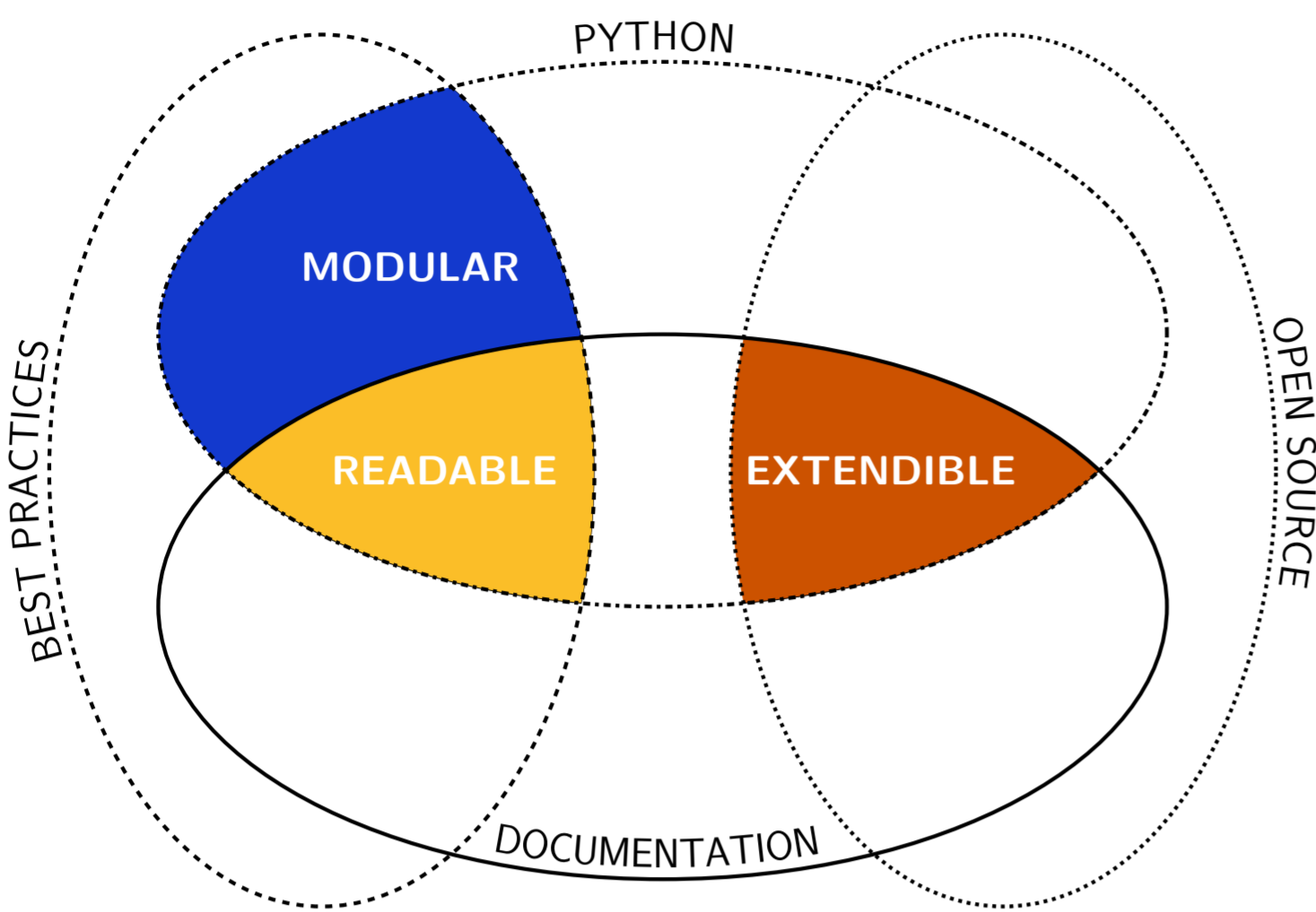


Reproducibility is the “cornerstone of cumulative science” (Sandve et al. (2013)), but many simulation software fail in this aspect. In Kilgore (2001) three properties of simulation software are identified as being vital for reproducibility: **readability**, **modularity** and **extendibility**. Ciw strives to accomplish this:

