Design Review

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Kimberly Allison

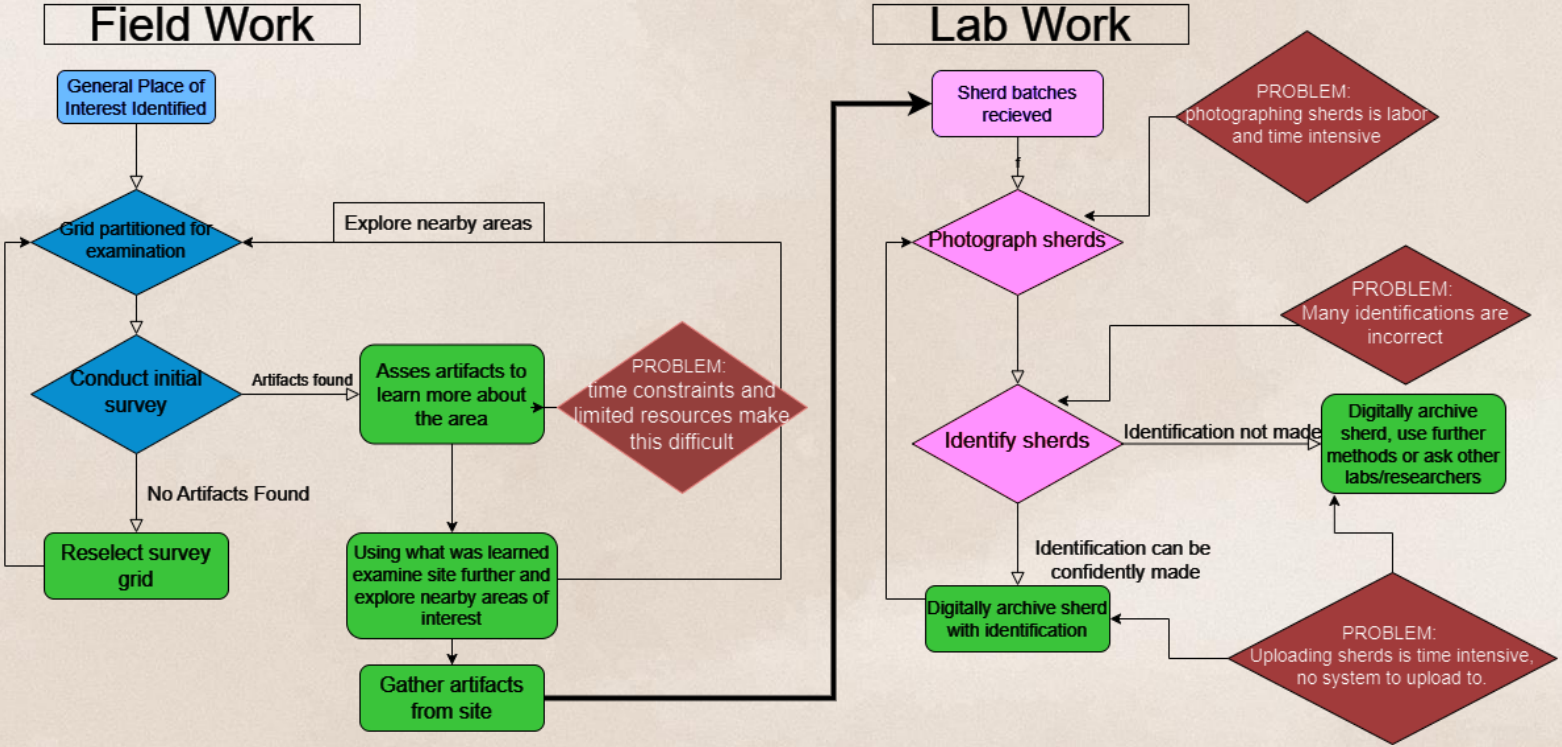
Client Communicator and Recorder

OUR CLIENT

