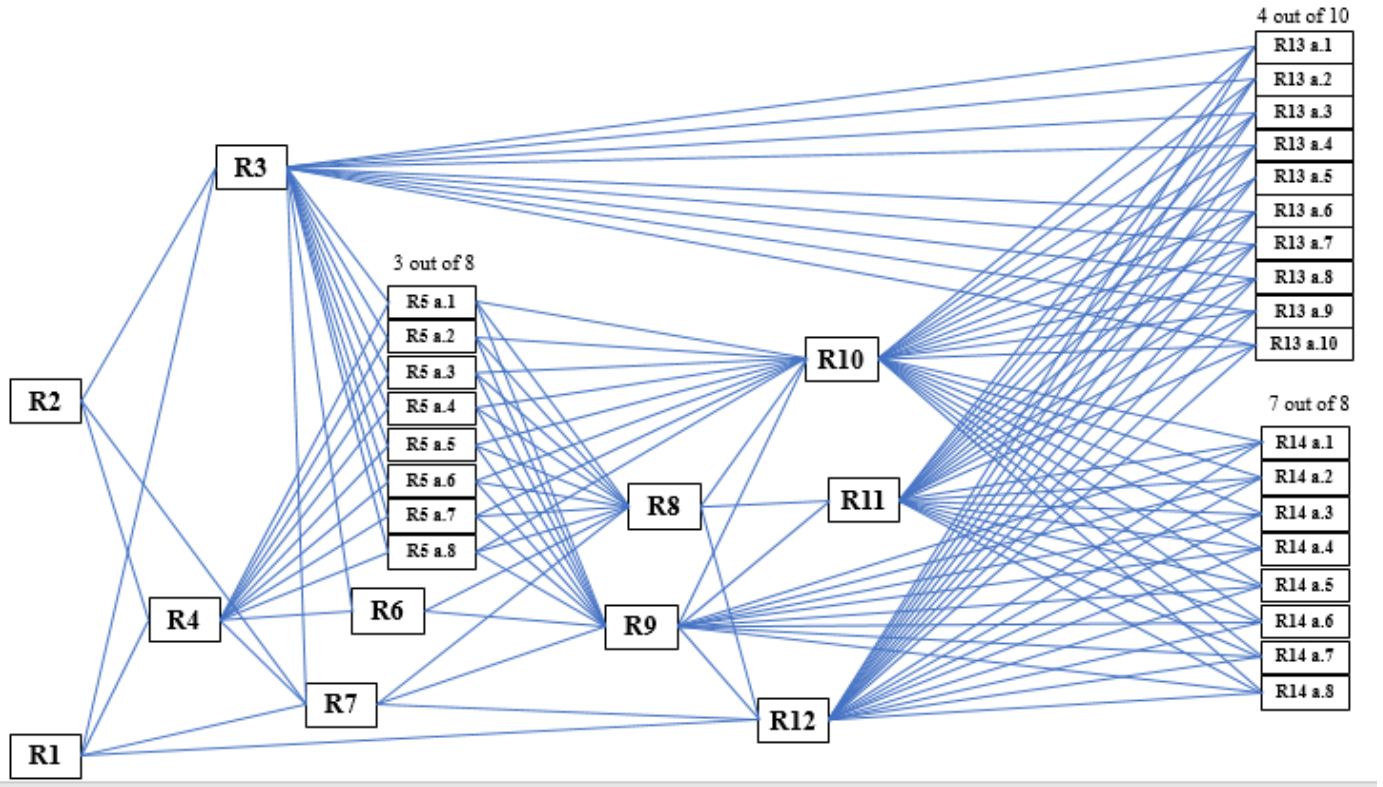
Reliability Analysis

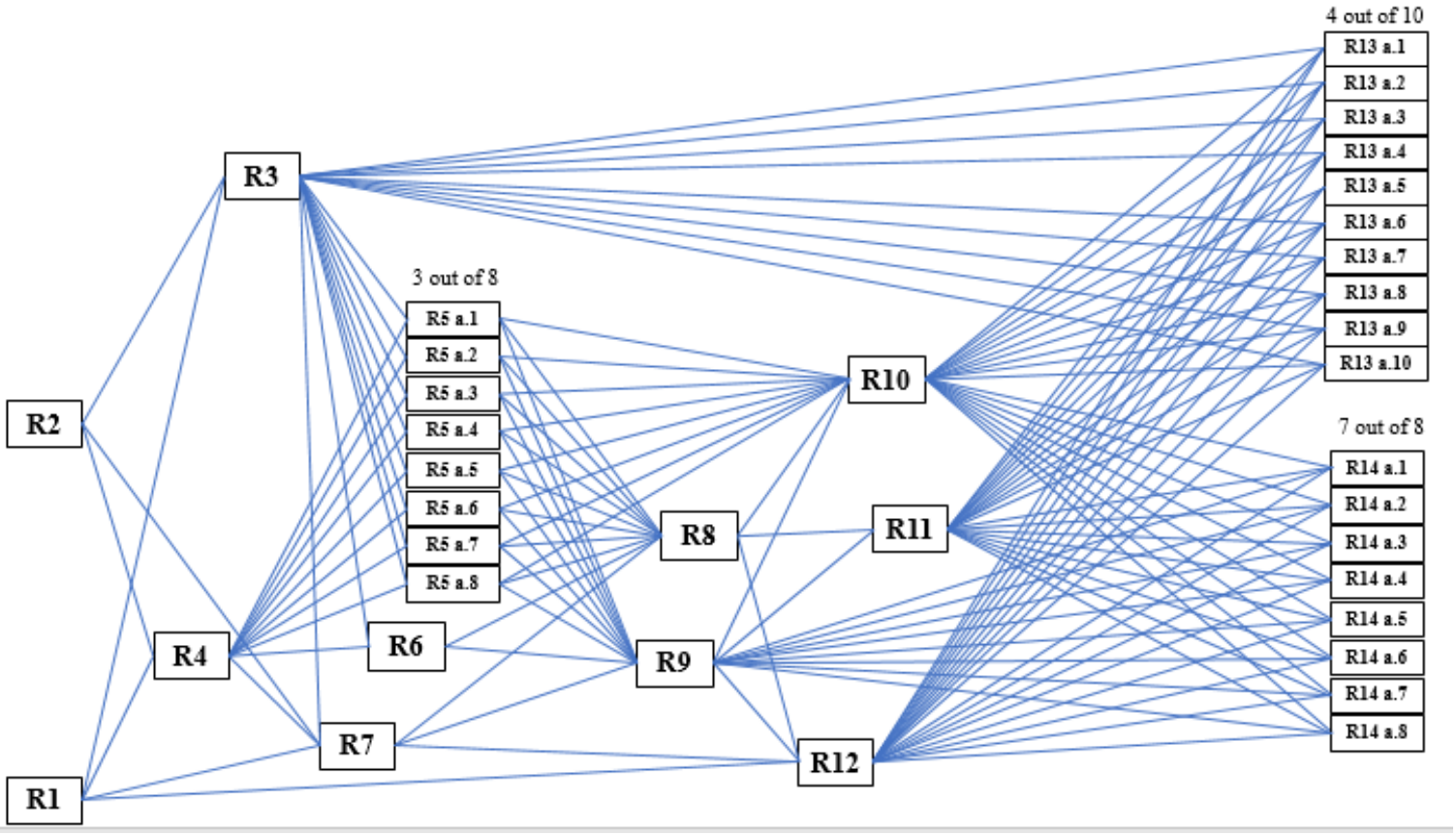
Implementation of a novel combinatorial algorithm in conditional and redundancy systems using advanced computational techniques



