Ten-Years Pedagogical Experiment at Moscow University of Geodesy and Cartography: C++ Programming Course Tailored for Surveying Students

Session 02.2 June 22, time 10:45
Teaching C++ programming

• A C++ programming course tailored for cartographers and surveyors has been developed and implemented in the educational process at the Moscow State University of Geodesy and Cartography.

• Pedagogical experiment on the development of the new course has been carried out since 2009. Blended learning combining the advantages of both conventional and remote teaching methods is suitable for a wide range of academic disciplines for example computer science associated with geodesy and cartography.

• The C++ programming course contains a large number of cartographic and geodetic tasks aimed at illustrating various constructions of the programming language.
Teaching C++ programming

• The program is designed to study passing of parameters to the functions by value and with the help of a pointer and a reference. The program computes the reverse true azimuth of heading using several functions.

• Concerning the programming, the significant reasons that disturb the blended learning of students to program in C++ were not revealed. Moreover, in comparison with conventional face-to-face teaching in lecture halls and classrooms, students absorb the knowledge gotten from video lectures fast, and effectively. A similar situation occurs around C++ practicals.
Computing the Reverse True Azimuth

- The straight line A-B is set and the true azimuth of this line at point A is known. It is required to calculate the reverse true azimuth of this line at point B if the convergence of meridians for points A and B is known.
```cpp
#include <iostream>

using namespace std;

void NoChangingAzimuthByValue(double, double);

void ChangingAzimuthByPointer(double *, double);

void ChangingAzimuthByReference(double &, double);

int main(void)
{
    double trueAzimuth = 44.1;  // 44°06'00"
    double convergenceOfMeridian = +1.4;  // +01°24'00"
    double &azimuth = trueAzimuth;

cout << "Initial azimuth value:" << trueAzimuth << endl;

cout << "Reference value:" << azimuth << "Reference address:" << &azimuth << endl;

cout << " // passing the first parameter by value
NoChangingAzimuthByValue(trueAzimuth, convergenceOfMeridian);

cout << "Azimuth after calling NoChangingAzimuthByValue:" << trueAzimuth << endl;

cout << "TrueAzimuth variable address:" << &trueAzimuth << endl;

    // passing the first parameter by address through pointer
    ChangingAzimuthByPointer(&trueAzimuth, convergenceOfMeridian);

cout << "Azimuth after calling ChangingAzimuthByPointer:" << trueAzimuth << endl;

cout << "TrueAzimuth variable address:" << &trueAzimuth << endl;

    // passing the first parameter by address through reference
    ChangingAzimuthByReference(azimuth, convergenceOfMeridian);

cout << "Azimuth after calling ChangingAzimuthByReference:" << trueAzimuth << endl;

cout << "Reverse true azimuth in NoChangingAzimuthByValue:" << trueAzimuth << endl;

return 0;
}

void NoChangingAzimuthByValue(double trueAzimuth, double convergenceOfMeridian)
{
    trueAzimuth += 180 + convergenceOfMeridian;

cout << "Reverse true azimuth in NoChangingAzimuthByValue:" << trueAzimuth << endl;

}

void ChangingAzimuthByPointer(double *trueAzimuth, double convergenceOfMeridian)
{
    *trueAzimuth += 180 + convergenceOfMeridian;

cout << "Reverse true azimuth in ChangingAzimuthByPointer:" << *trueAzimuth << endl;

}

void ChangingAzimuthByReference(double &azimuth, double convergenceOfMeridian)
{
    azimuth -= 180 - convergenceOfMeridian;

cout << "Reverse true azimuth in ChangingAzimuthByReference:" << azimuth << endl;

}
```

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**SMART SURVEYORS FOR LAND AND WATER MANAGEMENT**

**CHALLENGES IN A NEW REALITY**

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[Image with logos: Trimble, Esri, FIG, ING, KU Leuven, and ITC.]
Conclusions

• The tailored for geodesy and cartography students process of teaching the C++ programming implemented at the Moscow University of Geodesy and Cartography. One of the developed programs was discussed.

• Modern internet technologies make it possible to bring the educational process to students' homes, not to lock them in classrooms and laboratories.

• However, some courses, such as the Applied Geodesy, would not be taught only distantly. Practicals are to be carried out in a laboratory or on a test site because such work cannot be performed remotely. Blended learning is the best method for teaching applied disciplines as well as C++ programming.