NA17 Kompresija podataka

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1 Kompresija podataka

QR rastav s pivotiranjem stupaca možemo koristiti za *kompresiju (sažimanje) podataka*.

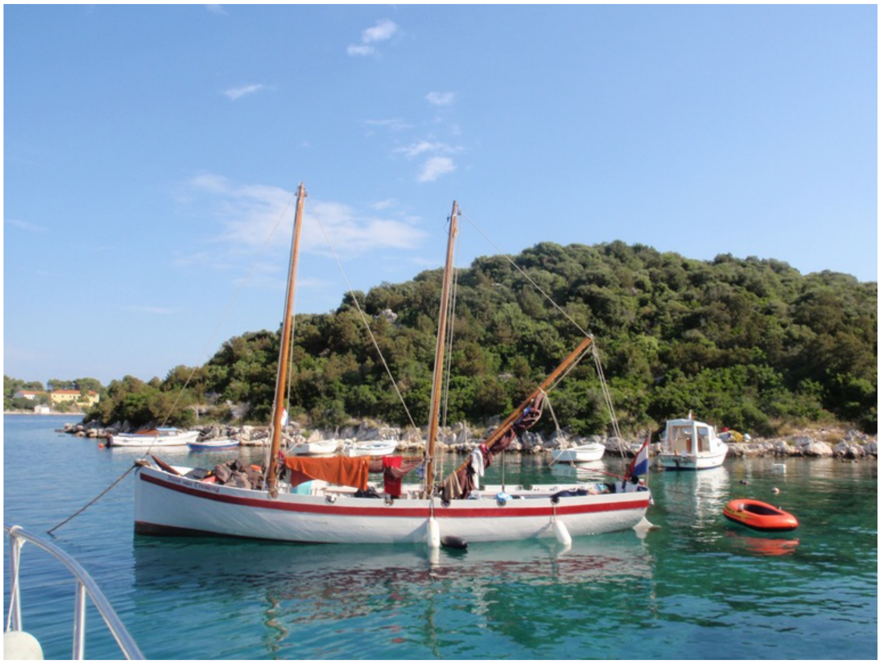
Dijagonalni elementi matrice R padaju po apsolutnoj vrijednosti pa možemo odrezati djelove matrica Q i R za koje smatramo da nisu značajni.

