

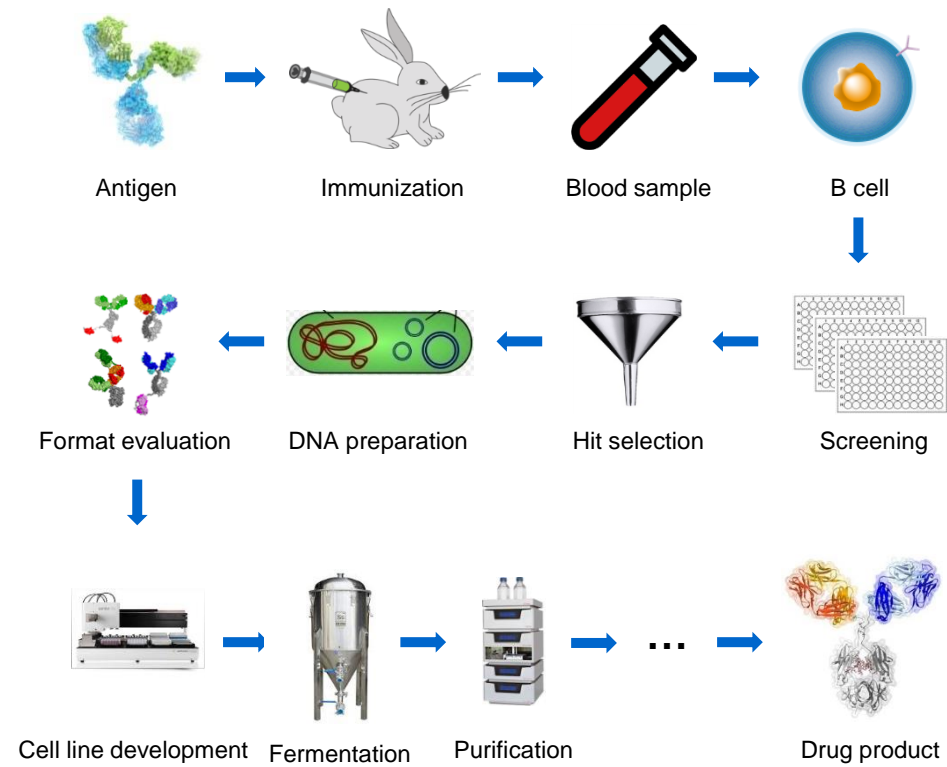
# Deep Learning in imaging for increased efficiency in drug discovery



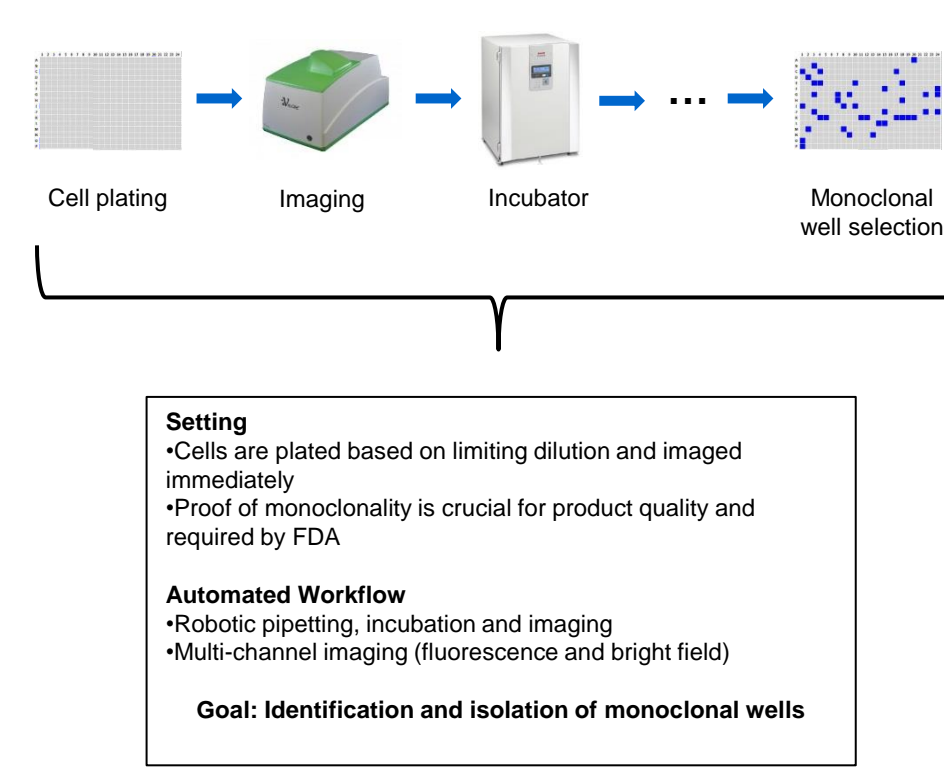
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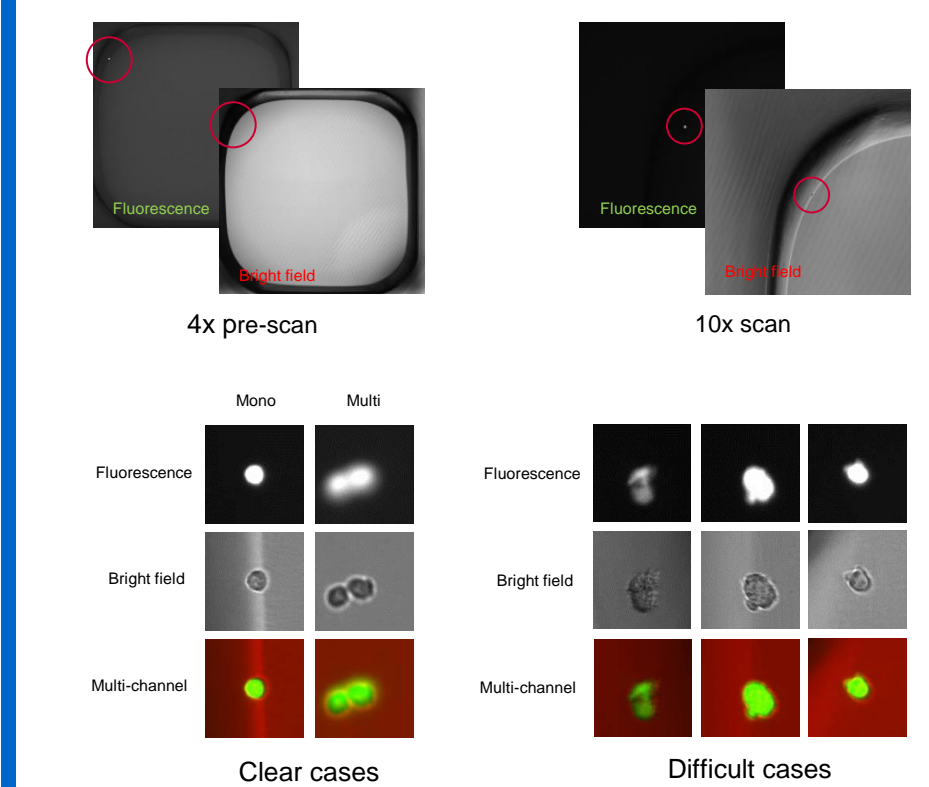
## 1 – Large Molecule Research value chain



