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DIGITAL TRANSFORMATION OF INTEGRATING COMPUTER PROGRAMS IN MATHEMATICS EDUCATION IN THE CONTEXT OF DIGITAL TECHNOLOGIES

Khudazarov Ravshan Saparovich
Muhhamad-Al Khxarazmi Tashkent University of Information
Technology Associate Professor of the Department of Higher Mathematics

Abstract
This scientific article highlights the integration of computer programs in the field of mathematics under the conditions of digital technologies. The article discusses methods for developing students' digital competencies by creatively organizing the educational process through the digitization of lessons in the current era of digital transformation.

Introduction

In our country, comprehensive measures are being implemented to actively develop the digital economy and widely introduce modern information and communication technologies across all sectors and fields, particularly in public administration, education, healthcare, and agriculture. In this regard, the Decree No. PF-6079 dated October 6, 2020, titled “On Approving the ‘Digital Uzbekistan — 2030’ Strategy and Measures for Its Effective Implementation,” was adopted by our nation’s leader.

This scientific article is significant in the context of the digital economy policy being implemented in our country, as well as for mathematics teachers and users in higher education institutions who are working to develop their digital competencies. The importance of modern technologies in mathematics education is steadily increasing. With the help of mathematical software (e.g., MATLAB, Wolfram Mathematica, Python, GeoGebra), tasks such as complex calculations, graphing, solving equations, and modeling can be performed accurately and efficiently. This article examines the capabilities of mathematical software and the methods of solving mathematical problems using these tools.

The Importance of Mathematical Software

Mathematical software assists in performing the following tasks:

• Complex Calculations: For example, solving integral and differential equations.
• Graphing: Presenting function graphs in a visual format.
• Modeling: Representing physical, economic, or biological processes through mathematical models.
• Statistical Analysis: Analyzing data using statistical methods.

Popular Mathematical Software

Below is a list of the most widely used mathematical software:

1. MATLAB - Widely applied in engineering and scientific calculations.
2. Wolfram Mathematica - Convenient for symbolic calculations and graphing.

3. Python (NumPy, SciPy, Simply) - Solving mathematical problems based on programming.
4. GeoGebra - An interactive tool for solving geometry and algebra problems.
5. Maple - Used in mathematical analysis and engineering problems.

Let's Consider a Method for Solving Some Problems Using Python

Example 1: Solving an Equation

Solving an equation using the Simply library in the Python programming language:

```
from sympy import symbols, Eq, solve
x = symbols('x')
tenglama = Eq(x**2 - 5*x + 6, 0)
yechim = solve(tenglama, x)
print(yechim)  # Natija: [2, 3]
```

Example 2: Graphing

Drawing a function graph using MATLAB:

```
matlab
Copy
x = -10:0.1:10;
y = sin(x);
plot(x, y);
title('Funksiya grafigi: y = sin(x)');
xlabel('x');
ylabel('y');
```

Example 3: Calculating an Integral

Calculating an integral using Wolfram Mathematica:

```
mathematica
Copy
Integrate[x^2 + 3*x + 2, x]
Natija: x^3/3 + (3*x^2)/2 + 2*x + C
```

The Python programming language offers extensive capabilities for creating mathematical graphs. Libraries such as Matplotlib, Seaborn, and Plotly are used for this purpose. The most commonly used library is Matplotlib. Below, we provide several examples of creating mathematical graphs using Python.

Simple Line Graph

Creating a simple line graph using the Matplotlib library:

```
python
Copy
import matplotlib.pyplot as plt
import numpy as np
# Ma'lumotlar yaratish
x = np.linspace(0, 10, 100)  # 0 dan 10 gacha 100 ta nuqta
y = np.sin(x)  # y = sin(x)
# Grafikni chizish
```

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```
plt.plot(x, y, label='y = sin(x)')
plt.title('Chiziqli Grafik: y = sin(x)')
plt.xlabel('x')
plt.ylabel('y')
plt.legend()
plt.grid(True)
plt.show()
```

Parabola Graph

Drawing a parabola graph:

```
python
Copy
import matplotlib.pyplot as plt
import numpy as np
# Ma'lumotlar yaratish
x = np.linspace(-10, 10, 100)
y = x**2  # y = x^2
# Grafikni chizish
plt.plot(x, y, label='y = x^2', color='red')
plt.title('Parabola Grafigi: y = x^2')
plt.xlabel('x')
plt.ylabel('y')
plt.legend()
plt.grid(True)
plt.show()
```

Plotting multiple graphs: Plotting multiple functions on one graph

