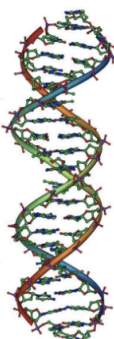
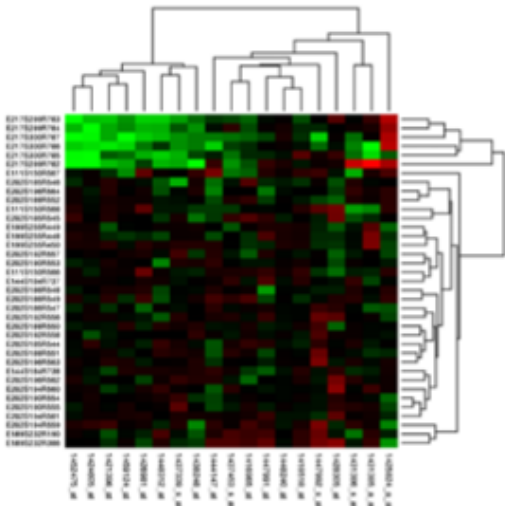
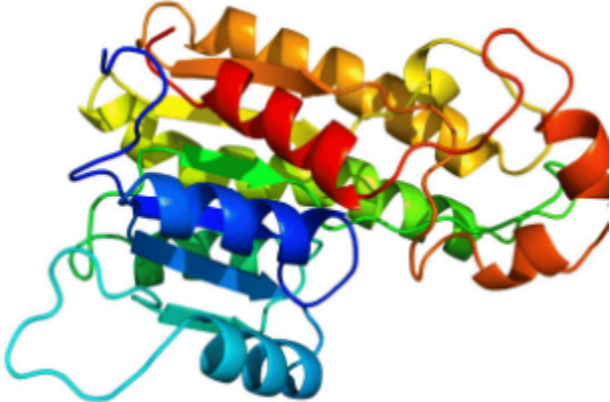
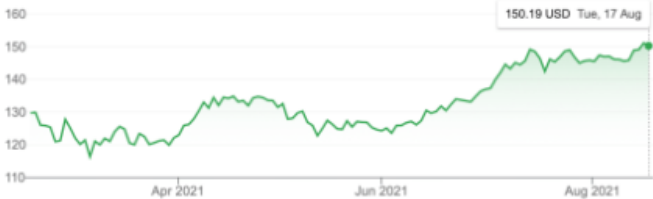
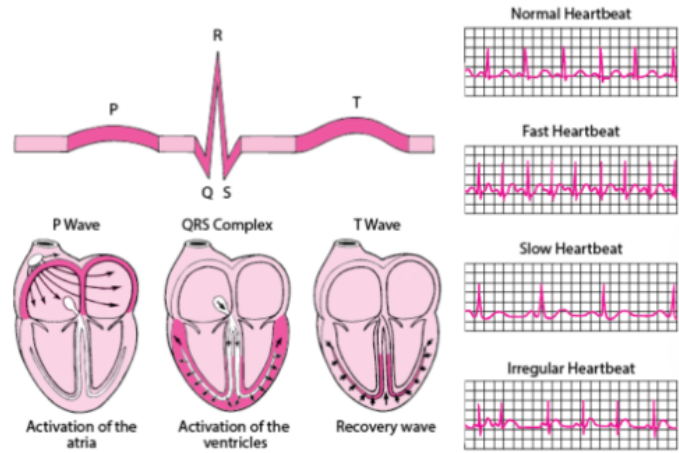
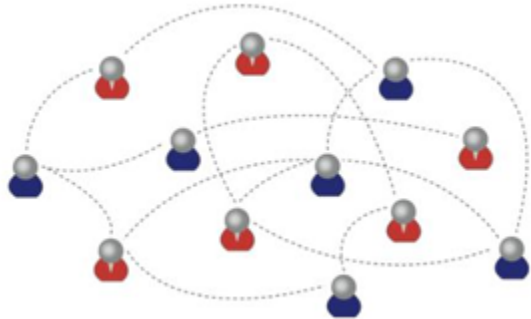


