The serious side of coding for fun

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Microsoft Research, Redmond, USA

Working for fun

Enjoyment adds to long term retention on a task

Discovery is a powerful driver, contrasting with direct instructions

Gaming joins these two, and is hugely popular

Can we add these elements to coding?

ICPC 2014 World Finals Ekaterinburg
acm International Collegiate Programming Contest

Write a program to determine all the sets of effectively identical rooms in a maze. (A page of background, sample input and output given)

Curious? Learn More!

Pex

Coding Duel for fun

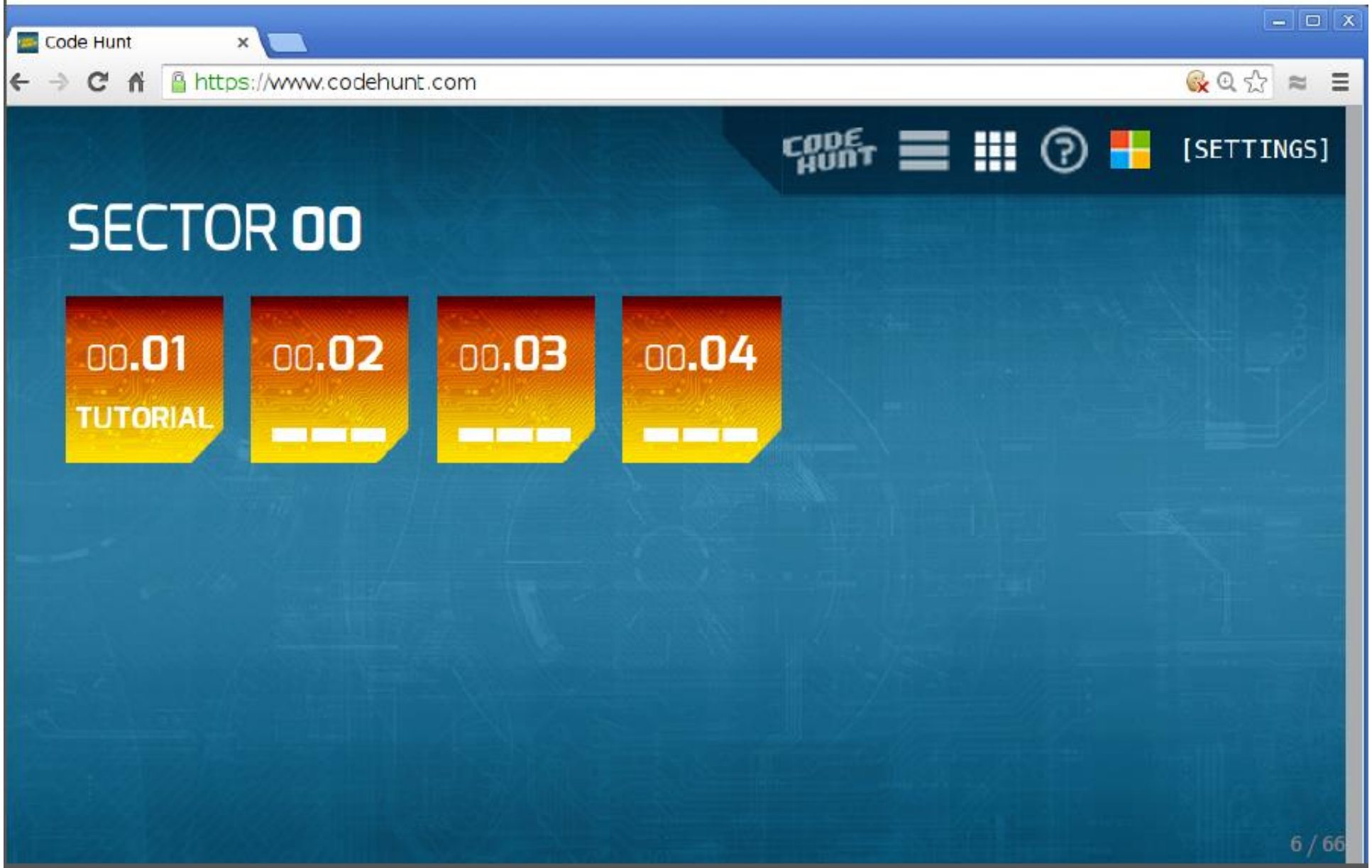
This puzzle is an interactive Coding Duel. Can you write code that matches a secret implementation? Other people have already won this Duel 1911 times! Help

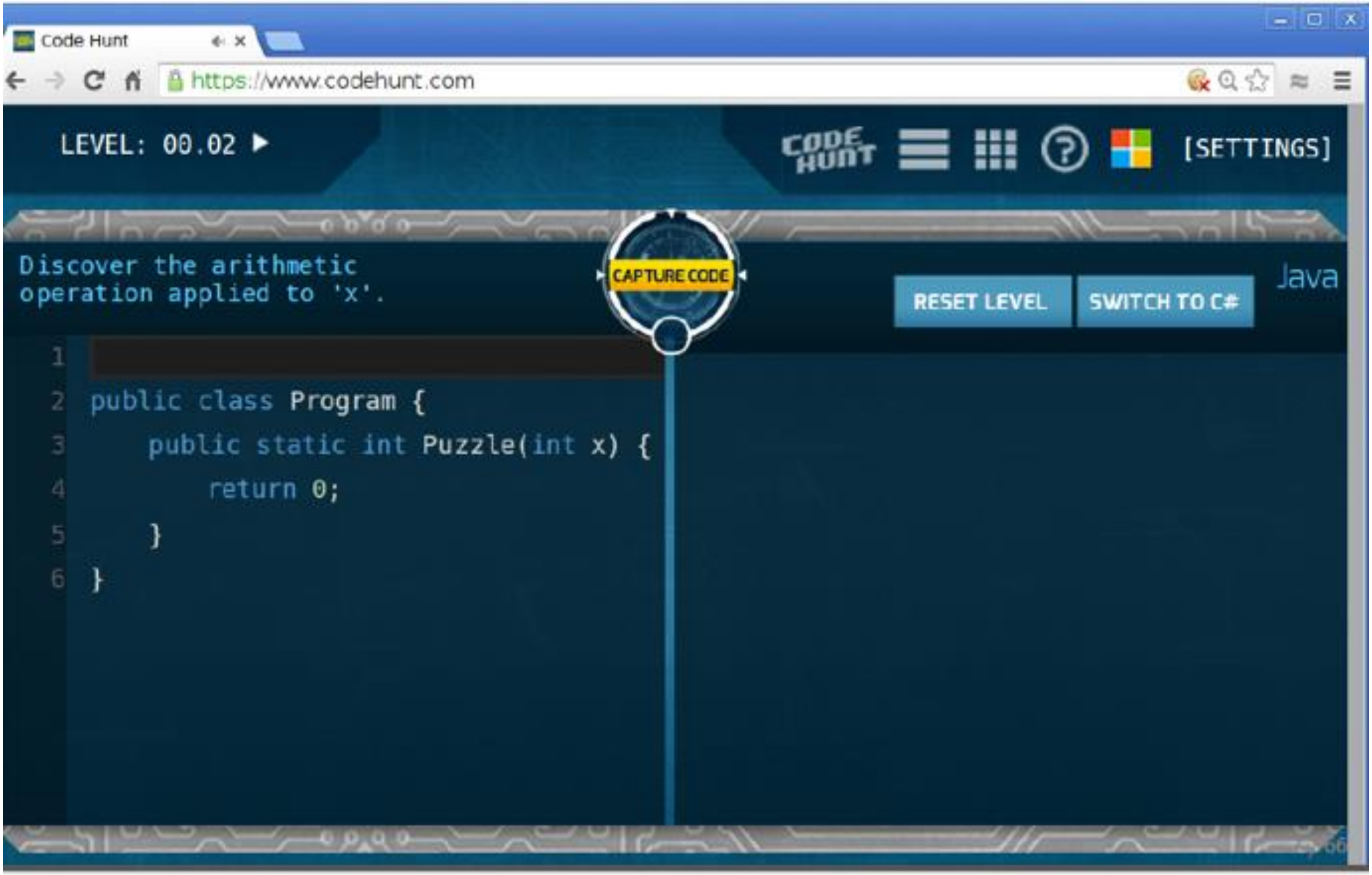
```
using System;

public class Program {
  public static int[] Puzzle(int[] a, int[] b) {
    // Can you write code to solve the puzzle? Ask Pex to see how close you are.
    return null;
  }
}
```

