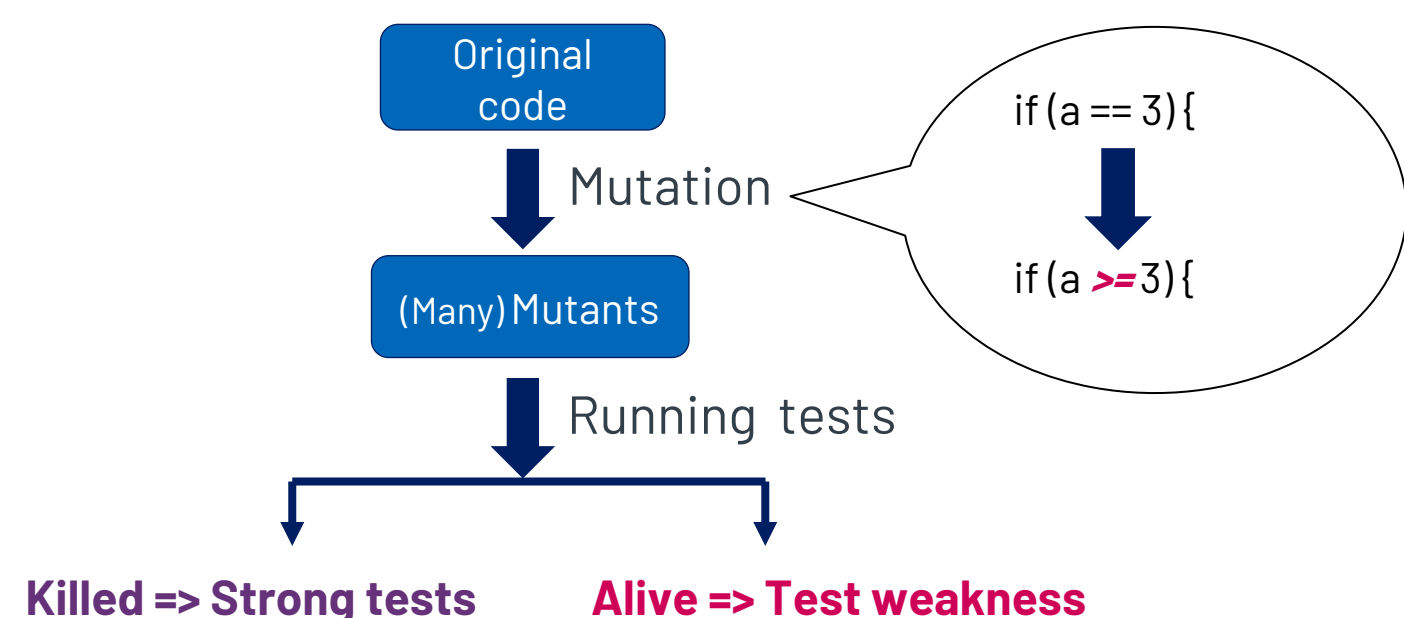


# Trinity College Dublin's Complex Software Lab

Anthony Ventresque

## 1 MUTATION ANALYSIS:

- Mutation Analysis consists in inserting artificial bugs to assess the quality of test suites - **testing the tests** - to make software applications more robust.



- We have analysed and improved mutation testing tools for Java
- We have proposed new mutant selections techniques (e.g., focusing on code commits)
- We have evaluated more complex mutants (Higher Order Mutants)

### Impact:

- 15 publications
- 3 Best Paper Awards: ICSME 2020 (CORE A); Mutation Workshop (co-located with ICST; CORE A) 2020 & 2022
- SFI Frontiers for the Future Award



## 2 EXPANDING THE SCOPE OF MUTATION ANALYSIS:

### Database Systems:

- Created a mutation engine for RDBMS procedures
- Improved testing practices through feedback to QA engineers

