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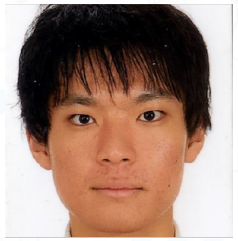
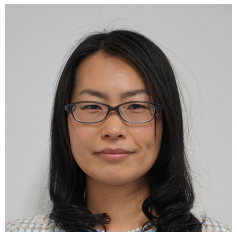
大阪府立大学
Osaka Prefecture University

Automatic Calculation of Infection Rate of Arbuscular Mycorrhizal Fungi Using Deep CNN

Kaoru Muta[1], Shiho Takada[2], Yuzuko Utsumi[1], Atsushi Matsumura[2], Masakazu Iwamura[1] and Koichi Kise[1]



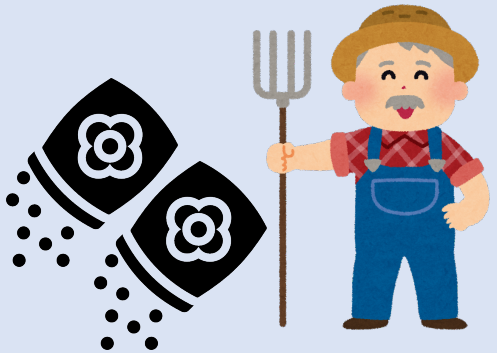



1: Graduate School of Engineering, Osaka Prefecture University
2: Graduate School of Life and Environmental Science, Osaka Prefecture University

Current Situation of Phosphorus and Soil Environment

Phosphorus: One of three nutrients for plants

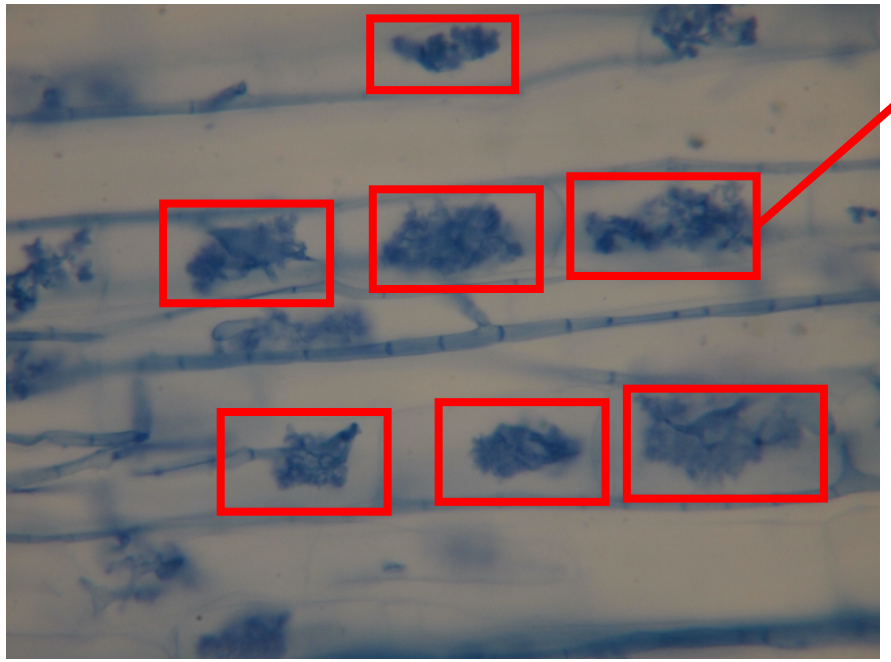
Overuse of phosphate fertilizer



Negative impact on soil environment!

How to use phosphorus in the soil environment more efficiently?

What is Arbuscular Mycorrhizal Fungi?



Arbuscular Mycorrhizal Fungi (AMF)

Supposition

- contribute to the absorption of phosphorus

Future prospect

- Expected to be used as microbial fertilizer

Supposition is not yet proven!

Why is the supposition not yet proven?