Dat ćemo primjer kompresije slike.

```
In [1]: using Images, ImageMagick
```

```
In [2]: img=load("P8040001a.jpg")
```

```
Out[2]:
```



```
In [3]: # Opis podataka
        typeof(img)
```

```
Out[3]: Array{RGB{Normed{UInt8,8}},2}
```

```
In [4]: img[1,1]
```

```
Out[4]:
```

```
In [5]: show(img[1,1])
```

```
RGB{N0f8}(0.439,0.624,0.843)
```

```
In [6]: # Razdvojimo sliku na R, G i B komponente
        channels=channelview(img)
```

```
Out[6]: 3×576×768 reinterpret(N0f8, ::Array{RGB{N0f8},3}):
        [:, :, 1] =
         0.439  0.447  0.439  0.435  0.447  …  0.886  0.886  0.89   0.894  0.894
         0.624  0.631  0.624  0.62   0.631     0.886  0.886  0.89   0.894  0.894
         0.843  0.851  0.843  0.839  0.851     0.847  0.847  0.851  0.855  0.855

        [:, :, 2] =
         0.439  0.443  0.443  0.439  0.443  …  0.89   0.89   0.89   0.894  0.894
         0.624  0.627  0.627  0.624  0.627     0.89   0.89   0.89   0.894  0.894
         0.843  0.847  0.847  0.843  0.847     0.851  0.851  0.851  0.855  0.855

        [:, :, 3] =
         0.443  0.439  0.447  0.447  0.439  …  0.898  0.898  0.898  0.902  0.902
         0.627  0.624  0.631  0.631  0.624     0.898  0.898  0.898  0.902  0.902
         0.847  0.843  0.851  0.851  0.843     0.859  0.859  0.859  0.863  0.863

        ...

        [:, :, 766] =
         0.62   0.624  0.624  0.624  0.627  …  0.263  0.267  0.302  0.302  0.286
         0.769  0.773  0.773  0.773  0.769     0.447  0.451  0.478  0.478  0.463
```

```
 0.953  0.957  0.957  0.957  0.957     0.565  0.569  0.6    0.6    0.584

[:, :, 767] =
 0.624  0.624  0.62   0.62   0.624  …  0.271  0.271  0.302  0.302  0.286
 0.773  0.773  0.769  0.769  0.773     0.455  0.455  0.478  0.478  0.463
 0.965  0.965  0.961  0.953  0.957     0.573  0.573  0.6    0.6    0.584

[:, :, 768] =
 0.627  0.624  0.62   0.62   0.62   …  0.271  0.271  0.302  0.306  0.294
 0.776  0.773  0.769  0.769  0.769     0.451  0.455  0.478  0.482  0.471
 0.969  0.965  0.961  0.961  0.953     0.58   0.573  0.6    0.604  0.592
```

```
In [7]: Red=channels[1,:,:]
        Green=channels[2,:,:]
        Blue=channels[3,:,:]
```

```
Out[7]: 576×768 Array{N0f8,2} with eltype Normed{UInt8,8}:
 0.843  0.843  0.847  0.847  0.847  …  0.949  0.953  0.953  0.965  0.969
 0.851  0.847  0.843  0.839  0.839     0.953  0.957  0.957  0.965  0.965
 0.843  0.847  0.851  0.851  0.851     0.957  0.961  0.957  0.961  0.961
 0.839  0.843  0.851  0.855  0.855     0.957  0.961  0.957  0.953  0.961
 0.851  0.847  0.843  0.839  0.839     0.957  0.957  0.957  0.957  0.953
 0.847  0.847  0.843  0.843  0.843  …  0.953  0.953  0.957  0.957  0.957
 0.839  0.843  0.851  0.855  0.855     0.953  0.957  0.957  0.957  0.957
 0.847  0.847  0.847  0.847  0.851     0.957  0.957  0.957  0.957  0.953
 0.855  0.855  0.855  0.855  0.851     0.957  0.957  0.953  0.953  0.957
 0.855  0.851  0.847  0.847  0.851     0.961  0.965  0.961  0.957  0.961
 0.855  0.851  0.847  0.847  0.851  …  0.953  0.961  0.957  0.957  0.957
 0.859  0.855  0.851  0.851  0.851     0.949  0.961  0.957  0.953  0.953
 0.855  0.855  0.855  0.851  0.851     0.953  0.961  0.961  0.961  0.957
 ⋮                                  ⋱                ⋮
 0.847  0.851  0.855  0.859  0.855     0.592  0.592  0.592  0.588  0.584
 0.847  0.851  0.855  0.855  0.851  …  0.6    0.588  0.576  0.58   0.584
 0.843  0.847  0.855  0.855  0.847     0.596  0.584  0.58   0.584  0.592
 0.835  0.839  0.847  0.851  0.847     0.588  0.596  0.592  0.58   0.569
 0.835  0.839  0.847  0.859  0.855     0.576  0.576  0.573  0.573  0.58
 0.839  0.843  0.851  0.863  0.859     0.576  0.576  0.573  0.569  0.573
 0.843  0.847  0.855  0.867  0.863  …  0.58   0.58   0.58   0.584  0.584
 0.847  0.851  0.859  0.871  0.867     0.561  0.553  0.565  0.573  0.58
 0.847  0.851  0.859  0.871  0.871     0.573  0.565  0.569  0.573  0.573
 0.851  0.851  0.859  0.871  0.871     0.612  0.6    0.6    0.6    0.6
 0.855  0.855  0.863  0.871  0.871     0.612  0.608  0.6    0.6    0.604
 0.855  0.855  0.863  0.875  0.871  …  0.604  0.596  0.584  0.584  0.592
```

```
In [8]: colorview(Gray,Blue)
```

```
Out[8]:
```