**UI testing:** assessed the quality of UI tests by mutating the code received by web browsers

**Accessibility Testing:** created tests for WCAG guidelines and assessed their quality using mutants

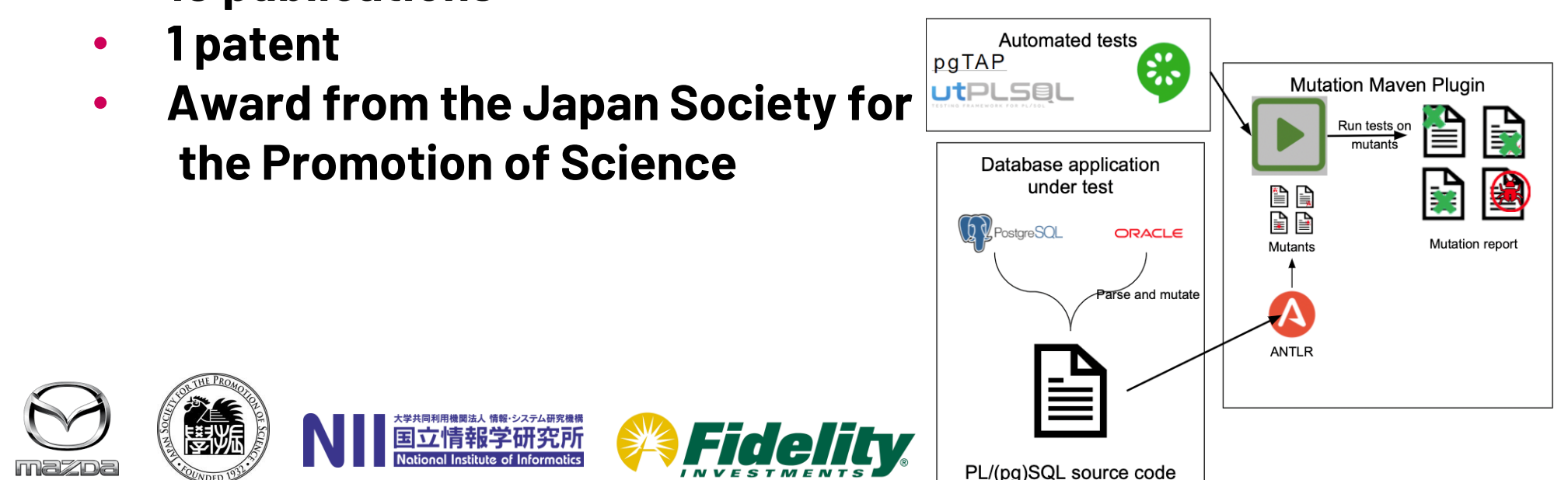
**API testing:** used mutation analysis for distributed applications testing

**Machine Learning testing:** adapted mutation analysis to these complex systems, redefining mutants and units of test

- New mutation operators for ML systems
- Mutants selection to limit their number
- Better "unit tests" for ML practitioners

### Impact:

- 10 publications
- 1 patent
- Award from the Japan Society for the Promotion of Science

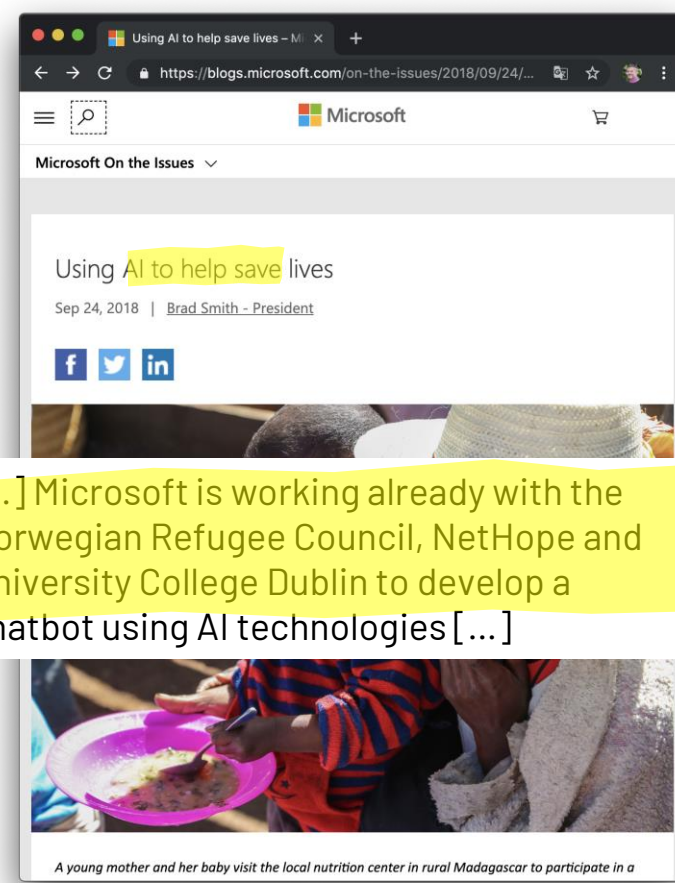
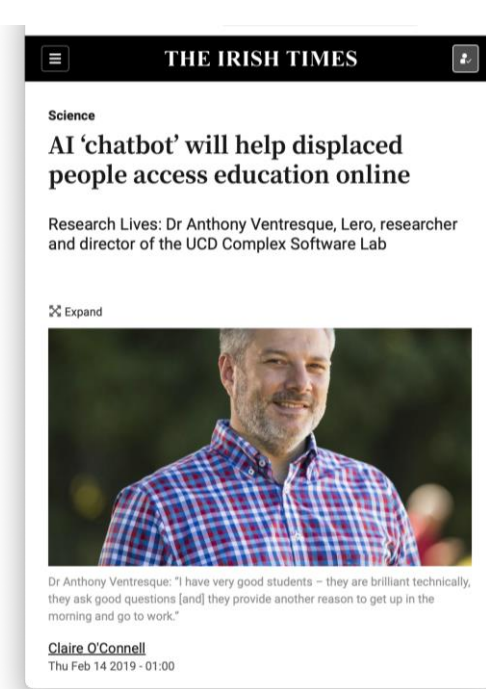
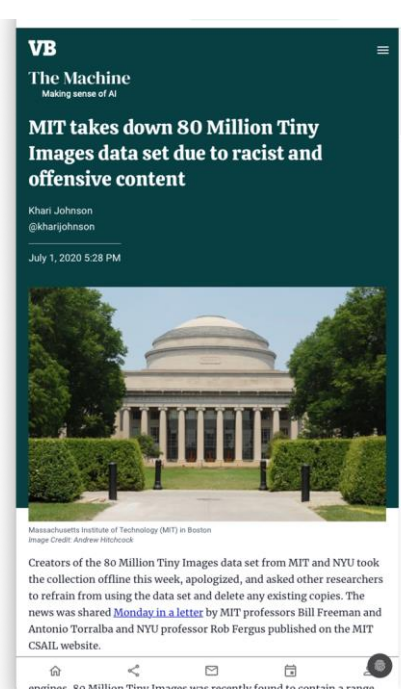


