Erasmus MC
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# Continuous Integration for Grand Challenges

## The Design of the “Continuous Registration Challenge”

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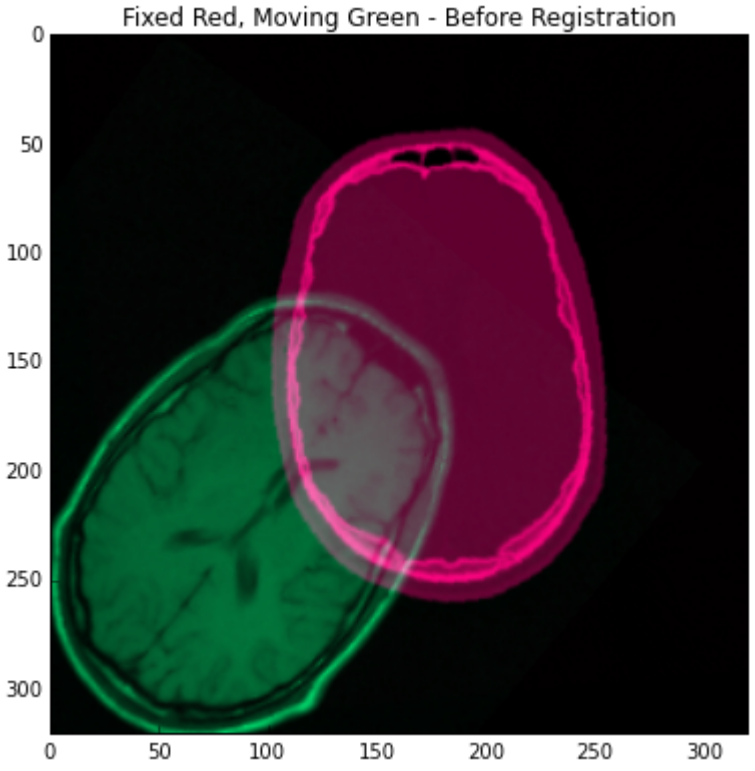
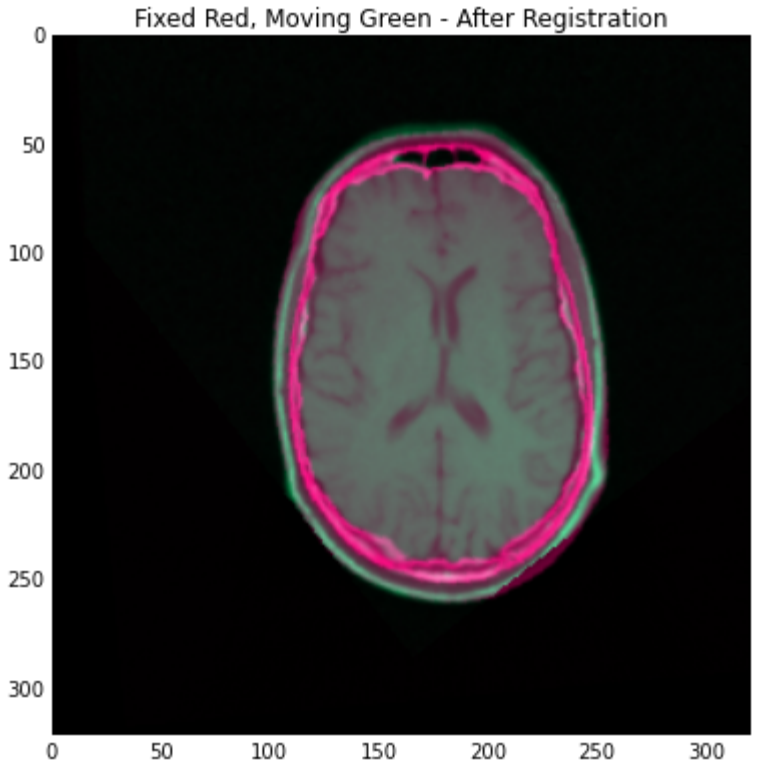
# Goals

- Reproducible experiments
- High-quality codebase
- Collaboration over competition
- Modern software development practices

# Image Registration



# Image Registration

- Which method should we use?
- Which method should we use for a particular data set?

