CloudCoder: Building a Community for Using and Sharing Programming Exercises

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tl;dr

- CloudCoder is a free, open-source, web-based **programming exercise** system
- Multiple languages: C/C++, Java, Python, Ruby
- It has a **repository of free exercises** (contributions welcome)
- Ask us for a **demo server account**
- Did we mention that it's **free**?

http://cloudcoder.org

Programming exercises!

- Automatically-evaluated exercises are useful in introductory programming courses[1]
 - For learning **syntax**
 - For learning **basic concepts** (variables, decisions, loops, etc.)
 - For extra **practice**
 - For assessment
- They can be **incorporated easily** into an existing course without major $\mathbf{changes}$
 - Use them to supplement readings, for quizzes, for practice, etc.

We need another system?

- Many **existing systems**: CodingBat, PracticeIt!, CodeLab, etc.
- We didn't know of one which
 - Was open source
 - Was community-supported
 - Had freely-redistributable exercises
 - Allowed self-hosting and **full** access to student data
 - Supported in-class assessment (i.e., quizzes) – Supported C/C++

Need for a community

Exercise repository

https://cloudcoder.org/repo



University of Auckland

David Hovemeyer York College of Pennsylvania

Requirements

• Students need just a web browser

- **No plugin** required: client is 100% HTML/CSS/JavaScript

• System runs on two Linux servers

– One (network-facing) for webapp and database: EC2 micro instance works well

– One (network connected) to build and test submissions: can be any PC connected to network

• Relatively easy installation

• Thesis: for a programming exercise system to be as useful as it can be, it needs a *community*

- To provide exercises that can be freely reused and improved

- To share experience about how to use exercises most effectively

• Writing good exercises is a challenge: but many hands make light work

• More generally: preparing curriculum materials is labor intensive

- We spend a lot of time preparing materials that are used only in one course at one institution

- Effective mechanisms for sharing materials could make all of us more efficient

- User-contributed exercises

– All exercises available under permissive licenses (Creative Commons or GNU FDL)

We need your help!

Courses	E
User admin Cou	rse admin
Summer 2013	
ENGGEN 131 - Introd Engineering Computa Software Developmer	luction to tion and nt
Fall 2012	
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Research questions, preliminary data

• Can we detect students engaging in



- Are exercises an effective "prescription" for students who are struggling?
- How can we motivate students to do practice problems?
 - Badges? Other forms of rewards/encouragement?
- What are student perceptions of exercises?
- Can exercises be reused effectively?
 - In different courses? - At different institutions?
- Can instructors find appropriate exercises to reuse?

Kelly Rivers

John Stamper

Human-Computer Interaction Institute, Carnegie-Mellon University

Screenshots

Main menu, choosing an exercise

Xercises Refresh Name Description Assigned Due Status					
Name Description Assigned Due Status					
How many points EstimatedPoints will Jordan 2013-01-30 12:04 2013-02-09 12:04 TESTS_PASSEI probably score? probably score? Description Description Description					
Will your IsWinningHand blackjack cards 2013-01-30 12:08 2013-02-09 12:08 TESTS_PASSE win?					
WeeklyPay Calculate take-home pay at the end of the week TESTS_PASSE)				
xercise Description					
sWinningHand - Will your blackjack cards win?					
<i>lackjack</i> is a card game where the values of the cards that you hold are summed together to give you a score. The aim f the game is to have a higher score than the dealer, however, if your score exceeds 21 then you automatically lose his is known as a "bust" in blackjack).					
your score does not exceed 21, then you might win! In this situation you will either win if your score is higher than the ealer's score, or if the dealer's score exceeds 21 (in which case the dealer is said to have "bust"). In all other situations ou do not win.					
omplete the IsWinningHand() function that takes your score and the dealers score as inputs, and returns true (i.e. 1) you win and false (i.e. 0) if you do not win.					
or example, the following function call:					
WinningHand(16, 16) should return false (i.e. 0)					

unproductive trial and error coding?

• Do we see improved outcomes when students do exercises? Exams in CS 101 at York College and CS 141 at Knox College, Spring 2013



Moderate ($r \approx 0.36$ at York, $r \approx 0.48$ at Knox) correlation between number of CloudCoder practice exercises solved and exam score

- Can we add social features to the exercise repository to allow users to
 - Classify exercises? (tagging) – Rate exercises?
 - Improve existing exercises?
 - Recommend exercises?
 - Recommend sequences of exercises?



Working on an exercise

IsWinningHan	d - Will your black	ack cards win?	<< Back Log out
<i>Blackjack</i> is a card gar together to give you a s	ne where the values of the car score. The aim of the game is	ds that you hold are summed to have a higher score than the utomatically lose (this is known	
as a "bust" in blackjaci	().	atomatically lose (this is known -	Reset
If your score does not e win if your score is hig	exceed 21, then you might win her than the dealer's score, or i	In this situation you will either if the dealer's score exceeds 21	- Submit!
1 int IsWinn	ingHand (int myScore,	int dealersScore)	<u> </u>
3 - if (my	Score > 21) {		
4 re	turn 0;	<u>х г</u>	
5 } eise	1T (dealersScore > 21	<i>.)</i> (
7 - } else	<pre>if (myScore > dealers</pre>	Score) {	
8 re	turn 1;		
9 } else	{		
10 re	C		
12 }			
,			
			T
		=	
Test results Co	mpiler errors		
Outcome	Message	Output	Error output

References

Knox

[1] Kirsti M Ala-Mutka. A survey of automated assessment approaches for programming assignments. Computer Science Education, 15(2):83-102, 2005.

Support

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Get involved!

We want to expand our user base for Fall 2013!

- We already have over 100 C/C++ and Java exercises to get you started!
- Are your exercises better than ours?
- What are you waiting for?

Check it out! http://cloudcoder.org

