MATH 151 Lab 3

TA: Nida Obatake

Use Python to solve each problem!

In [25]:
```
from sympy import *
from sympy.plotting import *
```

In [26]:
```
matplotlib notebook
```

In [27]:
```
x = symbols('x')
```

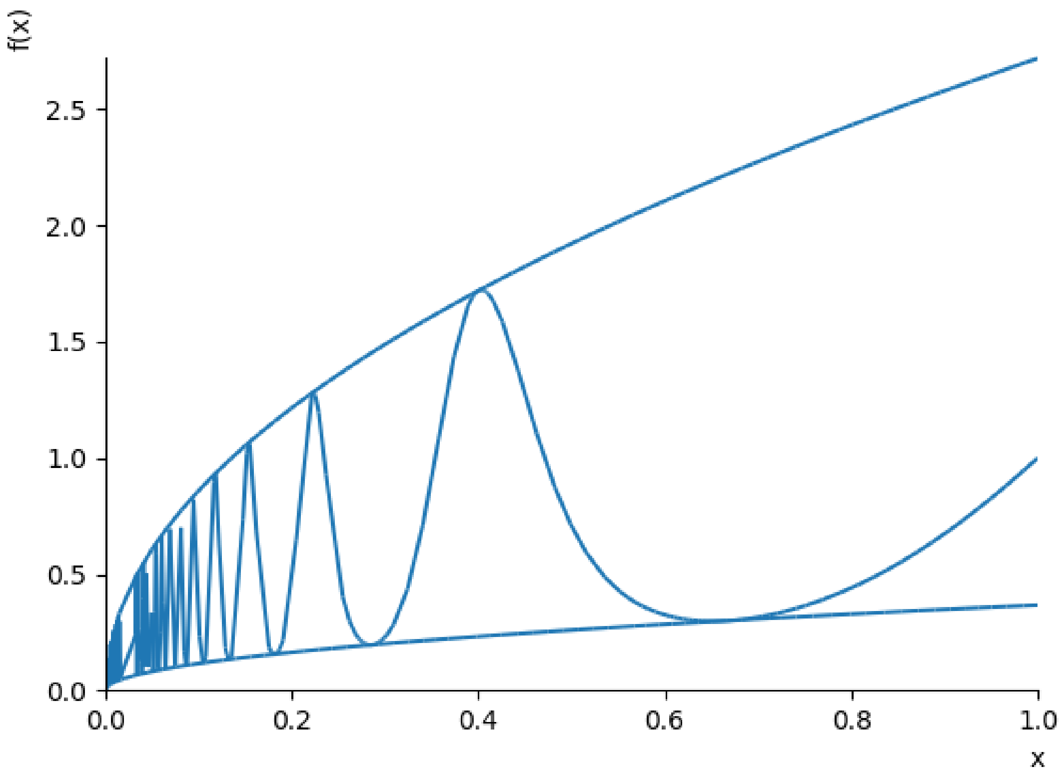
1. Let $g(x) = \sqrt(x)e^{\sin(\pi/x)}$.

(a) Find $\lim_{x \to 0^+} g(x)$.

(b) This limit can be proven using the Squeeze Theorem. Find functions f and h which satisfy the Squeeze Theorem and graph all three functions on one set of axes in the domain $x \in [0, 1]$.

In [38]:
```
#1a
g = sqrt(x)*exp(sin(pi/x))
print('The limit of g(x) as x approaches 0 from the right is {}.'.format
(limit(g,x,0,'+')))
#1b
f = sqrt(x)*exp(-1)
h = sqrt(x)*exp(1)
plot(g,f,h,(x,0,1))
```

```
The limit of g(x) as x approaches 0 from the right is 0.
```