Jesus Olivera, Data Analytics & Visualization Student at Yeshiva University /Data Engineer at IBM

In collaboration with A.O. Olivera, Mechanical & Electrical Engineering Student at University of Puerto Rico – Mayaguez Campus

Introduction



Problem Statement

National Laboratories

Adrian Olivera Olivera

Education:

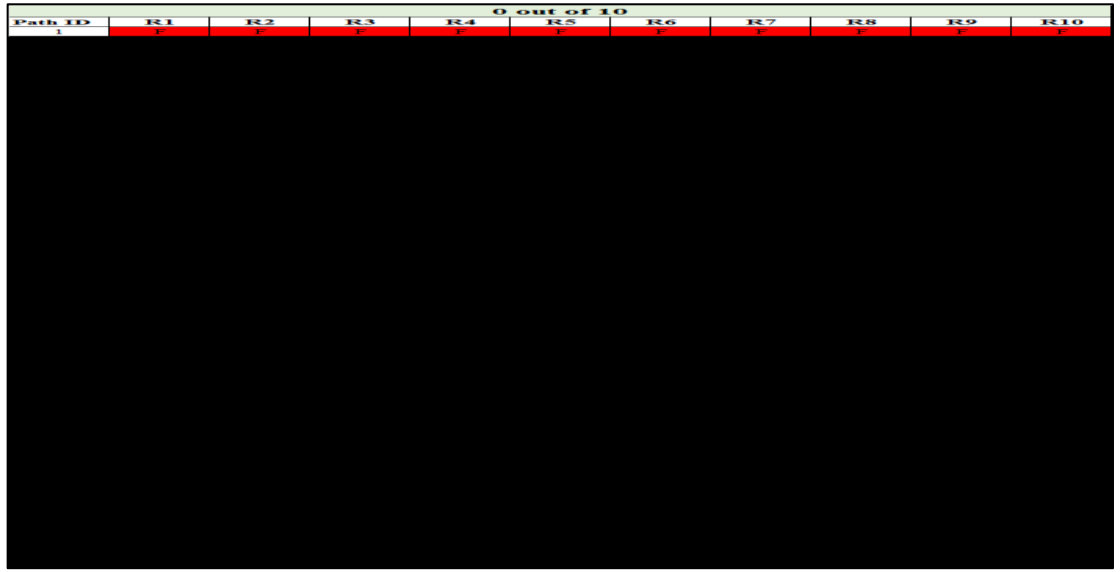
- **Double BS** (*In Progress*)**:** Mechanical and Electrical Engineering
- Cybersecurity Certification (2019):

Experience:

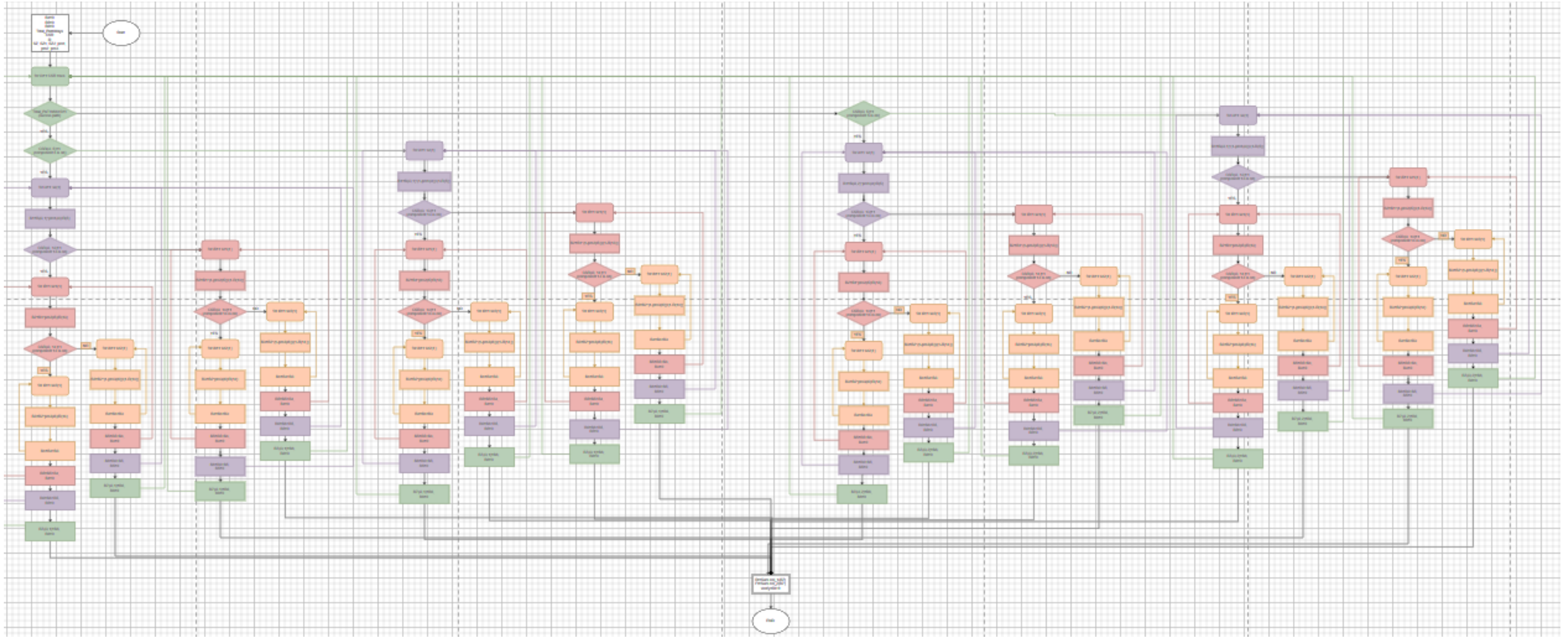
Sandia National Laboratory (2018, 2019, 2021), Army Research Laboratory, NASA, Lilly Del Caribe, Pratt & Whitney