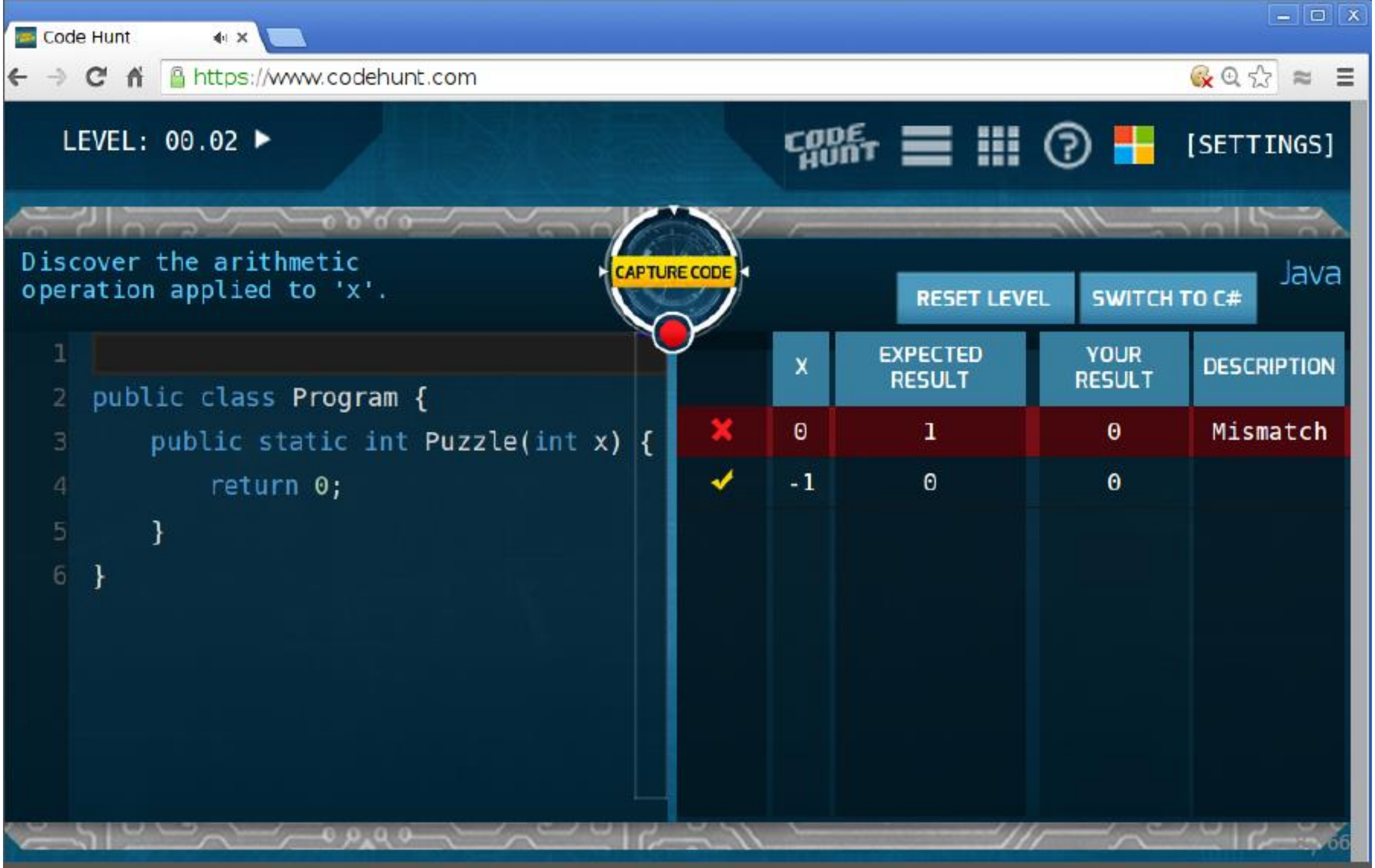
Code Hunt programming game

Code Hunt programming game

Code Hunt programming game




Code Hunt
https://www.codehunt.com
LEVEL: 00.02
[SETTINGS]
Discover the arithmetic operation applied to 'x'.
CAPTURE CODE
RESET LEVEL
SWITCH TO C#
Java
1
2 public class Program {
3 public static int Puzzle(int x) {
4 return 0;
5 }
6 }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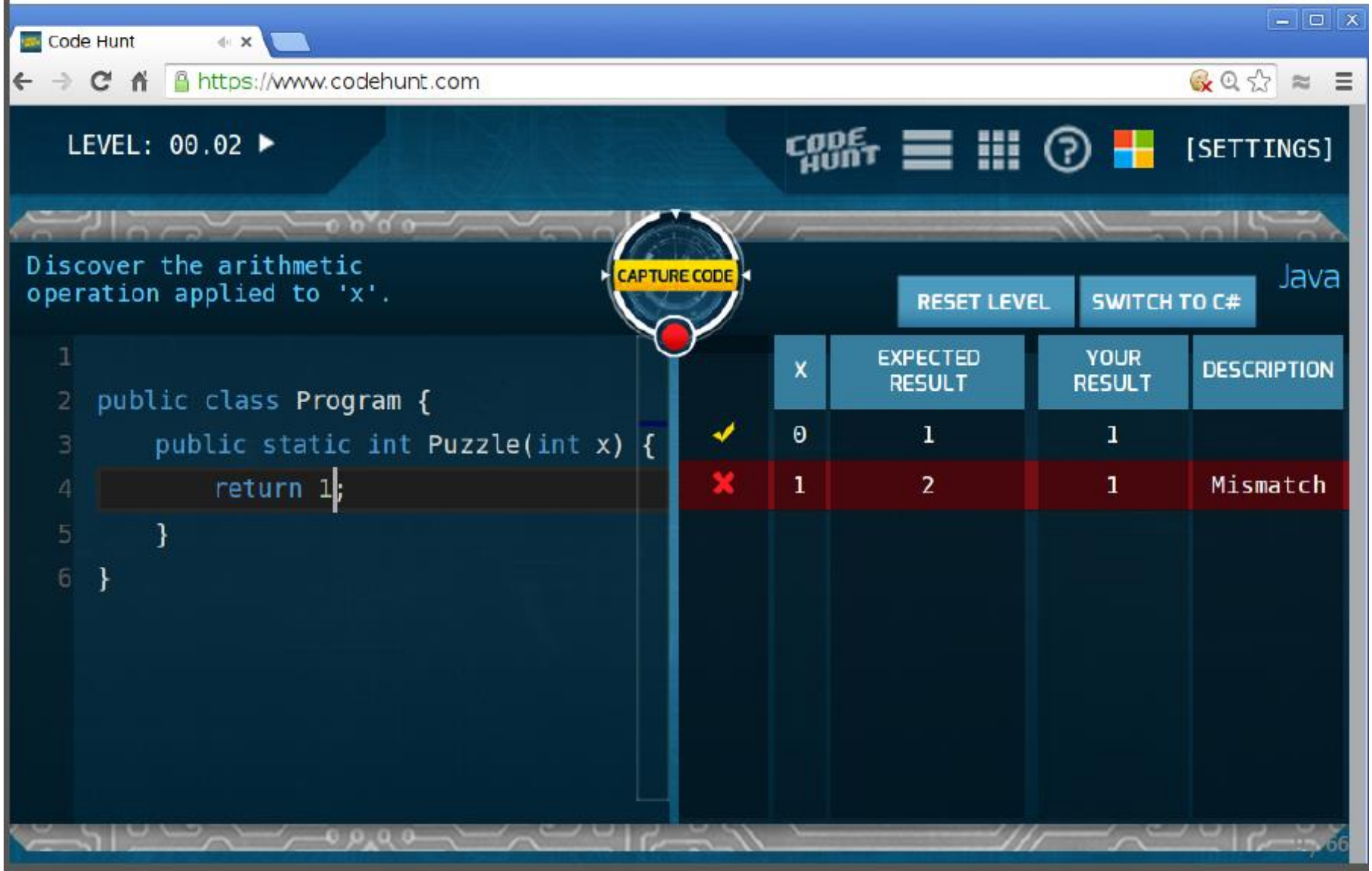
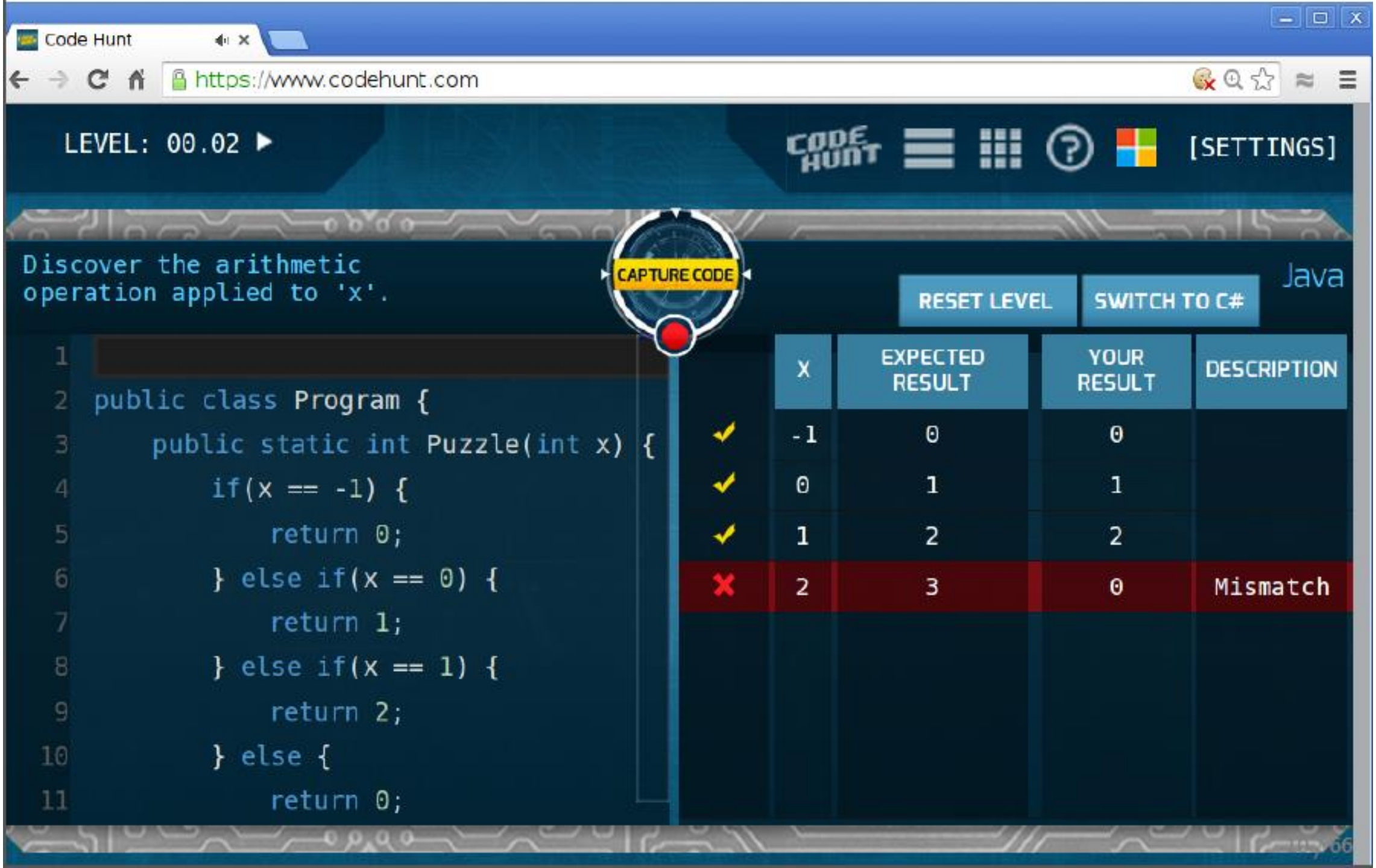
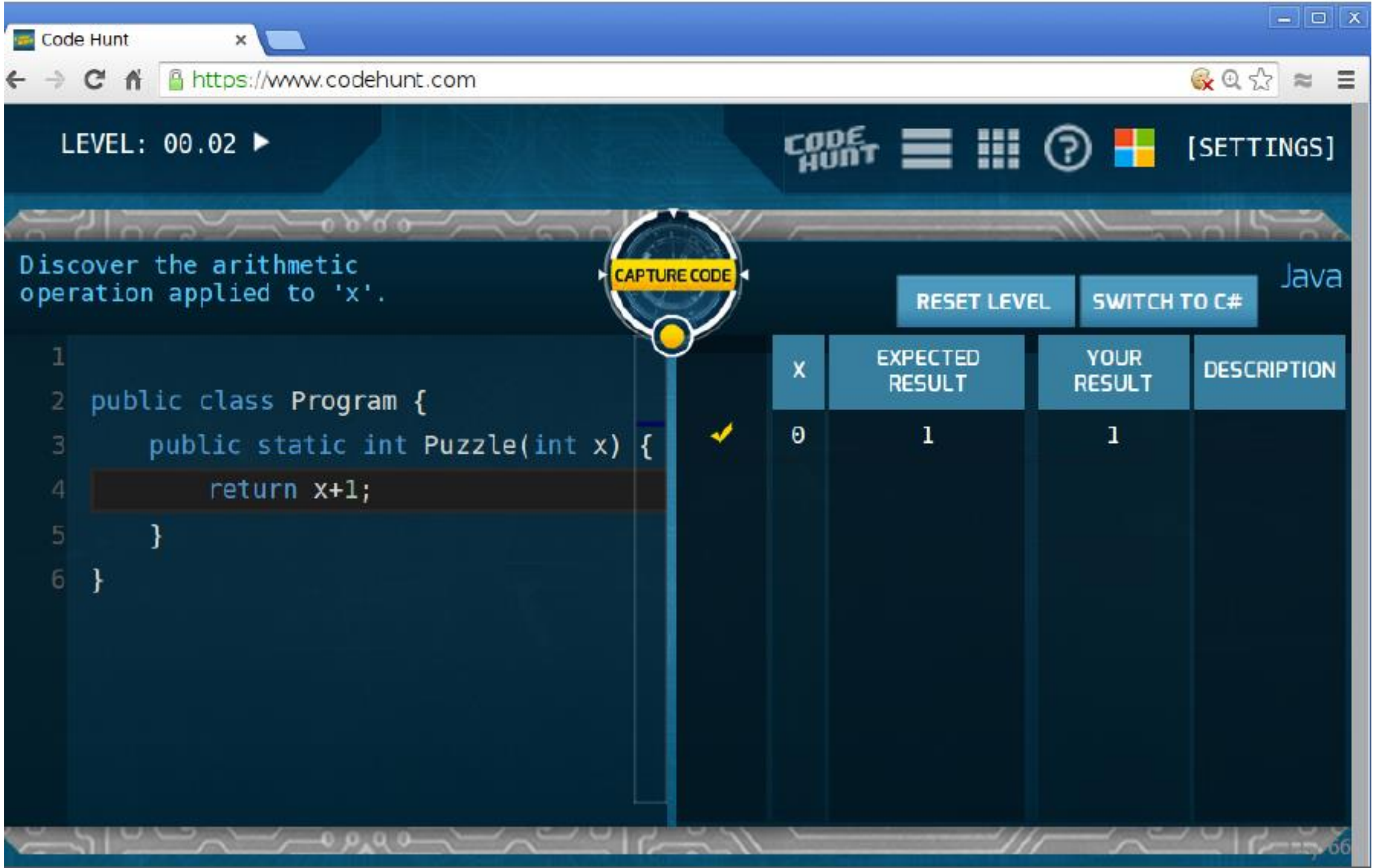
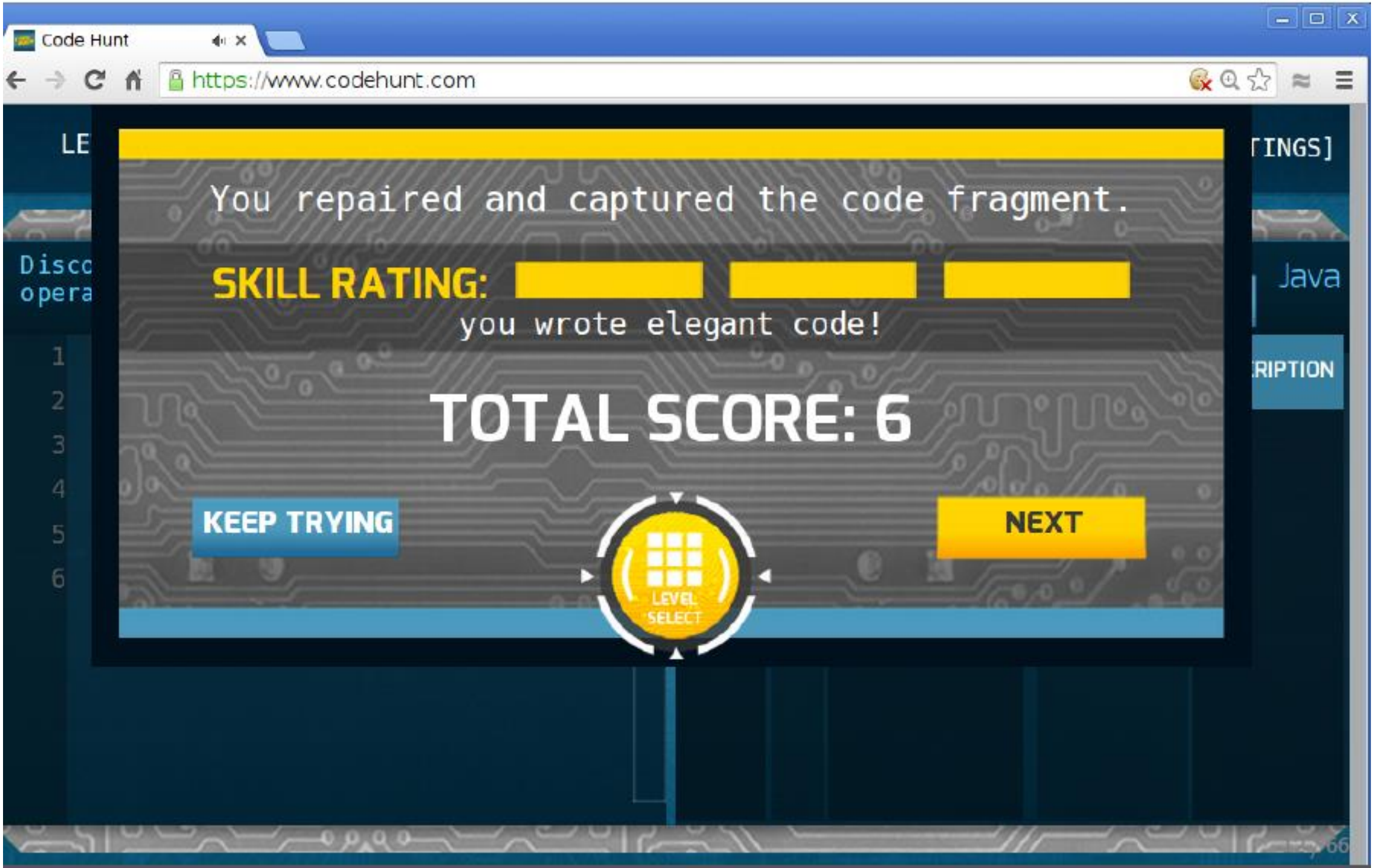
LEVEL: 00.02
CODE HUNT
[SETTINGS]
Discover the arithmetic operation applied to 'x'.
CAPTURE CODE
Java
RESET LEVEL
SWITCH TO C#
1
2 public class Program {
3 public static int Puzzle(int x) {
4 return 0;
5 }
6 }
X
EXPECTED RESULT
YOUR RESULT
DESCRIPTION
0
1
0
Mismatch
-1
0
0

