Breakout Session 7:

A Sustainable Medical Imaging Challenge Cloud Infrastructure (MedICCI)

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A Sustainable Medical Imaging Challenge Cloud Infrastructure (MedICCI)

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Goal:

To develop a sustainable medical imaging challenge cloud infrastructure that will allow submission of tools for continuous benchmarking.

AI Challenges

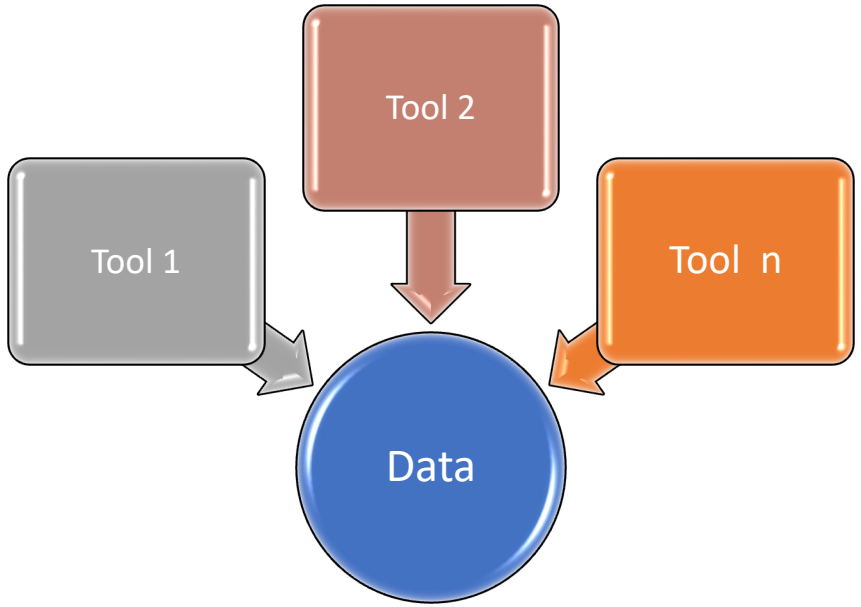
- Open competitions on well-defined scientific/technical problems (tasks)

➢ Allow for direct comparison of different algorithms all applied to a common dataset and evaluated with a uniform set of metrics

➢ Eliminate variability in system performance due to the composition of the data, the reference standard, and the scoring metric used to evaluate system output

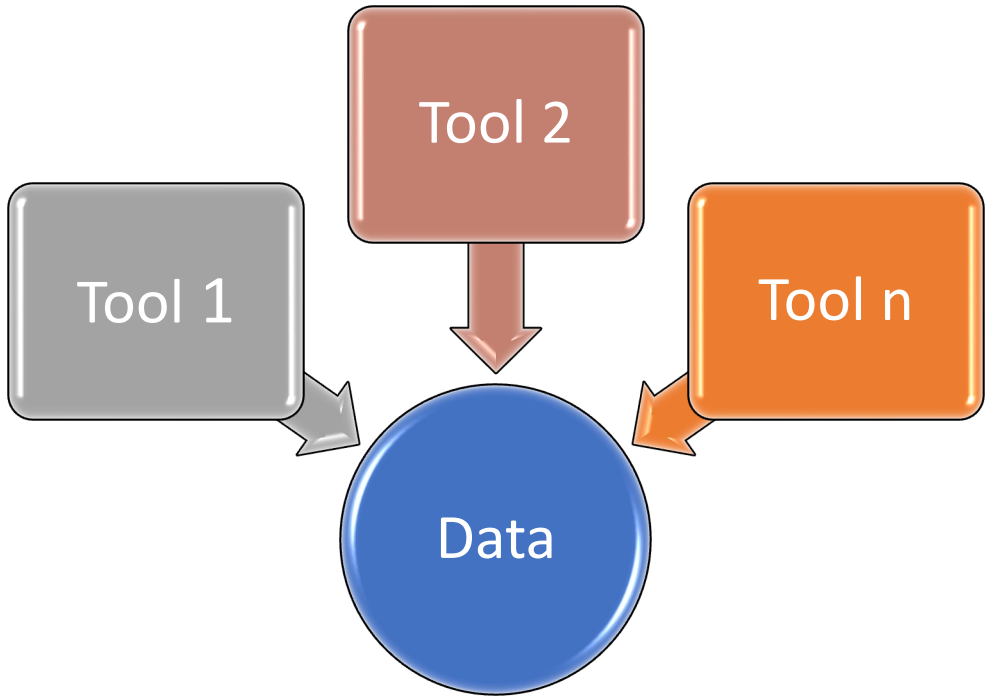
Elements of an AI Challenge

- ❑ Training of algorithms on a reference (training) dataset – labels revealed
- ❑ Validation of performance on a small dataset and leaderboard placement
- ❑ Testing of algorithms on a challenge (test) dataset – labels hidden



Why do a challenge?

