Math 451

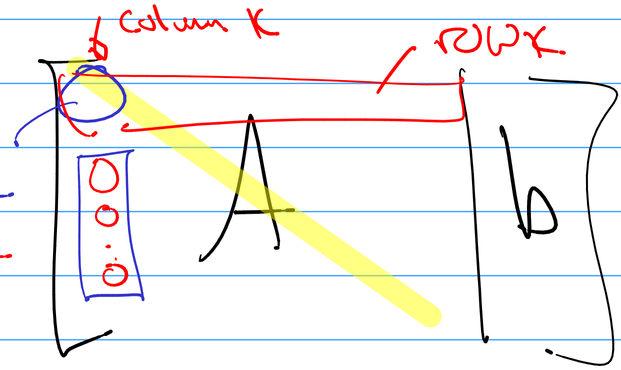
Solving systems of linear eqns

1. gauss with and without pivots
2. Solving: a) gauss jordan
   b) gauss → backsolve

Apps

gauss with pivots

$Ax = b$

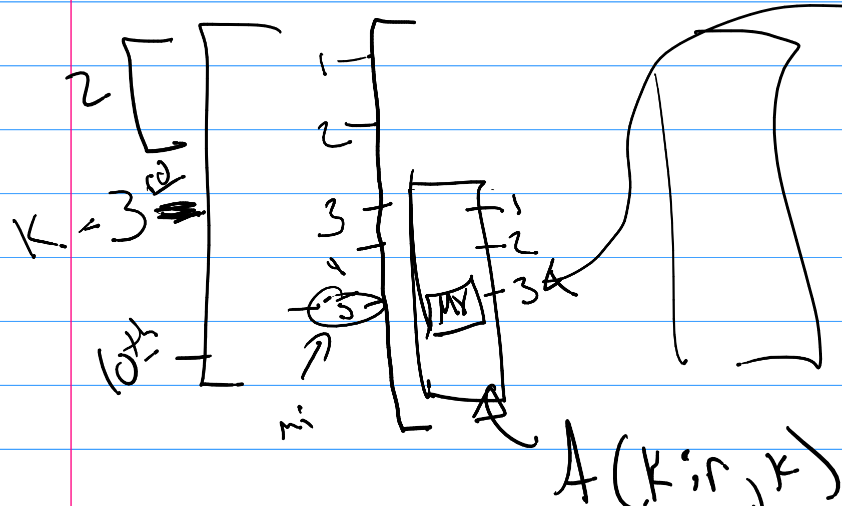


a_{kk} or a_{kk} and row k

to make col_k below a_{kk} into all zeros.

[r c] = size(A)

```
[mv mi] = max(abs(A(k:r,k)));
mi = mi + (k - 1);
A([k mi],:) = A([mi k],:);
```



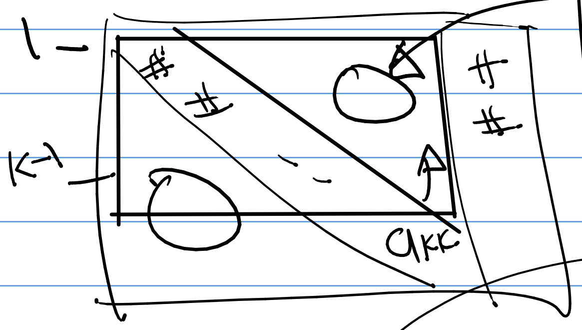
Solve: gauss-jordan

→ gauss with pivot

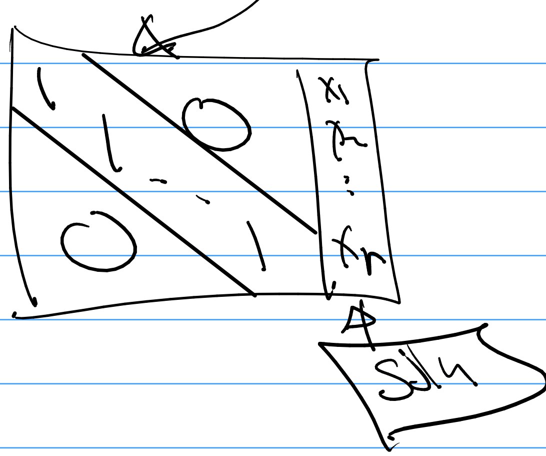
→ jordan elim.