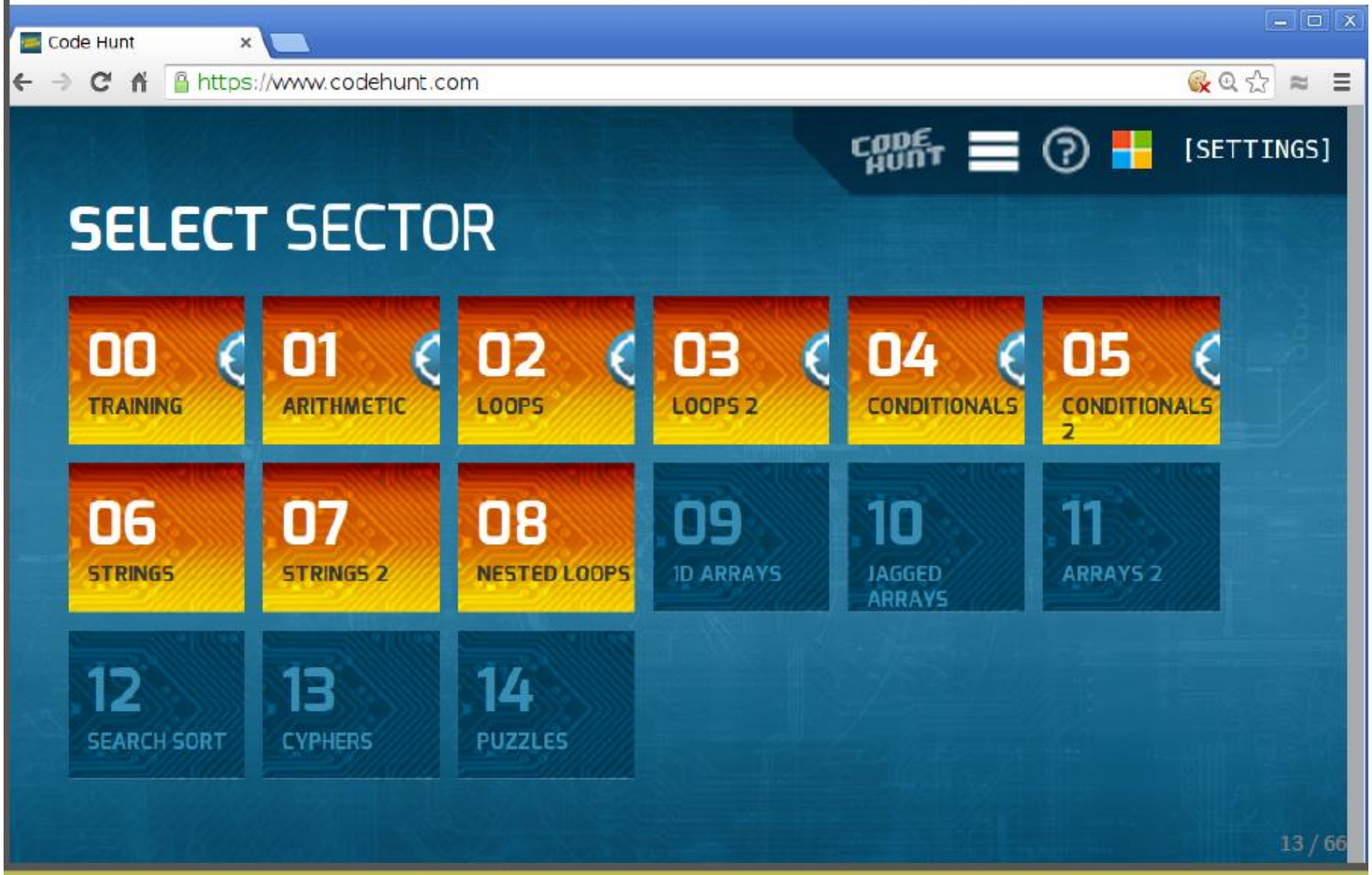

Code Hunt
https://www.codehunt.com
LEVEL: 00.02
[SETTINGS]
Discover the arithmetic operation applied to 'x'.
CAPTURE CODE
RESET LEVEL
SWITCH TO C#
Java
1
2 public class Program {
3 public static int Puzzle(int x) {
4 return 1;
5 }
6 }
X
EXPECTED RESULT
YOUR RESULT
DESCRIPTION
0
1
1
1
2
1
Mismatch