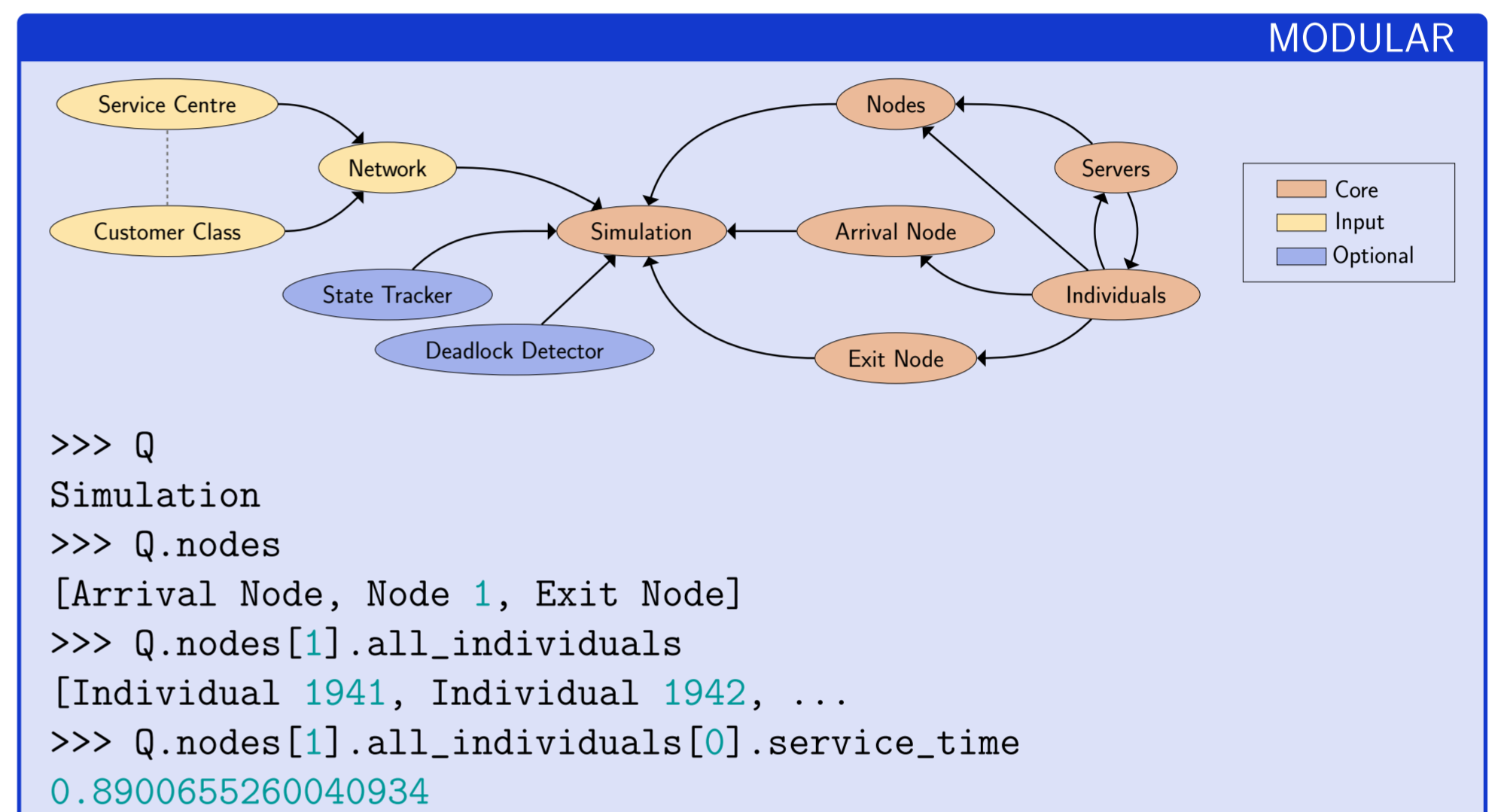


```

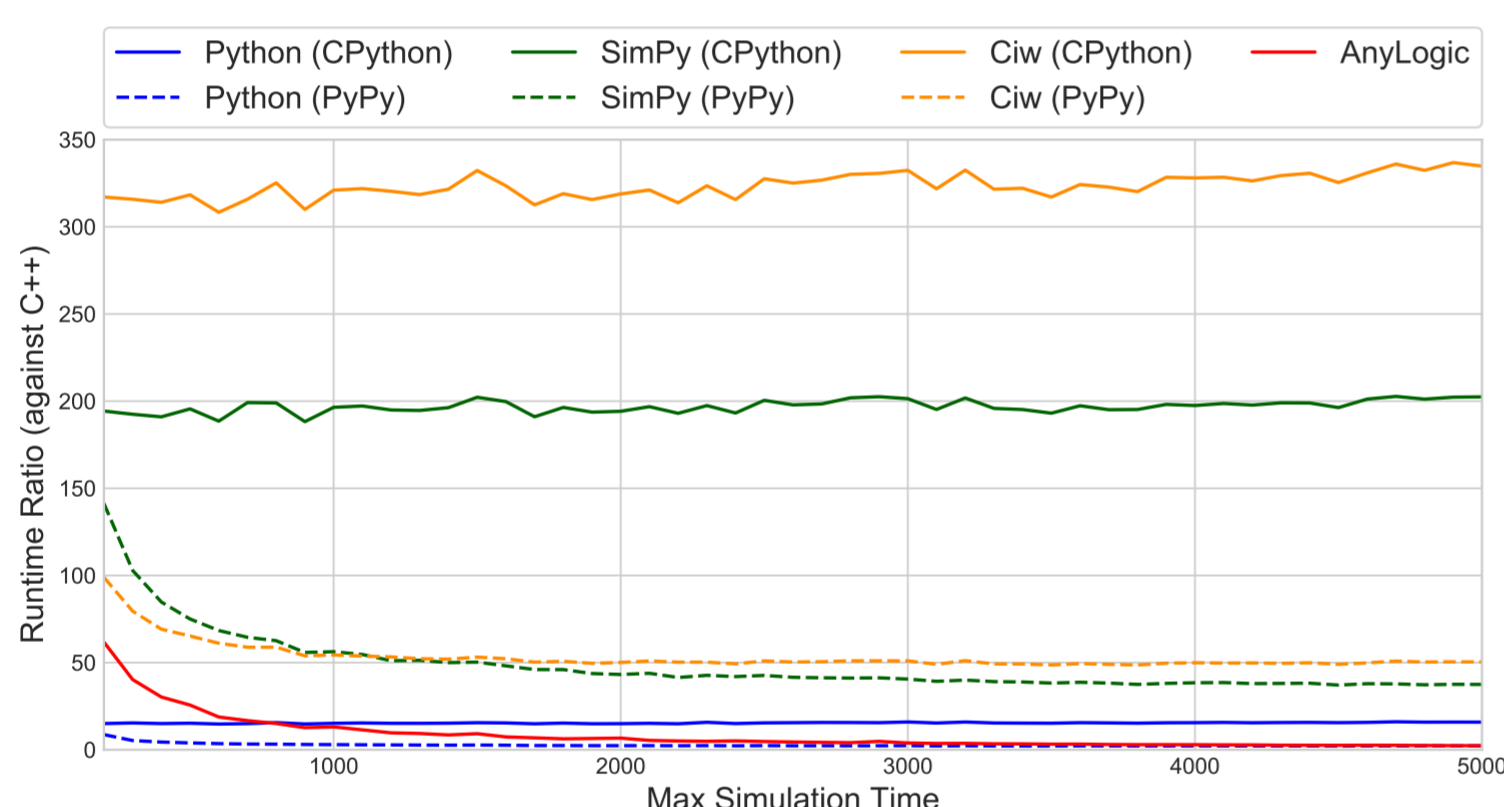
READABLE
>>> import ciw
>>> N = ciw.create_network(
...     Arrival_distributions=[['Exponential', 10.0]],
...     Service_distributions=[['Exponential', 4.0]],
...     Number_of_servers=[3],
... )

>>> ciw.seed(0)
>>> Q = ciw.Simulation(N)
>>> Q.simulate_until_max_time(200)
>>> recs = Q.get_all_records()
>>> waits = [r.waiting_time for r in recs if r.arrival_date > 50]
>>> sum(waits) / len(waits)
0.3796...
    
```