## Data and Phyton (L2)

### A) Type of Data

| No.    | Type of Data    | Example                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Details                                                                               |            |             |    |      |    |    |      |    |    |      |    |    |      |    |                                                                                                                                                                                                   |
|--------|-----------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|------------|-------------|----|------|----|----|------|----|----|------|----|----|------|----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1      | Sequential Data | <div></div> <div>ATGAAAAAGACAGCTATCGGATTGCACTGGCACTGGCTGGTTTCGCTACCGTGGCC<br/>CAGGCGGCCTCTGAGGGAACAGTGACTGCTACTTTGGGAATGGGTACGCTACCG<br/>TGGCAGCACAGCCTCACCAGTGGGGTGCCTCCTGCTCCCGTGGAAATTCATGAT<br/>CCTGATAGGCAAGTTTACACAGACAGAAACCCAGTGGCAAGCACTGGGCTGG<br/>GCAACATAAATTAAGTGGGAAATCTGATGGGATGCCAAGCCTGGTGGCAGTG<br/>CTGAAGAACCGCAGGCTGACGTGGGAGTACTGTGATGGCCTCCTGCTCCACCTGC<br/>GGCTGAGACAGTACAGCCAGCCTCAGTTTCGATCAAAAGGAGGGCTCTTCGCCGA<br/>CATCGCCTCCACCCCTGGCAGGCTGCCATCTTTGCCAAGCACAGGAGGTGCGCCGG<br/>AGAGCGGTTCTGTGGGGGGCATACTCATCAGCTCCTGCTGGATTCTCTGCGCG<br/>CCAATGCTTCCAGGAGAGGTTTCCGCCCACTGACGGTGTATCTTGGGCAGAAC<br/>ATACCGGGTGGTCCCTGGCGAGGAGGAGCAGAAATTTGAAGTCGAAAAATACATTG<br/>TCCATAAGGAATTCGATGATGACACTTACGACAATGACATTGCGCTGCTGACGTGA<br/>AATCGGATTCTGTCGGCTGTGCCAGGAGAGCAGCGTGGTCCGCACTGTGTGCTCTC<br/>CCCCGGCGGACCTGCAGCTGCCGAGTGGACGGAAGTGTGAGCTCTCCGGTACGGC<br/>AAGCATGAGGCTTGTCTCTTTCTATTTCGGAGCGGCTGAAGGAGGCTCATGTGAGA<br/>CTGTACCCATCCAGCGCTGCACATCACAATTACTTAACAGAACAGTACCCGAC<br/>AACATGCTGTGTGCTGGAGACACTCGGAGCGCGCGGCCCGAGGCAAACTTCGACGA<br/>CGCCTGCCAGGGCGGATTGCGGAGGCCCCCTGGTGTGTCTGAACGATGGCCGATGA<br/>CTTTGGTGGGCATCATCAGCTGGGGCTGGGCTGTGGACAGAAAGGATGTCCCGGT<br/>GTGTACACAAAGTTACCAACTACCTAGACTGGATTCTGTGACAACATGGCACCG<br/>(SEQ ID NO:2)</div> <div>Fig 1. DNA Sequence</div> | Where the <b>order of the data matters</b> , so what comes after depends on previous. |            |             |    |      |    |    |      |    |    |      |    |    |      |    |                                                                                                                                                                                                   |
| 2      | Data Matrix     | <table><thead><tr><th>Person</th><th>Height (m)</th><th>Weight (kg)</th></tr></thead><tbody><tr><td>P1</td><td>1.79</td><td>75</td></tr><tr><td>P2</td><td>1.64</td><td>54</td></tr><tr><td>P3</td><td>1.70</td><td>63</td></tr><tr><td>P4</td><td>1.88</td><td>78</td></tr></tbody></table> <div>Fig 2. (4 x 2) matrix with consist of 4 individuals height and weight</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Person                                                                                | Height (m) | Weight (kg) | P1 | 1.79 | 75 | P2 | 1.64 | 54 | P3 | 1.70 | 63 | P4 | 1.88 | 78 | <p><b>Collection of records</b> which have a <b>fixed set of attributes</b> consist of <b>row and column</b>.</p> <p><b>Swapping/ shuffling</b> rows or columns <b>won't affect</b> the data.</p> |
| Person | Height (m)      | Weight (kg)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |                                                                                       |            |             |    |      |    |    |      |    |    |      |    |    |      |    |                                                                                                                                                                                                   |
| P1     | 1.79            | 75                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                       |            |             |    |      |    |    |      |    |    |      |    |    |      |    |                                                                                                                                                                                                   |
| P2     | 1.64            | 54                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                       |            |             |    |      |    |    |      |    |    |      |    |    |      |    |                                                                                                                                                                                                   |
| P3     | 1.70            | 63                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                       |            |             |    |      |    |    |      |    |    |      |    |    |      |    |                                                                                                                                                                                                   |
| P4     | 1.88            | 78                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                                       |            |             |    |      |    |    |      |    |    |      |    |    |      |    |                                                                                                                                                                                                   |