Novel Closed Form Solutions for Hard Reliability Problems!

- Based on a novel combinatorial math method.
  - ✓ "***the right rotation method***"

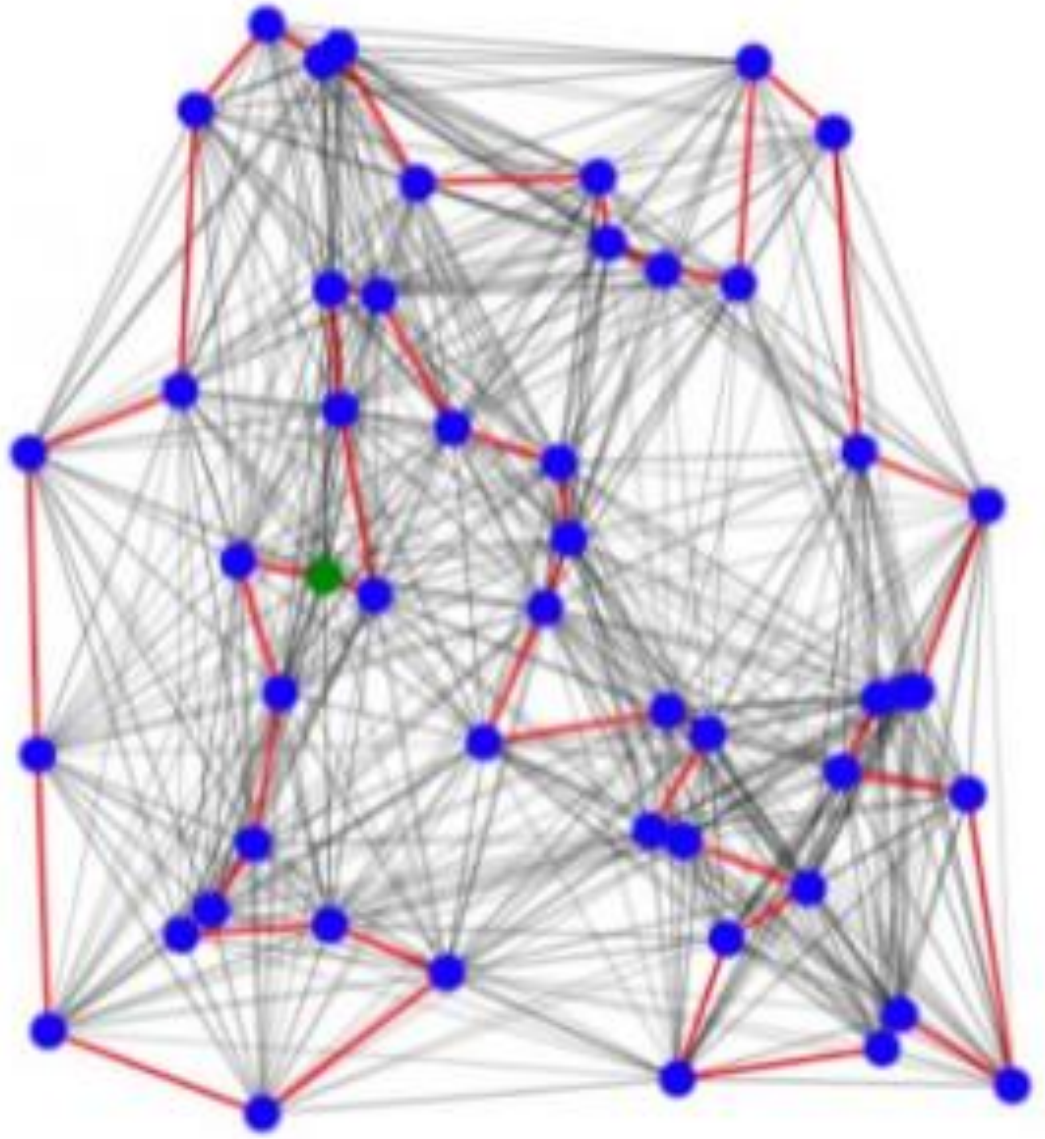


Objective

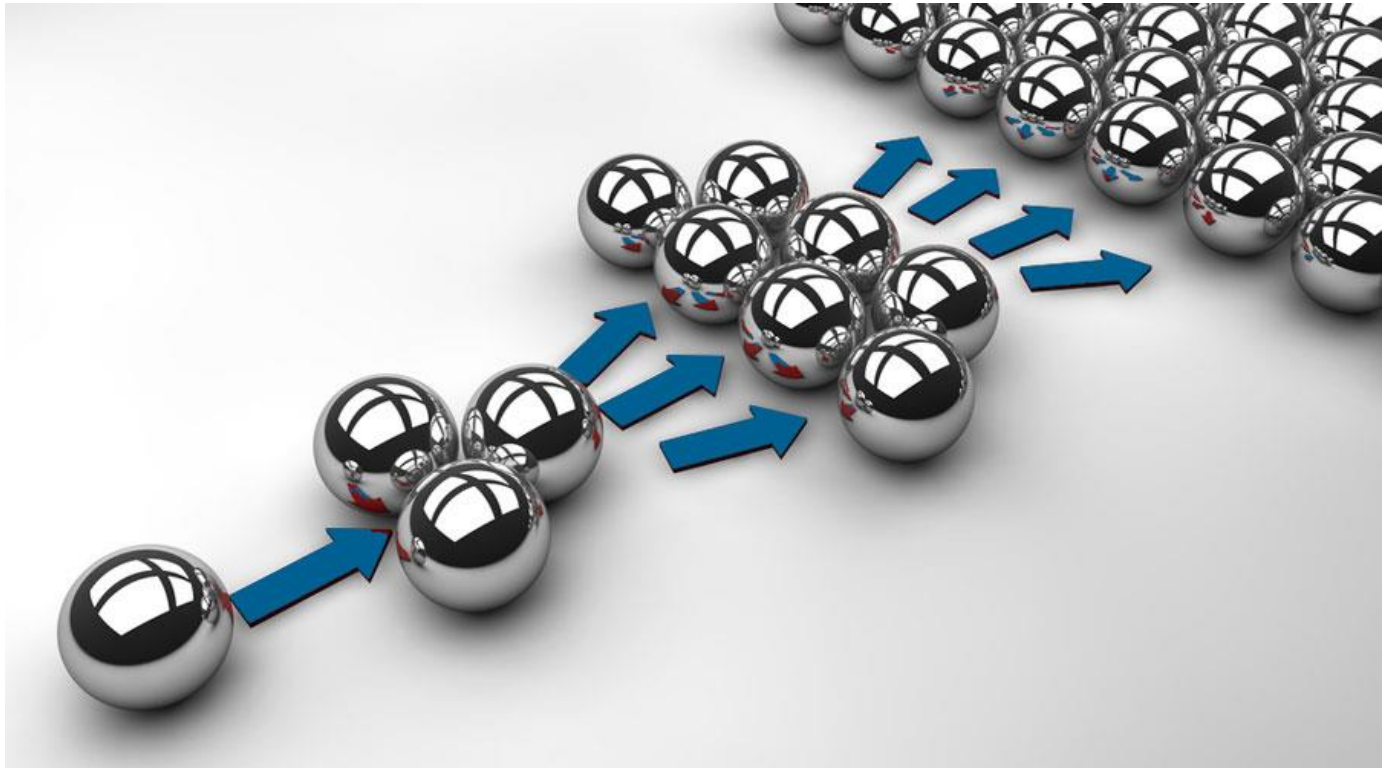


Previous Research & Current Knowledge

1. Overview of the conditional algorithm developed by A.O. Olivera
2. Algorithm optimization and enhancement of computational resources to solved the use case, by Jesus Olivera.