- **Open-Source:** Software with source code that anyone can freely obtain, use, and modify.
- **Python:** A free open-source programming language that prioritises readability, with a well established scientific ecosystem.
- **Documentation:** User guides, references and tutorials on how to use software and how the software works.
- **Best Practices:** Well written code incorporating readable and modular code, and automated tests.



PERFORMANCE

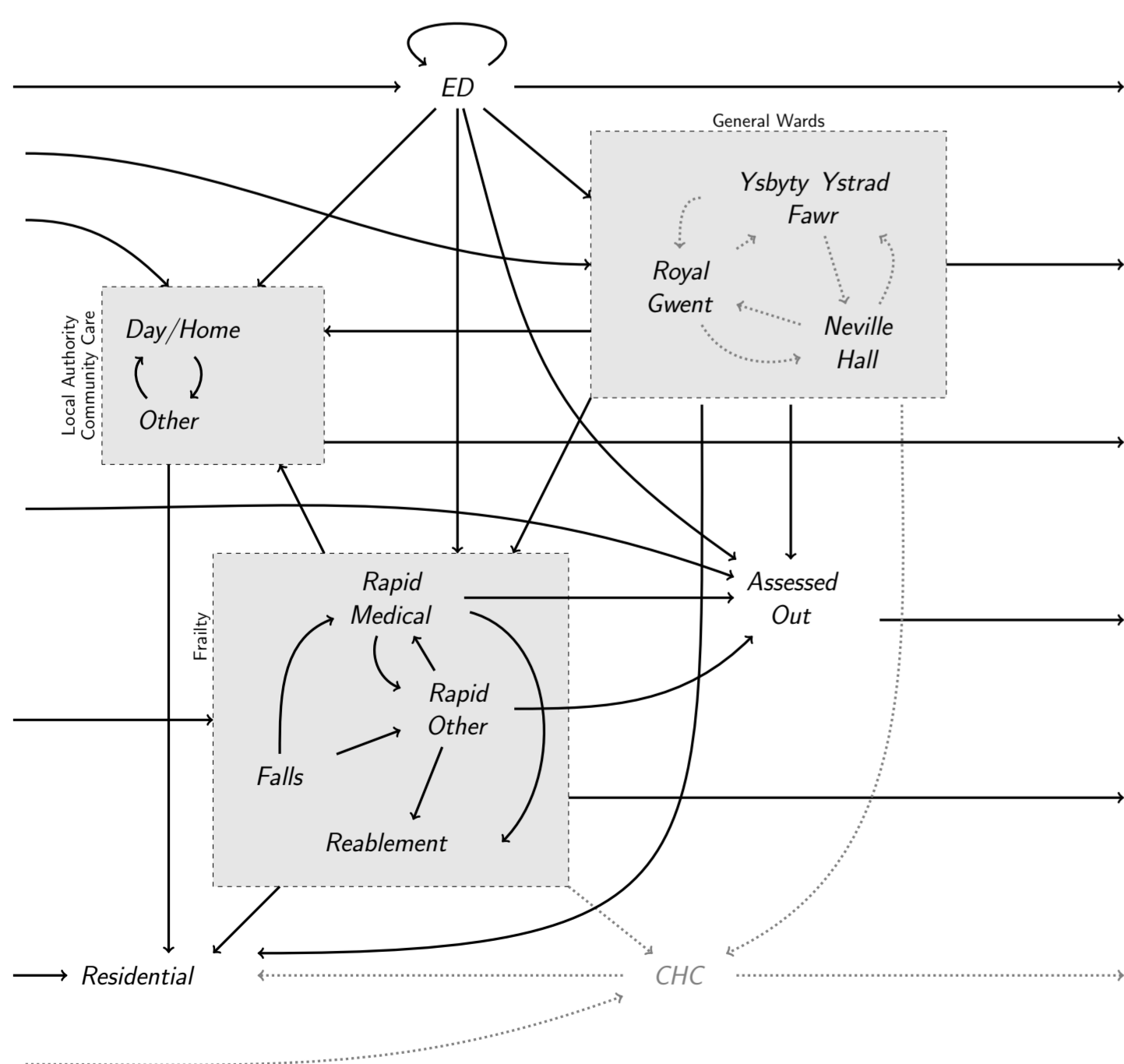


Open, permissive licence allows modifications.

