A study on implementation and usage of web based programming assessment system: Code

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Contents

Introduction

- 900 students in 2012
- 1029 students in 2013
- *Code* is a web-based system for automatic assessment of programming problems
- Help insturctors in identified dificulties in assessing students' solutions
- Also used in practical exams that involve programming assignments
- Timed and informative feedback and automatic assessment is top priority

Methodology

- We analyze the data generated from the usage of the system at FCSE
- The system is in use from September 2012 in more than 10 courses that involve some kind of programming assignments in programming languages such as C, C++ or Java
- More than 1200 problems, 45% are exams
- Students mostly work using the the web-based editor in introductionary courses and IDEs in more advanced courses
- Unlimited submissions and as many problem attempt records

Problems success rate

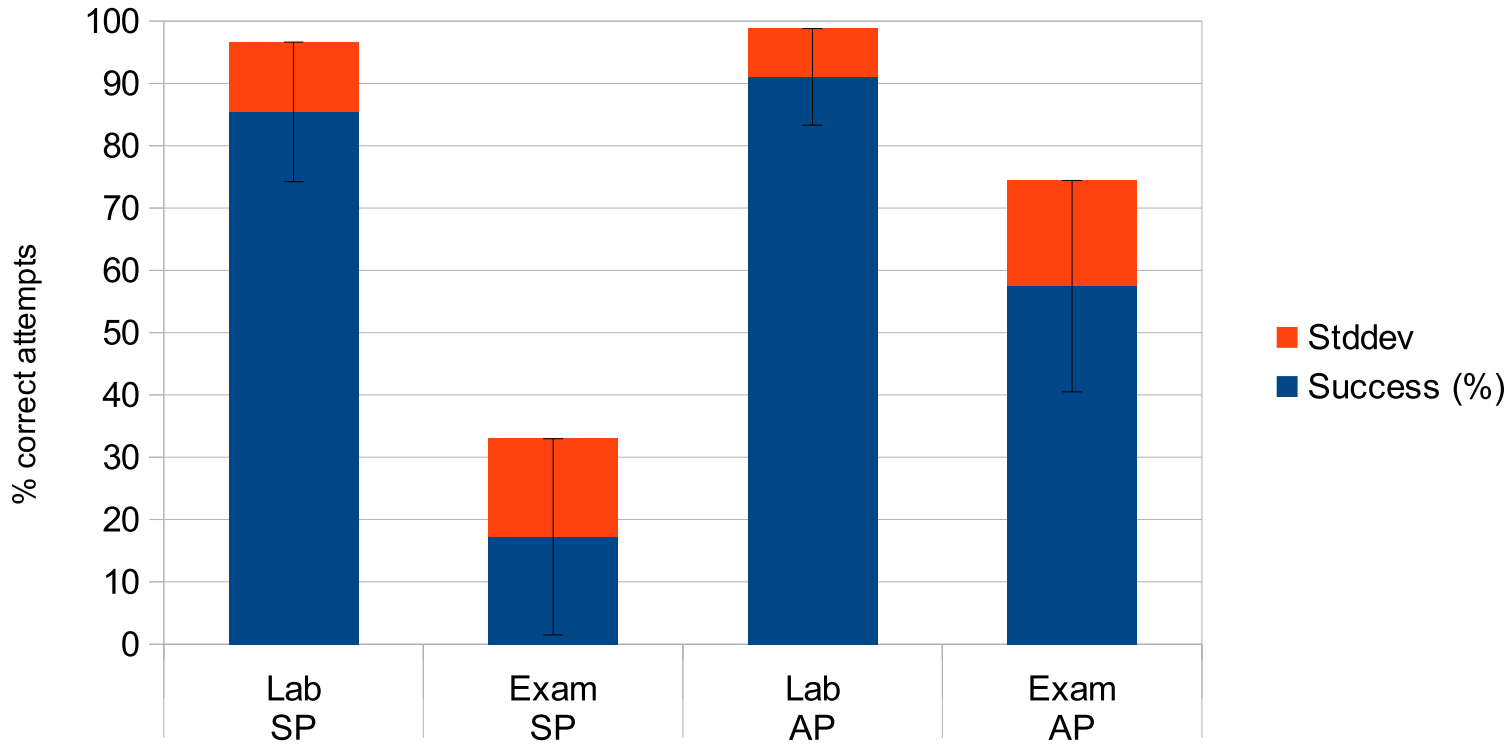
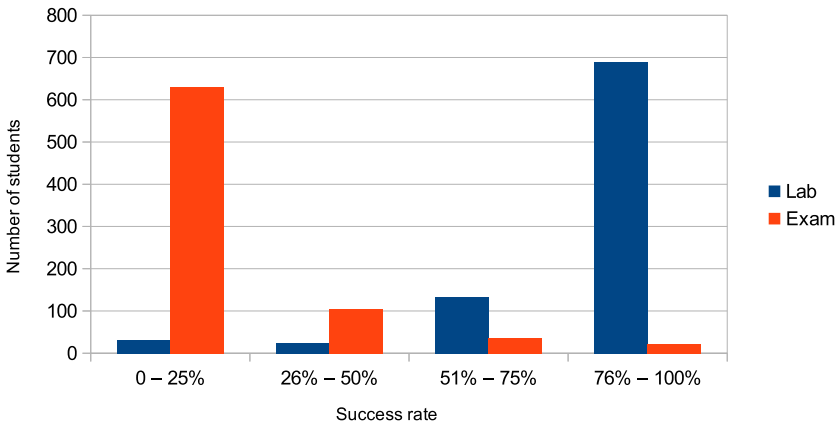
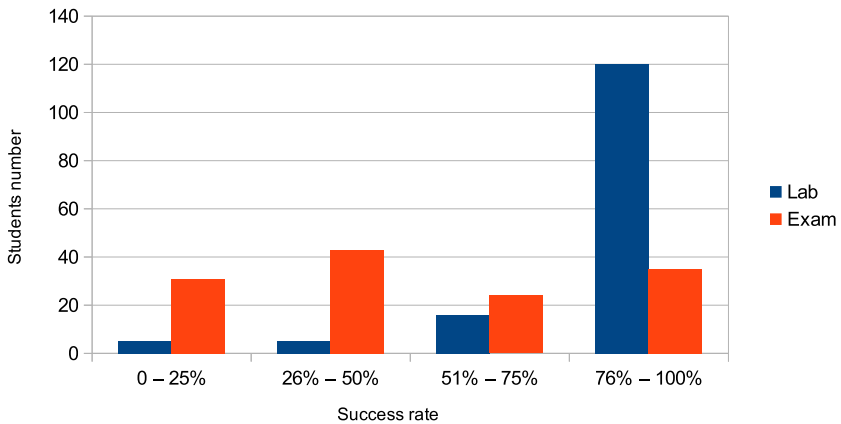