# Which method should we use?

- Experiment
- Try many different methods
- … on many different data sets

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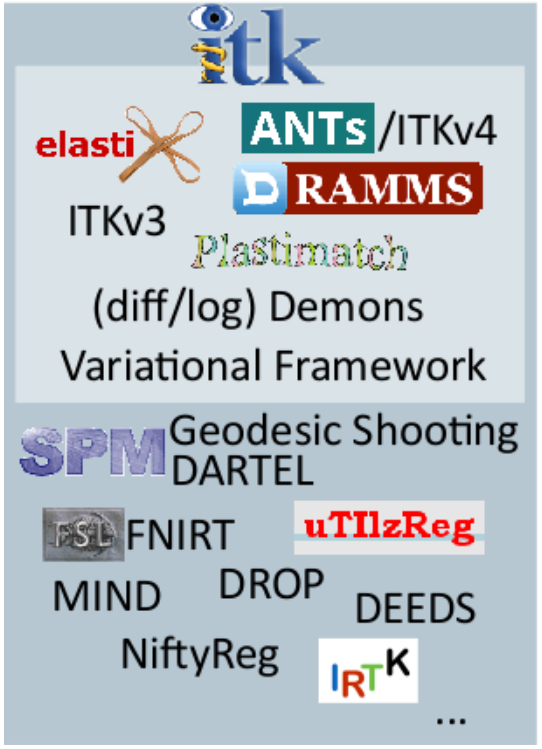

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## Which method should we use?

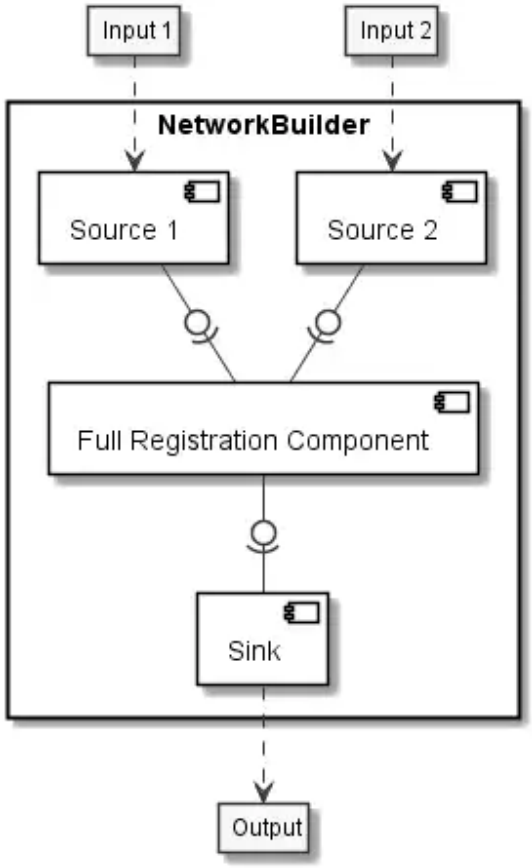
- Experiment
- Try many different methods
- … on many different data sets

