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QUASI-GAUGES AND FIXED POINTS

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Abstract

In this paper a generalization of a common fixed point theorem from [1] for quasi - gauges spaces is proved. Some further common fixed point theorems are obtained.

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In this paper we discuss some common fixed point theorems on quasi-gauge space.

The concept of quasi-gauge space is due to Reilly [4]. As in P. V. Subrahmanyam [5] we define the left (right) Cauchy sequences and sequential completeness of quasi-gauge space.

A quasi-pseudometric on a set X is non-negative real valued function on $X \times X$ such that for any x, y, z in X $p(x,x) = 0$ and $p(x,y) \leq p(x,y)+p(z,y)$.

A quasi-gauge structure for a topological space (X,T) is a family P of quasi-pseudometrics on X such that T has as a subspace the family

$$\{B(x,p,\varepsilon):\ x \text{ in } X,\ p \text{ in } P,\ \varepsilon > 0\}$$

where $B(x,p,\varepsilon)$ is the set $\{y \text{ in } X\ :\ \ p(x,y) < \varepsilon\}$. If a topological space (X,T) has a quasi-gauge structure P is called a quasi-gauge space.

Definition 1. *If (X, P) is a quasi-gauge space then the sequence $\{x_n\}$ in X is called left P-Cauchy sequence if for each p in P and each $\varepsilon > 0$ there is a point x in X and an integer k such that $p(x, x_m) < \varepsilon$ for all $m \geq k$ (x and k may depend upon ε and p).*

Similarly $\{x_n\}$ is a right P-Cauchy sequence if for each p in P and each $\varepsilon > 0$ there is an element x in X and an integer k such that $p(x_n, x) < \varepsilon$ for all $m \geq k$.

In paper [5] examples are given to show that right P-Cauchy sequence need not to be left P-Cauchy sequence.

A quasi-gauge space (X, T) is left (right) sequentially complete if every left (right) P-Cauchy sequence in X converge to some element of X.

In paper [1] the following theorem was proved.

Theorem 1. *Let S and T be two continuous mappings of a complete metric space (X, d) into itself satisfying the following inequality*

$$\begin{aligned} d((ST)^p x, (TS)^p y) \leq\ & c \max\{d((ST)^r x, (TS)^s y), d(S(TS)^{s'} y, (TS)^s y), \\ & d((ST)^r x, T(ST)^{r'} x), d(S(TS)^{s'} y, T(ST)^{r'} x) \\ & 0 \leq r, s \leq p,\ 0 \leq r', s' < p\} \end{aligned}$$

for all x, y in X where $0 \leq c < 1$ and p is a fixed positive integer. Then S and T have a unique common fixed point.

We now prove a theorem in quasi-gauge space which will be a generalization of Theorem 1.

Theorem 2. *Let S and T be two continuous mappings defined on a left (right) sequentially complete quasi-gauge Hausdorff space (X, P) into itself satisfying the inequality for each p in P*

$$\begin{aligned} (1) \qquad & \max\{p((ST)^q x, (TS)^q y), p((TS)^q y, (ST)^q x)\} \\ \leq\ & c \max\{p((ST)^r x, (TS)^s y), p(S(TS)^{s'} y, (TS)^s y), \\ & p((ST)^r x, T(ST)^{r'} x), p(S(TS)^{s'} y, T(ST)^{r'} x) \\ & 0 \leq r, s \leq q,\ 0 \leq r', s' < q\} \end{aligned}$$

for all x, y in X where $0 \leq c < 1$ and q is fixed positive integer. Then S and T have a unique common fixed point.

Proof. Chose c such that $c/(1-c) > 1$. Let x be an arbitrary point and define the points inductively by $x_0 = x$, $x_{2n+1} = Tx_{2n}$, $x_{2n+2} = Sx_{2n+1}$ for $n = 0, 1, 2, \ldots$. The sequence of points $\{x_n : n = 1, 2, \ldots\}$ is bounded. If not either the set of real numbers

$$\{p(x_{2n+1}, x_{2q}), p(x_{2n}, x_{2q+1}) : n = 0, 1, \ldots\}$$

or

$$\{p(x_{2q}, x_{2n+1}), p(x_{2q+1}, x_{2n}) : n = 0, 1, \ldots\}$$

is unbounded for at least one p in P.

