Name :- umesh sharma - 2301010128

Ques:-

$$A = \begin{bmatrix} 1 & 2 & 3 & 0 \\ 2 & 4 & 3 & 2 \\ 3 & 2 & 1 & 3 \\ 6 & 8 & 7 & 5 \end{bmatrix}$$

$R_2 \to R_2 - 2R_1$
$R_3 \to R_3 - 3R_1$
$R_4 \to R_4 - 4R_1$

$$\begin{bmatrix} 1, & 2, & 3, & 0 \\ 0, & 0, & -3, & 2 \\ 0, & -4, & -8, & 3 \\ 0, & -4, & -11, & 8 \end{bmatrix}$$

$R_2 \leftrightarrow R_3 \Rightarrow \begin{bmatrix} 1 & 2 & 3 & 0 \\ 0 & -4 & -8 & 3 \\ 0 & 0 & -3 & 2 \\ 0 & -4 & -11 & 5 \end{bmatrix}$

$R_4 \to R_4 - R_2$ $\begin{bmatrix} 1 & 2 & 3 & 0 \\ 0 & -4 & -8 & 3 \\ 0 & 0 & -3 & 2 \\ 0 & 0 & -3 & 2 \end{bmatrix}$

- $R_4 \to R_4 - R_3$ $\begin{bmatrix} 1, & 2, & 3, & 0 \\ 0, & -4, & -8, & 3 \\ 0, & 0, & -3, & 2 \\ 0 & 0 & 0, & 0 \end{bmatrix}$

So Because we have Three non-Zero Row in Row echelon form

$\boxed{Rank = 3}$

$\lambda_1 = \begin{bmatrix} 1 \\ 1 \end{bmatrix}, \quad x_2 = \begin{bmatrix} -1 \\ 1 \end{bmatrix}$

Umesh

Que 2:- $T: W \to P_2$ $\quad T\begin{bmatrix} a & b \\ c & d \end{bmatrix} = (a-b) + (b-c)x + (c-d)x^2$

Given

→ dimension of ω :-

Symmetric 2×2 Have $\frac{n(n+1)}{2} = \frac{2\times3}{2} = 3$

Independent Value

→ The diagonal Element $\begin{bmatrix} a & b \\ c & d \end{bmatrix}$ $[b=c]$ $[a]$ $[d]$

And off diagonal element

$\boxed{\dim(\omega) = 3}$

Rank of T :- T mapping to all polynomial of degree ≤ 2

Rank = 3 & nullity = dim(v) − Rank = 0

Que 3:- $A = \begin{bmatrix} 2 & -1 \\ -1 & 2 \end{bmatrix}$ find

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→ Find THE Eigenvalue And Eigenvector of A^{-1} And $A+4I$

Soln:- Finding Eigen value of A

$\det(A-\lambda I)=0$ $\quad A = \begin{bmatrix} 2 & -1 \\ -1 & 2 \end{bmatrix}$ $\quad \det(A-\lambda I) = \begin{vmatrix} 2-\lambda & -1 \\ -1 & 2-\lambda \end{vmatrix}$

$(2-\lambda)^2 - (-1)(-1) = 0$

$\Rightarrow \lambda^2 - 4\lambda + 3 = 0$ $\quad (\lambda-1)(\lambda-3) = 0$

So $\boxed{\lambda = 1, 3}$ Eigenvalue of $\boxed{A = 1, 3}$

→ Eigenvalue of $A = 1, 3$

→ Eigenvalue of A^{-1} = Reciprocal of eigenvalue of A

So $\boxed{A^{-1} \text{ Eigenvalues} = 1; 1/3}$

→ Eigenvalue of $A+4I$ = 4 + Eigenvalue of A

$4+1=5$

$4+3=7$

$\boxed{A+4I \text{ Eigenvalue} = 5, 7}$

→ Eigenvector

for $A^{-1} = \begin{bmatrix} 2 & -1 \\ -1 & 2 \end{bmatrix}$

$A^{-1} = \frac{1}{|A|} \text{adj} A$ $\quad \det(A) = 4-1 = 3$

$x=1$ Then $= y = (-1)$

→ Quez – continue → umesh sharma

→ Now $A^{-1} = \frac{1}{3}\begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$ And $\boxed{\lambda \text{ for } A^{-1} = 1 \text{ or } 1/3}$