# SuperElastix

One toolbox to rule them all

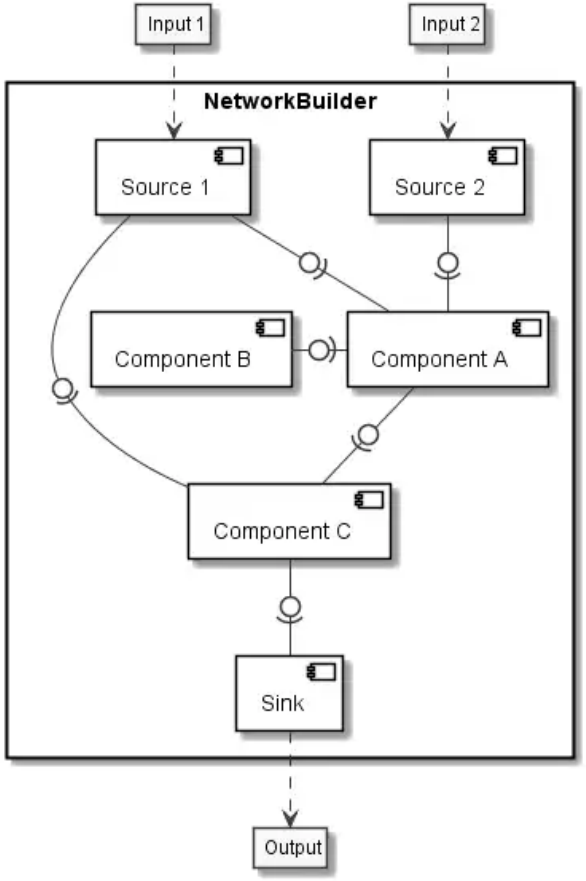
# SuperElastix

- Elastix
- ANTs
- NiftyReg
- ITKv4



# SuperElastix

- Elastix
- ANTs
- NiftyReg
- ITKv4
- Hybrid methods



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# Which method for a particular data set?

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# Which method for a particular data set?

- **Experiment**

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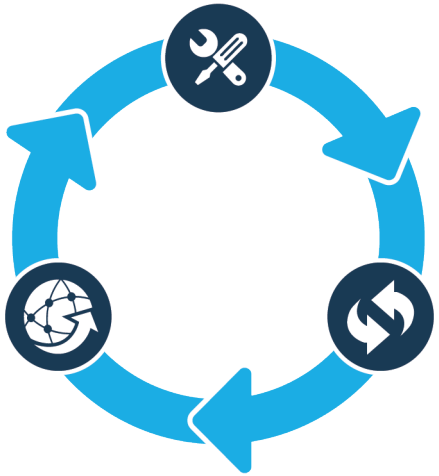
# Which method for a particular data set?

- **Experiment**
  - **Reproducible:** Benchmark many different algorithms on many different data sets
  - **Accessibility:** High-quality codebase, easily accessible via command line- and library interfaces.
  - **Collaborative:** Work with peers on developing, comparing and continuously improve algorithms.

# Continuous Registration Challenge (CRC)

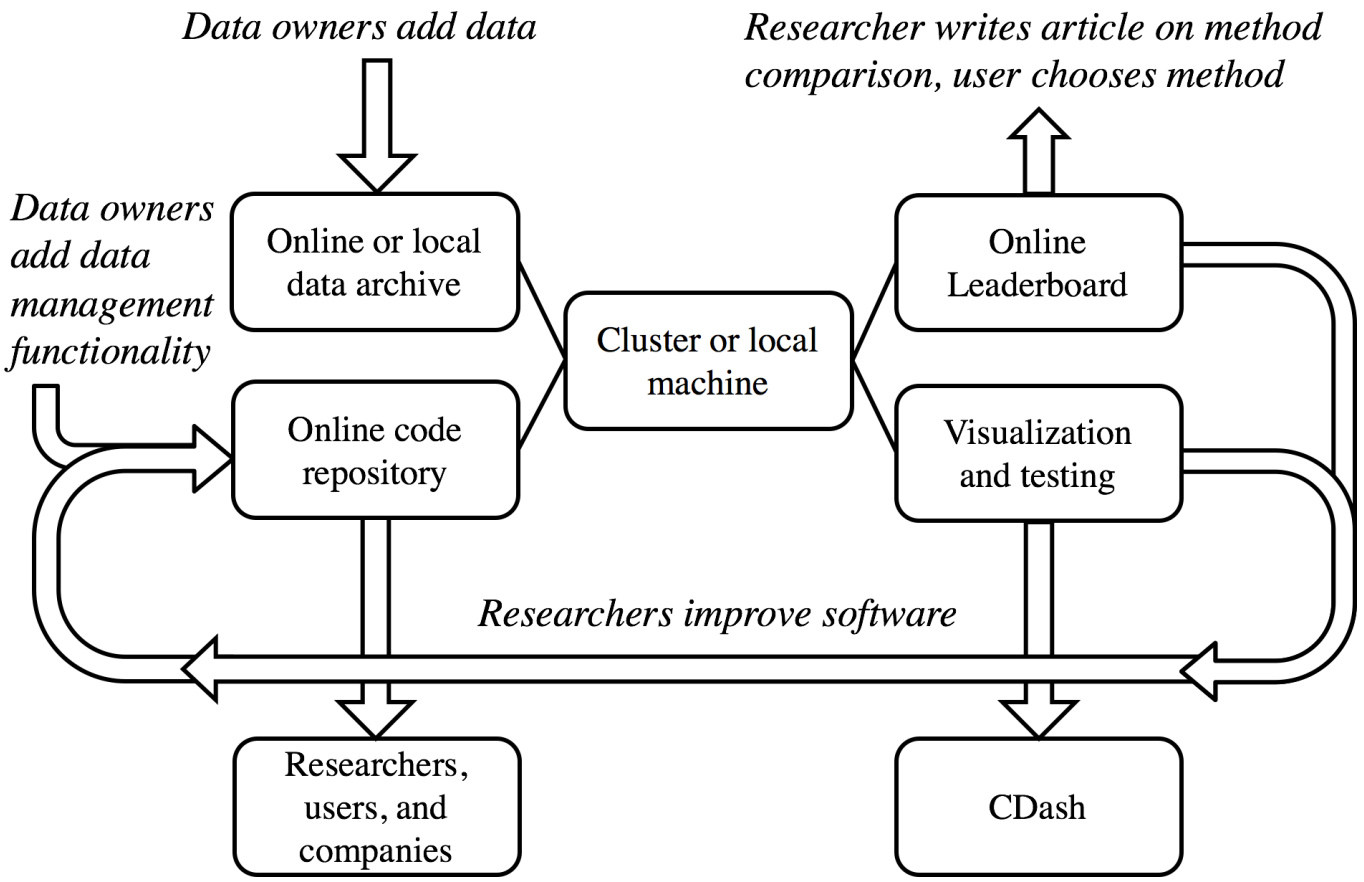
```
$ git commit –m “ENH: Add registration algorithm”
```

