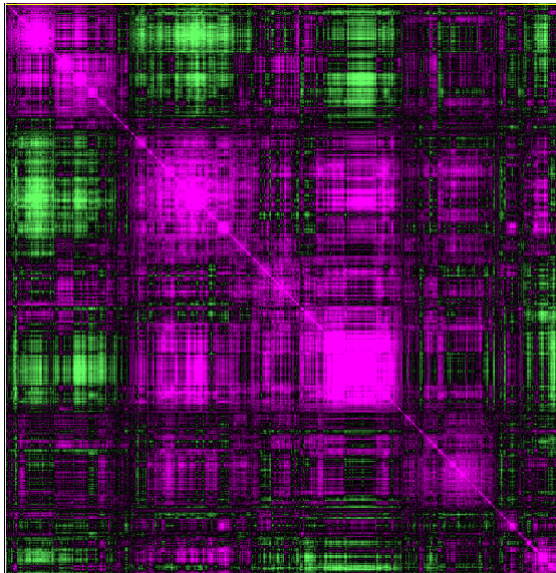


Practical Bioinformatics

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Clustering exercises – Visualizing the distance matrix



```
dictionary = {"A" : "T" , "T" : "A" , "G" : "C" , "C" : "G" }  
dictionary ["G"]  
dictionary ["N"] = "N"  
dictionary . has_key ("C" )
```

```
geneticCode = {"TTT": "F", "TTC": "F", "TTA": "L", "TTG": "L",  
              "CTT": "L", "CTC": "L", "CTA": "L", "CTG": "L",  
              "ATT": "I", "ATC": "I", "ATA": "I", "ATG": "M",  
              "GTT": "V", "GTC": "V", "GTA": "V", "GTG": "V",  
  
              "TCT": "S", "TCC": "S", "TCA": "S", "TCG": "S",  
              "CCT": "P", "CCC": "P", "CCA": "P", "CCG": "P",  
              "ACT": "T", "ACC": "T", "ACA": "T", "ACG": "T",  
              "GCT": "A", "GCC": "A", "GCA": "A", "GCG": "A",  
  
              "TAT": "Y", "TAC": "Y", "TAA": "*", "TAG": "*",  
              "CAT": "H", "CAC": "H", "CAA": "Q", "CAG": "Q",  
              "AAT": "N", "AAC": "N", "AAA": "K", "AAG": "K",  
              "GAT": "D", "GAC": "D", "GAA": "E", "GAG": "E",  
  
              "TGT": "C", "TGC": "C", "TGA": "*", "TGG": "W",  
              "CGT": "R", "CGC": "R", "CGA": "R", "CGG": "R",  
              "AGT": "S", "AGC": "S", "AGA": "R", "AGG": "R",  
              "GGT": "G", "GGC": "G", "GGA": "G", "GGG": "G" }
```

- 1 Write a function to return the antisense strand of a DNA sequence in 3'→5' orientation.
- 2 Write a function to return the complement of a DNA sequence in 5'→3' orientation.
- 3 Write a function to translate a DNA sequence