- Productive use of reference datasets
- Promote open science
- Algorithmic excellence
- Benchmarking algorithms
- Reproducibility of methods
- Consensus on methodologies
- Drive Standards & Best Practices



Running a Challenge

Requirements

- Dataset
- Task
- Platform(s)
- Evaluation metric(s)
- Quality control

Potential Products

- Annotated dataset
- Benchmarked tools
- Leaderboard
- Report publication

Q. What happens after a challenge is over?

→ Need a sustainable approach to allow testing and benchmarking of new tools

Initial approach

- Implement the NCI-sponsored Medical Image Challenge Infrastructure (MedICI) in NCI Cloud Two (GCP)
- Run an imaging AI challenge
- Allow tools to be benchmarked well beyond the official end date of the challenge

Unforeseen issue and remediation

- Issue: NCI Cloud Two (GCP) Authorization to Operate (ATO) was significantly delayed

- Mitigation measure: Use alternative GCP-based challenge platform

Sage Bionetworks: NCI ITCR U24 Grant

“Advancing cancer benchmarking and data sharing through crowd-sourced challenges”

Aim 3: Expand the Challenge & benchmarking community through improvements in education, outreach, and empowering the organization of independent challenges.

Biomedical imaging → The Medical Image Computing and Computer Assisted Intervention Society (MICCAI)

Clinical algorithms → FDA

EHR & Real-world data → OHDSI (Observational Health Data Sciences and Informatics)

Precision oncology → AACR American Association for Cancer Research (Finding Cures Together) / PROJECT GENIE (Genomics Evidence Neoplasia Information Exchange)

Cancer informatics → NIH National Cancer Institute Informatics Technology for Cancer Research

Brain Tumor Segmentation (BraTS) Challenges (2012-2023)

BraTS overarching goal: Benchmarking of state-of-the-art models for segmentation of brain tumors in multiparametric magnetic resonance imaging (MRI) scans.

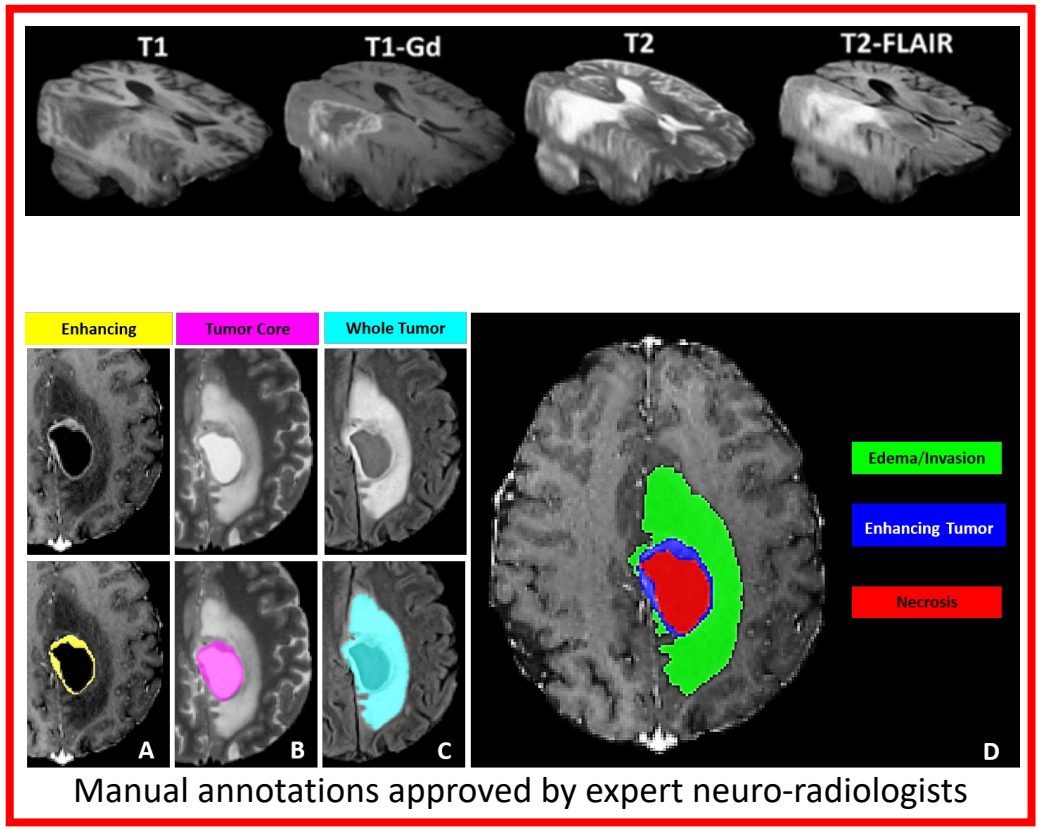
B.Menze, et al., IEEE TMI, 34:1993-2024, 2015

BraTS 2023 Challenge Datasets

- The largest n: 2040 patients (training, validation, testing)
  n:1251 n:219 n:570

- Consistent annotation protocol for manual annotations by neuro-radiologists.
- Appropriate algorithmic evaluation:
  - involvement of biostatisticians