Out[38]: `<sympy.plotting.plot.Plot at 0x11611def0>`

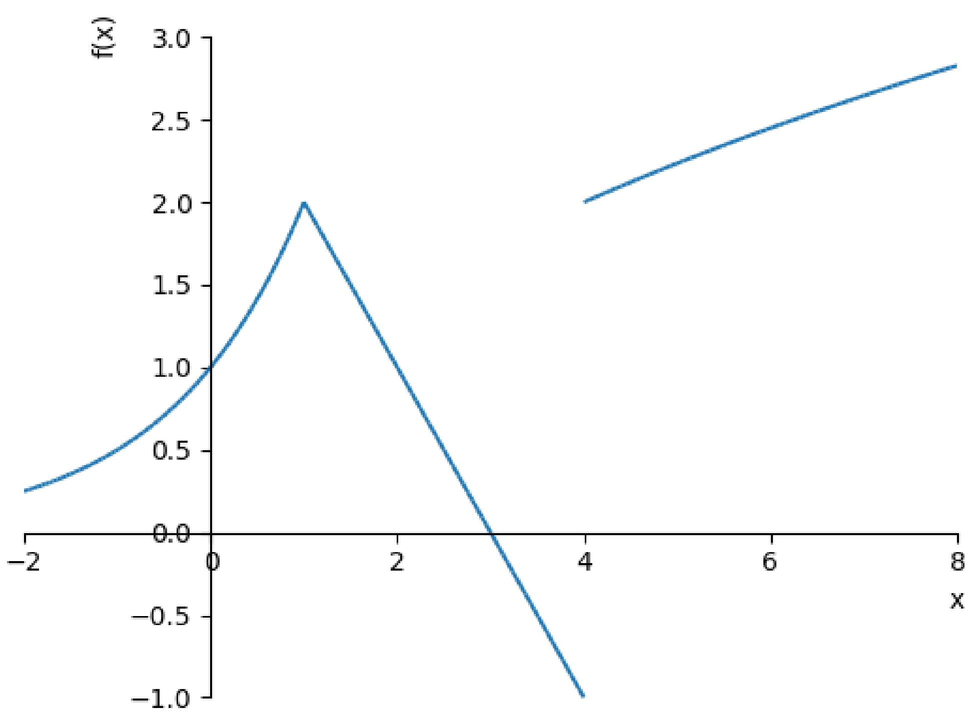
#2 Let $f(x) = \begin{cases} 2^x & \text{if } x \leq 1 \\ 3 - x & \text{if } 1 < x \leq 4 \\ \sqrt(x) & \text{if } x > 4 \end{cases}$.

(a) Find the left and right hand limits of f at both "break points" to determine whether f is continuous at these points or not.

(b) Graph the function in the domain $[-2, 8]$ to confirm your answer to part (a).

In [39]:
```
#2
f1 = 2**x
f2 = 3-x
f3 = sqrt(x)
#2a
print("The left hand limit of f at the first breakpoint (x=1) is {}.".fo
rmat(limit(f1,x,1,'-')))
print("The right hand limit of f at the first breakpoint (x=1) is {}.".f
ormat(limit(f2,x,1,'+')))
print("The left hand limit of f at the second breakpoint (x=4) is {}.".f
ormat(limit(f2,x,4,'-')))
print("The right hand limit of f at the second breakpoint (x=4) is {}.".
format(limit(f3,x,4,'+')))
#2b
print("The graph of the piecewise function f is below:")
plot( (f1,(x,-2,1)), (f2,(x,1,4)), (f3,(x,4,8)) ) #this nice shortcut fo
r plotting multiple functions with different domains
```

```
The left hand limit of f at the first breakpoint (x=1) is 2.
The right hand limit of f at the first breakpoint (x=1) is 2.
The left hand limit of f at the second breakpoint (x=4) is -1.
The right hand limit of f at the second breakpoint (x=4) is 2.
The graph of the piecewise function f is below:
```



Out[39]: `<sympy.plotting.plot.Plot at 0x116e0cc88>`

#3. Given $f(x) = \frac{2e^x}{e^x - 5}$.