Suppose that

$$\{p(x_{2n+1}, x_{2q}), p(x_{2n}, x_{2q+1}) : n = 0, 1, \ldots\}$$

is unbounded. Then there exists an integer n such that

$$(2) \qquad (1-c)\max\{p(x_{2n+1}, x_{2q}), p(x_{2n}, x_{2q+1})\}$$
$$> c\max\{p(x_s, x_{2q}), p(x_s, x_{2q+1}), p(x_{2q}, x_s), p(x_{2q+1}, x_s) : 0 \le s \le 2q\}.$$

Let n be the smallest such n so that

$$(3) \quad \max\{p(x_{2n+1}, x_{2q}), p(x_{2n}, x_{2q+1})\} > \max\{p(x_{2q}, x_{2r+1}), p(x_{2q+1}, x_{2r}), p(x_{2r}, x_{2q+1}), p(x_{2r+1}, x_{2q}) : 0 \le r < n\}$$

Since $c/(1-c) > 1$ from (2) it is clear that $n > q$. From (2) and (3)

$$\begin{aligned}
\max\{p(x_{2n+1}, x_{2q}), p(x_{2n}, x_{2q+1})\} &> c\max\{p(x_{2s}, x_{2q}), \\
&\quad p(x_{2s+1}, x_{2q+1}), p(x_{2q}, x_{2s}), \\
&\quad p(x_{2q+1}, x_{2s+1}) : 0 \le s \le q\} \\
&\ge c\max\{p(x_{2s+1}, x_{2r}) - p(x_{2q+1}, x_{2r}), \\
&\quad p(x_{2s}, x_{2r+1}) - p(x_{2q}, x_{2r+1}) \\
&\quad p(x_{2r}, x_{2s+1}) - p(x_{2r}, x_{2q+1}), \\
&\quad p(x_{2r+1}, x_{2s}) - p(x_{2r+1}, x_{2q}) : \\
&\quad 0 \le s \le q,\ 0 \le r < n\} \\
&\ge c\max\{p(x_{2s+1}, x_{2r}), p(x_{2s}, x_{2r+1}), \\
&\quad p(x_{2r}, x_{2s+1}), p(x_{2r+1}, x_{2s}) :
\end{aligned}$$

$$\begin{aligned} & 0 \le s \le q,\ 0 \le r < n\} \\ - \ & c \max\{p(x_{2q+1}, x_{2r}), p(x_{2q}, x_{2r+1}), \\ & p(x_{2r}, x_{2q+1}) - p(x_{2r+1}, x_{2q}) : \\ & 0 \le r < n\} \end{aligned}$$

i. e.

(4)
$$\begin{aligned} & \max\{p(x_{2n+1}, x_{2q}), p(x_{2n}, x_{2q+1})\} \\ > \ & c \max\{p(x_{2s+1}, x_{2r}) - p(x_{2s}, x_{2r+1}), \\ & p(x_{2r}, x_{2s+1}) - p(x_{2r+1}, x_{2s}) : \\ & 0 \le s \le q,\ 0 \le r < n\}. \end{aligned}$$

By applying the inequality

$$\begin{aligned} & \max\{p(x_{2n}, x_{2q+1}), p(x_{2n+1}, x_{2q}), p(x_{2q}, x_{2n+1}), p(x_{2q+1}, x_{2n})\} \\ \le \ & c \max\{p(x_{2r}, x_{2s+1}), p(x_{2s'+2}, x_{2r'+1}), p(x_{2r'}, x_{2r'+1}), p(x_{2s+2}, x_{2s'+1}), \\ & p(x_{2s}, x_{2r+1}), p(x_{2r'+2}, x_{2s'+1}), p(x_{2s}, x_{2s'+1}), p(x_{2r'+2}, x_{2r+1}) : \\ & 0 \le q + r - n, s \le q; 0 \le q + r' - n, s' < q\} \\ \le \ & c \max\{p(x_{2r}, x_{2s+1}) :\ 0 \le r, s \le n\} \end{aligned}$$

and so

(5)
$$\begin{aligned} & \max\{p(x_{2n}, x_{2q+1}), p(x_{2n+1}, x_{2q}), \\ & p(x_{2q}, x_{2n+1}), p(x_{2q+1}, x_{2n})\} \\ \le \ & c^k \max\{p(x_{2r}, x_{2s+1}) :\ 0 \le r, s \le n\} \end{aligned}$$

when $k = 1$. Now assume that the inequality holds for some positive integer k. Because on inequality (4)

$$\begin{aligned} & \max\{p(x_{2n}, x_{2q+1}), p(x_{2n+1}, x_{2q}), \\ & p(x_{2q}, x_{2n+1}), p(x_{2q+1}, x_{2n})\} \\ \le \ & c^k \max\{p(x_{2r}, x_{2s+1}) :\ q \le r, s \le n\}. \end{aligned}$$