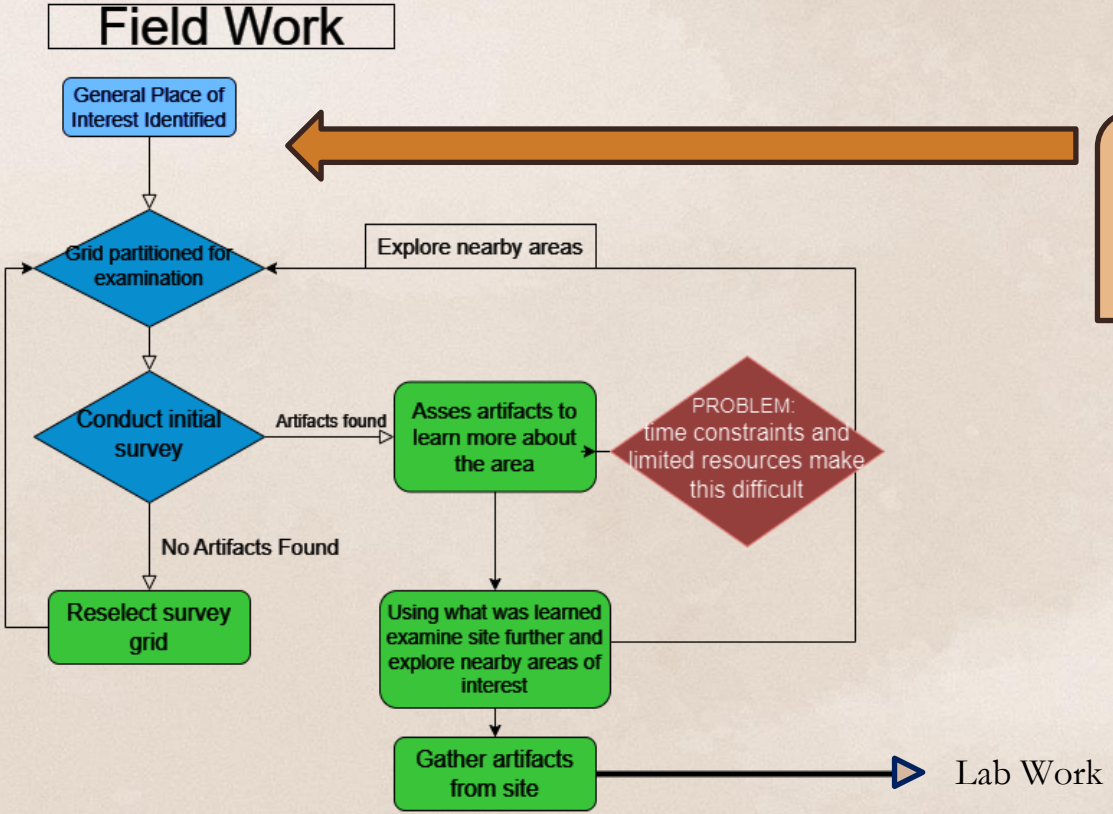
Dr. **Leszek** Pawlowicz

Assistant Research Professor,
Department of Anthropology

Client Workflow

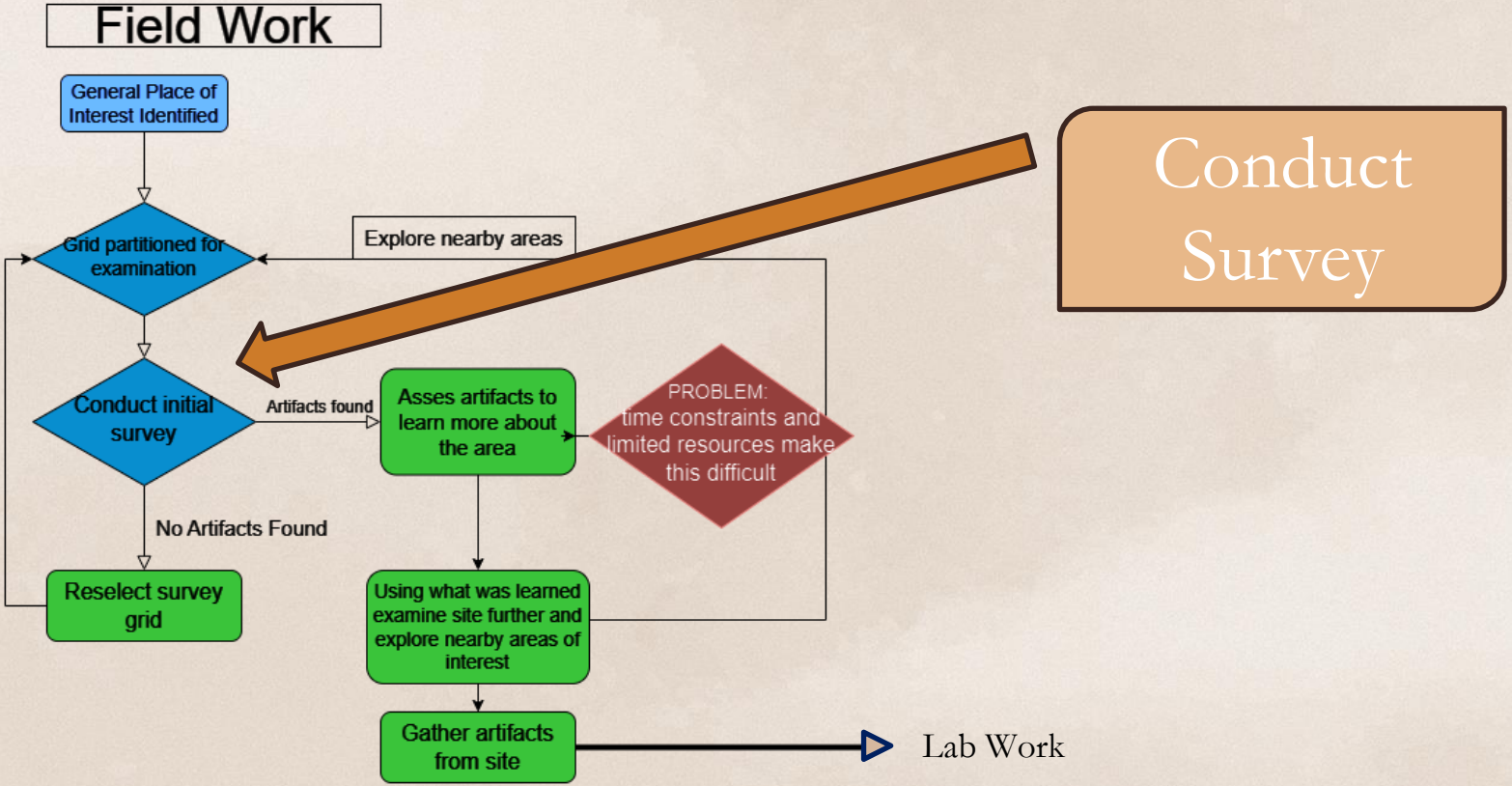


