

(* ImgImprove works by finding the edges of the image, which shows us where the characters are. Inpainting is then used to estimate what the background looks like without any text. This is subtracted from the original image to obtain only the text (thus eliminating lighting effects), which is then sharpened (essentially a deconvolution with a Gaussian kernel), binarized, and colour flipped. The variable t defines the threshold used for binarizing. A value of t = 0.2 seems to work well*)


```

ImgImprove[img_, t_] :=
  Module[{edges, background, out}, edges = Dilation[EdgeDetect[img, 0.5], 3];
  background = Inpaint[img, edges];
  ;
  out = ColorNegate[Binarize[Sharpen[ImageSubtract[img, background], 10], t]];
  Print[img];
  Print[background]; Print[out]]

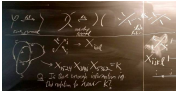
```

(* Load 5 sample images*)

```
img1 = ;
```

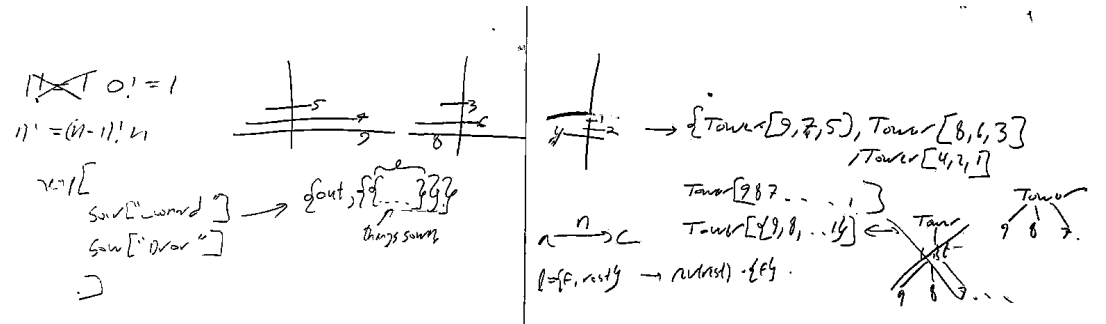
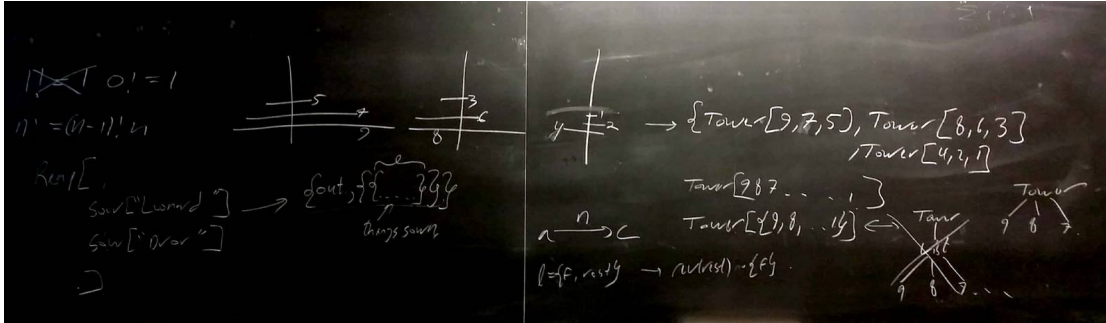
```
img2 = ;
```

```
img3 = ;
```