The factors that promote absorbing phosphorus

AMF

Plant species

Soil Environment

The comprehensive investigation is required to prove supposition

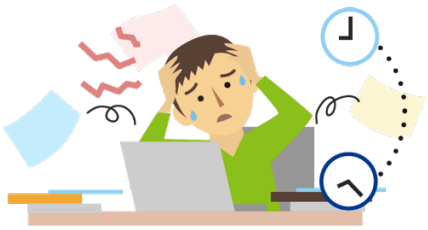
Problems in Current Investigation

Investigation is conducted manually

Limited samples have been used

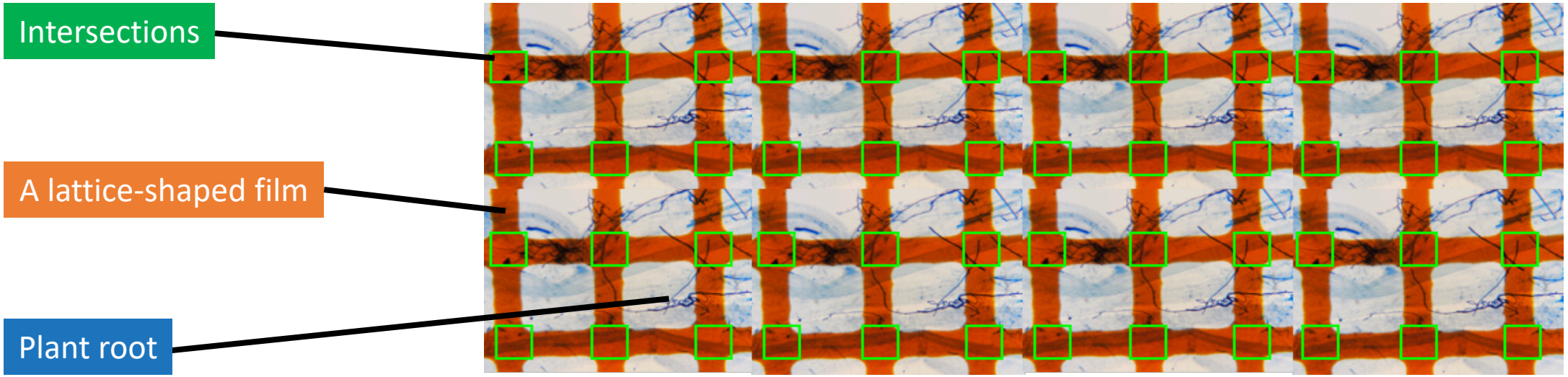
An observer spends much time for the estimation

Each observer has his/her own criterion



Direct Counting Method

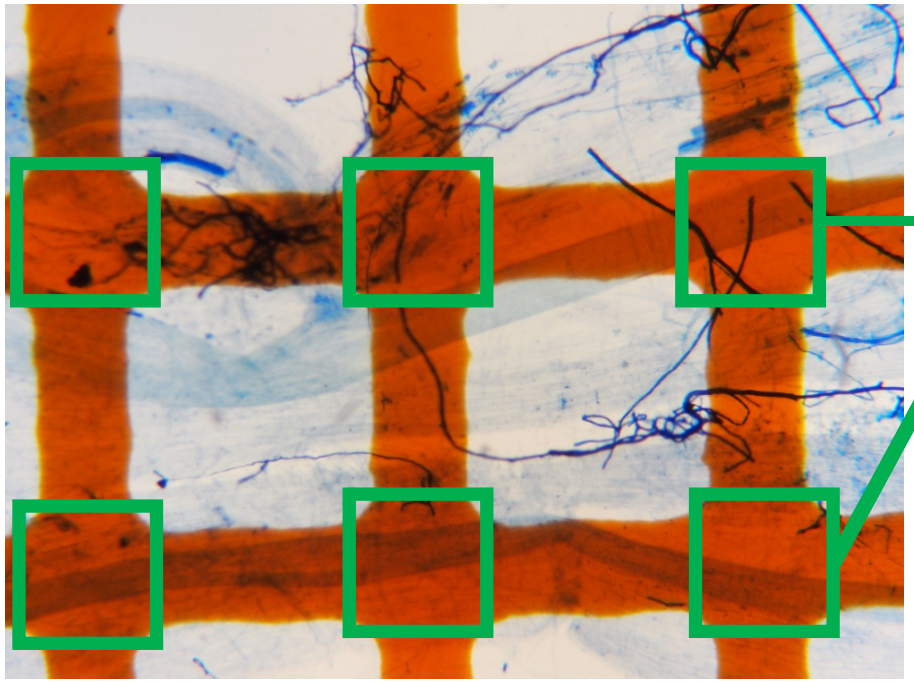
- An observer detects the intersections and judges whether they are infected or not
- In general, 200 intersections are investigated in preparation