Client Workflow

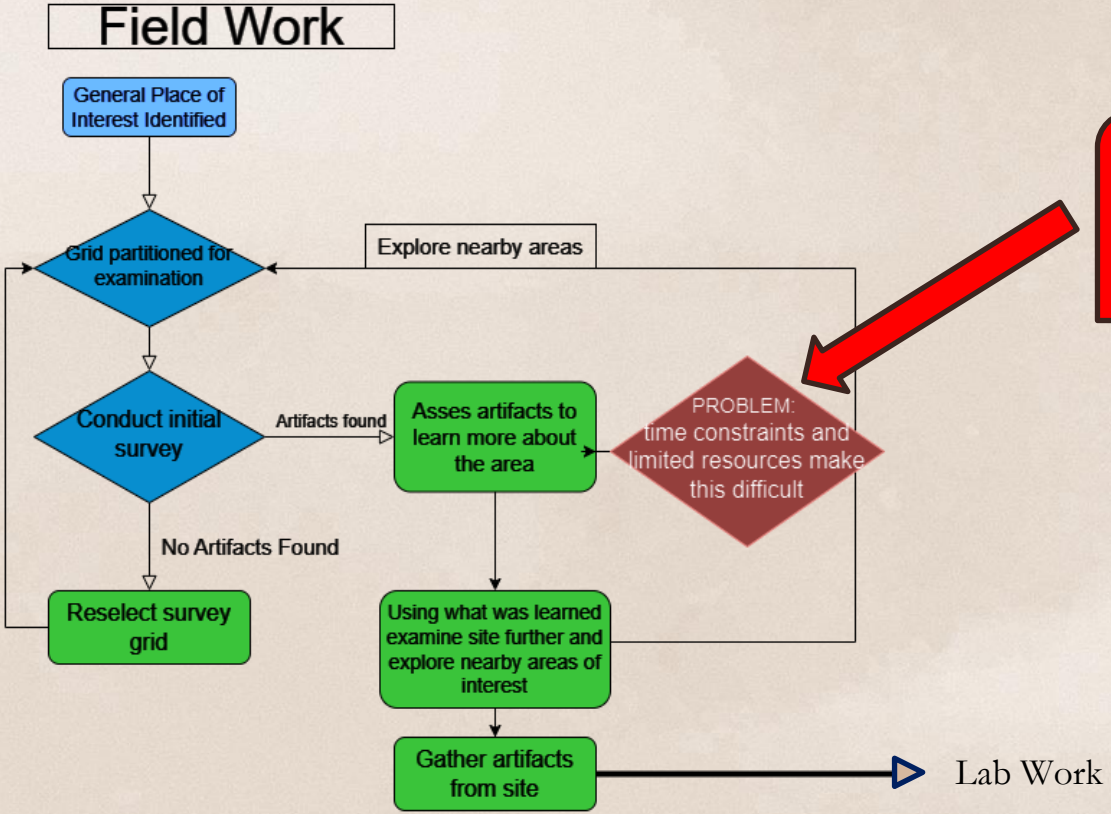


Identify Area & Grid

Client Workflow

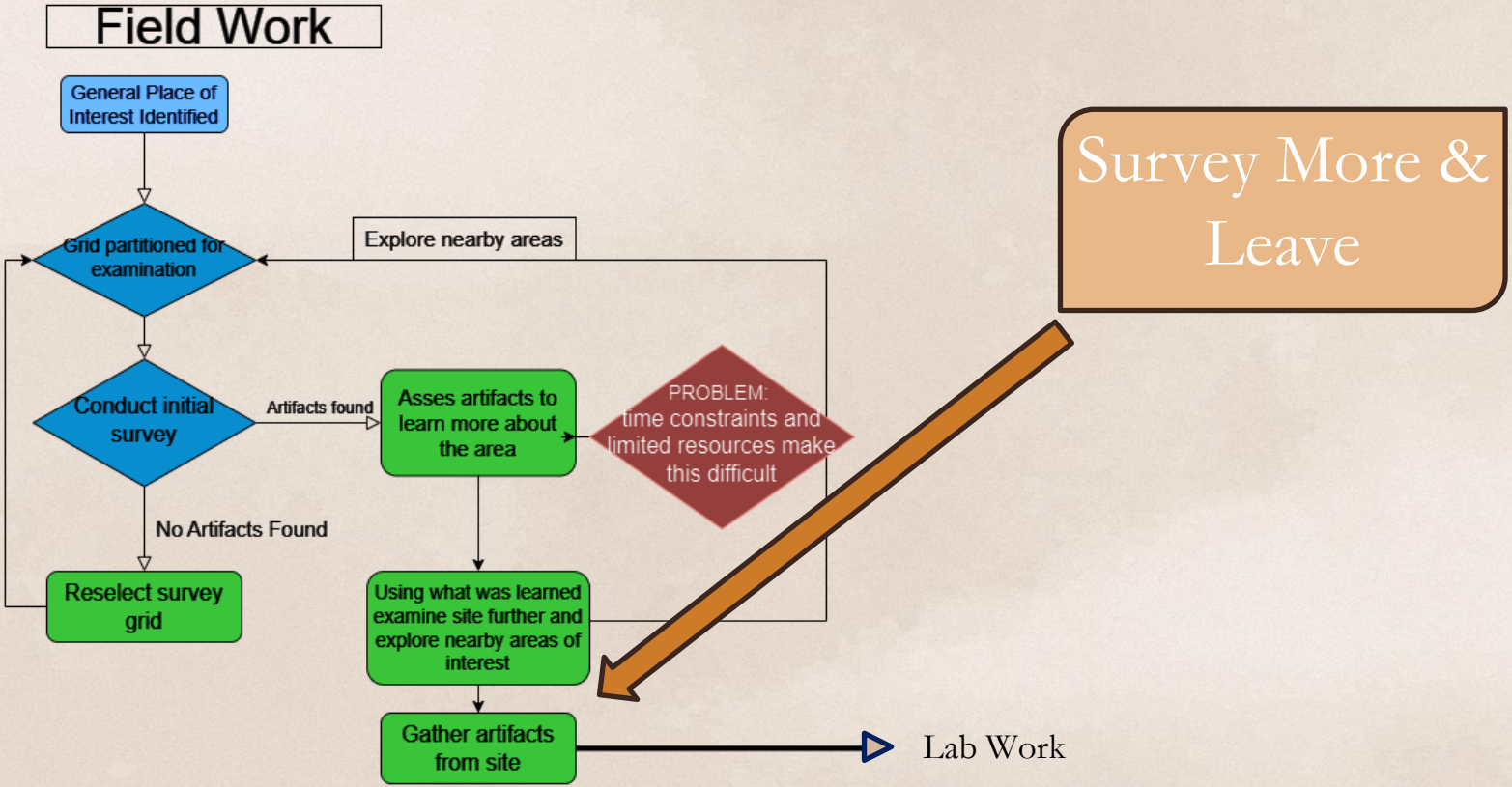


Client Workflow



PROBLEM

Client Workflow



