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Generalized Pre-Semi Closed Mappings in Intuitionistic Fuzzy Topological Spaces

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ABSTRACT
The notions of intuitionistic fuzzy generalised pre-semi closed mappings, intuitionistic fuzzy generalised pre-semi open mappings, and intuitionistic fuzzy I -generalized pre-semi closed mappings are discussed and introduced in this chapter.

Keywords: Intuitionistic fuzzy sets, Intuitionistic fuzzy topology, Intuitionistic fuzzy topological spaces, Generalized pre-semi closed mappings

Introduction:
Gurcay et al [1] proposed and researched intuitionistic fuzzy closed mappings in 1997. The features of open and closed mappings in intuitionistic fuzzy topological spaces were explored by Lee & Lee [8] in 2000. In intuitionistic fuzzy topological spaces, Jeon et al [2] introduced and researched semiopen mappings, α-open mappings, and pre-open mappings. Several writers have recently contributed to the generalisation of closed and open mappings in intuitionistic fuzzy topological spaces [3,4,5,6,7,9,10].

Intuitionistic Fuzzy Generalized Pre-Semi Closed mapping:
Definition 1:
A function $f : (X, \square) \square (Y, \square)$ is said to be the intuitionistic fuzzy generalized pre-semi closed mapping ($IFGPSCM$) if $f(A)$ is $IFGPSCS$ in Y for each $IFCS$ A in X .

Example 2:
Let $= \{a, b\}$, $Y = \{u, v\}$ and $H_1 = \langle x, (0.6, 0.7), (0.4, 0.2)\rangle$, $H_2 = \langle y, (0.5, 0.4), (0.5, 0.6)\rangle$. Then $\square = \{0\sim, H_1, 1\sim\}$ and $\sigma = \{0\sim, H_2, 1\sim\}$ are $IFTs$ on X and Y respectively.

The function is defined as $f : (X, \square) \square (Y, \square)$ by $f(a) = u$ and $f(b) = v$. Here f is an $IFGPSCM$.

Theorem 3:
Each $IFCM$ is an $IFGPSCM$ but not contrariwise.
Proof:
If $f : (X, \square) \square (Y, \square)$ be an $IFCM$. If A is an $IFCS$ in .
Here $f(A)$ is an $IFCS$ in .
Then $f(A)$ is an $IFGPSCS$ in Y.
Hereafter f is an $IFGPSCM$.

Theorem 4:
Each $IF\ \alpha CM$ is an $IFGPSCM$ but not contrariwise.
Proof:
If $f : (X, \square) \square (Y, \square)$ is an $IF\alpha\ CM$.
If A is an $IFCS$ in X.

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Here $f(A)$ is an $IF\alpha CS$ in Y .
Then $f(A)$ is an $IFGPSCS$ in Y.
Hereafter f is an $IFGPSCM$.

Theorem 5:
Each $IFWCM$ is an $IFGPSCM$ but not contrariwise.
Proof:
If $f : (X, \tau) \to (Y, \sigma)$ be an $IFWCM$.
If A be an $IFCS$ in .
Here $f(A)$ be an $IFWCS$ in Y.
Then $f(A)$ be an $IFGPSCS$ in Y.
Hereafter f be an $IFGPSCM$.

Theorem 6:
Each $IFPCM$ is an $IFGPSCM$ but not contrariwise.
Proof:
If $f : (X, \tau) \to (Y, \sigma)$ be an $IFPCM$.
If A be an $IFCS$ in X.
Here $f(A)$ be an $IFPCS$ in Y.
Then $f(A)$ be an $IFGPSCS$ in Y.
Hereafter f is an $IFGPSCM$.

Example 7:
If $X = \{a, b\}, Y = \{u, v\}$ and $H_1 = \langle x, (0.1, 0.4), (0.9, 0.6)\rangle$,
$H_2 = \langle y, (0.2, 0.1), (0.8, 0.9)\rangle$ and $H_3 = \langle y, (0.5, 0.6), (0.5, 0.4)\rangle$.
Then $\tau = \{0\sim, H_1, 1\sim\}$ and $\sigma = \{0\sim, H_1, H_2, 1\sim\}$ are $IFTs$ on X and Y respectively.

The function is defined as $f : (X, \tau) \to (Y, \sigma)$ by $f(a) = u$ and $f(b) = v$. Here f is an $IFGPSCM$ but not an $IFPCM$.

Theorem 8:
Each $IFGPSCM$ is an $IFGSPCM$ but not contrariwise.
Proof:
If $f : (X, \tau) \to (Y, \sigma)$ be an $IFGPSCM$. If A is an $IFCS$ in X.
Here $f(A)$ be an $IFGPSCS$ in Y.
Then $f(A)$ be an $IFGSPCS$ in Y.
Hereafter f be an $IFGSPCM$.