## 3 TESTING AI SYSTEMS:

- We proposed new solutions to test conversational AI
- We developed the concept of (AI) dataset auditing
- We addressed chatbot's quality of experience (ethics, personality) for conversational AI

### Impact:

- 15 publications
- Engineered a chatbot for Syrian refugees, with NGOs (NRC, NetHope) - co-designed with 100 refugees
- 1 Best Paper Award: FAccT 2022
- 50+ news items (Irish Times, SiliconRepublic, Time, Business Post, Irish Independent, etc.)
- BBC StoryWorks "Battling AI" 2021
- VentureBeat AI Innovation Award 2020



## 4 ENGINEERING AI SOFTWARE APPLICATIONS:

- The TCD Complex Software Lab has worked on engineering complex software applications with AI components, focusing on impact and co-construction with users and stakeholders

**Language:** Sign Language, Speech Recognition

**Sports Analytics:** Rugby

**Computational Archaeology:** Megalithic Art

**Accessibility:** Deaf and Hard of Hearing, Low vision

### Impact:

- 10 publications
- Collaboration with the Deaf community
- Collaboration with the IRFU
- Collaboration with EDC (Education NGO) and Zeeko (Education company)

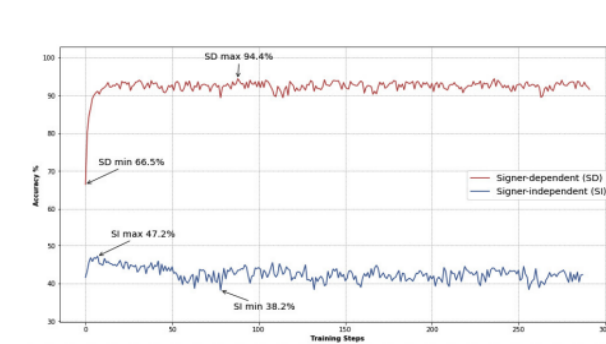
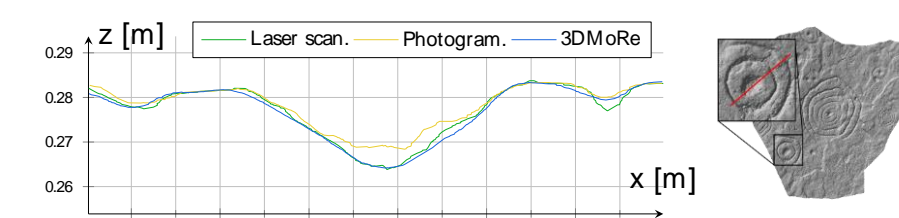


Figure 2: Validation accuracy for the sign-dependent and sign-independent models trained on graphic images with only signs added to the pre-trained VGG network (see text). Maximum and minimum values are indicated.



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