The BioVRPi project:

a valuable and sustainable alternative for genomic analysis

Treccani Mirko, Veschetti Laura, Malerba Giovanni

Department of Neurosciences, Biomedicine and Movement Sciences

University of Verona

www.sites.google.com/view/gmlab

mirko.treccani@univr.it

Bio

- Current socio-economic situation: the UN 2030 Agenda
- Raspberry Pi Foundation Sustain 2025 project
- Community interest for Pi devices in bioinformatics

VR

Pi

- Multi-platform: Raspberry Pi and Orange Pi
- Low-cost, accessible and environmental-friendly
- Tailored for education and suitable for scalability issues

Performed analyses

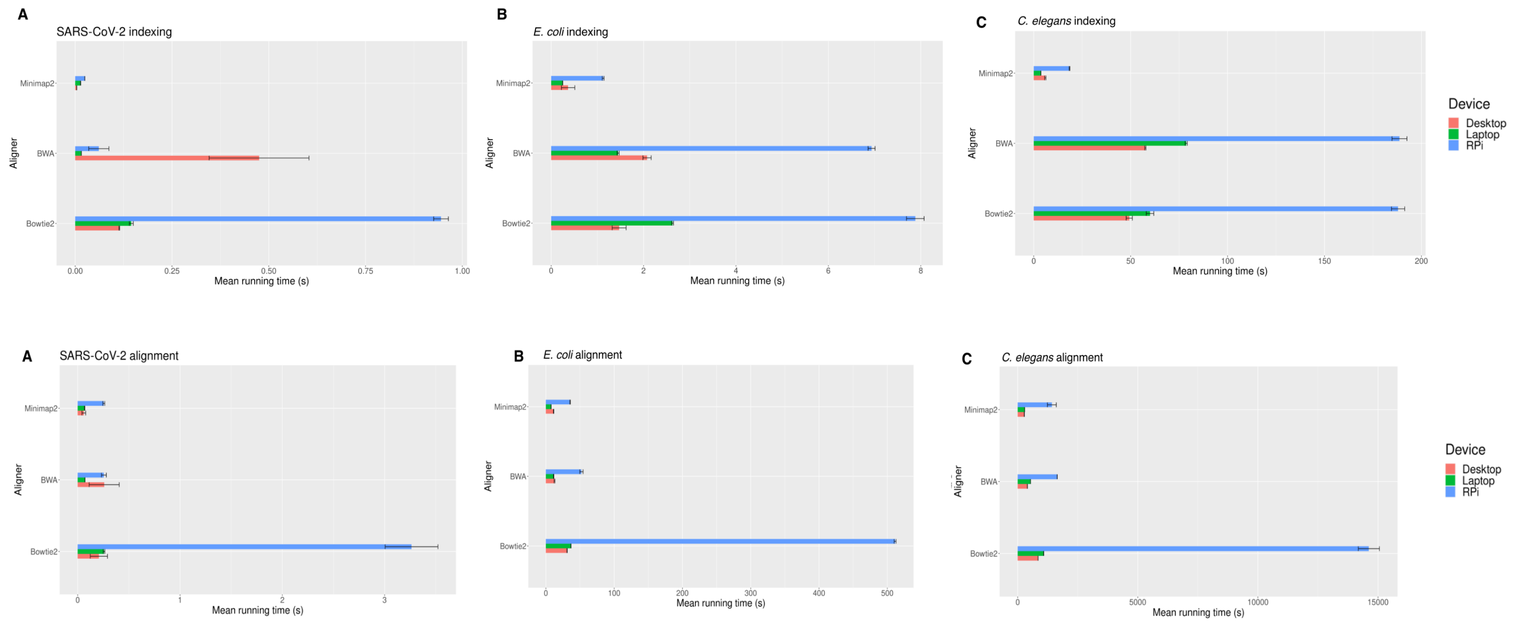
Bioinformatics - Benchmarking

Platforms (64-bit):

- Raspberry Pi 4 (RaspiOS): Cortex-A72 - 8 GB RAM - USB HDD storage
- Laptop (MacOS): Intel Core i5 - 16 GB RAM - SSD storage
- Desktop (Ubuntu): Intel Core i7 - 32 GB RAM - HDD storage

Organisms:

- SARS-CoV-2: virus - 29.9 Kbp
- Escherichia coli: bacterium - 4.6 Mbp
- Caenorhabditis elegans: nematode - 100.3 Mbp



Performance plots. Running time (in second) of the aligners for the indexing (top) and alignment (bottom) processes.