Example 9:
Let $X = \{a, b\}, Y = \{u, v\}$ and $H_1 = \langle x, (0.5, 0.6), (0.5, 0.4)\rangle$,
$H_2 = \langle y, (0.3, 0.2), (0.7, 0.8)\rangle$. Then $\tau = \{0\sim, H_1, 1\sim\}$ and $\sigma = \{0\sim, H_2, 1\sim\}$ are $IFTs$ on X and Y respectively.

The function is defined as $f : (X, \tau) \to (Y, \sigma)$ by $f(a) = u$ and $f(b) = v$. Here f be an $IFGSPCM$ but not an $IFGPSCM$.

Theorem 10:
Each $IFGPSCM$ is an $IFGSPRCM$ but not contrariwise.
Proof:
If $f : (X, \tau) \to (Y, \sigma)$ be an $IFGPSCM$.
If A is an $IFCS$ in .
Here $f(A)$ be an $IFGPSCS$ in .
Then $f(A)$ be an $IFGSPRCS$ in Y.
Hereafter f be an $IFGSPRCM$.

JOURNAL OF ALGEBRAIC STATISTICS
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Example 11:
Let $X = \{a, b\}, Y = \{u, v\}$ and H_1 = ⟨x, (0.5, 0.6), (0.5, 0.4)⟩,
H_2 = ⟨y, (0.3, 0.2), (0.7, 0.8)⟩. Then □ = {0∼,H_1, 1∼} and □ = {0∼,H_1, H_2, 1∼} are $IFTs$ on X and Y correspondingly. The function is defined as f : (X, □) □ (Y, □) by $f(a) = u$ and $f(b) = v$. Here f is an $IFGSPRCM$ but not an $IFGPSCM$.

Definition 12:
A mapping f : (X, □) □ (Y, □) is supposed to be intuitionistic fuzzy generalized pre-semi open mapping ($IFGPSOM$) if $f(A)$ is an $IFGPSOS$ in Y for all $IFOS$ in X .

Definition 13:
A mapping f : (X, □) □ (Y, □) is supposed to be intuitionistic fuzzy i -generalized pre-semi closed mapping ($IF\ i\ GPSCM$) if $f(A)$ is an $IFGPSCS$ in Y for all $IFGPSCS\ A$ in X .

Definition 14:
A mapping f : (X, □) □ (Y, □) is supposed to be intuitionistic fuzzy i -generalized pre-semi open mapping ($IF\ i\ GPSOM$) if $f(A)$ is an $IFGPSOS$ in Y for all $IFGPSOS\ A$ in X .

Example 15:
Let $X = \{a, b\}, Y = \{u, v\}$ and H_1 = ⟨x, (0.3, 0.2), (0.7, 0.8)⟩,
H_2 = ⟨y, (0.5, 0.4), (0.5, 0.6)⟩. Then □ = {0∼,H_1, 1∼} and □ = {0∼, H_2, 1∼} are $IFTs$ on X and Y correspondingly. The function is defined as f : (X, □) □ (Y, □) by $f(a) = u$ and $f(b) = v$. Here f is an $IF\ i\ GPSCM$.

Theorem 16:
Each $IF\ i\ GPSCM$ is an $IFGPSCM$ but not contrariwise.
Proof:
If f : (X, □) □ (Y, □) is an $IF\ I\ GPSCM$.
If A be an $IFCS$ in X.
Here A is an $IFGPSCS$ in Y.
By supposition $f(A)$ is an $IFGPSCS$ in .
Hence f is an $IFGPSCM$.

Example 17:
Let $X = \{a, b\}, Y = \{u, v\}$ and H_1 = ⟨x, (0.8, 0.9), (0.2, 0.1)⟩,
H_2 = ⟨y, (0.3, 0.2), (0.7, 0.8)⟩. Then □ = {0∼,H_1, 1∼} and □ = {0∼, H_2, 1∼} are $IFTs$ on X and Y correspondingly. The function is defined as f : (X, □) □ (Y, □) by $f(a) = u$ and $f(b) = v$. Here f is an $IFGPSCM$ but not an IF i GPSCM.

Theorem 18:
If f : (X, □) □ (Y, □) be the function. The subsequent declarations are comparable if Y is an $IFPST_{1/2}$ space:
(i) f is an $IFGPSCM$,
(ii) $pcl(f(A))$ □ $f(cl(A))$ for all $IFS\ A$ of .
Proof:
(i) ⇒ (ii) If A is an IFS in X .
Here $cl(A)$ is an $IFCS$ in Y .
(i) implies that $f(cl(A))$ is an $IFGPSCS$ in Y .

Since Y is an $IFPST_{1/2}$ space, $f(cl(A))$ is an $IFPCS$ in Y.

Consequently $pcl(f(cl(A))) = f(cl(A))$.

Now $pcl(f(A))$ □ $l(f(cl(A))) = f(cl(A))$.

Hence $pcl(f(A))$ □ $f(cl(A))$ for each $IFS\ A$ of X.

(ii) ⇒ (i) Let A be any $IFCS$ in X .