After applying inequality (1) to the right side of this inequality it follows that

$$\begin{aligned} & \max\{p(x_{2n}, x_{2q+1}), p(x_{2n+1}, x_{2q}), \\ & p(x_{2q}, x_{2n+1}), p(x_{2q+1}, x_{2n})\} \\ \le \ & c^{k+1} \max\{p(x_{2r}, x_{2s+1}) :\ 0 \le r, s \le n\}. \end{aligned}$$

Inequality (5) now follows by induction. On letting k tend to infinity in inequality (5) we have

$$\max\{p(x_{2n}, x_{2q+1}), p(x_{2n+1}, x_{2q}), p(x_{2q}, x_{2n+1}), p(x_{2q+1}, x_{2n})\} = 0,$$

contradicting the definition of n. Hence $\{x_n\}$ is bounded and so for each p in P

$$\sup\{p(x_r, x_s) : r, s = 1, 2, \dots\} = M_p < \infty.$$

For arbitrary $\varepsilon > 0$ choose N_p so that

$$c^{N_p} M_p < \varepsilon.$$

It follows that for $n > 2N_p$ and on using inequality (1) N_p times

$$\max\{p(x_{2N_p}, x_n), p(x_n, x_{2N_p})\} \leq c^{N_p} M_p < \varepsilon$$

if n is odd and

$$\begin{aligned}\max\{p(x_{2N_p}, x_n), p(x_n, x_{2N_p})\} \quad \leq \quad & c \max\{p(x_{2N_p+1}, x_n) + p(x_{2N_p}, x_{2N_p+1}), \\ & p(x_n, x_{2N_p+1}) + p(x_{2N_p+1}, x_{2N_p}) < 2\varepsilon\end{aligned}$$

if n is even.

Thus $\{x_n\}$ is left and right P-Cauchy sequence in a left (right) sequentially complete quasi-gauge Hausdorff space. So $\{x_n\}$ converges to some z in X and since S and T are continuous and X is Hausdorff

$$Sz = Tz = z.$$

Let z' be another common fixed point of S and T. Then by applying the inequality

$$\max\{p(z, z'), p(z', z)\} \leq c \max\{p(z, z'), p(z', z)\}.$$

Since $c < 1$, $p(z, z') = p(z', z) = 0$ for all p in P and X is a Hausdorff space, so

$$z' = z.$$

Thus S and T have a unique common fixed point. □

Corollary 1. *Let S and T be two continuous mappings of a left (right) sequentially complete quasi-gauge Hausdorff space satisfying the inequality*

$$(6)\qquad \begin{aligned} &\max\{p((ST)^q x,(TS)^u y), p((TS)^u y,(ST)^q x)\}\\ \leq\ & c\max\{p((ST)^r x,(TS)^s y), p((ST)^r x, T(ST)^{r'} x),\\ & p(S(TS)^{s'} y, T(ST)^{r'} x), p(S(TS)^{s'} y,(TS)^s y)\\ & 0\leq r\leq q,\ 0\leq r' < q,\\ & 0\leq s\leq u,\ 0\leq s' < u\} \end{aligned}$$

for all x, y in X, where $0 \leq c < 1$, q and u are fixed positive integers then S and T have a unique fixed point.

Proof. Suppose $q > u$ then

$$\begin{aligned} &\max\{p((ST)^q x,(TS)^q y), p((TS)^q y,(ST)^q x)\}\\ \leq\ & c\max\{p((ST)^r x,(TS)^s y), p((ST)^r x, T(ST)^{r'} x),\\ & p(S(TS)^{s'} y, T(ST)^{r'} x), p(S(TS)^{s'} y,(TS)^s y)\\ & 0\leq r\leq q,\ 0\leq r' < q,\\ & q-u\leq s\leq u,\ q-u\leq s' < u\} \end{aligned}$$

for all x, y in X for each p in P. Then the result follows from the theorem.