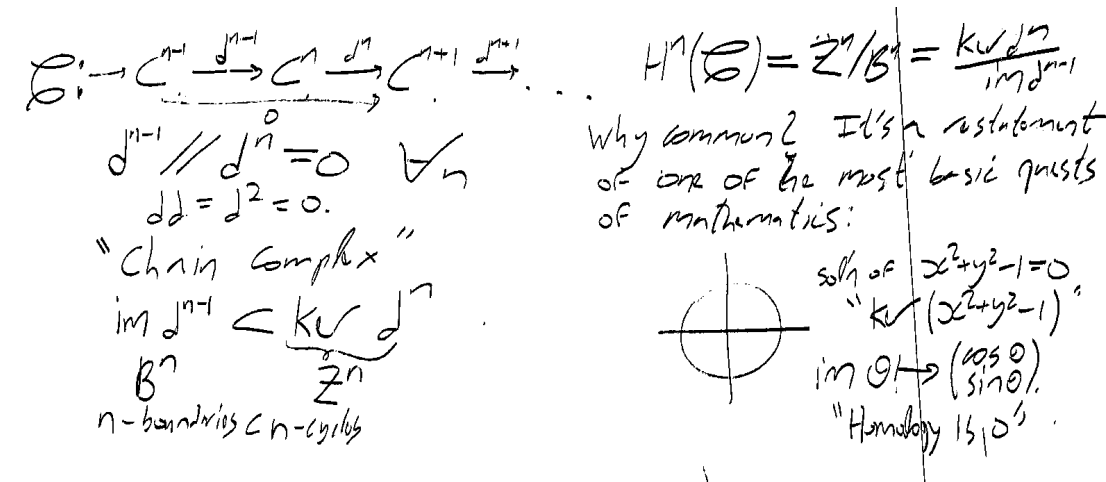
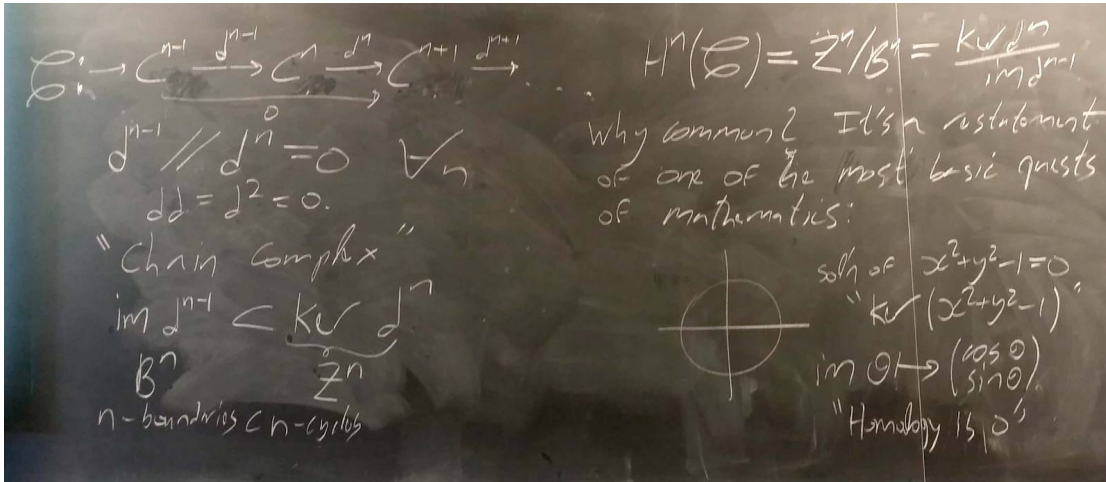
```
img4 = ;
```

```
img5 = ;
```

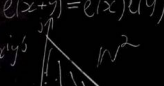
```
ImgImprove[img1, 0.2]
```



ImgImprove[img2, 0.2]



ImgImprove [img3, 0.2]

$e: \mathbb{R}^+ \text{ homom} \rightarrow \mathbb{R}^x$
 $x \mapsto e^x$
 A miracle! $e^x = \sum a_k x^k$
 $e(x+y) = e(x)e(y)$


N^2 eqn's on N unknowns
 \Rightarrow No sol'n's.
 Math vid. complete your understandings.
 $|x| = \begin{cases} x & x > 0 \\ 0 & x = 0 \\ -x & x < 0 \end{cases}$
 Which / Switch

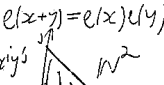
x	art
a	\neq
9	3

$C \rightarrow C \perp C \rightarrow$
 rank-nullity thm.
 $\dim \text{Dom} = \text{rank} + \text{nullity}$

$FC_n = \text{Free commutative unital algebra on } x_1, \dots, x_n$
 $= \langle 1, x_1, x_1 x_2, x_1^2, x_2 x_1 = x_1 x_2, \dots \rangle$
 $= \text{polynomial algebra in } x_i$
 $FC_0 \rightarrow FC_1 \rightarrow FC_2 \rightarrow FC_3 \rightarrow$

$FA_n = \text{Free associative unital algebra on } x_1, \dots, x_n$
 $x_1 x_2 \neq x_2 x_1, x_1 + x_2 = x_2 + x_1$
 $x_1 (x_2 + x_3) = x_1 x_2 + x_1 x_3, \dots$
 $FA_0 \rightarrow FA_1 \rightarrow FA_2 \rightarrow \dots$



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 $FA_0 \rightarrow FA_1 \rightarrow FA_2 \rightarrow \dots$

ImgImprove [img4, 0.3]

$0 \xrightarrow{A_1} \dots$
 rank 1

$\dots \xrightarrow{A_2} \dots$
 overlap
 rank 2

$\dots \xrightarrow{A_3} \dots$
 slide
 later

$X_{ijkl} \rightarrow X_{ijkl}$

$X_{1524} X_{3146} X_{5362} = K$


Q. Is there enough information in this relation to recover K ?

X_{ijkl}

$i \quad j$

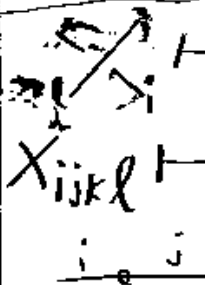


$\left(\begin{array}{c} 0 \\ 1 \end{array} \xrightarrow{K_1} \right) \quad \left(\begin{array}{c} \text{arc} \\ \text{loop} \end{array} \xrightarrow{K_2} \right) \quad \left(\begin{array}{c} \text{slide} \\ \text{link} \end{array} \right)$


 $\begin{array}{c} \nearrow^K \\ \searrow^i \\ \nearrow^j \\ \searrow^i \end{array} \rightarrow X_{ijkl}$

$X_{1524} X_{3146} X_{5362} = K$

Q. Is there enough information in this relation to recover K ?



X_{ijkl}

$i \quad j$

ImgImprove [img5, 0.2]