Preparation on which an observer detects the intersections through a microscope

TAIM

A web-based automatic tool for investigation of AMF

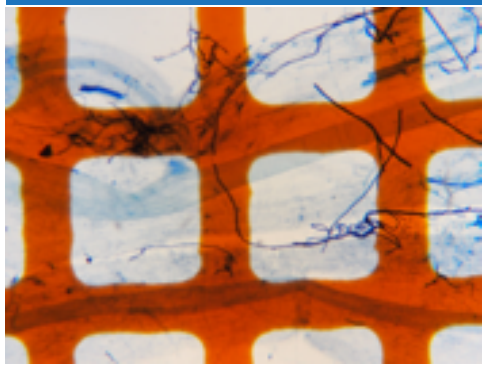


Judge infected or not automatically

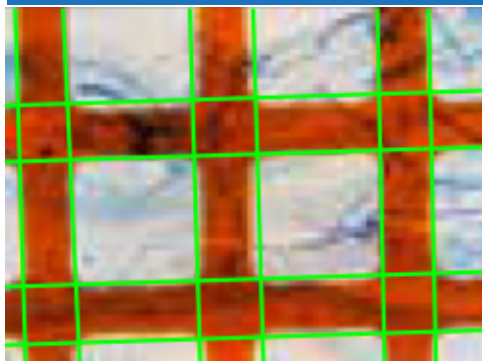
Calculate infection rate of AMF

Overview of Estimation Process in TAIM

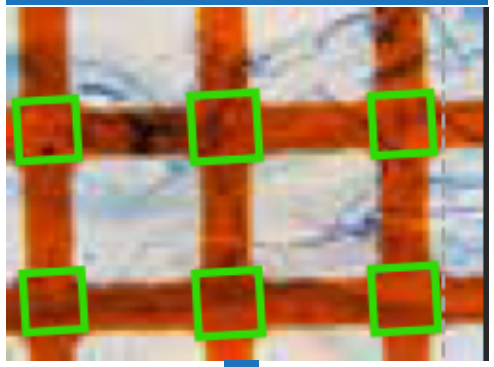
Input image



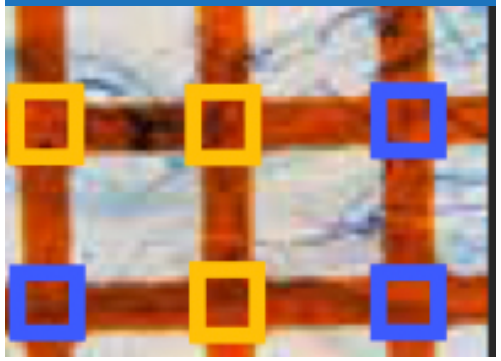
Edges



Intersections



Judgment

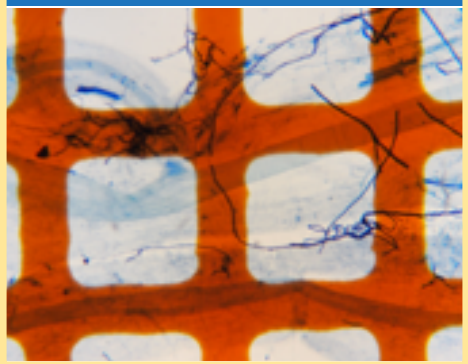


Infection rate

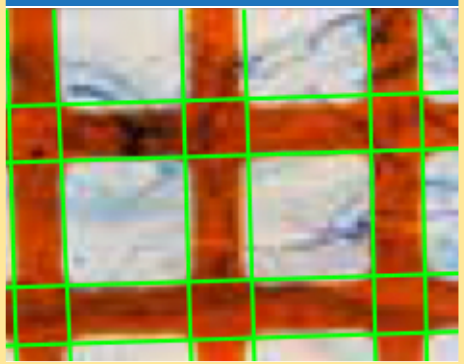
X%

Overview of Estimation Process in TAIM

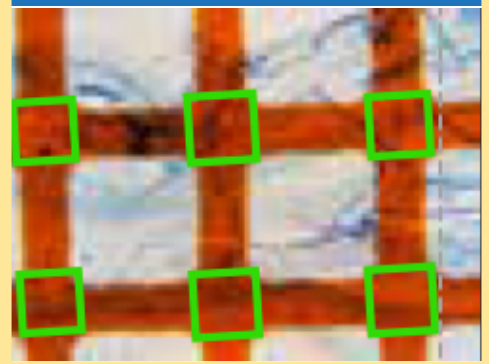
Input image



Edges



Intersections



Judgment

Infection rate

X%

