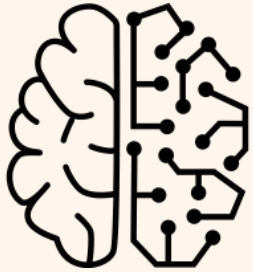
Automated Microscopic Malarial Diagnosis

ESC204
Team 104E

UNIVERSITY OF TORONTO
FACULTY OF APPLIED SCIENCE & ENGINEERING

eHealth AFRICA



Value proposition: To help malaria testing clinics who need **faster results**, **higher accuracy**, and the ability to **reallocate resources** toward treatment instead of diagnosis, by automating the microscopy step in malaria testing.

What's important to us?

Core algorithmic performance

- Accuracy
- Precision / Uncertainty
- Efficiency

Non-algorithmic priorities

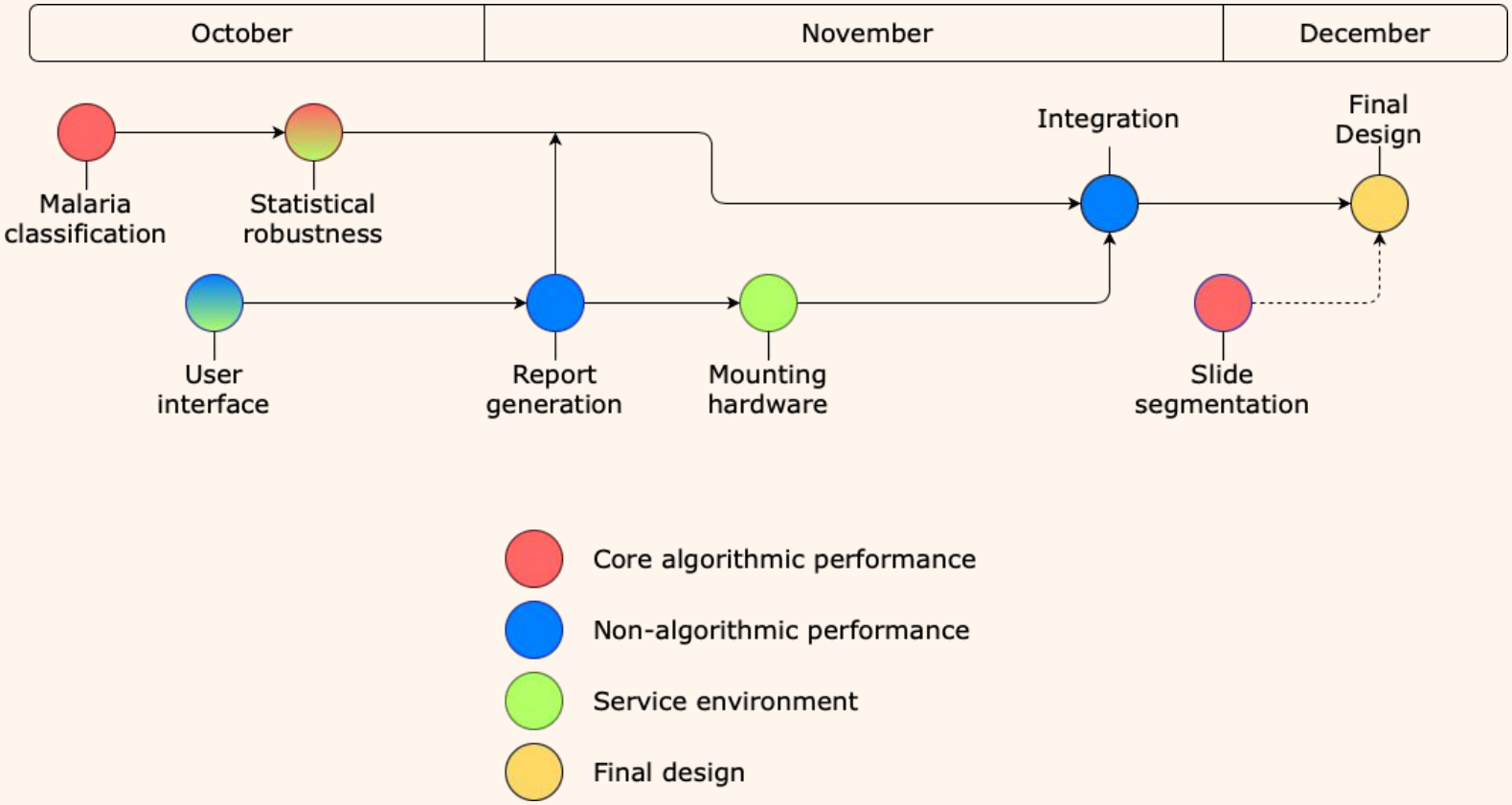
- Usability
- Interpretability of results
- Transparency of model
- Testability