The same result holds if $u > q$. □

For a more generalized inequality the result also hold.

Corollary 2. *Let S and T be two continuous mappings defined on a left or right sequentially complete quasi-gauge Hausdorff space satisfying the inequality for each p in P.*

$$(7)\qquad \begin{aligned} &\max\{p((ST)^q x,(TS)^u y), p((TS)^u y,(ST)^q x)\}\\ \leq\ & c\max\{p((ST)^r x,(TS)^s y), p((ST)^r x, T(ST)^{r'} x),\\ & p(S(TS)^{s'} y, T(ST)^{r'} x), p(S(TS)^{s'} y,(TS)^s y),\\ & p((TS)^s y,(ST)^r x), p(T(ST)^{r'} x, S(TS)^{s'} y),\\ & p((TS)^s y, S(TS)^{s'} y), p(T(ST)^{r'} x,(ST)^r x)\\ & 0\leq r\leq q,\ 0\leq r' < q,\\ & 0\leq s\leq u,\ 0\leq s' < u\} \end{aligned}$$

for all x, y in X, where $0 \leq c < 1$, q and u are fixed positive integers. Then S and T have a unique common fixed point.

Proof. Follows exactly the same steps of Theorem 2.

Corollary 3. *If S and T are continuous mappings in a sequentially complete Hausdorff gauge space (X,P) satisfying the following inequality for each p in P*

$$
\begin{aligned}
(8) \qquad & \max\{p((TS)^u x, (ST)^q y)\} \\
\leq \;& c\max\{p((ST)^r y, (TS)^s x), p(S(TS)^{s'} x, (TS)^s x), \\
& p((ST)^r y, T(ST)^{r'} y), p(S(TS)^{s'} x, T(ST)^{r'} y) : \\
& 0 \leq r \leq q,\ 0 \leq r' < q, \\
& 0 \leq s \leq u,\ 0 \leq s' < u\}
\end{aligned}
$$

for all x, y in X where $0 \leq c < 1$, and q and u are fixed positive integers. Then S and T have a unique common fixed point.

Proof. Since $p(x,y) = p(y,x)$ for all p in P, the result follows immediately from Corollary 1 of Theorem 2. □

We note that in the left (right) sequentially complete quasi-gauge Hausdorff space (X,P), if S and T are two continuous functions defined on X into itself satisfying the inequality (8) may not have a common fixed point. This is easily seen by an example.

Example 1. Let $X = [0,1]$, (X,P) be a quasi-gauge space. P is defined by a single quasi-pseudometric p by

$$p(x,y) = \begin{cases} x - y & \text{if} \quad x \geq y \\ \frac{y-x}{2} & \text{if} \quad y \geq x. \end{cases}$$

(X,P) is a sequentially complete quasi-gauge Hausdorff space. Define the continuous functions as follows.

$$Sx = 1 - x \text{ and } Tx = \frac{x}{2}$$

$$STx = \frac{2-x}{2} \text{ and } TSx = \frac{1-x}{2}$$

$$p((ST)x, (TS)y) = \frac{1+y-x}{2}$$

$$p((TS)y, (ST)x) = \frac{1+y-x}{4}$$

$$\max\{p((TS)y,(ST)x)\} \leq 1/2\max\{p((ST)^r x,(TS)^s y), p(Sy,Tx), p(Sy,(ST)^s y), p((ST)^r x, Tx) : \text{for } s=0,1,\ r=0,1\}.$$

But $p((St)(0),(TS)(1)) = 1$.

We can not find out a c, $0 \leq c < 1$ such that

$$\begin{aligned} &\max\{p((TS)y,(ST)x), p((ST)x,(TS)y)\} \\ \leq\ & c\max\{p((ST)^r x,(TS)^s y), p(Sy,Tx), \\ & p((Sy,(ST)^s y), p((ST)^r x, Tx) : \\ & \text{for } s=0,1,\ r=0,1\}. \end{aligned}$$

Hence S and T have no common points.