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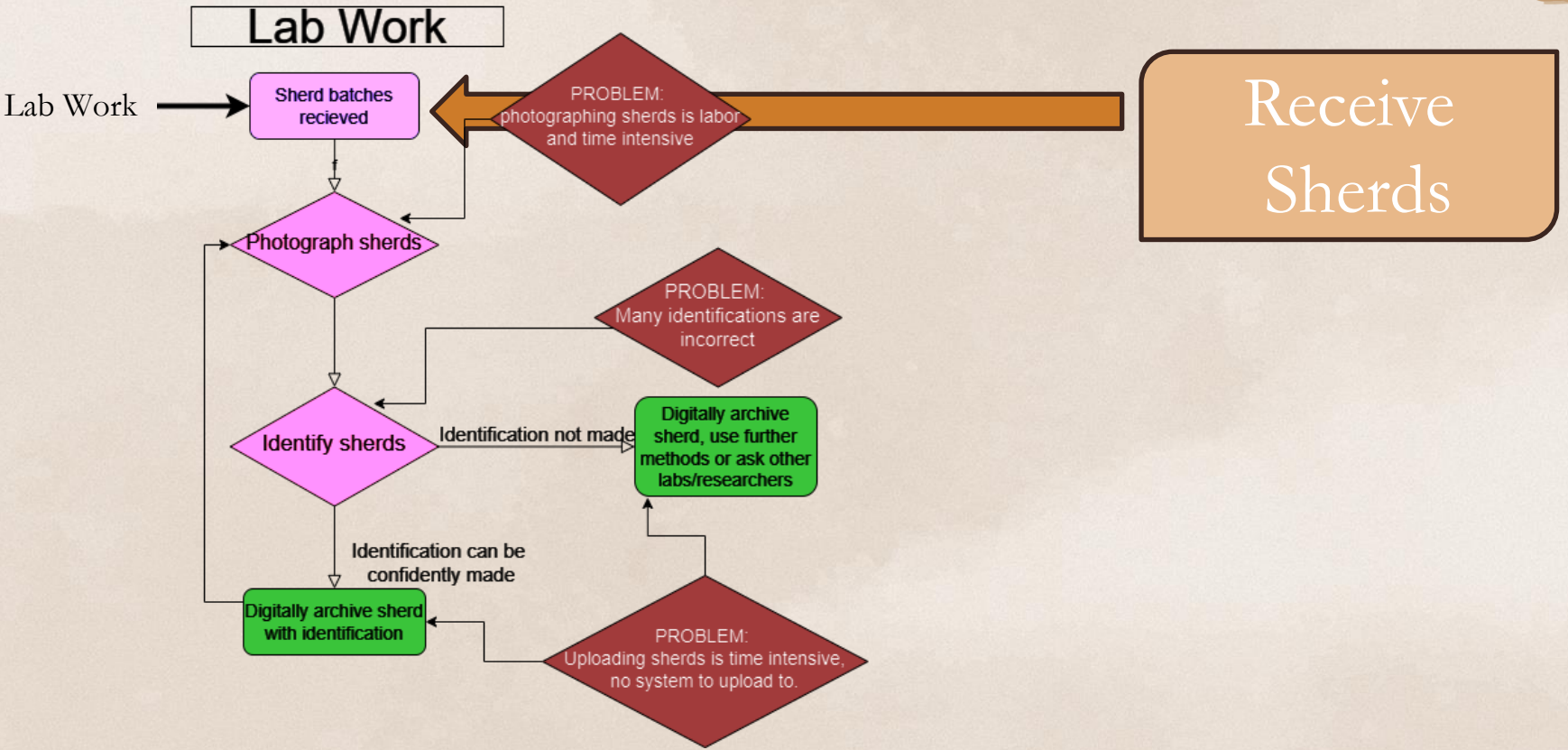
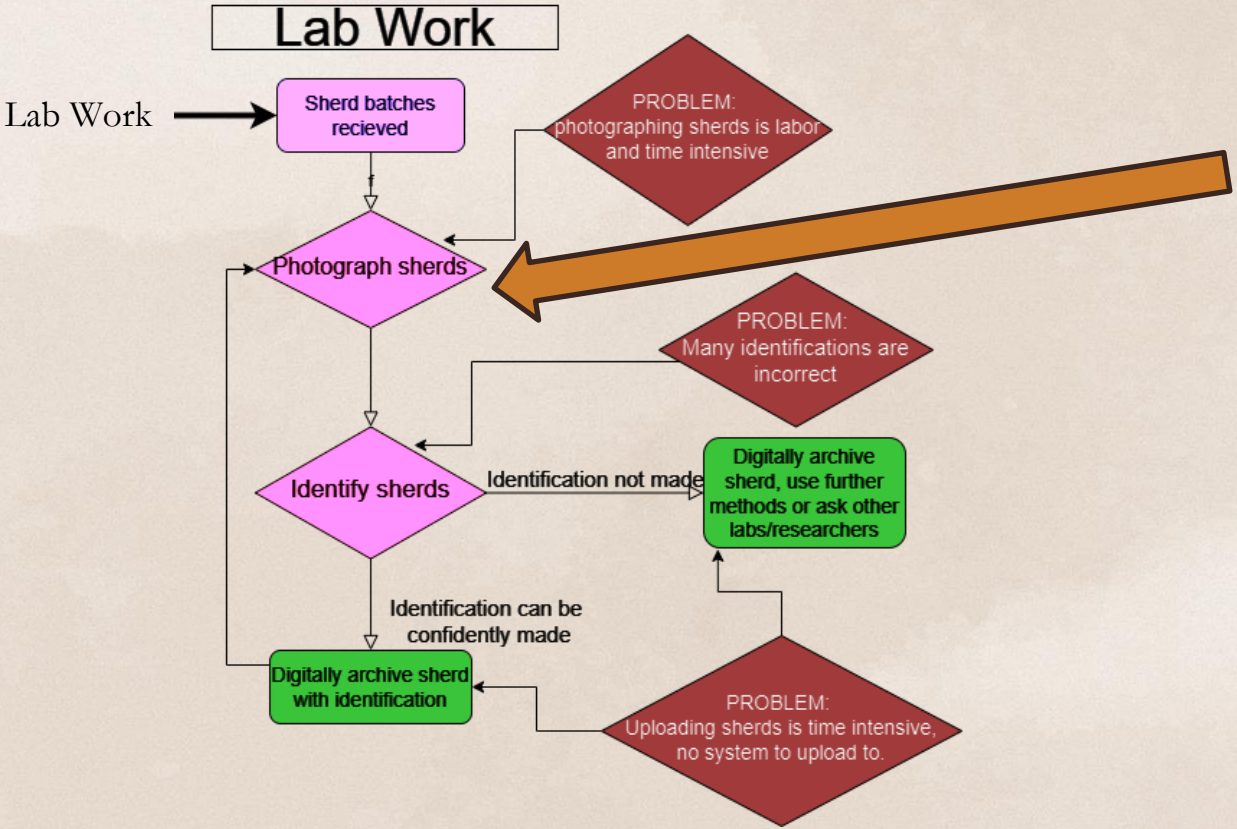
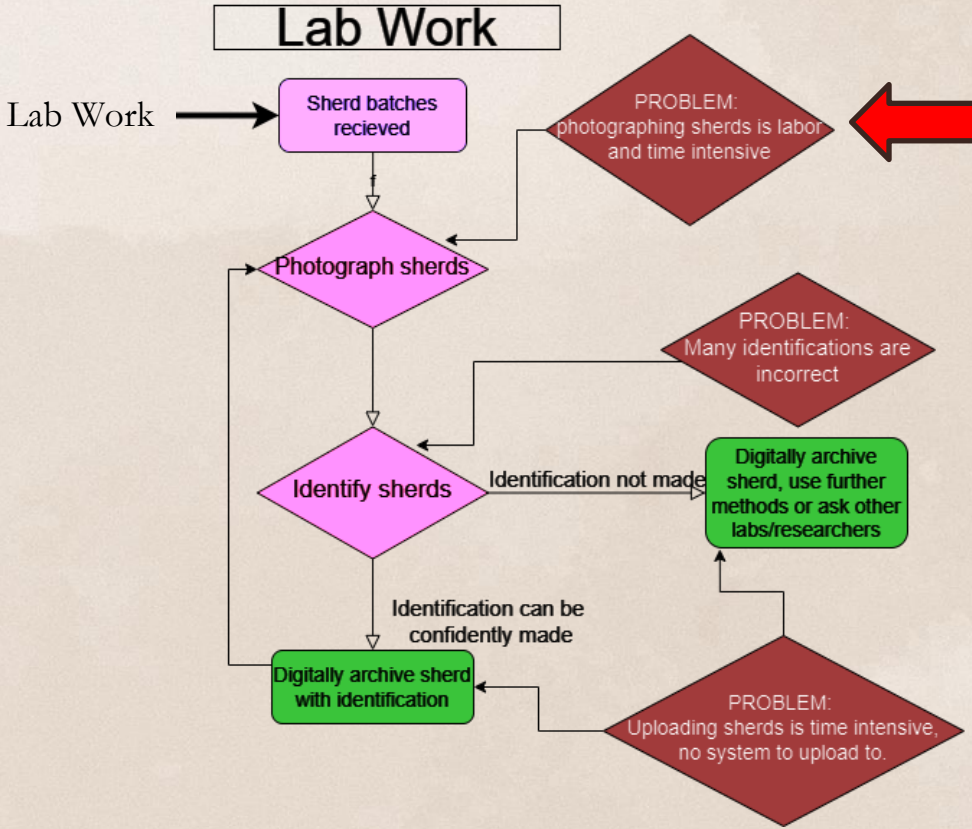