```
python
Copy
import matplotlib.pyplot as plt
import numpy as np
# Ma'lumotlar yaratish
x = np.linspace(0, 10, 100)
y1 = np.sin(x)
y2 = np.cos(x)
# Grafikni chizish
plt.plot(x, y1, label='y = sin(x)', color='blue')
plt.plot(x, y2, label='y = cos(x)', color='green')
plt.title('Bir Nechta Grafiklar')
plt.xlabel('x')
plt.ylabel('y')
plt.legend()
plt.grid(True)
plt.show()
```

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3D Graph: Using mpl_toolkits.mplot3d to Create 3D Graphs

```
python
Copy
import matplotlib.pyplot as plt
import numpy as np
from mpl_toolkits.mplot3d import Axes3D

# Ma'lumotlar yaratish
x = np.linspace(-5, 5, 100)
y = np.linspace(-5, 5, 100)
x, y = np.meshgrid(x, y)
z = np.sin(np.sqrt(x**2 + y**2))  # z = sin(sqrt(x^2 + y^2))

# 3D grafikni chizish
fig = plt.figure()
ax = fig.add_subplot(111, projection='3d')
ax.plot_surface(x, y, z, cmap='viridis')
ax.set_title('3D Grafik: z = sin(sqrt(x^2 + y^2))')
ax.set_xlabel('x')
ax.set_ylabel('y')
ax.set_zlabel('z')
plt.show()
```

Histogram: Displaying statistical data in the form of a histogram

```
python
Copy
import matplotlib.pyplot as plt
import numpy as np

# Ma'lumotlar yaratish
data = np.random.randn(1000)  # 1000 ta tasodifiy normal taqsimlangan qiymat

# Histogram chizish
plt.hist(data, bins=30, color='orange', edgecolor='black')
plt.title('Histogram')
plt.xlabel('Qiymatlar')
plt.ylabel('Chastota')
plt.grid(True)
plt.show()
```

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Polar Graph: Plotting a graph in polar coordinates

```
python
Copy
import matplotlib.pyplot as plt
import numpy as np

# Ma'lumotlar yaratish
theta = np.linspace(0, 2 * np.pi, 100)
r = np.sin(3 * theta)  # r = sin(3θ)

# Polar grafikni chizish
ax = plt.subplot(111, projection='polar')
ax.plot(theta, r, label='r = sin(3θ)', color='green')
ax.set_title('Polar Grafik')
ax.legend()
plt.show()
```

Interactive Graphs (Plotly): Creating interactive graphs using the Plotly library

```
Copy
import plotly.express as px
import numpy as np

# Ma'lumotlar yaratish
x = np.linspace(0, 10, 100)
y = np.sin(x)

# Interaktiv grafik yaratish
fig = px.line(x=x, y=y, title='Interaktiv Grafik: y = sin(x)', labels={'x': 'x', 'y': 'y'})
fig.show()
```

Opportunities

Mathematical programs are integrating with artificial intelligence (AI) and big data, creating new possibilities. For example, creating mathematical models with the help of AI or analyzing large datasets.

Conclusion

The global digital civilization, exponential processes, artificial intelligence-based production, smart technologies, global competition in the labor market, and increasing demands on the quality of human capital have brought about profound changes in the key areas of societal life (social, cultural, economic, political). The digital economy demands the provision of educational services to develop an individual's creative abilities, innovative thinking, the formation of motivation for lifelong self-development and self-awareness in learners,

continuous updating of knowledge structures, the development of new labor skills, and the preparation of competitive, socially active specialists.

Mathematical programs play a significant role in modern mathematics and scientific fields. With their help, complex problems can be solved quickly and accurately, while also making the learning process engaging and effective. In the future, the development of these programs will elevate mathematical research to a new level. Using the Python programming language, various types of mathematical graphs can be created. Libraries such as Matplotlib, Seaborn, and Plotly enable the implementation of a wide range of visualizations, from simple to complex graphs.

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Elektron manbalar

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2. Wolfram Mathematica qo'llanmasi: wolfram.com
3. Python dasturlash tili va matematik kutubxonalar: python.org
4. GeoGebra dasturi: geogebra.org