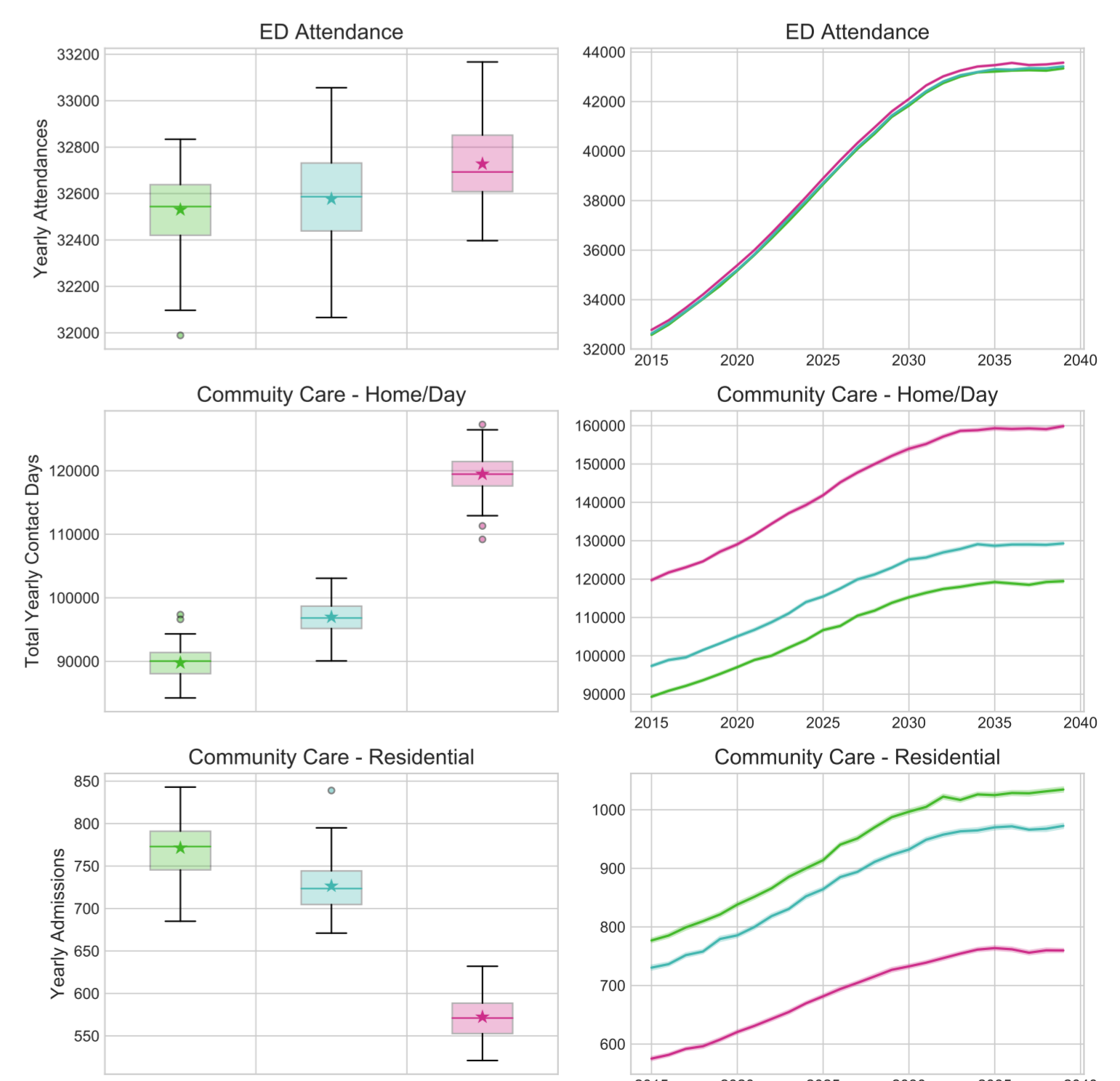
Modular structure enables contained adaptations and custom components.

Systematic forking in GitHub gives opportunity for changes to be released.

A HEALTHCARE APPLICATION



- Stay Well Plans (SWPs) offered to older people in Gwent.
- Ciw simulations used to evaluate their effects on system demand.
- Three scenarios compared:
 - SWPs not offered in Gwent.
 - SWPs offered in Newport county only.
 - SWPs offered in all counties of Gwent.
- Inconsequential increases in demand at secondary care.
- Large increases in demand at home and day community care.
- Large decreases in demand at residential care services.



REFERENCES:

- 2001: **Open source simulation modeling language (sml)**. Kilgore, RA. In *Proceedings of the 33rd conference on Winter simulation* (pp. 607-613). IEEE Computer Society
- 2013: **Ten simple rules for reproducible computational research**. Sandve, GK., Nekrutenko, A., Taylor, J., Hovig, E. *PLoS Computational Biology*
- 2018: **Ciw: An open source discrete event simulation library**. Palmer GI, Knight VA, Harper PR, Hawa AL. *Journal of simulation*.