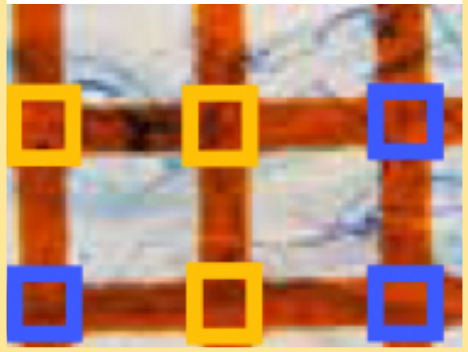
Overview of Estimation Process in TAIM

Input image

Edges

Intersections

Judgment



Infection rate

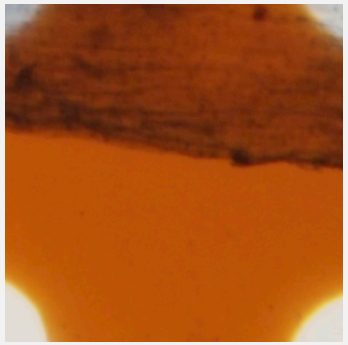
X%

Classes and infection rate

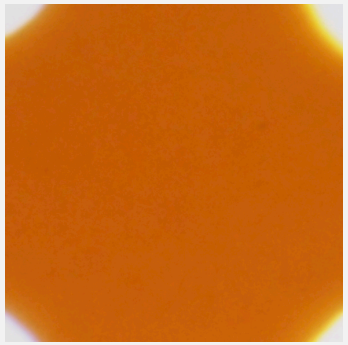
Classified input images into 3 classes

Infected

Not infected



No root

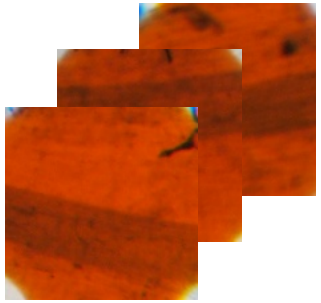


$$\text{Infection rate} = \frac{\text{\# Infected}}{\text{\# Infected} + \text{\# Not infected}}$$

Experimental Setup

- Dataset: 5,014 intersections in soy images
- Label: Infected, not infected and no root
- Evaluation: Stratified 5-fold cross-validation
- CNN for feature extraction:

  AlexNet, VGG-19 and ResNet-18 pretrained on ImageNet
- Classifier: Fully connected layer