In [9]:
```
# Izračunajmo QR rastav s pivotiranjem matrice svakog kanala
using LinearAlgebra
R=qr(Red,Val(true))
G=qr(Green,Val(true))
B=qr(Blue,Val(true));
```

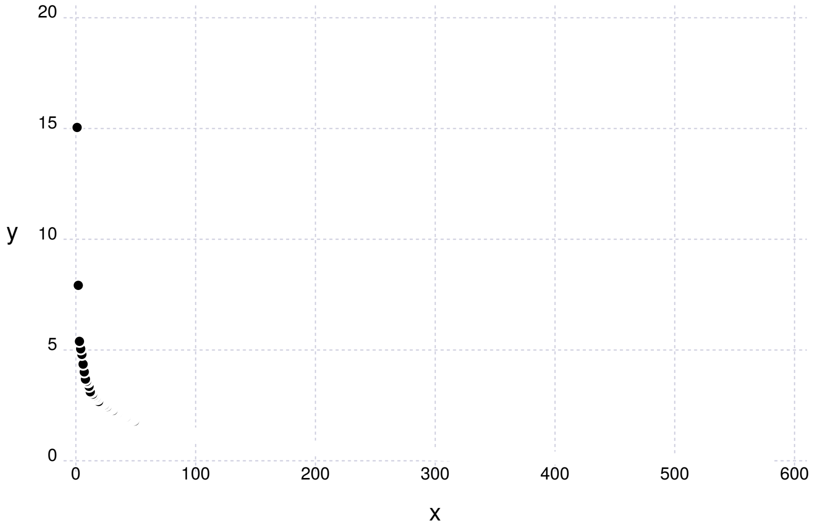
In [10]:
```
norm(R.Q*R.R[:,invperm(R.p)]-float(Red))
```

Out[10]:
```
0.00020910783f0
```

In [11]:
```
import Gadfly
```

In [12]:
```
# Nacrtajmo dijagonalne elemente
Gadfly.plot(x=1:size(R.R,1),y=abs.(diag(R.R)))
```

Out[12]:



```
In [13]: # Izračunajmo komprimirane matrice za svaki kanal, RedC, GreenC i BlueC
         # Funkcija Matrix() je nužna radi bržeg generiranja matrice Q
         k=50
         RedC=Matrix(R.Q)[:,1:k]*R.R[1:k,invperm(R.p)]
         GreenC=Matrix(G.Q)[:,1:k]*G.R[1:k,invperm(G.p)]
         BlueC=Matrix(B.Q)[:,1:k]*B.R[1:k,invperm(B.p)]
```

```
Out[13]: 576×768 Array{Float32,2}:
          0.846009  0.845908  0.846347  0.847124  …  0.952303  0.952581  0.954205
          0.846752  0.847336  0.847957  0.848277     0.95254   0.953014  0.954357
          0.850864  0.851758  0.852974  0.853171     0.953747  0.9537    0.956009
          0.853217  0.853922  0.854729  0.853921     0.953028  0.95291   0.955143
          0.855111  0.855731  0.856358  0.855784     0.950925  0.951316  0.953952
          0.854893  0.855375  0.855883  0.856206  …  0.949433  0.949907  0.952582
          0.855159  0.855322  0.855875  0.856268     0.95544   0.955519  0.957598
          0.855548  0.856303  0.85657   0.857649     0.951908  0.951511  0.952662
          0.853055  0.853722  0.854407  0.856438     0.948731  0.948006  0.948622
          0.857237  0.857739  0.85757   0.858625     0.95457   0.953532  0.953981
          0.860174  0.860686  0.860601  0.86153   …  0.9535    0.952296  0.952384
          0.860947  0.861715  0.861924  0.862076     0.950508  0.950109  0.950441
          0.859382  0.859246  0.859719  0.859474     0.953047  0.9532    0.953628
          ⋮                                         ⋱  ⋮
          0.861595  0.866287  0.870514  0.888945     0.60186   0.599455  0.599131
          0.868299  0.870359  0.867996  0.881116  …  0.621021  0.614113  0.612208
          0.831901  0.839093  0.839436  0.852965     0.624606  0.61462   0.613881
          0.788801  0.796709  0.805558  0.826768     0.592743  0.588192  0.590012
```