Figure : Problem success rate.

Students success rate



(a) SP success rate



(b) AP success rate

Figure : Success rate on students

Source code evolution

Table : Source code evolution data

Problem		**Average delta time (seconds)**	**Average compile success**	**Average deltas**	**Average lines**
Recursion	Correct	408.7	0.77	1.72	29.8
	Incorrect	172.4	0.49	1.47	25.0
Matrix	Correct	137.6	0.90	1.85	40.4
	Incorrect	228.1	0.61	1.79	32.6
Files	Correct	75.8	0.64	1.19	52.5
	Incorrect	484.5	0.58	1.26	49.4

Plagiarism

Table : Results on plagiarism detection using MOSS

Course	Settings	Average percentage match	Average lines matched	Potential plagiarism pairs
SP	Lab Exam	52.04% 22.74%	16.37 8.06	3869 20
AP	Lab Exam	10.08% 10.26%	28.22 20.12	1 2

Plagiarism example

/home/git/code/plagiats/p1200/c/131078

```
#include <stdio.h>
#define MAX 100

int main (){
int mat[MAX][MAX],m,n,i,j,sum=0;
    scanf("%d%d",&n,&m);
    for(i=0;i<n;i++)
        for(j=0;j<m;j++)
    {
    scanf("%d",&mat[i][j]);
    }

    for(i=0;i<n;i++)
       for(j=0;j<m;j++)
    {
        if(i==0||j==(m-1)||j==0||i==(n-1))
            sum+=mat[i][j];
    }
    printf("%d\n",sum);
    return 0;


}
```

/home/git/code/plagiats/p1200/c/116038

```
#include <stdio.h>
#define MAX 100

int main(){
        int a[MAX][MAX],i,j,n,m,zbir=0;
    scanf("%d%d", &n,&m);
    for(i=0;i<n;i++)
        for(j=0;j<m;j++){
                scanf("%d", &a[i][j]);
        }

    for(i=0;i<n;i++)
        for(j=0;j<m;j++){
                if((j==0 || j==m-1) || (i==0 || i==n-1))
                        zbir+=a[i][j];
        }
        printf("%d\n", zbir);
}
```

Figure : Plagiarism example.

Evaluation

- Group of 48 students in period of 10 days
- Three group of questions
  - General questions
  - System evaluation questions
  - Learning programming questions

General usage questions

Table : General usage questions

I used Code in?	1. Structured Programming (C)	40%
	2. Object Oriented Programming (C++/Java)	49%
	3. Algorithms and Data Structures (C/Java)	5%
	4. Advanced Programming (Java)	3%
	5. Advanced Algorithms (Java)	3%
I access Code from?	1. Faculty labs	38%
	2. From anywhere	62%
Do you want access from anywhere?	Yes	98%
	No	2%
How often do you use Code?	1. I don't use it	1%
	2. Once a week	42%
	3. 2-3 times a week	42%
	4. More than 3 times a week	15%

System evaluation questions

Table : System evaluation questions (1-5 grades)

Simple to use?	1 (0%)	2 (2%)	3 (10%)	4 (21%)	5 (67%)
Quality of presentation in problem view?	1 (0%)	2 (13%)	3 (6%)	4 (21%)	5 (60%)
Code editor functionality?	1 (4%)	2 (13%)	3 (13%)	4 (40%)	5 (31%)
Performance and speed?	1 (0%)	2 (6%)	3 (6%)	4 (31%)	5 (56%)
Do you think Code helps you in correctly solving the problem?	Yes (62%)			No (38%)	
When using Code?	First use IDE and then copy the solution (83%)		Use the web-based code editor (13%)		Other (4%)

Learning programming

Table : Learning programming

Where do you feel that you most learn (programming)?	1. Lectures	4%
	2. TA Exams lectures	17%
	3. Lab exercises	31%
	4. Individual learning	31%
	5. Solving problems in Code	5%
	6. Other	6%
What kind of materials helps you most in learning?	1. Books on subject	13%
	2. Lectures slides	15%
	3. Exercises questions and answers	4%
	4. Example problems with solutions	46%
	5. Interactive visualization of solutions	13%
	6. Other	10%
While solving problem on code I mostly need help in?	1. Understand a problem and think of algorithm	21%
	2. Implementing (coding) my solution	27%
	3. Locating and fixing errors in my solution	46%
	4. Other	6%
What kind of help would be useful to be implemented?	1. Automatically showing relevant materials with similar problems and solutions	63%
	2. Direct communication with tutors over chat	23%
	3. Other	7%

Questions

http://code.finki.ukim.mk

Thank You for the attention

Questions?