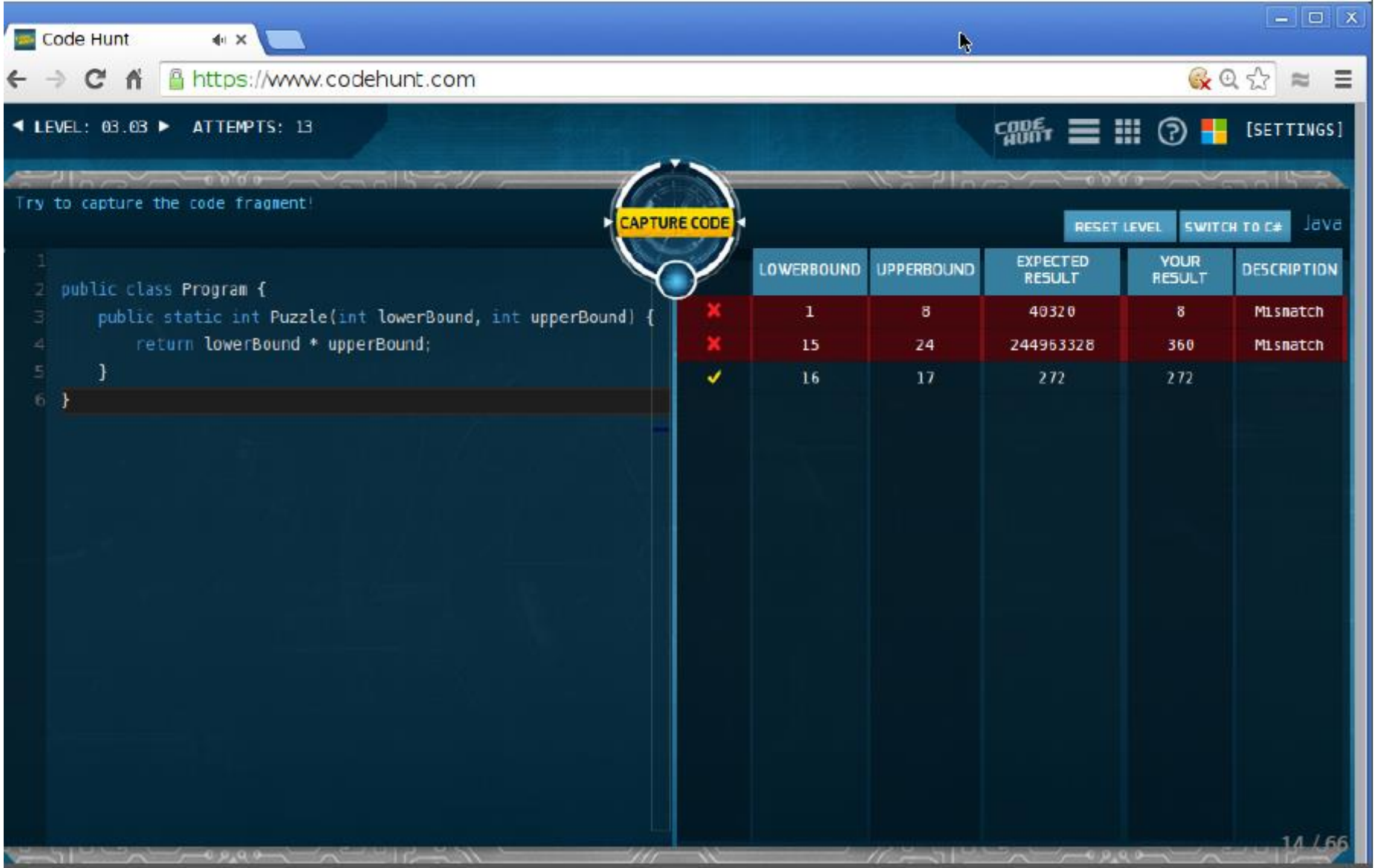

Code Hunt
https://www.codehunt.com
LEVEL: 00.02
[SETTINGS]
Discover the arithmetic operation applied to 'x'.
CAPTURE CODE
RESET LEVEL
SWITCH TO C#
Java
1
2 public class Program {
3 public static int Puzzle(int x) {
4 if(x == -1) {
5 return 0;
6 } else if(x == 0) {
7 return 1;
8 } else if(x == 1) {
9 return 2;
10 } else {
11 return 0;
X
EXPECTED RESULT
YOUR RESULT
DESCRIPTION
-1 0 0
0 1 1
1 2 2
2 3 0 Mismatch

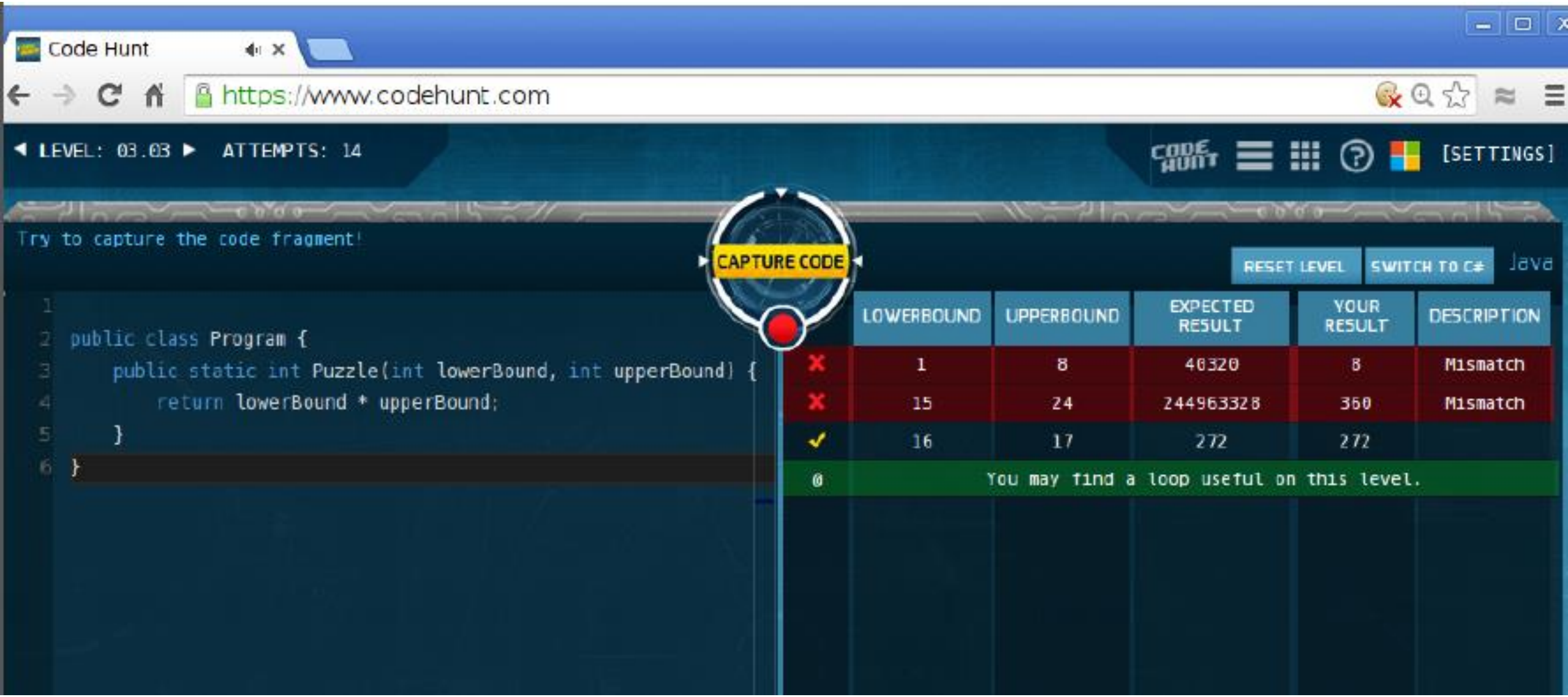

Code Hunt
https://www.codehunt.com
LEVEL: 00.02
[SETTINGS]
Discover the arithmetic operation applied to 'x'.
CAPTURE CODE
RESET LEVEL
SWITCH TO C#
Java
1
2 public class Program {
3 public static int Puzzle(int x) {
4 return x+1;
5 }
6 }
X
EXPECTED RESULT
YOUR RESULT
DESCRIPTION
0
1
1