Service environment requirements

- Safety
- Affordability
- Maintainability
- Assembly

What are we trying to do?

Timeline

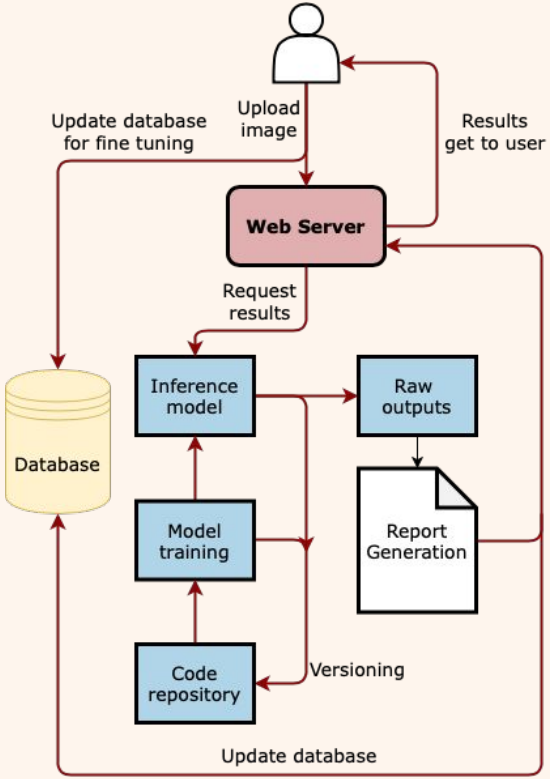

October
November
December
Malaria classification
Statistical robustness
User interface
Report generation
Mounting hardware
Integration
Final Design
Slide segmentation
Core algorithmic performance
Non-algorithmic performance
Service environment
Final design

