(a)

```
using Plots
     gr()
     p = 0:0.01:1
     I(p) = -p * log2(p)
     H(p) = I(p) + I(1 - p)
[1]: plot(p, [I.(p), I.(1.-p), H.(p)], label=["I(p)" "I(1-p)" "H(p)"])
```

```
1.00
                                                                                         I(p)
                                                                                          I(1-p)
                                                                                          H(p)
0.75
0.50
0.25
```

(b)

0.00

0.00

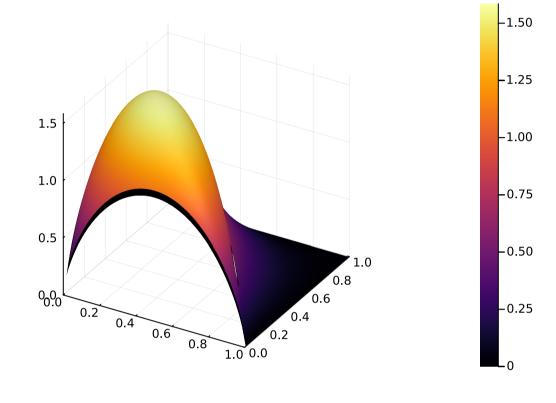
```
p = 0:0.01:1
     I(p) = -p * log2(abs(p))
     H(p1, p2) = I(p1) + I(p2) + I(1 - p1 - p2)
[2]: surface(p, p, H)
```

0.50

0.75

1.00

0.25



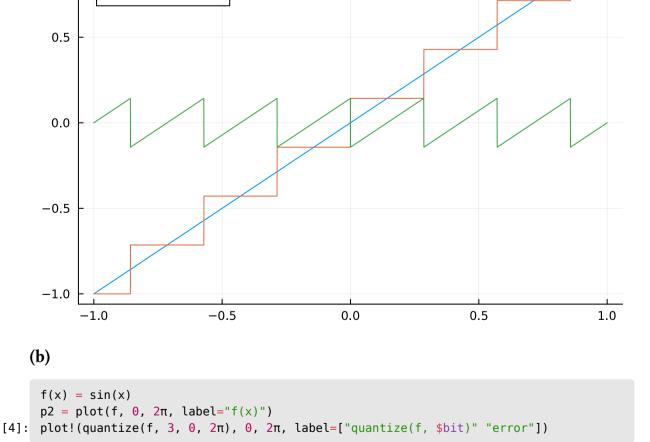
2. The derivative image has a lower entropy than the original image, because most of its pixel values

are close to zero and have a high probability. This means that the derivative image contains less information per pixel than the original image, and therefore it can be compressed more efficiently. **3.**

(a)

```
using Optim
function quantize(f::Function, bits::Int, first::Real, last::Real)
```

```
min = optimize(f, first, last).minimum
          max = -optimize(x \rightarrow -f(x), first, last).minimum
          step = (max - min) / (2^bits - 1)
          # return quantize function and error function
          return [x \rightarrow min + step * round((f(x) - min) / step), x \rightarrow f(x) - min - step *
      round((f(x) - min) / step)]
      bit = 3
      f(x) = x
      p1 = plot(f, -1, 1, label="f(x)")
      plot!(quantize(f, bit, -1, 1), -1, 1, label=["quantize(f, $bit)" "error"],
[3]: legend=:topleft)
       1.0
                      f(x)
                      quantize(f, 3)
```



```
1.0
                                                                                   f(x)
                                                                                   quantize(f, 3)
                                                                                   error
0.5
```

```
0.0
-0.5
```