bottom up

```
for k = r:-1:2
   i = 1:k-1;
   s = A(i,k)./A(k,k);
   A(i,:) = A(i,:) - s*A(k,:);
end
```




```
for k = 1:r
   A(k,:) = A(k,:)./A(k,k);
end
```



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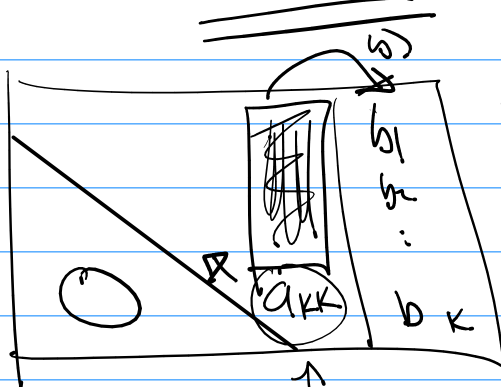
gauss with backsolve

① gauss with pivots

② backsolve



k^{th} soln

a) k^{th} soln b_k / a_{kk}

b) $\begin{bmatrix} b_1 \\ \vdots \\ b_{k-1} \end{bmatrix} = \begin{bmatrix} b_1 \\ \vdots \\ b_{k-1} \end{bmatrix} - k^{th}\text{ soln} \begin{bmatrix} \; \end{bmatrix}$

c) go to k-1

ex Sale @ the Store

3 people give ① Bills ② Items

\$12	3a, 2b, c
\$20	5a, b, 2c
\$7	a, b, c

$$\rightarrow \left[\begin{array}{ccc|c} 3 & 2 & 1 & 12 \\ 5 & 1 & 2 & 20 \\ 1 & 1 & 1 & 7 \end{array}\right]$$

$$\begin{bmatrix} 1 & 2 & 3 & 4 \\ 5 & 6 & 7 & 8 \\ 9 & 10 & 11 & 12 \end{bmatrix} \rightarrow \begin{bmatrix} 1 & 2 & 3 & 4 \\ 0 & 1 & 2 & 3 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

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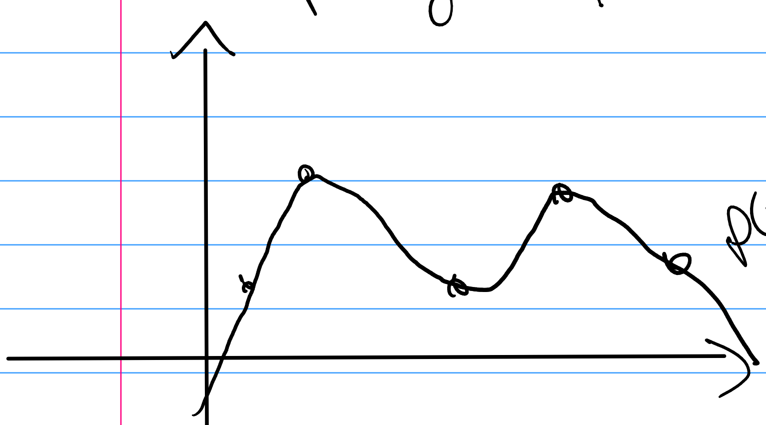
app

Interpolating Polynomial



ex 5 points.

$$p(x) = c_1x^4 + c_2x^3 + c_3x^2 + c_4x + c_5$$

Point 1 : $y_1 = p(x_1)$

2 : $y_2 = p(x_2)$

$\vdots$

5 : $y_5 = p(x_5)$

$$c_1 x_1^4 + c_2 x_1^3 + c_3 x_1^2 + c_4 x_1 + c_5 = y_1$$

$$\underbrace{\begin{bmatrix} x_1^4 & \cdots & x_1 & 1 \\ x_2^4 & & x_2 & 1 \\ \vdots & & \vdots & \vdots \\ x_5^4 & & x_5 & 1 \end{bmatrix}}_{X} \begin{bmatrix} c_1 \\ c_2 \\ \vdots \\ c_5 \end{bmatrix} = \underbrace{\begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_5 \end{bmatrix}}_{Y}$$

gaussbacksolve([X Y])

X = [x'.^4 x.^3 x.^2 x.^1 x.^0]

with

$$x = \begin{bmatrix} x_1 \\ \vdots \\ x_5 \end{bmatrix}$$