Client Workflow



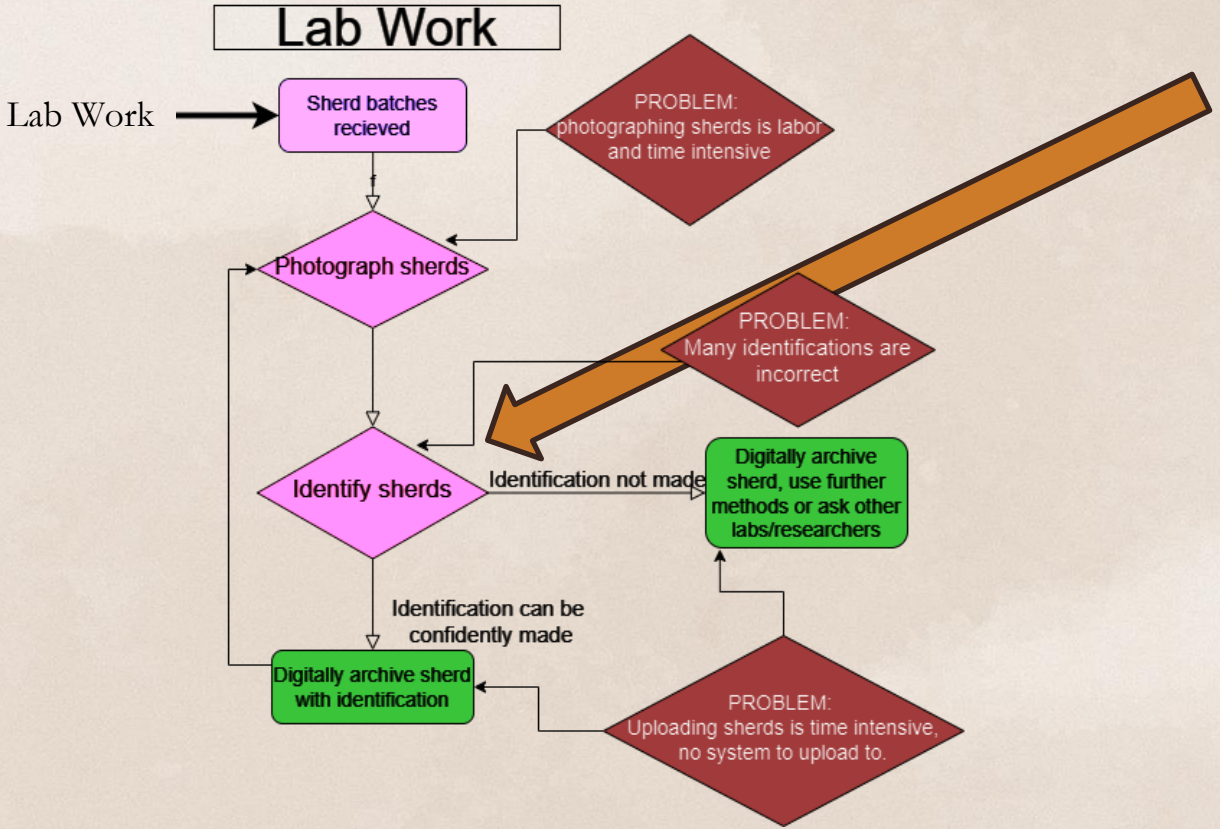
Photograph new sherds

Client Workflow



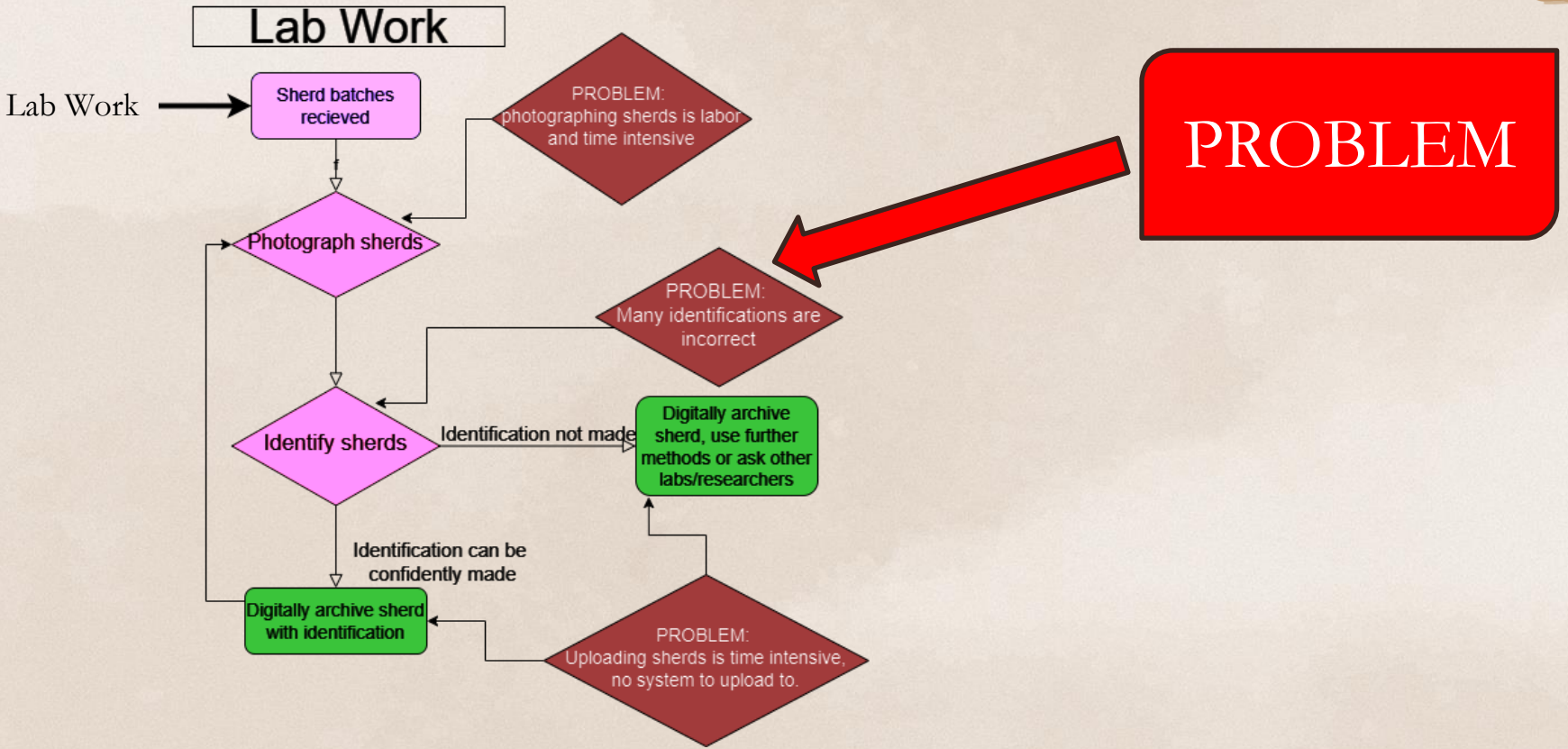
PROBLEM

Client Workflow

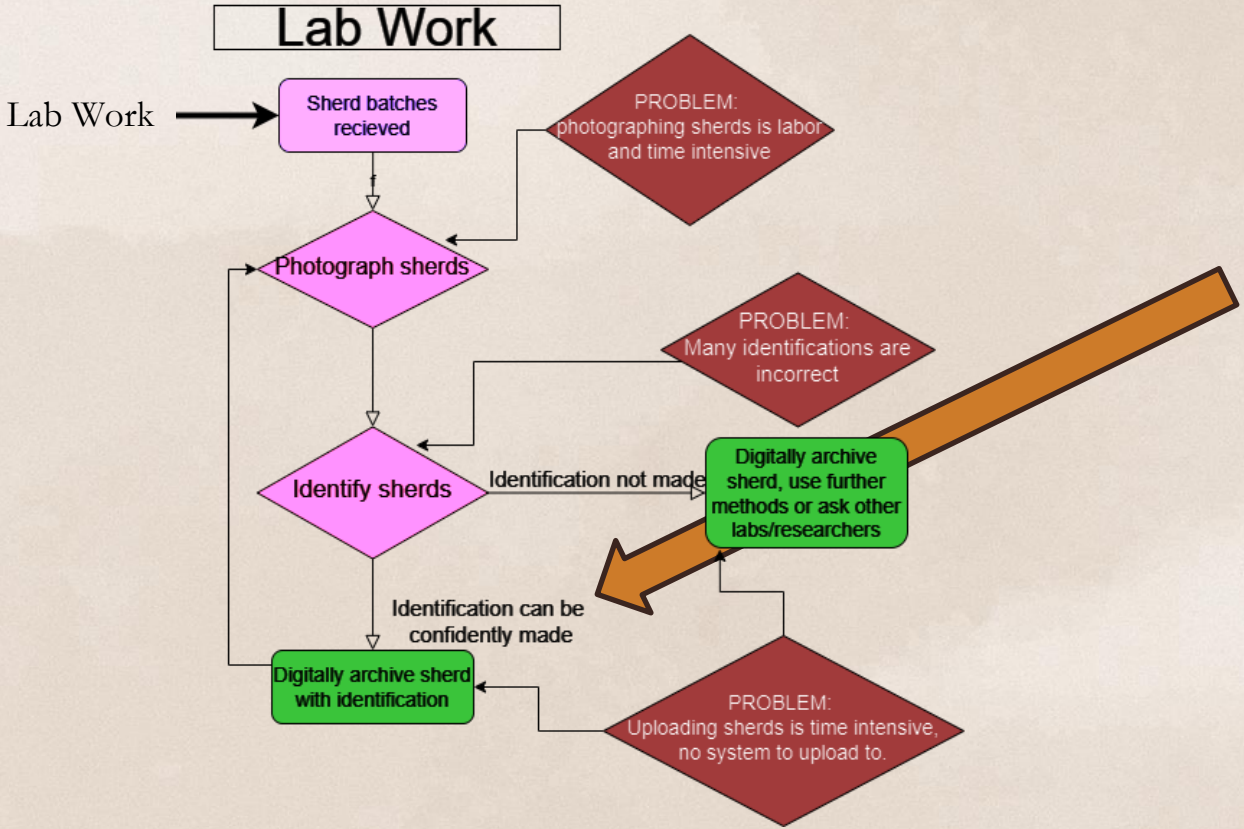


Identify Sherds

Client Workflow

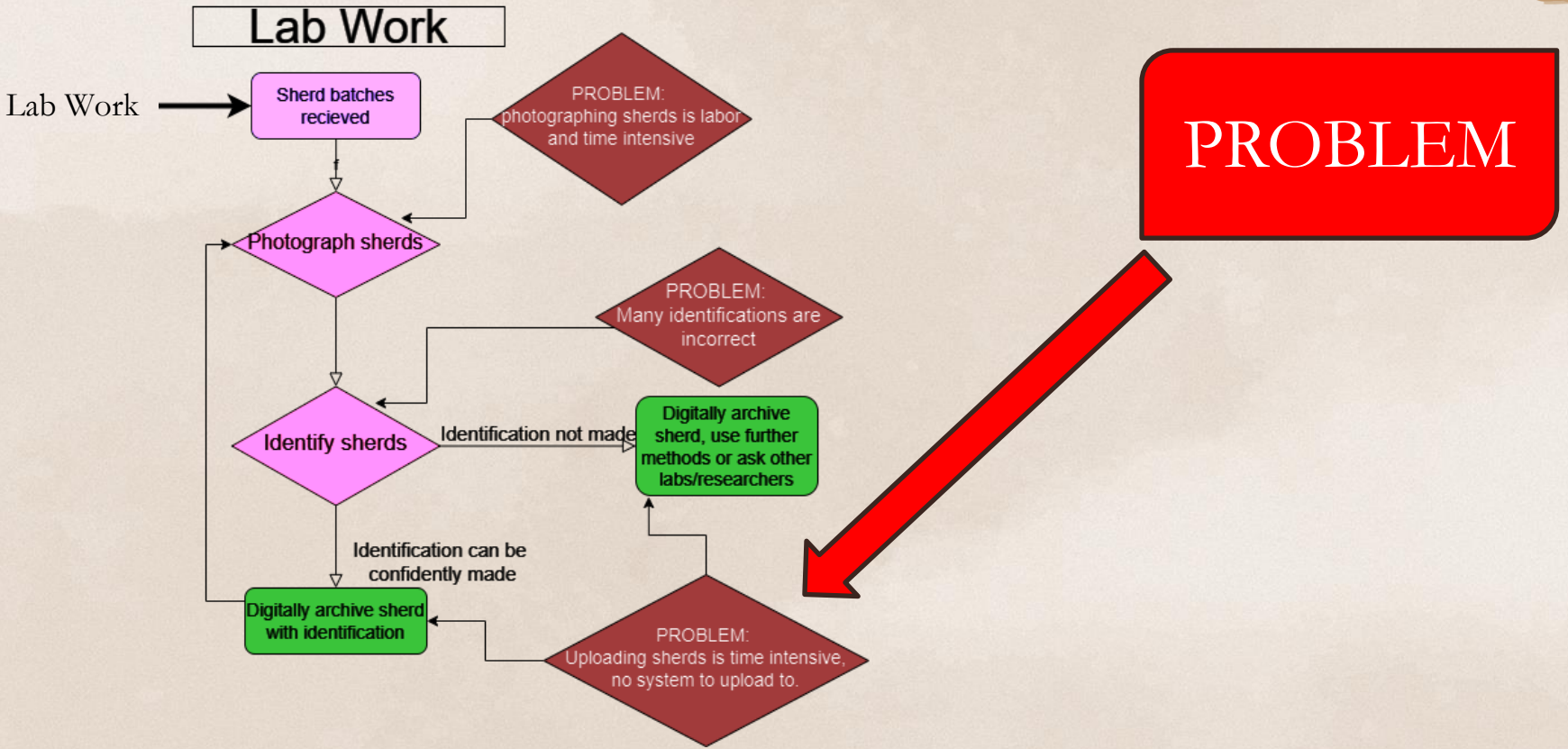


Client Workflow



Archive Sherds