Fisher [1] gives an example to show that for Theorem 1 if p is greater than 1, then S and T have to be continuous. In the next theorem T need not to be continuous.

Theorem 3. *Let S be a continuous mapping and T be a ,mapping of left (right) sequentially complete quasi-gauge Hausdorff space satisfying the inequality*

$$\begin{aligned} (9)\qquad &\max\{p((TS)y,(ST)^q x), p((ST)^q x,(TS)y)\} \\ \leq\ & c\max\{p((ST)^r x,(TS)^s y), p(Sy, T(ST)^{r'}x), \\ & p(Sy,(TS)^s y), p((ST)^r x, T(ST)^{r'}x) : \\ & 0 \leq r \leq q,\ 0 \leq r' < q,\ s=0,1\}. \end{aligned}$$

for all x,y in X, for each p in P, where $0 \leq c < 1$ and q is a fixed positive integer. Then S and T have a unique common fixed point z.

Proof. Let x be an arbitrary point in X and define $\{x_n : n = 1,2\ldots\}$ as in the prof of Theorem 2. Then since inequality (1) holds if inequality (9) holds, the sequence $\{x_n : n = 1,2\ldots\}$ is again P-Cauchy sequence with a limit point z in a left (right) sequentially complete quasi-gauge Hausdorff space X. Since S is continuous z is a fixed point of S. Further,

$$\begin{aligned} p(z,Tz) = p(z,TSz) &\leq p(z,x_{2n}) + p(x_{2n},TSz) \\ &\leq p(z,x_{2n}) + c\max\{p(x_{2n},(TS)^s z), p(Sz, x_{2r'+1}), \\ &\quad p(x_{2r}, x_{2r'+1}), p(Sz,(TS)^s z) : \\ &\quad 0 \leq q+r-n \leq q,\ 0 \leq q+r'-n < q,\ s=0,1\}. \end{aligned}$$

$$\begin{aligned} p(Tz,z) = p(TSz,z) &\leq p(x_{2n},z) + p(TSz,x_{2n}) \\ &\leq p(x_{2n},z) + c\max\{p(x_{2r},(TS)^s z), p(Sz,x_{2r'+1}), \\ &\quad p(x_{2r},x_{2r'+1}), p(Sz,(TS)^s z) : \\ &\quad 0 \leq q+r-n \leq q,\ 0 \leq q+r'-n < q,\ s = 0,1\}. \end{aligned}$$

as n tends to infinity

$$p(z,Tz) \leq cp(Tz,z)$$

and

$$p(Tz,z) \leq cp(z,Tz)$$

since $c < 1$, $p(z,Tz) = p(Tz,z) = 0$ for all p in P and X is a Hausdorff space. So

$$z = Tz.$$

Thus z is a common fixed point of S and T. Uniqueness follows as before. □

Corollary 4. *Let S be a continuous mapping and T be a mapping defined on a complete gauge Hausdorff space (X,P) satisfying the inequality for each p in P.*

$$\begin{aligned} (10)\, p((TS)y,(ST)^q x) &\leq c\max\{p((ST)^r x,(TS)^s y), p(Sy,T(ST)^{r'} x), \\ &\quad p(((ST)^r x, T(ST)^{r'} x), p(Sy,(TS)^s y) : \\ &\quad 0 \leq r \leq q,\ 0 \leq r' < q,\ s = 0,1\}. \end{aligned}$$

for all x,y in X where $0 \leq c < 1$ and q is a fixed positive integer. Then S and T have a unique common fixed point.

As in the case of Theorem 2 it can be noted that if S is a continuous mapping and T is a mapping defined on a left (right) sequentially complete quasi-gauge Hausdorff space satisfying the inequality (10) may not have a common fixed point by an example.

Example 2. Let (X,P) be a quasi-gauge Hausdorff space as defined in Example 1. Define the continuous function S and the mapping T as follows:

$$Sx = \begin{cases} x & \text{if} \quad x \geq 1/2 \\ 1/2 & \text{if} \quad x \leq 1/2 \end{cases}$$

$$Tx = \begin{cases} x/2 & \text{if} \quad x \neq 0 \\ 1 & \text{if} \quad x = 0 \end{cases}$$

S and T satisfy the inequality (10) for $c = 1/2$. But

$$\begin{aligned} p((ST)^q x, (TS)y) \not\leq\ & c\max\{p((ST)^r x, (TS)^s y), p(Sy, T(ST)^{r'} x), \\ & p(((ST)^r x, T(ST)^{r'} x), p(Sy, (TS)^s y) : \\ & 0 \leq r \leq q,\ 0 \leq r' < q,\ s = 0, 1\}. \end{aligned}$$

for $x = 1/2$, $1/4 \leq y \leq 1/2$.