we Assume $= \boxed{A^{-1} = B}$

To find Eigenvector

$[B - \lambda I]X = 0$ → for $\boxed{\lambda = 1}$ $[B - I]x = 0$

$$= \begin{bmatrix} \frac{2}{3}, & \frac{1}{3} \\ \frac{1}{3}, & \frac{2}{3} \end{bmatrix} - \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

$$= \begin{bmatrix} -\frac{1}{3}, & \frac{1}{3} \\ \frac{1}{3}, & -\frac{1}{3} \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$$

$-\frac{x}{3} + \frac{y}{3} = 0$ $\quad \frac{x}{3} = \frac{y}{3}$ $\quad \boxed{x = y}$

→ $\boxed{\text{if } X = 1, \ y = 1}$

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$[(B-3I)x]=0$

$\Rightarrow \left[\begin{bmatrix} \frac{2}{3}, & \frac{1}{3} \\ \frac{1}{3}, & \frac{2}{3} \end{bmatrix} - \begin{bmatrix} \frac{1}{3}, & 0 \\ 0, & \frac{1}{3} \end{bmatrix}\right] \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$

$\Rightarrow \begin{bmatrix} \frac{1}{3}, & \frac{1}{3} \\ \frac{1}{3}, & \frac{1}{3} \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$

$= \frac{x}{3} + \frac{y}{3} = 0, \quad \frac{x}{\cancel{3}} = -\frac{y}{\cancel{3}} \quad$ if $(x=1, \; y=-1)$

for A^{-1} Eigenvectors $x_1 = \begin{bmatrix} 1 \\ 1 \end{bmatrix}, x_2 = \begin{bmatrix} -1 \\ 1 \end{bmatrix}$

Now $(A+4I) \Rightarrow \begin{bmatrix} 2 & -1 \\ -1 & 2 \end{bmatrix} + \begin{bmatrix} 4 & 0 \\ 0 & 4 \end{bmatrix} = C$

$C = \begin{bmatrix} 6, & -1 \\ -1, & 6 \end{bmatrix} \Rightarrow \boxed{\lambda = 5, 7}$

$\boxed{[C-\lambda I]x = 0}$

For $\lambda = 5$

$\left[\begin{bmatrix} 6 & -1 \\ -1 & 6 \end{bmatrix} - \begin{bmatrix} 5 & 0 \\ 0 & 5 \end{bmatrix}\right] \begin{bmatrix} x \\ y \end{bmatrix} = 0$

$= \begin{bmatrix} 1 & -1 \\ -1 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$

For $\lambda = 7$

$\begin{bmatrix} 6 & -1 \\ -1, & 6 \end{bmatrix} - \begin{bmatrix} 7, & 0 \\ 0, & 7 \end{bmatrix}$

$= \begin{bmatrix} -1, & -1 \\ -1, & -1 \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \end{bmatrix}$

$= -x - y = 0$

$\boxed{x = -y}$

Que:- Matrix A-[...

→ Que-2-umesnonar

Eigenvectors A+4I Is $x_1 = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$, $x_2 = \begin{bmatrix} -1 \\ 1 \end{bmatrix}$

To summarize:-

Eigenvalues:- $A: \lambda_1 = 1, \lambda_2 = 3$

$A^{-1} = \lambda_1 = 1, \lambda_2 = 1/3$

$A+4I = \lambda_1 = 5, \lambda_2 = 7$

Eigenvectors:-

$A^{-1} = x_1 = \begin{bmatrix} 1 \\ 1 \end{bmatrix}, x_2 = \begin{bmatrix} -1 \\ 1 \end{bmatrix}$