Client Workflow



Problem Statement

- Archeologists often dispute sherd identifications.
- Archeologists consistently make unreliable assessments.
- Archeologists and researchers have a limited window of time to make their assessments.
- Manually classifying and recording large batches of sherds can be highly inefficient.

Our Solutions – Deep Learning Model

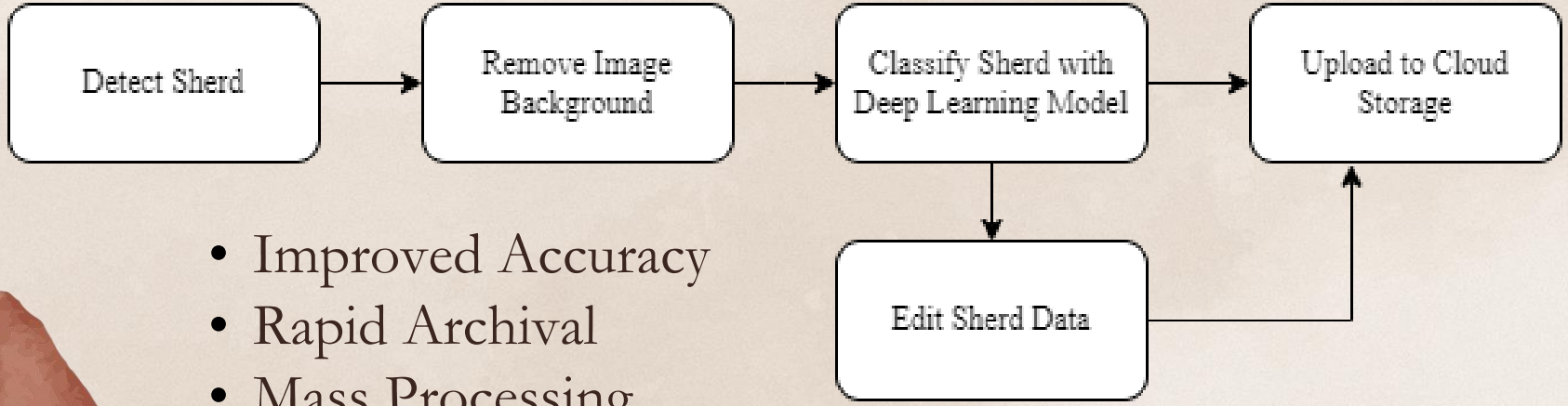
On-the-Go Classification

- Field setting
- Online/Offline
- Accessible
- For hobbyists and researchers alike

Mass Classification

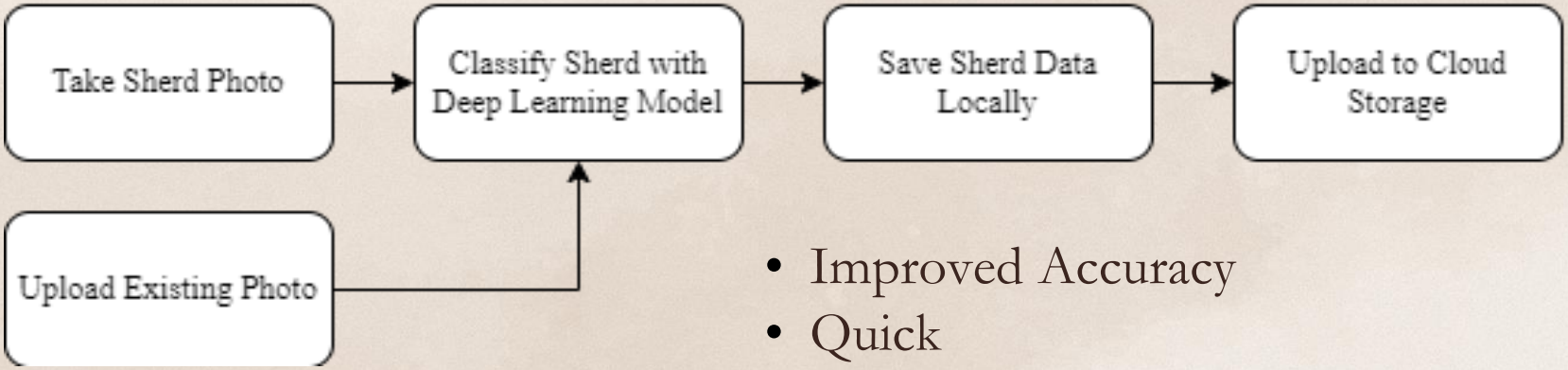
- Lab setting
- Prioritize rapid classification
- Mass archival projects