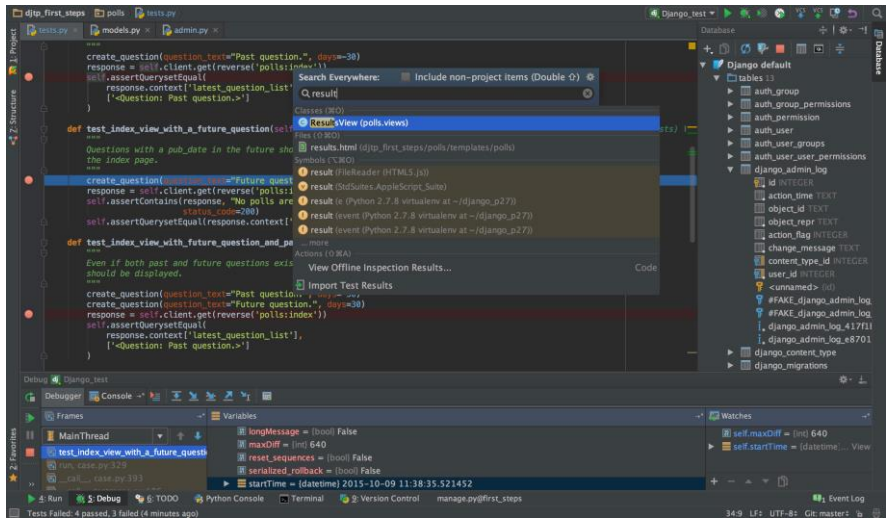


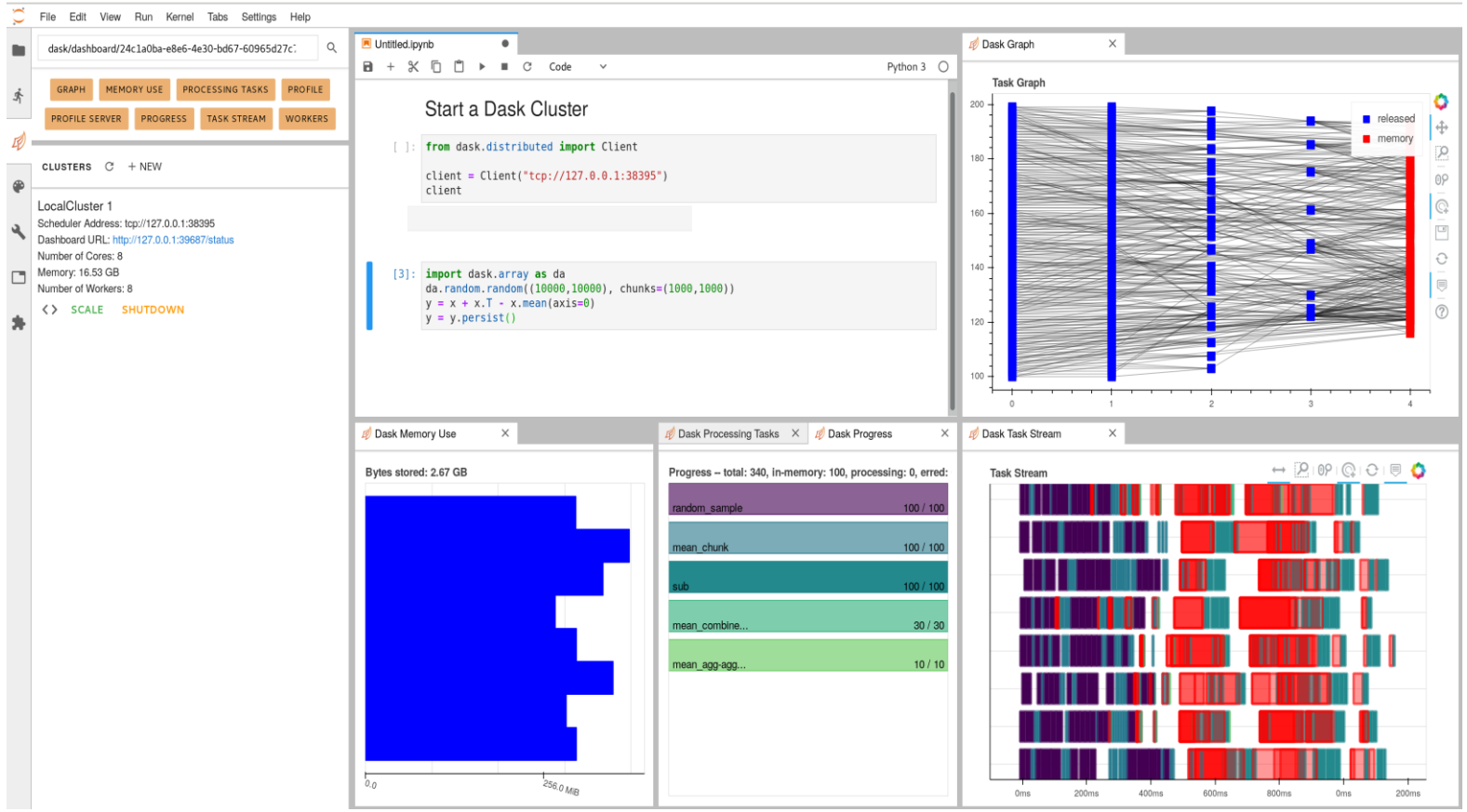
Importance & Broader Impact



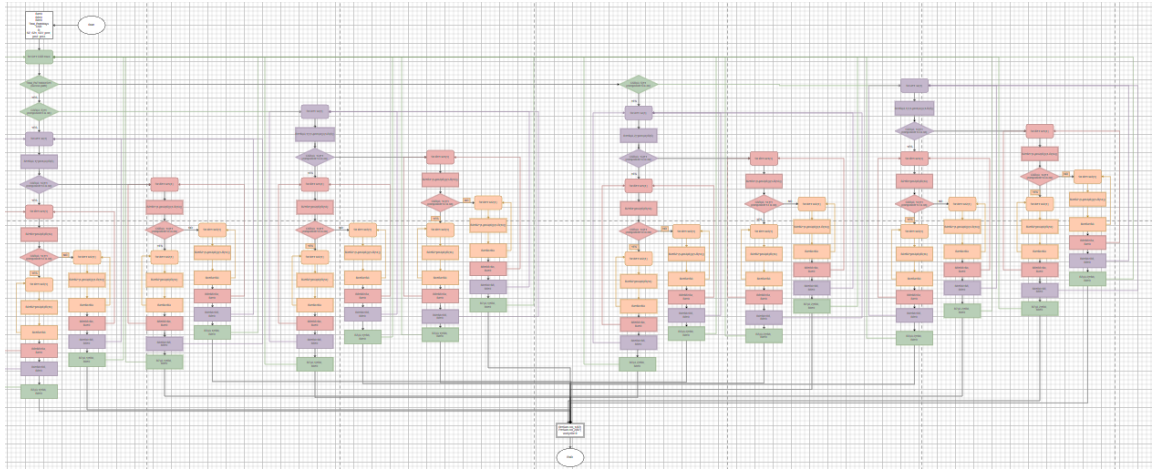
Testing Environment Overview

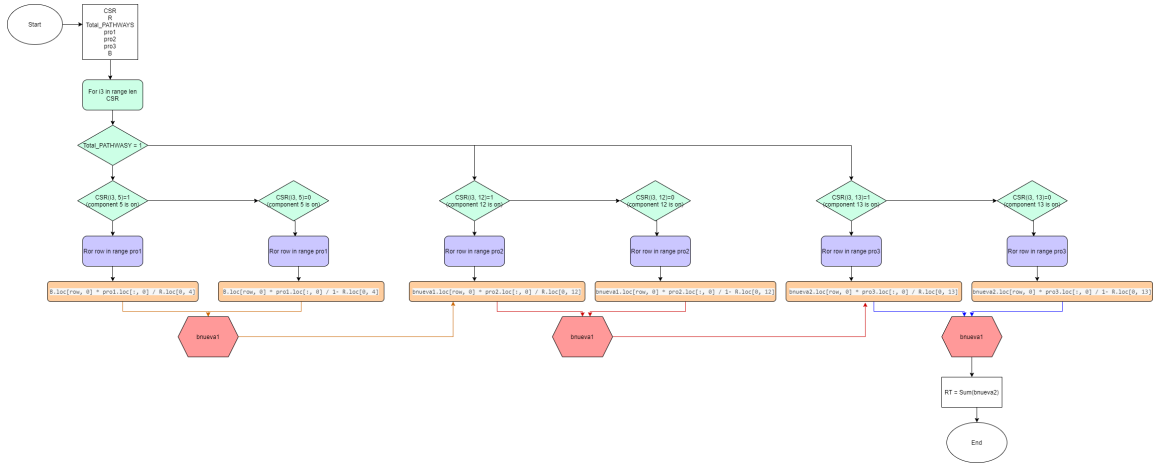
Exploring Distributed Computing & Parallelism





Optimization Techniques





Challenges & Resolutions

Data Alignment

```
bnueva = bnueva.append(pd.DataFrame(a), ignore_index=True).replace(0, np.nan).dropna(how='all', axis=0)
```