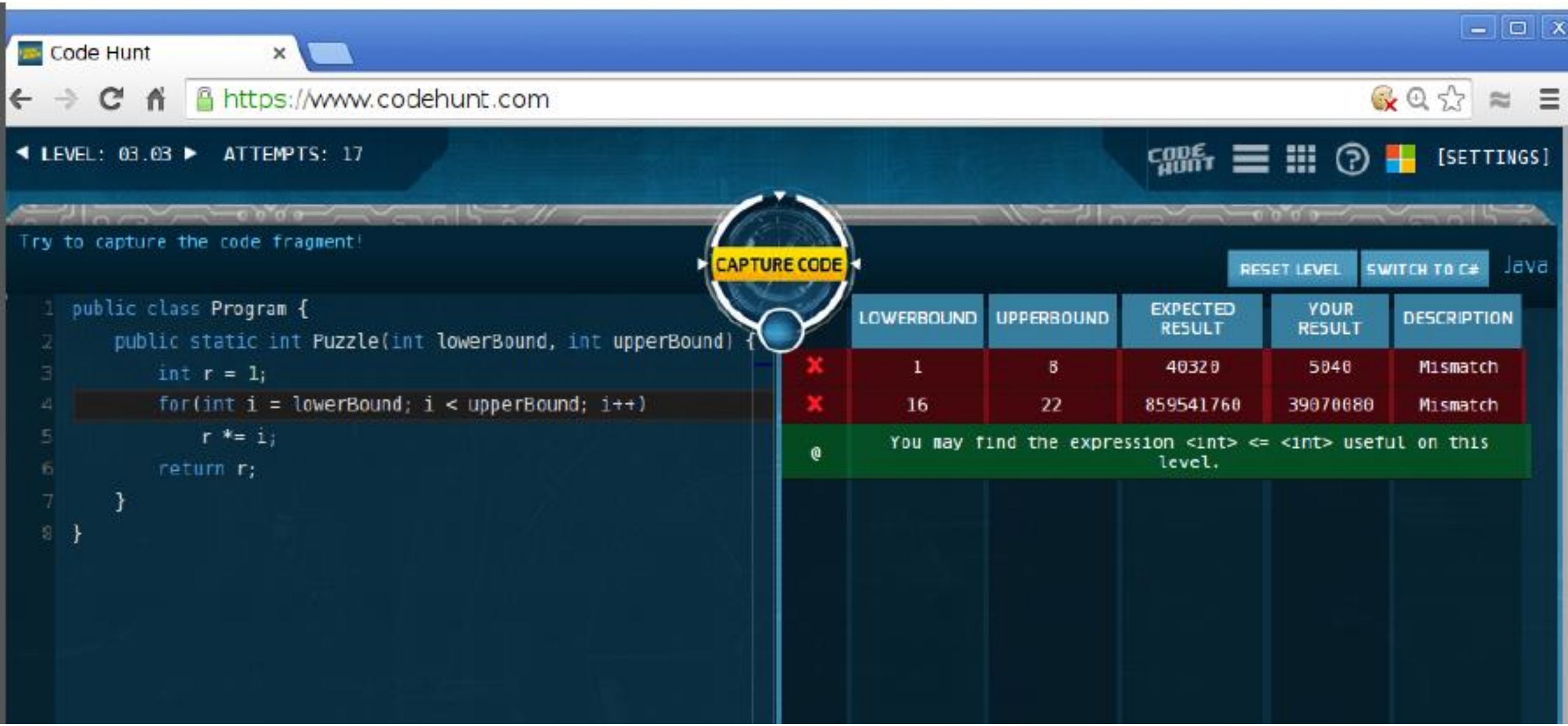

Code Hunt
https://www.codehunt.com
You repaired and captured the code fragment.
SKILL RATING:
you wrote elegant code!
TOTAL SCORE: 6
KEEP TRYING
LEVEL SELECT
NEXT

More difficult level



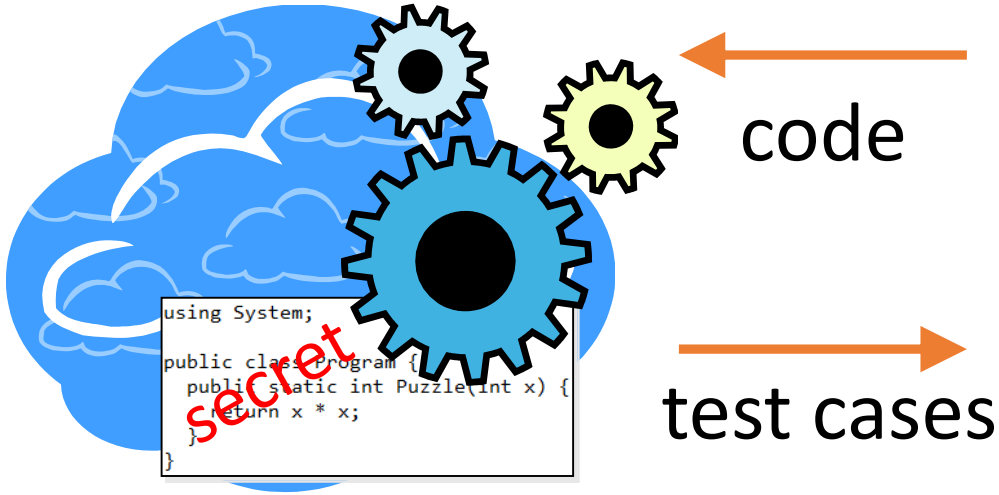

Code Hunt
https://www.codehunt.com
LEVEL: 03.03
ATTEMPTS: 13
[SETTINGS]
Try to capture the code fragment!
CAPTURE CODE
RESET LEVEL
SWITCH TO C#
Java
public class Program {
public static int Puzzle(int lowerBound, int upperBound) {
return lowerBound * upperBound;
}
}
LOWERBOUND
UPPERBOUND
EXPECTED RESULT
YOUR RESULT
DESCRIPTION
1
8
40320
8
Mismatch
15
24
244963328
360
Mismatch
16
17
272
272
14 / 66

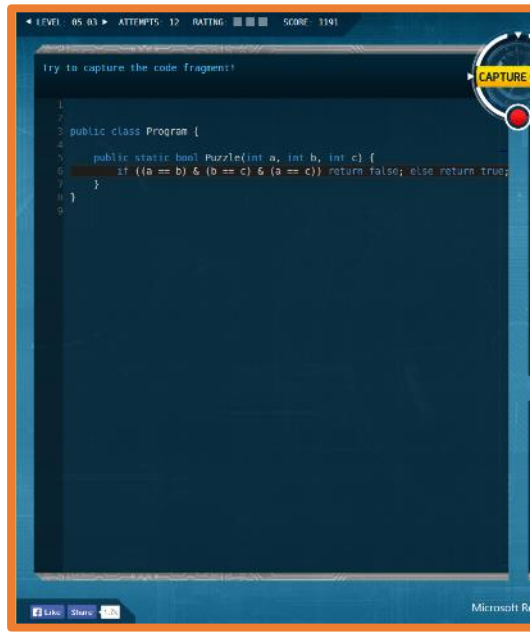

Code Hunt
https://www.codehunt.com
◄ LEVEL: 03.03 ► ATTEMPTS: 14
[SETTINGS]
Try to capture the code fragment!
CAPTURE CODE
RESET LEVEL
SWITCH TO C#
Java
1
2 public class Program {
3 public static int Puzzle(int lowerBound, int upperBound) {
4 return lowerBound * upperBound;
5 }
6 }
LOWERBOUND
UPPERBOUND
EXPECTED RESULT
YOUR RESULT
DESCRIPTION
1
8
40320
8
Mismatch
15
24
244963328
360
Mismatch
16
17
272
272
0
You may find a loop useful on this level.


Code Hunt
https://www.codehunt.com
LEVEL: 03.03
ATTEMPTS: 17
[SETTINGS]
Try to capture the code fragment!
CAPTURE CODE
RESET LEVEL
SWITCH TO C#
Java
public class Program {
public static int Puzzle(int lowerBound, int upperBound) {
int r = 1;
for(int i = lowerBound; i < upperBound; i++)
r *= i;
return r;
}
}
LOWERBOUND
UPPERBOUND
EXPECTED RESULT
YOUR RESULT
DESCRIPTION
1
8
40320
5040
Mismatch
16
22
859541760
39070080
Mismatch
You may find the expression <int> <= <int> useful on this level.

It’s a game!

iterative gameplay
adaptive
personalized
no cheating
clear winning criterion





Audiences

Students: proceed through a sequence on puzzles to learn and practice.

Educators: exercise different parts of a curriculum, and track students' progress

Recruiters: use contests to inspire communities and results to guide hiring

Researchers: mine extensive data in Azure to evaluate how people code and learn

Code Hunt Usage

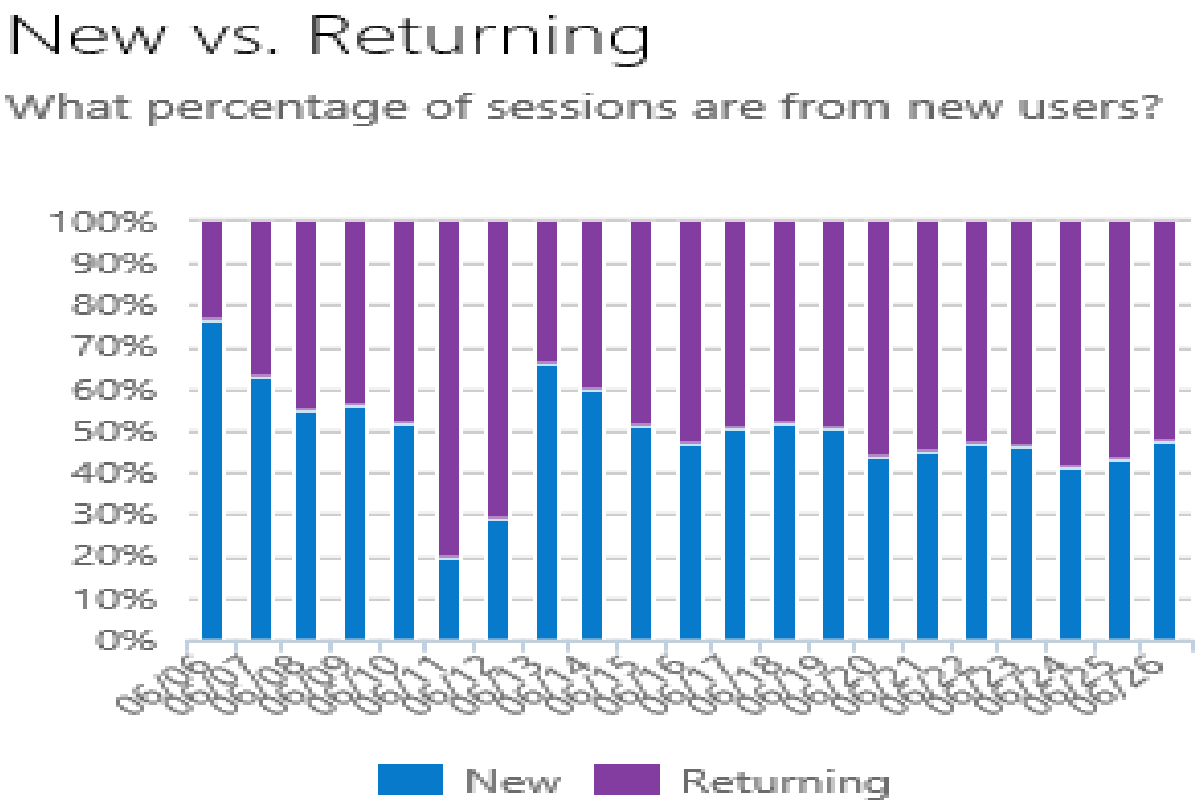
Code Hunt has had several **hundred thousands** of users since launch in March 2014

Stats from Visual Studio Analytics over the period May 22-June 26 indicate 40,235 users

