Fixed points and their types

Katta o'qituvchi ***Tufliyev Egamberdi Olimovich***

Katta o'qituvchi ***Xudoyqulov Jamshid Xolmatovich***

Karshi Engineering and Economic Institute, Karshi

Qashqadaryo,O'zbekiston. jamshidd-0890@mail.ru

Annotatsiya. *Ushbu maqolada dinamik sistemalarning qo'zg'almas nuqtalari va ularning turlari Lagranj teoremalari yordamida isbotlangan o'rganilgan*

Abstract*. In this article, the fixed points of dynamic systems and their types are studied, proved using Lagrange's theorems.*

Kalit so'zlar*. Lagranj teoremasi, Giperbolik nuqta, qo'zg'almas nuqta, dinamik sistemalar*

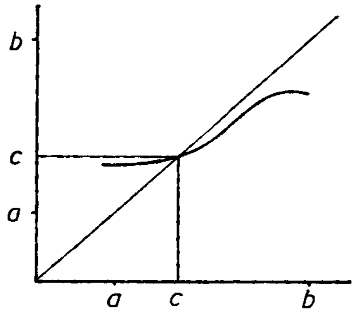
Key words*. Lagrange's theorem, hyperbolic point, fixed point, dynamical systems*

Definition 1. If the equality $f(x) = x$ is fulfilled for a point x, the point x is called a fixed point of the function $f(x)$.

Lemma 1. Let the given function $f: I \to I$ be continuous, then the function $f(x)$ has at least one fixed point in the interval I.

Proof. Let $f(x) - x = g(x)$. It is known that $g(x)$ is continuous in I. Let $f(a) > a$, $f(b) < b$ be. From this, $g(a) > 0$, $g(b) < 0$,

According to the mean value theorem, there exists such a point $c \in [a, b]$) that $g(c) = 0$ becomes $g(c) = f(c) - c$. $g(c) = 0 \Rightarrow f(c) = c$.



Picture 1

Lemma 2. If the function $f\colon I \to I$ is continuous and $|f'(x)| < 1$ for $\forall x \in I$, then the function f has a unique fixed point belonging to I. Also, for the $\forall x, y \in I, x \neq y$

$\forall x, y \in I, x \neq y$ inequality is appropriate.

Proof. By Lemma 1, $f(x)$ has at least one fixed point. Let x and y $(x \neq y)$ be fixed points. According to Lagrange's theorem, there exists a point c between the points x and y ,

$$f'(c) = \frac{f(y) - f(x)}{y - x} = 1$$

But this equality contradicts the inequality $|f'(c)| < 1$ for $\forall c \epsilon I$. So our assumption is wrong. $x = y$ will be. That is, the function $f(x)$ has unique fixed point in I.

In proving the second part of the lemma, we again use Lagrange's theorem. $\forall x, y \in I, x \neq y,$

$|f(y) - f(x)| = |f'(c)||y - x| < |y - x|$ for s

Definition 2. Let the point x be a fixed point of $f(x)$. A point x is called a periodic point with period n if $f^n(x) = x$.

Example 1. Let's find fixed points of $f(x) = x^3$ functions.

We find the roots of equation $x^3 - x = 0$.

$$x^3 - x = 0$$

$$x(x^2 - 1) = 0$$

$x_1 = 0, x_2 = 1, x_3 = -1$

So, the points 0, 1, and -1 are fixed points of the function $f(x)$.

Example 2. Let's find the fixed points of the function $f(x) = x^2 - 1$.

$$x^2 - 1 = x$$

$$x^2 - x - 1 = 0$$

$$x_{1,2} = (1 \pm \sqrt{5})/2$$

So, the fixed points of the given function $f(x)$ are $x_{1,2} = (1 \pm \sqrt{5})/2$ points.

In other words, when finding fixed points, it is necessary to find the points of intersection of the graph of the given function with the graph of the function $x = y$.

Hyperbolic points.

Functions $f(x) = x$ and $f(x) = -x$are different in the theory of dynamical systems. An unusual feature of such reflections is that all their points are periodic. Most reflections do not have this feature. Therefore, we introduce the concept of hyperbolicity.

Let us be given a function $f(x)$ defined on the real domain.

Definition 3. Let the point p be a periodic point with n periods. If$|(f^n)'(p)| \neq 1$, then n is called a hyperbolic point.

LITERATURE

1. Шабат Б.В.,*Введение в комплексный анализ,*часть 1, М., “Наука”, 1985г.

2. Л.А.Айзенберг. “Формулы Карлемана в комплексном анализе” Новосибирск«Наука» 1990г.247с

3. Ibragimov-Dots, S., Xudoyqulov-Ass, J., & Boboxonov-Ass, S. (2022). DIRIXLE PROBLEM FOR A (z)-HARMONIC FUNCTION. *Web of Scientist: International Scientific Research Journal*, *3*(9), 124-126.

4. Ibragimov, S. L., Xudoyqulov, J. X., & Boboxonov, S. S. (2022). INTEGRATION BY SUBSTITUTION. *Current Issues of Bio Economics and Digitalization in the Sustainable Development of Regions*, 381-385.

5. Xudoyqulov, J., & Boboxonov, S. (2022). GOLIZIN-KRYLOV METHOD FOR-ANALYTIC FUNCTION.

6. Eshmatov, B. E., Boboxonov, S., & Omonova, N. (2022). On the solvability of problems with an oblique derivative for a mixed parabolic-hyperbolic equation. *Web of Scientist: International Scientific Research Journal*, *3*(3), 536-538.

7. Tufliyev, E., & Boboxonov, S. (2023). PROOF OF CAUCHY'S THEOREM IN GENERAL. CONCEPT OF HOMOTOPY PATH. *Евразийский журнал академических исследований*, *3*(3 Part 2), 48-51.

8. Bobokhonov, S. .S., & Hamrayev , S. (2023). Cauchy’s integral formula. Academic International Conference on Multi-Disciplinary Studies and Education, 1(5), 87–89. Retrieved from

9. Bobokhonov, S. .S., & Namozov , D. (2023). A generalization of Cauchy’s theorem. International Conference on Science, Engineering & Technology, 1(1), 88–89. Retrieved from

10. Бозаров Д. У. Determinantlar mavzusini mustaqil oqishga doir misollar //Журнал Физико-математические науки. – 2022. – Т. 3. – №. 1.

11. Bozarov D. U. IKKI O ‘ZGARUVCHILI FUNKSIYANING EKSTREMUMIDAN FOYDALANIB, TEKISLIKDAGI IKKITA FIGURA ORASIDAGI MASOFANI TOPISH //Oriental renaissance: Innovative, educational, natural and social sciences. – 2022. – Т. 2. – №. 11. – С. 292-301.