# Special Project Presentation

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## Algorithm:

- Frames extracted
- Arrow detected for each frame
- Non-arrow objects extracted from frame zero
- Objects classified
- For each frame:
  - Equation updated according to arrow location
  - Arrow trajectory drawn
  - if “=” reached, calculated, added to equation
- Frames converted to video

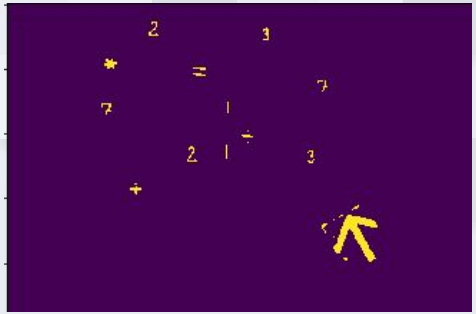
# Arrow Detection

**Algorithm:**

Given an image (frame):

- Pixel intensity is rescaled
- Image is thresholded in RGB color channels for red, turned to grayscale
- Median filtered, binarized
- Region detection applied (from scikit-image)
- The sufficiently large region is selected, its center and size recorded.

# Object Extraction From First Frame



**Algorithm:**

- First frame is preprocessed:

  Intensity rescaled, turned to grayscale, median filtered, edge enhancement applied through deconvolving with a Gaussian filter, closing applied

- Region detection applied (from scikit-image)
- Significant regions are selected based on:
  - The **area of their bounding box** (within a specified range)
  - Their **height to width ratio** (eliminates unwanted line segments etc)
  - Their **distance to the arrow** (eliminates objects formed around arrow

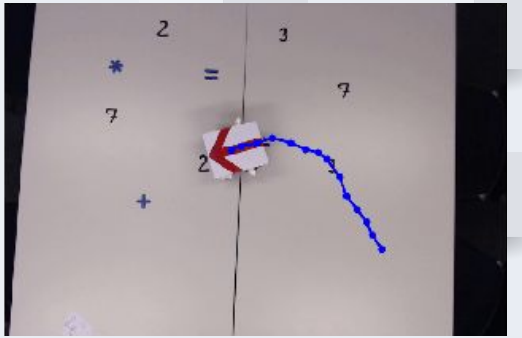
# Symbol Classification

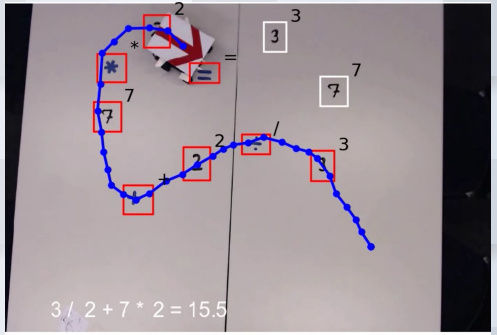
Classifier model is a CNN

- Classifies between 14 classes, 9 digits and 5 operators
  - ( If “-” and “1” are misclassified, alternation of digits and operators is used to solve it externally during equation formation)
- Training data is obtained as follows:
  - Sources: Mnist dataset (for digits) and digital images of operators
  - Data augmentation applied to datasets:

    Translation, rotation, scaling

# Processing Frames






## Algorithm:

For each frame:

- The new arrow location is added to the arrow locations (trajectory)
- If the arrow intersects an object, its class label is added to the equation, object is marked as passed.
- The current equation and arrow trajectory are drawn on the frame.
- If “=” is reached, the equation result is added to the equation