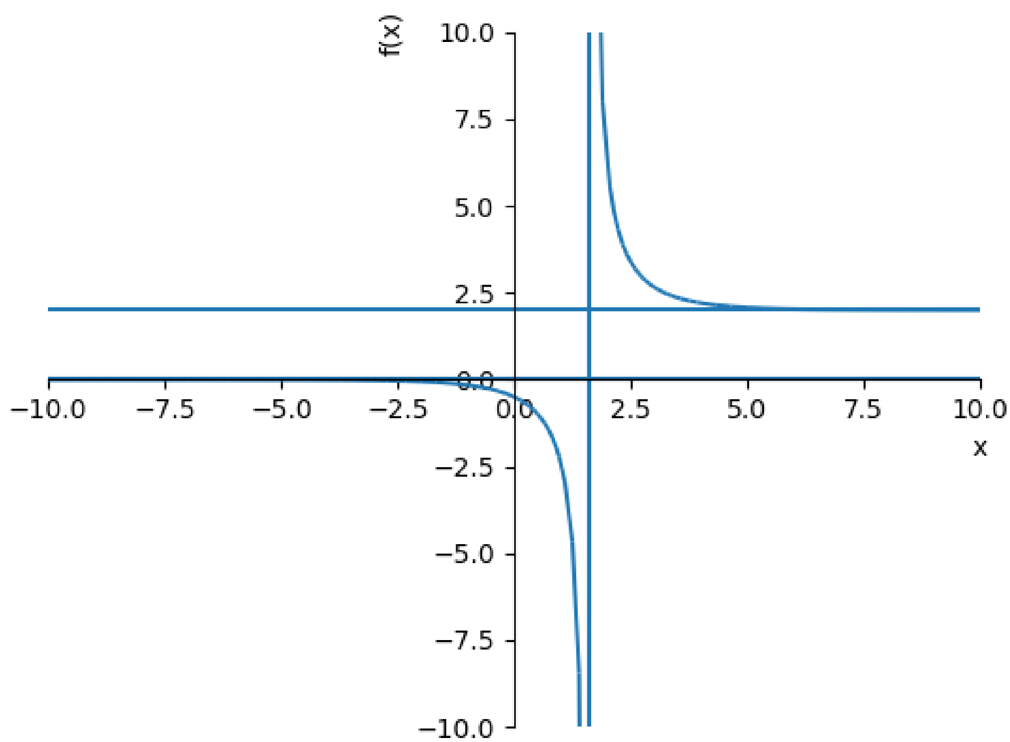
(a) Use the for command (list comprehension) to evaluate the function at $x = 10, 50, 100$, then at $x = -10, -50, -100$ to numerically estimate $\lim_{x \to \infty} f(x)$ and $\lim_{x \to -\infty} f(x)$.

(b) Compute the limits in part (a) exactly.

(c) Plot f and the horizontal asymptote(s) on the domain $[-10, 10]$ and range $[-10, 10]$ to graphically verify your answers.

In [43]:
```
#3
f = 2*exp(x) / (exp(x) - 5)
#3a
rightvals = [f.subs({x:xnew}) for xnew in [10.0, 50.0, 100.0]]
leftvals = [f.subs({x:xnew}) for xnew in [-10.0, -50.0, -100.0]]
print("As x is getting larger and larger positive, we get the outputs:")
print(rightvals)
print("As x is getting larger and larger negative, we get the outputs:")
print(leftvals)
#3b
print("The limit of f as x goes to oo is {}.".format(limit(f,x,oo)))
print("The limit of f as x goes to -oo is {}.".format(limit(f,x,-oo)))
#3c
plot(f,0,2,(x,-10,10),ylim=(-10,10))
```

```
As x is getting larger and larger positive, we get the outputs:
[2.00045410237871, 2.00000000000000, 2.00000000000000]
As x is getting larger and larger negative, we get the outputs:
[-1.81601367987810e-5, -7.71499939185567e-23, -1.48803039040833e-44]
The limit of f as x goes to oo is 2.
The limit of f as x goes to -oo is 0.
```



Out[43]: `<sympy.plotting.plot.Plot at 0x117780400>`