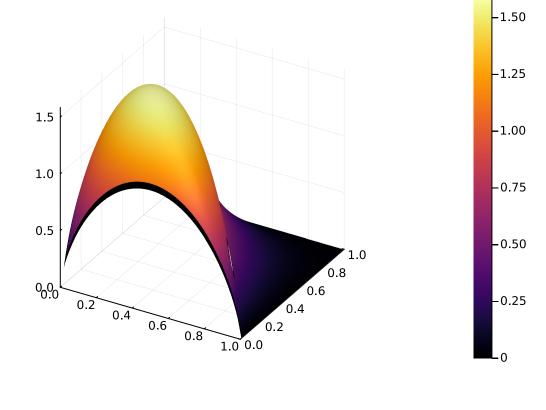
(a)

```
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 0.00 0.00 0.25 0.50 0.75 1.00 **(b)** 

```
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)
```



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.** 

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

(a)

using Optim

-1.0

2.

```
function quantize(f::Function, bits::Int, first::Real, last::Real)
           min = optimize(f, first, last).minimum
           \begin{array}{lll} \text{max} &=& \text{-optimize(x -> -f(x), first, last).minimum} \\ \text{step} &=& \text{(max - min) / (2^bits - 1)} \end{array}
           # 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)]
      end
      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)
                         error
```

```
0.5
   0.0
  -0.5
  -1.0
        -1.0
                            -0.5
                                                 0.0
                                                                     0.5
                                                                                         1.0
(b)
 f(x) = \sin(x)
 p2 = plot(f, 0, 2\pi, label="f(x)")
```

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

[4]: plot!(quantize(f, 3, 0,  $2\pi$ ), 0,  $2\pi$ , label=["quantize(f, \$bit)" "error"])

2

```
0.0
-0.5
```

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