* Part 1: Netfilex (6000)
  + Abstract (100)
    - Discuss the algorithm and what it returns.
    - Discuss the need for a tool like this.
  + Introduction (200)
    - Talk about the SKA and the data expectations & need for automation.
    - Compare recent Radio surveys in terms of resolution, sensitivity and number of detected sources with SKA.
    - Historically, classification would be done by inspection (Galaxy Zoo)
    - Talk about the increased use of ML due to abundance of data, ease of use and the increased availability of GPUs
    - Talk about the use of CNNs for image recognition in astronomy.
  + Theory (1500)
    - How basic NNs work, discussion of neurons, model parameters & statistics.
    - How CNNs work. With filter images.
    - Types of layers: convolutional, activation, batch norm, pooling, dense.
    - Optimisation & SGD
    - Discussion of overfitting and regularization techniques (dropout & early stopping).
    - GANs & CAEs
  + Procedure (1500)
    - Preparation & Sorting: Cutting the image twice with one being recentred & choice of 128\*128 images. Sorting into categories (first with filfinder and then iteratively with pre-trained models) & sorting by eye (including removal of low-quality images).
    - Preparation for learning: sigma clipping, choice of sigma=1, normalisation (to ensure that decisions are based on morphology only as opposed to intensity), nan removal.
    - Data augmentation techniques: Flips, Rotations, Synthetic filaments and GANs.
    - CNN development including hyperparameter tuning. Include a model schematic.
    - Use of the pre-trained CNN in the algorithm to find neighbouring filament cuts. Use of “Padding” on the surrounding 8 cuts to ensure that filaments are complete when combined into one fits image. Ignoring instances of filaments cuts that didn’t neighbour any other filament cuts.
    - Improving CNN accuracy by overpopulating the “0” dataset with incorrect identifications.
  + Results (500)
    - CNN validation accuracy and loss plots with different compositions of the training dataset. With confusion matrices. Mention how earlystopping was used to save the weights of the epoch corresponding to the minimum validation loss.
    - Page of all the final filament cuts.
  + Discussion (1500)
    - Discuss precision, recall and accuracy.
    - Discussion of the ratio of original filament and non-filament cuts and how this was improved without affecting val\_acc.
    - Effect of rotations introducing dark corners and methods to mitigate this: ensuring that the “1” and “0” datasets both have a significant number of rotated images so that the model learns that sudden dark edges aren’t a characteristic feature.
    - Discussion as to why the GAN and synthetic filaments weren’t used in final training. & Discussion of why the GAN failed (over-representation of unusual looking filaments and lack of unique data points)
    - Lack of labelled data limits the feature space causing the need for augmentation, which can heavily affect the performance.
    - Discussion of how filaments may not be identified if only partially visible and methods to mitigate this: recentring the cuts to increase the diversity of edge interactions, and use of padding.
  + Conclusion (700)
    - Summarise the algorithm and how it is better than traditional methods.
    - Improvements that can be made to the model architecture or datasets.
    - Discussion of the “art” in selecting filaments that are of poor quality.
    - talk about how in the context of a filament extractor, the CNN is only as good as the quality of the dataset.
    - Development of a model to find lengths, orientations curvatures immediately.
    - Improvement on model upon release of new data.
    - Whether the model will be able to generalise to filaments found in other galaxies. (Dependent on the properties of the local magnetic field)
* Part 2: Analysis of filaments (2000)
  + Abstract (100)
    - Some key obtained values from filfinder.
  + Introduction (300)
    - Historical research into NTFs
  + Theory (500)
    - What NTF’s are
    - Some credible proposed formations mechanisms.
    - Use of Filfinder to analyse properties of NTF’s
  + Procedure (200)
    - Use of isolated filaments from the previous algorithm.
    - Use of filfinder to skeletonize the images and discussion into the selection of pruning criteria.
  + Results (300)
    - Some key properties of the detected filaments including total intensity, length, orientation, curvature presented with histograms.
    - Radial profile plots of some filaments.
  + Discussion (300)
    - How these results tie into the literature.
  + Conclusion (300)
    - Future work into filaments.