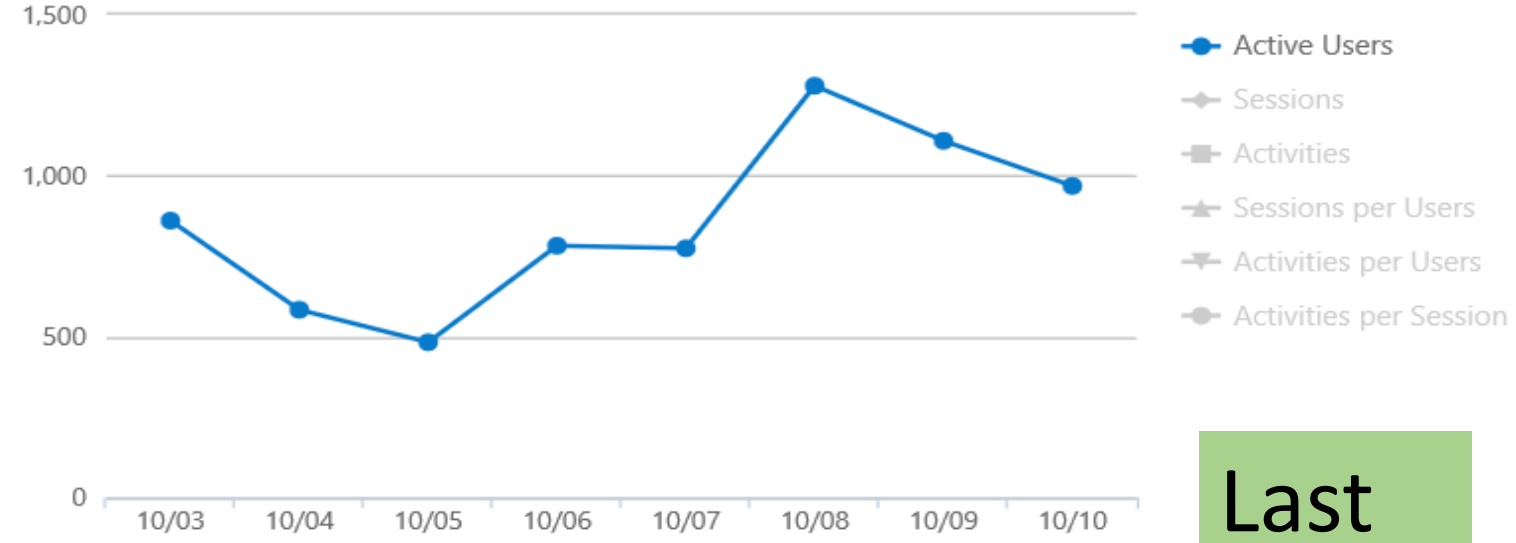
Stickiness (loyalty) is very high

% Returning
< 14 days

99.79%

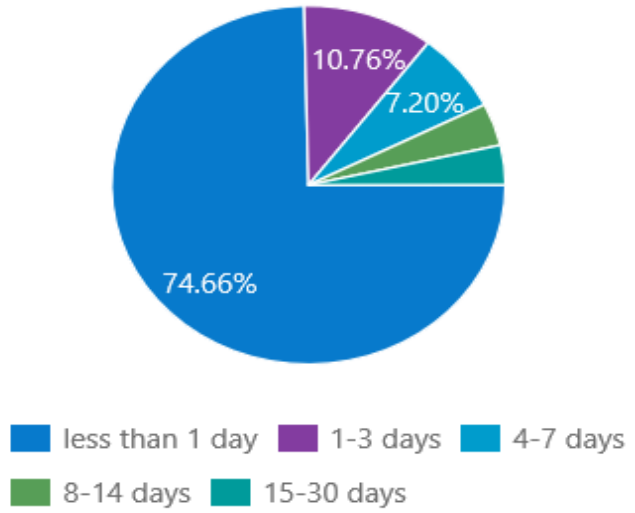


Trend of active users by day



User Frequency

How long before my known users return?



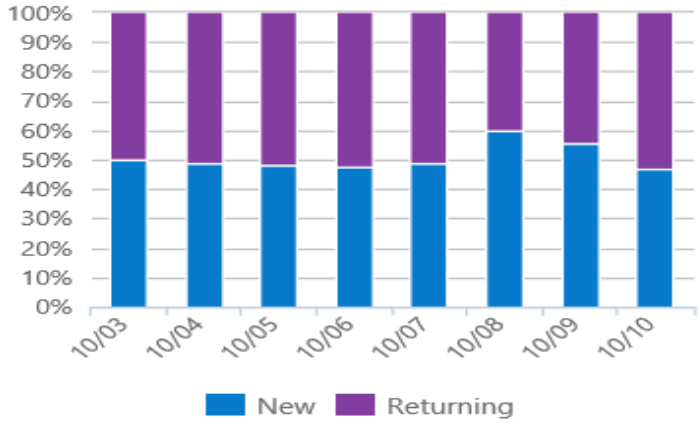
Last week

Active user key performance indicators

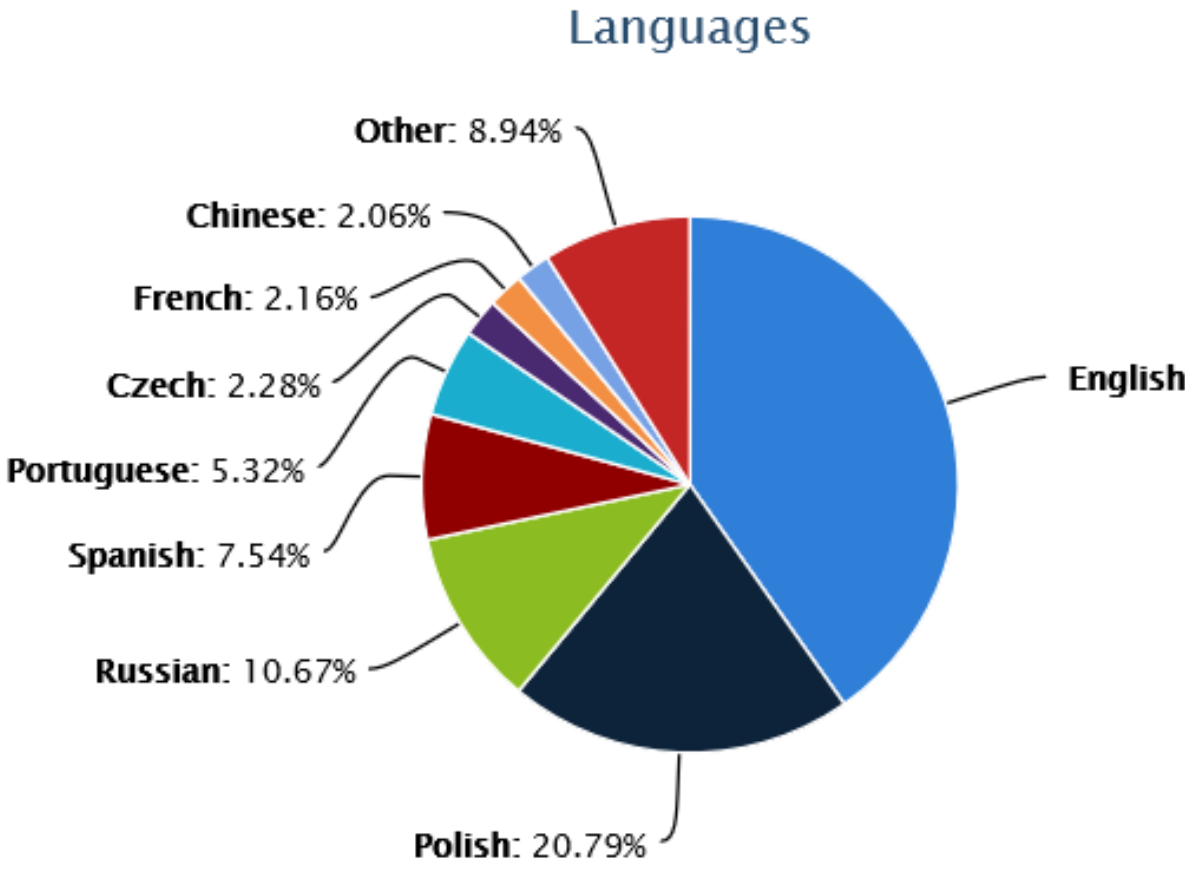
Avg. Daily Users	Activities	Sessions	Activities per Session
854	1.65M	8.77k	187.91

New vs. Returning

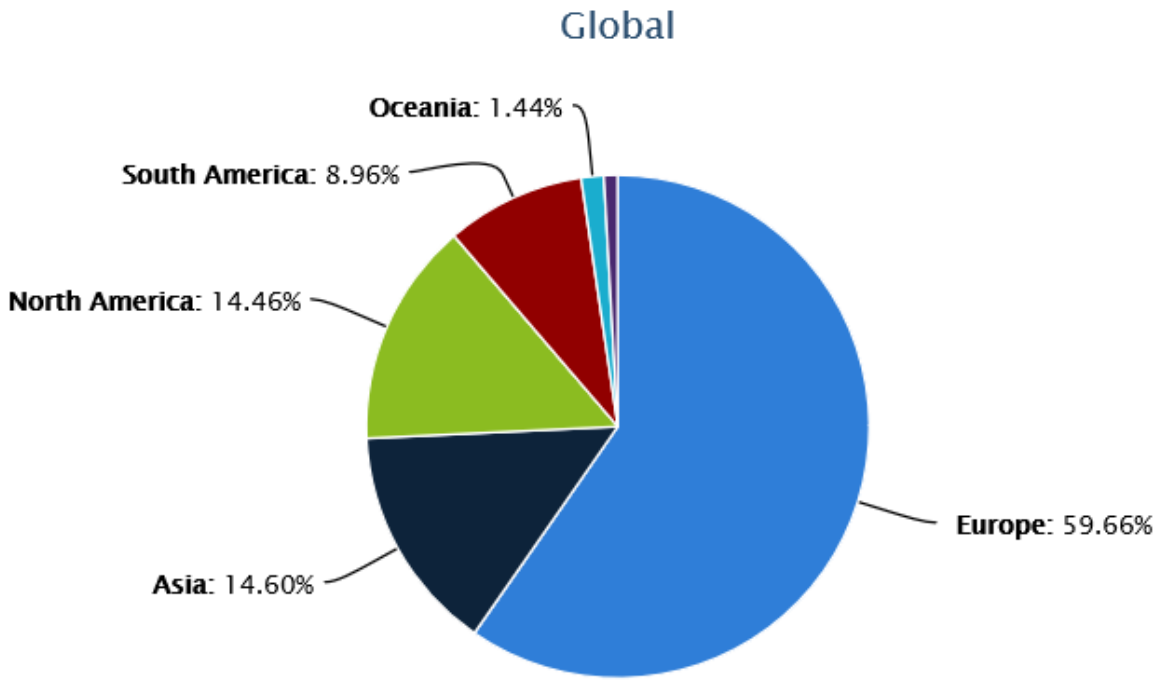
What percentage of sessions are from new users?