|   |              |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                                                                     |
|---|--------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
|   |              |  <p>A heatmap visualization of gene expression data. The x-axis and y-axis both represent individual genes, identified by long alphanumeric IDs. A dendrogram at the top clusters the genes based on their expression profiles. The heatmap cells are colored in a gradient from green (low expression) to red (high expression), showing distinct clusters of genes with similar expression patterns.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |                                                                     |
| 3 | Spatial Data |  <p>A world map titled "Mineral Map of THE WORLD" showing the global distribution of various minerals. The map is marked with colored dots and symbols corresponding to different resources. A legend in the bottom-left corner identifies the symbols: Uranium (triangle), Silver (star), Oil (circle), Lead &amp; Zinc (square), Iron (diamond), Diamond (circle with cross), Bauxite (square with cross), Coal (circle with dot), Copper (asterisk), and Gold (square). A scale bar indicates 5000 km, and a north arrow is present in the top-right corner.</p>  <p>A 3D ribbon diagram of a protein structure. The protein is composed of multiple polypeptide chains, each represented by a colored ribbon. The chains are intertwined, forming a complex tertiary structure. The colors used include blue, green, yellow, orange, and red, highlighting different regions or subunits of the protein.</p> | Data that involved <b>locations</b> and <b>spatial</b> information. |

|      |                   |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                                                                      |            |         |       |            |        |      |        |           |       |            |        |     |        |           |       |           |        |                                  |
|------|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------|------------|---------|-------|------------|--------|------|--------|-----------|-------|------------|--------|-----|--------|-----------|-------|-----------|--------|----------------------------------|
| 4    | Temporal Data     | <div><div>Apple Inc</div><div>150.19 USD</div><div>+20.48 (15.79%) ↑ past 6 months</div><div>Closed: 18 Aug, 7:38 am GMT-4 · Disclaimer</div><div>Pre-market 150.34 +0.15 (0.100%)</div><div><div>1D</div><div>5D</div><div>1M</div><div>6M</div><div>YTD</div><div>1Y</div><div>5Y</div><div>Max</div></div><div><div>150.19 USD Tue, 17 Aug</div></div><div><table><tr><td>Open</td><td>150.23</td><td>Mkt cap</td><td>2.48T</td><td>Prev close</td><td>151.12</td></tr><tr><td>High</td><td>151.68</td><td>P/E ratio</td><td>29.41</td><td>52-wk high</td><td>151.68</td></tr><tr><td>Low</td><td>149.09</td><td>Div yield</td><td>0.59%</td><td>52-wk low</td><td>103.10</td></tr></table></div></div> <div>Fig 6. Stock Market</div> | Open                                                                 | 150.23     | Mkt cap | 2.48T | Prev close | 151.12 | High | 151.68 | P/E ratio | 29.41 | 52-wk high | 151.68 | Low | 149.09 | Div yield | 0.59% | 52-wk low | 103.10 | Data that involved <b>time</b> . |
| Open | 150.23            | Mkt cap                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | 2.48T                                                                | Prev close | 151.12  |       |            |        |      |        |           |       |            |        |     |        |           |       |           |        |                                  |
| High | 151.68            | P/E ratio                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 29.41                                                                | 52-wk high | 151.68  |       |            |        |      |        |           |       |            |        |     |        |           |       |           |        |                                  |
| Low  | 149.09            | Div yield                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | 0.59%                                                                | 52-wk low  | 103.10  |       |            |        |      |        |           |       |            |        |     |        |           |       |           |        |                                  |
|      |                   | <div><div><div><div><div>P</div><div>R</div><div>T</div></div><div><div>Q</div><div>S</div></div></div><div><div><div>P Wave</div><div>QRS Complex</div><div>T Wave</div></div><div><div>Activation of the atria</div><div>Activation of the ventricles</div><div>Recovery wave</div></div></div></div><div><div>Normal Heartbeat</div><div>Fast Heartbeat</div><div>Slow Heartbeat</div><div>Irregular Heartbeat</div></div></div> <div>Fig 7. ECG signals in Heart</div>                                                                                                                                                                                                                                                               |                                                                      |            |         |       |            |        |      |        |           |       |            |        |     |        |           |       |           |        |                                  |
| 5    | Graph or Networks |  <div>Fig 8. Social Network</div>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Data that consists of <b>objects</b> with their <b>connections</b> . |            |         |       |            |        |      |        |           |       |            |        |     |        |           |       |           |        |                                  |