$A+4I = x_1 = \begin{bmatrix} 1 \\ 1 \end{bmatrix}, x_2 = \begin{bmatrix} -1 \\ 1 \end{bmatrix}$

$A = x_1 = \begin{bmatrix} 1 \\ 1 \end{bmatrix}, x_2 = \begin{bmatrix} -1 \\ 1 \end{bmatrix}$

Que:- (4)

$$\begin{cases} 3x - 0.1y - 0.2z = 7.85 & \text{---(1)} \\ 0.1x + 7y - 0.3z = -19.3 & \text{---(2)} \\ 0.3x + 0.2y + 10z = 71.4 & \text{---(3)} \end{cases}$$

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first itreat

→ Sol^n Assume $y=0, z=0$

{Umesh Sharma}

$3x - 0.1(0) - 0.2(0) = 7.85$

$3x = 7.85$

$x = \frac{7.85}{3} = 2.616666667$

for y. $\boxed{z=0}$

$0.1(2.6166) + 7y - 0.3(0) = -19.3$

$= 0.261666667 + 7y = -19.3$

$7y = -19.3 - 0.26166666$

$7y = -19.561666667$ $\boxed{y = -2.7880}$

for z,

$\Rightarrow 0.3x - 0.2(y) + 10z = 71.4$

$= 0.3(2.6166667) - 0.2(-2.788) + 10z = 71.4$

$= 0.785 - 0.5576 + 10z = 71.4$

$0.228 + 10z = 71.4$

$= 10z = 71.400 - 0.228$ $\boxed{z = 7.1172}$

Second iteration :-

$3x - 0.1y_1 - 0.2z_1 = 7.85$

$3x - 0.1(-2.788) - 0.2(7.117) = 7.85$

$3x + 0.2788 - 1.4234 = 7.85$

$3x - 1.1446 = 7.85$

$3x = 7.8500 + 1.1446 = 8.9946$

$\boxed{x_2 = 2.9982}$

for $y \rightarrow$ $\boxed{x_2 = 2.9982}$ $\boxed{z_1 = 7.1172}$

$= 0.1(2.9982) + 7y - 0.3(7.1172) = -19.3$

$\Rightarrow 0.29982 + 7y - 2.13516 = -19.3$

$7y - 1.83534 = -19.3$

$7y = -19.3 + 1.83534$ $\boxed{y_2 = -2.4949}$

for $z \rightarrow$ $\boxed{x_2 = 2.9982}$ $\boxed{y_2 = -2.4949}$

$\Rightarrow 0.3(x_2) - 0.2(y_2) + 10z = 71.4$

$\Rightarrow 0.3(2.9982) - 0.2(-2.4949) + 10z = 71.4$

$\Rightarrow 0.89946 + 0.49898 + 10z = 71.4$

$\Rightarrow 1.39844 + 10z = 71.4$ $\boxed{z_2 = 7.000156}$

for Third iteration $\boxed{y_2 = -2.4949, \quad z_2 = 7.000156}$

for x_3 :- $3x - 0.1(-2.4949) - 0.2(7.000156) = 7.85$

$3x + 0.24949 - 1.4000312 = 7.85$

$3x = 9.0005412$ $\boxed{x = 3.0001804}$

For y_3 0.1

$\Rightarrow 0.3000$

$\Rightarrow 0.3000$

7.

For z_3 0.3(

$= 0.3($

$\Rightarrow 0.900$

$=$

$x_3 =$

for satisfy

$\Rightarrow 3($

$\Rightarrow 9$

$\Rightarrow$

$\Rightarrow 0.30001804 + 7y - 0.3(7.000152) = -19.3$

$\Rightarrow 0.30001804 + 7y - 2.1000468 = -19.3$

$7y - 1.8000288 = -19.3$

$7y = -19.3 + 1.8000288$

$7y = -17.4999712$

$\boxed{y_3 = -2.4999958806}$

For z_3

$0.3(x_3) - 0.2(y_3) + 10z = 71.4$

$= 0.3(3.0001804) - 0.2(-2.4999958806) + 10z = 71.4$

$\Rightarrow 0.90005412 + 0.499999171 + 10z = 71.4$

$= 1.400053291 + 10z = 71.4$

$10z = 70.000$

$\boxed{z_3 = 7.00000}$

$x_3 = 3.00018, \ y_3 = -2.49999, \ z_3 = 7.0001$

for satisfy :-

$\Rightarrow 3(3.00018) - 0.1(-2.4999) - 0.2(7.0001) =$

$\Rightarrow 9.00054 + 0.249999 - 1.40002$

$\Rightarrow 9.25013 - 1.40004$

$= \boxed{7.85012} \ \boxed{\Rightarrow 7.85}$

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Given:

$x+3y+2z=0$
$2x-y+3z=0$
$3x-5y+4z=0$
$x+17y+4z=0$

$\boxed{AX=0}$ form

$$\begin{bmatrix} 1 & 3 & 2 \\ 2 & -1 & 3 \\ 3 & -5 & 4 \\ 1 & 17 & 4 \end{bmatrix} \quad x=\begin{bmatrix} x \\ y \\ z \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ 0 \\ 0 \end{bmatrix}$$

Augmented matrix:

$$\left[\begin{array}{ccc|c} 1 & 3 & 2 & 0 \\ 2 & -1 & 3 & 0 \\ 3 & -15 & 4 & 0 \\ 1 & 17 & 4 & 0 \end{array}\right]$$

Row-echelon form:

$R_2 \to R_2-2R_1$
$R_3 \to R_3-3R_1$
$R_4 \to R_4-R_1$

$$= \left[\begin{array}{ccc|c} 1, & 3, & 2 & 0 \\ 0, & -7 & -1, & \\ 0, & -14, & -2 & \\ 0, & 14, & 2 & \end{array}\right]$$

$R_4 \to R_4+R_3$

$$\Rightarrow \begin{bmatrix} 1, & 3, & 2 \\ 0, & -7, & -1 \\ 0, & -14, & -2 \\ 0, & 0, & 0 \end{bmatrix} \quad R_3 \to R_3-2R_2 = \begin{bmatrix} 1, & 3, & 2 \\ 0, & -7, & -1 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{bmatrix}$$

$\rho(A)=2$

$\rho(A:B)=2$

$\boxed{\rho(A)=\rho(A:B)}$

$\to$ Consist

$\rho(A) <$ no of unknown (infinite sol)

$$\left[\begin{array}{ccc|c} 1, & 3, & 2 & 0 \\ & & & 0 \end{array}\right]$$

→ Que-5:- continue — umesh sharma

$$\begin{bmatrix}1, & 3, & 2\\ 0, & -7, & -1\\ 0, & 0, & 0\end{bmatrix}\begin{bmatrix}x\\ y\\ z\end{bmatrix} = \begin{bmatrix}0\\ 0\\ 0\end{bmatrix}$$

$= x+3y+2z=0$ — (1)

$-7y-z=0$ — (2)

$\boxed{z=-7y}$ Put in (1)

$x+3y+2(-7y)=0$

$x+3y-14y=0$

$\boxed{x-11y=0}$

$\Rightarrow \boxed{\boxed{x=-17y} = -\frac{17}{7}z}$

$\boxed{x=11y=-\frac{11}{7}z}$

So $\boxed{x=0, y=0, z=0}$

Ans

ROLL NO.: DATE:

Q6:- Given :- $T(a+bx+cx^2) = (a+1)+(b+1)x+(c+1)x^2$

Additivity :- $T(u+v) = T(u)+T(v)$

for All u, v in P_2

Homogenity :- $T(au) = aT(u)$ for all u in P_2 And a scalel

(1)

Soln:- $U = a+bx+cx^2$ And $V = a'+b'x+c'x^2$ in P_2

Then $u+v = (a+a')+(b+b')x+(c+c')x^2$

Now $T(U) = (a+1)+(b+1)x+(c+1)x^2$ And

$T(V) = (a'+1)+(b'+1)x+(c'+1)x^2$

$T(u+v) = (a+a'+1)+(b+b'+1)x+(c+c'+1)x^2$

$T(u)+T(v) = (a+1)+(b+1)x+(c+1)x^2+(a'+1)+(b'+1)x$
$+(c'+1)x^2$

$(\ldots)+(b+b'+1)+(c+c'+1)x^2$

$$T(u+v) = (a+a'+1) + (b+b'+1)x + (c+c'+1)x^2$$

$\downarrow$

$$T(u)+T(v) = (a+1) + (b+1)x + (c+1)x^2 + (a'+1) + (b'+1)x + (c'+1)x^2$$

$$= (a+a'+1) + (b+b'+1) + (c+c'+1)x^2$$

$T(u+v) = T(u)+T(v) \Rightarrow$ so satisfied

(2) $v = a+bx+cx^2 \rightarrow P_2$ let α any scaler

$$\alpha v = \alpha a + \alpha b x + \alpha c x^2$$

$$T(\alpha v) = (\alpha a+1) + (\alpha b+1)x + (\alpha c+1)x^2$$

$\downarrow$

$$\alpha T(v) = \alpha(a+1) + \alpha(b+1)x + \alpha(c+1)x^2$$

$$= (\alpha a+1) + (\alpha b+1)x + (\alpha c+1)x^2$$

Satisfy $\rightarrow$ satisfy both it's linear Transform

UMESH SHARMA

Q7:- $S = \begin{bmatrix} 1 & 2 & 3 \\ 3 & 1 & 0 \\ -2 & 1 & 3 \end{bmatrix}$ Applying R.R.E.F.

$R_2 \rightarrow R_2 - 3R_1$
$R_3 \rightarrow R_3 + 2R_1$ $= \begin{bmatrix} 1 & 2 & 3 \\ 0 & -5 & -9 \\ 0 & 5 & 7 \end{bmatrix}$ $R_3 \rightarrow R_3 + R_2$ $\begin{bmatrix} 1 & 2 & 3 \\ 0 & -5 & -9 \\ 0 & 0 & 0 \end{bmatrix}$

$\rho(A) <$ no. of unknown → linearly dependent

And Having infinite many solution

→ So it's not A basis $V3(R)$.

To determine dimension and basis subspace spanned by S. we use Row-Reduced form (1, 2, 3) And (3, 3, 0)

Then dimension of sub-space = 2

$x - 3y + 7z = 16 \quad - (3)$

with Initial value $\boxed{x_0 = 1,\ y_0 = 1,\ z_0 = 1}$

Soln

x_1 :- $3x_1 - 6y_0 + 2z_0 = 23 \Rightarrow 3x_1 - 6 + 2 = 23,$

$3x_1 = 27, \quad \boxed{x_1 = 9}$

y_1 :- $-4x_0 + y_1 - z_0 = -18, \quad -4 + y_1 - 1 = -18, \quad \boxed{y_1 = -10}$