- Harmonized pre-processing of all scans
(Open source via publicly available tools)



Manual annotations approved by expert neuro-radiologists

U.Baid, et al., arXiv:2107.02314, 2021 , B.Menze, et al., IEEE TMI, 34:1993-2024, 2015, S.Bakas, et al., arXiv:1811.02629, 2018

BraTS 2023 Data Contributors

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Segmentation - Adult Glioma

991 Registered participants, 97 teams with 1300+ submissions in validation phase

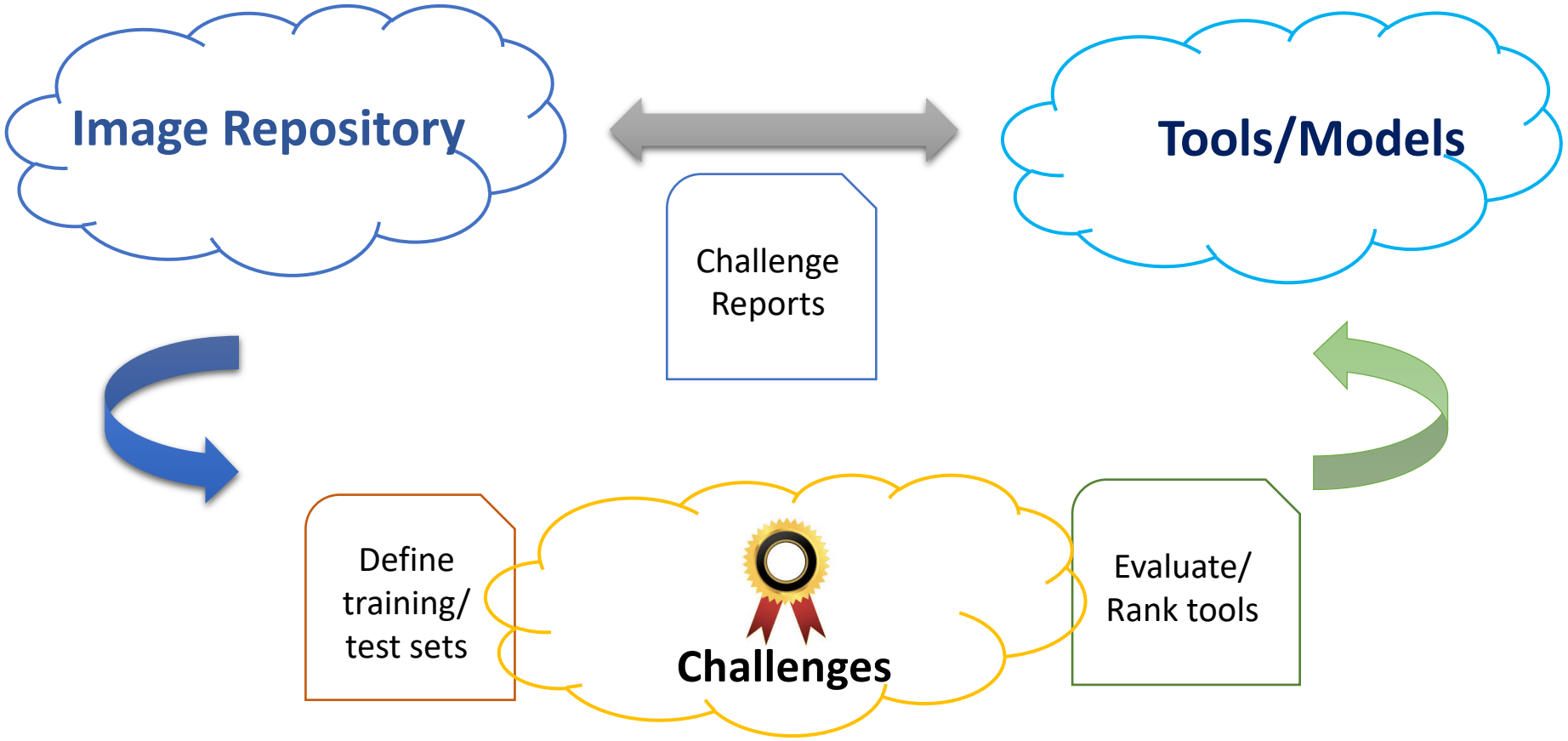
Top-performing teams in alphabetical order

BiomedMBZ: Fadillah Adamsyah Maani et al., *Advanced Tumor Segmentation in Medical Imaging: An Ensemble Approach for BraTS 2023 Adult Glioma and Pediatric Tumor Tasks*

Faking_it: André Ferreira et al., *Enhanced Data Augmentation using Synthetic Data for Brain Tumour Segmentation*

NVAUTO: Andriy Myronenko et al., *Auto3DSeg for Brain Turmor Segmentation from 3D MRI in BraTS 2023 Challenge*

An Ecosystem for Data, Benchmarks, and Tools



Transparent, Scalable, and Sustainable

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