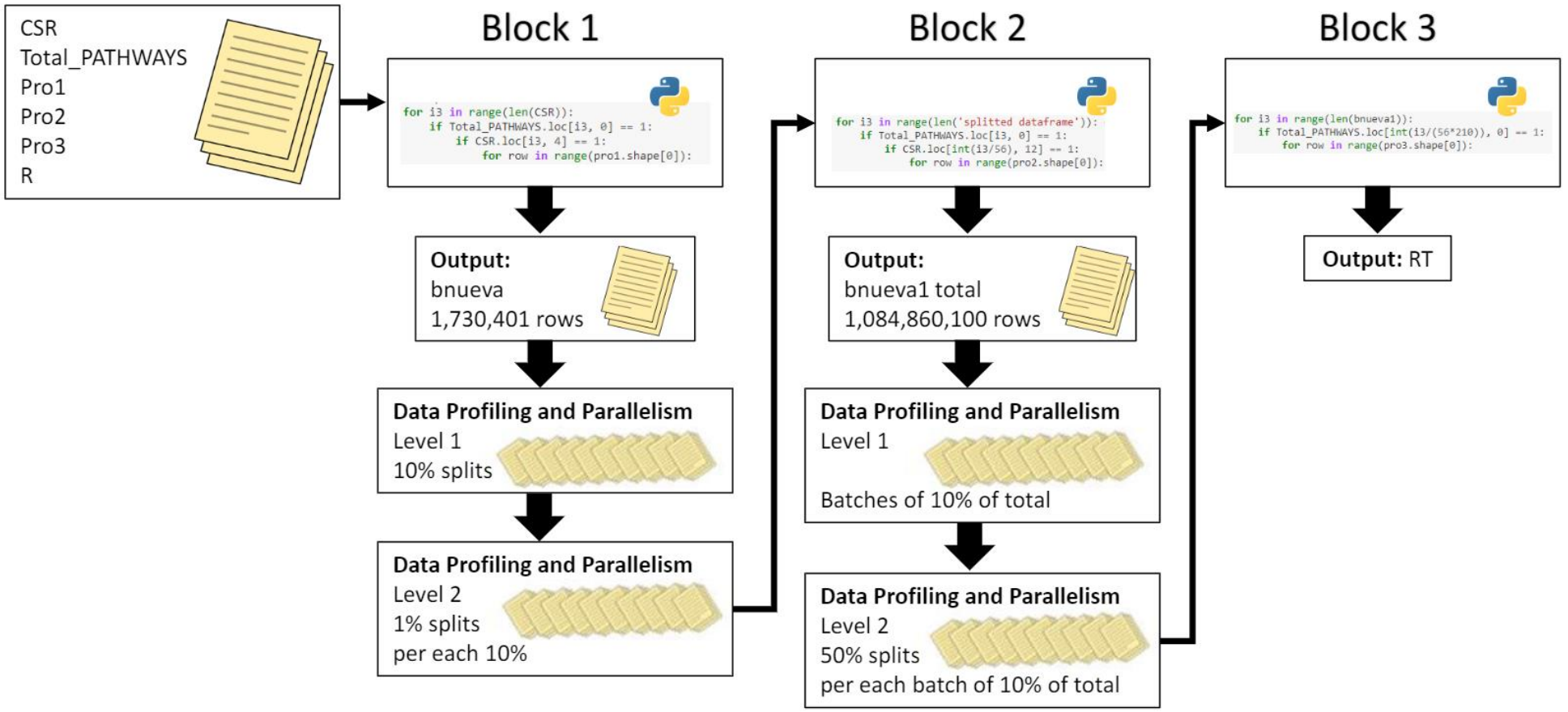
Profiling and Parallelism

```
bnueva_A = bnueva.iloc[0:173040,:].copy().reset_index(drop=True)
```

```
bnueva_A1 = bnueva.iloc[0:1000,:].copy().reset_index(drop=True)
```

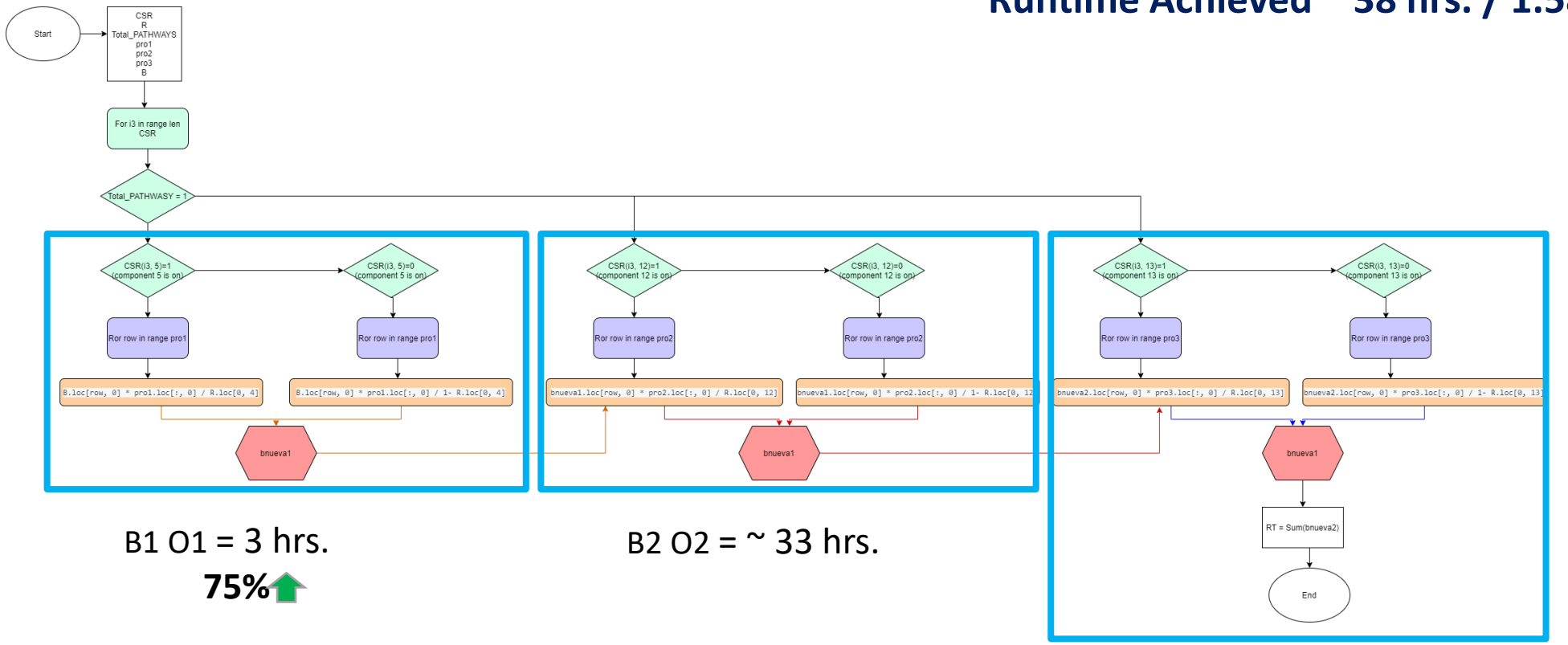
```
bnueva1 = bnueva.iloc[0:5424301,:].copy().reset_index(drop=True)
bnueva2 = bnueva.iloc[5424301:10848602,:].copy().reset_index(drop=True)
```