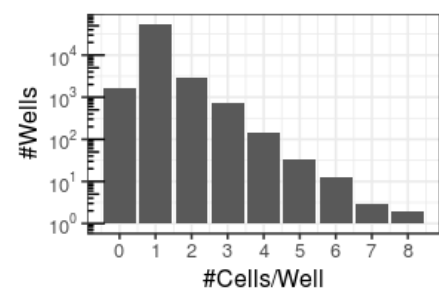
## 2 – Cell Line Development: Single cell cloning



## 3 – Automated image-based monoclonality assessment



## 4 – Imperfect detection requires manual re-assessment



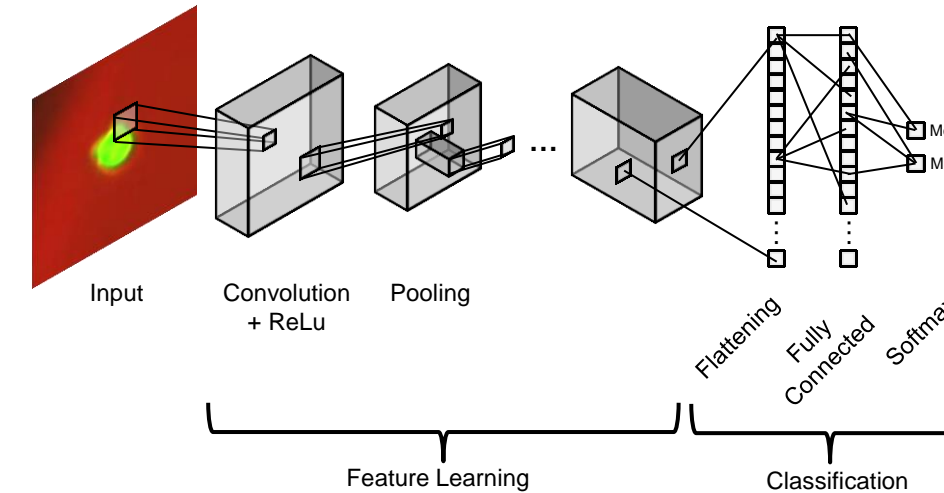
Poisson-distributed cell plating

Monoclonality detection rate

- Wells contain varying number of cells
- Hit picking based on monoclonality detection and antibody titer
- Manual re-assessment of ~200 clones / project by multiple raters
- Data volume: ~10 projects / year (increasing)

**Goal: Reduce manual workload and bias from manual re-assessment with additional AI / image analysis.**

## 5 – Convolutional Neural Network for monoclonality detection



**Data Set**

- Train: ~ 60.000 imaged wells
- Test: ~ 250 hand picked and originally misclassified wells

**Pre-processing**

- Blob detection and channel stacking (128 x 128 pixels)
- Data augmentation (horizontal/vertical flip, rotation, noise)

**Infrastructure:** High performance cluster with GPUs

## 6 – Results: Significantly improved detection rates

**Fit model to training data**

- Class imbalance (mono > multi)
- 4-layer network
- 200 epochs in ~5h on two GPUs

**Predict monoclonality for test data**

- ~250 manually classified images originally misclassified
- Retain class label and predict solely on unseen image
- Prediction output: probability of monoclonality in percent [%]

**Performance assessment**

- Accuracy: 85% (danger: class imbalance!)
- Area under the ROC curve: 0.79

**Outlook**

- Validation on larger test set (~1700 manually classified images)
- Integration of POC into Cell Line Development pipeline
- Fine-tuning network architecture