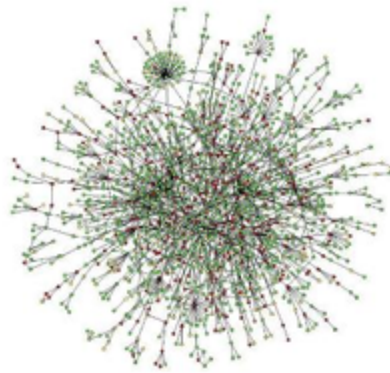


Fig 9. PPI network

6

Text



Fig 10. Wikipedia

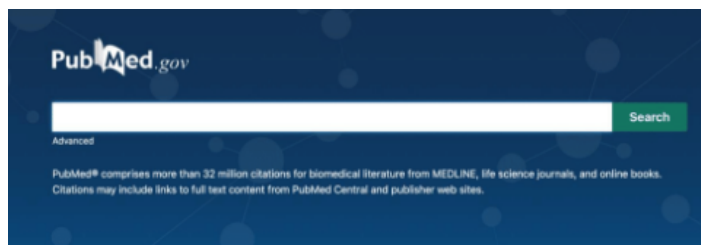


Fig 11. Pubmed

Data that consists of short or long sentences (documents).

|   |                     |                                                                                                                                                                                                                                                                                                  |                                                                             |
|---|---------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
|   |                     |                                                                                                                                                                                                                |                                                                             |
| 7 | Multi Modality Data |  <p>Fig. 13 Video<br/>(Temporal image + audio + transcript)</p> <p>Electronic Health Records<br/>(Data matrix + images + text)</p> <p>Spatial Transcriptomics<br/>(Spatial data + sequence + data matrix)</p> | Combination of various data types.                                          |
| 8 | Unknown Data Type   | <p>Diet</p> <p>Exercise</p>                                                                                                                                                                                                                                                                      | Data <b>not been shown</b> . Only when it is shown we know what type it is. |

## B) Python

Code : The **message** that you use to communicate  
Python : The **app/software** that is used to communicate  
Programming : Method to **communicate with a computer** so it can do something that we requested.

| Code                                                | Return                                        | Details                                                                                                                 |
|-----------------------------------------------------|-----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| Import numpy                                        |                                               | Plug in to make python more powerful<br><br>Beside numpy, there is also <b>scipy and pandas</b> which is also a plug-in |
| a = [1,2,3,4,5]                                     |                                               | <b>Storing values</b> in array                                                                                          |
| numpy.mean(a)                                       | 3.0                                           | Find the <b>average</b>                                                                                                 |
| numpy.median(a)                                     | 3.0                                           | Find the <b>median/middle number</b>                                                                                    |
| numpy.max(a)                                        | 5                                             | Find the <b>biggest number</b>                                                                                          |
| numpy.min(a)                                        | 1                                             | Find the <b>smallest number</b>                                                                                         |
| numpy.std(a)                                        | 1.4142135623730951                            | Find the <b>standard deviation</b>                                                                                      |
| print(a)                                            | [1,2,3,4,5]                                   | <b>Write</b> the value                                                                                                  |
| a_mean = numpy.mean(a)                              |                                               | <b>Store</b> the average of a to <b>"a_mean"</b>                                                                        |
| print("The a array is ", a, "Its mean is ", a_mean) | The a array is [1,2,3,4,5]<br>Its mean is 3.0 |                                                                                                                         |