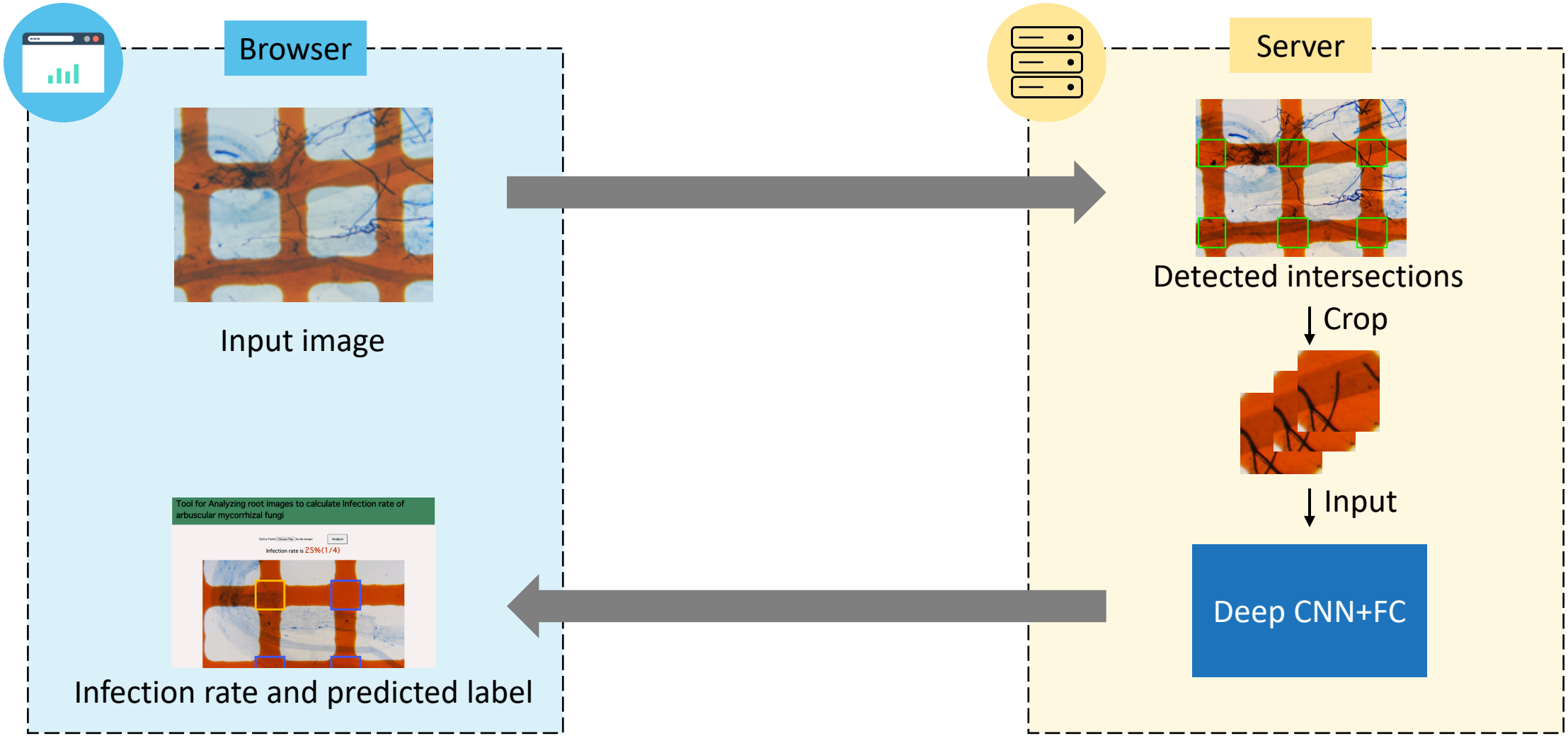


Experiment Result

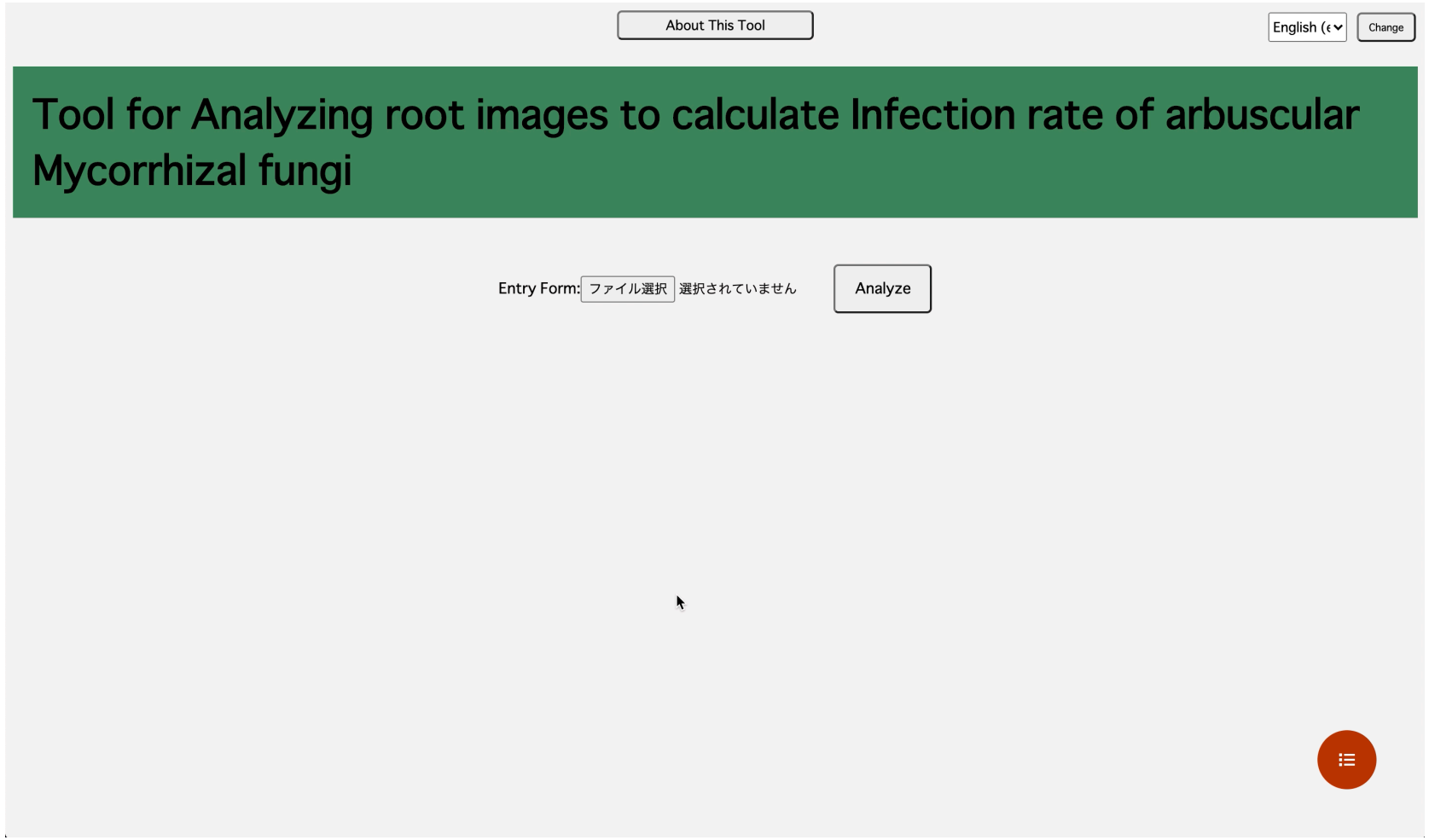
The classification results are almost good on using CNN

CNN	Classification Accuracy (%)
AlexNet	86.4
VGG-19	87.2
ResNet-18	87.4

System Architecture of TAIM



Demo Movie


About This Tool
English (
Change
Tool for Analyzing root images to calculate Infection rate of arbuscular Mycorrhizal fungi
Entry Form:
ファイル選択
選択されていません
Analyze

Check it out! → http://taim.imlab.jp/

If you’d like to know further information, let’s discuss together!