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SMART SURVEYORS FOR LAND AND WATER MANAGEMENT CHALLENGES IN A NEW REALITY



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

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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.



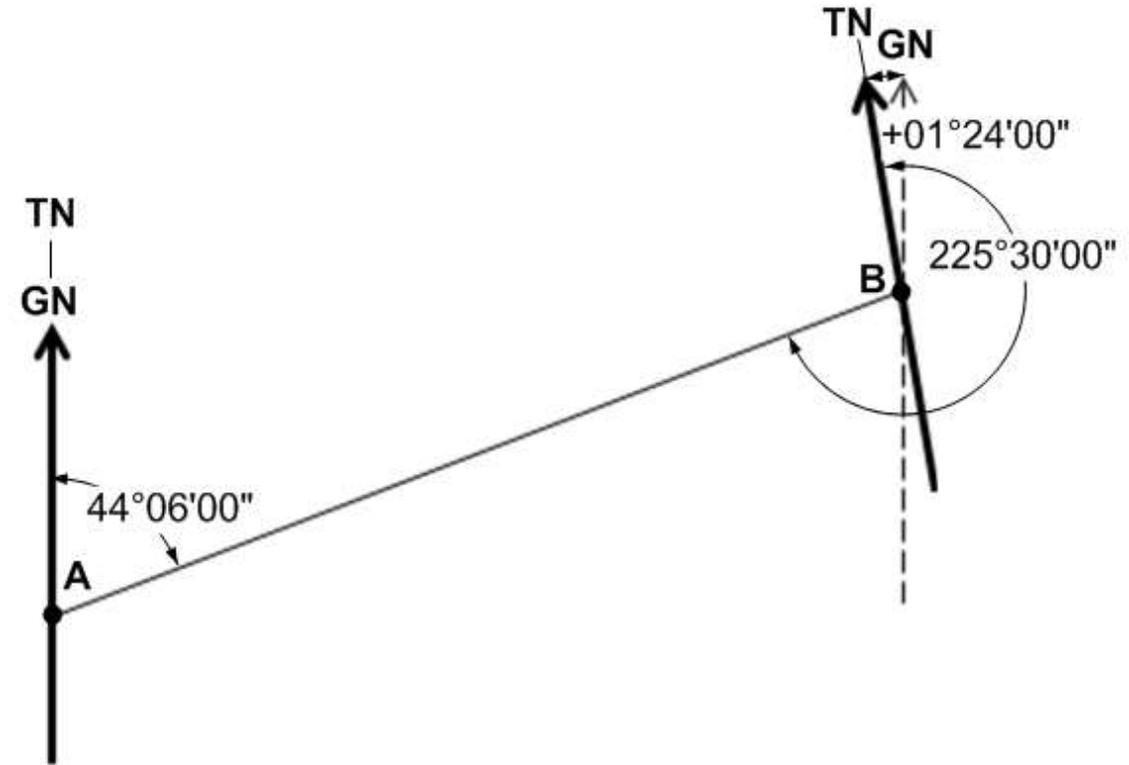
Teaching C++ programming

- 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.





```

01: #include <iostream>
02: using namespace std;
03:
04: void NoChangingAzimuthByValue(double, double );
05: void ChangingAzimuthByPointer(double *, double);
06: void ChangingAzimuthByReference(double &, double);
07: int main(void)
08: {
09:     double trueAzimuth = 44.1;           // 44°06'00"
10:     double convergenceOfMeridian = +1.4; // +01°24'00"
11:     double &azimuth = trueAzimuth;
12:     cout <<"Initial azimuth value: "<< trueAzimuth << endl;
13:     cout <<"Reference value: "<< azimuth <<"Reference address: "
13:         << &azimuth << endl;
14:     // passing the first parameter by value
15:     NoChangingAzimuthByValue(trueAzimuth,
15:                             convergenceOfMeridian);
16:     cout <<"Azimuth after calling NoChangingAzimuthByValue:"
16:         << trueAzimuth << endl;
17:     cout <<"TrueAzimuth variable address:"<< &trueAzimuth
17:         << endl;
18:     // passing the first parameter by address through pointer
19:     ChangingAzimuthByPointer(&trueAzimuth,
19:                             convergenceOfMeridian);
20:     cout <<"Azimuth after calling ChangingAzimuthByPointer: "
20:         << trueAzimuth << endl;
21:     // passing the first parameter by address through reference
22:     ChangingAzimuthByReference(azimuth,
22:                             convergenceOfMeridian);
23:     cout <<"Azimuth after calling ChangingAzimuthByReference: "
23:         << trueAzimuth << endl;
24:
25:     return 0;
26: }
27: void NoChangingAzimuthByValue(double trueAzimuth,
27:                             double convergenceOfMeridian)
28: {
29:     trueAzimuth += 180 + convergenceOfMeridian;
30:     cout <<"Reverse true azimuth in NoChangingAzimuthByValue:"
30:         << trueAzimuth << endl;
31: }
32: void ChangingAzimuthByPointer(double * trueAzimuth,
32:                             double convergenceOfMeridian)
33: {
34:     * trueAzimuth += 180 + convergenceOfMeridian;
35:     cout <<"Reverse true azimuth in ChangingAzimuthByPointer: "
35:         << * trueAzimuth << endl;
36: }
37: void ChangingAzimuthByReference(double & azimuth,
37:                             double convergenceOfMeridian)
38: {
39:     azimuth -= 180 - convergenceOfMeridian;
40:     cout <<
40:         "Reverse true azimuth in ChangingAzimuthByReference: "
40:         << azimuth << endl;
41: }

```



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.