Algorithm Data Flow Diagram



Optimization Techniques

Runtime Achieved ~ 38 hrs. / 1.58 Days



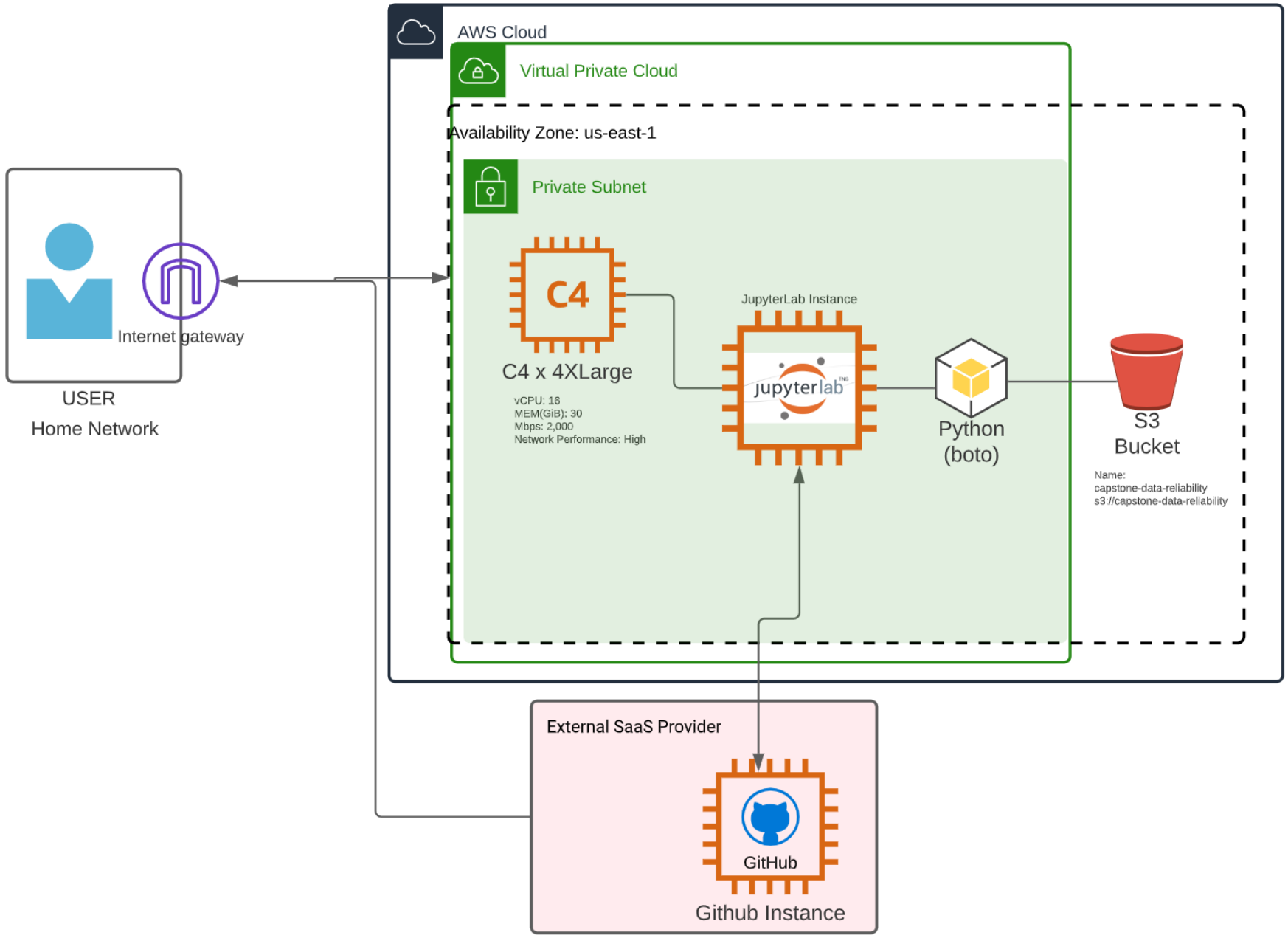
B1 O1 = 3 hrs.

75%

B2 O2 = ~ 33 hrs.

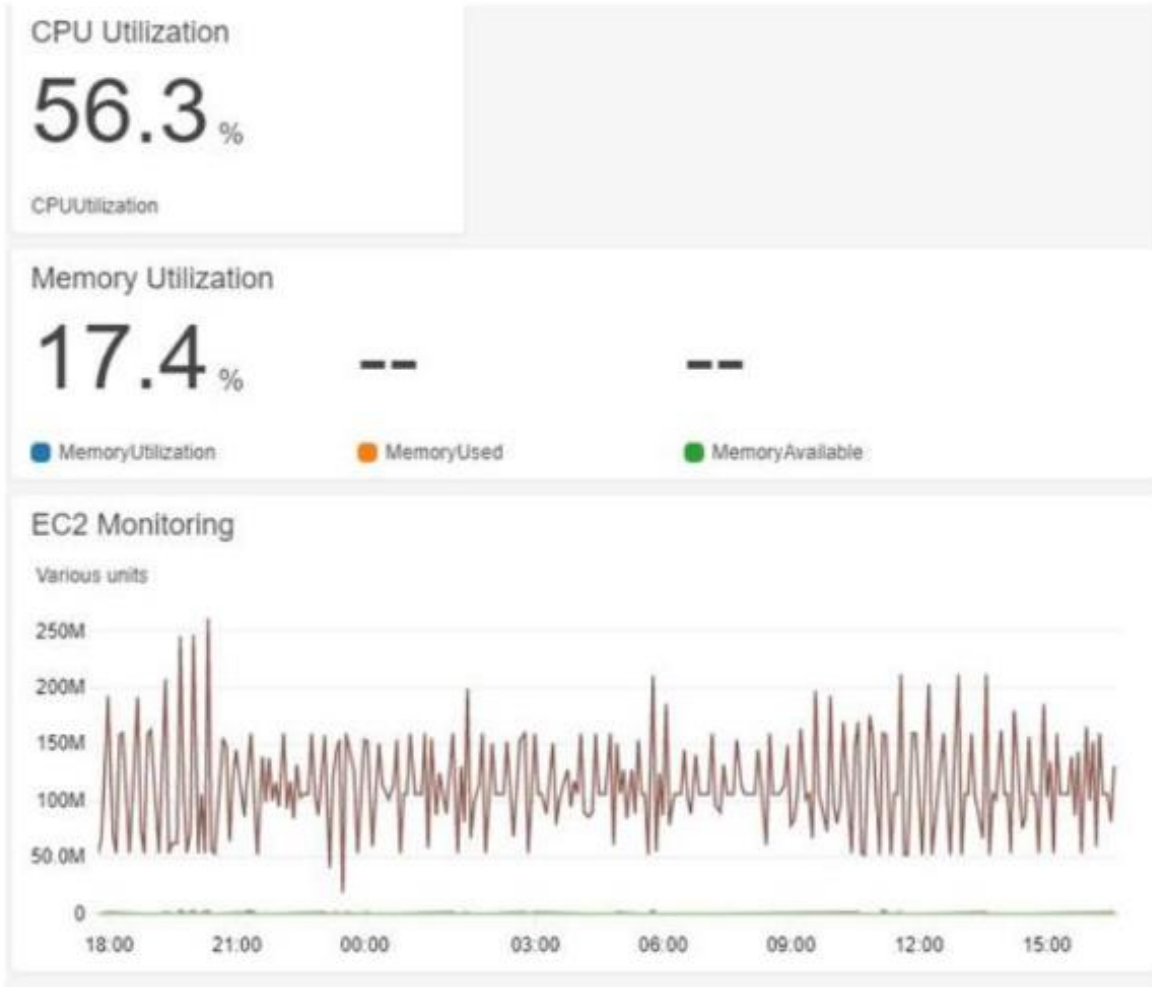
B3 O3 = ~ 2 hrs.