Publish results



Run on many data sets

# Architecture



# Leaderboard

## Leaderboards

Leaderboards are generated from a subset of the full data sets. Evaluations are run nightly.

POPI | DIRLAB | LPBA40 | ISBR18 | CUMC12 | MGH10 | HAMMERS | SPREAD

| Team | Blueprint | Date | Completed | Hausdorff | TRE | InverseConsistencyTRE |
|---|---|---|---|---|---|---|
| TeamRadboudumc | BSplineTransformLungMI | 25-10-2018 | 20/20 | 16.70 \pm 7.90 | 3.37 \pm 1.85 | 0.99 \pm 0.48 |
| TeamRadboudumc | BSplineTransformLungSSD | 25-10-2018 | 20/20 | 15.14 \pm 7.48 | 2.98 \pm 1.70 | 0.65 \pm 0.39 |
| TeamElastix | IdentityTransform | 25-10-2018 | 20/20 | 22.25 \pm 6.58 | 8.46 \pm 3.16 | 0.00 \pm 0.00 |
| TeamElastix | NiftyReg | 25-10-2018 | 20/20 | 26.42 \pm 7.04 | 10.49 \pm 3.31 | 2.18 \pm 1.81 |
| TeamElastix | AffineTransform | 25-10-2018 | 20/20 | 21.87 \pm 7.11 | 8.35 \pm 3.53 | 0.09 \pm 0.07 |
| TeamElastix | ITKv4_SVF_ANTS_CC | 25-10-2018 | 20/20 | 22.25 \pm 6.58 | 8.46 \pm 3.16 | 0.00 \pm 0.00 |
| TeamElastix | NiftyRegITKHybrid | 25-10-2018 | 0 | N/A | N/A | N/A |
| TeamElastix | BSplineTransformDIRLAB | 25-10-2018 | 20/20 | 14.84 \pm 7.81 | 2.91 \pm 1.80 | 1.81 \pm 0.95 |
| TeamElastix | ITKv4_SyN_CC | 25-10-2018 | 20/20 | 20.73 \pm 7.38 | 7.66 \pm 3.53 | 0.01 \pm 0.01 |
| RB | PreliminaryAffine_DIRLAB | 25-10-2018 | 20/20 | 14.57 \pm 6.01 | 4.52 \pm 2.19 | 0.47 \pm 0.34 |

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# Incentives and Rewards for partipants

- Automated experiment
- Debugging tools
- Run on cluster
- Accessibility
- Citations

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# Take-home messages

- Keep the architecture simple (Unix philosophy)
- Test, test, test
- Learning curve might be a barrier to some participants
- Interfaces over implementation
- Anticipate failure
- Documentation, examples, logs, results
- Strict, transparent development process
- Code reviews

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# Thank you