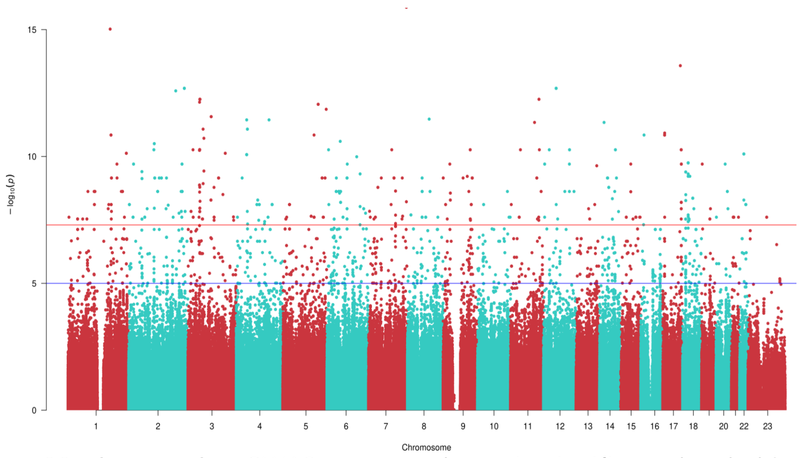
Genomics - GWAS

Dataset:

- 395 human samples
- 1’047’171 markers (WGS)
- Quantitative phenotype (complex trait)

Platforms (64-bit):

- Raspberry Pi 4 (RaspiOS): Cortex-A72 - 8 GB RAM - 1.5 GHz
- Desktop (Ubuntu): Intel Core i7 - 32 GB RAM - 3.0 GHz



Manhattan plot. GWAS on a complex trait; significant threshold set to -log(p)=8, suggestive threshold set to -log(p)=5

Step	Pi (sec)	Desktop (sec)
Pre-processing	60	3
Quality control	120	4
Association	300	60

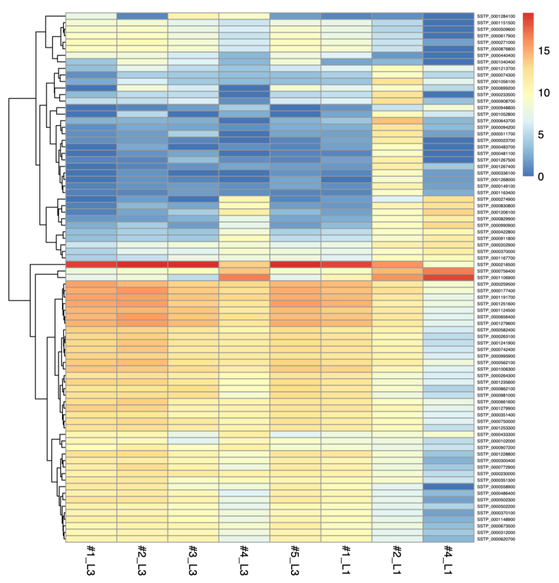
Transcriptomics – *Strongyloides stercoralis*

Dataset:

- mRNA-sequencing reads
- 5 *S. stercoralis* samples
- 2 larval stage: L1 (rhabditiform) and L3 (infective)

Platforms (64-bit):

- Raspberry Pi 4 (RaspiOS): Cortex-A72 - 8 GB RAM - 1.5 GHz
- Laptop (MacOs): Apple M1 - 16 GB RAM - 3.2 GHz



Heatmap. Analysis of 81 differential expressed genes between L1 and L3 larval stages

Step	Pi (min)	Desktop (min)
Alignment	60	30
Gene reconstruction	25	28
Gene counting	41	7

Take-Home Messages

1. Pi devices are **low-cost**, **accessible** and **environmental-friendly** alternatives for bioinformatics analyses
2. Tools and parameters on Pi devices ensure **good quality** and **equivalent results** compared to other platforms
3. **Package optimization** for ARM architecture needs to be investigated and will lead to a greater scalability for more complex analyses

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