Key Design Decisions

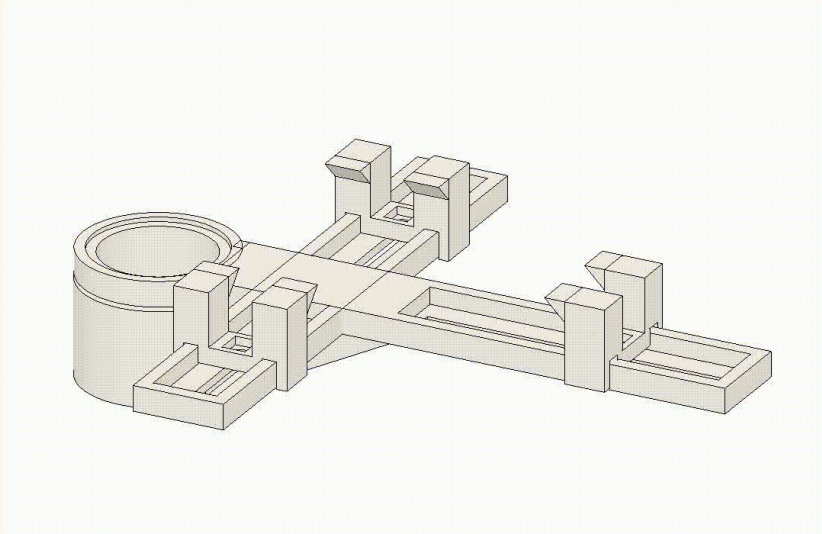
```
.
├── checkpoints
│   ├── malaria_detection.pt
│   ├── malaria_detection_tuned.pt
│   ├── model.onnx
│   └── single_cell_baseline.ckpt
├── configs
│   └── train_single_cell.yaml
├── datasets
│   ├── __init__.py
│   └── single_cell.py
├── diagnose.py
├── env.yml
├── __init__.py
├── LICENSE
├── models
│   └── classify.py
├── Procfile
├── README.md
├── reportgen
│   ├── __init__.py
│   └── report_generation.py
├── report.pdf
├── requirements.txt
├── server.py
├── templates
│   ├── report_template.html
│   └── upload.html
└── utils.py

6 directories, 22 files
```

```
❯ python diagnose.py -h
usage: diagnose.py [-h] [--config CONFIG] [--print_config [={comments,skip_null}+]]
                   {fit,validate,test,predict,tune} ...

pytorch-lightning trainer command line tool

optional arguments:
  -h, --help            Show this help message and exit.
  --config CONFIG       Path to a configuration file in json or yaml format.
  --print_config [={comments,skip_null}+]
                        Print configuration and exit.

subcommands:
  For more details of each subcommand add it as argument followed by --help.

  {fit,validate,test,predict,tune}
    fit                 Runs the full optimization routine.
    validate            Perform one evaluation epoch over the validation set.
    test                Perform one evaluation epoch over the test set.
    predict             Run inference on your data.
    tune                Runs routines to tune hyperparameters before training.
```