Period 3-10 October, 2014



Sessions: **8,769** Activities: **1,647,76**



Sessions: **6,909** Activities: **1,444,846**

Microsoft Research launches Code Hunt, an educational Web game for learning programming

Jade Mulders 27 May 2014 12:57 AM | 0

Blog originally posted on thenextweb.com

Microsoft Research today launched Code Hunt, a browser-based game for anyone interested in learning how to code by playing. The premise is straightforward: the player must write code to advance in the game.

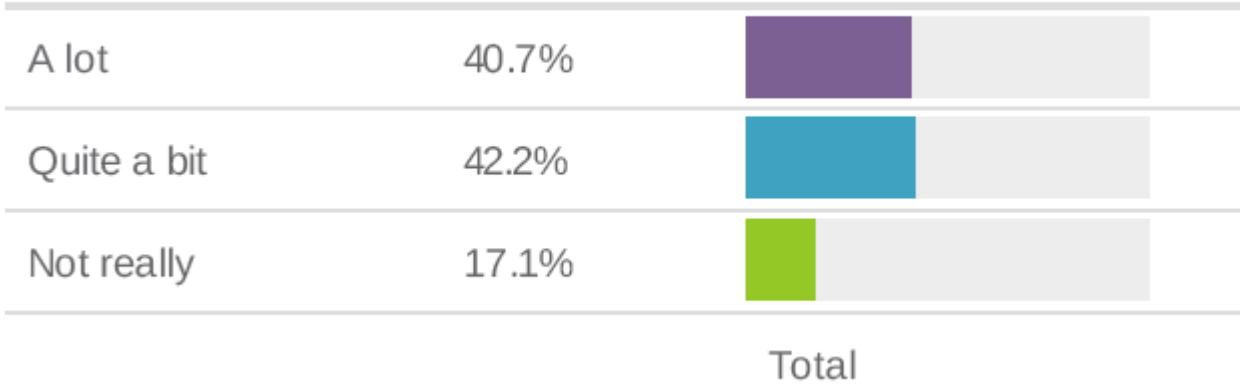
The built-in tutorial introduces you to the game:

> *Greetings, program! You are an experimental application known as a CODE HUNTER. You, along with other code hunters, have been sent into a top-secret computer system to find, restore, and capture as many code fragments as possible. Your progress, along with your fellow code hunters, will be tracked. Good luck.*

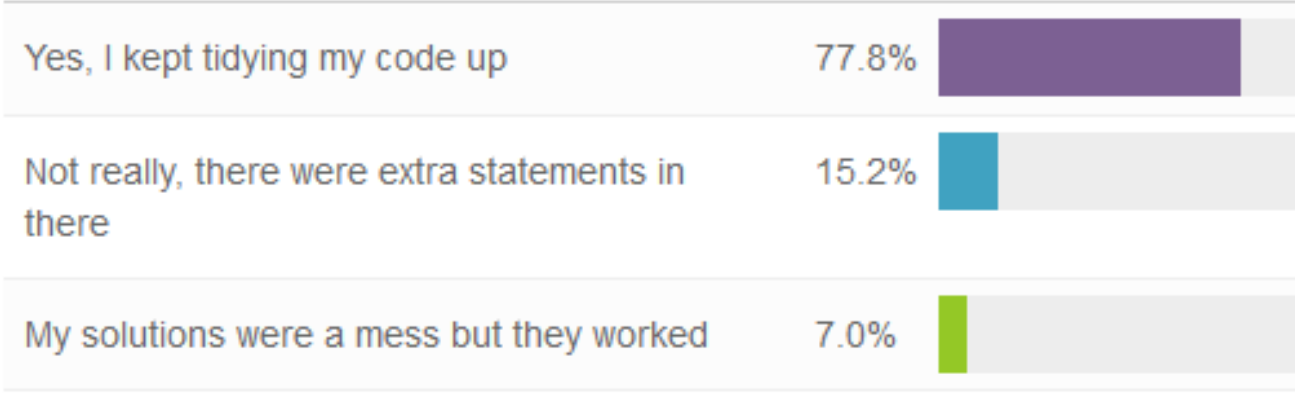
Code Hunt uses puzzles, which players explore by means of clues presented as test cases, and encourages players to iterate on their code to "capture" it. Their work is then scored depending on the elegance of their solution, and players are encouraged to continue on to the next challenge.

Survey results (735 respondents)

How much did the puzzle aspect of Code Hunt keep you interested in reaching a solution?



In your opinion, were your final solutions well-structured code?



We have many other statistics, but not so relevant to contests

Contest Goals

identify top coders

make online competitions more fun

2,353 players	**41.0** average tries per level
350 top players	**7.6** average tries per level

Completed in 2014

Beauty of Programming, Microsoft China – 2,500 players in four rounds

TEALS – high schoolers across the USA

Computer Science Teachers Association Conference

High School Intern Boot Camp

Imagine Cup September, Oct 2014 – April 2014

LASER Summer School, Elba, September 2014

Upcoming

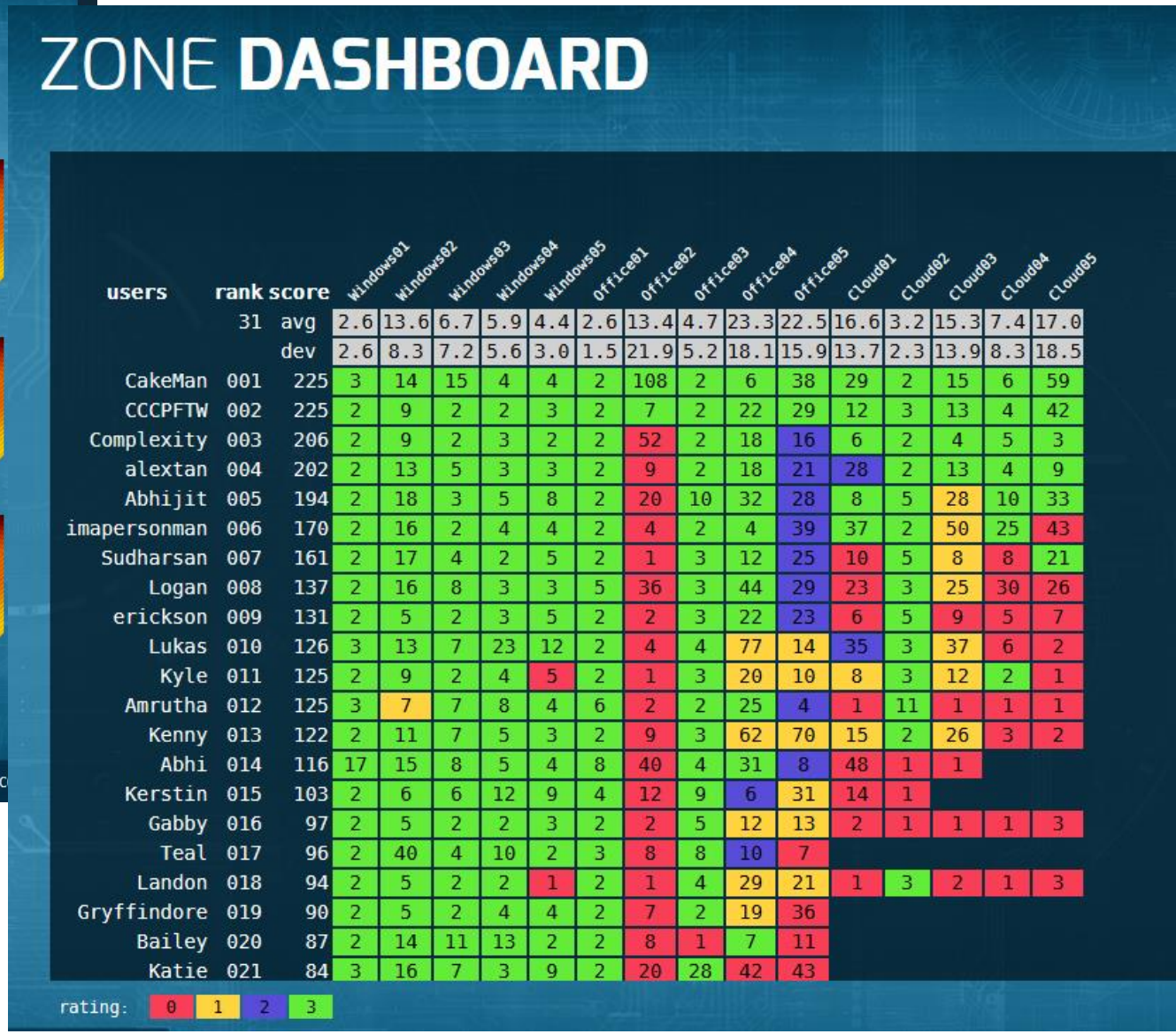
Code Hunt Polska, 17 October 2014

Creating new contests

- Creating new puzzles
- Requires curation of a puzzle bank
- Original data about each puzzle
  - Group – numbers, arrays, strings, bools, binary
  - Subjective difficulty
  - Source – who wrote the puzzle
  - Features
- Each contest should have a sequence of sectors in increasing difficulty
- Avoid “Bad” puzzles early on – those that fool users