Computational Virtual Environment



Computational Virtual Environment

High Peak Performance



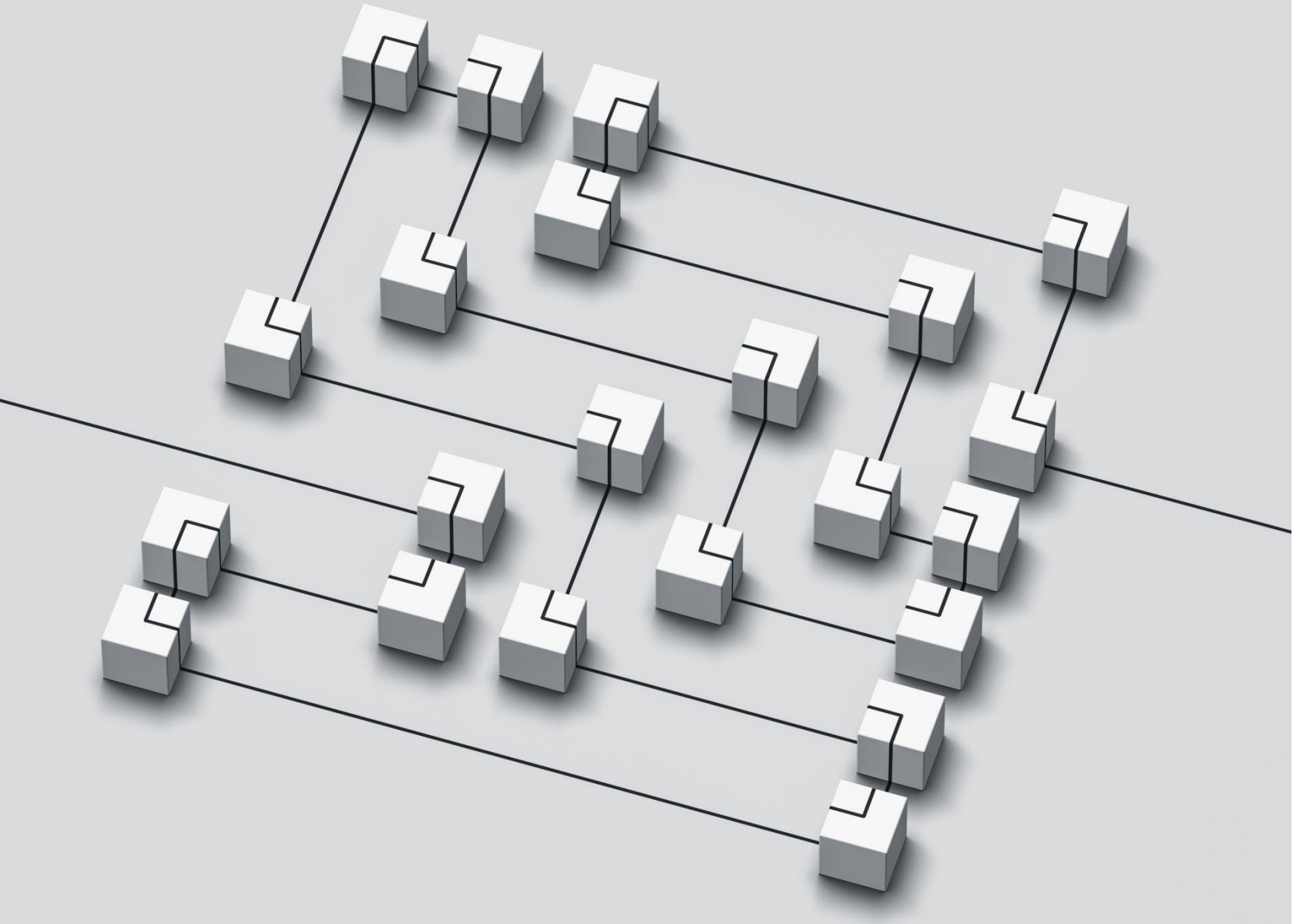
Minimum Resources Requirements (peak)

vCPU: 9

MEM(GiB): 5.1

NetworkOut (Bytes): 110,444,655

NetworkIn (Bytes): 5,706,704



Future Steps

- Leverage functions and input parametrization
- Explore automation by building ETL integration
- Design a deployment space
- Built deployment space
- Expose deployment space
- Explore big data processing libraries like PySpark, Vaex, Dask, Rapids, Koalas, etc.

Thanks !

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