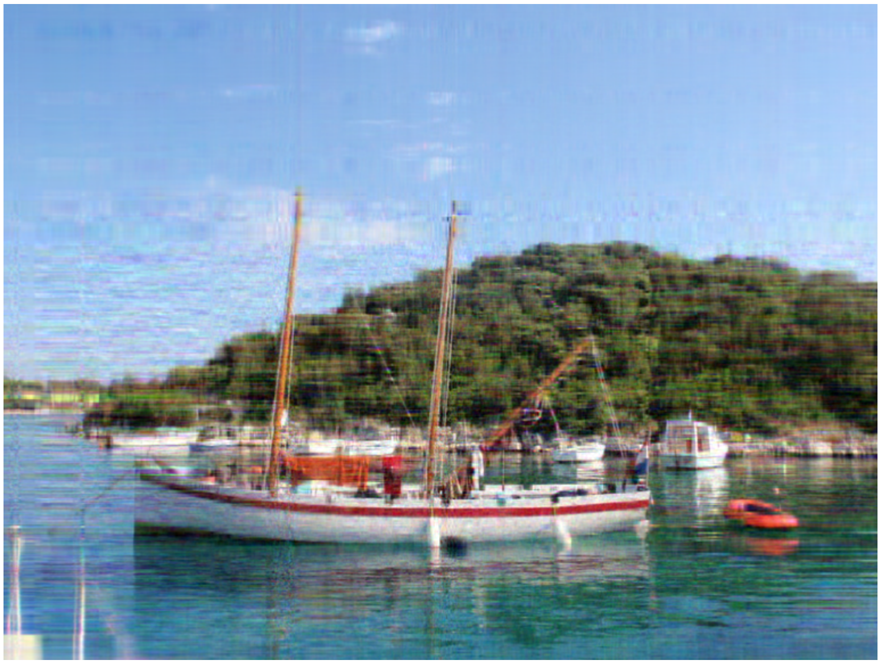
```
 0.790148  0.793604  0.803352  0.823281     0.561922  0.561613  0.568912
 0.770256  0.773408  0.784455  0.808381     0.573375  0.568954  0.569441
 0.80895   0.812651  0.820964  0.836053  …  0.585196  0.58063   0.583133
 0.824016  0.829633  0.83888   0.852058     0.590872  0.581689  0.586055
 0.797955  0.804032  0.816756  0.835299     0.600911  0.587578  0.589304
 0.804283  0.809073  0.816338  0.834984     0.616115  0.598988  0.595386
 0.811135  0.816777  0.820665  0.834612     0.611235  0.590299  0.58575
 0.806234  0.811347  0.821854  0.840017  …  0.592066  0.571771  0.562386
```

```
In [14]: norm(Red-RedC)/norm(Red)
```

```
Out[14]: 0.10693458f0
```

```
In [15]: # Nacrtajmo komprimiranu sliku
         colorview(RGB, RedC, GreenC, BlueC)
```

```
Out[15]:
```



```
In [16]: # Pogledajmo kako raste kvalita
         k=100
         k1=k
         k2=k
         k3=k
         RedC=Matrix(R.Q)[:,1:k1]*R.R[1:k1,invperm(R.p)]
```

```
GreenC=Matrix(G.Q)[:,1:k2]*G.R[1:k2,invperm(G.p)]
BlueC=Matrix(B.Q)[:,1:k3]*B.R[1:k3,invperm(B.p)]
colorview(RGB,RedC,GreenC,BlueC)
```

Out[16]: