EE 364b Convex Optimization II Page 1

5:33 AM	
Introduction: structure; [2] Relations	
El Lipschile constants, nonexpansive and contractive operators	
A monotone operator & generalizative idea of monotone increasing, functional	
This a point iteration algorithm flinds the fixed points of Lipschitz monotone operators	
B Basic results for resolvent and Cases operations.	
[7] Prozimal point method & Sinds zeros of general monotone operators ?	
B Oregan Suma news Lected way have but infinds	
E	
# Belation other names: point-to-set mapping,	
nulti-valued function	
R: Relation on R' is subset on R'AR"	
R={ (x.3); He R(x)} listos all pairs such that HeR(*)	
Rizi forenoaded function instaliona = { = { x = 1 (x = 2) eR }	
and a Printeles and a Principa of the Internet range a plan in maller.	
K(c)=\$20000000 Y (0)\$ = \$ K\$200000000 } miscon case \$=K(c) is minim	
obecutor also called	
Eset-image notations for functions in relations: $R(s) = U_{set}R(s)$	
antic notation and input fortra nel. SEa set of adimensional points, safes	
set, i.e., 3 with griath dement relations	
igile, then the resultant union of all such	
bulpulsels for each of those points	
Example: • Emply relation, k=0	
• Full relation, R=R ⁰ xR ⁰	
 Zero relation for function lood, R=0={(2,0) 2ex*3 	
 Ferning reasons, 1-10,21 [KeK-5] 1 this is a function too 	
~* 5 \$D, 16 * R, 16 * 8	
 By Economical 3 = { (x, 3) ∈ C × C Y Kee T(x) > 3(x) + 3x (x-x) } technically reint down 5 for 3570 	
$\frac{qr(t)}{(x,y) \in \partial S} \leftrightarrow x \in C \land A \in C \land Y_{pec} = \frac{\xi(z) \geqslant \xi(x) + 4_{x}^{T}(z-x)}{z}$	
& Deresting on solutions' on a tab Subaradien'	
$\frac{1}{(2)} = \frac{1}{(2)} = \frac{1}$	Ratis empty set annhilders any otherset during averloaded) set 6,4dillion
anne fri van her verstigt i mis an formiger	
• (omp osition and second seco	
q Retriations2.56.0012 v(+ 10.02) //Vdleman notation: 2838(X.9)68	
K.2 - Patricularitania_1M213 ⁴ Y26Y6K23	by sum of relation law:
# Similar to matrix multiplication: the relation to be applied first is innermost, the second relation to be applied is the left of the first relation and so on	$\mathbf{T}_{i_1} + \mathbf{T}_{i_2} = \{ (\mathbf{X}, \mathbf{x}_{i_1} + \mathbf{x}_{i_2}) \mid (\mathbf{Y}, \mathbf{x}_{i_1}) \in \mathbf{T}_{i_2}, (\mathbf{X}, \mathbf{x}_{i_2}) \in \mathbf{T}_{i_2} \}$
	50,
	$\mathfrak{V} \in (\mathfrak{r}_{\mathfrak{g}_{1}} \mathfrak{r}_{\mathfrak{g}_{2}})(\mathfrak{t}) \leftrightarrow (\mathfrak{t}, \mathfrak{V}) \in (\mathfrak{r}_{\mathfrak{g}_{1}} \mathfrak{r}_{\mathfrak{g}_{2}}) \Leftrightarrow \mathfrak{z}_{\mathfrak{V}_{1}, \mathfrak{V}_{2}} \mathfrak{V}_{\mathfrak{g}_{1}} \mathfrak{V}_{\mathfrak{g}_{1}}(\mathfrak{t}), \mathfrak{v}_{\mathfrak{t}} \in \mathfrak{r}_{\mathfrak{g}_{1}}(\mathfrak{t}), \mathfrak{v}_{\mathfrak{t}} \in \mathfrak{r}_{\mathfrak{g}_{1}}(\mathfrak{t}), \mathfrak{v}_{\mathfrak{t}} \mathfrak{v}_{\mathfrak{g}_{1}}(\mathfrak{t}), \mathfrak{v}_{\mathfrak{t}} \mathfrak{v}_{\mathfrak{t}} \mathfrak{v}_{\mathfrak{g}_{1}}(\mathfrak{t}), \mathfrak{v}_{\mathfrak{t}} \mathfrak{v}_{\mathfrak{g}_{1}}(\mathfrak{t}), \mathfrak{v}_{\mathfrak{t}} \mathfrak{v}_{\mathfrak{t}})$
	the state of the s
R: SESUM OF MINIMUNDER (R.S. SER, (R.S) (R	$d_1 - d_1 + d_2 + d_2 + d_3 + d_2 + d_3 + d_$
$ \begin{array}{l} \begin{array}{l} \begin{array}{l} \begin{array}{l} \begin{array}{l} \begin{array}{l} \begin{array}{l} \begin{array}{l}$. (ta. (ta.)(2) = ta.(3) + ta.(3) . Ese the overlanded sum operative sur relation
$\int \left(\begin{array}{c} y \in R(x), \ z \in S(x) \end{array} \right) \Leftrightarrow \ y + \varepsilon \in \{k+S\}(k) = R(k) + S(k) \\ \end{array}$	has Additivity]
zero of arelation." DER(z) Ex is a zero of R	statement: overloaded sum operator for relations has additivity
Zero of anelalion: OER(I) 整义 is a zero of R l extonsion to zero of a Junction: O=\$(V) 整义 is a zero of f Units is	statement: overloaded sum operator for relations has additivity
Žero of a relation: DER(I) 整义 is a tero of R Uztonsian to zero of a Junction: D=\$(I) 整 x is a zero of 5 (thus is	statement: overhaaded sum operator for relations has additivity $\lambda F = \int \{r_1 - \lambda w_1 - r_1 - w_1 + c_1^2 \}$
$\frac{1}{2} \frac{1}{2} \frac{1}$	statement: evertabled sum operator for relations has additively $\lambda F \approx \left\{ (\mathbf{L}, \Lambda \mathbf{S}) \mid (\mathbf{L}, \mathbf{S}) \in F \right\}$ $\lambda F \approx \left\{ (\mathbf{L}, \Lambda \mathbf{S}) \mid (\mathbf{L}, \mathbf{S}) \in F \right\}$
Zero of a relation: $D \in R(\mathbf{z}) \xrightarrow{\mathbb{R}} x$ is a zero of R Il extonsion to zero of a gunction: $D = \mathfrak{g}(\mathbf{z}) \xrightarrow{\mathbb{R}} x$ is a zero of f Inis is zero set of a relation: $R^{-1}(OS) = \{z_1 (z_i, O) \in R\}$ gents set of all zeros of a relation R II i.e., $z \in R^{-1}(OS) \rightarrow O \in R(Z)$	$ \lambda F = \left\{ \left(x_{1} \wedge y_{1} \right) \mid \left(\lambda_{1} \cdot y_{1} \in F \right\} \\ \lambda \widetilde{F} = \left\{ \left(x_{1} \wedge \widetilde{x}_{1} \right) \mid \left(\lambda_{1} \cdot y_{1} \in F \right) \\ F = \left\{ \left(x_{1} \wedge \widetilde{x}_{1} \right) \mid \left(x_{1} \cdot y_{1} \in F \right) \\ F = \left\{ \left(x_{1} \wedge \widetilde{x}_{1} \right) \mid \left(x_{1} \cdot y_{1} \in F \right) \\ F = \left\{ \left(x_{1} \wedge \widetilde{x}_{1} \right) \mid \left(x_{1} \cdot y_{1} \in F \right) \\ F = \left\{ \left(x_{1} \wedge \widetilde{x}_{1} \right) \mid \left(x_{1} \cdot y_{1} \in F \right) \\ F = \left\{ \left(x_{1} \wedge \widetilde{x}_{1} \right) \mid \left(x_{1} \cdot y_{1} \in F \right) \\ F = \left\{ \left(x_{1} \wedge \widetilde{x}_{1} \right) \mid \left(x_{1} \cdot y_{1} \in F \right) \\ F = \left\{ \left(x_{1} \wedge \widetilde{x}_{1} \right) \mid \left(x_{1} \cdot y_{1} \in F \right) \\ F = \left\{ \left(x_{1} \wedge \widetilde{x}_{1} \right) \mid \left(x_{1} \cdot y_{1} \in F \right) \\ F = \left\{ \left(x_{1} \wedge \widetilde{x}_{1} \right) \mid \left(x_{1} \cdot y_{1} \in F \right) \\ F = \left\{ \left(x_{1} \wedge \widetilde{x}_{1} \right) \mid \left(x_{1} \cdot y_{1} \in F \right) \\ F = \left\{ \left(x_{1} \wedge \widetilde{x}_{1} \right) \mid \left(x_{1} \cdot y_{1} \in F \right) \\ F = \left\{ \left(x_{1} \wedge \widetilde{x}_{1} \right) \mid \left(x_{1} \cdot y_{1} \in F \right) \\ F = \left\{ \left(x_{1} \wedge \widetilde{x}_{1} \right) \mid \left(x_{1} \cdot y_{1} \in F \right) \\ F = \left\{ \left(x_{1} \wedge \widetilde{x}_{1} \right) \mid \left(x_{1} \cdot y_{1} \in F \right) \\ F = \left\{ \left(x_{1} \wedge \widetilde{x}_{1} \right) \mid \left(x_{1} \cdot y_{1} \in F \right) \\ F = \left\{ \left(x_{1} \wedge \widetilde{x}_{1} \right) \mid \left(x_{1} \cdot y_{1} \in F \right) \\ F = \left\{ \left(x_{1} \wedge \widetilde{x}_{1} \right) \mid \left(x_{1} \cdot y_{1} \in F \right) \\ F = \left\{ \left(x_{1} \wedge \widetilde{x}_{1} \right) \mid \left(x_{1} \cdot y_{1} \in F \right) \\ F = \left\{ \left(x_{1} \wedge \widetilde{x}_{1} \right) \right\} \right\}$
$\begin{aligned} \vec{x}rO & of a relation: D \in R(\mathbf{x}) \stackrel{k}{\cong} \chi_{15} o_{1}2ero O \leq R \\ \vec{x}rO rsion in zero Of a gunction: D = S(\mathbf{x}) \stackrel{k}{\cong} \chi_{15} is a 2ero of \leq S \\ \vec{y}_{14is} is \end{aligned}$ $\begin{aligned} zero set Of a relation: R^{-1}(10S) = \{\chi_{1}(\chi_{1},0) \in R\} qets Set of G a relation \\ \qquad $	statement: overlaaded sum operator for relations has additivity $\begin{split} \lambda F &= \left\{ \left(x, \lambda y \right) \middle \ \left(x, y \right) \in F \right\} \\ \lambda \widetilde{F} &= \left\{ \left(x, \lambda z \right) \middle \ \left(x, z \right) \in F \right\} \\ F &= \left\{ \left(x, y + z \right) \middle \ \left(x, z \right) \in F, \left(x, z \right) \in F \right\} \\ 1 &= \left\{ \left(x, y + z \right) \middle \ \left(x, y \right) \in F, \left(x, z \right) \in F \right\} \\ 2 &= \left\{ \left(x, y + z \right) \middle \ \left(x, y \right) \in F, \left(x, z \right) \in F \right\} \\ 2 &= \left\{ \left(x, y + z \right) \middle \ \left(x, y \right) \in F, \left(x, z \right) \in F \right\} \\ 2 &= \left\{ \left(x, y + z \right) \middle \ \left(x, y \right) \in F, \left(x, z \right) \in F \right\} \\ 2 &= \left\{ \left(x, y + z \right) \middle \ \left(x, y \right) \in F, \left(x, z \right) \in F \right\} \\ 2 &= \left\{ \left(x, y + z \right) \middle \ \left(x, y \right) \in F, \left(x, z \right) \in F \right\} \\ 2 &= \left\{ \left(x, y + z \right) \middle \ \left(x, y \right) \in F, \left(x, z \right) \in F \right\} \\ 2 &= \left\{ \left(x, y + z \right) \middle \ \left(x, y \right) \in F, \left(x, z \right) \in F \right\} \\ 2 &= \left\{ \left(x, y + z \right) \middle \ \left(x, y \right) \in F, \left(x, z \right) \in F \right\} \\ 2 &= \left\{ \left(x, y + z \right) \right\} \\ 2 $
$\begin{aligned} \hat{\mathcal{L}}_{\text{CP}} & o \int a \operatorname{relation} : O \in \mathcal{R}(\mathbf{X}) \stackrel{\text{le}}{=} \mathbf{X} \text{ is } a \operatorname{cero } o \in \mathcal{R} \\ & \int \partial \mathcal{L}_{\text{CP}}(\operatorname{relation}) : O = \mathcal{S}(\mathbf{X}) \stackrel{\text{le}}{=} \mathbf{X} \text{ is } a \operatorname{cero } o \in \mathcal{L}_{\text{CP}} \\ & \int \partial \mathcal{L}_{\text{CP}}(\operatorname{relation}) : \mathcal{R}^{-1}(\{O_{\mathcal{L}}\}) = \left\{ \mathbf{X} \mid (\mathbf{x}, O) \in \mathcal{R} \right\} \P^{\operatorname{relation}} \\ & \ i^{\operatorname{cero}} \cdot \mathbf{X} \in \mathcal{R}^{-1}(\{O_{\mathcal{L}}\}) \leftrightarrow O \in \mathcal{R}(\mathbf{X}) \\ & \ i^{\operatorname{cero}} \cdot \mathbf{X} \in \mathcal{R}^{-1}(\{O_{\mathcal{L}}\}) \leftrightarrow O \in \mathcal{R}(\mathbf{X}) \\ & \\ & \stackrel{\text{def}}{=} \operatorname{constraint} con$	$\lambda F = \{(x, \lambda, y) (\lambda, y) \in F \}$ $\lambda \overline{F} = \{(x, \lambda, z) (\lambda, y) \in F, \{x, z\} \in F \}$ $F^{+} \overline{F} = \{(x, \lambda + z) (x, z) \in F, (x, z) \in F \}$ $\lambda F_{+} \overline{k} = \{(x, \lambda + \lambda z) (x, \lambda + \lambda z) (x, \lambda + \lambda z) \in \lambda F, (x, \lambda z) \in \lambda \overline{F} \}$ $\lambda F_{+} \overline{k} = \{(x, \lambda + \lambda z) (x, \lambda + \lambda z) (x, \lambda + \lambda z) \in \lambda F \}$ $\lambda F_{+} \overline{k} = \{(x, \lambda + \lambda z) (x, \lambda + \lambda z) (x, \lambda + \lambda z) \in \lambda F \}$ $\lambda F_{+} \overline{k} = \{(x, \lambda + \lambda z) (x, \lambda + \lambda z) (x, \lambda + \lambda z) (x, \lambda + \lambda z) \in \lambda F \}$ $\lambda F_{+} \overline{k} = \{(x, \lambda + \lambda z) (x, \lambda $
$\frac{1}{2} \frac{1}{2} \frac{1}$	$\begin{aligned} \lambda F &= \left\{ (\mathbf{x}, \lambda \mathbf{y}) \mid (\mathbf{\lambda}, \mathbf{y}) \in F \right\} \\ \lambda \overline{F} &= \left\{ (\mathbf{x}, \lambda \mathbf{y}) \mid (\mathbf{\lambda}, \mathbf{y}) \in F \right\} \\ F^{+} \overline{F} &= \left\{ (\mathbf{x}, \lambda \mathbf{y}) \mid (\mathbf{x}, \mathbf{y}) \in F, (\mathbf{x}, \mathbf{x}) \in F \right\} \\ \lambda F_{+} \overline{A}^{-} &= \left\{ (\mathbf{x}, \lambda \mathbf{y}, \mathbf{x}) \mid (\mathbf{x}, \mathbf{y}) \in F, (\mathbf{x}, \mathbf{x}) \in A\overline{F} \right\} \\ \lambda F_{+} \overline{A}^{-} &= \left\{ (\mathbf{x}, \lambda \mathbf{y}, \mathbf{x}) \mid (\mathbf{x}, \mathbf{y}) \in F, (\mathbf{x}, \mathbf{x}) \in A\overline{F} \right\} \\ \lambda (F_{+} \overline{F}) &= \left\{ (\mathbf{x}, \lambda (\mathbf{y}, \mathbf{x})) \mid (\mathbf{x}, \mathbf{y}) \in F, (\mathbf{x}, \mathbf{x}) \in F \right\} \end{aligned}$
$\frac{2}{\sqrt{2}} \frac{1}{\sqrt{2}} \frac{1}{\sqrt{2}$	$\lambda F = \left\{ (\mathbf{x}, \lambda \mathbf{y}) \mid (\lambda, \mathbf{y}) \in F \right\}$ $\lambda \overline{F} = \left\{ (\mathbf{x}, \lambda \mathbf{y}) \mid (\lambda, \mathbf{y}) \in F \right\}$ $F^{\dagger} \overline{F} = \left\{ (\mathbf{x}, \lambda \mathbf{y} + \lambda \mathbf{i}) \mid (\mathbf{x}, \mathbf{y}) \in F, (\mathbf{x}, \mathbf{z}) \in F \right\}$ $\lambda [F^{\dagger} \overline{F} = \left\{ (\mathbf{x}, \lambda \mathbf{y} + \lambda \mathbf{z}) \mid (\mathbf{x}, \mathbf{x}) \in F, (\mathbf{x}, \lambda \mathbf{z}) \in \lambda \overline{F}, (\mathbf{x}, \lambda \mathbf{z}) \in \lambda \overline{F} \right\}$ $\lambda [F^{\dagger} \overline{F}] = \left\{ (\mathbf{x}, \lambda \mathbf{y} + \lambda \mathbf{z}) \mid (\mathbf{x}, \mathbf{y}) \in F, (\mathbf{x}, \mathbf{z}) \in F \right\}$ $\lambda [F^{\dagger} \overline{F}] = \left\{ (\mathbf{x}, \lambda \mathbf{y} + \lambda \mathbf{z}) \mid (\mathbf{x}, \mathbf{y}) \in F, (\mathbf{x}, \mathbf{z}) \in F \right\}$
$\begin{aligned} \frac{1}{2} & \frac{1}{2} \text{ of a relation}: 0 \in \mathcal{R}(\mathbf{x}) \stackrel{\text{leg}}{=} \mathbf{x} \text{ is } a_{1} \text{ error } 0 \leq \mathcal{R} \\ \frac{1}{2} & \frac{1}{2} \text{ chorsion in } \text{ is } \text{ zeror } 0 \leq \mathbf{x} \text{ - } \frac{1}{2} \text{ (log)} = \{\mathbf{x}, _{(\mathbf{x}, 0)} \in \mathbf{R}\} \text{ of } \mathbf{x} \text{ is } a_{2} \text{ error } 0 \leq \mathbf{x} \text{ - } \frac{1}{2} \text{ (log)} = \{\mathbf{x}, _{(\mathbf{x}, 0)} \in \mathbf{R}\} \text{ of } \mathbf{x} of$	$\lambda F = \left\{ (x, \lambda y) \mid (\lambda, y) \in F \right\}$ $\lambda F = \left\{ (x, \lambda z) \mid (\lambda, z) \in F \right\}$ $F + F = \left\{ (x, \lambda z) \mid (\lambda, z) \in F, (x, z) \in F \right\}$ $\lambda F + \lambda F = \left\{ (x, \lambda z) \mid (x, x) \in F, (x, z) \in F \right\}$ $\lambda (F + F) = \left\{ (x, \lambda (y + \lambda z)) \mid (x, y) \in F, (x, z) \in F \right\}$ $\lambda (F + F) = \left\{ (x, \lambda (y + \lambda z)) \mid (x, y) \in F, (x, z) \in F \right\}$ $z = \left\{ (x, \lambda (y + \lambda z)) \mid (x, y) \in F, (x, z) \in F \right\}$
$\begin{aligned} & \text{Zero of a relation}: 0 \in \mathcal{R}(\mathbf{X}) \stackrel{\text{le}}{=} \mathbf{X} \text{ is a fero of } \mathcal{R} \\ & \text{Lextonsion in zero of a function}: 0 = \mathcal{G}(\mathbf{X}) \stackrel{\text{le}}{=} \mathbf{X} \text{ is a zero of } \mathbf{G} \\ & \text{Lextonsion in zero of a function}: \mathcal{R}^{-1}(05) = \{\mathbf{x}_1 \mid (\mathbf{x}, 0) \in \mathbf{R}\} \text{qeffs set of } \mathbf{G} \\ & \text{Lextonsion}: \mathcal{R}^{-1}(05) = \{\mathbf{x}_1 \mid (\mathbf{x}, 0) \in \mathbf{R}\} \text{qeffs set of } \mathbf{G} \\ & \text{Lextonsion}: \mathcal{R}^{-1}(05) = \{\mathbf{x}_1 \mid (\mathbf{x}, 0) \in \mathbf{R}\} \text{qeffs set of } \mathbf{G} \\ & \text{Lextonsion}: \mathbf{R}^{-1}(05) = \{\mathbf{x}_1 \mid (\mathbf{x}, 0) \in \mathbf{R}\} \text{qeffs set of } \mathbf{G} \\ & \text{Lextonsion}: \mathbf{R}^{-1}(05) = \{\mathbf{x}_1 \mid (\mathbf{x}, 0) \in \mathbf{R}, \mathbf{x}_1\} \\ & \text{Texampler Resolvent of Cayley operator is going to play an important role later on, so let's try to get used to it gradually \\ & \mathbf{R}^{-1}(\mathbf{L}+\mathbf{AF})^{-1} \text{let's fina out that is this} \\ & \text{Lextonsion}: \mathcal{H} \text{Herr} 1 = identify \text{modrive}: \\ & \text{Lextonsion}: \mathcal{H} \text{Herr} 1 = identify \text{modrive}: \\ & \text{Lextonsion}: \mathcal{L} \mathcal{H} \text{Lextonsion}: \mathcal{L} \mathcal{L} \mathcal{H} \mathcal{L} L$	$\begin{aligned} \lambda F &= \left\{ (\mathbf{x}, \Lambda \Psi) \mid (\mathbf{x}, \Psi) \in F \right\} \\ \lambda \overline{F} &= \left\{ (\mathbf{x}, \Lambda \Psi) \mid (\mathbf{x}, \Psi) \in F \right\} \\ F^{+} \overline{F} &= \left\{ (\mathbf{x}, \Lambda \Psi) \mid (\mathbf{x}, \Psi) \in F, (\mathbf{x}, R) \in F \right\} \\ \lambda F^{+} \lambda \overline{F} &= \left\{ (\mathbf{x}, \Lambda \Psi + \lambda R) \mid (\mathbf{x}, \Lambda \Psi) \in \lambda F, (\mathbf{x}, \Lambda R) \in \lambda \overline{F} \right\} \\ \lambda (F^{+} \overline{F}) &= \left\{ (\mathbf{x}, \Lambda (\Psi + R)) \mid (\mathbf{x}, \Psi) \in F, (\mathbf{x}, R) \in F \right\} \\ &= \left\{ (\mathbf{x}, \Lambda (\Psi + R)) \mid (\mathbf{x}, \Psi) \in F, (\mathbf{x}, R) \in F \right\} \end{aligned}$
$\begin{aligned} & \text{Zero of a relation}: 0 \in R(L) \stackrel{k}{\cong} \chi_{15} \text{ is } q_{2}ero \text{ of } R \\ & \text{Lextonsion to zero of a function}: 0 = S(X) \stackrel{k}{\cong} \chi_{15} \text{ is } q_{2}ero \text{ of } g \\ & \text{Lextonsion} \text{ is } zero \text{ of a relation}: R^{-1}(fo_{2}) = \{\chi_{1}(\chi_{10}) \in R\} \P^{10}(S \ S(T \text{ of } M) \ Zeros \text{ of } g \\ & \text{ is} \end{aligned}$ $zero \text{ set of } G \ a \text{ relation}: R^{-1}(fo_{2}) = \{\chi_{1}(\chi_{10}) \in R\} \P^{10}(S \ S(T \text{ of } M) \ Zeros \ O(g \ a, relation) R \\ & \text{ is} \end{aligned}$ $zero \text{ set of } G \ a \text{ relation}: R^{-1}(fo_{2}) \to 0 \in R(\chi_{1}) \\ & \text{ is} \qquad \qquad$	$\lambda F = \left\{ (x, \lambda y) \mid (\lambda, y) \in F \right\}$ $\lambda \overline{F} = \left\{ (x, \lambda \xi) \mid [x, y] \in F \right\}$ $F^{\dagger} \overline{F} = \left\{ (x, \lambda \xi) \mid [x, \lambda y] \in F, (x, \xi) \in F \right\}$ $\lambda F + \lambda \overline{F} = \left\{ (x, \lambda y + \lambda \xi) \mid (x, \lambda y) \in A, (x, \lambda \xi) \in \lambda \overline{F} \right\}$ $\lambda (F + \overline{F}) = \left\{ (x, \lambda (y + \delta)) \mid (x, y) \in F, (x, \xi) \in F \right\}$ $= \left\{ (x, \lambda y + \lambda \xi) \mid (x, y) \in F, (x, \xi) \in F \right\}$ $= \left\{ (x, \lambda y + \lambda \xi) \mid (x, y) \in F, (x, \xi) \in F \right\}$ $= \left\{ (x, \lambda y + \lambda \xi) \mid (x, y) \in F, (x, \xi) \in F \right\}$
$\begin{aligned} \frac{2}{4} \frac{1}{4} $	$\lambda F = \{ (\mathbf{x}, \lambda \mathbf{y}) \mid (\mathbf{x}, \mathbf{y}) \in F \}$ $\lambda \overline{F} = \{ (\mathbf{x}, \lambda \mathbf{y}) \mid (\mathbf{x}, \mathbf{y}) \in F \}$ $F^{+} \overline{F} = \{ (\mathbf{x}, \lambda \mathbf{y}, \mathbf{z}) \mid (\mathbf{x}, \mathbf{x}) \in F \}$ $\lambda F_{+} \overline{A} = \{ (\mathbf{x}, \lambda \mathbf{y}, \mathbf{z}) \mid (\mathbf{x}, \mathbf{x}) \in F, (\mathbf{x}, \mathbf{z}) \in F \}$ $\lambda \{F_{+} \overline{F} = \{ (\mathbf{x}, \lambda \mathbf{y}, \mathbf{z}) \mid (\mathbf{x}, \mathbf{x}) \in F, (\mathbf{x}, \mathbf{z}) \in F \}$ $\lambda \{F_{+} \overline{F} = \{ (\mathbf{x}, \lambda \mathbf{y}, \mathbf{z}) \mid (\mathbf{x}, \mathbf{y}) \in F, (\mathbf{x}, \mathbf{z}) \in F \}$ $z \{ (\mathbf{x}, \lambda \mathbf{y}, \mathbf{z}) \mid (\mathbf{x}, \mathbf{y}) \in F, (\mathbf{x}, \mathbf{z}) \in F \}$ $y \in \lambda F(\mathbf{x}) we have a subset of the property of the methods is a subset of the property of the methods is a subset of the property of the methods is a subset of the property of the methods is a subset of the property of the methods is a subset of the property of the methods is a subset of the property of the property of the methods is a subset of the property of the methods is a subset of the property of the$
$\frac{2}{\sqrt{16}} = \frac{1}{\sqrt{16}} = $	$\lambda F = \left\{ (\mathbf{x}, \lambda \mathbf{y}) \mid (\lambda, \mathbf{y}) \in F \right\}$ $\lambda F = \left\{ (\mathbf{x}, \lambda \mathbf{y}) \mid (\lambda, \mathbf{y}) \in F \right\}$ $F + F = \left\{ (\mathbf{x}, \lambda \mathbf{y}, \mathbf{z}) \mid (\mathbf{x}, \mathbf{z}) \in F \right\}$ $\lambda F + \lambda F = \left\{ (\mathbf{x}, \lambda \mathbf{y}, \mathbf{z}) \mid (\mathbf{x}, \mathbf{z}) \in F, (\mathbf{x}, \lambda \mathbf{z}) \in \lambda F, (\mathbf{x}, \lambda \mathbf{z}) \in \lambda F \right\}$ $\lambda (F + F) = \left\{ (\mathbf{x}, \lambda \mathbf{y}, \mathbf{z}) \mid (\mathbf{x}, \mathbf{y}) \in F, (\mathbf{x}, \mathbf{z}) \in F \right\}$ $z \in \left\{ (\mathbf{x}, \lambda \mathbf{y}, \mathbf{z}) \mid (\mathbf{x}, \mathbf{y}) \in F, (\mathbf{x}, \mathbf{z}) \in F \right\}$ $z \in \left\{ (\mathbf{x}, \lambda \mathbf{y}, \mathbf{z}) \mid (\mathbf{x}, \mathbf{y}) \in F, (\mathbf{x}, \mathbf{z}) \in F \right\}$ $z \in \left\{ (\mathbf{x}, \lambda \mathbf{y}, \mathbf{z}) \mid (\mathbf{x}, \mathbf{y}) \in F, (\mathbf{x}, \mathbf{z}) \in F \right\}$ $z = \left\{ (\mathbf{x}, \lambda \mathbf{y}, \mathbf{z}) \mid (\mathbf{x}, \mathbf{y}) \in F, (\mathbf{x}, \mathbf{z}) \in F \right\}$ $z = \left\{ (\mathbf{x}, \lambda \mathbf{y}, \mathbf{z}) \mid (\mathbf{x}, \mathbf{y}) \in F, (\mathbf{x}, \mathbf{z}) \in F \right\}$ $z = \left\{ (\mathbf{x}, \lambda \mathbf{y}, \mathbf{z}) \mid (\mathbf{x}, \mathbf{y}) \in F, (\mathbf{x}, \mathbf{z}) \in F \right\}$ $z = \left\{ (\mathbf{x}, \lambda \mathbf{y}, \mathbf{z}) \mid (\mathbf{x}, \mathbf{y}) \in F, (\mathbf{x}, \mathbf{z}) \in F \right\}$ $z = \left\{ (\mathbf{x}, \lambda \mathbf{y}, \mathbf{z}) \mid (\mathbf{x}, \mathbf{y}) \in F, (\mathbf{x}, \mathbf{z}) \in F \right\}$ $z = \left\{ (\mathbf{x}, \lambda \mathbf{y}, \mathbf{z}) \mid (\mathbf{x}, \mathbf{y}) \in F, (\mathbf{x}, \mathbf{z}) \in F \right\}$ $z = \left\{ (\mathbf{x}, \lambda \mathbf{y}, \mathbf{z}) \mid (\mathbf{x}, \mathbf{y}) \in F, (\mathbf{x}, \mathbf{z}) \in F \right\}$ $z = \left\{ (\mathbf{x}, \lambda \mathbf{y}, \mathbf{z}) \mid (\mathbf{x}, \mathbf{y}) \in F, (\mathbf{x}, \mathbf{z}) \in F \right\}$
$\frac{2}{\sqrt{10}} = \frac{1}{\sqrt{10}} \frac{1}{\sqrt{10}} = \frac{1}{\sqrt{10}} $	$\lambda F = \left\{ (x, \lambda y) \mid (\lambda, y) \in F \right\}$ $\lambda F = \left\{ (x, \lambda y) \mid (\lambda, y) \in F \right\}$ $F + F = \left\{ (x, \lambda y + \lambda E) \mid (x, x) \in F, (x, z) \in F \right\}$ $\lambda F + \lambda F = \left\{ (x, \lambda y + \lambda E) \mid (x, \lambda y) \in F, (x, z) \in F \right\}$ $\lambda (F + F) = \left\{ (x, \lambda (y + z)) \mid (x, y) \in F, (x, z) \in F \right\}$ $z = \left\{ (x, \lambda y + \lambda E) \mid (x, y) \in F, (x, z) \in F \right\}$ $r = \left\{ (x, \lambda y + \lambda E) \mid (x, y) \in F, (x, z) \in F \right\}$ $x = \left\{ (x, \lambda y + \lambda E) \mid (x, y) \in F, (x, z) \in F \right\}$ $x = \left\{ (x, \lambda y + \lambda E) \mid (x, y) \in F, (x, z) \in F \right\}$ $x = \left\{ (x, \lambda y + \lambda E) \mid (x, y) \in F, (x, z) \in F \right\}$ $x = \left\{ (x, \lambda y + \lambda E) \mid (x, y) \in F, (x, z) \in F \right\}$ $x = \left\{ (x, \lambda y + \lambda E) \mid (x, y) \in F, (x, z) \in F \right\}$ $x = \left\{ (x, \lambda y + \lambda E) \mid (x, y) \in F, (x, z) \in F \right\}$ $x = \left\{ (x, \lambda y + \lambda E) \mid (x, y) \in F, (x, z) \in F \right\}$ $x = \left\{ (x, \lambda y + \lambda E) \mid (x, y) \in F, (x, z) \in F \right\}$ $x = \left\{ (x, \lambda y + \lambda E) \mid (x, y) \in F, (x, z) \in F \right\}$ $x = \left\{ (x, \lambda y + \lambda E) \mid (x, y) \in F, (x, z) \in F \right\}$ $x = \left\{ (x, \lambda y + \lambda E) \mid (x, y) \in F, (x, z) \in F \right\}$ $x = \left\{ (x, \lambda y + \lambda E) \mid (x, y) \in F, (x, z) \in F \right\}$ $x = \left\{ (x, \lambda y + \lambda E) \mid (x, y) \in F, (x, z) \in F \right\}$ $x = \left\{ (x, \lambda y + \lambda E) \mid (x, y) \in F, (x, z) \in F \right\}$
$\frac{1}{2} \operatorname{cro} \circ \mathfrak{f} \operatorname{arclalion}: \operatorname{O} \in R(\mathfrak{L}) \stackrel{k}{\cong} \chi_{1} is \mathfrak{o}_{2} \operatorname{cro} \circ \mathfrak{f} R$ $\frac{1}{2} \operatorname{crosion} io \operatorname{zero} \circ \mathfrak{g} \mathfrak{o}_{2} \operatorname{dunklion}: 0 = \mathfrak{s}(\chi) \stackrel{k}{\cong} \chi_{1} is \mathfrak{o}_{2} \operatorname{cro} \circ \mathfrak{f} \mathfrak{g}$ $\frac{1}{2} \operatorname{crosion} io \operatorname{zero} \mathfrak{g} \mathfrak{o}_{2} \operatorname{dunklion}: \mathfrak{g}^{-1}[(\mathfrak{g}_{1}) = \{\chi_{1}(\chi_{0}) \in \mathbb{R}\} \mathfrak{q}^{-1}(\mathfrak{g}_{1}) \to \mathfrak{O} \in \mathbb{R}(\chi_{1})$ $\frac{1}{2} \stackrel{i \to \infty}{\underset{p = adult}{}} \operatorname{cros} \mathfrak{g} \mathfrak{o}_{1} \operatorname{relation}: \mathfrak{g}^{-1}[(\mathfrak{g}_{1}) \to \mathfrak{O} \in \mathbb{R}(\chi_{1})$ $\frac{1}{2} \stackrel{i \to \infty}{\underset{p = adult}{}} \operatorname{cros} \mathfrak{g} \mathfrak{o}_{2} \mathfrak{o}_{2} \operatorname{relation} \mathfrak{g}$ $\frac{1}{2} \stackrel{i \to \infty}{\underset{p = adult}{}} \operatorname{cros} \mathfrak{g} \mathfrak{o}_{2} \mathfrak{o}_{2} \operatorname{relation} \mathfrak{g}$ $\frac{1}{2} \stackrel{i \to \infty}{\underset{p = adult}{}} \operatorname{cros} \mathfrak{g} \mathfrak{o}_{2} \mathfrak{g} \mathfrak{g} \mathfrak{g} \mathfrak{g} \mathfrak{g} \mathfrak{g} \mathfrak{g} g$	$\lambda F^{\pm} = \{(x, \lambda y) (x, y) \in F\}$ $\lambda F^{\pm} = \{(x, \lambda y) (x, y) \in F, \{x, x\} \in F\}$ $\lambda F^{\pm} F^{\pm} = \{(x, \lambda y + \lambda x) (x, x) \in F, \{x, x\} \in F\}$ $\lambda F^{\pm} F^{\pm} = \{(x, \lambda y + \lambda x) (x, \lambda y) \in F, (x, x\} \in F\}$ $\lambda (F^{\pm} F)^{\pm} = \{(x, \lambda (y + x)) (x, y) \in F, (x, z) \in F\}$ $\lambda (F^{\pm} F)^{\pm} = \{(x, \lambda (y + z)) (x, y) \in F, (x, z) \in F\}$ $x = \{(x, \lambda (y + z)) (x, y) \in F, (x, z) \in F\}$
$\begin{aligned} z ro & of a relation: 0 \in R(L) \stackrel{k}{\cong} \chi_{15} a_{1} error 0 \leq R \\ \frac{1}{2} \chi_{1005inn} i_{0} z rer og a_{2} unchion: 0 = S(X) \stackrel{k}{\cong} \chi_{15} a_{2} z ro og \leq g \\ \frac{1}{4} his is \end{aligned}$ $z ro set of a relation: R^{-1}[0] = [\chi_{1}(\chi_{0}) \in R] qrh_{15} s c rod g ll z rod s 0 \leq a relation R \\ \qquad \qquad$	$\lambda F^{\pm} = \{(x, \lambda, y) \mid (\lambda, y) \in F\}$ $\lambda F^{\pm} = \{(x, \lambda, y) \mid (\lambda, y) \in F, \{x, x\} \in F\}$ $\lambda F^{\pm} F^{\pm} = \{(x, \lambda, y, x\} \mid \{x, \lambda, y\} \in F, \{x, x\} \in F\}$ $\lambda F^{\pm} \lambda F^{\pm} = \{(x, \lambda, y, x\} \mid \{x, \lambda, y\} \in F, \{x, x\} \in F\}$ $\lambda \{F^{\pm} F^{\pm} = \{(x, \lambda, y, x\} \mid \{x, \lambda, y\} \in F, \{x, x\} \in F\}$ $\lambda \{F^{\pm} F^{\pm} = \{(x, \lambda, y, x\} \mid \{x, \lambda, y\} \in F, \{x, x\} \in F\}$ $z = \{(x, \lambda, y, y, x\} \mid \{x, y\} \in F, \{x, x\} \in F\}$ $y \in \lambda F^{\pm} x = \frac{1}{2} \xrightarrow{\lambda 1} \xrightarrow{\lambda 2} x$ $x_{1} \mid x \neq y \in F(x)$ $x_{2} \mid x \neq y \in F(x)$ $x_{3} \mid x \neq y \in F(x)$
$\begin{aligned} zrro of a relation: OER(L) & x is a zero of R \\ zrrosion to zero of a gunction: O=S(L) & x is a zero of f \\ this is \\ zero set of a relation: R^{-1}[0] = [x] (x,0)ER] quits Set of all zeros of a relation R \\ & i = x, x \in R^{-1}(0] \Rightarrow OER(X) \\ \hline \\ & F Example Resolvent of Captey operator is going to play an important role later on, no let's try to get used to it gradually \\ & R = (1+\lambda F)^{-1} [R!S find out labol is this & honzero // Here 1= identify modriu. & honzero // Here 1= identify modriu. & honzero // Here 1= identify modriu. & i = (1+\lambda F)^{-1} [R!S find out labol is this & honzero // Here 1= identify modriu. & honzero // E is unolher velation / point to set mapping (a, v) eR = (1+\lambda F)^{-1} ev (u) eR^{-1} = (1+\lambda F) \\ & u = [R] = \frac{V}{V} & u \in (3+\lambda F)V \notin :: (X,Y) eR & XRS \\ & u = [R] = \frac{V}{V} & i : vF\pi] \\ & = Vt \lambda [T: vF\pi] \\ & = [v + \lambda T: vF\pi] \\ & \Rightarrow = (u = v + \lambda T : vF\pi] \\ & \Rightarrow = \frac{1}{V} (u = v + \lambda T : vF\pi] \\ & \Rightarrow = \frac{1}{V} (u = v + \lambda T : vF\pi] \end{aligned}$	$\begin{aligned} \lambda F = \left\{ (x, \lambda y) \mid (x, y) \in F \right\} \\ \lambda F = \left\{ (x, \lambda y) \mid (x, y) \in F \right\} \\ \lambda F + \overline{x} = \left\{ (x, \lambda y) \mid (x, y) \in F, (x, \xi) \in F \right\} \\ \lambda F + \lambda \overline{x} = \left\{ (x, \lambda y) \mid (x, y) \in F, (x, \xi) \in F \right\} \\ \lambda (F + \overline{F}) = \left\{ (x, \lambda (y + \xi)) \mid (x, y) \in F, (x, \xi) \in F \right\} \\ \lambda (F + \overline{F}) = \left\{ (x, \lambda (y + \xi)) \mid (x, y) \in F, (x, \xi) \in F \right\} \\ = \left\{ (x, \lambda (y + \xi)) \mid (x, y) \in F, (x, \xi) \in F \right\} \end{aligned}$
$\frac{1}{2} \frac{1}{2} \frac{1}$	$\begin{aligned} \lambda_{F}^{F} = \left\{ (x, \Lambda, y) \mid (x, y) \in F \right\} \\ \lambda_{F}^{F} = \left\{ (x, \lambda; z) \mid (x, z) \in F \right\} \\ \lambda_{F+\lambda}^{F} = \left\{ (x, \lambda; y+\lambda z) \mid (x, y) \in \lambda, (x, z) \in F \right\} \\ \lambda_{F+\lambda}^{F} = \left\{ (x, \lambda; y+\lambda z) \mid (x, \lambda; y) \in \lambda, F, (x, \lambda; z) \in \lambda ^{F} \right\} \\ \lambda_{F+F}^{F} = \left\{ (x, \lambda; y+\lambda z) \mid (x, y) \in F, (x, z) \in F \right\} \\ z \in (x, \lambda; y+\lambda z) \mid (x, y) \in F, (x, z) \in F \\ z \in (x, \lambda; y+\lambda z) \mid (x, y) \in F, (x, z) \in F \\ x = \int_{x} \int_{$

Monotone Operators: Introduction, Relations

So for any output E (operator//resolvent[])(input) hole a scaled version of the input output difference will belong to operator(output) % Let's make up a dory suppose aliens are sending us some signal x but while it his earth it changes into y by going through h resolvent of some space-time perator (alient technology). All we get to see it y, now waru anto find out that is the original, now suppose constru citing F is cheap, so we take takt y input it through F and find out that one element (we are in luck and F is a function) is (1/Å)(x y), from which we can eccontruct original alien meage y.
* Inverse of subditectering : [at] "We are going to show something amazing: we will show that if a vair belong to inverse of a
$(\mathbf{u},\mathbf{v}) \in [05]^{-1} \leftrightarrow \mathbf{v} \in [05]^{-1} \mathbf{u}$ mbdifferential, then those pairs are tight in Younge's inequality with the input being the argument of the conjugate function and the output being the argument of the function itself.
es (V, u) eas v is some point us is the scubgradient of S at v
~ 4x 5(x) > 5(v)+u ² (x-v)
f(x)-utx > f(x)-utv 11 so v minimizes f(x)-utx over all x
$\leftrightarrow \lambda \in ardiniv (t(x) - a_X)$
$v \in (0S)^{-1}(u) \leftrightarrow v \in \operatorname{argmin}_{(S(u)-u^* K)}$
$[x]_{z} = x \max_{x} \sum_{x} \sum_{x$
He can relate this to conjugate function \int_{x}^{x} , where $\int_{x}^{y} (u^{T}x - f(x)) = \int_{x}^{y} (u^{T}x - f(x)) + \int_{x}^{y} \int_{x}^{y} (u^{T}x - f(x)) = \int_{x}^{y} (u^{T}x - f(x)) = \int_{x}^{y} \int_{x}^{y} (u^{T}x - f(x)) = \int_{x}^{y} \int_{x}^{y} \int_{x}^{y} (u^{T}x - f(x)) = \int_{x}^{y} \int_{x}^$
(a s v ∈ orgmax (ux - s(x))
- T //w
$\Leftrightarrow \mathfrak{f}^{*}(\mathfrak{u}) + \mathfrak{g}(\mathfrak{v}) = \mathfrak{u}^{*} \mathcal{V}$
$(\mathbf{n},\mathbf{n}) \in [\mathbf{s}]_{L_1} \leftrightarrow (_{\mathbf{q}}(\mathbf{n}) + \{(\mathbf{n}) = \mathbf{n}_{\mathbf{n}})$
(U,V) ∈ [∂fr" ↔ U.v. are tight in Mounaré inre.ualitu
(and (a) (a) (a) and (a) and (a) and (a) and (b) and (b)
*Another important result: For a CCPEOsed, convex, property function f, $(1)^{-1} = 25^{4}$ $f \in F(C) = flace (marks, property f4+ = 6 ± 60. Applying (onjugate operator indice on a CCP function is the function itself.$
Titer entremented in a hear energy and the second s
qqi f={rxt)ek ⁿ⁺¹ xedom5, s(x)e\$} f[1]}
dam j= 10
nam for fecces
$(a, w) \in (\partial S^{-1})$ $\phi(w) = \phi(w)$
$\leftrightarrow 5^*(\tilde{u}) + \{[v]) = u^{T_V} \leftrightarrow \{(^*(u)) + \{(v)\}^* = \psi(u) + \psi(u) + v^{T_V}$
$\int_{0}^{44} \{V\} \left[:: \int_{0}^{4} \{(t)^{\frac{3}{2}} \right] \qquad \Rightarrow \phi^{\frac{3}{2}} [V] + \phi(u) = \sqrt{u} \qquad \# \text{ Remember conjugate function is always convex}$
$\leftrightarrow \left(\underbrace{(\mathbf{y}, \mathbf{u})}_{\mathbf{y}, \mathbf{u}} \in \left(\partial \mathbf{y} \right)^{-1} = \left(\partial \int_{\mathbf{x}}^{\Psi} \right)^{-1} $ conjugate_function(input)+normal_function(output)=input ⁷ output \Leftrightarrow (input,output) \in (∂ function) ⁻¹
\Leftrightarrow $(u,v) \in \partial \xi^{\#}$
≝ (∂{) ⁻¹ =(}{0}