z_1 :- $x_0 - 3y_0 + 7z_0 = 16 \Rightarrow 1 - 3 + 7z_0 = 16, \quad 7z_0 = 18$

$z_0 = \boxed{18/7}$

$\rightarrow \boxed{x_1 = 9,\ y_1 = -10,\ z_1 = 2.571}$

→ Iteration 2 using value of 1 :-

x_2 :- $3x_2 - 6(-10) + 2 \times 2.571 = 23 \Rightarrow 3x_2 = 23 - 65.14$

$\boxed{x_2 = -14.04}$

y_2 :- $-4x_1 + y_2 - z_0 = -15$

$-4 \times 9 + y_2 - 2.57 = -18, \quad y_2 = -15 + 38.57$

$\boxed{y_2 = 23.571}$

z_2 :- $x_1 - 3(y_1) + 7z_2 = 16 \Rightarrow 9 - 3(-10) + 7z_2 = 16$

$7z_2 = 16 - 39 \quad z_2 = -\frac{23}{7} = \boxed{-3.2857}$

$\boxed{z_2 = -3.28571}$

Que-8-Continue-Ummesh

Now working on 3rd iteration using 2nd iteration value:-

$\boxed{x_2 = -14.04}$, $\boxed{y_2 = 23.571}$, $\boxed{z_2 = -3.2857}$

x_3:- $3x_3 - 6y_2 + 2z = 23$

$\Rightarrow 3x_3 - 6(23.57) + 2(-3.28) = 23$

$\Rightarrow 3x_3 - 141.42 + 6.56 = 23$

$3x_3 = 170.98$ $\boxed{x_3 = 56.9933}$

y_3:- $-4x_2 + y_3 - z_2 = -15$

$-4(-14.04) + y_3 - (-3.28) = -15$

$= 56.16 + y_3 + 3.28 = -18$

$\boxed{y_3 = -74.44}$

z_3:- $x_2 - 3y_2 + 7z_3 = 16$

$-14.04 - 3(23.571) + 7z_3 = 16$

$\Rightarrow -14.04 - 70.713 + 7z_3 = 16$

$\Rightarrow -84.753 + 7z_3 = 16$

$7z_3 = 100.753$

last iteration value is

$x_3 = 56.9933$

$y_3 = -74.44$

$z_3 = 14.39$

Que 9

soln:- The
Image
The
rotating
Repre

Bluring

To unders
understa

→ digital
curren
pixel.
Gradi

→ A digi
which a
Image
a dig

→ Basically
(1) Black-
(1) Black-
An
format

→ computer
→ In Gre
(1-255

Que 9:- Umesh

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Soln:- There are many use of Matrix operations in Image processing one of Them is Image Transformation. The Transformation Include such Transition like rotating, scaling, And shearing which can be Represented by matrix multiplication

Bluring An Image is Also one of Them

~~To understand Bluring process first we have to~~ understand what are The digital image:—

→ digital image made up a series of pixels. Currently use "24 bit RGB" system of color each pixel. That mean each color have 256 gradient.

→ A digital image formed by small bit of data which are stored in computers. When we capture an Image in camera presence of light. The camera works like a digital sensor And convert into digital signals.

→ Basically Image has Three types
(1) Black-white (2) Gray-scale (3) R.G.B)

(1) Black-white :- In This image we use 1 as white And 0 As black At fix every Pixel in format of Matrix ct one dimensond

→ computer see image only on The basis of Matrix
→ In Grey scale picture, 0 — black, 256-white (1–255) — different shades

RGB:- image → it is A 3-D matrix first comp ~~Red, Than Green Than Blue~~ Value Matrix

If we select Any value it Return
RGB(100, 200, 150)

[Que-9-umesh]

→ Blurring a image:- Computer take A Kernal Matrix. And it's place multiplied with Every 3X3 matrix formation on The image matrix, After The done of multiplicat, Average value placed on central pixel That Region but on a new-empty image matrix

→ Than That process Goes over The All matrix place Appropiate value In new matrix.

→ After done we got Another matrix which consist value of blured image with The Help of Average value pixel. which Is Nothing But The Requied Blurred image

→ The particular blur which we'll get by multiply kernal containing All 1/9 element called Box-Blur

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Q10 :- A Linear Transformation for Rotating a 2D Image Involves Applying a mathematical operation to The Image matrix That Effectively rotates The images By a Specified Angle Around A chosen Center point

Transformation Can Be Represented by a 2x2 rotation matrix:

$$\begin{pmatrix} \cos(\theta), & -\sin(\theta) \\ \sin(\theta), & \cos(\theta) \end{pmatrix} \rightarrow \theta \text{ is rotation In Radians}$$

To rotate Each Pixel rotate And mapped to a new- position to The rotated Image According To The Transition matrix.

Rotated - cordinate can be calculated By Multiplying The orignal cordinates of Each pixel of rotation matrix

Linear Transformation preserve The straightness of lines And Angle In The image, making it a common operation In Computer - Vision task such as Image processing, object Recognization And Geometric Transformation