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Then $cl(A) = A$. (ii) implies that $pcl(f(A))$ □ $f(cl(A)) = f(A)$.
But $f(A)$ □ $l(f(A))$.
Therefore $l(f(A)) = f(A)$.
This implies $f(A)$ be an $IFPCS$ in .
Subsequently all $IFPCS$ be an $IFGPSCS$,
$f(A)$ be an $IFGPSCS$ in Y .
Here f be an $IFGPSCM$.

Theorem 19:
If f : $(X,$ □ $)$ □ $(Y,$ □$)$ be the function. The subsequent are correspondent if Y is an $IFPST_{1/2}$ space:
(i) f is an $IFGPSOM$.
(ii) $f(int(A))$ □ $pint(f(A))$ for each IFS A of X.
(iii) $int(f^{-1}(B))$ □ $f^{-1}(pint(B))$ for all IFS B of Y .

Proof:
(i) ⇒ (ii) If f is an $IFGPSOM$.
Let A be any IFS in .
Then $int(A)$ is an $IFOS$ in .
(i) implies that $f(int(A))$ is an $IFGPSOS$ in Y .
Since Y is an $IFPST_{1/2}$ space, $f(int(A))$ be an $IFPOS$ in Y.

Consequently $nt(f(int(A))) = f(int(A))$.

Now $f(int(A)) = pint(f(int(A)))$ □ $nt(f(A))$.

(ii) ⇒ (iii) If B is an IFS in Y.
Here $f^{-1}(B)$ be an IFS in X .

By (ii) $f(int(f^{-1}(B)))$ □ $pint(f(f^{-1}(B)))$ □ $pint(B)$.

Now $int(f^{-1}(B))$ □ $f^{-1}(f(int(f^{-1}(B))))$ □ $f^{-1}(pint(B))$.

(iii) ⇒ (i) If A is an $IFOS$ in X.
Here $int(A) = A$ and $f(A)$ is an IFS in .

By (iii) $int(f^{-1}(f(A)))$ □ $f^{-1}(pint(f(A)))$.
Now $A = int(A)$ □ $int(f^{-1}(f(A)))$ □ $f^{-1}(pint(f(A)))$.
Therefore $f(A)$ □ $f(f^{-1}(pint(f(A))))$ □ $pint(f(A))$ □ $f(A)$.
This implies $pint(f(A)) = f(A)$ be an $IFPOS$ in Y and hereafter an $IFGPSOS$ in Y.
Accordingly f is an $IFGPSOM$.

Theorem 20:
A mapping f : $(X,$ □ $)$ □ $(Y,$ □$)$ is an $IFGPSCM$ if $f(pint(A))$ □ $pint(f(A))$ for all A □ X .

Proof:
Let A be an $IFOS$ in .
Here $int(A) = A$. At present $f(A) = f(int(A))$ □ $f(pint(A))$ □ $nt(f(A))$, by hypothesis. But $pint(f(A))$ □ (A) .
Therefore $f(A)$ is an $IFPOS$ in .
Then $f(A)$ be an $IFGPSOS$ in .
Hereafter f is an $IFGPSCM$, by Theorem 19.

Theorem 21:
f : $(X,$ □ $)$ □ (Y, □) be the function here X and Y are $IFPST_{1/2}$ space, where succeeding announcements are correspondent:
(i) f be an $IF\ i\ GPSCM$.

JOURNAL OF ALGEBRAIC STATISTICS
Volume 13, No. 3, 2022, p. 382 - 386
https://publishoa.com
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(ii) $f(A)$ is an $IFGPSOS$ in Y for every $IFGPSOS\ A$ in X .
(iii) $f(pint(B))$ □ $pint(f(B))$ for every $IFS\ B$ in .
(iv) $pcl(f(B))$ □ $f(pcl(B))$ for every $IFS\ B$ in .

Proof:
(i) $\Rightarrow$ (ii) obvious.
(ii) $\Rightarrow$ (iii) If B is any IFS in X .
Since $pint(B)$ be an $IFPOS$, it is an $IFGPSOS$ in X .
Formerly by proposition, $f(pint(B))$ be an $IFGPSOS$ in Y.
Subsequently Y be an $IFPST_{1/2}$ space, $f(pint(B))$ be an $IFPOS$ in Y.
Therefore $f(pint(B)) = pint(f(pint(B)))$ □ $nt(f(B))$.
(iii) $\Rightarrow$ (iv) is obvious by taking complement in (iii) .
(iv) $\Rightarrow$ (i) Let A be an $IFGPSCS$ in X .
By Hypothesis, $pcl(f(A))$ □ $(pcl(A))$.
Since X is an $IFPST_{1/2}$ space, A is an $IFPCS$ in .
Therefore $pcl(f(A))$ □ $f(pcl(A)) = f(A)$ □ $(pcl(A))$.
Hereafter $f(A)$ be an $IFPCS$ in Y and hereafter $IFGPSCS$ in Y.
Here f be an $IF\ iGPSCM$.

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