Solution Overview – Conveyor Belt



- Improved Accuracy
- Rapid Archival
- Mass Processing

Solution Overview – Mobile App



- Improved Accuracy
- Quick
- Accessible Offline
- Field-ready

Implementation Details

Mobile App

- Flutter
- Firebase (Auth, Firestore)
- TFLite
- Foreign Function Interface

Conveyor Belt

- OpenCV
- Firebase (Firestore)
- Model Integration

Deep Learning Models

- ResNet
- ConvNeXt
- Swin Transformer
- Custom Model

Implementation Details: Mobile App

- **Flutter**
  - Cross Platform
  - Single Codebase
- **Firebase**
  - Authentication (Firebase Auth)
  - Database (Firebase Firestore)
- **TFLite**
  - TensorFlow Model Integration
  - Cross Platform Support
- **Foreign Function Interface**
  - Optimization for older devices with limited hardware.

Implementation Details: Conveyor Belt

- **OpenCV**
  - Computer Vision Library
  - Handles capture & formatting
- **Firebase**
  - Image Storage (Firebase Firestore)
- **Model Integration**
  - Automatic classification

Implementation Details: Deep Learning Models

- **ResNet**
  - Premade from Keras framework
  - Fine-Tuned on sherd data
- **ConvNeXt**
  - Premade from Keras framework
- **Swin Transformer**
  - Custom transformer layers subclassed from Keras Layers
- **Custom CNN**
  - Utilizes residual blocks


Challenges and Resolutions

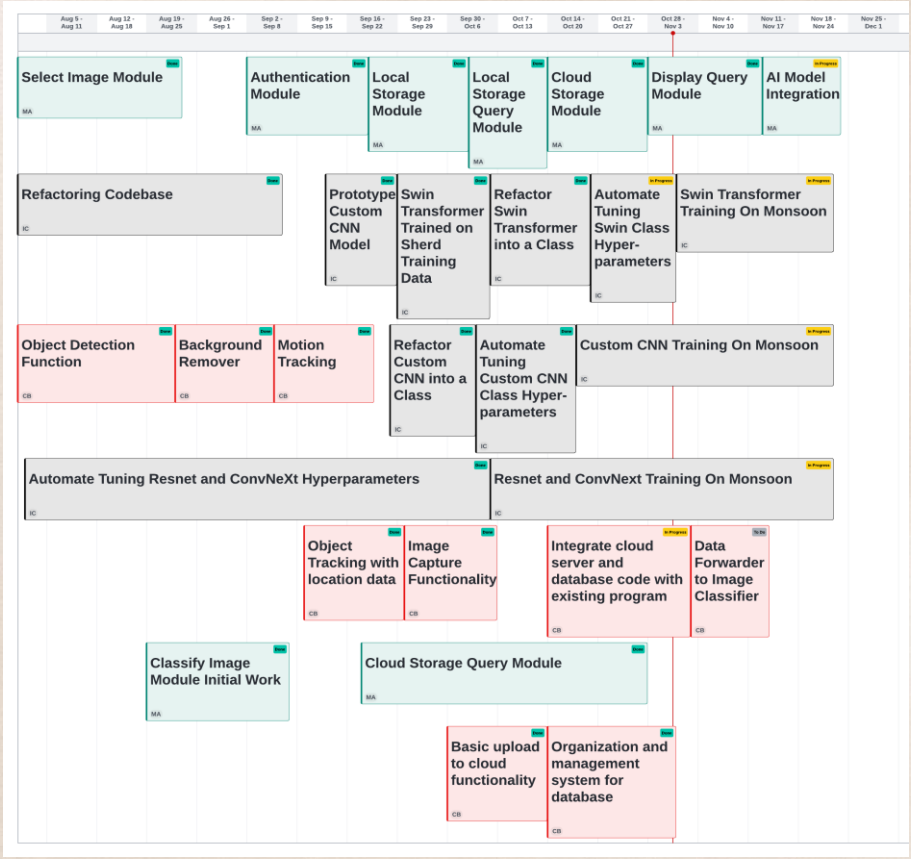
Challenges

- Mobile app performance degrades on older hardware
  - Classifying sherds results in noticeable lag
- Conveyor belt program results are impacted by quality of light
  - Harsh light washes out images
- Deep learning best practices do not improve our models
  - Little to no improvement from original models

Resolutions

- Mobile app lags on older hardware
  - Code running deep learning model optimized
- Conveyor belt susceptible to harsh light
  - Light box to block outside light
- Deep learning models not improving through best practices
  - Hyperparameters optimized through automated training

Schedule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Aug 12 - Aug 18
Aug 19 - Aug 25
Aug 26 - Sep 1
Sep 2 - Sep 8
Sep 9 - Sep 15
Sep 16 - Sep 22
Sep 23 - Sep 29
Sep 30 - Oct 6
Oct 7 - Oct 13
Oct 14 - Oct 20
Oct 21 - Oct 27
Oct 28 - Nov 3
Nov 4 - Nov 10
Nov 11 - Nov 17
Nov 18 - Nov 24
Nov 25 - Dec 1
Select Image Module
MA
Authentication Module
MA
Local Storage Module
MA
Local Storage Query Module
MA
Cloud Storage Module
MA
Display Query Module
MA
AI Model Integration
MA
Refactoring Codebase
IC
Prototype Custom CNN Model
IC
Swin Transformer Trained on Sherd Training Data
IC
Refactor Swin Transformer into a Class
IC
Automate Tuning Swin Class Hyper-parameters
IC
Swin Transformer Training On Monsoon
IC
Object Detection Function
CB
Background Remover
CB
Motion Tracking
CB
Refactor Custom CNN into a Class
IC
Automate Tuning Custom CNN Class Hyper-parameters
IC
Custom CNN Training On Monsoon
IC
Automate Tuning Resnet and ConvNeXt Hyperparameters
IC
Resnet and ConvNext Training On Monsoon
IC
Object Tracking with location data
CB
Image Capture Functionality
CB
Integrate cloud server and database code with existing program
CB
Data Forwarder to Image Classifier
CB
Classify Image Module Initial Work
MA
Cloud Storage Query Module
MA
Basic upload to cloud functionality
CB
Organization and management system for database
CB

Conclusion

- **Problem**
  - Archaeologists struggle to classify sherds fast and consistently
- **Solution**
  - CRAFT project will speed up field work and gathering data
- **Design**
  - Mobile app
  - Conveyor belt
  - Deep learning