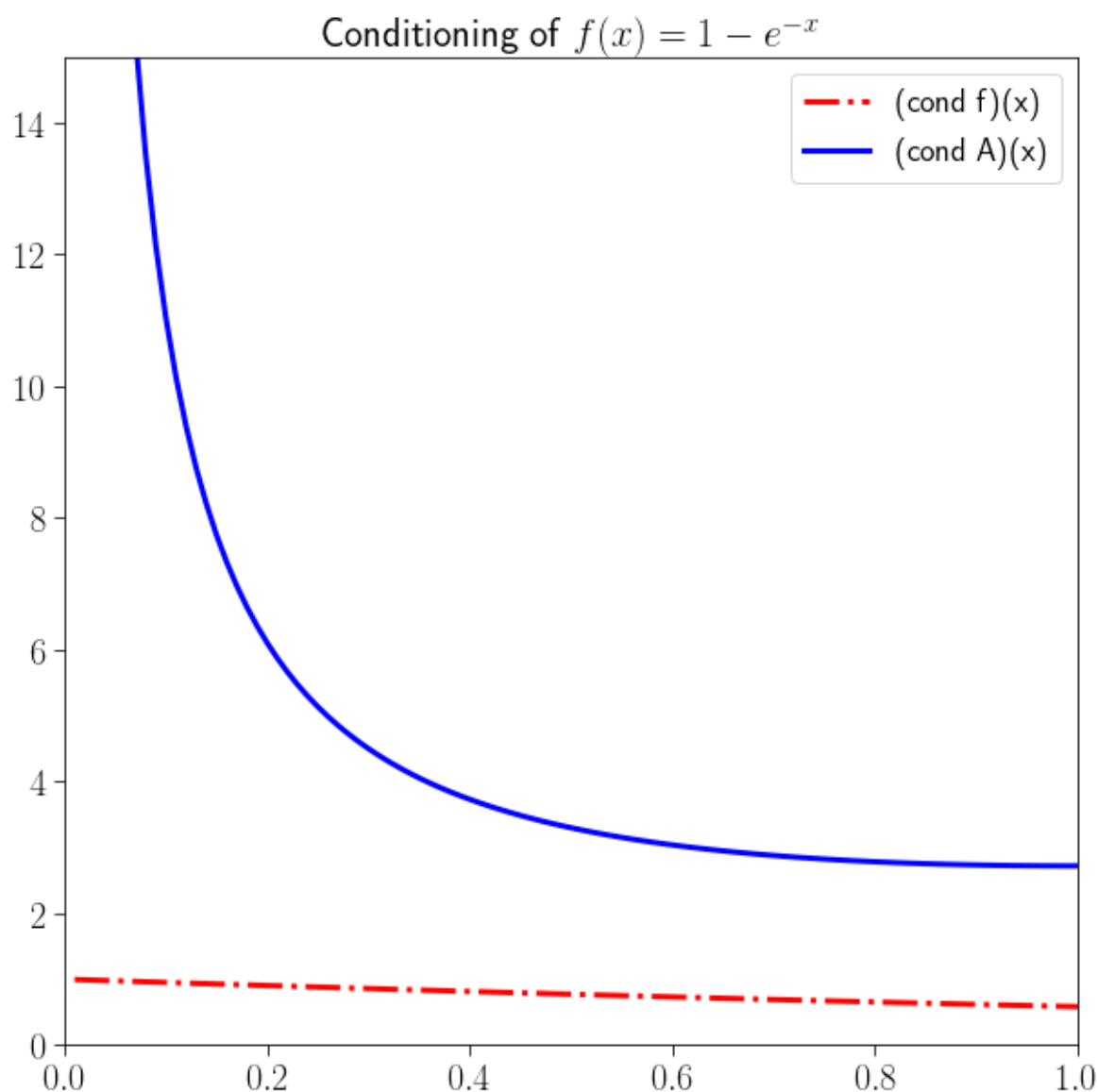
Problem 4

```
In [16]: import numpy as np
import matplotlib.pyplot as plt

xpoints=1.e2
x=np.linspace(1./xpoints, 1., num=int(xpoints))

condf = x/(np.exp(x)-1)
condA=np.exp(x)/x

plt.figure(figsize=(10,10))
plt.plot(x, condf, '-.r', label='(cond f)(x)')
plt.plot(x, condA, '-b', label='(cond A)(x)')
plt.title('Conditioning of  $f(x)=1-e^{-x}$ ')
plt.xlim([0,1])
plt.ylim([0, 15])
plt.legend();
```



See plot above. This is poorly conditioned for small x since $(\text{cond}A)(x) = e^x/x$ diverges as $x \rightarrow 0$, since its denominator goes to zero while its numerator goes to 1. The origin of this poor conditioning is that we are trying to calculate $f(x) = 1 - e^{-x}$, which get very close to each other when $x \rightarrow 0$. As we saw in class, subtracting two numbers which are close can result in a large amount of precision being lost, and that is what we do here as $x \rightarrow 0$.