Leaderboard and Dashboard

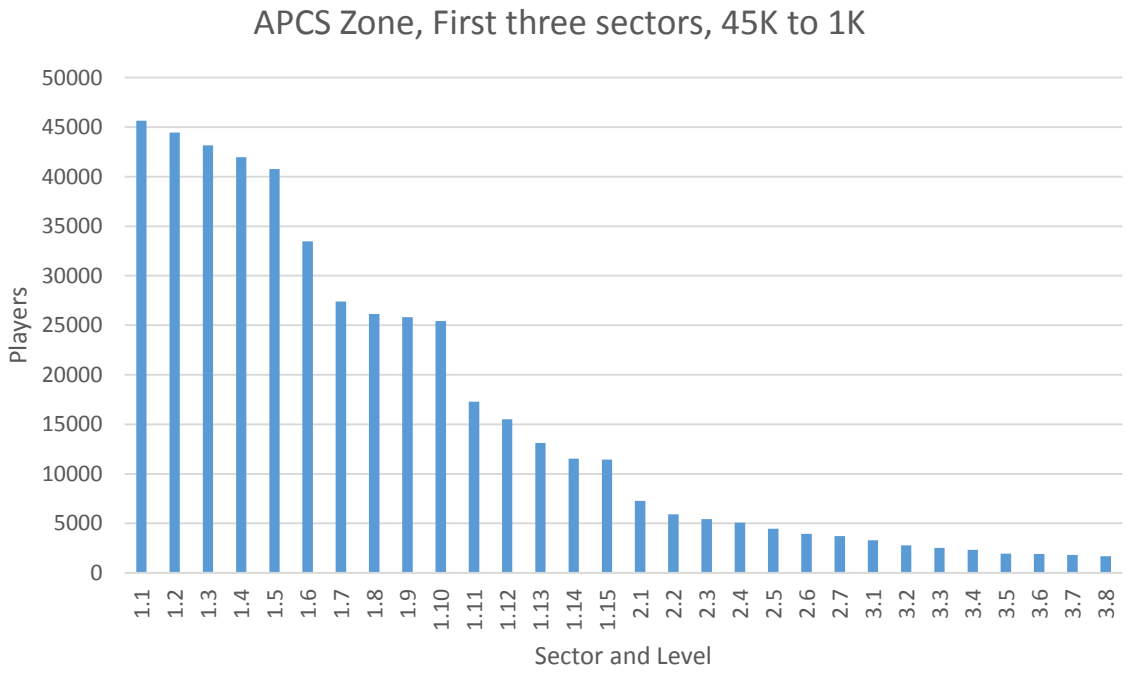
Visible only to the organizer

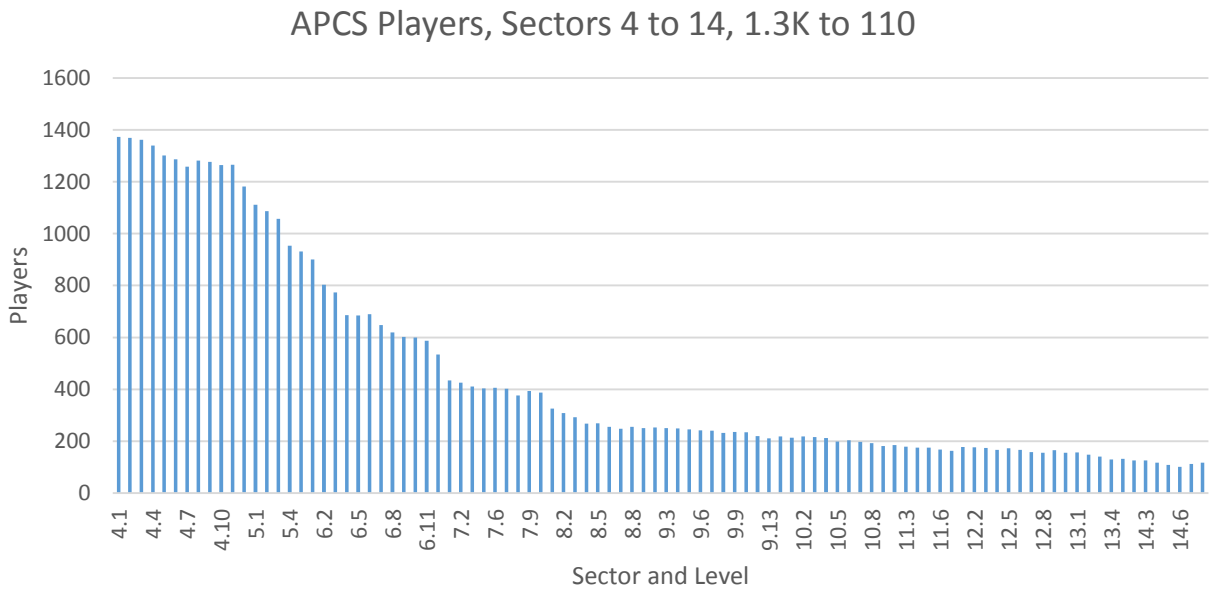


Publically visible, updated during the contest

Code Hunt - the APCS (default) Zone

- Opened in March 2014
- 129 problems covering the Advanced Placement Computer Science course
- So far, over 45,000 users started.

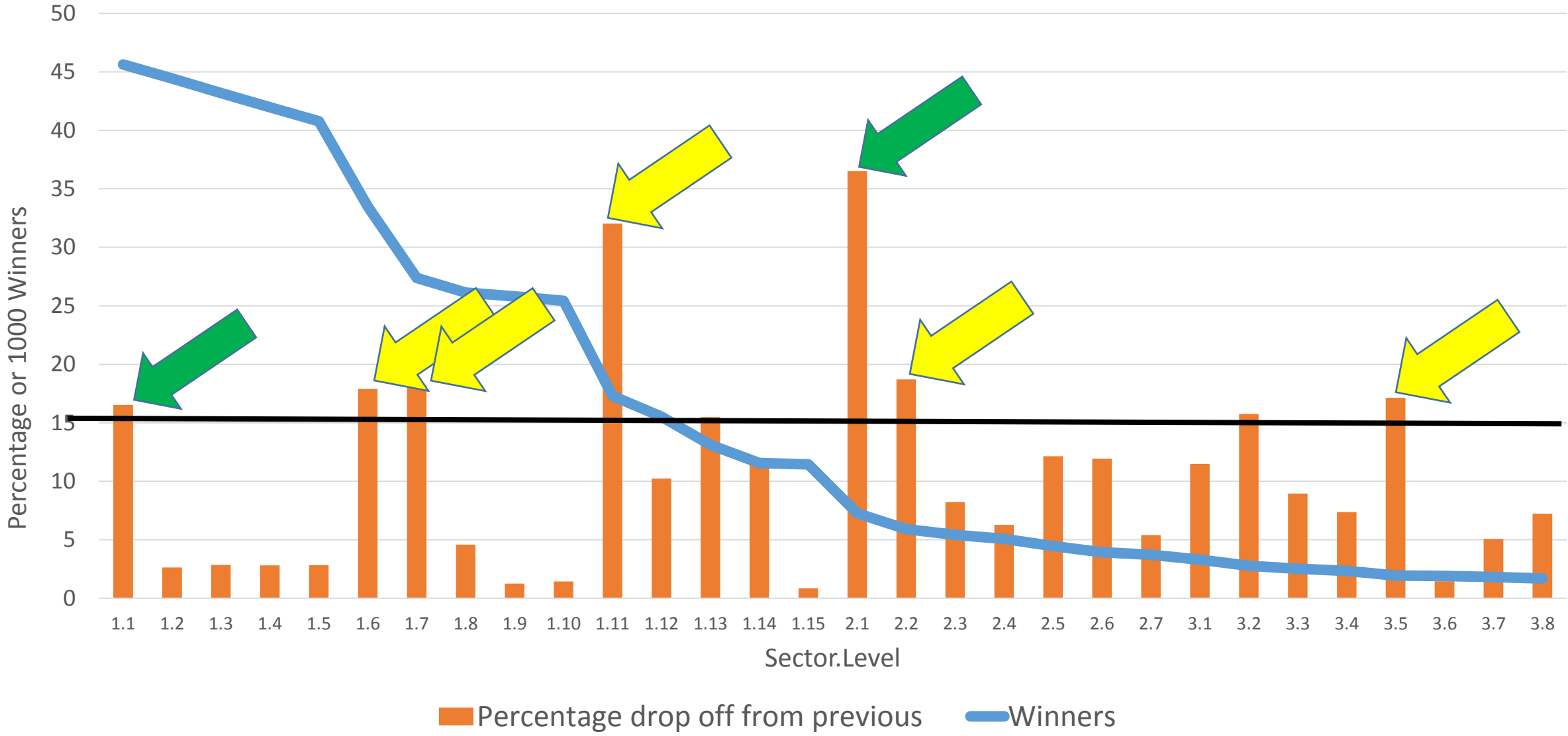




Updating the puzzle bank statistics

- Updating the used field
- Modifying the difficulty rating based on user experience
- Options
  - Score – but the score is 1-3 and we know from the survey that 77% of users improve their code to get a 3
  - Tries – a fairly objective reflection of how long it took to find the pattern and program a correct solution
- CAVEAT!!! Users in areas with poor internet are known to use the Capture Code button less

Effect of difficulty on drop off in sectors 1-3



Formula for perceived difficulty

For a particular puzzle

a + b * tries + c * tries * distance

a = 1, b = 0.05, c = 0.02, or for APCS c = 0.001

tries are the average tries for all winners
distance is the number of levels so far

D = 1 + 8.88/20 + 8.88 * 29 / 1000
= 1.74

Original difficulty was 2

D= 1 + 45.08/20 + 45.08 * 69 / 1000
= 6.36

Original difficulty was 2

Examples

Players	Tries	Sector.Level
1683	8.88	3.8

Players	Tries	Sector.Level
376	45.08	7.8

How players perceive difficulty

BoP China (same community)

a=1, b=0.05, c=0.02

	Subjective difficulty	Perceived difficulty	Starting players	Ending players	Levels with average tries over 10
BoPQuali	1.59	2.86	13773	307	3 out of 17 = 18%
BoPPrelimA	2.17	1.93	1017	125	3 out of 6 = 50%
BoPPrelimB	2.50	1.97	141	131	2 out of 6 = 33%
BoPSemi	2.60	2.49	1164	113	2 out of 10 = 20%

CSTA and TEALS (identical contests)

a=1, b=0.05, c=0.02

	Subjective difficulty	Perceived difficulty	Starting players	Ending players	Levels with average tries over 10
TEALS (students)	1.96	5.22	61	3	5 out of 23 = 22%
CSTA (teachers)	1.96	4.38	14	4	7 out of 23 = 30%

Planned Developments

Technical enhancements

Catalog tool for puzzles

Editing tool for universes

Automatic testing tool for new universes

Universe management tool

Crowdsourcing puzzle creation

Live feed showing active game play

Website integrated dashboard

Content testing of Office Mix plug in

Maintaining the Java translator

Support for user-defined types (objects)

Management tool for data access

Plug-in infrastructure for new APIs

Community engagement

New content semi-annually

Working with contest Organizers

Building a research community

Building a user community

Collecting usage statistics and answering bug reports

Some of these can be done by stakeholders/partners

Summary:
Code Hunt: A Game for Coding

For **individuals** (K12, introductory courses, geeks)

For **competitions** at any level, world-wide or in house

Based on long-term **research** on symbolic program analysis (Pex, Z3)

Works with **Java** and C#

Runs in any modern **browser**

Now working on **tablets** and **phones**

www.codehunt.com
aka.ms/codehuntpolska