Hence S and T have no common fixed point.

The following example shows that it is still necessary for S to be continuous in the theorem. Let (X, P) be a quasi-gauge space as defined in Example 1. Define the discontinues mappings S and T on X by

$$Sx = \frac{1}{3}x,\ Tx = \frac{1}{2}x \text{ if } x \neq 0$$

$$S(0) = T(0) = 1.$$

Inequality (9) is satisfied with $c = 1/2$. But neither S nor T has a fixed point. In the following theorem it is not necessary for either S or T to be continuous.

Theorem 4. *Let S and T be mappings defined on a left (right) sequentially complete quasi-gauge Hausdorff space (X, P) into itself satisfying the inequality for each p in P*

(11)
$$\begin{aligned} & \max\{p(Ty, (ST)x), p((ST)x, Ty)\} \\ \not\leq\ & c\max\{p(Tx, y), p(x, Ty), \\ & p(y, Tx), p(x, Tx), p(Tx, (ST)x) :\}. \end{aligned}$$

for all x, y in X, where $0 \leq c < 1$. Then S and T have a unique common fixed point z. Further z is the unique fixed point of T.

Proof. Let x be an arbitrary point in X and let the sequence $\{x_n : n = 1, 2, \ldots\}$ be as defined in the proof of Theorem 2. Then since inequality (7) holds if inequality (11) holds the sequence $\{x_n : n = 1, 2, \ldots\}$ is again a P-Cauchy sequence with limit z in a left (right) sequentially complete quasi-gauge space X. Thus

$$\max\{p(z, Tz), p(Tz, z)\} \ \leq\ \max\{p(z, x_{2n}) + p(x_{2n}, Tz)$$

$$
\begin{aligned}
& p(Tz, x_{2n}) + p(x_{2n}, z)\} \\
\leq\ & \max\{p(z, x_{2n}), p(x_{2n}, z)\} \\
+\ & c\max\{p(x_{2n-1}, z), p(x_{2n-2}, z), p(z, Tz), \\
& p(x_{2n}, x_{2n-1}), p(x_{2n-1}, x_{2n})\}
\end{aligned}
$$

and on letting n to tend to infinity we have

$$\max\{p(z, Tz) + p(Tz, z)\} \leq cp(z, Tz).$$

It follows that z is a fixed point of T also

$$
\begin{aligned}
\max\{p(Sz, z), p(z, Sz)\} &= \max\{p(STz, Tz) + p(Tz, STz)\} \\
&\leq c\max\{p(z, Tz), p(Tz, z), \\
&\quad p(z, Tz), p(Tz, STz)\} \\
&\leq p(z, Sz)
\end{aligned}
$$

Hence z is the common fixed point of S and T. Now suppose that T has a second fixed point w. Then

$$
\begin{aligned}
\max\{p(z, w), p(w, z)\} &= \max\{p(STz, Tw), p(Tw, STz)\} \\
&\leq c\max\{p(z, Tw), p(Tz, w), \\
&\quad p(w, Tw), p(Tz, STz)\} \\
&\leq p(z, w)
\end{aligned}
$$

and it follows that z is the unique fixed point of T.

References

[1] Fisher, B., Fund. Math. 113 (1981), 37-43.

[2] Fisher, B., Proc. Amer. Math. Soc. 75 (1979), 321-325.

[3] Reilly, I. I., Bull. Austral. Math. Soc. 10 (1974), 359-363.

[4] Reilly, I. I., J. London Math. Soc. (2) 6 (1973), 481-487.

[5] Subrahmanyam, P. V., J. Math. Phy. Sci. 8 (1974) 445-457.

REZIME

KVAZI RASTOJANJE I NEPOKRETNE TAČKE

U ovom radu je dokazana generalizacija teoreme o zajedničkoj nepokretnoj tački u prostorima sa kvazirastojanjem iz [1].

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