Final Design



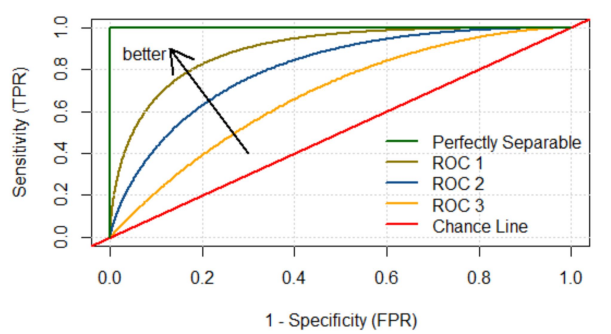
System diagram

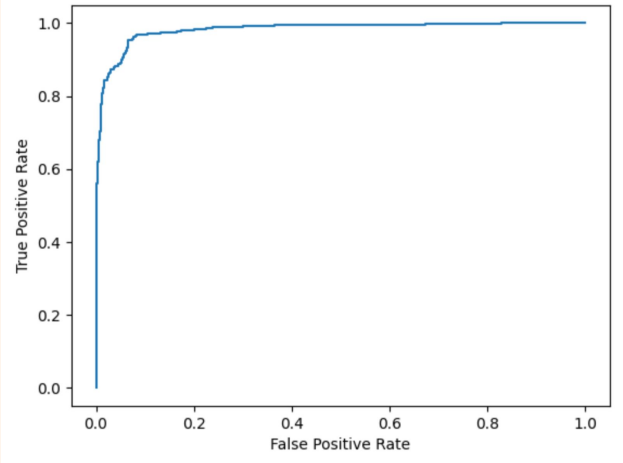


Microscope hardware

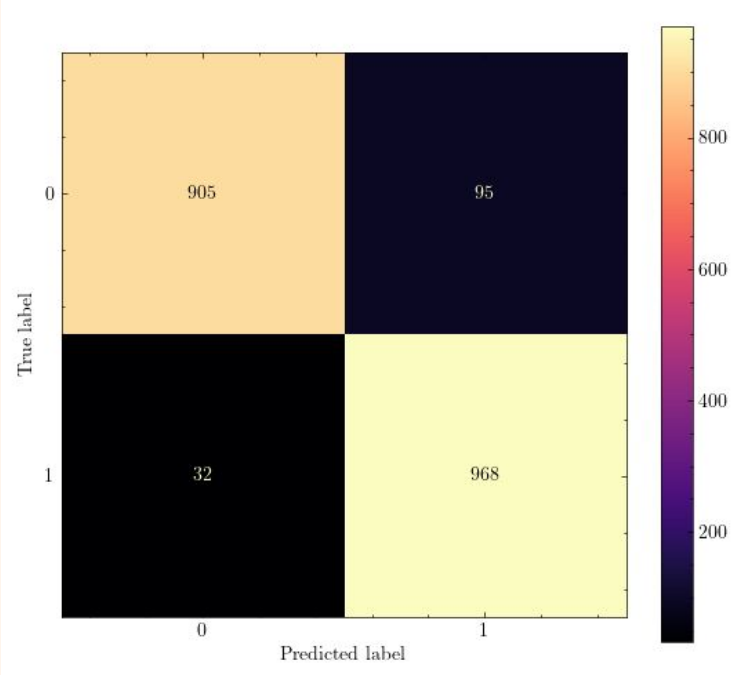
Demo

ROC Curve

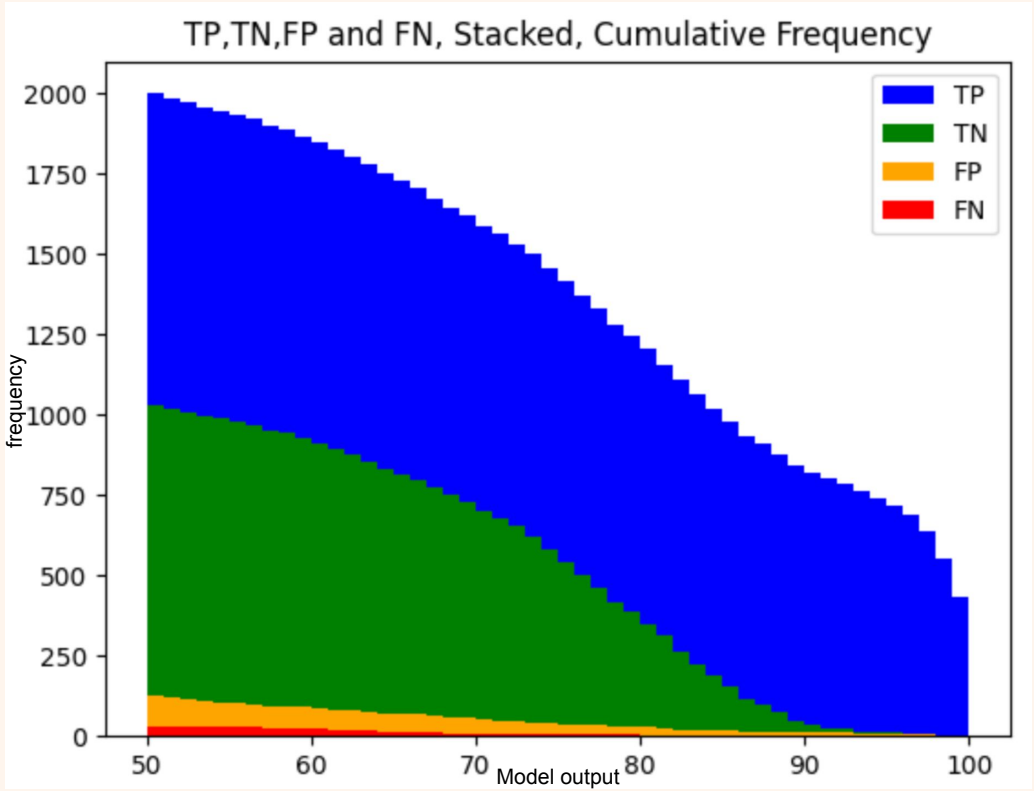




Confusion Matrix



IDK Class


TP,TN,FP and FN, Stacked, Cumulative Frequency
TP
TN
FP
FN
frequency
2000
1750
1500
1250
1000
750
500
250
0
50
60
70
80
90
100
Model output

Limitations, Assumptions & Next Steps

Bayesian inference and models

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Vision transformers